Handbook of Basic Atomic Spectroscopic Data

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Contents

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1. Introduction

This handbook is designed to provide a selection of the most important and frequently used atomic spectroscopic data in an easily accessible compact format. The compilation includes data for the neutral and singly-ionized atoms of all elements hydrogen through einsteinium ($Z=1-99$). The wavelengths, intensities, and spectrum assignments are given in a table for each element, and the data for the approximately 12 000 lines of all elements are also collected into a single table, sorted by wavelength (a "finding list").

More complete data for a smaller number of the most persistent lines of each spectrum are given in additional tables for each element. In addition to the wavelengths and intensities, the energy levels and transitions probabilities (where available) are listed for a total of about 2400 lines in these tables. We also give a separate table of energy level data for each spectrum which, although incomplete, includes levels additional to those involved in the persistent-line transitions.

More complete data than those selected for this Handbook can usually be found in references given with the tables for particular spectra. The data from most of the NIST compilations we have used are available online from the Atomic Spectra Database (ASD) (see [MFKM99]). In addition to more extensive data for many of the spectra in this Handbook, the ASD has data for higher ionization stages of many elements and includes the references.

Although we have made heavy use of previous compilations, our tables for the great majority of elements include at least some data compiled by us from more recent original literature and, in some cases, from unpublished material. Our most extensive use of data from the original literature has been for the heavier elements. Although the data are incomplete, our wavelength and energy level tables for these elements, especially, comprise a supplement to the ASD. For example, the current version of the ASD includes energy-level data for only two spectra (Mo I,II) of the 72 spectra of the neutral and singly-ionized atoms of the elements Rb to Ba ($Z=37-56$) and Hf to Ra ($Z=72-88$). No complete and critical compilations of energy levels have appeared for most of these spectra since Vols. 2 and 3 of Atomic Energy Levels [M52, M58]. For the actinide elements Ac–Es ($Z=89-99$), we were able to rely almost entirely on the very complete compilation by Blaise and Wyart [BW92b].

For some spectra, especially some of the lighter elements, we have taken data from existing compilations that have been superseded by data reported in more recent literature.

1.1. Atomic Data Tables

A small selection of nonspectroscopic atomic data has been provided for each element. Included are the atomic number and weight and a list of naturally occurring isotopes, including the isotopic mass, the relative abundance, the nuclear spin (in units of $h/2\pi$), and the magnetic moment (in units of nuclear magnetons). For elements with no naturally occurring isotopes, the most commonly observed isotopes are listed. These data are taken from J. Emsley [E95].

1.2. Strong Line Tables

For each of the elements a list of the strongest lines in the spectra of the neutral and singly-ionized atom has been compiled. This list includes the wavelength, the ionization stage, the reference for the wavelength measurement, and an intensity. Unless otherwise noted, the spectroscopic data in this Handbook pertain to the naturally occurring isotopic mix for each element.

1.2.1. Wavelengths

The wavelengths for many spectra have been taken from Reader *et al.*, [RCWM80]. Wavelengths given to three decimal places in [RCWM80] have a stated uncertainty of less than 0.001, and many of the two-place wavelengths in [RCWM80] are rounded off from three-place values in the original literature.

Laboratory observations carried out since the publication of [RCWM80] have yielded improved wavelength data for many spectra, including more accurate wavelengths, increased range of wavelength coverage, and more reliable assignments of observed lines to particular spectra. We have used more recent data for many of the spectra. However, it is important to note that our retention of wavelengths from [RCWM80], for any particular spectrum does not imply that more accurate data do not now exist.

In compiling these data, we have in many cases departed from the practice of [RCWM80] by quoting wavelengths from the literature without rounding off, especially in cases where the literature values were given to three or fewer decimal places. The original references should be consulted for uncertainty estimates.

1.2.2. Intensities

Unlike the other tabulated data, the relative intensities are not basic data and must be used with caution. The relative intensities of the spectral lines observed for any element depend upon the light source and excitation conditions. Thus, even if the relative intensities observed in a particular experiment are adjusted to correct for the wavelength dependence of the sensitivity of the spectrometer and detector, the intensities will in general be different from relative intensities given by a previous observer or tabulated in a compilation such as this one. With a caveat that users should keep these considerations in mind, we list a relative intensity for each line. For some lines the wavelengths are so close to another that it was impossible to make two separate intensity measurements. For those lines the intensity of the blended line is given for each and both intensities are marked with an asterisk.

For uniformity we have assigned an intensity of 1000 to the strongest line(s) of each spectrum. In most cases the chosen line (or lines) can reasonably be regarded as the ultimate line (Sec. IV). The relative intensities for most spectra here are based on values from [RCWM80]. We have attempted to give improved intensities for some spectra by using more recent and apparently more accurate data than that available to the compilers of [RCWM80].

It should be noted that the intensities in [RCWM80] for lines of neutral and singly-ionized atoms of about half the elements (mainly nd- and nf-shell metals) were taken at least in part from [MCS75]. These intensities were obtained from observations of 10 A 220 V direct-current arc discharges between copper electrodes having 0.1% of the element under investigation. The relative intensities were put on a linear scale by the use of standardized lamps.

For several spectra we have altered some of the intensities found in the literature to give smoother transitions between wavelength regions covered by different observers. We have also adjusted reported intensities given in a single reference in some cases where the reported values were clearly affected by strong self-absorption and/or by large wavelength-dependent nonlinearities. Such adjustments were necessary in order to assign the largest intensities to the inherently strongest persistent lines (usually the ultimate lines).

Lines we have selected as persistent (Sec. IV) are indicated by the letter "P" following the intensity. For some spectra, other descriptive codes have been included to characterize the line shape or give other related information. They have the following meanings:

b—band head
c—complex
d—line consists of two unresolved lines
h—hazy
l—shaded to longer wavelengths
P—a persistent line
r—easily reversed
s—shaded to shorter wavelengths
u—unresolved shoulder on strong line
w—wide
*—intensity may be affected by nearby line

In general, the character of a line depends on the spectroscopic source used, the resolution of the spectrometer, etc. Most of the line characterizations in our tables are quoted from [RCWM80], so that the characters given for lines of metallic elements usually pertain to the arc source used by Meggers *et al.* [MCS75] (see above). In some cases we have given character notations from [RCWM80] for lines for which the tabulated wavelengths were obtained with a very different (low-pressure) source.

1.3. Persistent Line Tables

In spectroscopic observations made with low concentrations of a particular element relative to other substances in the source, the number of observable lines of the element is found to decrease with decreasing concentration until only the most "persistent" or "sensitive" lines remain. Some authors refer to the last such line(s) as the raie(s) ultime, i.e., the ultimate line(s). Although the ultimate lines depend in principle on the source, the spectrometer, and other features of the experiment, a relatively small group of lines can be specified for each element that will include the ultimate lines as observed over a broad range of experimental conditions. We designate our selection of these lines "persistent lines."

The strongest persistent lines usually include one or more resonance lines, i.e., transitions to the ground level or term. We include at least one of the resonance lines in our persistent line table for each spectrum. The most sensitive or ultimate lines for many spectra lie in the vacuum-ultraviolet region (wavelength$<$2000 Å). In such cases we have tried to include some lines above 2000 Å in the persistent lines list. We have also tried to make these tables more generally useful for many spectra by covering broader wavelength ranges than most tables of this sort.

In addition to the information given in the strong lines table, the list of persistent lines includes the energy levels involved in the transition, complete with configuration, term designations, and J values. Where available, the transition probability is also given, along with the reference from which it is taken.

1.3.1. Transition Probabilities

The values are listed as A_{ki} in units of $10^8\ \mathrm{s}^{-1}$. These A_{ki} values can easily be converted to oscillator strengths, f_{ik}, $g_i f_{ik}$, or $\log(g_i f_{ik})$, or line strength, S, using the following formula:

$$g_i f_{ik} = 1.499\times10^{-8} A_{ki}\lambda^2 g_k = 303.8\lambda^{-1} S,$$

where i refers to the lower energy level, k refers to the upper level, λ is the wavelength in Ångstroms, and $g=2J+1$ for a given level.

The transition probability data are taken primarily from three compilations and from references cited therein. The NIST compilation [FW96] contains transition probabilities for about 9000 lines, covering most elements. Major recent compilations by Morton for elements from H to Ga [M91,M03] and from Ge to Bi (plus Th and U) [M00] have data for wavelengths longward of the Lyman limit (911.754 Å), and include a number of useful new references.

1.3.2. Energy-Level Classifications

Data pertaining to the two levels classifying each line are given with data for the lower level above that for the upper level. Included are the level values, configurations, term names, and J values for the levels classifying the line. The energy-level classifications for a few persistent lines are not known, as indicated by the absence of level values. The accuracies and spectroscopic designations of the levels are discussed in the next section.

1.4. Energy Level Tables

The tabulated energy levels represent a selection of the available data for each spectrum, including all levels involved in the persistent-line classifications. At least the lower levels of the ground configuration and other low-lying configurations are given. The levels of some of the simpler spectra are given complete up through the highest tabulated level, but most of the known energy level structures of the more complex spectra are omitted here. The ionization energies are included except for a few spectra for which no reliable values are available. The reference for each level represents the source of the level value.

Estimated uncertainties for the levels can usually be found in the references. In our tables, the uncertainties are only roughly indicated by the number of decimal places or significant figures in the values. The uncertainty corresponding to a particular number of decimals may easily vary by an order of magnitude, however, even within the data for one spectrum. In most cases, the uncertainty is between 1 and ~ 30 units in the last decimal place or significant figure, but still larger errors can occur. The uncertainty in the relative position of two levels having different uncertainties is at least as large as the greater of the two level uncertainties. In this regard, it is important to notice the number of decimals given for the ground level; the uncertainties of the absolute values of the excited levels and ionization energy are at least as large as the indicated ground-level uncertainty.

The configuration and term notations are standard for NIST compilations. Explanations of the notations for the different coupling schemes and of the arrangement of the data can be found in [MZH78], [MW96] and online as a part of the "Help" section of ASD [MFKM99]. Some levels of complex spectra are given without term names, either because the level has not been interpreted theoretically or because the calculated eigenvector for the level yields no meaningful unique name. Some of these levels have been assigned simple numerical designations under "Term." The parity of levels lacking designations is indicated by a degree symbol in the "Term" column for odd-parity levels.

1.5. Finding List

This table gives the wavelength, intensity, spectrum, and reference for each line in this compilation, listed in order of increasing wavelength. Although this list has fewer lines than the finding list of [RCWM80] or [MCS75], it includes some lines not given in the earlier publications.

1.6. Acknowledgments

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2. Data Tables for the Elements (Ordered Alphabetically)

Actinium (Ac)

Atomic number = 89
Atomic weight = (227)

Isotope	Mass	Abundance	Spin	Mag moment
^{227}Ac	227.027750	Trace	3/2	−1.1
^{228}Ac	228.031015	Trace	3	

Ac I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 6d 7s^2\ {}^2D_{3/2}$
Ionization energy: 41 700 cm^{-1} (5.17 eV)

Ac II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 7s^2\ {}^1S_0$
Ionization energy: 94 800 cm^{-1} (11.75 eV)

Strong Lines of Actinium (Ac)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
100 h	2847.16	Ac II	MFT57
130	2994.17	Ac II	MFT57
300	3043.30	Ac II	MFT57
130	3069.36	Ac II	MFT57
130	3112.83	Ac II	MFT57
300 s	3153.09	Ac II	MFT57
300 s	3154.41	Ac II	MFT57
150 s	3164.81	Ac II	MFT57
130 s	3230.59	Ac II	MFT57
300	3260.91	Ac II	MFT57
130 s	3383.53	Ac II	MFT57
130	3413.84	Ac II	MFT57
200	3417.77	Ac II	MFT57
300 s	3481.16	Ac II	MFT57
130	3489.53	Ac II	MFT57
130 s	3554.99	Ac II	MFT57
700 P,s	3565.59	Ac II	MFT57
150 s	3756.67	Ac II	MFT57
70	3799.82	Ac II	MFT57
700 P,s	3863.12	Ac II	MFT57
400 P	3885.56	Ac I	MFT57
200	4034.63	Ac I	MFT57
150 s	4061.60	Ac II	MFT57
200	4063.10	Ac I	MFT57
1000 P,s	4088.44	Ac II	MFT57
700 P,s	4168.40	Ac II	MFT57
1000 P	4179.98	Ac I	MFT57
500 P	4183.12	Ac I	MFT57
400 P	4194.40	Ac I	MFT57
100 s	4209.69	Ac II	MFT57
130	4359.13	Ac II	MFT57
300 P,l	4384.53	Ac I	MFT57
500 P,l	4386.41	Ac II	MFT57
400 P	4396.71	Ac I	MFT57
400 P	4462.73	Ac I	MFT57
700 P,l	4507.20	Ac II	MFT57
300	4605.45	Ac II	MFT57
300 P	4613.93	Ac I	MFT57
200	4705.78	Ac I	MFT57
500 P	4716.58	Ac I	MFT57
300 s	4720.16	Ac II	MFT57

Strong Lines of Actinium (Ac)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	4812.22	Ac II	MFT57
300 P	5258.24	Ac I	MFT57
200	5569.26	Ac I	MFT57
70 l	5732.05	Ac II	MFT57
130	5758.97	Ac II	MFT57
300 P	5910.85	Ac II	MFT57
200 l	6164.75	Ac II	MFT57
30 l	6167.83	Ac II	MFT57
100	6242.83	Ac II	MFT57
300 P	6359.86	Ac I	MFT57
200 P,l	6691.27	Ac I	MFT57
300 P	7290.40	Ac I	MFT57
200 l	7866.10	Ac I	MFT57

Persistent Lines of Neutral Actinium (Ac I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	3885.56		$6d7s^2$	^2D	3/2	0.00	MFT57	
			$6d7s(^3D)7p$	$^2P^o$	1/2	25729.03		
1000	4179.98		$6d7s^2$	^2D	3/2	0.00	MFT57	
			$6d7s(^3D)7p$	$^2F^o$	5/2	23916.84		
500	4183.12		$6d7s^2$	^2D	3/2	0.00	MFT57	
			$6d7s(^3D)7p$	$^4P^o$	5/2	23898.86		
400	4194.40		$6d7s^2$	^2D	5/2	2231.43	MFT57	
			$6d7s(^1D)7p$	$^2D^o$	3/2	26066.04		
300	4384.53		$6d7s^2$	^2D	3/2	0.00	MFT57	
			$6d7s(^3D)7p$	$^4P^o$	3/2	22801.10		
400	4396.71		$6d7s^2$	^2D	5/2	2231.43	MFT57	
			$6d7s(^3D)7p$	$^2F^o$	7/2	24969.30		
400	4462.73		$6d7s^2$	^2D	3/2	0.00	MFT57	
			$6d7s(^3D)7p$	$^4P^o$	1/2	22401.52		
300	4613.93		$6d7s^2$	^2D	5/2	2231.43	MFT57	
			$6d7s(^3D)7p$	$^4P^o$	5/2	23898.86		
500	4716.58		$6d7s^2$	^2D	3/2	0.00	MFT57	
			$6d7s(^3D)7p$	$^4D^o$	5/2	21195.87		
300	5258.24		$6d7s^2$	^2D	3/2	0.00	MFT57	
			$6d7s(^3D)7p$	$^4D^o$	3/2	19012.46		
300	6359.86		$6d7s^2$	^2D	5/2	2231.43	MFT57	
			$6d7s(^3D)7p$	$^2D^o$	5/2	17950.71		
200	6691.27		$6d7s^2$	^2D	3/2	0.00	MFT57	
			$6d7s(^3D)7p$	$^4F^o$	5/2	14940.72		
300	7290.40		$6d7s^2$	^2D	3/2	0.00	MFT57	
			$6d7s(^3D)7p$	$^4F^o$	3/2	13712.90		

Energy Levels of Neutral Actinium (Ac I)

Configuration	Term	J	Level (cm^{-1})	Ref
$6d7s^2$	^2D	3/2	0.00	MFT57
		5/2	2231.43	MFT57
$6d^27s$	^4F	3/2	9217.28	MFT57
		5/2	9863.59	MFT57
		7/2	10 906.02	MFT57
		9/2	12 078.07	MFT57
$6d7s(^3D)7p$	$^4F^o$	3/2	13 712.90	MFT57
		5/2	14 940.72	MFT57
		7/2	17 683.87	MFT57
$6d7s(^3D)7p$	$^4D^o$	1/2	17 199.71	MFT57
		3/2	19 012.46	MFT57
		5/2	21 195.87	MFT57
		7/2	23 475.94	MFT57
$6d7s(^3D)7p$	$^2D^o$	3/2	17 736.26	MFT57
		5/2	17 950.71	MFT57
$6d7s(^3D)7p$	$^4P^o$	1/2	22 401.52	MFT57
		3/2	22 801.10	MFT57
		5/2	23 898.86	MFT57
$6d7s(^3D)7p$	$^2F^o$	5/2	23 916.84	MFT57
		7/2	24 969.30	MFT57
$6d7s(^3D)7p$	$^2P^o$	1/2	25 729.03	MFT57
		3/2	27 009.84	MFT57
$6d7s(^1D)7p$	$^2D^o$	3/2	26 066.04	MFT57
		5/2	26 533.16	MFT57
$6d7s(^1D)7p$	$^2F^o$	5/2	26 836.20	MFT57
		7/2	28 568.40	MFT57
$6d7s(^1D)7p$	$^2P^o$	3/2	30 396.61	MFT57
$6d^2(^3F)7p$	$^4G^o$	5/2	31 494.68	MFT57
		7/2	32 219.62	MFT57
		9/2	32 867.39	MFT57
		11/2	33 429.76	MFT57
Ac II ($^1S_0$)		*Limit*	41700	S74

Persistent Lines of Singly-ionized Actinium (Ac II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	3565.59		$6d7s$	^3D	2	5267.16	MFT57	
			$6d7p$	$^3D^o$	2	33304.96		
700	3863.12		$6d7s$	^3D	3	7426.52	MFT57	
			$6d7p$	$^3D^o$	2	33304.96		
1000	4088.44		$6d7s$	^3D	3	7426.52	MFT57	
			$6d7p$	$^1D^o$	2	31878.87		
700	4168.40		$6d7s$	^3D	2	5267.16	MFT57	
			$6d7p$	^{o}	1	29250.40		
500	4386.41		$6d7s$	^1D	2	9087.54	MFT57	
			$6d7p$	$^1D^o$	2	31878.87		

Persistent Lines of Singly-ionized Actinium (Ac II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	4507.20		$7s^2$	^1S	0	0.00	MFT57	
			$7s7p$	$^3P^o$	1	22180.52		
300	5910.85		$6d7s$	^3D	2	5267.16	MFT57	
			$7s7p$	$^3P^o$	1	22180.52		

Energy Levels of Singly-ionized Actinium (Ac II)

Configuration	Term	J	Level (cm^{-1})	Ref
$7s^2$	^1S	0	0.00	MFT57
$6d7s$	^3D	1	4739.63	MFT57
		2	5267.16	MFT57
		3	7426.52	MFT57
$6d7s$	^1D	2	9087.54	MFT57
$6d^2$	^3F	2	13236.46	MFT57
		3	14949.21	MFT57
		4	16756.90	MFT57
$6d^2$	^3P	0	17737.10	MFT57
		1	19015.32	MFT57
		2	22199.45	MFT57
$6d^2$	^1D	2	19203.02	MFT57
$6d^2$	^1G	4	20848.23	MFT57
$7s7p$	$^3P^o$	0	20956.40	MFT57
		1	22180.52	MFT57
		2	26446.96	MFT57
$6d7p$	$^3F^o$	2	28201.11	MFT57
$6d7p$	^{o}	1	29250.40	MFT57
$5f7s$	$^1F^o$	3	29881.09	MFT57
$6d7p$	^{o}	3	31174.60	MFT57
$6d7p$	$^1D^o$	2	31878.87	MFT57
$5f7s$	$^3F^o$	4	32965.55	MFT57
$6d7p$	$^3D^o$	2	33304.96	MFT57
		1	33388.61	MFT57
		3	36144.35	MFT57
Ac III ($7s\ ^2S_{1/2}$)		*Limit*	**94800**	MHRS74

Aluminum (Al)
Atomic number = 13
Atomic weight = 26.981 54

Isotope	Mass	Abundance	Spin	Mag moment
^{27}Al	26.981540	100%	5/2	+3.6415

Al I Ground state: $1s^22s^22p^63s^23p\ ^2P_{1/2}$
Ionization energy: 48 278.48 cm^{-1} (5.985 768 eV)

Al II Ground state: $1s^22s^22p^63s^2\ ^1S_0$
Ionization energy: 151 862.5 cm^{-1} (18.828 55 eV)

Strong Lines of Aluminum (Al)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
800 P	1539.830	Al II	KM91b
1000 P	1670.7886	Al II	GK00
800 P	1719.440	Al II	KM91b
500	1721.244	Al II	KM91b
900 P	1721.271	Al II	KM91b
500	1724.952	Al II	KM91b
900 P	1724.984	Al II	KM91b
30	1762.899	Al I	KM91b
500	1763.869	Al II	KM91b
700 P	1763.952	Al II	KM91b
50	1765.636	Al I	KM91b
300	1765.815	Al II	KM91b
50	1766.385	Al I	KM91b
400	1767.731	Al II	KM91b
50	1769.140	Al I	KM91b
600	1828.588	Al II	KM91b
700 P	1858.026	Al II	KM91b
1000 P	1862.311	Al II	KM91b
700	1990.531	Al II	KM91b
	Air		
700	2094.264	Al II	KM91b
40 P	2269.096	Al I	KM91b
50 P	2367.052	Al I	KM91b
90 P	2373.124	Al I	KM91b
25	2567.984	Al I	KM91b
50 P	2575.094	Al I	KM91b
600 P	2816.185	Al II	KM91b
40	3050.073	Al I	KM91b
50	3057.144	Al I	KM91b
500 P	3082.153	Al I	KM91b
800 P	3092.710	Al I	KM91b
200 P	3092.839	Al I	KM91b
400	3586.557	Al II	KM91b
400	3900.675	Al II	KM91b
500 P	3944.006	Al I	KM91b
1000 P	3961.520	Al I	KM91b
1000 P	4663.056	Al II	KM91b
600	4666.800	Al II	KM91b
400	5593.302	Al II	KM91b
400	6006.410	Al II	KM91b
400	6073.198	Al II	KM91b

Strong Lines of Aluminum (Al)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400 h	6183.42	Al II	KM91b
400	6201.463	Al II	KM91b
400 P	6243.36	Al II	KM91b
400	6335.701	Al II	KM91b
40	6696.015	Al I	KM91b
30	7836.134	Al I	KM91b
40	8772.866	Al I	KM91b
50	8773.896	Al I	KM91b
50	11253.189	Al I	KM91b
60	11254.926	Al I	KM91b
60	13123.378	Al I	KM91b
50	13150.708	Al I	KM91b
30	16750.429	Al I	KM91b

Persistent Lines of Neutral Aluminum (Al I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
40	2269.096	0.691	$3s^2(^1S)3p$	$^2P^o$	3/2	112.061	KM91b	M03
			$3s^2(^1S)5d$	^2D	5/2	44168.847		
50	2367.052	0.628	$3s^2(^1S)3p$	$^2P^o$	1/2	0.000	KM91b	M03
			$3s^2(^1S)4d$	^2D	3/2	42233.742		
90	2373.124	0.748	$3s^2(^1S)3p$	$^2P^o$	3/2	112.061	KM91b	M03
			$3s^2(^1S)4d$	^2D	5/2	42237.783		
50	2575.094	0.226	$3s^2(^1S)3p$	$^2P^o$	3/2	112.061	KM91b	M03
			$3s^2(^1S)4d$	y ^2D	5/2	38933.968		
500	3082.153	0.622	$3s^2(^1S)3p$	$^2P^o$	1/2	0.000	KM91b	M03
			$3s^2(^1S)3d$	^2D	3/2	32435.453		
800	3092.710	0.738	$3s^2(^1S)3p$	$^2P^o$	3/2	112.061	KM91b	M03
			$3s^2(^1S)3d$	^2D	5/2	32436.796		
200	3092.839	0.123	$3s^2(^1S)3p$	$^2P^o$	3/2	112.061	KM91b	M03
			$3s^2(^1S)3d$	^2D	3/2	32435.453		
500	3944.006	0.498	$3s^2(^1S)3p$	$^2P^o$	1/2	0.000	KM91b	M03
			$3s^2(^1S)4s$	^2S	1/2	25347.756		
1000	3961.520	0.982	$3s^2(^1S)3p$	$^2P^o$	3/2	112.061	KM91b	M03
			$3s^2(^1S)4s$	^2S	1/2	25347.756		

Energy Levels of Neutral Aluminum (Al I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^2(^1S)3p$	$^2P^o$	1/2	0.000	MZ79
		3/2	112.061	MZ79,BE99
$3s^2(^1S)4s$	^2S	1/2	25347.756	MZ79
$3s3p^2$	^4P	1/2	29020.41	MZ79
		3/2	29066.96	MZ79
		5/2	29142.78	MZ79
$3s^2(^1S)3d$	^2D	3/2	32435.453	MZ79
		5/2	32436.796	MZ79
$3s^2(^1S)4p$	$^2P^o$	1/2	32949.807	MZ79
		3/2	32965.639	MZ79
$3s^2(^1S)5s$	^2S	1/2	37689.407	MZ79
$3s^2(^1S)4d$	y ^2D	3/2	38929.413	MZ79
		5/2	38933.968	MZ79
$3s^2(^1S)5p$	$^2P^o$	1/2	40271.978	MZ79
		3/2	40277.883	MZ79
$3s^2(^1S)4f$	$^2F^o$	5/2	41319.390	MZ79
		7/2	41319.398	MZ79
$3s^2(^1S)6s$	^2S	1/2	42144.411	MZ79
$3s^2(^1S)4d$	^2D	3/2	42233.742	MZ79
		5/2	42237.783	MZ79
$3s^2(^1S)6p$	$^2P^o$	1/2	43335.024	MZ79
		3/2	43337.889	MZ79
$3s^2(^1S)5f$	$^2F^o$	5/2	43831.101	MZ79
		7/2	43831.105	MZ79
$3s^2(^1S)5g$	^2G	7/2,9/2	43875.749	MZ79
$3s^2(^1S)5d$	^2D	3/2	44166.398	MZ79
		5/2	44168.847	MZ79
Al II ($^1S_0$)		*Limit*	**48278.48**	KM91b

Persistent Lines of Singly-ionized Aluminum (Al II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	1539.830	8.8	$3s3p$	$^1P^o$	1	59852.02	KM91b	FW96
			$3s4d$	^1D	2	124794.13		
1000	1670.7886	14.6	$3s^2$	^1S	0	0.00	GK00	FW96
			$3s3p$	$^1P^o$	1	59852.02		
800	1719.440	6.79	$3s3p$	$^3P^o$	0	37393.03	KM91b	FW96
			$3s3d$	^3D	1	95551.44		
900	1721.271	9.14	$3s3p$	$^3P^o$	1	37453.91	KM91b	WSM69
			$3s3d$	^3D	2	95550.51		
900	1724.984	12.1	$3s3p$	$^3P^o$	2	37577.79	KM91b	WSM69
			$3s3d$	^3D	3	95549.42		

Persistent Lines of Singly-ionized Aluminum (Al II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	1763.952	9.8	$3s3p$	$^3P^o$	2	37577.79	KM91b	FW96
			$3p^2$	^3P	2	94268.68		
700	1858.026	2.48	$3s3p$	$^3P^o$	1	37453.91	KM91b	FW96
			$3s4s$	^3S	1	91274.50		
1000	1862.311	4.12	$3s3p$	$^3P^o$	2	37577.79	KM91b	FW96
			$3s4s$	^3S	1	91274.50		
600	2816.185	3.83	$3s3p$	$^1P^o$	1	59852.02	KM91b	FW96
			$3s4s$	^1S	0	95350.60		
1000	4663.056	0.53	$3p^2$	^1D	2	85481.35	KM91b	FW96
			$3s4p$	$^1P^o$	1	106920.56		
400	6243.36	1.1	$3s4p$	$^3P^o$	2	105470.93	KM91b	FW96
			$3s4d$	^3D	3	121483.50		

Energy Levels of Singly-ionized Aluminum (Al II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^2$	^1S	0	0.00	MZ79
$3s3p$	$^3P^o$	0	37393.03	MZ79
		1	37453.91	MZ79
		2	37577.79	MZ79
$3s3p$	$^1P^o$	1	59852.02	MZ79
$3p^2$	^1D	2	85481.35	MZ79
$3s4s$	^3S	1	91274.50	MZ79
$3p^2$	^3P	0	94084.96	MZ79
		1	94147.46	MZ79
		2	94268.68	MZ79
$3s4s$	^1S	0	95350.60	MZ79
$3s3d$	^3D	3	95549.42	MZ79
		2	95550.51	MZ79
		1	95551.44	MZ79
$3s4p$	$^3P^o$	0	105427.52	MZ79
		1	105441.50	MZ79
		2	105470.93	MZ79
$3s4p$	$^1P^o$	1	106920.56	MZ79
$3s3d$	^1D	2	110089.83	MZ79
$3p^2$	^1S	0	111637.33	MZ79
$3s5s$	^3S	1	120092.919	MZ79
$3s5s$	^1S	0	121366.725	MZ79
$3s4d$	^3D	3	121483.50	MZ79
		2	121483.92	MZ79
		1	121484.252	MZ79

Energy Levels of Singly-ionized Aluminum (Al II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3s4f$	$^3F^o$	2	123418.48	MZ79
		3	123420.45	MZ79
		4	123423.36	MZ79
$3s4f$	$^1F^o$	3	123470.5	MZ79
$3s4d$	^1D	2	124794.13	MZ79
Al III ($^2S_{1/2}$)		*Limit*	**151862.5**	KM91b

Americium (Am)
Atomic number = 95
Atomic weight = (243)

Isotope	Mass	Abundance	Spin	Mag moment
^{241}Am	241.056823	0	5/2	+1.61
^{243}Am	243.061375	0	5/2	+1.61

Am I Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}4f^{14}5s^25p^65d^{10}6s^26p^65f^77s^2\ {}^8S^o_{7/2}$
Ionization energy: 48 182 cm^{-1} (5.9738 eV)

Am II Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}4f^{14}5s^25p^65d^{10}6s^26p^65f^77s\ {}^9S^o_4$
Ionization energy: not available

Strong Lines of Americium (Am)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
40 s	2756.550	Am II	FT57
40 s	2812.920	Am II	FT57
200 l	2815.282	Am II	FT57
1000 P,s	2832.258	Am II	FT57
200 l	2888.505	Am II	FT57
40 l	2899.562	Am II	FT57
40 l	2911.130	Am II	FT57
200 s	2920.593	Am II	FT57
40 l	2927.534	Am II	FT57
40 l	2936.992	Am II	FT57
100 l	2950.393	Am II	FT57
200 l	2966.712	Am II	FT57
200 l	2969.292	Am II	FT57
200 s	2987.238	Am II	FT57
100 l	2993.508	Am II	FT57
200 s	3004.250	Am II	FT57
100 s	3027.990	Am II	FT57
100 l	3038.363	Am II	FT57
40 s	3053.688	Am II	FT57
400 s	3120.486	Am II	FT57
40 s	3161.826	Am II	FT57
100 s	3282.320	Am II	FT57
40 l	3286.666	Am II	FT57
10 l	3343.867	Am I	FT57
100 s	3362.546	Am II	FT57
20 l	3395.010	Am I	FT57
40 s	3419.662	Am II	FT57
20	3446.186	Am I	FT57
200 l	3452.098	Am II	FT57
1000 P,l	3483.308	Am II	FT57
500 P	3510.127	Am I	FT57
100 l	3530.948	Am I	FT57
40 s	3562.680	Am II	FT57
500 P	3569.163	Am I	FT57
50	3603.410	Am I	FT57
500 P	3673.121	Am I	FT57
200 s	3696.420	Am II	FT57
1000 P,l	3777.504	Am II	FT57
1000 P,l	3926.248	Am II	FT57
200 l	3952.576	Am II	FT57
10 s	4020.252	Am I	FT57

Strong Lines of Americium (Am)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
10 s	4035.808	Am I	FT57
100 s	4036.365	Am II	FT57
1000 P,s	4089.291	Am II	FT57
10 s	4140.959	Am I	FT57
200 s	4188.121	Am II	FT57
100	4265.550	Am I	FT57
500 P	4289.258	Am I	FT57
40 s	4309.652	Am II	FT57
400 s	4324.570	Am II	FT57
400 s	4441.357	Am II	FT57
1000 P,l	4509.450	Am II	FT57
1000 P,l	4575.590	Am II	FT57
200 s	4593.307	Am II	FT57
10 l	4649.119	Am I	FT57
10 l	4653.448	Am I	FT57
500 P,l	4662.790	Am I	FT57
200 l	4681.651	Am I	FT57
400 l	4699.700	Am II	FT57
100 l	4706.802	Am I	FT57
400 l	4872.220	Am II	FT57
20 l	4990.786	Am I	FT57
10 s	5000.21	Am I	FT57
200 l	5020.96	Am II	FT57
40 l	5215.99	Am II	FT57
100 s	5402.62	Am I	FT57
100 s	5424.70	Am I	FT57
200 l	5584.21	Am II	FT57
100 s	5598.13	Am I	FT57
1000 P,l	6054.64	Am I	FT57
100 l	6405.11	Am I	FT57
50 l	6544.16	Am I	FT57
50 s	6955.58	Am I	FT57

Persistent Lines of Neutral Americium (Am I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3510.127		$5f^7(^8S^o)7s^2$	$^8S^o$	7/2	0.00	FT57	
			$5f^7(^8S^o_{7/2})7s7p(^1P_1)$	(7/2,1)	9/2	28480.87		
500	3569.163		$5f^7(^8S^o)7s^2$	$^8S^o$	7/2	0.00	FT57	
			$5f^7(^8S^o_{7/2})7s7p(^1P_1)$	(7/2,1)	7/2	28009.81		
500	3673.121		$5f^7(^8S^o)7s^2$	$^8S^o$	7/2	0.00	FT57	
			$5f^7(^8S^o_{7/2})7s7p(^1P_1)$	(7/2,1)	5/2	27217.14		
500	4289.258		$5f^7(^8S^o)7s^2$	$^8S^o$	7/2	0.00	FT57	
					9/2	23307.41		
500	4662.790		$5f^7(^8S^o)7s^2$	$^8S^o$	7/2	0.00	FT57	
			$5f^7(^8S^o_{7/2})7s7p(^3P_2)$	(7/2,2)	7/2	21440.37		
1000	6054.638		$5f^7(^8S^o)7s^2$	$^8S^o$	7/2	0.00	FT57	
			$5f^7(^8S^o_{7/2})7s7p(^3P_1)$	(7/2,1)	9/2	16511.82		

Energy Levels of Neutral Americium (Am I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^7(^8S^o)7s^2$	$^8S^o$	7/2	0.00	BW92b
$5f^6(^7F)6d7s^2$	^8H	3/2	10683.57	BW92b
$5f^6(^7F)6d7s^2$	^8H	5/2	12974.03	BW92b
$5f^6(^7F)6d7s^2$	^8D	3/2	13292.51	BW92b
$5f^7(^8S^o)6d7s$	$^{10}D^o$	5/2	14506.92	BW92b
		7/2	14752.02	BW92b
		9/2	15136.02	BW92b
		11/2	15764.81	BW92b
		13/2	—	
$5f^6(^7F)6d7s^2$	^8G	1/2	14943.63	BW92b
$5f^7(^8S^o)7s^2$	$^6P^o$	7/2	15017.69	BW92b
$5f^6(^7F)6d7s^2$	^8H	7/2	15273.16	BW92b
$5f^7(^8S^o_{7/2})7s7p(^3P^o_1)$	(7/2,1)	9/2	16511.82	BW92b
$5f^7(^8S^o_{7/2})7s7p(^3P^o_2)$	(7/2,2)	7/2	21440.37	BW92b
		9/2	23307.41	BW92b
$5f^7(^8S^o_{7/2})7s7p(^1P^o_1)$	(7/2,1)	5/2	27217.14	BW92b
		7/2	28009.81	BW92b
		9/2	28480.87	BW92b
Am II $(^9S^o_4)$		*Limit*	**48182**	KDEE97

Persistent Lines of Singly-ionized Americium (Am II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2832.258		$5f^7(^8S^o)7s$	$^9S^o$	4 5	0.00 35297.13	FT57	
1000	3483.308		$5f^7(^8S^o)7s$	$^7S^o$	3 4	2598.32 31298.50	FT57	
1000	3777.504		$5f^7(^8S^o)7s$	$^7S^o$	3 3	2598.32 29063.30	FT57	
1000	3926.248		$5f^7(^8S^o)7s$	$^7S^o$	3 4	2598.32 28060.74	FT57	
1000	4089.291		$5f^7(^8S^o)7s$	$^9S^o$	4 4	0.00 24447.22	FT57	
1000	4509.450		$5f^7(^8S^o)7s$	$^7S^o$	3 4	2598.32 24767.76	FT57	
1000	4575.590		$5f^7(^8S^o)7s$	$^7S^o$	3 4	2598.32 24447.22	FT57	

Energy Levels of Singly-ionized Americium (Am II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^7(^8S^o)7s$	$^9S^o$	4	0.00	BW92b
$5f^7(^8S^o)7s$	$^7S^o$	3	2598.32	BW92b
$5f^7(^8S^o)6d$	$^9D^o$	2,3	14222.21	BW92b
$5f^7(^8S^o)6d$	$^9D^o$	3,4	14479.56	BW92b
$5f^7(^8S^o)6d$	$^9D^o$	4,5	14905.50	BW92b
		4	24447.22	BW92b
		4	24767.76	BW92b
		4	28060.74	BW92b
		3	29063.30	BW92b
		4	31298.50	BW92b
		5	35297.13	BW92b
Am III ($^8S^o_{7/2}$)		*Limit*		

Antimony (Sb)

Atomic number = 51
Atomic weight = 121.75

Isotope	Mass	Abundance	Spin	Mag moment
^{121}Sb	120.903821	57.3%	5/2	+3.3592
^{123}Sb	122.904216	42.7%	7/2	+2.5466

Sb I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^3\ ^4S^o_{3/2}$
Ionization energy: 69 431.34 cm^{-1} (8.608 39 eV)

Sb II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^2\ ^3P_0$
Ionization energy: 134 100 cm^{-1} (16.63 eV)

Strong Lines of Antimony (Sb)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
800 P	1274.938	Sb II	AJK89
800 P	1327.378	Sb II	AJK89
800	1354.955	Sb II	AJK89
600	1358.009	Sb II	AJK89
800 P	1384.656	Sb II	AJK89
1000 P	1387.565	Sb II	AJK89
600	1407.784	Sb II	AJK89
800 P	1436.447	Sb II	AJK89
800	1498.549	Sb II	AJK89
800	1513.255	Sb II	AJK89
800	1524.367	Sb II	AJK89
800	1565.501	Sb II	AJK89
900 P	1576.099	Sb II	AJK89
800	1581.353	Sb II	AJK89
1000 P	1606.952	Sb II	AJK89
700	1814.964	Sb II	AJK89
400 P,r	1871.154	Sb I	SM02
200	1882.568	Sb I	SM02
300 r	1950.393	Sb I	SM02
	Air		
30 r	2039.792	Sb I	SM02
60 P,r	2049.577	Sb I	SM02
100	2054.734	Sb II	AJK89
400 P,r	2068.344	Sb I	SM02
20 r	2098.424	Sb I	SM02
40 P,r	2139.698	Sb I	SM02
40 P,r	2144.841	Sb I	SM02
100	2170.855	Sb II	AJK89
600 P,r	2175.818	Sb I	SM02
100 P,r	2179.190	Sb I	SM02
120 P,r	2208.430	Sb I	SM02
120 r	2262.483	Sb I	SM02
120 r	2306.507	Sb I	SM02
1000 P,r	2311.463	Sb I	SM02
150 h	2373.631	Sb I	SM02
120 h	2383.616	Sb I	SM02
150 r	2445.502	Sb I	SM02
150	2478.316	Sb I	SM02
800 P,r	2528.509	Sb I	SM02
600 P,r	2598.048	Sb I	SM02

Strong Lines of Antimony (Sb)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200 r	2598.084	Sb I	SM02
120 r	2612.304	Sb I	SM02
120 r	2670.630	Sb I	SM02
150 r	2769.931	Sb I	SM02
400 P,r	2877.913	Sb I	SM02
200 r	3029.809	Sb I	SM02
250 P,r	3232.495	Sb I	SM02
300 P,r	3267.491	Sb I	SM02
200	4711.68	Sb II	C66b
400 P	5568.12	Sb II	C66b
200	5639.77	Sb II	C66b
500 P	6005.57	Sb II	C66b
200	6079.67	Sb II	C66b
300 P	6130.00	Sb II	C66b
150	9518.68	Sb I	SM02
150	9949.14	Sb I	SM02
120	10260.849	Sb I	SM02
400	10677.246	Sb I	SM02
300	10741.898	Sb I	SM02
250	10839.571	Sb I	SM02
150	10879.698	Sb I	SM02
120	11012.728	Sb I	SM02
60	11266.082	Sb I	SM02
12	11863.229	Sb I	SM02

Persistent Lines of Neutral Antimony (Sb I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	1871.154		$5s^25p^3$	$^4S^o$	3/2	0.000	SM02	
			$5s^25p^2(^3P)5d$	^4P	5/2	53442.967		
60	2049.577		$5s^25p^3$	$^2D^o$	3/2	8512.125	SM02	
			$5s^25p^2(^3P)5d$	^2F	5/2	57287.052		
400	2068.344	1.81	$5s^25p^3$	$^4S^o$	3/2	0.000	SM02	GL80
			$5s^25p^2(^3P)6s$	^4P	5/2	48332.424		
40	2139.698	1.74	$5s^25p^3$	$^2D^o$	3/2	8512.125	SM02	GL80
			$5s^25p^2(^1D)6s$	^2D	3/2	55232.963		
40	2144.841		$5s^25p^3$	$^2D^o$	3/2	8512.125	SM02	
			$5s^25p^2(^3P)5d$	^4F	5/2	55120.943		
600	2175.818	1.75	$5s^25p^3$	$^4S^o$	3/2	0.000	SM02	GL80
			$5s^25p^2(^3P)6s$	^4P	3/2	45945.340		
100	2179.190	2.39	$5s^25p^3$	$^2D^o$	5/2	9854.018	SM02	GL80
			$5s^25p^2(^1D)6s$	^2D	5/2	55728.264		
120	2208.430		$5s^25p^3$	$^2D^o$	5/2	9854.018	SM02	
			$5s^25p^2(^3P)5d$	^4F	5/2	55120.943		
1000	2311.463	1.69	$5s^25p^3$	$^4S^o$	3/2	0.000	SM02	GL80
			$5s^25p^2(^3P)6s$	^4P	1/2	43249.337		
800	2528.509	1.77	$5s^25p^3$	$^2D^o$	5/2	9854.018	SM02	GL80
			$5s^25p^2(^3P)6s$	^2P	3/2	49391.133		

Persistent Lines of Neutral Antimony (Sb I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	2598.048	0.210	$5s^25p^3$	$^2D^o$	3/2	8512.125	SM02	GL80
			$5s^25p^2(^3P)6s$	^2P	1/2	46991.058		
400	2877.913	0.424	$5s^25p^3$	$^2D^o$	3/2	8512.125	SM02	GL80
			$5s^25p^2(^3P)6s$	^4P	1/2	43249.337		
250	3232.495	0.307	$5s^25p^3$	$^2P^o$	3/2	18464.202	SM02	GL80
			$5s^25p^2(^3P)6s$	^2P	3/2	49391.133		
300	3267.491	0.495	$5s^25p^3$	$^2P^o$	1/2	16395.359	SM02	GL80
			$5s^25p^2(^3P)6s$	^2P	1/2	46991.058		

Energy Levels of Neutral Antimony (Sb I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5s^25p^3$	$^4S^o$	3/2	0.000	HARV88
$5s^25p^3$	$^2D^o$	3/2	8512.125	HARV88
		5/2	9854.018	HARV88
$5s^25p^3$	$^2P^o$	1/2	16395.359	HARV88
		3/2	18464.202	HARV88
$5s^25p^2(^3P)6s$	^4P	1/2	43249.337	HARV88
		3/2	45945.340	HARV88
		5/2	48332.424	HARV88
$5s^25p^2(^3P)6s$	^2P	1/2	46991.058	HARV88
		3/2	49391.133	HARV88
$5s^25p^2(^3P)5d$	^4P	5/2	53442.967	HARV88
		3/2	56151.802	HARV88
		1/2	56698.608	HARV88
$5s^25p^2(^3P)5d$	^4F	3/2	53527.956	HARV88
		5/2	55120.943	HARV88
		7/2	56528.132	HARV88
$5s^25p^2(^1D)6s$	^2D	3/2	55232.963	HARV88
		5/2	55728.264	HARV88
$5s^25p^2(^3P)5d$	^2F	5/2	57287.052	HARV88
		7/2	61125.741	HARV88
$5s^25p^2(^1S)6s$	^2S	1/2	65654.41	HARV88
Sb II ($^3P_0$)		*Limit*	**69431.34**	BW86

Persistent Lines of Singly-ionized Antimony (Sb II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	1274.938		$5s^25p^2$	^1D	2	12789.8	AJK89	
			$5s^25p5d$	$^1F^o$	3	91225.0		
800	1327.378		$5s^25p^2$	^3P	1	3054.6	AJK89	
			$5s5p^3$	$^3P^o$	2	78390.9		
800	1384.656	1.1	$5s^25p^2$	^3P	1	3054.6	AJK89	M00
			$5s^25p6s$	$^3P^o$	2	75274.5		
1000	1387.565		$5s^25p^2$	^3P	2	5658.2	AJK89	
			$5s^25p5d$	$^3F^o$	3	77726.9		
800	1436.447	5.2	$5s^25p^2$	^3P	2	5658.2	AJK89	M00
			$5s^25p6s$	$^3P^o$	2	75274.5		
800	1576.099		$5s^25p^2$	^3P	1	3054.6	AJK89	
			$5s5p^3$	$^3D^o$	2	66502.3		
1000	1606.952		$5s^25p^2$	^3P	2	5658.2	AJK89	
			$5s5p^3$	$^3D^o$	3	67887.5		
400	5568.12		$5s^25p6s$	$^1P^o$	1	75898.9	C66b	
			$5s^25p6p$	^1D	2	93853.2		
500	6005.57		$5s^25p6s$	$^3P^o$	1	69535.7	C66b	
			$5s^25p6p$	^3D	2	86183.6		
300	6130.00		$5s^25p6s$	$^3P^o$	2	75274.5	C66b	
			$5s^25p6p$	^3D	3	91583.2		

Energy Levels of Singly-ionized Antimony (Sb II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5s^25p^2$	^3P	0	0.0	AJK89
		1	3054.6	AJK89
		2	5658.2	AJK89
$5s^25p^2$	^1D	2	12789.8	AJK89
$5s^25p^2$	^1S	0	23905.5	AJK89
$5s5p^3$	$^5S^o$	2	51722.9	AJK89
$5s5p^3$	$^3D^o$	1	66291.6	AJK89
		2	66502.3	AJK89
		3	67887.5	AJK89
$5s^25p6s$	$^3P^o$	0	69137.3	AJK89
		1	69535.7	AJK89
		2	75274.5	AJK89
$5s^25p5d$	$^1D^o$	2	72389.7	AJK89
$5s^25p6s$	$^1P^o$	1	75898.9	AJK89
$5s^25p5d$	$^3F^o$	2	76691.8	AJK89
		3	77726.9	AJK89
		4	81083.0	AJK89

Energy Levels of Singly-ionized Antimony (Sb II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5s5p^3$	$^3P^o$	0	76857.8	AJK89
		1	77139.4	AJK89
		2	78390.9	AJK89
$5s^25p6p$	^3D	1	83826.4	C66b
		2	86183.6	C66b
		3	91583.2	C66b
$5s^25p5d$	$^3D^o$	1	85094.1	AJK89
		2	86027.3	AJK89
		3	88259.7	AJK89
$5s^25p5d$	$^1F^o$	3	91225.0	AJK89
$5s^25p6p$	^1D	2	93853.2	C66b
Sb III ($^2P^o_{1/2}$)		*Limit*	**134100**	C66b

Argon (Ar)
Atomic number = 18
Atomic weight = 39.948

Isotope	Mass	Abundance	Spin	Mag moment
^{36}Ar	35.967545	0.337%	0	
^{38}Ar	37.962732	0.063%	0	
^{40}Ar	39.962384	99.600%	0	

Ar I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6\ ^1S_0$
Ionization energy: 127 109.842 cm^{-1} (15.759 610 eV)

Ar II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^5\ ^2P^o_{3/2}$
Ionization energy: 222 848.3 cm^{-1} (27.629 66 eV)

Strong Lines of Argon (Ar)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
10	487.2272	Ar II	M71
15	490.6495	Ar II	M71
10	490.7013	Ar II	M71
10	519.3270	Ar II	M71
10	542.9124	Ar II	M71
70	543.2033	Ar II	M71
25	547.4606	Ar II	M71
25	556.8170	Ar II	M71
25	573.3619	Ar II	M71
10	576.7364	Ar II	M71
25	580.2632	Ar II	M71
10	583.4371	Ar II	M71
25	597.7001	Ar II	M71
10	602.8584	Ar II	M71
10	612.3716	Ar II	M71
150 P	661.8690	Ar II	M71
10	664.5623	Ar II	M71
70	666.0109	Ar II	M71
300 P	670.9455	Ar II	M71
1000 P	671.8513	Ar II	M71
25	676.2425	Ar II	M71
10	677.9518	Ar II	M71
10	679.2184	Ar II	M71
70	679.4006	Ar II	M71
70	718.0899	Ar II	M71
1000 P	723.3606	Ar II	M71
150	725.5485	Ar II	M71
25	730.9297	Ar II	M71
70	740.2692	Ar II	M71
70	744.9248	Ar II	M71
25	745.3223	Ar II	M71
20	802.85896	Ar I	M73
100	806.4710	Ar I	M73
60	806.86887	Ar I	M73
30	807.21842	Ar I	M73
40	807.6529	Ar I	M73
50	809.92660	Ar I	M73
120	816.23193	Ar I	M73
70	816.46391	Ar I	M73

Strong Lines of Argon (Ar)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
80	820.12352	Ar I	M73
120	825.34592	Ar I	M73
120	826.36484	Ar I	M73
150	834.3918	Ar I	M73
100	835.00210	Ar I	M73
100	842.80506	Ar I	M73
180 P	866.79997	Ar I	M73
150 P	869.75411	Ar I	M73
180P	876.05767	Ar I	M73
180 P	879.94656	Ar I	M73
150 P	894.31013	Ar I	M73
300 P	919.7810	Ar II	M71
300 P	932.0537	Ar II	M71
1000 P	1048.21987	Ar I	VHU99
500 P	1066.65980	Ar I	M73
	Air		
2	2420.456	Ar II	N73
3	2516.789	Ar II	N73
3	2534.709	Ar II	N73
5	2562.087	Ar II	N73
8	2891.612	Ar II	N73
70	2942.893	Ar II	N73
30	2979.050	Ar II	N73
15	3033.508	Ar II	N73
15	3093.402	Ar II	N73
7	3243.689	Ar II	N73
8	3293.640	Ar II	N73
7	3307.228	Ar II	N73
8	3350.924	Ar II	N73
8	3376.436	Ar II	N73
8	3388.531	Ar II	N73
25	3476.747	Ar II	N73
7	3478.232	Ar II	N73
15	3491.244	Ar II	N73
30	3491.536	Ar II	N73
25	3509.778	Ar II	N73
25	3514.388	Ar II	N73
25	3545.596	Ar II	N73
25	3545.845	Ar II	N73
30	3559.508	Ar II	N73
30	3561.030	Ar II	N73
25	3576.616	Ar II	N73
8	3581.608	Ar II	N73
15	3582.355	Ar II	N73
25	3588.441	Ar II	N73
8	3622.138	Ar II	N73
7	3639.833	Ar II	N73
12	3718.206	Ar II	N73
25	3729.309	Ar II	N73
15	3737.889	Ar II	N73
50	3765.270	Ar II	N73
15	3766.119	Ar II	N73
1	3770.369	Ar I	N73
7	3770.520	Ar II	N73

Strong Lines of Argon (Ar)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
8	3780.840	Ar II	N73
8	3803.172	Ar II	N73
15	3809.456	Ar II	N73
25	3850.581	Ar II	N73
12	3868.528	Ar II	N73
12	3925.719	Ar II	N73
15	3928.623	Ar II	N73
8	3932.547	Ar II	N73
25	3946.097	Ar II	N73
1	3948.979	Ar I	N73
7	3979.356	Ar II	N73
12	3994.792	Ar II	N73
15	4013.857	Ar II	N73
15	4033.809	Ar II	N73
7	4035.460	Ar II	N73
50	4042.894	Ar II	N73
1	4044.418	Ar I	N73
30	4052.921	Ar II	N73
70	4072.005	Ar II	N73
25	4072.385	Ar II	N73
8	4076.628	Ar II	N73
12	4079.574	Ar II	N73
8	4082.387	Ar II	N73
50	4103.912	Ar II	N73
100	4131.724	Ar II	N73
12	4156.086	Ar II	N73
11	4158.590	Ar I	N73
1	4164.180	Ar I	N73
12	4179.297	Ar II	N73
1	4181.884	Ar I	N73
3	4190.713	Ar I	N73
1	4191.029	Ar I	N73
6	4198.317	Ar I	N73
11	4200.674	Ar I	N73
8	4218.665	Ar II	N73
8	4222.637	Ar II	N73
8	4226.988	Ar II	N73
30	4228.158	Ar II	N73
30	4237.220	Ar II	N73
1	4251.185	Ar I	N73
6	4259.362	Ar I	N73
3	4266.286	Ar I	N73
25	4266.527	Ar II	N73
4	4272.169	Ar I	N73
200 P	4277.528	Ar II	N73
7	4282.898	Ar II	N73
3	4300.101	Ar I	N73
8	4300.650	Ar II	N73
25	4309.239	Ar II	N73
70	4331.200	Ar II	N73
15	4332.030	Ar II	N73
3	4333.561	Ar I	N73
1	4335.338	Ar I	N73
1	4345.168	Ar I	N73

Strong Lines of Argon (Ar)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
250 P	4348.064	Ar II	N73
15	4352.205	Ar II	N73
8	4362.066	Ar II	N73
15	4367.832	Ar II	N73
70	4370.753	Ar II	N73
25	4371.329	Ar II	N73
15	4375.954	Ar II	N73
50	4379.667	Ar II	N73
15	4385.057	Ar II	N73
25	4400.097	Ar II	N73
70	4400.986	Ar II	N73
130	4426.001	Ar II	N73
50	4430.189	Ar II	N73
15	4430.996	Ar II	N73
15	4433.838	Ar II	N73
7	4439.461	Ar II	N73
12	4448.879	Ar II	N73
30	4474.759	Ar II	N73
70	4481.811	Ar II	N73
3	4510.733	Ar I	N73
1	4522.323	Ar I	N73
7	4530.552	Ar II	N73
130	4545.052	Ar II	N73
7	4564.405	Ar II	N73
130	4579.350	Ar II	N73
130	4589.898	Ar II	N73
200 P	4609.567	Ar II	N73
12	4637.233	Ar II	N73
130	4657.901	Ar II	N73
7	4721.591	Ar II	N73
200 P	4726.868	Ar II	N73
15	4732.053	Ar II	N73
100	4735.906	Ar II	N73
250 P	4764.865	Ar II	N73
200 P	4806.020	Ar II	N73
50	4847.810	Ar II	N73
15	4865.910	Ar II	N73
250 P	4879.864	Ar II	N73
25	4889.042	Ar II	N73
7	4904.752	Ar II	N73
12	4933.209	Ar II	N73
70	4965.080	Ar II	N73
15	5009.334	Ar II	N73
25	5017.163	Ar II	N73
25	5062.037	Ar II	N73
7	5090.495	Ar II	N73
30	5141.783	Ar II	N73
25	5145.308	Ar II	N73
8	5165.773	Ar II	N73
1	5187.746	Ar I	N73
7	5216.814	Ar II	N73
1	5495.874	Ar I	N73
1	5558.702	Ar I	N73
1	5606.733	Ar I	N73

Strong Lines of Argon (Ar)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1	5650.704	Ar I	N73
1	5888.584	Ar I	N73
1	5912.085	Ar I	N73
2	6032.127	Ar I	N73
1	6043.223	Ar I	N73
1	6059.372	Ar I	N73
30	6114.923	Ar II	N73
50	6172.278	Ar II	N73
8	6243.120	Ar II	N73
1	6384.717	Ar I	N73
2	6416.307	Ar I	N73
8	6483.082	Ar II	N73
8	6638.221	Ar II	N73
7	6639.740	Ar II	N73
15	6643.698	Ar II	N73
8	6666.359	Ar II	N73
3	6677.282	Ar I	N73
12	6684.293	Ar II	N73
4	6752.834	Ar I	N73
7	6861.269	Ar II	N73
4	6871.289	Ar I	N73
1	6937.664	Ar I	N73
300 P	6965.431	Ar I	N73
4	7030.251	Ar I	N73
300 P	7067.218	Ar I	N73
3	7068.736	Ar I	N73
1	7107.478	Ar I	N73
1	7125.820	Ar I	N73
30 P	7147.042	Ar I	N73
2	7206.980	Ar I	N73
60 P	7272.936	Ar I	N73
1	7311.716	Ar I	N73
1	7316.005	Ar I	N73
2	7353.293	Ar I	N73
6	7372.118	Ar I	N73
7	7380.426	Ar II	N73
300	7383.980	Ar I	N73
1	7392.980	Ar I	N73
1	7435.368	Ar I	N73
600 P	7503.869	Ar I	N73
400	7514.652	Ar I	N73
700 P	7635.106	Ar I	N73
400	7723.761	Ar I	N73
300	7724.207	Ar I	N73
600 P	7948.176	Ar I	N73
600 P	8006.157	Ar I	N73
700 P	8014.786	Ar I	N73
600 P	8103.693	Ar I	N73
1000 P	8115.311	Ar I	N73
300	8264.522	Ar I	N73
1	8392.27	Ar I	M73
400	8408.210	Ar I	N73
600	8424.648	Ar I	N73
400	8521.442	Ar I	N73

Strong Lines of Argon (Ar)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
130	8667.944	Ar I	N73
7	8771.860	Ar II	N73
5	8849.91	Ar I	M73
1	9075.394	Ar I	N73
1000 P	9122.967	Ar I	N73
15	9194.638	Ar I	N73
400	9224.499	Ar I	N73
11	9291.531	Ar I	N73
50	9354.220	Ar I	N73
700 P	9657.786	Ar I	N73
130	9784.503	Ar I	N73
5	10052.06	Ar I	M73
1	10332.72	Ar I	M73
30	10467.177	Ar II	N73
50	10470.054	Ar I	N73
5	10506.50	Ar I	M73
6	10673.565	Ar I	N73
2	10683.034	Ar II	N73
1	10733.87	Ar I	M73
1	10759.16	Ar I	M73
2	10812.896	Ar II	N73
1	11106.46	Ar I	M73
11	11488.109	Ar I	N73
6	11668.710	Ar I	N73
6	12112.326	Ar I	N73
1	12139.738	Ar I	N73
1	12343.393	Ar I	N73
6	12402.827	Ar I	N73
6	12439.321	Ar I	N73
3	12456.12	Ar I	N73
6	12487.663	Ar I	N73
4	12702.281	Ar I	N73
1	12733.418	Ar I	N73
6	12802.739	Ar I	N73
1	12933.195	Ar I	N73
14	12956.659	Ar I	N73
6	13008.264	Ar I	N73
6	13213.99	Ar I	N73
6	13228.107	Ar I	N73
3	13230.90	Ar I	N73
14	13272.64	Ar I	N73
30	13313.210	Ar I	N73
30	13367.111	Ar I	N73
1	13499.41	Ar I	N73
30	13504.191	Ar I	N73
1	13599.333	Ar I	N73
11	13622.659	Ar I	N73
6	13678.550	Ar I	N73
30	13718.577	Ar I	N73
6	14093.640	Ar I	N73
3	15046.50	Ar I	N73
1	15172.69	Ar I	N73
1	15989.49	Ar I	N73
1	16519.86	Ar I	N73

Strong Lines of Argon (Ar)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
14	16940.58	Ar I	N73
1	20616.23	Ar I	N73
1	20986.11	Ar I	N73
1	23133.20	Ar I	N73
1	23966.52	Ar I	N73

Persistent Lines of Neutral Argon (Ar I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
180	866.79997	3.14	$3p^6$	^1S	0	0.000	M73	VVF96
			$3p^5(^2P^o_{1/2})3d$	$^2[3/2]^o$	1	115366.871		
150	869.75411	0.35	$3p^6$	^1S	0	0.000	M73	VVF96
			$3p^5(^2P^o_{1/2})5s$	$^2[1/2]^o$	1	114975.024		
180	876.05767	2.69	$3p^6$	^1S	0	0.000	M73	VVF96
			$3p^5(^2P^o_{1/2})3d$	$^2[3/2]^o$	1	114147.737		
180	879.94656	0.77	$3p^6$	^1S	0	0.000	M73	VVF96
			$3p^5(^2P^o_{1/2})5s$	$^2[3/2]^o$	1	113643.265		
150	894.31013		$3p^6$	^1S	0	0.000	M73	
			$3p^5(^2P^o_{3/2})3d$	$^2[1/2]^o$	1	111818.033		
1000	1048.21987	5.32	$3p^6$	^1S	0	0.000	VHU99	M03
			$3p^5(^2P^o_{1/2})4s$	$^2[1/2]^o$	1	95399.8329		
500	1066.65980	1.32	$3p^6$	^1S	0	0.000	M73	M03
			$3p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	1	93750.6031		
300	6965.431	0.067	$3p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	2	93143.7653	N73	RCWM80
			$3p^5(^2P^o_{1/2})4p$	$^2[1/2]$	1	107496.4219		
300	7067.218	0.0395	$3p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	2	93143.7653	N73	RCWM80
			$3p^5(^2P^o_{1/2})4p$	$^2[3/2]$	2	107289.7054		
600	7503.869	0.472	$3p^5(^2P^o_{1/2})4s$	$^2[1/2]^o$	1	95399.8329	N73	RCWM80
			$3p^5(^2P^o_{1/2})4p$	$^2[1/2]$	0	108722.6247		
700	7635.106	0.274	$3p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	2	93143.7653	N73	RCWM80
			$3p^5(^2P^o_{3/2})4p$	$^2[3/2]$	2	106237.5571		
600	7948.176	0.196	$3p^5(^2P^o_{1/2})4s$	$^2[1/2]^o$	0	94553.6705	N73	RCWM80
			$3p^5(^2P^o_{1/2})4p$	$^2[3/2]$	1	107131.7139		
600	8006.157	0.0490	$3p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	1	93750.6031	N73	FW96
			$3p^5(^2P^o_{3/2})4p$	$^2[3/2]$	2	106237.5571		
700	8014.786	0.0928	$3p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	2	93143.7653	N73	FW96
			$3p^5(^2P^o_{3/2})4p$	$^2[5/2]$	2	105617.2753		
600	8103.693	0.25	$3p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	1	93750.6031	N73	FW96
			$3p^5(^2P^o_{3/2})4p$	$^2[3/2]$	1	106087.2651		
1000	8115.311	0.331	$3p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	2	93143.7653	N73	FW96
			$3p^5(^2P^o_{3/2})4p$	$^2[5/2]$	3	105462.7649		
1000	9122.967	0.189	$3p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	2	93143.7653	N73	FW96
			$3p^5(^2P^o_{3/2})4p$	$^2[1/2]$	1	104102.1043		
700	9657.786	0.0543	$3p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	1	93750.6031	N73	FW96
			$3p^5(^2P^o_{3/2})4p$	$^2[1/2]$	1	104102.1043		

Energy Levels of Neutral Argon (Ar I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3p^6$	^1S	0	0.000	VHU99
$3p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	2	93143.7653	M73
		1	93750.6031	M73
$3p^5(^2P^o_{1/2})4s$	$^2[1/2]^o$	0	94553.6705	M73
		1	95399.8329	VHU99
$3p^5(^2P^o_{3/2})4p$	$^2[1/2]$	1	104102.1043	M73
		0	107054.2773	M73
$3p^5(^2P^o_{3/2})4p$	$^2[5/2]$	3	105462.7649	M73
		2	105617.2753	M73
$3p^5(^2P^o_{3/2})4p$	$^2[3/2]$	1	106087.2651	M73
		2	106237.5571	M73
$3p^5(^2P^o_{1/2})4p$	$^2[3/2]$	1	107131.7139	M73
		2	107289.7054	M73
$3p^5(^2P^o_{1/2})4p$	$^2[1/2]$	1	107496.4219	M73
		0	108722.6247	M73
$3p^5(^2P^o_{3/2})3d$	$^2[1/2]^o$	0	111667.771	M73
		1	111818.033	M73
$3p^5(^2P^o_{3/2})3d$	$^2[3/2]^o$	2	112138.929	M73
		1	114147.737	M73
$3p^5(^2P^o_{3/2})3d$	$^2[7/2]^o$	4	112750.158	M73
		3	113020.360	M73
$3p^5(^2P^o_{3/2})3d$	$^2[5/2]^o$	2	113425.969	M73
		3	113716.560	M73
$3p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	2	113468.478	M73
		1	113643.265	M73
$3p^5(^2P^o_{1/2})3d$	$^2[5/2]^o$	2	114640.997	M73
		3	114821.944	M73
$3p^5(^2P^o_{1/2})3d$	$^2[3/2]^o$	2	114805.140	M73
		1	115366.871	M73
$3p^5(^2P^o_{1/2})5s$	$^2[1/2]^o$	0	114861.640	M73
		1	114975.024	M73
Ar II ($^2P^o_{3/2}$)		*Limit*	**127109.842**	VHU99

Persistent Lines of Singly-ionized Argon (Ar II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
150	661.8690	8.05	$3s^23p^5$	$^2P^o$	3/2	0.0000	M71	VVF96
			$3s^23p^4(^3P)3d$	^2D	5/2	151087.3128		
300	670.9455	6.43	$3s^23p^5$	$^2P^o$	1/2	1431.5831	M71	VVF96
			$3s^23p^4(^3P)3d$	^2D	3/2	150474.9900		
1000	671.8513	7.90	$3s^23p^5$	$^2P^o$	3/2	0.0000	M71	VVF96
			$3s^23p^4(^1D)4s$	^2D	5/2	148842.4674		
1000	723.3606	23.1	$3s^23p^5$	$^2P^o$	3/2	0.0000	M71	VVF96
			$3s^23p^4(^3P)4s$	^2P	3/2	138243.6442		
300	919.7810	1.43	$3s^23p^5$	$^2P^o$	3/2	0.0000	M71	M03
			$3s3p^6$	^2S	1/2	108721.53		
300	932.0537	0.700	$3s^23p^5$	$^2P^o$	1/2	1431.5831	M71	M03
			$3s3p^6$	^2S	1/2	108721.53		
200	4277.528	0.80	$3s^23p^4(^1D)4s$	^2D	5/2	148842.4674	N73	FW96
			$3s^23p^4(^1D)4p$	$^2P^o$	3/2	172213.8800		
250	4348.064	1.17	$3s^23p^4(^3P)4s$	^4P	5/2	134241.7392	N73	FW96
			$3s^23p^4(^3P)4p$	$^4D^o$	7/2	157234.0200		
200	4609.567	0.789	$3s^23p^4(^1D)4s$	^2D	5/2	148842.4674	N73	FW96
			$3s^23p^4(^1D)4p$	$^2F^o$	7/2	170530.4041		
200	4726.868	0.588	$3s^23p^4(^3P)4s$	^2P	3/2	138243.6442	N73	FW96
			$3s^23p^4(^3P)4p$	$^2D^o$	3/2	159393.3850		
250	4764.865	0.64	$3s^23p^4(^3P)4s$	^2P	1/2	139258.3384	N73	FW96
			$3s^23p^4(^3P)4p$	$^2P^o$	3/2	160239.4280		
200	4806.020	0.780	$3s^23p^4(^3P)4s$	^4P	5/2	134241.7392	N73	FW96
			$3s^23p^4(^3P)4p$	$^4P^o$	5/2	155043.1622		
250	4879.864	0.823	$3s^23p^4(^3P)4s$	^2P	3/2	138243.6442	N73	FW96
			$3s^23p^4(^3P)4p$	$^2D^o$	5/2	158730.2997		

Energy Levels of Singly-ionized Argon (Ar II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^23p^5$	$^2P^o$	3/2	0.0000	YKH85
		1/2	1431.5831	YKH85
$3s3p^6$	^2S	1/2	108721.53	M71
$3s^23p^4(^3P)3d$	^4D	7/2	132327.3621	WACB95
		5/2	132481.2071	WACB95
		3/2	132630.7281	WACB95
		1/2	132737.7041	WACB95
$3s^23p^4(^3P)4s$	^4P	5/2	134241.7392	WACB95
		3/2	135085.9960	M71
		1/2	135601.7336	WACB95
$3s^23p^4(^3P)4s$	^2P	3/2	138243.6442	WACB95
		1/2	139258.3384	WACB95
$3s^23p^4(^3P)3d$	^4F	9/2	142186.3157	WACB95
		7/2	142717.0967	WACB95
		5/2	143107.6804	WACB95
		3/2	143371.4365	WACB95
$3s^23p^4(^1D)4s$	^2D	3/2	148620.1411	WACB95
		5/2	148842.4674	WACB95
$3s^23p^4(^3P)3d$	^2D	3/2	150474.9900	WACB95
		5/2	151087.3128	WACB95
$3s^23p^4(^3P)4p$	$^4P^o$	5/2	155043.1622	WACB95
		3/2	155351.1209	WACB95
		1/2	155708.1080	WACB95
$3s^23p^4(^3P)4p$	$^4D^o$	7/2	157234.0200	WACB95
		5/2	157673.4136	WACB95
		3/2	158167.8003	WACB95
		1/2	158428.1087	WACB95
$3s^23p^4(^3P)4p$	$^2D^o$	5/2	158730.2997	WACB95
		3/2	159393.3850	WACB95
$3s^23p^4(^3P)4p$	$^2P^o$	1/2	159706.5334	WACB95
		3/2	160239.4280	WACB95
$3s^23p^4(^1D)4p$	$^2F^o$	5/2	170401.0168	WACB95
		7/2	170530.4041	WACB95
$3s^23p^4(^1D)4p$	$^2P^o$	3/2	172213.8800	WACB95
		1/2	172816.2926	WACB95
Ar III ($^3P_2$)		*Limit*	**222848.3**	M60b

Arsenic (As)
Atomic number = 33
Atomic weight = 74.9216

Isotope	Mass	Abundance	Spin	Mag moment
^{75}As	74.921594	100%	3/2	+1.43947

As I Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^3\ ^4S^o_{3/2}$
Ionization energy: 78 950 cm^{-1} (9.7886 eV)

As II Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^2\ ^3P_0$
Ionization energy: 149 932 cm^{-1} (18.5892 eV)

Strong Lines of Arsenic (As)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
800	1211.17	As II	LA71
800	1218.10	As II	LA71
800	1241.31	As II	LA71
1000 P	1243.08	As II	LA71
900	1245.67	As II	LA71
800	1258.58	As II	LA71
1000 P	1263.77	As II	LA71
800	1266.34	As II	LA71
800	1267.59	As II	LA71
700	1280.99	As II	LA71
700	1287.54	As II	LA71
700	1305.70	As II	LA71
800	1333.15	As II	LA71
1000 P	1341.55	As II	LA71
800	1355.93	As II	LA71
1000 P	1369.77	As II	LA71
800	1373.65	As II	LA71
1000 P	1375.07	As II	LA71
800	1375.78	As II	LA71
800	1394.64	As II	LA71
800	1400.31	As II	LA71
700 P,r	1890.43	As I	HA85
400 P,r	1937.59	As I	HA85
200 P,r	1972.62	As I	HA85
	Air		
200 P,r	2003.35	As I	HA85
50 P,r	2288.12	As I	HA85
100 P,r	2349.84	As I	HA85
70 P,r	2370.77	As I	HA85
400 P,r	2456.53	As I	HA85
900 P,r	2780.22	As I	HA85
1000 P,r	2860.44	As I	HA85
700	4190.082	As II	LA71
700	4458.469	As II	LA71
700	4466.348	As II	LA71
800	4494.230	As II	LA71
800	4507.659	As II	LA71
700	4543.483	As II	LA71
500	6170.27	As II	LA71
150	9597.92	As I	HA85
150	9626.65	As I	HA85
200	9833.78	As I	HA85
250	9923.03	As I	HA85
200	10024.01	As I	HA85

Persistent Lines of Neutral Arsenic (As I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	1890.43	2.7	$4p^3$	$^4S^o$	3/2	0.000	HA85	M00
			$4p^2(^3P)5s$	^4P	5/2	52898.056		
400	1937.59	2.2	$4p^3$	$^4S^o$	3/2	0.000	HA85	M00
			$4p^2(^3P)5s$	^4P	3/2	51610.393		
200	1972.62	2.0	$4p^3$	$^4S^o$	3/2	0.000	HA85	M00
			$4p^2(^3P)5s$	^4P	1/2	50693.897		
200	2003.35		$4p^3$	$^2D^o$	5/2	10914.866	HA85	
			$4p^2(^1D)5s$	^2D	5/2	60815.218		
50	2288.12	2.8	$4p^3$	$^2D^o$	5/2	10914.866	HA85	FW96
			$4p^2(^3P)5s$	^2P	3/2	54605.491		
100	2349.84	3.1	$4p^3$	$^2D^o$	3/2	10592.666	HA85	FW96
			$4p^2(^3P)5s$	^2P	1/2	53135.750		
70	2370.77	0.42	$4p^3$	$^2P^o$	3/2	18647.663	HA85	FW96
			$4p^2(^1D)5s$	^2D	5/2	60815.218		
400	2456.53	0.072	$4p^3$	$^2D^o$	5/2	10914.866	HA85	FW96
			$4p^2(^3P)5s$	^4P	3/2	51610.393		
900	2780.22	0.78	$4p^3$	$^2P^o$	3/2	18647.663	HA85	FW96
			$4p^2(^3P)5s$	^2P	3/2	54605.491		
1000	2860.44	0.55	$4p^3$	$^2P^o$	1/2	18186.328	HA85	FW96
			$4p^2(^3P)5s$	^2P	1/2	53135.750		

Energy Levels of Neutral Arsenic (As I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4p^3$	$^4S^o$	3/2	0.000	HA85
$4p^3$	$^2D^o$	3/2	10592.666	HA85
		5/2	10914.866	HA85
$4p^3$	$^2P^o$	1/2	18186.328	HA85
		3/2	18647.663	HA85
$4p^2(^3P)5s$	^4P	1/2	50693.897	HA85
		3/2	51610.393	HA85
		5/2	52898.056	HA85
$4p^2(^3P)5s$	^2P	1/2	53135.750	HA85
		3/2	54605.491	HA85
$4p^2(^1D)5s$	^2D	5/2	60815.218	HA85
		3/2	60834.954	HA85
As II ($^3P_0$)		*Limit*	**78950**	BJ71

Persistent Lines of Singly-ionized Arsenic (As II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1243.08	2.9	$4p^2$	^3P	1	1063.49	LA71	M00
			$4p5s$	$(3/2,1/2)^o$	2	81508.925		
1000	1263.77	3.6	$4p^2$	^3P	0	0.0	LA71	M00
			$4p5s$	$(1/2,1/2)^o$	1	79128.33		
1000	1341.55		$4p^2$	^1D	2	10095.82	LA71	
			$4p4d$	$^3P^o$	1	84636.186		
1000	1369.77		$4p^2$	^1D	2	10095.82	LA71	
			$4p4d$	$^1D^o$	2	83100.804		
1000	1375.07		$4p^2$	^1D	2	10095.82	LA71	
			$4p5s$	$(3/2,1/2)^o$	1	82819.214		

Energy Levels of Singly-ionized Arsenic (As II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4p^2$	^3P	0	0.0	LA71
		1	1063.49	LA71
		2	2541.35	LA71
$4p^2$	^1D	2	10095.82	LA71
$4p^2$	^1S	0	22598.6	LA71
$4s4p^3$	$^5S^o$	2	54817.08	LA71
$4s4p^3$	$^3D^o$	1	73749.89	LA71
		2	73862.33	LA71
		3	74244.42	LA71
$4p5s$	$(1/2,1/2)^o$	0	78730.893	LA71
		1	79128.33	LA71
$4p5s$	$(3/2,1/2)^o$	2	81508.925	LA71
		1	82819.214	LA71
$4p4d$	$^1D^o$	2	83100.804	LA71
$4p4d$	$^3P^o$	1	84636.186	LA71
		0	84648.426	LA71
		2	85105.86	LA71
As III ($^2P^o_{1/2}$)		*Limit*	**149932**	LA71

Astatine (At)

Atomic number = 85
Atomic weight = 210

Isotope	Mass	Abundance	Spin	Mag moment
^{210}At	209.987126	0	5	
^{221}At	210.987469	0	9/2	

At I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^5\ {}^2\mathrm{P}^{\circ}_{3/2}$
Ionization energy: not available

Strong Lines of Astatine (At)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
800 P	2162.25	At I	M64a
1000 P	2244.01	At I	M64a

Persistent Lines of Neutral Astatine (At I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	2162.25		$6p^5$	^{2}P$^{\circ}$	3/2	0.0	M64a	
			$6p^4(^3\mathrm{P})7s$	^{4}P	3/2	46233.6?		
1000	2244.01		$6p^5$	^{2}P$^{\circ}$	3/2	0.0	M64a	
			$6p^4(^3\mathrm{P})7s$	^{4}P	5/2	44549.3?		

Energy Levels of Neutral Astatine (At I)

Configuration	Term	J	Level (cm^{-1})	Ref
$6p^5$	^{2}P$^{\circ}$	3/2	0.0	M64a
$6p^4(^3\mathrm{P})7s$	^{4}P	5/2	44549.3?	M64a
		3/2	46233.6?	M64a
At II (^{3}P$_2$)		*Limit*		

Barium (Ba)
Atomic number=56
Atomic weight=137.327

Isotope	Mass	Abundance	Spin	Mag moment
^{130}Ba	129.906282	0.11%	0	
^{132}Ba	131.905042	0.10%	0	
^{134}Ba	133.904486	2.42%	0	
^{135}Ba	134.905665	6.59%	3/2	+0.8365
^{136}Ba	135.904553	7.85%	0	
^{137}Ba	136.905812	11.23%	3/2	+0.9357
^{138}Ba	137.905232	71.70%	0	

Ba I Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^25p^66s^2\ ^1S_0$
Ionization energy: 42 034.91 cm^{-1} (5.211 664 eV)

Ba II Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^25p^66s\ ^2S_{1/2}$
Ionization energy: 80 686.30 cm^{-1} (10.003 83 eV)

Strong Lines of Barium (Ba)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
20 P	2304.247	Ba II	KL99
30 P	2335.267	Ba II	KL99
30 P	3071.584	Ba I	KL99
80 P	3501.108	Ba I	KL99
20 P	3891.779	Ba II	KL99
25 P	4130.649	Ba II	KL99
9	4132.427	Ba I	KL99
3	4166.001	Ba II	KL99
30	4283.097	Ba I	KL99
2	4524.926	Ba II	KL99
1000 P	4554.033	Ba II	KL99
6	4899.927	Ba II	KL99
300 P	4934.077	Ba II	KL99
1000 P	5535.481	Ba I	KL99
80	5777.619	Ba I	KL99
40	5853.675	Ba II	KL99
80	5997.087	Ba I	KL99
250	6110.783	Ba I	KL99
300 P	6141.713	Ba II	KL99
200 P	6496.898	Ba II	KL99
250 P	6498.760	Ba I	KL99
110 P	6527.312	Ba I	KL99
100 P	6595.325	Ba I	KL99
50	6675.270	Ba I	KL99
50 P	6693.842	Ba I	KL99
9	6865.686	Ba I	KL99
200 P	7059.943	Ba I	KL99
30	7120.331	Ba I	KL99
9	7195.230	Ba I	KL99
150 P	7280.296	Ba I	KL99
15	7392.405	Ba I	KL99
25	7488.075	Ba I	KL99
80 P	7672.085	Ba I	KL99
50	7780.478	Ba I	KL99
25	7905.747	Ba I	KL99

Strong Lines of Barium (Ba)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
12	7911.329	Ba I	KL99
9	8210.239	Ba I	KL99
60 P	8559.998	Ba I	KL99
8	8915.013	Ba I	KL99
50	9370.119	Ba I	KL99
15	9608.894	Ba I	KL99
40	10032.139	Ba I	KL99
60 P	14999.852	Ba I	KL99
50 P	23253.56	Ba I	KL99
60 P	25514.88	Ba I	KL99

Persistent Lines of Neutral Barium (Ba I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
30	3071.584	0.41	$6s^2$	^1S	0	0.000	KL99	KFW02
			$6s7p$	$^1P^o$	1	32547.033		
80	3501.108	0.35	$6s^2$	^1S	0	0.000	KL99	KFW02
			$5d6p$	$^1P^o$	1	28554.221		
1000	5535.481	1.19	$6s^2$	^1S	0	0.000	KL99	KFW02
			$6s6p$	$^1P^o$	1	18060.261		
250	6498.760	0.54	$6s5d$	^3D	3	9596.533	KL99	KFW02
			$5d6p$	$^3D^o$	3	24979.834		
110	6527.312	0.33	$6s5d$	^3D	2	9215.501	KL99	KFW02
			$5d6p$	$^3D^o$	2	24531.513		
100	6595.325	0.38	$6s5d$	^3D	1	9033.966	KL99	KFW02
			$5d6p$	$^3D^o$	1	24192.033		
50	6693.842	0.146	$6s5d$	^3D	3	9596.533	KL99	KFW02
			$5d6p$	$^3D^o$	2	24531.513		
200	7059.943	0.50	$6s5d$	^3D	3	9596.533	KL99	KFW02
			$5d6p$	$^3F^o$	4	23757.049		
150	7280.296	0.32	$6s5d$	^3D	2	9215.501	KL99	KFW02
			$5d6p$	$^3F^o$	3	22947.423		
80	7672.085	0.15	$6s5d$	^3D	1	9033.966	KL99	KFW02
			$5d6p$	$^3F^o$	2	22064.645		
60	8559.998	0.20	$6s5d$	^1D	2	11395.350	KL99	KFW02
			$5d6p$	$^1D^o$	2	23074.387		
60	14999.852	0.0025	$6s5d$	^1D	2	11395.350	KL99	KFW02
			$6s6p$	$^1P^o$	1	18060.261		
50	23253.56		$6s5d$	^3D	2	9215.501	KL99	
			$6s6p$	$^3P^o$	2	13514.745		
60	25514.88		$6s5d$	^3D	3	9596.533	KL99	
			$6s6p$	$^3P^o$	2	13514.745		

Energy Levels of Neutral Barium (Ba I)

Configuration	Term	J	Level (cm^{-1})	Ref
$6s^2$	^1S	0	0.000	KL99
$6s5d$	^3D	1	9033.966	KL99
		2	9215.501	KL99
		3	9596.533	KL99
$6s5d$	^1D	2	11395.350	KL99
$6s6p$	$^3P^o$	0	12266.024	KL99
		1	12636.623	KL99
		2	13514.745	KL99
$6s6p$	$^1P^o$	1	18060.261	KL99
$5d6p$	$^3F^o$	2	22064.645	KL99
		3	22947.423	KL99
		4	23757.049	KL99
$5d6p$	$^1D^o$	2	23074.387	KL99
$5d6p$	$^3D^o$	1	24192.033	KL99
		2	24531.513	KL99
		3	24979.834	KL99
$5d6p$	$^1P^o$	1	28554.221	KL99
$6s7p$	$^1P^o$	1	32547.033	KL99
Ba II ($^2S_{1/2}$)		*Limit*	**42034.91**	PVHA85

Persistent Lines of Singly-ionized Barium (Ba II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
20	2304.247		$5d$	^2D	3/2	4873.852	KL99	
			$4f$	$^2F^o$	5/2	48258.617		
30	2335.267		$5d$	^2D	5/2	5674.824	KL99	
			$4f$	$^2F^o$	7/2	48483.332		
20	3891.779	2.17	$6p$	$^2P^o$	1/2	20261.561	KL99	KFW02
			$6d$	^2D	3/2	45949.472		
25	4130.649	2.18	$6p$	$^2P^o$	3/2	21952.404	KL99	KFW02
			$6d$	^2D	5/2	46154.847		
1000	4554.033	1.11	$6s$	^2S	1/2	0.000	KL99	KFW02
			$6p$	$^2P^o$	3/2	21952.404		
300	4934.077	0.953	$6s$	^2S	1/2	0.000	KL99	KFW02
			$6p$	$^2P^o$	1/2	20261.561		
300	6141.713	0.412	$5d$	^2D	5/2	5674.824	KL99	KFW02
			$6p$	$^2P^o$	3/2	21952.404		
200	6496.898	0.310	$5d$	^2D	3/2	4873.852	KL99	KFW02
			$6p$	$^2P^o$	1/2	20261.561		

Energy Levels of Singly-ionized Barium (Ba II)

Configuration	Term	J	Level (cm^{-1})	Ref
$6s$	^2S	1/2	0.000	KL99
$5d$	^2D	3/2	4873.852	KL99
		5/2	5674.807	KL99
$6p$	$^2P^o$	1/2	20261.561	KL99
		3/2	21952.404	KL99
$7s$	^2S	1/2	42355.175	KL99
$6d$	^2D	3/2	45949.472	KL99
		5/2	46154.847	KL99
$4f$	$^2F^o$	5/2	48258.617	KL99
		7/2	48483.332	KL99
$7p$	$^2P^o$	1/2	49389.822	KL99
		3/2	50011.340	KL99
Ba III ($^1S_0$)		*Limit*	**80686.30**	KL99

Berkelium (Bk)
Atomic number=97
Atomic weight=(247)

Isotope	Mass	Abundance	Spin	Mag moment
^{247}Bk	247.070300	0	3/2	
^{249}Bk	249.074980	0	7/2	2.0

Bk I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^9 7s^2$ $^6\mathrm{H}^o_{15/2}$
Ionization energy: 49 989 cm^{-1} (6.1979 eV)

Bk II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^9 7s$ $(15/2,1/2)^o_8$
Ionization energy: not available

Strong Lines of Berkelium (Bk)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
1000 s	2748.019	Bk II	WC78
1000 s	2827.567	Bk II	WC78
1000 l	2872.114	Bk II	WC78
1000 P,s	2878.572	Bk II	WC78
1000 l	2884.772	Bk II	WC78
1000 s	2889.803	Bk II	WC78
1000 s	2893.660	Bk II	WC78
1000 l	2910.645	Bk II	WC78
1000 s	2926.489	Bk II	WC78
1000 s	2927.907	Bk II	WC78
1000 l	2941.713	Bk II	WC78
1000 P,l	2951.761	Bk II	WC78
1000 l	2969.125	Bk II	WC78
1000 l	2987.755	Bk II	WC78
1000 l	3178.466	Bk II	WC78
1000 P,s	3247.262	Bk II	WC78
1000	3252.191	Bk I	WC78
1000 s	3263.473	Bk II	WC78
1000 P,l	3288.750	Bk I	WC78
1000 P	3289.347	Bk I	WC78
1000	3335.261	Bk I	WC78
1000 s	3387.446	Bk II	WC78
1000	3408.281	Bk I	WC78
1000 P,l	3412.131	Bk II	WC78
1000 P	3426.951	Bk I	WC78
1000 P	3442.664	Bk I	WC78
1000 l	3453.897	Bk I	WC78
1000 s	3461.244	Bk II	WC78
1000 s	3464.133	Bk II	WC78
1000 s	3472.016	Bk II	WC78
1000 s	3477.620	Bk II	WC78
1000	3528.721	Bk I	WC78
1000 l	3531.397	Bk I	WC78
1000 l	3535.731	Bk I	WC78
1000 P,s	3542.187	Bk II	WC78
1000	3553.596	Bk I	WC78
1000	3556.515	Bk I	WC78
1000 l	3567.254	Bk II	WC78
1000	3590.320	Bk I	WC78
1000	3595.880	Bk I	WC78

Strong Lines of Berkelium (Bk)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1000	3601.115	Bk I	WC78
1000 s	3603.201	Bk II	WC78
1000	3604.781	Bk I	WC78
1000 P	3609.614	Bk I	WC78
1000	3616.620	Bk I	WC78
1000 s	3621.805	Bk II	WC78
1000	3627.607	Bk I	WC78
1000 l	3637.054	Bk I	WC78
1000	3640.255	Bk I	WC78
1000 s	3640.928	Bk II	WC78
1000 l	3675.585	Bk I	WC78
1000 s	3681.221	Bk II	WC78
1000 l	3684.427	Bk I	WC78
1000 l	3686.737	Bk I	WC78
1000	3695.368	Bk I	WC78
1000	3703.279	Bk I	WC78
1000 s	3704.015	Bk I	WC78
1000 s	3711.135	Bk II	WC78
1000	3712.929	Bk I	WC78
1000	3725.385	Bk I	WC78
1000	3739.916	Bk I	WC78
1000	3743.047	Bk I	WC78
1000	3745.403	Bk I	WC78
1000	3750.075	Bk I	WC78
1000	3751.905	Bk I	WC78
1000	3757.851	Bk I	WC78
1000 s	3771.060	Bk II	WC78
1000	3788.205	Bk I	WC78
1000	3791.419	Bk I	WC78
1000	3796.206	Bk I	WC78
1000	3798.629	Bk I	WC78
1000 s	3802.345	Bk I	WC78
1000	3802.470	Bk I	WC78
1000 s	3823.098	Bk II	WC78
1000 s	3824.083	Bk II	WC78
1000	3825.190	Bk I	WC78
1000 s	3825.844	Bk II	WC78
1000 l	3831.565	Bk II	WC78
1000 s	3833.480	Bk I	WC78
1000 s	3835.967	Bk II	WC78
1000	3842.185	Bk I	WC78
1000 l	3846.618	Bk I	WC78
1000	3847.626	Bk I	WC78
1000	3855.030	Bk I	WC78
1000 l	3859.888	Bk II	WC78
1000 l	3877.937	Bk II	WC78
1000	3880.106	Bk I	WC78
1000 l	3882.602	Bk I	WC78
1000 P,l	3894.547	Bk II	WC78
1000 P,s	3906.094	Bk II	WC78
1000 l	3916.365	Bk II	WC78
1000	3921.415	Bk I	WC78
1000 l	3928.045	Bk II	WC78
1000 l	4147.134	Bk II	WC78

Strong Lines of Berkelium (Bk)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1000 P,s	4189.692	Bk II	WC78
1000 P,s	4197.441	Bk II	WC78
1000 l	4329.580	Bk I	WC78
1000	4351.504	Bk I	WC78
1000 P	4363.636	Bk I	WC78
1000	4423.011	Bk I	WC78
1000 P	4466.457	Bk I	WC78
1000 l	4765.40	Bk I	WC78
1000 l	5118.24	Bk I	WC78
1000 s	5135.53	Bk II	WC78
1000	5170.61	Bk I	WC78
1000	5197.55	Bk I	WC78
1000 P	5212.53	Bk I	WC78
1000 P	5271.95	Bk I	WC78
1000	5392.03	Bk I	WC78
1000	5394.24	Bk I	WC78
1000	5449.63	Bk I	WC78
1000 l	5467.47	Bk I	WC78
1000 s	5484.58	Bk I	WC78
1000	5512.22	Bk II	WC78
1000 l	5537.93	Bk I	WC78
1000 l	5556.80	Bk I	WC78
1000 s	5557.09	Bk I	WC78
1000	5581.21	Bk I	WC78
1000 l	5656.54	Bk I	WC78
1000 P	5659.03	Bk I	WC78
1000	5702.24	Bk I	WC78
1000 P	5910.71	Bk I	WC78
1000 l	7040.85	Bk I	WC78
1000	7107.85	Bk I	WC78
1000	7252.50	Bk I	WC78
1000	7306.94	Bk I	WC78
1000	7394.26	Bk I	WC78
1000 s	7903.90	Bk I	WC78
1000 s	9429.13	Bk I	CWBC77
1000 l	9862.39	Bk II	CWBC77
1000	10126.20	Bk I	CWBC77
1000	10292.44	Bk I	CWBC77
1000 l	10570.53	Bk I	CWBC77
1000 P,l	11293.14	Bk I	CWBC77
1000 P,l	11500.30	Bk I	CWBC77
1000 s	11575.34	Bk I	CWBC77
1000 P,s	11793.09	Bk I	CWBC77
1000 s	12159.05	Bk I	CWBC77
1000	13498.36	Bk I	CWBC77
1000 s	14196.93	Bk I	CWBC77

Persistent Lines of Neutral Berkelium (Bk I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3288.750		$5f^97s^2$	$^6F^o$	11/2	5416.690	WC78	
					13/2	35814.60		
1000	3289.347							
1000	3426.951		$5f^97s^2$	$^6H^o$	15/2	0.000	WC78	
			$5f^9(^6H^o_{13/2})7s7p(^3P^o_2)$	(13/2,2)	17/2	29172.103		
1000	3442.664		$5f^97s^2$	$^6H^o$	15/2	0.000	WC78	
			$5f^9(^6H^o_{13/2})7s7p(^3P^o_2)$	(13/2,2)	15/2	29038.930		
1000	3609.614		$5f^97s^2$	$^6H^o$	15/2	0.000	WC78	
					15/2	27695.870		
1000	4363.636		$5f^97s^2$	$^6H^o$	15/2	0.000	WC78	
			$5f^9(^6H^o_{15/2})7s7p(^3P^o_2)$	(15/2,2)	15/2	22910.225		
1000	4466.457		$5f^97s^2$	$^6H^o$	15/2	0.000	WC78	
			$5f^9(^6H^o_{15/2})7s7p(^3P^o_2)$	(15/2,2)	17/2	22382.830		
1000	5212.53		$5f^97s^2$	$^6H^o$	15/2	0.000	WC78	
			$5f^9(^6H^o_{15/2})7s7p(^3P^o_1)$	(15/2,1)	15/2	19179.210		
1000	5271.95		$5f^97s^2$	$^6H^o$	13/2	6530.720	WC78	
					13/2	25493.793		
1000	5659.03		$5f^97s^2$	$^6H^o$	15/2	0.000	WC78	
			$5f^9(^6H^o_{15/2})7s7p(^3P^o_1)$	(15/2,1)	17/2	17665.980		
1000	5910.71		$5f^97s^2$	$^6H^o$	15/2	0.000	WC78	
			$5f^9(^6H^o_{15/2})7s7p(^3P^o_0)$	(15/2,0)	15/2	16913.770		
1000	11293.14		$5f^86d7s^2$	^8G	13/2	9141.115	CWBC77	
			$5f^8(^7F_6)7s^27p_{1/2}$	$(6,1/2)^o$	13/2	17993.628		
1000	11500.30		$5f^86d7s^2$	^8D	11/2	9300.585	CWBC77	
			$5f^8(^7F_6)7s^27p_{1/2}$	$(6,1/2)^o$	13/2	17993.628		
1000	11793.09		$5f^86d7s^2$	^8D	11/2	9300.585	CWBC77	
			$5f^8(^7F_6)7s^27p_{1/2}$	$(6,1/2)^o$	11/2	17777.808		

Energy Levels of Neutral Berkelium (Bk I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^97s^2$	$^6H^o$	15/2	0.000	BW92b
		13/2	6530.720	BW92b
		11/2	9535.130	BW92b
		9/2	10605.570	BW92b
		7/2	12067.63	BW92b
$5f^97s^2$	$^6F^o$	11/2	5416.690	BW92b
		9/2	5757.440	BW92b
		7/2	10985.83	BW92b
		5/2	12568.38	BW92b

Energy Levels of Neutral Berkelium (Bk I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^8 6d7s^2$	^{8}G	13/2	9141.115	BW92b
		15/2	10587.345	BW92b
		7/2	13191.915	BW92b
		9/2	13439.485	BW92b
		11/2	13769.315	BW92b
		5/2	13931.000	BW92b
		3/2	15626.860	BW92b
		1/2	16145.840	BW92b
$5f^8 6d7s^2$	^{8}D	11/2	9300.585	BW92b
$5f^8 6d7s^2$	^{8}D	9/2	10735.955	BW92b
$5f^8 6d7s^2$	^{8}D	7/2	14920.166	BW92b
$5f^9(^6H^o_{15/2})7s7p(^3P^o_0)$	(15/2,0)	15/2	16913.770	BW92b
$5f^9(^6H^o_{15/2})7s7p(^3P^o_1)$	(15/2,1)	17/2	17665.980	BW92b
		15/2	19179.210	BW92b
		13/2	19334.710	BW92b
$5f^8(^7F_6)7s^2 7p_{1/2}$	$(6,1/2)^o$	11/2	17777.808	BW92b
		13/2	17993.628	BW92b
$5f^9(^6H^o_{15/2})7s7p(^3P^o_2)$	(15/2,2)	17/2	22382.830	BW92b
$5f^9(^6H^o_{15/2})7s7p(^3P^o_2)$	(15/2,2)	15/2	22910.225	BW92b
		13/2	25493.793	BW92b
		15/2	27695.870	BW92b
$5f^9(^6H^o_{13/2})7s7p(^3P^o_2)$	(13/2,2)	15/2	29038.930	BW92b
$5f^9(^6H^o_{13/2})7s7p(^3P^o_2)$	(13/2,2)	17/2	29172.103	BW92b
		13/2	35814.60	BW92b
Bk II $((15/2,1/2)^o_8)$		*Limit*	**49989**	KDEE97

Persistent Lines of Singly-ionized Berkelium (Bk II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2878.572		$5f^9(^6H^o_{15/2})7s$	$(15/2,1/2)^o$	8	0.00	WC78	
			$5f^9(^6H^o_{15/2})7p_{3/2}$	(15/2,3/2)	9	34729.28		
1000	2951.761		$5f^9(^6H^o_{15/2})7s$	$(15/2,1/2)^o$	7	1487.51	WC78	
					8	35355.68		
1000	3247.262		$5f^9(^6H^o_{15/2})7s$	$(15/2,1/2)^o$	8	0.00	WC78	
					7	30786.30		
1000	3412.131		$5f^9(^6H^o_{15/2})7s$	$(15/2,1/2)^o$	7	1487.51	WC78	
					7	30786.30		
1000	3542.187		$5f^9(^6H^o_{15/2})7s$	$(15/2,1/2)^o$	8	0.00	WC78	
			$5f^8 6d7s$	^{7}H	8	28223.10		
1000	3894.547		$5f^9(^6H^o_{15/2})7s$	$(15/2,1/2)^o$	7	1487.51	WC78	
			$5f^9(^6H^o_{15/2})7p_{1/2}$	(15/2,1/2)	8	27157.155		
1000	3906.094		$5f^9(^6H^o_{15/2})7s$	$(15/2,1/2)^o$	8	0.00	WC78	
			$5f^8 6d7s$	^{9}H	8	25593.755		

Persistent Lines of Singly-ionized Berkelium (Bk II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	4189.692		$5f^9(^6H^o_{15/2})7s$	$(15/2,1/2)^o$	8	0.00	WC78	
					7	23861.38		
1000	4197.441		$5f^9(^6H^o_{15/2})7s$	$(15/2,1/2)^o$	8	0.00	WC78	
					7	23817.32		

Energy Levels of Singly-ionized Berkelium (Bk II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^9(^6H^o_{15/2})7s$	$(15/2,1/2)^o$	8	0.00	BW92b
		7	1487.51	BW92b
$5f^9(^6F^o_{11/2})7s$	$(11/2,1/2)^o$	6	5598.10	BW92b
		5	6906.07	BW92b
$5f^9(^6F^o_{9/2})7s$	$(9/2,1/2)^o$	5	6051.18	BW92b
		4	7038.48	BW92b
$5f^9(^6H^o_{13/2})7s$	$(13/2,1/2)^o$	7	6809.52	BW92b
		6	7786.75	BW92b
$5f^87s^2$	^7F	6	7040.98	BW92b
$5f^87s^2$	^7F	5	10191.14	BW92b
$5f^86d7s$	^9G	8	12340.96	BW92b
$5f^86d7s$	^9G	7	12558.97	BW92b
$5f^86d7s$	^9G	6	12583.03	BW92b
$5f^86d7s$	^9G	5	13889.43	BW92b
		7	23817.32	BW92b
		7	23861.38	BW92b
$5f^86d7s$	^9H	8	25593.755	BW92b
$5f^9(^6H^o_{15/2})7p_{1/2}$	$(15/2,1/2)$	8	27157.155	BW92b
$5f^86d7s$	^7H	8	28223.10	BW92b
		7	30786.30	BW92b
$5f^9(^6H^o_{15/2})7p_{3/2}$	$(15/2,3/2)$	9	34729.28	BW92b
		8	35355.68	BW92b
Bk III $(^6H^o_{15/2})$		*Limit*		

Beryllium (Be)

Atomic number=4
Atomic weight=9.01218

Isotope	Mass	Abundance	Spin	Mag moment
^{9}Be	9.012182	100%	3/2	−1.1776
^{10}Be	10.013534	Trace	0	

Be I Ground state: $1s^{2}2s^{2}\ {}^{1}S_{0}$
Ionization energy: 75 192.64 cm^{-1} (9.322 70 eV)

Be II Ground state: $1s^{2}2s\ {}^{2}S_{1/2}$
Ionization energy: 146 882.8 cm^{-1} (18.211 14 eV)

Strong Lines of Beryllium (Be)

Intensity		Wavelength (Å)	Spectrum	Ref
		Vacuum		
200		1143.039	Be II	J61a
400		1197.188	Be II	J61a
600	P	1512.269	Be II	J61a
800	P,c	1512.412	Be II	J61a
100	P	1661.478	Be I	KM97
50	c	1964.59	Be I	KM97
60	c	1998.01	Be I	KM97
		Air		
50		2056.012	Be I	KM97
50	P,c	2174.986	Be I	KM97
60	P	2175.103	Be I	KM97
1000	P	2348.610	Be I	KM97
60		2350.703	Be I	KM97
300	P	2350.829	Be I	KM97
100	P	2494.728	Be I	KM97
100	P	2650.454	Be I	KM97
60	P	2650.550	Be I	KM97
200*	P	2650.613	Be I	KM97
200*	P	2650.619	Be I	KM97
60	P	2650.694	Be I	KM97
100	P	2650.760	Be I	KM97
1000	P	3130.4219	Be II	BWWI85
600	P	3131.0667	Be II	BWWI85
100	P	3321.340	Be I	KM97
15		3813.454	Be I	KM97
60	P	4360.663	Be II	J61a
100	P	4360.988	Be II	J61a
12	P	4572.664	Be I	KM97
140	P	4673.329	Be II	J61a
200	P	4673.423	Be II	J61a
40		4828.159	Be II	J61a
60		5270.28	Be II	J61a
100	P	5270.81	Be II	J61a
12		6547.89	Be II	J61a
12		6558.36	Be II	J61a
10		6982.749	Be I	KM97
10		7209.134	Be I	KM97
4	P	8254.070	Be I	KM97
5		8801.370	Be I	KM97
12		10119.92	Be II	J61a
20		12095.36	Be II	J61a
6		14643.92	Be I	KM97
6		14644.75	Be I	KM97
5		16157.72	Be I	HJ69
6		18143.54	Be I	KM97
5		31778.70	Be I	HJ69

Persistent Lines of Neutral Beryllium (Be I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
100	1661.478	0.0726	$2s^2$	^1S	0	0.000	KM97	M03
			$2s3p$	$^1P^o$	1	60187.34		
1000	2348.610	5.53	$2s^2$	^1S	0	0.000	KM97	M03
			$2s2p$	$^1P^o$	1	42565.35		
100	2494.728	1.6	$2s2p$	$^3P^o$	2	21981.27	KM97	FW96
			$2s3d$	^3D	1,2,3	62053.72		
100	2650.454	4.24*	$2s2p$	$^3P^o$	1	21978.925	KM97	FW96
			$2p^2$	^3P	2	59697.08		
60	2650.550	4.24*	$2s2p$	$^3P^o$	0	21978.28	KM97	FW96
			$2p^2$	^3P	1	59695.07		
200*	2650.613	4.24*	$2s2p$	$^3P^o$	1	21978.925	KM97	FW96
			$2p^2$	^3P	1	59695.07		
200*	2650.619	4.24*	$2s2p$	$^3P^o$	2	21981.27	KM97	FW96
			$2p^2$	^3P	2	59697.08		
60	2650.694	4.24*	$2s2p$	$^3P^o$	1	21978.925	KM97	FW96
			$2p^2$	^3P	0	59693.65		
100	2650.760	4.24*	$2s2p$	$^3P^o$	2	21981.27	KM97	FW96
			$2p^2$	^3P	1	59695.07		
100	3321.340		$2s2p$	$^3P^o$	2	21981.27	KM97	
			$2s3s$	^3S	1	52080.94		
12	4572.664	0.79	$2s2p$	$^1P^o$	1	42565.35	KM97	FW96
			$2s3d$	^1D	2	64428.31		
4	8254.070		$2s2p$	$^1P^o$	1	42565.35	KM97	
			$2s3s$	^1S	0	54677.26		

Energy Levels of Neutral Beryllium (Be I)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^2$	^1S	0	0.000	KM97
$2s2p$	$^3P^o$	0	21978.28	KM97
		1	21978.925	KM97
		2	21981.27	KM97
$2s2p$	$^1P^o$	1	42565.35	KM97
$2s3s$	^3S	1	52080.94	KM97
$2s3s$	^1S	0	54677.26	KM97
$2p^2$	^1D	2	56882.43	KM97
$2s3p$	$^3P^o$	0,1	58907.45	KM97
		2	58907.83	KM97
$2p^2$	^3P	0	59693.65	KM97
		1	59695.07	KM97
		2	59697.08	KM97
$2s3p$	$^1P^o$	1	60187.34	KM97
$2s3d$	^3D	1,2,3	62053.72	KM97
$2s3d$	^1D	2	64428.31	KM97
Be II ($^2S_{1/2}$)		*Limit*	**75192.64**	KM97

Persistent Lines of Singly-ionized Beryllium (Be II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	1512.269	9.2	$1s^22p$	$^2P^o$	1/2	31928.744	J61a	FW96
			$1s^23d$	^2D	3/2	98054.55		
800	1512.412	11.	$1s^22p$	$^2P^o$	3/2	31935.320	J61a	FW96
			$1s^23d$	^2D	5/2	98055.10		
			$1s^22p$	$^2P^o$	3/2	31935.320		
			$1s^23d$	^2D	3/2	98054.55		
1000	3130.4219	1.13	$1s^22s$	^2S	1/2	0.000	BWWI85	M03
			$1s^22p$	$^2P^o$	3/2	31935.320		
600	3131.0667	1.13	$1s^22s$	^2S	1/2	0.000	BWWI85	M03
			$1s^22p$	$^2P^o$	1/2	31928.744		
60	4360.663	0.92	$1s^23p$	$^2P^o$	1/2	96495.34	J61a	FW96
			$1s^24d$	^2D	3/2	119421.18		
100	4360.988	1.1	$1s^23p$	$^2P^o$	3/2	96497.26	J61a	FW96
			$1s^24d$	^2D	5/2	119421.42		
140	4673.329		$1s^23d$	^2D	3/2	98054.55	J61a	
			$1s^24f$	$^2F^o$	5/2	119446.59		
200	4673.423		$1s^23d$	^2D	5/2	98055.10	J61a	
			$1s^24f$	$^2F^o$	7/2	119446.71		
100	5270.811	0.66	$1s^23p$	$^2P^o$	3/2	96497.26	J61a	FW96
			$1s^24s$	^2S	1/2	115464.38		

Energy Levels of Singly-ionized Beryllium (Be II)

Configuration	Term	J	Level (cm^{-1})	Ref
$1s^22s$	^2S	1/2	0.000	BWWI85
$1s^22p$	$^2P^o$	1/2	31928.744	BWWI85
		3/2	31935.320	BWWI85
$1s^23s$	^2S	1/2	88231.89	KM00
$1s^23p$	$^2P^o$	1/2	96495.34	KM00
		3/2	96497.26	KM00
$1s^23d$	^2D	3/2	98054.55	KM00
		5/2	98055.10	KM00
$1s^24s$	^2S	1/2	115464.38	KM00
$1s^24p$	$^2P^o$	1/2	118760.51	KM00
		3/2	118761.30	KM00
$1s^24d$	^2D	3/2	119421.18	KM00
		5/2	119421.42	KM00
$1s^24f$	$^2F^o$	5/2	119446.59	KM00
		7/2	119446.71	KM00
Be III ($^1S_0$)		*Limit*	**146882.84**	KM00

Bismuth (Bi)
Atomic number = 83
Atomic weight = 208.9804

Isotope	Mass	Abundance	Spin	Mag moment
^{209}Bi	208.980347	100%	9/2	+4.110
^{210}Bi	209.984095	Trace	1	−0.044

Bi I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^3\ {}^4S_{3/2}$
Ionization energy: 58 762.0 cm^{-1} (7.2855 eV)

Bi II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^2\ {}^3P_0$
Ionization energy: 134 720 cm^{-1} (16.703 eV)

Strong Lines of Bismuth (Bi)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
400 P	1241.045	Bi II	WBBF01
300 P	1283.715	Bi II	WBBF01
400 P	1436.810	Bi II	WBBF01
500	1455.091	Bi II	WBBF01
400	1486.954	Bi II	WBBF01
400	1520.549	Bi II	WBBF01
400	1533.139	Bi II	WBBF01
300	1536.745	Bi II	WBBF01
400	1538.037	Bi II	WBBF01
400	1573.69	Bi II	WBBF01
600 P	1591.76	Bi II	WBBF01
400	1609.69	Bi II	WBBF01
400	1611.358	Bi II	WBBF01
800 P	1777.05	Bi II	WBBF01
600	1787.406	Bi II	WBBF01
700 P	1791.842	Bi II	WBBF01
700 P	1823.728	Bi II	WBBF01
1000 P	1902.341	Bi II	WBBF01
300 P	1954.706	Bi I	WBBF01
250 P	1960.049	Bi I	WBBF01
	Air		
250 P	2021.149	Bi I	WBBF01
300 P	2061.634	Bi I	WBBF01
400 h	2068.937	Bi II	WBBF01
200 P	2110.217	Bi I	WBBF01
120	2133.600	Bi I	WBBF01
600 P	2186.930	Bi II	DLW02
400 h	2214.031	Bi II	DLW02
120 P	2228.203	Bi I	WBBF01
600 P	2230.602	Bi I	WBBF01
600 P	2368.384	Bi II	DLW02
80	2627.904	Bi I	WBBF01
50	2780.476	Bi I	WBBF01
500 P	2897.965	Bi I	WBBF01
400 P	2938.297	Bi I	WBBF01
300 P	2989.019	Bi I	GMV85
80 P	2993.336	Bi I	GMV85
300 P	3024.621	Bi I	GMV85
1000 P,c	3067.700	Bi I	WBBF01
70 c	3397.198	Bi I	GMV85
400 c	3430.605	Bi II	DLW02
60 c	3510.864	Bi I	GMV85
50 c	3596.097	Bi I	GMV85

Strong Lines of Bismuth (Bi)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
700 P	3792.564	Bi II	DLW02
300	3864.025	Bi II	DLW02
400 h	4079.072	Bi II	DLW02
800 P,h	4259.413	Bi II	DLW02
700 P,h	4301.697	Bi II	DLW02
600 P,h	4705.285	Bi II	DLW02
70 P,c	4722.527	Bi I	GMV85
300	4730.267	Bi II	DLW02
500 P,h	5124.356	Bi II	DLW02
600 P,h	5144.492	Bi II	DLW02
800 P,h	5209.325	Bi II	DLW02
400 h	5270.512	Bi II	DLW02
400 h	5719.138	Bi II	DLW02
400 h	6600.339	Bi II	DLW02
500 h	6809.196	Bi II	DLW02
300	8532.	Bi II	CM34
70 P,d	9657.04	Bi I	GMV85
50 P,d	11710.83	Bi I	GMV85

Persistent Lines of Neutral Bismuth (Bi I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	1954.706	0.586	$6p^3$	$^4S^o$	3/2	0.000	WBBF01	CBZS95
			$6p^2(^3P_0)7d$	$^2[2]$	5/2	51158.494		
250	1960.049	0.154	$6p^3$	$^4S^o$	3/2	0.000	WBBF01	CBZS95
			$6p^2(^3P_0)7d$	$^2[2]$	3/2	51019.090		
250	2021.149	0.060	$6p^3$	$^4S^o$	3/2	0.000	WBBF01	FW96
			$6p^2(^3P_2)7s$	$^2[2]$	3/2	49460.910		
300	2061.634	0.96	$6p^3$	$^4S^o$	3/2	0.000	WBBF01	CBZS95
			$6p^2(^3P_2)7s$	$^2[2]$	5/2	48489.869		
200	2110.217	0.53	$6p^3$	$^4S^o$	3/2	0.000	WBBF01	CBZS95
			$6p^2(^3P_0)8s$	$^2[0]$	1/2	47373.477		
120	2228.203	0.88	$6p^3$	$^4S^o$	3/2	0.000	WBBF01	CBZS95
			$6p^2(^3P_1)7s$	$^2[1]$	3/2	44865.076		
600	2230.602	2.34	$6p^3$	$^4S^o$	3/2	0.000	WBBF01	CBZS95
			$6p^2(^3P_0)6d$	$^2[2]$	5/2	44816.841		
500	2897.965	1.53	$6p^3$	$^2D^o$	3/2	11419.039	WBBF01	FW96
			$6p^2(^3P_1)7s$	$^2[1]$	1/2	45915.883		
400	2938.297	1.23	$6p^3$	$^2D^o$	5/2	15437.501	WBBF01	FW96
			$6p^2(^3P_2)7s$	$^2[2]$	3/2	49460.910		
300	2989.019	0.54	$6p^3$	$^2D^o$	3/2	11419.039	GMV85	CBZS95
			$6p^2(^3P_1)7s$	$^2[1]$	3/2	44865.076		
80	2993.336	0.145	$6p^3$	$^2D^o$	3/2	11419.039	GMV85	CBZS95
			$6p^2(^3P_0)6d$	$^2[2]$	5/2	44816.841		
300	3024.621	0.86	$6p^3$	$^2D^o$	5/2	15437.501	GMV85	CBZS95
			$6p^2(^3P_2)7s$	$^2[2]$	5/2	48489.869		endtab

Persistent Lines of Neutral Bismuth (Bi I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3067.700	1.67	$6p^3$	$^4S^o$	3/2	0.000	WBBF01	CBZS95
			$6p^2(^3P_0)7s$	$^2[0]$	1/2	32588.221		
70	4722.527	0.094	$6p^3$	$^2D^o$	3/2	11419.039	GMV85	CBZS95
			$6p^2(^3P_0)7s$	$^2[0]$	1/2	32588.221		
70	9657.04		$6p^2(^3P_0)7s$	$^2[0]$	1/2	32588.221	GMV85	
			$6p^2(^3P_0)7p$	$^2[1]^o$	3/2	42940.519		
50	11710.83		$6p^2(^3P_0)7s$	$^2[0]$	1/2	32588.221	GMV85	
			$6p^2(^3P_0)7p$	$^2[1]^o$	1/2	41124.985		

Energy Levels of Neutral Bismuth (Bi I)

Configuration	Term	J	Level (cm^{-1})	Ref
$6p^3$	$^4S^o$	3/2	0.000	GMV85
$6p^3$	$^2D^o$	3/2	11419.039	GMV85
		5/2	15437.501	GMV85
$6p^3$	$^2P^o$	1/2	21660.914	GMV85
		3/2	33164.805	GMV85
$6p^2(^3P_0)7s$	$^2[0]$	1/2	32588.221	GMV85
$6p^2(^3P_0)7p$	$^2[1]^o$	1/2	41124.985	GMV85
		3/2	42940.519	GMV85
$6p^2(^3P_0)6d$	$^2[2]$	3/2	43912.374	GMV85
		5/2	44816.841	GMV85
$6p^2(^3P_1)7s$	$^2[1]$	3/2	44865.076	GMV85
		1/2	45915.883	GMV85
$6p^2(^3P_0)8s$	$^2[0]$	1/2	47373.477	GMV85
$6p^2(^3P_2)7s$	$^2[2]$	5/2	48489.869	GMV85
		3/2	49460.910	GMV85
$6p^2(^3P_0)7d$	$^2[2]$	3/2	51019.090	GMV85
		5/2	51158.494	GMV85
Bi II ($^3P_0$)		*Limit*	**58761.65**	MGGB89

Persistent Lines of Singly-ionized Bismuth (Bi II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	1241.045		$6p^2$	(1/2,1/2)	0	0.000	WBBF01	
			$6p6d$	$(1/2,3/2)^o$	1	80577.071		
300	1283.715		$6p^2$	(3/2,1/2)	2	17031.698	WBBF01	
			$6s6p^3$	$^3D^o$	2	94930.640		
400	1436.810	3.47	$6p^2$	(1/2,1/2)	0	0.000	WBBF01	M00
			$6p7s$	$(1/2,1/2)^o$	1	69598.475		
600	1591.76		$6p^2$	(3/2,1/2)	1	13325.401	WBBF01	
			$6s6p^3$	$^5S^o$	2	76148.712		
800	1777.05	0.970	$6p^2$	(3/2,1/2)	1	13325.401	WBBF01	M00
			$6p7s$	$(1/2,1/2)^o$	1	69598.475		
700	1791.842	6.41	$6p^2$	(3/2,1/2)	1	13325.401	WBBF01	M00
			$6p7s$	$(1/2,1/2)^o$	0	69133.891		
700	1823.728		$6p^2$	(3/2,3/2)	2	33938.718	WBBF01	
			$6p7s$	$(3/2,1/2)^o$	2	88771.443		
1000	1902.341	3.55	$6p^2$	(3/2,1/2)	2	17031.698	WBBF01	M00
			$6p7s$	$(1/2,1/2)^o$	1	69598.475		
600	2186.930		$6p^2$	(3/2,3/2)	0	44173.768	DLW02	
			$6p7s$	$(3/2,1/2)^o$	1	89885.675		
700	3792.564		$6p6d$	$(1/2,3/2)^o$	2	79091.141	DLW02	
			$6p5f$	(1/2,5/2)	3	105451.045		
800	4259.413		$6p6d$	$(1/2,5/2)^o$	3	82257.251	DLW02	
			$6p5f$	(1/2,7/2)	4	105728.060		
700	4301.697		$6p6d$	$(1/2,5/2)^o$	2	82049.632	DLW02	
			$6p5f$	(1/2,7/2)	3	105289.732		
600	4705.285		$6p7p$	(1/2,1/2)	1	84280.446	DLW02	
			$6p7d$	$(1/2,3/2)^o$	2	105527.197		
500	5124.356		$6p7s$	$(3/2,1/2)^o$	2	88771.443	DLW02	
			$6p7p$	(3/2,3/2)	3	108280.656		
600	5144.492		$6p7s$	$(1/2,1/2)^o$	0	69133.891	DLW02	
			$6p7p$	(1/2,3/2)	1	88566.685		
800	5209.325		$6p7s$	$(1/2,1/2)^o$	1	69598.475	DLW02	
			$6p7p$	(1/2,3/2)	2	88789.478		

Energy Levels of Singly-ionized Bismuth (Bi II)

Configuration	Term	J	Level (cm^{-1})	Ref
$6p^2$	(1/2,1/2)	0	0.000	DLW02
$6p^2$	(3/2,1/2)	1	13325.401	DLW02
		2	17031.698	DLW02
$6p^2$	(3/2,3/2)	2	33938.718	DLW02
$6p^2$	(3/2,3/2)	0	44173.768	DLW02
$6p7s$	$(1/2,1/2)^o$	0	69133.891	DLW02
		1	69598.475	DLW02
$6s6p^3$	$^5S^o$	2	76148.712	DLW02
$6p6d$	$(1/2,3/2)^o$	2	79091.141	DLW02
		1	80577.071	DLW02
$6p6d$	$(1/2,5/2)^o$	2	82049.632	DLW02
		3	82257.251	DLW02
$6p7p$	(1/2,1/2)	1	84280.446	DLW02
		0	87078.777	DLW02
$6p7p$	(1/2,3/2)	1	88566.685	DLW02
		2	88789.478	DLW02
$6p7s$	$(3/2,1/2)^o$	2	88771.443	DLW02
		1	89885.675	DLW02
$6s6p^3$	$^3D^o$	1	94442.227	DLW02
		2	94930.640	DLW02
		3	96062.356	DLW02
$6p5f$	(1/2,7/2)	3	105289.732	DLW02
		4	105728.060	DLW02
$6p5f$	(1/2,5/2)	3	105451.045	DLW02
$6p7d$	$(1/2,3/2)^o$	2	105527.197	DLW02
$6p7p$	(3/2,3/2)	3	108280.656	DLW02
Bi III ($^2P^o_{1/2}$)		*Limit*	**134720**	JM86

Boron (B)
Atomic number = 5
Atomic weight = 10.81

Isotope	Mass	Abundance	Spin	Mag moment
^{10}B	10.012937	19.9%	3	+1.8007
^{11}B	11.009305	80.1%	3/2	+2.6886

B I Ground state: $1s^2 2s^2 2p\ ^2\mathrm{P}^{\mathrm{o}}_{1/2}$
Ionization energy: 66 928.04 cm^{-1} (8.298 02 eV)

B II Ground state: $1s^2 2s^2\ ^1\mathrm{S}_0$
Ionization energy: 202 887.0 cm^{-1} (25.1548 eV)

Strong Lines of Boron (B)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
180	693.947	B II	O70
500	882.543	B II	O70
500	882.681	B II	O70
500	1081.875	B II	O70
500	1082.073	B II	O70
500	1230.160	B II	O70
1000 P	1362.463	B II	LZJK98
700 P	1623.597	B II	LZJK98
500 P	1623.790	B II	LZJK98
1000 P	1624.023	B II	LZJK98
300	1624.175	B II	LZJK98
700 P	1624.376	B II	LZJK98
300	1666.850	B I	BTG74
500	1667.272	B I	BTG74
300	1817.843	B I	BTG74
500	1818.348	B I	BTG74
800 P	1825.894	B I	EL01
1000 P	1826.400	B I	EL01
500 P	1842.820	B II	LZJK98
	Air		
200	2066.364	B I	GV72,GM62
200	2066.646	B I	GV72,GM62
250	2067.186	B I	GV72,GM62
400 P	2088.889	B I	JLKK93
500 P	2089.570	B I	JLKK93
200 P	2395.048	B II	O70
500 P	2496.769	B I	JLKK93
800 P	2497.722	B I	JLKK93
700	2918.076	B II	O70
500 P	3451.303	B II	LZJK98
300	4121.933	B II	O70
110	4194.792	B II	O70
110	4472.101	B II	O70
110	4472.851	B II	O70
110	4940.376	B II	O70
110	6080.44	B II	O70
100 P	11660.028	B I	EL01
50 P	11662.452	B I	EL01

Persistent Lines of Neutral Boron (B I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	1825.894	1.70	$2s^22p$	$^2P^o$	1/2	0.000	EL01	M03
			$2s^23d$	^2D	3/2	54767.698		
1000	1826.400	2.04	$2s^22p$	$^2P^o$	3/2	15.287	EL01	M03
			$2s^23d$	^2D	5/2	54767.844		
400	2088.889	0.361	$2s^22p$	$^2P^o$	1/2	0.000	JLKK93	M03
			$2s2p^2$	^2D	3/2	47857.127		
500	2089.570	0.432	$2s^22p$	$^2P^o$	3/2	15.287	JLKK93	M03
			$2s2p^2$	^2D	5/2	47856.807		
500	2496.769	0.837	$2s^22p$	$^2P^o$	1/2	0.000	JLKK93	M03
			$2s^23s$	^2S	1/2	40039.695		
800	2497.722	1.67	$2s^22p$	$^2P^o$	3/2	15.287	JLKK93	OL92
			$2s^23s$	^2S	1/2	40039.695		
100	11660.028		$2s^23s$	^2S	1/2	40039.695	EL01	
			$2s^23p$	$^2P^o$	3/2	48613.655		
50	11662.452		$2s^23s$	^2S	1/2	40039.695	EL01	
			$2s^23p$	$^2P^o$	1/2	48611.872		

Energy Levels of Neutral Boron (B I)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^22p$	$^2P^o$	1/2	0.000	JLKK93
		3/2	15.287	JLKK93
$2s2p^2$	^4P	1/2	$28870.0+x$	RT76
		3/2	$28875.0+x$	RT76
		5/2	$28881.3+x$	RT76
$2s^23s$	^2S	1/2	40039.695	JLKK93
$2s2p^2$	^2D	5/2	47856.807	JLKK93
		3/2	47857.127	JLKK93
$2s^23p$	$^2P^o$	1/2	48611.872	EL01
		3/2	48613.655	EL01
$2s^23d$	^2D	3/2	54767.698	EL01
		5/2	54767.844	EL01
$2s^24s$	^2S	1/2	55010.236	EL01
$2s^24p$	$^2P^o$	1/2	57786.436	EL01
		3/2	57787.071	EL01
$2s^24f$	$^2F^o$	5/2,7/2	60031.085	EL01
B II ($^1S_0$)		*Limit*	**66928.04**	R02

Persistent Lines of Singly-ionized Boron (B II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1362.463	11.9	$2s^2$	^{1}S	0	0.00	LZJK98	M03
			$2s2p$	^{1}P^o	1	73396.51		
700	1623.597		$2s2p$	^{3}P^o	1	37342.15	LZJK98	
			$2p^2$	^{3}P	2	98933.76		
500	1623.790		$2s2p$	^{3}P^o	0	37336.04	LZJK98	
			$2p^2$	^{3}P	1	98920.37		
1000	1624.023	15.6	$2s2p$	^{3}P^o	2	37358.30	LZJK98	LZJK98
			$2p^2$	^{3}P	2	98933.76		
700	1624.376		$2s2p$	^{3}P^o	2	37358.30	LZJK98	
			$2p^2$	^{3}P	1	98920.37		
500	1842.820	13.3	$2s2p$	^{1}P^o	1	73396.51	LZJK98	LZJK98
			$2p^2$	^{1}S	0	127661.19		
200	2395.05		$2p^2$	^{1}D	2	102362.77	O70	
			$2s3p$	^{1}P^o	1	144103.17		
500	3451.303	0.54	$2s2p$	^{1}P^o	1	73396.51	LZJK98	LZJK98
			$2p^2$	^{1}D	2	102362.77		

Energy Levels of Singly-ionized Boron (B II)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^2$	^{1}S	0	0.00	LZJK98
$2s2p$	^{3}P^o	0	37335.54	R98
		1	37341.65	R98
		2	37357.80	R98
$2s2p$	^{1}P^o	1	73396.51	LZJK98
$2p^2$	^{3}P	0	98911.38	R98
		1	98919.87	R98
		2	98933.26	R98
$2p^2$	^{1}D	2	102362.77	LZJK98
$2p^2$	^{1}S	0	127661.19	LZJK98
$2s3s$	^{3}S	1	129773.21	R98
$2s3p$	^{3}P^o	0	143989.33	R98
		2	143989.94	R98
		1	143993.49	R98
$2s3p$	^{1}P^o	1	144102.81	R98
$2s3d$	^{3}D	1,2,3	150649.09	R98
$2s3d$	^{1}D	2	154685.96	R98
B III (^{2}S$_{1/2}$)		*Limit*	**202887.0**	R98

Bromine (Br)
Atomic number = 35
Atomic weight = 79.904

Isotope	Mass	Abundance	Spin	Mag moment
^{79}Br	78.918336	50.69%	3/2	+2.1064
^{81}Br	80.916289	49.31%	3/2	+2.2706

Br I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5\ {}^2\mathrm{P}^{\mathrm{o}}_{3/2}$
Ionization energy: 95 284.8 cm^{-1} (11.8138 eV)

Br II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^4\ {}^3\mathrm{P}_2$
Ionization energy: 174 140 cm^{-1} (21.591 eV)

Strong Lines of Bromine (Br)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
1000 P	889.25	Br II	MT84
500	896.65	Br II	MT84
500	906.01	Br II	MT84
500	984.99	Br II	MT84
500	1012.13	Br II	MT84
1000 P	1015.53	Br II	MT84
500	1036.98	Br II	MT84
1000 P	1048.94	Br II	MT84
400	1064.71	Br II	MT84
500	1071.84	Br II	MT84
100	1232.43	Br I	T63
150	1384.60	Br I	T63
700 P	1488.45	Br I	T63
400	1531.74	Br I	T63
300 P	1540.65	Br I	T63
400 P	1574.84	Br I	T63
250	1576.39	Br I	T63
300	1582.31	Br I	T63
1000 P	1633.40	Br I	T63
	Air		
500 h	2317.30	Br II	R58
500	2386.70	Br II	R58
400	2388.96	Br II	R58
500	2389.69	Br II	R58
400	2521.70	Br II	R58
500 h	2972.26	Br II	R58
500	3914.38	Br II	RR44
500	3980.38	Br II	K40
1000	4223.89	Br II	K40
1000	4365.63	Br II	K40
130	4441.74	Br I	T63
130	4472.61	Br I	T63
250	4477.72	Br I	T63
200	4525.59	Br I	T63
500	4542.89	Br II	K40
500	4678.70	Br II	K40
500 P	4704.92	Br II	K40
500 P	4785.48	Br II	K40
500 P	4816.68	Br II	K40
400	4930.62	Br II	K40

Strong Lines of Bromine (Br)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500	5182.36	Br II	K40
500	5238.26	Br II	K40
500	5332.07	Br II	K40
500	5506.72	Br II	K40
500	6148.60	Br I	T63
800	6350.73	Br I	T63
250	6544.57	Br I	T63
700 c	6559.80	Br I	T63
250	6582.17	Br I	T63
700 c	6631.62	Br I	T63
250	6682.28	Br I	T63
130	6692.13	Br I	T63
130	7005.19	Br I	T63
130 P	7348.51	Br I	T63
500 P	7512.96	Br I	T63
400 P	7803.02	Br I	T63
400 P,c	7938.68	Br I	T63
130	7978.57	Br I	T63
400	7989.94	Br I	T63
400	8131.52	Br I	T63
130	8153.75	Br I	T63
300	8154.00	Br I	T63
200	8264.96	Br I	T63
1000 P,c	8272.44	Br I	T63
250	8334.70	Br I	T63
130 P	8343.70	Br I	T63
500 P	8446.55	Br I	T63
250	8638.66	Br I	T63
130 c	8793.47	Br I	T63
200	8819.96	Br I	T63
300	8825.22	Br I	T63
400	8897.62	Br I	T63
400	9166.06	Br I	T63
200	9173.63	Br I	T63
250	9178.16	Br I	T63
500	9265.42	Br I	T63
200	9320.86	Br I	T63
130	9896.40	Br I	T63
400	10457.96	Br I	T63

Persistent Lines of Neutral Bromine (Br I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	1488.45	2.0	$4p^5$	$^2P^o$	3/2	0.00	T63	M00
			$4p^4(^3P)5s$	^2P	3/2	67183.58		
300	1540.65	2.2	$4p^5$	$^2P^o$	3/2	0.00	T63	M00
			$4p^4(^3P)5s$	^4P	3/2	64907.19		
400	1574.84	0.20	$4p^5$	$^2P^o$	1/2	3685.24	T63	M00
			$4p^4(^3P)5s$	^2P	3/2	67183.58		
1000	1633.40	0.23	$4p^5$	$^2P^o$	1/2	3685.24	T63	M00
			$4p^4(^3P)5s$	^4P	3/2	64907.19		

Persistent Lines of Neutral Bromine (Br I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
130	7348.51	0.12	$4p^4(^3P)5s$	^4P	3/2	64907.19	T63	FW96
			$4p^4(^3P)5p$	$^2D^o$	5/2	78511.60		
500	7512.96	0.12	$4p^4(^3P)5s$	^4P	5/2	63436.45	T63	FW96
			$4p^4(^3P)5p$	$^4D^o$	3/2	76743.08		
400	7803.02	0.053	$4p^4(^3P)5s$	^4P	1/2	66883.87	T63	FW96
			$4p^4(^3P)5p$	$^2P^o$	3/2	79695.89		
400	7938.68	0.19	$4p^4(^1D)5s$	$^2D^o$	5/2	75890.33	T63	FW96
			$4p^4(^1D)5p$	$^2D^o$	5/2	88483.42		
1000	8272.44		$4p^4(^3P)5s$	^4P	5/2	63436.45	T63	
			$4p^4(^3P)5p$	$^4D^o$	7/2	75521.50		
130	8343.70	0.22	$4p^4(^3P)5s$	^4P	1/2	66883.87	T63	FW96
			$4p^4(^3P)5p$	$^4D^o$	1/2	78865.72		
500	8446.55	0.12	$4p^4(^3P)5s$	^4P	3/2	64907.19	T63	FW96
			$4p^4(^3P)5p$	$^4D^o$	3/2	76743.08		

Energy Levels of Neutral Bromine (Br I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4p^5$	$^2P^o$	3/2	0.00	T63
		1/2	3685.24	T63
$4p^4(^3P)5s$	^4P	5/2	63436.45	T63
		3/2	64907.19	T63
		1/2	66883.87	T63
$4p^4(^3P)5s$	^2P	3/2	67183.58	T63
		1/2	68970.21	T63
$4p^4(^3P)5p$	$^4P^o$	5/2	74672.32	T63
		3/2	75009.13	T63
		1/2	75814.00	T63
$4p^4(^3P)5p$	$^4D^o$	7/2	75521.50	T63
		5/2	75697.05	T63
		3/2	76743.08	T63
		1/2	78865.72	T63
$4p^4(^3P)5p$	$^2D^o$	5/2	78511.60	T63
		3/2	78676.65	T63
$4p^4(^3P)5p$	$^2S^o$	1/2	78076.00	T63
$4p^4(^3P)5p$	$^4S^o$	3/2	79178.33	T63
$4p^4(^3P)5p$	$^2P^o$	3/2	79695.89	T63
		1/2	79868.03	T63
$4p^4(^1D)5s$	^2D	5/2	75890.33	T63
		3/2	75908.53	T63
$4p^4(^1D)5p$	$^2F^o$	5/2	87061.23	T63
		7/2	87225.16	T63

Energy Levels of Neutral Bromine (Br I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4p^4(^1D)5p$	$^2D^o$	3/2	88438.78	T63
		5/2	88483.42	T63
$4p^4(^1D)5p$	$^2P^o$	3/2	87259.29	T63
		1/2	87499.03	T63
$4p^4(^1S)5s$	^2S	1/2	91937.95	T63
Br II ($^3P_2$)		*Limit*	**95284.8**	T63

Persistent Lines of Singly-ionized Bromine (Br II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	889.25		$4p^4$	^3P	2	0.00	MT84	
			$4p^3(^4S^o)4d$	$^3D^o$	3	112454.52		
1000	1015.53		$4p^4$	^3P	2	0.00	MT84	
			$4p^3(^4S^o)5s$	$^3S^o$	1	98470.12		
1000	1048.94		$4p^4$	^3P	1	3136.50	MT84	
			$4p^3(^4S^o)5s$	$^3S^o$	1	98470.12		
500	4704.92	1.1	$4p^3(^4S^o)5s$	$^5S^o$	2	93921.36	K40	FW96
			$4p^3(^4S^o)5p$	^5P	3	115170.02		
500	4785.48	0.94	$4p^3(^4S^o)5s$	$^5S^o$	2	93921.36	K40	FW96
			$4p^3(^4S^o)5p$	^5P	2	114812.00		
500	4816.68	1.1	$4p^3(^4S^o)5s$	$^5S^o$	2	93921.36	K40	FW96
			$4p^3(^4S^o)5p$	^5P	1	114676.79		

Energy Levels of Singly-ionized Bromine (Br II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4p^4$	^3P	2	0.0	MT84
		1	3136.5	MT84
		0	3837.4	MT84
$4p^4$	^1D	2	12089.1	MT84
$4p^4$	^1S	0	27867.1	MT84
$4p^3(^4S^o)5s$	$^5S^o$	2	93921.36	MT84
$4s4p^5$	$^3P^o$	2	96433.28	MT84
		1	98801.10	MT84
		0	100236.18	MT84
$4p^3(^4S^o)5s$	$^3S^o$	1	98470.12	MT84
$4p^3(^4S^o)4d$	$^5D^o$	3	104038.64	MT84
		2	104080.24	MT84
		4	104091.43	MT84
		1	104145.53	MT84
		0	104199.96	MT84
$4p^3(^2D^o)5s$	$^3D^o$	1	109422.21	MT84
		2	109676.51	MT84
		3	110372.20	MT84

Energy Levels of Singly-ionized Bromine (Br II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4p^3(^4S^o)4d$	$^3D^o$	2	111524.25	MT84
		1	112389.85	MT84
		3	112454.52	MT84
$4p^3(^2D^o)5s$	$^1D^o$	2	112933.31	MT84
$4s4p^5$	$^1P^o$	1	113336.75	MT84
$4p^3(^4S^o)5p$	^5P	1	114676.79	MT84
		2	114812.00	MT84
		3	115170.02	MT84
$4p^3(^4S^o)5p$	^3P	1	117555.18	MT84
		2	117761.14	MT84
		0	117828.36	MT84
Br III ($^4S^o_{3/2}$)		*Limit*	**174140**	M98

Cadmium (Cd)
Atomic number=48
Atomic weight=112.411

Isotope	Mass	Abundance	Spin	Mag moment
^{106}Cd	105.906461	1.25%	0	
^{108}Cd	107.904176	0.89%	0	
^{110}Cd	109.903005	12.51%	0	
^{111}Cd	110.904182	12.81%	1/2	−0.5943
^{112}Cd	111.902758	24.13%	0	
^{113}Cd	112.904400	12.22%	1/2	−0.6217
^{114}Cd	113.903357	28.72%	0	
^{116}Cd	115.904754	7.47%	0	

Cd I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2\ ^1S_0$
Ionization energy: 72 540.07 cm^{-1} (8.993 82 eV)

Cd II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s\ ^2S_{1/2}$
Ionization energy: 136 374.74 cm^{-1} (16.908 31 eV)

Strong Lines of Cadmium (Cd)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
200	1514.26	Cd II	SP49
200	1571.58	Cd II	SP49
300	1922.23	Cd II	SP49
200	1995.43	Cd II	SP49
	Air		
1000 P,r	2144.408	Cd II	SP49
1000	2194.557	Cd II	SP49
1000 P	2265.018	Cd II	SP49
800 P,r	2288.022	Cd I	BA56
1000 P	2312.766	Cd II	SP49
200	2321.074	Cd II	SP49
500 P	2572.930	Cd II	SP49
1000 P	2748.549	Cd II	SP49
100	2836.900	Cd I	BA56
100 r	2880.767	Cd I	BA56
200	2914.672	Cd II	SP49
200	2929.271	Cd II	SP49
500 r	2980.620	Cd I	BA56
100 r	2981.362	Cd I	BA56
100	3133.167	Cd I	BA56
150	3252.524	Cd I	BA56
150	3261.055	Cd I	BA56
400 P	3403.652	Cd I	BA56
500 P	3466.200	Cd I	BA56
400 P	3467.655	Cd I	BA56
500 P	3610.508	Cd I	BA56
400 P	3612.873	Cd I	BA56
200	4134.768	Cd II	SP49
1000	4415.63	Cd II	SP49
100 P	4678.149	Cd I	BA56
150 P	4799.912	Cd I	BA56
500 P,h	5085.822	Cd I	BA56
1000	5337.48	Cd II	SP49
1000	5378.13	Cd II	SP49

Strong Lines of Cadmium (Cd)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	5381.89	Cd II	SP49
150	6099.142	Cd I	BA56
400	6354.72	Cd II	SP49
500	6359.98	Cd II	SP49
1000 P	6438.470	Cd I	BA56
400	6464.94	Cd II	SP49
500	6725.78	Cd II	SP49
500	7345.670	Cd I	BA56

Persistent Lines of Neutral Cadmium (Cd I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	2288.022	5.3	$5s^2$	^1S	0	0.000	BA56	FW96
			$5s5p$	$^1P^o$	1	43692.384		
400	3403.652	0.77	$5s5p$	$^3P^o$	0	30113.990	BA56	FW96
			$5s5d$	^3D	1	59485.768		
500	3466.200	1.2	$5s5p$	$^3P^o$	1	30656.087	BA56	FW96
			$5s5d$	^3D	2	59497.868		
400	3467.655	0.67	$5s5p$	$^3P^o$	1	30656.087	BA56	FW96
			$5s5d$	^3D	1	59485.768		
500	3610.508	1.3	$5s5p$	$^3P^o$	2	31826.952	BA56	FW96
			$5s5d$	^3D	3	59515.980		
400	3612.873	0.35	$5s5p$	$^3P^o$	2	31826.952	BA56	FW96
			$5s5d$	^3D	2	59497.868		
100	4678.149	0.13	$5s5p$	$^3P^o$	0	30113.990	BA56	FW96
			$5s6s$	^3S	1	51483.980		
150	4799.912	0.41	$5s5p$	$^3P^o$	1	30656.087	BA56	FW96
			$5s6s$	^3S	1	51483.980		
500	5085.822	0.56	$5s5p$	$^3P^o$	2	31826.952	BA56	FW96
			$5s6s$	^3S	1	51483.980		
1000	6438.470	0.59	$5s5p$	$^1P^o$	1	43692.384	BA56	FW96
			$5s5d$	^1D	2	59219.734		

Energy Levels of Neutral Cadmium (Cd I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5s^2$	^1S	0	0.000	BA56
$5s5p$	$^3P^o$	0	30113.990	BA56
		1	30656.087	BA56
		2	31826.952	BA56
$5s5p$	$^1P^o$	1	43692.384	BA56
$5s6s$	^3S	1	51483.980	BA56
$5s6s$	^1S	0	53310.101	BA56
$5s5d$	^1D	2	59219.734	BA56
$5s5d$	^3D	1	59485.768	BA56
		2	59497.868	BA56
		3	59515.980	BA56
Cd II ($^2S_{1/2}$)		*Limit*	**72540.07**	BTG75

Persistent Lines of Singly-ionized Cadmium (Cd II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2144.408	2.8	$4d^{10}5s$	^2S	1/2	0.00	SP49	FW96
			$4d^{10}5p$	$^2P^o$	3/2	46618.55		
1000	2265.018	3.0	$4d^{10}5s$	^2S	1/2	0.00	SP49	FW96
			$4d^{10}5p$	$^2P^o$	1/2	44136.08		
1000	2312.766		$4d^{10}5p$	$^2P^o$	3/2	46618.55	SP49	
			$4d^{10}5d$	^2D	5/2	89843.78		
500	2572.930	1.7	$4d^{10}5p$	$^2P^o$	1/2	44136.08	SP49	FW96
			$4d^{10}6s$	^2S	1/2	82990.66		
1000	2748.549	2.8	$4d^{10}5p$	$^2P^o$	3/2	46618.55	SP49	FW96
			$4d^{10}6s$	^2S	1/2	82990.66		

Energy Levels of Singly-ionized Cadmium (Cd II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^{10}5s$	^2S	1/2	0.00	SP49
$4d^{10}5p$	$^2P^o$	1/2	44136.08	SP49
		3/2	46618.55	SP49
$4d^95s^2$	^2D	5/2	69258.91	SP49
		3/2	74893.66	SP49
$4d^{10}6s$	^2S	1/2	82990.66	SP49
$4d^{10}5d$	^2D	3/2	89689.25	SP49
		5/2	89843.78	SP49
Cd III ($^1S_0$)		*Limit*	**136374.74**	SP49

Calcium (Ca)

Atomic number = 20
Atomic weight = 40.078

Isotope	Mass	Abundance	Spin	Mag moment
^{40}Ca	39.962591	96.941%	0	
^{42}Ca	41.958618	0.647%	0	
^{43}Ca	42.958766	0.135%	7/2	+1.3173
^{44}Ca	43.955480	2.086%	0	
^{46}Ca	45.953689	0.004%	0	
^{48}Ca	47.952553	0.187%	0	

Ca I Ground state: $1s^22s^22p^63s^23p^64s^2\ ^1S_0$
Ionization energy: 49 305.95 cm^{-1} (6.113 16 eV)

Ca II Ground state: $1s^22s^22p^63s^23p^64s\ ^2S_{1/2}$
Ionization energy: 95 751.87 cm^{-1} (11.871 72 eV)

Strong Lines of Calcium (Ca)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
250	1649.858	Ca II	ER56
140	1651.991	Ca II	ER56
250	1840.061	Ca II	ER56
	Air		
	2197.787	Ca II	ER56
	2208.611	Ca II	ER56
120	2275.462	Ca I	R68
140 P	2721.645	Ca I	R68
700 P	3158.869	Ca II	ER56
800 P	3179.332	Ca II	ER56
700	3181.275	Ca II	ER56
700 P	3706.026	Ca II	ER56
800 P	3736.901	Ca II	ER56
1000 P	3933.6614	Ca II	L99
1000 P	3968.4673	Ca II	L99
1000 P	4226.727	Ca I	R68
500	4302.527	Ca I	R68
500	4307.741	Ca I	R68
500 P	4425.441	Ca I	R68
500 P	4434.960	Ca I	R68
500 P	4435.688	Ca I	R68
600 P	4454.781	Ca I	R68
600 P	4455.887	Ca I	R68
400 P	4456.605	Ca I	R68
500	4878.132	Ca I	R68
300	5019.971	Ca II	ER56
500	5188.848	Ca I	R68
500	5265.557	Ca I	R68
500	5270.270	Ca I	R68
500	5349.472	Ca I	R68
500	5581.971	Ca I	R68
500 P	5588.757	Ca I	R68
500	5590.120	Ca I	R68
500	5594.468	Ca I	R68
500	5598.487	Ca I	R68
600	5857.452	Ca I	R68

Strong Lines of Calcium (Ca)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500 P	6102.722	Ca I	R68
600 P	6122.219	Ca I	R68
600 P	6162.172	Ca I	R68
500	6169.055	Ca I	R68
600	6169.559	Ca I	R68
700 P	6439.073	Ca I	R68
600	6449.810	Ca I	R68
300	6456.874	Ca II	ER56
700 P	6462.566	Ca I	R68
600	6471.660	Ca I	R68
600 P	6493.780	Ca I	R68
600	6499.649	Ca I	R68
500 P	6572.777	Ca I	R68
600	6717.685	Ca I	R68
700	7148.147	Ca I	R68
600	7202.194	Ca I	R68
700	7326.146	Ca I	R68
300	7601.304	Ca II	R68
400	8201.720	Ca II	ER56
500	8248.797	Ca II	ER56
600	8498.018	Ca II	ER56
700 P	8542.089	Ca II	ER56
700 P	8662.140	Ca II	ER56
400	8912.07	Ca II	ER56
500	8927.36	Ca II	ER56
500	9213.900	Ca II	R68
400	9311.998	Ca II	R68
400	9319.560	Ca II	R68
500	9320.650	Ca II	R68
500	9416.967	Ca I	R68
400	9567.965	Ca II	R68
500	9599.235	Ca II	R68
300	9601.815	Ca II	R68
300	9854.74	Ca II	ER56
500	9890.63	Ca II	ER56
400	9931.39	Ca II	ER56
400	10223.04	Ca II	R68
500	12816.04	Ca I	R68
500	12909.10	Ca I	R68
600	13033.57	Ca I	R68
600	19046.14	Ca I	R68
1000	19309.20	Ca I	R68
1000	19452.99	Ca I	R68
900	19505.72	Ca I	R68
1000	19776.79	Ca I	R68
700	19853.10	Ca I	R68
700	19862.22	Ca I	R68
500	22624.93	Ca I	R68
600	22651.23	Ca I	R68

Persistent Lines of Neutral Calcium (Ca I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
140	2721.645	0.0027	$4s^2$	^1S	0	0.000	R68	M03
			$4s5p$	$^1P^o$	1	36731.615		
1000	4226.727	2.20	$4s^2$	^1S	0	0.000	R68	M03
			$4s4p$	$^1P^o$	1	23652.304		
500	4425.441	0.498	$4s4p$	$^3P^o$	0	15157.901	R68	FW96
			$4s4d$	^3D	1	37748.197		
500	4434.960	0.67	$4s4p$	$^3P^o$	1	15210.063	R68	FW96
			$4s4d$	^3D	2	37751.867		
500	4435.688	0.342	$4s4p$	$^3P^o$	1	15210.063	R68	FW96
			$4s4d$	^3D	1	37748.197		
600	4454.781	0.87	$4s4p$	$^3P^o$	2	15315.943	R68	FW96
			$4s4d$	^3D	3	37757.449		
600	4455.887	0.20	$4s4p$	$^3P^o$	2	15315.943	R68	FW96
			$4s4d$	^3D	2	37751.867		
400	4456.605		$4s4p$	$^3P^o$	2	15315.943	R68	
			$4s4d$	^3D	1	37748.197		
500	5588.757	0.49	$3d4s$	^3D	3	20371.000	R68	FW96
			$3d4p$	$^3D^o$	3	38259.124		
500	6102.722	0.096	$4s4p$	$^3P^o$	0	15157.901	R68	FW96
			$4s5s$	^3S	1	31539.495		
600	6122.219	0.287	$4s4p$	$^3P^o$	1	15210.063	R68	FW96
			$4s5s$	^3S	1	31539.495		
600	6162.172	0.354	$4s4p$	$^3P^o$	2	15315.943	R68	FW96
			$4s5s$	^3S	1	31539.495		
700	6439.073	0.53	$3d4s$	^3D	3	20371.000	R68	FW96
			$3d4p$	$^3F^o$	4	35896.889		
700	6462.566	0.47	$3d4s$	^3D	2	20349.260	R68	FW96
			$3d4p$	$^3F^o$	3	35818.713		
600	6493.780	0.44	$3d4s$	^3D	1	20335.360	R68	FW96
			$3d4p$	$^3F^o$	2	35730.454		
500	6572.777		$4s^2$	^1S	0	0.000	R68	
			$4s4p$	$^3P^o$	1	15210.063		

Energy Levels of Neutral Calcium (Ca I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4s^2$	^1S	0	0.000	SC85
$4s4p$	$^3P^o$	0	15157.901	SC85
		1	15210.063	SC85
		2	15315.943	SC85
$3d4s$	^3D	1	20335.360	SC85
		2	20349.260	SC85
		3	20371.000	SC85
$3d4s$	^1D	2	21849.634	SC85
$4s4p$	$^1P^o$	1	23652.304	SC85
$4s5s$	^3S	1	31539.495	SC85
$4s5s$	^1S	0	33317.264	SC85
$3d4p$	$^3F^o$	2	35730.454	SC85
		3	35818.713	SC85
		4	35896.889	SC85
$3d4p$	$^1D^o$	2	35835.413	SC85
$4s5p$	$^3P^o$	0	36547.688	SC85
		1	36554.749	SC85
		2	36575.119	SC85
$4s5p$	$^1P^o$	1	36731.615	SC85
$4s4d$	^1D	2	37298.287	SC85
$4s4d$	^3D	1	37748.197	SC85
		2	37751.867	SC85
		3	37757.449	SC85
$3d4p$	$^3D^o$	1	38192.392	SC85
		2	38219.118	SC85
		3	38259.124	SC85
$4p^2$	^3P	0	38417.543	SC85
		1	38464.808	SC85
		2	38551.558	SC85
Ca II ($^2S_{1/2}$)		*Limit*	**49305.95**	SC85

Persistent Lines of Singly-ionized Calcium (Ca II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	3158.869	3.1	$4p$	$^2P^o$	1/2	25191.51	ER56	FW96
			$4d$	^2D	3/2	56839.25		
800	3179.332	3.6	$4p$	$^2P^o$	3/2	25414.40	ER56	FW96
			$4d$	^2D	5/2	56858.46		
700	3706.026	0.88	$4p$	$^2P^o$	1/2	25191.51	ER56	FW96
			$5s$	^2S	1/2	52166.93		
800	3736.901	1.7	$4p$	$^2P^o$	3/2	25414.40	ER56	FW96
			$5s$	^2S	1/2	52166.93		
1000	3933.6614	1.35	$4s$	^2S	1/2	0.00	L99	M03
			$4p$	$^2P^o$	3/2	25414.40		
1000	3968.4673	1.32	$4s$	^2S	1/2	0.00	L99	M03
			$4p$	$^2P^o$	1/2	25191.51		
700	8542.089		$3d$	^2D	5/2	13710.88	ER56	
			$4p$	$^2P^o$	3/2	25414.40		
700	8662.140		$3d$	^2D	3/2	13650.19	ER56	
			$4p$	$^2P^o$	1/2	25191.51		

Energy Levels of Singly-ionized Calcium (Ca II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4s$	^2S	1/2	0.000	L99
$3d$	^2D	3/2	13650.20	SC85
		5/2	13710.89	SC85
$4p$	$^2P^o$	1/2	25191.518	L99
		3/2	25414.414	L99
$5s$	^2S	1/2	52166.94	SC85
$4d$	^2D	3/2	56839.26	SC85
		5/2	56858.47	SC85
$5p$	$^2P^o$	1/2	60533.03	SC85
		3/2	60611.29	SC85
$4f$	$^2F^o$	5/2,7/2	68056.92	SC85
$6s$	^2S	1/2	70677.63	SC85
Ca III ($^1S_0$)		*Limit*	**95751.88**	SC85

Californium (Cf)
Atomic number=98
Atomic weight=(251)

Isotope	Mass	Abundance	Spin	Mag moment
^{249}Cf	249.074844	0	9/2	
^{251}Cf	251.079580	0	1/2	
^{252}Cf	252.081621	0	0	

Cf I Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}4f^{14}5s^25p^65d^{10}6s^26p^65f^{10}7s^2\ {}^5I_8$
Ionization energy: 50 665 cm^{-1} (6.2817 eV)

Cf II Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}4f^{14}5s^25p^65d^{10}6s^26p^65f^{10}7s\ (8,1/2)_{17/2}$
Ionization energy: [95 000] cm^{-1} (11.8 eV)

Strong Lines of Californium (Cf)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
1000	2739.31	Cf II	RCWM80
1000 P,s	2759.10	Cf II	RCWM80
1000 P	2774.52	Cf II	RCWM80
1000 l	2852.03	Cf II	RCWM80
1000 s	2855.24	Cf II	RCWM80
1000 P	3298.14	Cf I	RCWM80
1000 P	3352.71	Cf I	RCWM80
1000 l	3367.79	Cf II	RCWM80
1000	3392.22	Cf I	RCWM80
1000	3481.07	Cf I	RCWM80
1000 l	3513.47	Cf II	RCWM80
1000	3531.49	Cf I	RCWM80
1000	3540.98	Cf I	RCWM80
1000 P	3598.77	Cf I	RCWM80
1000	3605.32	Cf I	RCWM80
1000	3612.11	Cf I	RCWM80
1000	3617.49	Cf I	RCWM80
1000 P,s	3626.76	Cf II	RCWM80
1000	3659.46	Cf I	RCWM80
1000	3662.70	Cf I	RCWM80
1000 s	3699.49	Cf II	RCWM80
1000 P,l	3722.11	Cf II	RCWM80
1000	3739.35	Cf I	RCWM80
1000	3785.61	Cf I	RCWM80
1000 l	3789.04	Cf II	RCWM80
1000 s	3893.23	Cf II	RCWM80
1000 P,l	3993.57	Cf II	RCWM80
1000	4035.45	Cf I	RCWM80
1000	4099.12	Cf I	RCWM80
1000	4242.38	Cf I	RCWM80
1000 P	4329.03	Cf I	RCWM80
1000	4335.22	Cf I	RCWM80
1000	5173.96	Cf I	RCWM80
1000	5179.08	Cf I	RCWM80
1000	5219.24	Cf I	RCWM80
1000 b,s	5279.01	Cf I	RCWM80
1000 s	5320.09	Cf I	RCWM80
1000 s	5339.13	Cf I	RCWM80
1000 P	5408.88	Cf I	RCWM80

Strong Lines of Californium (Cf)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1000	5726.05	Cf I	RCWM80
1000	6622.83	Cf I	RCWM80
1000	6631.26	Cf I	RCWM80
1000	6677.90	Cf I	RCWM80
1000	6894.59	Cf I	RCWM80
1000 P	6927.10	Cf II	RCWM80
1000 l	7074.52	Cf I	RCWM80
1000 s	7307.90	Cf I	RCWM80
1000 P	8141.29	Cf I	RCWM80
1000	8241.77	Cf II	RCWM80
1000	8333.85	Cf II	RCWM80
1000	8423.49	Cf II	RCWM80
1000	8568.83	Cf II	RCWM80
1000 l	9228.52	Cf I	RCWM80
1000	9337.70	Cf I	RCWM80
1000	9649.51	Cf I	RCWM80
1000 s	10308.41	Cf I	CWBV77
1000 l	10568.83	Cf I	CWBV77
1000 s	10614.84	Cf I	CWBV77
1000	11300.19	Cf I	CWBV77
1000	11681.85	Cf I	CWBV77
1000 P	11941.33	Cf I	CWBV77
1000 P,l	12183.05	Cf II	CWBV77
1000 s	12352.72	Cf I	CWBV77
1000 s	12437.48	Cf I	CWBV77
1000 P,l	12787.41	Cf I	CWBV77
1000 l	13329.98	Cf II	CWBV77
1000 s	13362.98	Cf I	CWBV77
1000 P,l	13376.89	Cf II	CWBV77
1000 l	13474.44	Cf I	CWBV77
1000 l	14772.49	Cf II	CWBV77
1000 s	15281.32	Cf I	CWBV77
1000	15587.12	Cf II	CWBV77
1000	15675.92	Cf I	CWBV77
1000 P	16759.06	Cf II	CWBV77
1000 s	17626.25	Cf I	CWBV77
1000 l	18718.69	Cf I	CWBV77
1000 h	19068.71	Cf I	CWBV77
1000 l	19336.96	Cf I	CWBV77
1000 l	19576.84	Cf I	CWBV77
1000 l	20393.38	Cf I	CWBV77
1000 s	20869.98	Cf I	CWBV77

Persistent Lines of Neutral Californium (Cf I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3298.14		$5f^{10}7s^2$	^{5}I	8	0.000	RCWM80	
				o	7	30311.400		
1000	3352.71		$5f^{10}7s^2$	^{5}I	8	0.000	RCWM80	
			$5f^9 6d7s^2$	o	8	29818.055		
1000	3598.77		$5f^{10}7s^2$	^{5}I	8	0.000	RCWM80	
			$5f^{10}(^5I_8)7s7p(^1P^o_1)$	$(8,1)^o$	9	27779.345		
1000	4329.03		$5f^{10}7s^2$	^{5}I	8	0.000	RCWM80	
			$5f^{10}(^5I_8)7s7p(^1P^o_2)$	$(8,2)^o$	9	23093.355		

Persistent Lines of Neutral Californium (Cf I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	5408.88		$5f^{10}7s^2$	^{5}I	8	0.000	RCWM80	
			$5f^{10}(^5I_8)7s7p(^3P^o_1)$	(8,1)^o	9	18483.060		
1000	8141.29		$5f^9(^6H^o_{15/2})6d_{3/2}7s^2$	(15/2,3/2)^o	9	19907.460	RCWM80	
			$5f^9(^6H^o_{15/2})7s^27p_{3/2}$	(15/2,3/2)	9	32187.145		
1000	11941.33		$5f^9(^6H^o_{15/2})6d_{3/2}7s^2$	(15/2,3/2)^o	8	16909.535	CWBV77	
			$5f^9(^6H^o_{15/2})7s^27p_{1/2}$	(15/2,1/2)	8	25281.530		
1000	12787.41		$5f^9(^6H^o_{15/2})6d_{3/2}7s^2$	(15/2,3/2)^o	8	16909.535	CWBV77	
			$5f^9(^6H^o_{15/2})7s^27p_{1/2}$	(15/2,1/2)	7	24727.600		

Energy Levels of Neutral Californium (Cf I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^{10}7s^2$	^{5}I	8	0.000	BW92b
		7	9078.145	BW92b
		6	11074.390	BW92b
		4	15375.470	BW92b
		5	15846.145	BW92b
$5f^{10}7s^2$	^{5}F	5	8516.380	BW92b
$5f^{10}7s^2$	^{3}P	2	10589.250	BW92b
$5f^{10}7s^2$	^{5}F	4	13965.750	BW92b
$5f^9(^6H^o_{15/2})6d_{3/2}7s^2$	(15/2,3/2)^o	8	16909.535	BW92b
		7	17308.170	BW92b
		6	19055.82	BW92b
		9	19907.460	BW92b
$5f^{10}(^5I_8)7s7p(^3P^o_0)$	(8,0)^o	8	17459.210	BW92b
$5f^{10}(^5I_8)7s7p(^3P^o_1)$	(8,1)^o	9	18483.060	BW92b
		8	19303.065	BW92b
		7	19322.220	BW92b
$5f^{10}(^5I_8)7s7p(^3P^o_2)$	(8,2)^o	9	23093.355	BW92b
$5f^9(^6H^o_{15/2})7s^27p_{1/2}$	(15/2,1/2)	7	24727.600	BW92b
		8	25281.530	BW92b
$5f^{10}(^5I_8)7s7p(^1P^o_1)$	(8,1)^o	9	27779.345	BW92b
$5f^96d7s^2$	^{o}	8	29818.055	BW92b
	^{o}	7	30311.400	BW92b
$5f^9(^6H^o_{15/2})7s^27p_{3/2}$	(15/2,3/2)	9	32187.145	BW92b
Cf II $(5f^{10}(^5I_8)7s\ (8,1/2)_{17/2})$		*Limit*	**50665**	KDEE97

Persistent Lines of Singly-ionized Californium (Cf II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2759.10		$5f^{10}(^5I_8)7s$	(8,1/2)	17/2	0.00	RCWM80	
			$5f^{10}(^5I_8)7p_{3/2}$	^{o}	17/2	36233.01		
1000	2774.52		$5f^{10}(^5I_8)7s$	(8,1/2)	17/2	0.00	RCWM80	
			$5f^{10}(^5I_8)7p_{3/2}$	$(8,3/2)^o$	19/2	36031.74		
1000	3626.76		$5f^{10}(^5I_8)7s$	(8,1/2)	17/2	0.00	RCWM80	
			$5f^{10}(^5I_8)7p_{1/2}$	$(8,1/2)^o$	17/2	27564.94		
1000	3722.11		$5f^{10}(^5I_8)7s$	(8,1/2)	17/2	0.00	RCWM80	
			$5f^{10}(^5I_8)7p_{1/2}$	$(8,1/2)^o$	15/2	26858.90		
1000	3993.57		$5f^{10}(^5I_8)7s$	(8,1/2)	15/2	1180.52	RCWM80	
			$5f^9 6d7s$	^{o}	17/2	26213.78		
1000	6927.10		$5f^{10}(^5I_8)6d_{3/2}$	(8,3/2)	19/2	21599.67	RCWM80	
			$5f^{10}(^5I_8)7p_{3/2}$	$(8,3/2)^o$	19/2	36031.74		
1000	12183.05		$5f^{10}(^5I_8)6d_{3/2}$	(8,3/2)	15/2	19359.06	CWBV77	
			$5f^{10}(^5I_8)7p_{1/2}$	$(8,1/2)^o$	17/2	27564.94		
1000	13376.89		$5f^{10}(^5I_8)6d_{3/2}$	(8,3/2)	17/2	20091.38	CWBV77	
			$5f^{10}(^5I_8)7p_{1/2}$	$(8,1/2)^o$	17/2	27564.94		
1000	16759.06		$5f^{10}(^5I_8)6d_{3/2}$	(8,3/2)	19/2	21599.67	CWBV77	
			$5f^{10}(^5I_8)7_{p1/2}$	$(8,1/2)^o$	17/2	27564.94		

Energy Levels of Singly-ionized Californium (Cf II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^{10}(^5I_8)7s$	(8,1/2)	17/2	0.00	BW92b
		15/2	1180.52	BW92b
$5f^{10}(^5F_5)7s$	(5,1/2)	11/2	8852.05	BW92b
		9/2	9633.09	BW92b
$5f^{10}(^5I_7)7s$	(7,1/2)	15/2	9350.19	BW92b
		13/2	9922.27	BW92b
$5f^{10}(^5I_8)6d_{3/2}$	(8,3/2)	15/2	19359.06	BW92b
		17/2	20091.38	BW92b
		13/2	20445.10	BW92b
		19/2	21599.67	BW92b
$5f^9 6d7s$	^{o}	19/2	24213.34	BW92b
$5f^9 6d7s$	^{o}	17/2	26213.78	BW92b
$5f^{10}(^5I_8)7p_{1/2}$	$(8,1/2)^o$	15/2	26858.90	BW92b
		17/2	27564.94	BW92b
$5f^{10}(^5I_8)7p_{3/2}$	$(8,3/2)^o$	19/2	36031.74	BW92b
$5f^{10}(^5I_8)7p_{3/2}$	$(8,3/2)^o$	17/2	36233.01	BW92b
Cf III ($^5I_8$)		*Limit*	[**95000**]	CNWM70

Carbon (C)
Atomic number = 6
Atomic weight = 12.011

Isotope	Mass	Abundance	Spin	Mag moment
^{12}C	12.000000	98.90%	0	
^{13}C	13.003355	1.10%	1/2	+0.70241

C I Ground state: $1s^2 2s^2 2p^2\ {}^3P_0$
Ionization energy: 90 820.45 cm^{-1} (11.260 30 eV)

C II Ground state: $1s^2 2s^2 2p\ {}^2P^o_{1/2}$
Ionization energy: 196 664.7 cm^{-1} (24.3833 eV)

Strong Lines of Carbon (C)

Intensity		Wavelength (Å)	Spectrum	Ref
		Vacuum		
600	P	687.0526	C II	KE74
1000	P	687.346	C II	KE74
150		903.6235	C II	KE74
300		903.9616	C II	KE74
750	P	904.1416	C II	KE74
150		904.4801	C II	KE74
250	P	1036.3367	C II	KE74
500	P	1037.0182	C II	KE74
300*		1193.0088	C I	J66
300*		1193.0308	C I	J66
400		1193.2402	C I	KE74
100		1193.2644	C I	KE74
200		1261.5520	C I	KE74
400	P	1277.2452	C I	KE74
800	P	1277.2824	C I	KE74
200	P	1277.5131	C I	KE74
1000	P	1277.5497	C I	KE74
800	P	1280.3330	C I	KE74
200		1329.5775	C I	KE74
100		1329.6005	C I	KE74
80	P	1334.5323	C II	KE74
150	P	1335.7077	C II	KE74
200		1560.309	C I	KE74
500	P	1560.682	C I	KE74
200	P	1560.709	C I	KE74
600	P	1561.438	C I	KE74
500	P	1656.267	C I	KE74
400	P	1656.928	C I	KE74
1000	P	1657.008	C I	KE74
400	P	1657.379	C I	KE74
400	P	1657.907	C I	KE74
500	P	1658.121	C I	KE74
500	P	1751.827	C I	KE74
1000	P	1930.906	C I	KE74
		Air		
400	P	2478.561	C I	J66
500	P	2836.710	C II	MG93
400	P	2837.603	C II	MG93
400	h	2992.618	C II	MG93
300	P	3918.978	C II	MG93

Strong Lines of Carbon (C)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400 P	3920.693	C II	MG93
400 P	4267.003	C II	MG93
500 P,c	4267.258	C II	MG93
300	5145.16	C II	MG93
200	5151.09	C II	MG93
150	5380.34	C I	J66
300	5889.77	C II	MG93
150	6013.22	C I	J66
400 P	6578.05	C II	MG93
300	6582.88	C II	MG93
400 P	7231.32	C II	MG93
500 P	7236.42	C II	MG93
250 P	8335.15	C I	J66
220	9094.83	C I	J66
150	9111.80	C I	J66
400 P	9405.73	C I	J66
150	9658.44	C I	J66
150	10691.25	C I	J66
90	11748.22	C I	JL65
140 P	11753.32	C I	JL65
110 P	11754.76	C I	JL65
50	16890.38	C I	JL65

Persistent Lines of Neutral Carbon (C I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	1277.2452	1.27	$2s^22p^2$	^{3}P	0	0.00000	KE74	WFD96
			$2s^22p(^2P^o)3d$	$^3D^o$	1	78293.50		
800	1277.2824	1.73	$2s^22p^2$	^{3}P	1	16.41671	KE74	WFD96
			$2s^22p(^2P^o)3d$	$^3D^o$	2	78307.62		
200	1277.5131	0.912	$2s^22p^2$	^{3}P	1	16.41671	KE74	WFD96
			$2s^22p(^2P^o)3d$	$^3D^o$	1	78293.50		
1000	1277.5497	2.31	$2s^22p^2$	^{3}P	2	43.41350	KE74	WFD96
			$2s^22p(^2P^o)3d$	$^3D^o$	3	78318.23		
800	1280.3330	0.577	$2s^22p^2$	^{3}P	2	43.41350	KE74	WFD96
			$2s^22p(^2P^o)4s$	$^3P^o$	2	78148.09		
500	1560.682	0.908	$2s^22p^2$	^{3}P	1	16.41671	KE74	M03
			$2s2p^3$	$^3D^o$	2	64090.97		
200	1560.709	0.505	$2s^22p^2$	^{3}P	1	16.41671	KE74	M03
			$2s2p^3$	$^3D^o$	1	64089.86		
600	1561.438	1.21	$2s^22p^2$	^{3}P	2	43.41350	KE74	M03
			$2s2p^3$	$^3D^o$	3	64086.95		
500	1656.267	0.858	$2s^22p^2$	^{3}P	1	16.41671	KE74	WFD96
			$2s^22p(^2P^o)3s$	$^3P^o$	2	60393.15		
400	1656.928	1.13	$2s^22p^2$	^{3}P	0	0.00000	KE74	WFD96
			$2s^22p(^2P^o)3s$	$^3P^o$	1	60352.64		
1000	1657.008	2.52	$2s^22p^2$	^{3}P	2	43.41350	KE74	WFD96
			$2s^22p(^2P^o)3s$	$^3P^o$	2	60393.15		

Persistent Lines of Neutral Carbon (C I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	1657.379	0.864	$2s^22p^2$	^{3}P	1	16.41671	KE74	WFD96
			$2s^22p(^2P^o)3s$	^{3}P^o	1	60352.64		
400	1657.907	3.43	$2s^22p^2$	^{3}P	1	16.41671	KE74	WFD96
			$2s^22p(^2P^o)3s$	^{3}P^o	0	60333.43		
500	1658.121	1.44	$2s^22p^2$	^{3}P	2	43.41350	KE74	WFD96
			$2s^22p(^2P^o)3s$	^{3}P^o	1	60352.64		
500	1751.827	0.907	$2s^22p^2$	^{1}S	0	21648.02	KE74	WFD96
			$2s^22p(^2P^o)3d$	^{1}P^o	1	78731.28		
1000	1930.906	3.51	$2s^22p^2$	^{1}D	2	10192.66	KE74	WFD96
			$2s^22p(^2P^o)3s$	^{1}P^o	1	61981.82		
400	2478.561	0.340	$2s^22p^2$	^{1}S	0	21648.02	J66	WFD96
			$2s^22p(^2P^o)3s$	^{1}P^o	1	61981.82		
250	8335.15	0.351	$2s^22p(^2P^o)3s$	^{1}P^o	1	61981.82	J66	WFD96
			$2s^22p(^2P^o)3p$	^{1}S	0	73975.91		
400	9405.73	0.291	$2s^22p(^2P^o)3s$	^{1}P^o	1	61981.82	J66	WFD96
			$2s^22p(^2P^o)3p$	^{1}D	2	72610.73		
140	11753.32	0.263	$2s^22p(^2P^o)3p$	^{3}D	3	69744.03	JL65	WFD96
			$2s^22p(^2P^o)3d$	^{3}F^o	4	78249.93		
101	11754.76	0.240	$2s^22p(^2P^o)3p$	^{3}D	2	69710.67	JL65	WFD96
			$2s^22p(^2P^o)3d$	^{3}F^o	3	78215.50		

Energy Levels of Neutral Carbon (C I)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^22p^2$	^{3}P	0	0.00000	YS91
		1	16.41671	YS91
		2	43.41350	YS91,CSBE86
$2s^22p^2$	^{1}D	2	10192.66	KW66
$2s^22p^2$	^{1}S	0	21648.02	KW66
$2s2p^3$	^{5}S^o	2	33735.22	J66
$2s^22p(^2P^o)3s$	^{3}P^o	0	60333.43	CG98
		1	60352.64	CG98
		2	60393.15	CG98
$2s^22p(^2P^o)3s$	^{1}P^o	1	61981.82	CG98
$2s2p^3$	^{3}D^o	3	64086.95	CG98
		1	64089.86	CG98
		2	64090.97	CG98
$2s^22p(^2P^o)3p$	^{1}P	1	68856.34	CG98
$2s^22p(^2P^o)3p$	^{3}D	1	69689.47	CG98
		2	69710.67	CG98
		3	69744.03	CG98
$2s^22p(^2P^o)3p$	^{3}S	1	70743.95	CG98

Energy Levels of Neutral Carbon (C I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^2 2p(^2P^o)3p$	^3P	0	71352.52	CG98
		1	71364.92	CG98
		2	71385.39	CG98
$2s^2 2p(^2P^o)3p$	^1D	2	72610.73	CG98
$2s^2 2p(^2P^o)3p$	^1S	0	73975.91	CG98
$2s2p^3$	$^3P^o$	1	75253.98	CG98
		2	75255.28	CG98
		0	75256.15	CG98
$2s^2 2p(^2P^o)3d$	$^1D^o$	2	77679.83	CG98
$2s^2 2p(^2P^o)4s$	$^3P^o$	0	78104.97	CG98
		1	78116.75	CG98
		2	78148.09	CG98
$2s^2 2p(^2P^o)3d$	$^3F^o$	2	78199.06	CG98
		3	78215.50	CG98
		4	78249.93	CG98
$2s^2 2p(^2P^o)3d$	$^3D^o$	1	78293.50	CG98
		2	78307.62	CG98
		3	78318.23	CG98
$2s^2 2p(^2P^o)3d$	$^1P^o$	1	78731.28	CG98
C II ($^2P^o_{1/2}$)		*Limit*	**90820.45**	J66

Persistent Lines of Singly-ionized Carbon (C II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	687.053	23.7	$2s^2(^1S)2p$	$^2P^o$	1/2	0.00	KE74	WFD96
			$2s^2(^1S)3d$	^2D	3/2	145549.27		
1000	687.345	28.4	$2s^2(^1S)2p$	$^2P^o$	3/2	63.42	KE74	WFD96
			$2s^2(^1S)3d$	^2D	5/2	145550.70		
750	904.142	34.2	$2s^2(^1S)2p$	$^2P^o$	3/2	63.42	KE74	WFD96
			$2s2p^2$	^2P	3/2	110665.56		
250	1036.3367	7.34	$2s^2(^1S)2p$	$^2P^o$	1/2	0.00	KE74	M03
			$2s2p^2$	^2S	1/2	96493.74		
500	1037.0182	14.7	$2s^2(^1S)2p$	$^2P^o$	3/2	63.42	KE74	M03
			$2s2p^2$	^2S	1/2	96493.74		
80	1334.5323	2.40	$2s^2(^1S)2p$	$^2P^o$	1/2	0.00	KE74	M03
			$2s2p^2$	^2D	3/2	74932.62		
150	1335.7077	2.88	$2s^2(^1S)2p$	$^2P^o$	3/2	63.42	KE74	M03
			$2s2p^2$	^2D	5/2	74930.10		
500	2836.710	0.398	$2s2p^2$	^2S	1/2	96493.74	MG93	WFD96
			$2s^2(^1S)3p$	$^2P^o$	3/2	131735.52		
400	2837.603	0.397	$2s2p^2$	^2S	1/2	96493.74	MG93	WFD96
			$2s^2(^1S)3p$	$^2P^o$	1/2	131724.37		

Persistent Lines of Singly-ionized Carbon (C II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	3918.978	0.636	$2s^2(^1S)3p$	$^2P^o$	1/2	131724.37	MG93	WFD96
			$2s^2(^1S)4s$	^2S	1/2	157234.07		
400	3920.693	1.27	$2s^2(^1S)3p$	$^2P^o$	3/2	131735.52	MG93	WFD96
			$2s^2(^1S)4s$	^2S	1/2	157234.07		
400	4267.003	2.23	$2s^2(^1S)3d$	^2D	3/2	145549.27	MG93	WFD96
			$2s^2(^1S)4f$	$^2F^o$	5/2	168978.34		
500	4267.258	2.38	$2s^2(^1S)3d$	^2D	5/2	145550.70	MG93	WFD96
			$2s^2(^1S)4f$	$^2F^o$	7/2	168978.34		
		0.159	$2s^2(^1S)3d$	^2D	5/2	145550.70		WFD96
			$2s^2(^1S)4f$	$^2F^o$	5/2	168978.34		
400	6578.05	0.363	$2s^2(^1S)3s$	^2S	1/2	116537.65	MG93	WFD96
			$2s^2(^1S)3p$	$^2P^o$	3/2	131735.52		
400	7231.32	0.352	$2s^2(^1S)3p$	$^2P^o$	1/2	131724.37	MG93	WFD96
			$2s^2(^1S)3d$	^2D	3/2	145549.27		
500	7236.42	0.422	$2s^2(^1S)3p$	$^2P^o$	3/2	131735.52	MG93	WFD96
			$2s^2(^1S)3d$	^2D	5/2	145550.70		

Energy Levels of Singly-ionized Carbon (C II)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^2(^1S)2p$	$^2P^o$	1/2	0.00	MG93
		3/2	63.42	MG93
$2s2p^2$	^4P	1/2	43003.3	MG93
		3/2	43025.3	MG93
		5/2	43053.6	MG93
$2s2p^2$	^2D	5/2	74930.10	MG93
		3/2	74932.62	MG93
$2s2p^2$	^2S	1/2	96493.74	MG93
$2s2p^2$	^2P	1/2	110624.17	MG93
		3/2	110665.56	MG93
$2s^2(^1S)3s$	^2S	1/2	116537.65	MG93
$2s^2(^1S)3p$	$^2P^o$	1/2	131724.37	MG93
		3/2	131735.52	MG93
$2p^3$	$^4S^o$	3/2	142027.1	MG93
$2s^2(^1S)3d$	^2D	3/2	145549.27	MG93
		5/2	145550.70	MG93
$2p^3$	$^2D^o$	5/2	150461.58	MG93
		3/2	150466.69	MG93
$2s^2(^1S)4s$	^2S	1/2	157234.07	MG93
$2s^2(^1S)4p$	$^2P^o$	1/2	162517.89	MG93
		3/2	162524.57	MG93
$2s2p(^3P^o)3s$	$^4P^o$	1/2	166967.13	MG93
		3/2	166990.73	MG93
		5/2	167035.71	MG93

Energy Levels of Singly-ionized Carbon (C II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^2(^1S)4d$	^2D	3/2	168123.74	MG93
		5/2	168124.45	MG93
$2p^3$	$^2P^o$	1/2	168729.53	MG93
		3/2	168748.30	MG93
$2s^2(^1S)4f$	$^2F^o$	5/2,7/2	168978.34	MG93
C III ($^1S_0$)		*Limit*	**196664.7**	MG93

Cerium (Ce)
Atomic number = 58
Atomic weight = 140.115

Isotope	Mass	Abundance	Spin	Mag moment
^{136}Ce	135.907140	0.19%	0	
^{138}Ce	137.905985	0.25%	0	
^{140}Ce	139.905433	88.48%	0	
^{142}Ce	141.909241	11.08%	0	

Ce I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f5d6s^2\ ^1G^o_4$
Ionization energy: 44 672 cm^{-1} (5.5387 eV)

Ce II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f5d^2\ ^4H^o_{7/2}$
Ionization energy: 87 500 cm^{-1} (10.85 eV)

Strong Lines of Cerium (Ce)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
200	3063.008	Ce II	C73
200	3194.821	Ce II	C73
300	3201.712	Ce II	C73
200	3218.944	Ce II	C73
250	3221.171	Ce II	C73
200	3227.114	Ce II	C73
200	3234.161	Ce II	C73
300	3272.253	Ce II	C73
200	3485.046	Ce II	C73
200	3539.076	Ce II	C73
300	3560.798	Ce II	C73
300	3577.450	Ce II	C73
200	3653.664	Ce II	C73
500 P	3655.843	Ce II	C73
250	3660.639	Ce II	C73
250	3667.976	Ce II	C73
300	3709.285	Ce II	C73
300	3709.926	Ce II	C73
400	3716.364	Ce II	C73
250	3728.414	Ce II	C73
200	3764.115	Ce II	C73
200	3781.616	Ce II	C73
250	3786.628	Ce II	C73
700 P	3801.520	Ce II	C73
250	3803.086	Ce II	C73
300	3808.110	Ce II	C73
300	3838.535	Ce II	C73
250	3848.595	Ce II	C73
250	3853.148	Ce II	C73
300	3854.187	Ce II	C73
300	3854.320	Ce II	C73
200	3855.301	Ce II	C73
200	3876.971	Ce II	C73
300	3878.358	Ce II	C73
400	3882.447	Ce II	C73
300	3889.984	Ce II	C73
200	3895.113	Ce II	C73
200	3907.286	Ce II	C73

Strong Lines of Cerium (Ce)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
300	3912.426	Ce II	C73
200	3918.269	Ce II	C73
200	3931.082	Ce II	C73
200	3940.326	Ce II	C73
600 P	3942.157	Ce II	C73
800 P	3942.746	Ce II	C73
200	3943.881	Ce II	C73
900 P	3952.545	Ce II	C73
300	3956.275	Ce II	C73
200	3960.913	Ce II	C73
200	3967.044	Ce II	C73
200	3984.671	Ce II	C73
200	3992.381	Ce II	C73
250	3993.818	Ce II	C73
800 P	3999.237	Ce II	C73
250	4003.769	Ce II	C73
250	4005.232	Ce I	M75c
800 P	4012.387	Ce II	C73
250	4014.897	Ce II	C73
250	4024.487	Ce II	C73
250	4028.404	Ce II	C73
250	4031.332	Ce II	C73
600 P	4040.752	Ce II	C73
250	4042.578	Ce II	C73
200	4046.337	Ce II	C73
200	4053.500	Ce II	C73
300	4055.836	Ce I	M75c
300	4071.773	Ce II	C73
500	4073.475	Ce II	C73
400	4075.698	Ce II	C73
400	4075.844	Ce II	C73
200	4081.219	Ce II	C73
250	4083.219	Ce II	C73
200	4118.141	Ce II	C73
300	4123.873	Ce II	C73
300	4127.371	Ce II	C73
800 P	4133.802	Ce II	C73
600 P	4137.649	Ce II	C73
200	4142.397	Ce II	C73
200	4144.996	Ce II	C73
300	4149.895	Ce II	C73
400	4151.969	Ce II	C73
400	4165.600	Ce II	C73
200	4166.881	Ce II	C73
1000 P	4186.596	Ce II	C73
200	4196.330	Ce II	C73
250	4198.715	Ce II	C73
250*	4202.926	Ce II	C73
250*	4202.956	Ce II	C73
400	4222.598	Ce II	C73
200	4227.747	Ce II	C73
300	4239.909	Ce II	C73
300	4248.668	Ce II	C73
200	4255.779	Ce II	C73
200	4270.186	Ce II	C73
600 P	4289.935	Ce II	C73
400	4296.680	Ce II	C73
200	4300.327	Ce II	C73
200	4306.722	Ce II	C73

Strong Lines of Cerium (Ce)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
300	4337.773	Ce II	C73
200	4349.788	Ce II	C73
250	4364.650	Ce II	C73
250	4382.164	Ce II	C73
200	4386.826	Ce II	C73
500	4391.660	Ce II	C73
300	4418.778	Ce II	C73
200	4429.265	Ce II	C73
200	4449.322	Ce II	C73
200	4450.727	Ce II	C73
700 P	4460.204	Ce II	C73
400	4471.237	Ce II	C73
200	4479.358	Ce II	C73
200	4483.891	Ce II	C73
250	4486.905	Ce II	C73
250	4506.413	Ce I	M75c
200	4523.077	Ce II	C73
250	4527.349	Ce II	C73
250	4528.472	Ce II	C73
250	4539.745	Ce II	C73
200	4560.283	Ce II	C73
600 P	4562.358	Ce II	C73
300	4572.281	Ce II	C73
250	4593.924	Ce II	C73
500	4628.157	Ce II	C73
500 P	4632.320	Ce I	BWCC91
300	4650.509	Ce I	M75c
300	4822.547	Ce I	M75c
400	4847.774	Ce I	M75c
300	4943.44	Ce I	MCS75
400	4994.627	Ce I	BWCC91
600 P	5009.098	Ce I	M75c
300	5040.846	Ce I	M75c
300	5071.775	Ce I	M75c
400	5112.703	Ce I	M75c
500	5129.569	Ce I	M75c
250	5149.993	Ce I	BWCC91
800 P	5159.686	Ce I	M75c
800 P	5161.484	Ce I	M75c
500	5174.554	Ce I	M75c
110	5187.459	Ce II	C73
500	5211.877	Ce I	BWCC91
700 P	5223.461	Ce I	M75c
500	5229.745	Ce I	M75c
700 P	5245.916	Ce I	M75c
100	5274.230	Ce II	C73
400	5296.563	Ce I	M75c
400	5328.082	Ce I	M75c
400	5397.638	Ce I	M75c
300	5420.380	Ce I	BWCC91
400	5449.239	Ce I	BWCC91
70	5512.049	Ce II	C73
300	5556.252	Ce I	BWCC91
500	5564.966	Ce I	M75c
400	5565.965	Ce I	M75c
250	5595.875	Ce I	BWCC91
600 P	5601.280	Ce I	M75c
500	5655.140	Ce I	M75c
600 P	5669.959	Ce I	M75c

Strong Lines of Cerium (Ce)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
300	5677.752	Ce I	BWCC91
300	5692.943	Ce I	BWCC91
800 P	5696.993	Ce I	M75c
1000 P	5699.226	Ce I	M75c
600 P	5719.031	Ce I	M75c
400	5773.122	Ce I	BWCC91
300	5788.143	Ce I	BWCC91
300	5812.919	Ce I	M75c
250	5862.491	Ce I	BWCC91
150	5926.301	Ce I	BWCC91
200	5928.342	Ce I	BWCC91
250	5937.720	Ce I	BWCC91
600 P	5940.857	Ce I	M75c
150	6001.901	Ce I	M75c
150	6005.861	Ce I	BWCC91
150	6006.817	Ce I	BWCC91
200	6013.419	Ce I	BWCC91
300	6024.193	Ce I	BWCC91
30	6043.378	Ce II	C73
150	6047.397	Ce I	BWCC91
90	6057.995	Ce I	M75c
90	6069.484	Ce I	M75c
90	6072.006	Ce I	BWCC91
90	6093.192	Ce I	M75c
120	6123.673	Ce I	BWCC91
90	6186.173	Ce I	BWCC91
90	6208.985	Ce I	BWCC91
90	6228.936	Ce I	M75c
13	6272.024	Ce II	C73
90	6295.574	Ce I	BWCC91
90	6310.013	Ce I	BWCC91
90	6430.067	Ce I	M75c
90	6458.031	Ce I	BWCC91
80	6555.645	Ce I	BWCC91
90	6704.272	Ce I	BWCC91
80	6924.813	Ce I	BWCC91
80	6986.015	Ce I	BWCC91
10	7061.75	Ce II	C73
10	7086.35	Ce II	C73
90	7252.710	Ce I	BWCC91
90	7397.764	Ce I	BWCC91
9	8025.57	Ce II	C73
60	8120.367	Ce I	BWCC91
50	8495.829	Ce I	BWCC91

Persistent Lines of Neutral Cerium (Ce I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	4632.320		$4f5d6s^2$	$^1G^o$	4	0.000	BWCC91	
			$4f5d(^3H^o)6s6p(^3P^o)$		5	21581.408		
600	5009.098		$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^5I^o$	4	3196.607	M75c	
					3	23154.693		
800	5159.686		$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^5I^o$	7	5315.803	M75c	
					6	24691.432		
800	5161.484		$4f^26s^2$	^3H	6	7780.202	M75c	
			$4f^2(^3H_6)6s6p(^1P^o_1)$	$(6,1)^o$?	7	27149.080?		
700	5223.461		$4f^26s^2$	^3H	4	4762.718	M75c	
			$4f^2(^3H_4)6s6p(^1P^o_1)$	$(4,1)^o$	4	23901.786		
700	5245.916		$4f^26s^2$	^3H	4	4762.718	M75c	
			$4f^2(^3H_4)6s6p(^1P^o_1)$	$(4,1)^o$	5	23819.871		
600	5601.280		$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^5I^o$	8	6809.128	M75c	
			$4f(^2F^o)5d^2(^3F)(^4I^o)6p$	^5I	8	24657.245		
600	5669.959		$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	5	3210.583	M75c	
			$4f(^2F^o)5d^2(^3F)(^4H^o)6p$	^5I	6	20842.504		
800	5696.993		$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^5I^o$	7	5315.803	M75c	
			$4f(^2F^o)5d^2(^3F)(^4I^o)6p$	^5K	8	22864.055		
1000	5699.226		$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^5I^o$	8	6809.128	M75c	
			$4f(^2F^o)5d^2(^3F)(^4I^o)6p$	^5K	9	24350.503		
600	5719.031		$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^5H^o$	7	5802.108	M75c	
			$4f(^2F^o)5d^2(^3F)(^4H^o)6p$	^5I	8	23282.722		
600	5940.857		$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^5I^o$	5	3764.008	M75c	
			$4f(^2F^o)5d^2(^3F)(^4I^o)6p$	^5K	6	20591.937		

Energy Levels of Neutral Cerium (Ce I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f5d6s^2$	$^1G^o$	4	0.000	MZH78
$4f5d6s^2$	$^3F^o$	2	228.849	MZH78
		3	1663.120	MZH78
		4	3100.151	MZH78
$4f5d6s^2$	$^3H^o$	4	1279.424	MZH78
		5	2208.657	MZH78
		6	3976.104	MZH78
$4f5d6s^2$	$^3G^o$	3	1388.941	MZH78
		5	4199.367	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^5H^o$	3	2369.068	MZH78
		4	2437.629	MZH78
		6	4746.627	MZH78
		7	5802.108	MZH78
$4f5d6s^2$	$^1D^o$	2	2378.827	MZH78

Energy Levels of Neutral Cerium (Ce I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^5I^o$	4	3196.607	MZH78
		5	3764.008	MZH78
		6	4455.756	MZH78
		7	5315.803	MZH78
		8	6809.128	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	5	3210.583	MZH78
$4f5d6s^2$	^{o}	4	3312.240	MZH78
$4f5d6s^2$	$^3D^o$	1	3710.513	MZH78
		2	4766.323	MZH78
		3	5006.719	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	0	3974.503	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	1	4020.954	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^3G^o$	3	4160.283	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	4	4173.494	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	5	4417.618	MZH78
$4f^26s^2$	^3H	4	4762.718	MZH78
		5	6238.934	MZH78
		6	7780.202	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^3S^o$	1	5097.777	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	2	5210.906	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^5G^o$	2	5409.236	MZH78
		3	6234.792	MZH78
		4	6856.559	MZH78
		5	7467.160	MZH78
		6	8055.526	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	3	5519.751	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	0	5571.156	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	4	5572.074	MZH78
$4f5d6s^2$	^{o}	1	5637.233	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^5F^o$	1	5674.829	MZH78
		2	5904.006	MZH78
		3	6337.061	MZH78
		4	7174.156	MZH78
		5	7933.558	MZH78
$4f5d6s^2$	^{o}	2	6303.984	MZH78
$4f(^2F^o)5d^2(^3F)6s(^2F)$	^{o}	4	6475.540	MZH78
$4f5d6s^2$	^{o}	3	6621.892	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	5	6663.226	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	2	6836.628	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	3	7169.751	MZH78

Energy Levels of Neutral Cerium (Ce I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f(^2F^o)5d^2(^3F)6s(^2F)$	^{o}	4	7348.299	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	6	7696.210	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$?	^{o}	5	7715.236	MZH78
$4f(^2F^o)5d^2(^3F)6s(^2F)$?	^{o}	5	7841.955	MZH78
$4f(^2F^o)5d^2(^1D)6s(^2D)$	^{o}	1	7853.119	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	^{o}	4	7890.429	MZH78
$4f(^2F^o)5d^2(^3P)6s(^4P)$	$^5G^o$	2	8088.912	MZH78
		3	8307.309	MZH78
		4	8762.126	MZH78
		5	9462.705	MZH78
		6	11030.470	MZH78
$4f(^2F^o)5d^2(^3F)6s(^4F)$	$^5P^o$	2	8101.187	MZH78
		3	8270.249	MZH78
		1	8430.846	MZH78
$4f^26s^2$	^3F	2	8235.605	MZH78
		3	9206.305	MZH78
		4	9379.148	MZH78
$4f(^2F^o)5d^2(^3F)(^4I^o)6p$	^5K	5	19791.740	MZH78
		6	20591.937	MZH78
		7	21654.060	MZH78
		8	22864.055	MZH78
		9	24350.503	MZH78
$4f5d(^3G^o)6s6p(^3P^o)$		5	20338.893	MZH78
$4f(^2F^o)5d^2(^3F)(^4H^o)6p$	^5I	6	20842.504	MZH78
		7	22063.473	MZH78
		8	23282.722	MZH78
$4f5d(^3H^o)6s6p(^3P^o)$		5	21581.408	MZH78
$4f(^2F^o)5d^2(^3F)(^4I^o)6p$	^5I	5	21725.348	MZH78
		6	22321.098	MZH78
		7	23452.626	MZH78
		8	24657.245	MZH78
		3	23154.693	MZH78
$4f^2(^3H_4)6s6p(^1P^o_1)$	$(4,1)^o$	5	23819.871	MZH78
		4	23901.786	MZH78
		3	—	
		6	24691.432	MZH78
$4f^2(^3H_6)6s6p(^1P^o_1)$?	$(6,1)^o$?	7	27149.080?	M75c
		5	27192.300?	MZH78
		6	27491.670	MZH78
Ce II ($^4H^o_{7/2}$)		*Limit*	**44672**	WSPC78

Persistent Lines of Singly-ionized Cerium (Ce II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3655.843	0.47	$4f(^2F^o)5d^2(^3F)$	$^4I^o$	11/2	2563.233	C73	BPQ01
			$4f5d(^3G^o)6p$	^4H	9/2	29908.904		
700	3801.520	1.7	$4f5d(^3G^o)6s$	$^4G^o$	11/2	7233.627	C73	BPQ01
			$4f5d(^3G^o)6p$	^4H	13/2	33531.388		
600	3942.157	0.43	$4f(^2F^o)5d^2(^3F)$	$^4H^o$	7/2	0.000	C73	BPQ01
			$4f5d(^3F^o)6p$	^4G	5/2	25359.686		
800	3942.746	1.4	$4f5d(^3H^o)6s$	$^4H^o$	13/2	6913.392	C73	BPQ01
			$4f5d(^3H^o)6p$	^4I	15/2	32269.252		
900	3952.545	0.38	$4f5d(^1G^o)6s$	^{o}	7/2	2641.559	C73	BPQ01
			$4f5d(^3H^o)6p$		9/2	27934.638		
800	3999.237	0.061	$4f5d(^1G^o)6s$	^{o}	9/2	2382.246	C73	BPQ01
			$4f5d(^1G^o)6p$		11/2	27379.949		
800	4012.387	0.80	$4f5d(^3H^o)6s$	$^4H^o$	9/2	4523.033	C73	BPQ01
			$4f5d(^3H^o)6p$		11/2	29438.817		
600	4040.752	0.81	$4f5d(^1G^o)6s$	^{o}	9/2	3593.882	C73	BPQ01
			$4f5d(^3H^o)6p$		9/2	28334.756		
800	4133.802	0.076	$4f^2(^3H)6s$	^4H	13/2	6967.547	C73	BPQ01
			$4f^2(^3H_6)6p_{3/2}$	$(6,3/2)^o$	11/2	31151.534		
600	4137.649	0.89	$4f^2(^3H)6s$	^4H	9/2	4165.550	C73	BPQ01
			$4f^2(^3H_4)6p_{3/2}$	$(4,3/2)^o$	11/2	28327.071		
1000	4186.596	1.3	$4f^2(^3H)6s$	^4H	13/2	6967.547	C73	BPQ01
			$4f^2(^3H_6)6p_{3/2}$	$(6,3/2)^o$	15/2	30846.582		
600	4289.935	0.63	$4f5d(^1G^o)6s$	^{o}	7/2	2641.559	C73	BPQ01
			$4f5d(^1G^o)6p$		7/2	25945.396		
700	4460.204	0.87	$4f^2(^3H)6s$	^4H	7/2	3854.012	C73	BPQ01
			$4f^2(^3H_4)6p_{1/2}$	$(4,1/2)^o$	7/2	26268.203		
600	4562.358	0.55	$4f^2(^3H)6s$	^4H	7/2	3854.012	C73	BPQ01
			$4f^2(^3H_4)6p_{1/2}$	$(4,1/2)^o$	9/2	25766.355		

Energy Levels of Singly-ionized Cerium (Ce II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f(^2F^o)5d^2(^3F)$	$^4H^o$	7/2	0.000	C73
		9/2	2581.257	C73
		11/2	2879.695	C73
		13/2	4203.934	C73
$4f(^2F^o)5d^2(^3F)$	^{o}	9/2	987.611	C73
$4f(^2F^o)5d^2(^3F)$	$^4I^o$	9/2	1410.304	C73
		11/2	2563.233	C73
		13/2	3793.634	C73
		15/2	5455.845	C73
$4f(^2F^o)5d^2(^3F)$	^{o}	7/2	1873.934	C73
$4f(^2F^o)5d^2(^3F)$	^{o}	1/2	2140.492	C73
$4f5d(^1G^o)6s$	^{o}	9/2	2382.246	C73
$4f5d(^3F^o)6s$	$^4F^o$	3/2	2595.644	C73
		5/2	3363.427	C73
		7/2	4459.872	C73
		9/2	5675.763	C73
$4f5d(^3F^o)6s$	^{o}	5/2	2634.666	C73
$4f5d(^1G^o)6s$	^{o}	7/2	2641.559	C73
$4f(^2F^o)5d^2(^3F)$	$^2S^o$	1/2	3508.470	C73
$4f5d(^1G^o)6s$	^{o}	9/2	3593.882	C73
$4f(^2F^o)5d^2(^3F)$	^{o}	7/2	3703.594	C73
$4f(^2F^o)5d^2(^3F)$	$^4D^o$	3/2	3745.475	C73
$4f^2(^3H)6s$	^4H	7/2	3854.012	C73
		9/2	4165.550	C73
		11/2	5513.709	C73
		13/2	6967.547	C73
$4f5d(^3H^o)6s$	$^4H^o$	7/2	3995.460	C73
		9/2	4523.033	C73
		11/2	5651.357	C73
		13/2	6913.392	C73
$4f(^2F^o)5d^2(^3F)$	$^4F^\circ$	3/2	4201.893	C73
		5/2	5010.870	C73
		7/2	5964.896	C73
		9/2	7059.072	C73
$4f5d(^3G^o)6s$	^{o}	7/2	4266.397	C73
$4f5d(^3G^o)6s$	^{o}	5/2	4322.708	C73
$4f5d(^3G^o)6s$	$^4G^o$	5/2	4511.257	C73
$4f(^2F^o)5d^2(^3F)$	^{o}	5/2	4737.373	C73
$4f(^2F^o)5d^2(^3F)$	^{o}	3/2	4844.644	C73
$4f5d(^3H^o)6s$	^{o}	11/2	4910.963	C73
$4f5d(^1D^o)6s$	^{o}	5/2	5118.806	C73
$4f(^2F^o)5d^2(^1D)$	^{o}	1/2	5283.029	C73

Energy Levels of Singly-ionized Cerium (Ce II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f(^2F^o)5d^2(^3F)$	$^4G^o$	7/2	5437.422	C73
		9/2	6389.942	C73
		11/2	7522.622	C73
$4f^2(^3H)6s$	^2H	9/2	5616.739	C73
		11/2	7341.007	C73
$4f(^2F^o)5d^2(^3F)$	^{o}	7/2	5716.216	C73
$4f5d(^3G^o)6s$	^{o}	9/2	5819.113	C73
$4f(^2F^o)5d^2(^3F)$	^{o}	3/2	5924.204	C73
$4f(^2F^o)5d^2(^3F)$	^{o}	7/2	5942.798	C73
$4f(^2F^o)5d^2(^1G)$	^{o}	11/2	5969.007	C73
$4f5d(^3F^o)6s$	^{o}	5/2	6517.619	C73
$4f5d(^3D^o)6s$	^{o}	3/2	6521.332	C73
$4f5d(^3F^o)6s$	^{o}	5/2	6549.908	C73
$4f(^2F^o)5d^2(^3F)$	^{o}	9/2	6638.258	C73
$4f^2(^3H)5d$	^2H	9/2	7011.804	C73
		11/2	8278.054	C73
$4f5d(^3D^o)6s$	$^4D^o$	1/2	7061.838	C73
		3/2	7818.147	C73
		5/2	8175.863	C73
		7/2	8402.668	C73
$4f^2(^3H)5d$	^4K	11/2	7092.265	C73
		13/2	8423.672	C73
		15/2	9771.956	C73
		17/2	11165.796	C73
$4f(^2F^o)5d^2(^3P)$	$^4G^o$	5/2	7202.529	C73
		7/2	7878.328	C73
		9/2	8804.224	C73
		11/2	10035.711	C73
$4f5d(^3G^o)6s$	$^4G^o$	11/2	7233.627	C73
$4f5d(^3F^o)6s$	^{o}	7/2	7259.075	C73
$4f(^2F^o)5d^2(^3F)$	$^4P^o$	3/2	7278.922	C73
		1/2	7522.458	C73
		5/2	7746.185	C73
$4f(^2F^o)5d^2(^3F)$	$^2I^o$	13/2	7293.938	C73
$4f^2(^3F)6s$	^4F	3/2	7454.951	C73
		5/2	7722.285	C73
		7/2	8531.678	C73
		9/2	8774.064	C73
$4f(^2F^o)5d^2(^1G)$	^{o}	9/2	7713.089	C73

Energy Levels of Singly-ionized Cerium (Ce II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^2(^3H)5d$	^4I	9/2	8131.217	C73
		11/2	8896.729	C73
		13/2	10058.226	C73
		15/2	11309.972	C73
$4f(^2F^o)5d^2(^3F)$	$^4S^o$	3/2	8169.698	C73
$4f(^2F^o)5d^2(^3P)$	$^2D^o$	5/2	8280.946	C73
		3/2	8702.444	C73
$4f^2(^3H)5d$	^4G	5/2	8448.641	C73
		7/2	9316.912	C73
		9/2	10314.162	C73
		11/2	11458.353	C73
$4f^2(^3F)6s$	^2F	5/2	8789.380	C73
		7/2	9053.629	C73
$4f5d(^3H^o)6s$	^{o}	11/2	8927.514	C73
$4f(^2F^o)5d^2(^1G)$	$^2G^o$	7/2	9198.326	C73
$4f(^2F^o)5d^2(^3P)$	^{o}	1/2	9269.826	C73
$4f5d(^3P^o)6s$	$^4P^o$	1/2	9491.493	C73
		3/2	9634.186	C73
		5/2	10641.442	C73
$4f(^2F^o)5d^2(^1G)$	^{o}	9/2	9723.335	C73
$4f^2(^3H)5d$	^4H	7/2	9725.733	C73
		9/2	10703.305	C73
		11/2	11759.467	C73
		13/2	13027.758	C73
$4f(^2F^o)6s^2$	$^2F^o$	5/2	9778.986	C73
$4f5d(^3F^o)6p$	^4G	5/2	25359.686	C73
		7/2	27187.047	C73
		9/2	29166.597	C73
		11/2	31089.731	C73
$4f^2(^3H_4)6p_{1/2}$	$(4,1/2)^o$	9/2	25766.355	C73
		7/2	26268.203	C73
$4f5d(^1G^o)6p$		7/2	25945.396	C73
$4f5d(^1G^o)6p$		11/2	27379.949	C73
$4f^2(^3H_4)6p_{3/2}$	$(4,3/2)^o$	9/2	27432.782	C73
		11/2	28327.071	C73
		7/2	28349.582	C73
		5/2	28396.150	C73
$4f5d(^3H^o)6p$		9/2	27934.638	C73
$4f5d(^3G^o)6p$	^4H	7/2	28297.473	C73
		9/2	29908.904	C73
		11/2	31738.484	C73
		13/2	33531.388	C73
$4f5d(^3H^o)6p$		9/2	28334.756	C73

Energy Levels of Singly-ionized Cerium (Ce II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f5d(^3H^o)6p$		11/2	29438.817	C73
$4f^2(^3H_6)6p_{3/2}$	$(6,3/2)^o$	15/2	30846.582	C73
		11/2	31151.534	C73
		13/2	31340.393	C73
		9/2	32372.621	C73
$4f5d(^3H^o)6p$	^4I	15/2	32269.252	C73
Ce III ($^3H_4$)		*Limit*	**87500**	SR65

Cesium (Cs)

Atomic number = 55
Atomic weight = 132.9054

Isotope	Mass	Abundance	Spin	Magmoment
^{133}Cs	132.905429	100%	7/2	+2.579

Cs I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6 6s\ ^2S_{1/2}$
Ionization energy: 31 406.467 69 cm^{-1} (3.893 905 eV)

Cs II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6\ ^1S_0$
Ionization energy: 186 777.4 cm^{-1} (23.157 44 eV)

Strong Lines of Cesium (Cs)

Intensity	Wavelength (Å)	Spectrum	Ref.
	Vacuum		
20	639.36	Cs II	RE75
150	718.14	Cs II	RE75
150 P	808.76	Cs II	RE75
150 P	813.84	Cs II	RE75
400 P	901.27	Cs II	RE75
400 P	926.66	Cs II	RE75
1	1840.50	Cs II	S81
1	1859.16	Cs II	S81
1	1883.93	Cs II	S81
1	1935.19	Cs II	S81
	Air		
15	2267.65	Cs II	S81
8	2273.84	Cs II	S81
14	2332.46	Cs II	S81
10	2392.86	Cs II	S81
15	2931.08	Cs II	S81
11 w	3785.44	Cs II	S81
25	3805.12	Cs II	S81
30 c	3876.15	Cs I	S81
10 c	3888.61	Cs I	S81
30	3896.99	Cs II	S81
40	3959.51	Cs II	S81
25	3965.20	Cs II	S81
20	3974.25	Cs II	S81
80	4039.85	Cs II	S81
20	4068.78	Cs II	S81
20	4213.14	Cs II	S81
20	4232.20	Cs II	S81
10	4234.41	Cs II	S81
140	4264.70	Cs II	S81
200 w	4277.13	Cs II	S81
50	4288.38	Cs II	S81
80	4363.30	Cs II	S81
40	4373.04	Cs II	S81
40 w	4405.26	Cs II	S81
120	4501.55	Cs II	S81
200 P	4526.74	Cs II	S81
40	4538.97	Cs II	S81
15 P,c	4555.28	Cs I	K62b
8 P,c	4593.17	Cs I	K62b
1000 P	4603.79	Cs II	S81

Strong Lines of Cesium (Cs)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
40 c	4616.17	Cs II	S81
70	4763.64	Cs II	S81
250	4830.19	Cs II	S81
200	4870.04	Cs II	S81
50 c	4880.05	Cs II	S81
400	4952.85	Cs II	S81
80	4972.60	Cs II	S81
250	5043.80	Cs II	S81
70 c	5209.58	Cs II	S81
800 P	5227.04	Cs II	S81
300	5249.38	Cs II	S81
110	5274.05	Cs II	S81
100 c	5349.13	Cs II	S81
200	5370.99	Cs II	S81
1 c	5465.94	Cs I	K62b
1	5502.88	Cs I	K62b
400	5563.02	Cs II	S81
2	5635.21	Cs I	K62b
3 c	5664.02	Cs I	K62b
50	5814.16	Cs II	S81
250	5831.14	Cs II	S81
1 c	5838.83	Cs I	K62b
5	5845.14	Cs I	K62b
500	5925.63	Cs II	S81
10 c	6010.49	Cs I	K62b
1	6034.09	Cs I	K62b
100	6128.61	Cs II	S81
15	6213.10	Cs I	K62b
3	6217.60	Cs I	K62b
5 c	6354.55	Cs I	K62b
80	6495.53	Cs II	S81
100 w	6536.44	Cs II	S81
8	6586.51	Cs I	K62b
2	6628.66	Cs I	EW70
90	6646.57	Cs II	S81
50 c	6723.28	Cs I	S81
100	6724.47	Cs II	S81
3	6824.65	Cs I	EW70
5	6870.45	Cs I	EW70
400	6955.50	Cs II	S81
80	6973.30	Cs I	K62b
150	6979.67	Cs II	S81
15	6983.49	Cs I	K62b
130 w	7149.54	Cs II	S81
13	7228.53	Cs I	EW70
2	7279.90	Cs I	EW70
20	7279.96	Cs I	EW70
40 c	7608.90	Cs I	K62b
25	7852.52	Cs II	S81
50	7943.88	Cs I	K62b
200	7997.44	Cs II	S81
20	8012.98	Cs II	S81
60	8015.73	Cs I	EW70
80 c	8047.13	Cs II	S81
	8078.94	Cs I	EW70
70	8079.04	Cs I	EW70
1000 P,c	8521.13	Cs I	EJN64
15	8608.31	Cs II	S81
250 P,c	8761.41	Cs I	EJN64

Strong Lines of Cesium (Cs)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
1000 P,c	8943.47	Cs I	EJN64
300 P	9172.32	Cs I	EJN64
90	9208.53	Cs I	EJN64
30 c	9220.75	Cs II	S81
14	9994.79	Cs II	S81
300	10024.36	Cs I	EW70
80	10123.41	Cs I	EW70
400	10123.60	Cs I	EW70
30 c	10176.02	Cs II	S81
25	10379.66	Cs II	S81
13	10480.93	Cs II	S81
50	10504.51	Cs II	S81
20 w	10807.88	Cs II	S81
11	12604.29	Cs II	S81
20 c	12735.52	Cs II	S81
50	13424.31	Cs I	S81
600 P,c	13588.29	Cs I	S81
140	13602.56	Cs I	S81
40 c	13692.91	Cs II	S81
90	13758.81	Cs I	S81
14 c	13868.82	Cs II	S81
900 P,c	14694.91	Cs I	S81
20 c	15293.80	Cs II	S81
15 c	15356.61	Cs II	S81
11 c	16426.14	Cs II	S81
13	16535.63	Cs I	S81
25	17012.32	Cs I	S81
12	20138.47	Cs I	S81
14	22811.86	Cs I	S81
20	23037.98	Cs I	S81
60	23344.47	Cs I	S81
70	24251.21	Cs I	S81
14	24374.96	Cs I	S81
9	25220.37	Cs II	S81
15 d	25763.51	Cs I	SAV81
8	25764.73	Cs I	SAV81
11 c	29310.06	Cs I	S81
50 P	30103.27	Cs I	S81
10 c	30953.06	Cs I	S81
20 P	34900.13	Cs I	S81
3	36131.00	Cs I	S81

Persistent Lines of Neutral Cesium (Cs I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
15	4555.28	0.0188	$6s$	^2S	1/2	0.0000	K62b	FW96
			$7p$	$^2P^o$	3/2	21946.396		
8	4593.17	0.0080	$6s$	^2S	1/2	0.0000	K62b	FW96
			$7p$	$^2P^o$	1/2	21765.35		
1000	8521.13	0.3276	$6s$	^2S	1/2	0.0000	EJN64	FW96
			$6p$	$^2P^o$	3/2	11732.3079		
250	8761.41		$6p$	$^2P^o$	1/2	11178.2686	EJN64	
			$6d$	^2D	3/2	22588.8210		
1000	8943.47	0.287	$6s$	^2S	1/2	0.0000	EJN64	FW96
			$6p$	$^2P^o$	1/2	11178.2686		
300	9172.32		$6p$	$^2P^o$	3/2	11732.3079	EJN64	
			$6d$	^2D	5/2	22631.6863		
600	13588.29		$6p$	$^2P^o$	1/2	11178.2686	S81	
			$7s$	^2S	1/2	18535.529		
900	14694.91		$6p$	$^2P^o$	3/2	11732.3079	S81	
			$7s$	^2S	1/2	18535.529		
50	30103.27		$6p$	$^2P^o$	1/2	11178.2686	S81	
			$5d$	^2D	3/2	14499.2584		
20	34900.13		$6p$	$^2P^o$	3/2	11732.3079	S81	
			$5d$	^2D	5/2	14596.8423		

Energy Levels of Neutral Cesium (Cs I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5p^6(^1S)6s$	^2S	1/2	0.0000	WS87
$5p^6(^1S)6p$	$^2P^o$	1/2	11178.2686	WS87
		3/2	11732.3079	EW70
$5p^6(^1S)7s$	^2S	1/2	18535.529	WS87
$5p^6(^1S)7p$	$^2P^o$	1/2	21765.35	WS87
		3/2	21946.396	K62b
$5p^6(^1S)5d$	^2D	3/2	14499.2584	WS87
		5/2	14596.8423	WS87
$5p^6(^1S)6d$	^2D	3/2	22588.8210	EJN64
		5/2	22631.6863	EJN64
Cs II ($^1S_0$)		*Limit*	**31406.46766**	WS87

Persistent Lines of Singly-ionized Cesium (Cs II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
150	808.76		$5p^6$	^1S	0	0.0	RE75	
			$5p^5(^2P^o_{3/2})5d$	$^2[3/2]^o$	1	123645.5813		
150	813.84		$5p^6$	^1S	0	0.0	RE75	
			$5p^5(^2P^o_{1/2})6s$	$^2[1/2]^o$	1	122875.4487		
400	901.27		$5p^6$	^1S	0	0.0	RE75	
			$5p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	1	110954.3607		
400	926.66		$5p^6$	^1S	0	0.0	RE75	
			$5p^5(^2P^o_{3/2})5d$	$^2[1/2]^o$	1	107914.1587		
200	4526.74		$5p^5(^2P^o_{3/2})5d$	$^2[1/2]^o$	1	107914.1587	S81	
			$5p^5(^2P^o_{3/2})6p$	$^2[3/2]$	1	129998.9106		
1000	4603.79		$5p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	2	107401.5602	S81	
			$5p^5(^2P^o_{3/2})6p$	$^2[5/2]$	3	129116.7070		
800	5227.04		$5p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	2	107401.5602	S81	
			$5p^5(^2P^o_{3/2})6p$	$^2[1/2]$	1	126527.5324		

Energy Levels of Singly-ionized Cesium (Cs II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5p^6$	^1S	0	0.0	S81
$5p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	2	107401.5602	S81
		1	110954.3607	S81
$5p^5(^2P^o_{3/2})5d$	$^2[1/2]^o$	0	107572.0610	S81
		1	107914.1587	S81
$5p^5(^2P^o_{3/2})5d$	$^2[3/2]^o$	2	112804.3010	S81
		1	123645.5813	S81
$5p^5(^2P^o_{1/2})6s$	$^2[1/2]^o$	0	122374.8156	S81
		1	122875.4487	S81
$5p^5(^2P^o_{3/2})6p$	$^2[1/2]$	1	126527.5324	S81
		0	133162.6932	S81
$5p^5(^2P^o_{3/2})6p$	$^2[5/2]$	2	128098.9117	S81
		3	129116.7070	S81
$5p^5(^2P^o_{3/2})6p$	$^2[3/2]$	1	129998.9106	S81
Cs III ($^2P^o_{3/2}$)		*Limit*	**186777.4**	S81

Chlorine (Cl)
Atomic number = 17
Atomic weight = 35.4527

Isotope	Mass	Abundance	Spin	Mag moment
^{35}Cl	34.968852	75.77%	3/2	+0.82187
^{37}Cl	36.965903	24.23%	3/2	+0.68412

Cl I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^5\ {}^2P^o_{3/2}$
Ionization energy: 104 591.0 cm^{-1} (12.967 63 eV)

Cl II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^4\ {}^3P_2$
Ionization energy: 192 070 cm^{-1} (23.8136 eV)

Strong Lines of Chlorine (Cl)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
600	787.580	Cl II	RK74
600	788.740	Cl II	RK74
600	793.342	Cl II	RK74
700 P	839.297	Cl II	RK74
900 P	839.599	Cl II	RK74
800 P	841.414	Cl II	RK74
600 P	851.691	Cl II	RK74
700 P	1063.831	Cl II	RK74
300 P	1067.945	Cl II	RK74
1000 P	1071.036	Cl II	RK74
700 P	1071.767	Cl II	RK74
600 P	1075.230	Cl II	RK74
600 P	1079.080	Cl II	RK74
150	1179.293	Cl I	RK69
300 P	1335.726	Cl I	RK69
1000 P	1347.240	Cl I	RK69
500 P	1351.657	Cl I	RK69
500 P	1363.447	Cl I	RK69
120	1373.116	Cl I	RK69
500 P	1379.528	Cl I	RK69
500 P	1389.693	Cl I	RK69
500 P	1389.957	Cl I	RK69
500 P	1396.527	Cl I	RK69
	Air		
25	3833.348	Cl II	RK74
15	3845.367	Cl II	RK74
20	3845.651	Cl II	RK74
60 P	3850.991	Cl II	RK74
40 P	3851.373	Cl II	RK74
140 P	3860.83	Cl II	RK74
25	3860.985	Cl II	RK74
60 P,h	4132.498	Cl II	RK74
30	4372.93	Cl II	RK74
25	4768.649	Cl II	RK74
	4781.318	Cl II	RK74
600 P	4794.55	Cl II	RK74
150 P	4810.06	Cl II	RK74
90	4819.471	Cl II	RK74
400 P	4896.77	Cl II	RK74

Strong Lines of Chlorine (Cl)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
250 P	4904.776	Cl II	RK74
140 P	4917.731	Cl II	RK74
60	4995.477	Cl II	RK74
140 P	5078.264	Cl II	RK74
300 P	5217.94	Cl II	RK74
130 P	5221.355	Cl II	RK74
80 P	5392.119	Cl II	RK74
600 P	5423.23	Cl II	RK74
60	5423.507	Cl II	RK74
110 P	5443.37	Cl II	RK74
60	5444.205	Cl II	RK74
30	5457.022	Cl II	RK74
40	7256.620	Cl I	RK69
25	7414.114	Cl I	RK69
60 P	7547.072	Cl I	RK69
12	7672.419	Cl I	RK69
40	7717.581	Cl I	RK69
50 P	7744.970	Cl I	RK69
11	7769.163	Cl I	RK69
11	7821.363	Cl I	RK69
8	7830.746	Cl I	RK69
15	7878.215	Cl I	RK69
12	7899.310	Cl I	RK69
9	7915.084	Cl I	RK69
15	7924.645	Cl I	RK69
10	7933.894	Cl I	RK69
8	7935.012	Cl I	RK69
14	7997.854	Cl I	RK69
11	8015.611	Cl I	RK69
8	8084.508	Cl I	RK69
11	8085.562	Cl I	RK69
15	8086.672	Cl I	RK69
12	8194.420	Cl I	RK69
11	8199.128	Cl I	RK69
11	8200.21	Cl I	RK69
90 P	8212.038	Cl I	RK69
15	8220.445	Cl I	RK69
100 P	8221.742	Cl I	RK69
90 P	8333.307	Cl I	RK69
500 P	8375.94	Cl I	RK69
80 P	8428.254	Cl I	RK69
11	8467.341	Cl I	RK69
11	8550.438	Cl I	RK69
100 P	8575.24	Cl I	RK69
400 P	8585.97	Cl I	RK69
20	8686.26	Cl I	RK69
11	8912.921	Cl I	RK69
15	8948.063	Cl I	RK69
10	9038.982	Cl I	RK69
12	9045.433	Cl I	RK69
10	9073.166	Cl I	RK69
40	9121.146	Cl I	RK69
15	9191.731	Cl I	RK69
20	9288.856	Cl I	RK69
20	9452.098	Cl I	RK69
	9592.222	Cl I	RK69
8	15730.1	Cl I	RK69
14	15869.7	Cl I	RK69

Persistent Lines of Neutral Chlorine (Cl I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	1335.726	2.24	$3s^23p^5$	$^2P^o$	3/2	0.00	RK69	M03
			$3s^23p^4(^3P)4s$	^2P	1/2	74865.667		
1000	1347.240	5.62	$3s^23p^5$	$^2P^o$	3/2	0.00	RK69	M03
			$3s^23p^4(^3P)4s$	^2P	3/2	74225.846		
500	1351.657	4.24	$3s^23p^5$	$^2P^o$	1/2	882.35	RK69	M03
			$3s^23p^4(^3P)4s$	^2P	1/2	74865.667		
500	1363.447	0.99	$3s^23p^5$	$^2P^o$	1/2	882.35	RK69	M03
			$3s^23p^4(^3P)4s$	^2P	3/2	74225.846		
500	1379.528	0.096	$3s^23p^5$	$^2P^o$	3/2	0.00	RK69	M03
			$3s^23p^4(^3P)4s$	^4P	3/2	72488.568		
500	1389.693	0.0030	$3s^23p^5$	$^2P^o$	3/2	0.00	RK69	M03
			$3s^23p^4(^3P)4s$	^4P	5/2	71958.363		
500	1389.957	0.023	$3s^23p^5$	$^2P^o$	1/2	882.35	RK69	M03
			$3s^23p^4(^3P)4s$	^4P	1/2	72827.038		
500	1396.527	0.011	$3s^23p^5$	$^2P^o$	1/2	882.35	RK69	M03
			$3s^23p^4(^3P)4s$	^4P	3/2	72488.568		
60	7547.072	0.12	$3s^23p^4(^3P)4s$	^4P	3/2	72488.568	RK69	FW96
			$3s^23p^4(^3P)4p$	$^4S^o$	3/2	85735.091		
50	7744.970	0.063	$3s^23p^4(^3P)4s$	^4P	1/2	72827.038	RK69	FW96
			$3s^23p^4(^3P)4p$	$^4S^o$	3/2	85735.091		
90	8212.038		$3s^23p^4(^3P)4s$	^4P	5/2	71958.363	RK69	
			$3s^23p^4(^3P)4p$	$^4D^o$	5/2	84132.262		
100	8221.742		$3s^23p^4(^3P)4s$	^4P	3/2	72488.568	RK69	
			$3s^23p^4(^3P)4p$	$^2D^o$	5/2	84648.100		
90	8333.307		$3s^23p^4(^3P)4s$	^4P	3/2	72488.568	RK69	
			$3s^23p^4(^3P)4p$	$^4D^o$	3/2	84485.309		
500	8375.94		$3s^23p^4(^3P)4s$	^4P	5/2	71958.363	RK69	
			$3s^23p^4(^3P)4p$	$^4D^o$	7/2	83894.037		
80	8428.254		$3s^23p^4(^3P)4s$	^4P	1/2	72827.038	RK69	
			$3s^23p^4(^3P)4p$	$^4D^o$	1/2	84688.637		
100	8575.24		$3s^23p^4(^3P)4s$	^4P	1/2	72827.038	RK69	
			$3s^23p^4(^3P)4p$	$^4D^o$	3/2	84485.309		
400	8585.97		$3s^23p^4(^3P)4s$	^4P	3/2	72488.568	RK69	
			$3s^23p^4(^3P)4p$	$^4D^o$	5/2	84132.262		

Energy Levels of Neutral Chlorine (Cl I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^23p^5$	$^2P^o$	3/2	0.00	RK69
		1/2	882.35	UH87
$3s^23p^4(^3P)4s$	^4P	5/2	71958.363	RK69
		3/2	72488.568	RK69
		1/2	72827.038	RK69
$3s^23p^4(^3P)4s$	^2P	3/2	74225.846	RK69
		1/2	74865.667	RK69
$3s^23p^4(^3P)4p$	$^4P^o$	5/2	82918.893	RK69
		3/2	83130.900	RK69
		1/2	83364.927	RK69
$3s^23p^4(^3P)4p$	$^4D^o$	7/2	83894.037	RK69
		5/2	84132.262	RK69
		3/2	84485.309	RK69
		1/2	84688.637	RK69
$3s^23p^4(^1D)4s$	^2D	5/2	84120.263	RK69
		3/2	84121.872	RK69
$3s^23p^4(^3P)4p$	$^2D^o$	5/2	84648.100	RK69
		3/2	84988.480	RK69
$3s^23p^4(^3P)4p$	$^2P^o$	1/2	85244.330	RK69
		3/2	85442.430	RK69
$3s3p^6$	^2S	1/2	85678.94	RK69
$3s^23p^4(^3P)4p$	$^4S^o$	3/2	85735.091	RK69
Cl II ($^3P_2$)		*Limit*	**104591.0**	RK69

Persistent Lines of Singly-ionized Chlorine (Cl II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	839.297		$3s^23p^4$	^3P	1	696.00	RK74	
			$3s^23p^3(^4S^o)3d$	$^3D^o$	1	119843.31		
900	839.599		$3s^23p^4$	^3P	1	696.00	RK74	
			$3s^23p^3(^4S^o)3d$	$^3D^o$	2	119800.32		
800	841.414		$3s^23p^4$	^3P	0	996.47	RK74	
			$3s^23p^3(^4S^o)3d$	$^3D^o$	1	119843.31		
600	851.691		$3s^23p^4$	^1D	2	11653.58	RK74	
			$3s^23p^3(^2D^o)4s$	$^1D^o$	2	129066.96		
700	1063.831	0.49	$3s^23p^4$	^3P	2	0.00	RK74	M03
			$3s3p^5$	$^3P^o$	1	93999.88		
300	1067.945	1.17	$3s^23p^4$	^3P	1	696.00	RK74	M03
			$3s3p^5$	$^3P^o$	0	94333.84		
1000	1071.036	0.87	$3s^23p^4$	^3P	2	0.00	RK74	M03
			$3s3p^5$	$^3P^o$	2	93367.56		
700	1071.767	0.29	$3s^23p^4$	^3P	1	696.00	RK74	M03
			$3s3p^5$	$^3P^o$	1	93999.88		

Persistent Lines of Singly-ionized Chlorine (Cl II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	1075.230	0.38	$3s^23p^4$	^3P	0	996.47	RK74	M03
			$3s3p^5$	$^3P^o$	1	93999.88		
600	1079.080	0.28	$3s^23p^4$	^3P	1	696.00	RK74	M03
			$3s3p^5$	$^3P^o$	2	93367.56		
60	3850.991	1.8	$3s^23p^3(^4S^o)4p$	^5P	2	128663.57	RK74	FW96
			$3s^23p^3(^4S^o)4d$	$^5D^o$	3	154623.57		
40	3851.373	1.6	$3s^23p^3(^4S^o)4p$	^5P	2	128663.57	RK74	FW96
			$3s^23p^3(^4S^o)4d$	$^5D^o$	2	154620.97		
140	3860.83		$3s^23p^3(^4S^o)4p$	^5P	3	128730.82	RK74	
			$3s^23p^3(^4S^o)4d$	$^5D^o$	4	154624.66		
60	4132.498	1.6	$3s^23p^3(^2D^o)4s$	$^1D^o$	2	129066.96	RK74	FW96
			$3s^23p^3(^2D^o)4p$	^1D	2	153258.61		
600	4794.55	1.04	$3s^23p^3(^4S^o)4s$	$^5S^o$	2	107879.66	RK74	FW96
			$3s^23p^3(^4S^o)4p$	^5P	3	128730.82		
150	4810.06	0.99	$3s^23p^3(^4S^o)4s$	$^5S^o$	2	107879.66	RK74	FW96
			$3s^23p^3(^4S^o)4p$	^5P	2	128663.57		
400	4896.77		$3s^23p^3(^2D^o)4s$	$^3D^o$	3	126784.37	RK74	
			$3s^23p^3(^2D^o)4p$	^3F	4	147200.24		
250	4904.776	0.81	$3s^23p^3(^2D^o)4s$	$^3D^o$	2	126744.97	RK74	FW96
			$3s^23p^3(^2D^o)4p$	^3F	3	147127.57		
140	4917.731	0.75	$3s^23p^3(^2D^o)4s$	$^3D^o$	1	126726.70	RK74	FW96
			$3s^23p^3(^2D^o)4p$	^3F	2	147055.61		
140	5078.264	0.77	$3s^23p^3(^2D^o)4s$	$^3D^o$	3	126784.37	RK74	FW96
			$3s^23p^3(^2D^o)4p$	^3D	3	146470.64		
300	5217.94		$3s^23p^3(^4S^o)4s$	$^3S^o$	1	112609.36	RK74	
			$3s^23p^3(^4S^o)4p$	^3P	2	131768.66		
130	5221.355		$3s^23p^3(^4S^o)4s$	$^3S^o$	1	112609.36	RK74	
			$3s^23p^3(^4S^o)4p$	^3P	1	131756.12		
80	5392.119	1.0	$3s^23p^3(^2D^o)4s$	$^1D^o$	2	129066.96	RK74	FW96
			$3s^23p^3(^2D^o)4p$	^1F	3	147607.37		
600	5423.23		$3s^23p^3(^4S^o)3d$	$^5D^o$	4	110296.84	RK74	
			$3s^23p^3(^4S^o)4p$	^5P	3	128730.82		
110	5443.37		$3s^23p^3(^4S^o)3d$	$^5D^o$	3	110297.72	RK74	
			$3s^23p^3(^4S^o)4p$	^5P	2	128663.57		

Energy Levels of Singly-ionized Chlorine (Cl II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^2 3p^4$	^3P	2	0.00	RK74
		1	696.00	RK74
		0	996.47	RK74
$3s^2 3p^4$	^1D	2	11653.58	RK74
$3s^2 3p^4$	^1S	0	27878.02	RK74
$3s 3p^5$	$^3P^o$	2	93367.56	RK74
		1	93999.88	RK74
		0	94333.84	RK74
$3s^2 3p^3(^4S^o)4s$	$^5S^o$	2	107879.66	RK74
$3s^2 3p^3(^4S^o)3d$	$^5D^o$	4	110296.84	RK74
		3	110297.72	RK74
		2	110300.56	RK74
		1	110303.12	RK74
		0	110304.52	RK74
$3s^2 3p^3(^4S^o)4s$	$^3S^o$	1	112609.36	RK74
$3s^2 3p^3(^2D^o)3d$	$^1P^o$	1	115657.77	RK74
$3s^2 3p^3(^4S^o)3d$	$^3D^o$	2	119800.32	RK74
		3	119811.22	RK74
		1	119843.31	RK74
$3s^2 3p^3(^2D^o)3d$	$^1S^o$	0	125245.89	RK74
$3s^2 3p^3(^2D^o)3d$	$^3F^o$	2	126033.54	RK74
		3	126220.74	RK74
		4	126458.10	RK74
$3s^2 3p^3(^2D^o)4s$	$^3D^o$	1	126726.70	RK74
		2	126744.97	RK74
		3	126784.37	RK74
$3s^2 3p^3(^4S^o)4p$	^5P	1	128622.99	RK74
		2	128663.57	RK74
		3	128730.82	RK74
$3s^2 3p^3(^2D^o)4s$	$^1D^o$	2	129066.96	RK74
$3s^2 3p^3(^4S^o)4p$	^3P	1	131756.12	RK74
		2	131768.66	RK74
		0	131769.41	RK74
$3s^2 3p^3(^2D^o)3d$	$^3G^o$	3	132164.13	RK74
		4	132175.11	RK74
		5	132193.12	RK74
$3s^2 3p^3(^2D^o)3d$	$^1G^o$	4	134393.27	RK74
$3s^2 3p^3(^2P^o)4s$	$^3P^o$	0	137771.77	RK74
		1	137806.15	RK74
		2	137879.37	RK74
$3s^2 3p^3(^2P^o)3d$	$^1D^o$	2	138624.73	RK74
$3s^2 3p^3(^2P^o)4s$	$^3P^o$	1	140260.64	RK74

Energy Levels of Singly-ionized Chlorine (Cl II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^23p^3(^2D^o)3d$	$^3D^o$	1	140741.80	RK74
		2	141011.58	RK74
		3	141351.14	RK74
$3s^23p^3(^2P^o)3d$	$^3F^o$	4	143998.08	RK74
		3	144176.42	RK74
		2	144345.56	RK74
$3s^23p^3(^2P^o)3d$	$^3P^o$	0	145175.45	RK74
		1	145421.24	RK74
		2	146014.75	RK74
$3s^23p^3(^2D^o)4p$	^1P	1	145470.16	RK74
$3s^23p^3(^2D^o)4p$	^3D	1	146331.76	RK74
		2	146335.55	RK74
		3	146470.64	RK74
$3s^23p^3(^2D^o)4p$	^3F	2	147055.61	RK74
		3	147127.57	RK74
		4	147200.24	RK74
$3s^23p^3(^2D^o)4p$	^1F	3	147607.37	RK74
$3s^23p^3(^2D^o)4p$	^3P	2	149800.12	RK74
		1	149954.18	RK74
		0	150020.90	RK74
$3s^23p^3(^2P^o)3d$	$^3D^o$	3	150683.38	RK74
		2	151020.06	RK74
		1	151135.31	RK74
$3s^23p^3(^2D^o)3d$	$^3S^o$	1	150813.12	RK74
$3s^23p^3(^2D^o)3d$	$^1F^o$	3	151094.06	RK74
$3s^23p^3(^4S^o)5s$	$^5S^o$	2	152234.91	RK74
$3s^23p^3(^2D^o)4p$	^1D	2	153258.61	RK74
$3s^23p^3(^4S^o)5s$	$^3S^o$	1	153634.97	RK74
$3s^23p^3(^4S^o)4d$	$^5D^o$	0	154618.09	RK74
		1	154619.10	RK74
		2	154620.97	RK74
		3	154623.57	RK74
		4	154624.66	RK74
Cl III ($^4S^o_{3/2}$)		*Limit*	**192070**	RK74

Chromium (Cr)
Atomic number=24
Atomic weight=51.9961

Isotope	Mass	Abundance	Spin	Mag moment
^{50}Cr	49.946046	4.35%	0	
^{52}Cr	51.940509	83.79%	0	
^{53}Cr	52.940651	9.50%	3/2	−0.47454
^{54}Cr	53.938882	2.36%	0	

Cr I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s\ ^7S_3$
Ionization energy: 54 575.6 cm^{-1} (6.766 51 eV)

Cr II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5\ ^6S_{5/2}$
Ionization energy: 132 966 cm^{-1} (16.4857 eV)

Strong Lines of Chromium (Cr)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
90	1220.165	Cr II	SKRR03
150	1247.554	Cr II	SKRR03
1000 P	1426.208	Cr II	SKRR03
800 P	1431.323	Cr II	SKRR03
600 P	1431.865	Cr II	SKRR03
600 P	1432.056	Cr II	SKRR03
500 P	1433.004	Cr II	SKRR03
600 P	1434.808	Cr II	SKRR03
400 P	1435.207	Cr II	SKRR03
350 P	1435.582	Cr II	SKRR03
300	1448.428	Cr II	SKRR03
170	1669.876	Cr II	SKRR03
150	1672.738	Cr II	SKRR03
200	1676.152	Cr II	SKRR03
180	1752.585	Cr II	SKRR03
180	1760.747	Cr II	SKRR03
150	1767.457	Cr II	SKRR03
	Air		
1000 P	2055.59	Cr II	K51
700 P	2061.54	Cr II	K51
500 P	2065.46	Cr II	K51
6	2383.303	Cr I	K53
7	2408.60	Cr I	K53
8	2496.30	Cr I	K53
10	2504.31	Cr I	K53
20	2519.51	Cr I	K53
8	2549.548	Cr I	K53
6	2560.695	Cr I	K53
8	2571.74	Cr I	K53
20	2591.84	Cr I	K53
13	2653.57	Cr II	K51
13	2658.59	Cr II	K51
15	2663.42	Cr II	K51
25	2666.02	Cr II	K51
15	2668.71	Cr II	K51
20	2671.80	Cr II	K51
15	2672.83	Cr II	K51

Strong Lines of Chromium (Cr)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90 P	2677.19	Cr II	K51
15	2678.79	Cr II	K51
12	2687.09	Cr II	K51
15	2691.03	Cr II	K51
9	2698.40	Cr II	K51
9	2698.68	Cr II	K51
9	2722.74	Cr II	K51
20	2726.496	Cr I	K53
14	2731.895	Cr I	K53
8	2736.463	Cr I	K53
13	2743.63	Cr II	K51
15	2748.98	Cr II	K51
20	2750.72	Cr II	K51
15	2751.85	Cr II	K51
8	2757.086	Cr I	K53
20	2757.72	Cr II	K51
40 P	2762.58	Cr II	K51
40 P	2766.55	Cr II	K51
12	2769.902	Cr I	K53
30	2780.695	Cr I	K53
9	2822.38	Cr II	K51
9	2830.46	Cr II	K51
130 P	2835.63	Cr II	K51
90 P	2843.24	Cr II	K51
60 P	2849.83	Cr II	K51
50 P	2855.67	Cr II	K51
30	2858.91	Cr II	K51
25	2860.92	Cr II	K51
40 P	2862.57	Cr II	K51
40 P	2865.10	Cr II	K51
30	2866.72	Cr II	K51
25	2867.65	Cr II	K51
11	2870.43	Cr II	K51
15	2875.97	Cr II	K51
12	2876.24	Cr II	K51
9	2877.97	Cr II	K51
8	2886.995	Cr I	K53
40	2889.294	Cr I	K53
20	2893.254	Cr I	K53
10	2894.168	Cr I	K53
10	2896.756	Cr I	K53
9	2905.477	Cr I	K53
13	2909.049	Cr I	K53
13	2910.892	Cr I	K53
12	2911.148	Cr I	K53
25	2967.64	Cr I	K53
25	2971.102	Cr I	K53
11	2971.90	Cr II	K51
25	2975.478	Cr I	K53
10	2979.73	Cr II	K51
20	2980.784	Cr I	K53
25	2985.849	Cr I	K53
80	2986.01	Cr I	K53
100	2986.466	Cr I	K53
30	2988.638	Cr I	K53
25	2991.877	Cr I	K53
12	2994.06	Cr I	K53
15	2995.094	Cr I	K53
40	2996.571	Cr I	K53

Strong Lines of Chromium (Cr)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
10	2998.783	Cr I	K53
60	3000.88	Cr I	K53
40	3005.06	Cr I	K53
40	3013.72	Cr I	K53
40	3014.756	Cr I	K53
70	3014.932	Cr I	K53
40	3015.197	Cr I	K53
140	3017.591	Cr I	K53
20	3018.492	Cr I	K53
12	3018.827	Cr I	K53
20	3020.671	Cr I	K53
140	3021.576	Cr I	K53
60	3024.359	Cr I	K53
8	3029.165	Cr I	K53
40	3030.25	Cr I	K53
7	3031.346	Cr I	K53
20	3034.191	Cr I	K53
30	3037.049	Cr I	K53
30	3040.837	Cr I	K53
40	3053.87	Cr I	K53
13	3118.64	Cr II	K51
25	3120.36	Cr II	K51
25	3124.94	Cr II	K51
30	3132.05	Cr II	K51
13	3180.70	Cr II	K51
12	3197.08	Cr II	K51
9	3209.19	Cr II	K51
6	3257.826	Cr I	K53
7	3339.81	Cr II	K51
9	3358.49	Cr II	K51
25	3368.04	Cr II	K51
9	3403.30	Cr II	K51
20	3408.76	Cr II	K51
11	3421.19	Cr II	K51
14	3422.73	Cr II	K51
14	3433.589	Cr I	K53
8	3436.190	Cr I	K53
7	3441.449	Cr I	K53
8	3445.604	Cr I	K53
8	3447.426	Cr I	K53
10	3453.328	Cr I	K53
6	3455.607	Cr I	K53
6	3573.636	Cr I	K53
15	3574.796	Cr I	K53
1000 P	3578.682	Cr I	K53
800 P	3593.481	Cr I	K53
20	3601.655	Cr I	K53
600 P	3605.320	Cr I	K53
6	3632.832	Cr I	K53
20	3636.588	Cr I	K53
30	3639.80	Cr I	K53
11	3641.84	Cr I	K53
11	3648.993	Cr I	K53
8	3653.916	Cr I	K53
11	3656.26	Cr I	K53
6	3663.206	Cr I	K53
6	3686.82	Cr I	K53
6	3687.25	Cr I	K53
6	3730.805	Cr I	K53

Strong Lines of Chromium (Cr)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
8	3732.03	Cr I	K53
25	3743.57	Cr I	K53
30	3743.887	Cr I	K53
15	3749.00	Cr I	K53
12	3757.659	Cr I	K53
13	3768.237	Cr I	K53
6	3791.384	Cr I	K53
6	3792.142	Cr I	K53
6	3793.872	Cr I	K53
7	3797.138	Cr I	K53
10	3797.714	Cr I	K53
25	3804.801	Cr I	K53
9	3815.438	Cr I	K53
9	3819.57	Cr I	K53
6	3826.427	Cr I	K53
20	3841.28	Cr I	K53
10	3848.983	Cr I	K53
7	3849.35	Cr I	K53
14	3850.029	Cr I	K53
7	3852.221	Cr I	K53
10	3854.229	Cr I	K53
7	3855.58	Cr I	K53
13	3857.63	Cr I	K53
30	3883.289	Cr I	K53
30	3885.24	Cr I	K53
20	3886.80	Cr I	K53
13	3894.039	Cr I	K53
20	3902.911	Cr I	K53
50	3908.762	Cr I	K53
10	3916.25	Cr I	K53
90	3919.165	Cr I	K53
30	3921.031	Cr I	K53
30	3928.647	Cr I	K53
20	3941.499	Cr I	K53
90	3963.694	Cr I	K53
80	3969.748	Cr I	K53
80	3976.674	Cr I	K53
50	3983.901	Cr I	K53
10	3984.339	Cr I	K53
8	3989.984	Cr I	K53
50	3991.118	Cr I	K53
8	3991.677	Cr I	K53
10	3992.846	Cr I	K53
8	4001.443	Cr I	K53
10	4039.098	Cr I	K53
8	4048.784	Cr I	K53
7	4126.513	Cr I	K53
7	4163.627	Cr I	K53
8	4174.808	Cr I	K53
8	4179.27	Cr I	K53
1000 P	4254.331	Cr I	K53
800 P	4274.806	Cr I	K53
500 P	4289.733	Cr I	K53
40	4337.566	Cr I	K53
60	4339.45	Cr I	K53
20	4339.74	Cr I	K53
90	4344.51	Cr I	K53
20	4351.055	Cr I	K53
120	4351.77	Cr I	K53

Strong Lines of Chromium (Cr)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
30	4359.647	Cr I	K53
25	4371.279	Cr I	K53
25	4384.974	Cr I	K53
30	4496.85	Cr I	K53
20	4526.458	Cr I	K53
20	4530.72	Cr I	K53
12	4535.714	Cr I	K53
12	4540.50	Cr I	K53
12	4540.715	Cr I	K53
7	4544.607	Cr I	K53
30	4545.946	Cr I	K53
20	4580.045	Cr I	K53
20	4591.405	Cr I	K53
25	4600.745	Cr I	K53
12	4613.36	Cr I	K53
30	4616.120	Cr I	K53
30	4626.181	Cr I	K53
80	4646.151	Cr I	K53
30	4651.285	Cr I	K53
40	4652.155	Cr I	K53
12	4698.46	Cr I	K53
10	4708.02	Cr I	K53
12	4718.43	Cr I	K53
7	4737.33	Cr I	K53
15	4756.09	Cr I	K53
10	4789.324	Cr I	K53
7	4870.79	Cr I	K53
6	4887.013	Cr I	K53
13	4922.276	Cr I	K53
250 P	5204.505	Cr I	K53
400 P	5206.021	Cr I	K53
600 P	5208.415	Cr I	K53
14	5247.58	Cr I	K53
25	5264.16	Cr I	K53
9	5265.73	Cr I	K53
15	5296.69	Cr I	K53
30	5298.29	Cr I	K53
15	5328.36	Cr I	K53
40	5345.77	Cr I	K53
20	5348.30	Cr I	K53
70	5409.78	Cr I	K53
9 h	5791.00	Cr I	K53
6	7400.22	Cr I	K53
8	7462.35	Cr I	K53

Persistent Lines of Neutral Chromium (Cr I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3578.682	1.48	$3d^5(^6S)4s$	a ^7S	3	0.00	K53	FW96
			$3d^4(^5D)4s4p(^3P^o)$	y $^7P^o$	4	27935.26		
800	3593.481	1.50	$3d^5(^6S)4s$	a ^7S	3	0.00	K53	FW96
			$3d^4(^5D)4s4p(^3P^o)$	y $^7P^o$	3	27820.23		
600	3605.320	1.62	$3d^5(^6S)4s$	a ^7S	3	0.00	K53	FW96
			$3d^4(^5D)4s4p(^3P^o)$	y $^7P^o$	2	27728.87		
1000	4254.331	0.315	$3d^5(^6S)4s$	a ^7S	3	0.00	K53	FW96
			$3d^5(^6S)4p$	z $^7P^o$	4	23498.84		
800	4274.806	0.307	$3d^5(^6S)4s$	a ^7S	3	0.00	K53	FW96
			$3d^5(^6S)4p$	z $^7P^o$	3	23386.35		
500	4289.733	0.316	$3d^5(^6S)4s$	a ^7S	3	0.00	K53	FW96
			$3d^5(^6S)4p$	z $^7P^o$	2	23305.01		
250	5204.505	0.509	$3d^5(^6S)4s$	a ^5S	2	7593.16	K53	FW96
			$3d^5(^6S)4p$	z $^5P^o$	1	26801.93		
400	5206.021	0.514	$3d^5(^6S)4s$	a ^5S	2	7593.16	K53	FW96
			$3d^5(^6S)4p$	z $^5P^o$	2	26796.28		
600	5208.415	0.506	$3d^5(^6S)4s$	a ^5S	2	7593.16	K53	FW96
			$3d^5(^6S)4p$	z $^5P^o$	3	26787.50		

Energy Levels of Neutral Chromium (Cr I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^5(^6S)4s$	a ^7S	3	0.00	SC85
$3d^5(^6S)4s$	a ^5S	2	7593.16	SC85
$3d^44s^2$	a ^5D	0	7750.78	SC85
		1	7810.82	SC85
		2	7927.47	SC85
		3	8095.21	SC85
		4	8307.57	SC85
$3d^5(^4G)4s$	a ^5G	2	20517.40	SC85
		6	20519.60	SC85
		3	20520.92	SC85
		4	20523.69	SC85
		5	20523.94	SC85
$3d^5(^4P)4s$	a ^5P	3	21840.84	SC85
		2	21847.88	SC85
		1	21856.94	SC85
$3d^44s^2$	a ^3P	0	23163.27	SC85
		1	23512.00	SC85
		2	24093.16	SC85
$3d^5(^6S)4p$	z $^7P^o$	2	23305.01	SC85
		3	23386.35	SC85
		4	23498.84	SC85

Energy Levels of Neutral Chromium (Cr I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^4(^5D)4s4p(^3P^o)$	z $^7F^o$	0	24971.21	SC85
		1	25010.64	SC85
		2	25089.20	SC85
		3	25206.02	SC85
		4	25359.62	SC85
		5	25548.64	SC85
		6	25771.40	SC85
$3d^5(^6S)4p$	z $^5P^o$	3	26787.50	SC85
		2	26796.28	SC85
		1	26801.93	SC85
$3d^4(^5D)4s4p(^3P^o)$	z $^7D^o$	1	27300.19	SC85
		2	27382.18	SC85
		3	27500.37	SC85
		4	27649.71	SC85
		5	27825.45	SC85
$3d^4(^5D)4s4p(^3P^o)$	y $^7P^o$	2	27728.87	SC85
		3	27820.23	SC85
		4	27935.26	SC85
Cr II ($^6S_{5/2}$)		*Limit*	**54575.6**	SC85

Persistent Lines of Singly-ionized Chromium (Cr II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1426.208		$3d^4(^5D)4s$	a ^6D	9/2	12496.44	SKRR03	
			$3d^3(^4F)4s4p(^3P^o)$	y $^6F^o$	11/2	82612.69		
800	1431.323		$3d^4(^5D)4s$	a ^6D	9/2	12496.44	SKRR03	
			$3d^3(^4F)4s4p(^3P^o)$	y $^6F^o$	9/2	82362.19		
600	1431.865		$3d^4(^5D)4s$	a ^6D	7/2	12303.86	SKRR03	
			$3d^3(^4F)4s4p(^3P^o)$	y $^6F^o$	7/2	82143.15		
600	1432.056		$3d^4(^5D)4s$	a ^6D	5/2	12147.82	SKRR03	
			$3d^3(^4F)4s4p(^3P^o)$	y $^6D^o$	7/2	81978.08		
500	1433.004		$3d^4(^5D)4s$	a ^6D	3/2	12032.58	SKRR03	
			$3d^3(^4F)4s4p(^3P^o)$	y $^6D^o$	5/2	81816.29		
600	1434.808		$3d^4(^5D)4s$	a ^6D	9/2	12496.44	SKRR03	
			$3d^3(^4F)4s4p(^3P^o)$	y $^6D^o$	9/2	82192.59		
400	1435.207		$3d^4(^5D)4s$	a ^6D	5/2	12147.82	SKRR03	
			$3d^3(^4F)4s4p(^3P^o)$	y $^6F^o$	3/2	81824.40		
350	1435.582		$3d^4(^5D)4s$	a ^6D	7/2	12303.86	SKRR03	
			$3d^3(^4F)4s4p(^3P^o)$	y $^6F^o$	5/2	81962.29		
1000	2055.59	1.2	$3d^5$	a ^6S	5/2	0.00	K51	M03
			$3d^4(^5D)4p$	z $^6P^o$	7/2	48632.12		
700	2061.54	1.2	$3d^5$	a ^6S	5/2	0.00	K51	M03
			$3d^4(^5D)4p$	z $^6P^o$	5/2	48491.10		
500	2065.46	1.2	$3d^5$	a ^6S	5/2	0.00	K51	M03
			$3d^4(^5D)4p$	z $^6P^o$	3/2	48398.95		

Persistent Lines of Singly-ionized Chromium (Cr II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
90	2677.19		$3d^4(^5D)4s$	a ^6D	9/2	12496.44	K51	
			$3d^4(^5D)4p$	z $^6D^o$	9/2	49838.38		
40	2762.58		$3d^4(^5D)4s$	a ^6D	7/2	12303.86	K51	
			$3d^4(^5D)4p$	z $^6P^o$	5/2	48491.10		
40	2766.55		$3d^4(^5D)4s$	a ^6D	9/2	12496.44	K51	
			$3d^4(^5D)4p$	z $^6P^o$	7/2	48632.12		
130	2835.63	2.0	$3d^4(^5D)4s$	a ^6D	9/2	12496.44	K51	FW96
			$3d^4(^5D)4p$	z $^6F^o$	11/2	47751.62		
90	2843.24	0.64	$3d^4(^5D)4s$	a ^6D	7/2	12303.86	K51	FW96
			$3d^4(^5D)4p$	z $^6F^o$	9/2	47464.55		
60	2849.83	0.92	$3d^4(^5D)4s$	a ^6D	5/2	12147.82	K51	FW96
			$3d^4(^5D)4p$	z $^6F^o$	7/2	47227.24		
50	2855.67		$3d^4(^5D)4s$	a ^6D	3/2	12032.58	K51	
			$3d^4(^5D)4p$	z $^6F^o$	5/2	47040.35		
40	2862.57	0.63	$3d^4(^5D)4s$	a ^6D	7/2	12303.86	K51	FW96
			$3d^4(^5D)4p$	z $^6F^o$	7/2	47227.24		
40	2865.10		$3d^4(^5D)4s$	a ^6D	5/2	12147.82	K51	
			$3d^4(^5D)4p$	z $^6F^o$	5/2	47040.35		

Energy Levels of Singly-ionized Chromium (Cr II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^5$	a ^6S	5/2	0.00	SC85
$3d^4(^5D)4s$	a ^6D	1/2	11961.81	SC85
		3/2	12032.58	SC85
		5/2	12147.82	SC85
		7/2	12303.86	SC85
		9/2	12496.44	SC85
$3d^4(^5D)4s$	a ^4D	1/2	19528.25	SC85
		3/2	19631.17	SC85
		5/2	19797.88	SC85
		7/2	20024.01	SC85
$3d^5$	a ^4G	5/2	20512.06	SC85
		11/2	20512.10	SC85
		7/2	20517.83	SC85
		9/2	20519.33	SC85
$3d^5$	a ^4P	5/2	21822.52	SC85
		1/2	21823.84	SC85
		3/2	21824.11	SC85
$3d^4(^5D)4p$	z $^6F^o$	1/2	46823.39	SC85
		3/2	46905.17	SC85
		5/2	47040.35	SC85
		7/2	47227.24	SC85
		9/2	47464.55	SC85
		11/2	47751.62	SC85

Energy Levels of Singly-ionized Chromium (Cr II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^4(^5D)4p$	z $^6P^o$	3/2	48398.95	SC85
		5/2	48491.10	SC85
		7/2	48632.12	SC85
$3d^4(^5D)4p$	z $^4P^o$	1/2	48749.36	SC85
		3/2	49005.93	SC85
		5/2	49706.33	SC85
$3d^4(^5D)4p$	z $^6D^o$	5/2	49351.80	SC85
		1/2	49492.77	SC85
		3/2	49564.60	SC85
		7/2	49645.77	SC85
		9/2	49838.38	SC85
$3d^3(^4F)4s4p(^3P^o)$	y $^6D^o$	1/2	81649.19	SC85
		3/2	81707.87	SC85
		5/2	81816.29	SC85
		7/2	81978.08	SC85
		9/2	82192.59	SC85
$3d^3(^4F)4s4p(^3P^o)$	y $^6F^o$	1/2	81735.02	SC85
		3/2	81824.40	SC85
		5/2	81962.29	SC85
		7/2	82143.15	SC85
		9/2	82362.19	SC85
		11/2	82612.69	SC85
Cr III ($^5D_0$)		*Limit*	**132966**	SC85

Cobalt (Co)
Atomic number = 27
Atomic weight = 58.933 20

Isotope	Mass	Abundance	Spin	Mag moment
^{59}Co	58.933198	100%	7/2	+4.627

Co I Ground state: $1s^22s^22p^63s^23p^63d^74s^2\ ^4F_{9/2}$
Ionization energy: 63 564.6 cm^{-1} (7.881 01 eV)

Co II Ground state: $1s^22s^22p^63s^23p^63d^8\ ^3F_4$
Ionization energy: 137 795 cm^{-1} (17.084 eV)

Strong Lines of Cobalt (Co)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
140	1970.769	Co I	PT96
	Air		
200	2193.605	Co II	PRUJ98
200	2256.745	Co II	PRUJ98
200	2283.522	Co II	PRUJ98
1000 P	2286.159	Co II	PRUJ98
200	2291.991	Co II	PRUJ98
300	2293.390	Co II	PRUJ98
300	2301.403	Co II	PRUJ98
800 P	2307.860	Co II	PRUJ98
120	2309.010	Co I	PT96
500 P	2311.604	Co II	PRUJ98
500 P	2314.056	Co II	PRUJ98
300	2314.975	Co II	PRUJ98
200	2317.070	Co II	PRUJ98
110	2323.145	Co I	PT96
300	2324.321	Co II	PRUJ98
200	2326.100	Co II	PRUJ98
500	2326.473	Co II	PRUJ98
200 P	2347.399	Co II	PRUJ98
200 P	2353.422	Co II	PRUJ98
90	2353.368	Co I	PT96
500 P	2363.800	Co II	PRUJ98
400 P	2378.626	Co II	PRUJ98
200	2381.765	Co II	PRUJ98
300 P	2383.459	Co II	PRUJ98
200 P	2386.370	Co II	PRUJ98
500 P	2388.917	Co II	PRUJ98
200	2397.386	Co II	PRUJ98
200	2404.172	Co II	PRUJ98
250 P	2407.256	Co I	PT96
250 P	2411.624	Co I	PT96
250	2414.464	Co I	PT96
250	2415.290	Co I	PT96
300	2417.659	Co II	PRUJ98
200 P	2424.935	Co I	PT96
150	2432.213	Co I	PT96
140	2436.662	Co I	PT96
110	2439.040	Co I	PT96
200	2442.617	Co II	PRUJ98
200	2446.017	Co II	PRUJ98

Strong Lines of Cobalt (Co)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	2447.711	Co II	PRUJ98
200	2450.002	Co II	PRUJ98
200	2464.199	Co II	PRUJ98
200	2486.441	Co II	PRUJ98
200	2498.821	Co II	PRUJ98
500	2506.464	Co II	PRUJ98
200	2511.160	Co II	PRUJ98
500	2519.823	Co II	PRUJ98
200 P	2521.365	Co I	PT96
200	2524.634	Co II	PRUJ98
300	2524.974	Co II	PRUJ98
500	2528.616	Co II	PRUJ98
140	2528.970	Co I	PT96
200	2530.080	Co II	PRUJ98
200	2533.801	Co II	PRUJ98
140	2535.966	Co I	PT96
300	2541.953	Co II	PRUJ98
200	2546.739	Co II	PRUJ98
300	2559.405	Co II	PRUJ98
200	2560.031	Co II	PRUJ98
500	2564.034	Co II	PRUJ98
800	2580.326	Co II	PRUJ98
300	2582.240	Co II	PRUJ98
500	2587.220	Co II	PRUJ98
500	2587.524	Co II	PRUJ98
200	2588.904	Co II	PRUJ98
200	2666.740	Co II	PRUJ98
200	2706.606	Co II	PRUJ98
200	2707.343	Co II	PRUJ98
150	3044.005	Co I	PT96
100	3395.373	Co I	PT96
500 P	3405.118	Co I	PT96
200	3409.176	Co I	PT96
300	3412.337	Co I	PT96
100	3412.633	Co I	PT96
130	3417.157	Co I	PT96
120	3431.582	Co I	PT96
200	3433.040	Co I	PT96
400 P	3443.645	Co I	PT96
200	3449.170	Co I	PT96
100	3449.440	Co I	PT96
1000 P	3453.510	Co I	PT96
250	3462.805	Co I	PT96
250	3465.793	Co I	PT96
400 P	3473.974	Co I	PT96
400 P	3474.042	Co I	PT96
250	3489.400	Co I	PT96
110	3495.682	Co I	PT96
500 P	3502.280	Co I	PT96
300	3506.312	Co I	PT96
140	3509.841	Co I	PT96
250	3512.640	Co I	PT96
200	3513.481	Co I	PT96
250	3518.347	Co I	PT96
130	3521.566	Co I	PT96
200	3523.433	Co I	PT96
300 P	3526.850	Co I	PT96
130	3529.033	Co I	PT96
300 P	3529.808	Co I	PT96

Strong Lines of Cobalt (Co)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400 P	3569.376	Co I	PT96
120	3575.360	Co I	PT96
300	3587.187	Co I	PT96
300	3845.469	Co I	PT96
250	3873.114	Co I	PT96
130	3873.955	Co I	PT96
400	3894.078	Co I	PT96
300	3995.308	Co I	PT96
130	4118.774	Co I	PT96
200	4121.318	Co I	PT96

Persistent Lines of Neutral Cobalt (Co I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
250	2407.256	3.6	$3d^7 4s^2$	a ^{4}F	9/2	0.000	PT96	FW96
			$3d^7(^4F)4s4p(^1P^o)$	x $^4G^o$	11/2	41528.455		
250	2411.624		$3d^7 4s^2$	a ^{4}F	7/2	816.000	PT96	
			$3d^7(^4F)4s4p(^1P^o)$	x $^4G^o$	9/2	42269.229		
200	2424.935	3.2	$3d^7 4s^2$	a ^{4}F	9/2	0.000	PT96	FW96
			$3d^7(^4F)4s4p(^1P^o)$	x $^4F^o$	9/2	41225.710		
200	2521.365	3.0	$3d^7 4s^2$	a ^{4}F	9/2	0.000	PT96	FW96
			$3d^7(^4F)4s4p(^1P^o)$	x $^4D^o$	7/2	39649.124		
500	3405.118	1.0	$3d^8(^3F)4s$	b ^{4}F	9/2	3482.780	PT96	FW96
			$3d^8(^3F)4p$	y $^4F^o$	9/2	32841.916		
400	3443.645	0.69	$3d^8(^3F)4s$	b ^{4}F	7/2	4142.631	PT96	FW96
			$3d^8(^3F)4p$	y $^4F^o$	7/2	33173.313		
1000	3453.510	1.1	$3d^8(^3F)4s$	b ^{4}F	9/2	3482.780	PT96	FW96
			$3d^8(^3F)4p$	y $^4G^o$	11/2	32430.535		
400*	3473.974	0.0299	$3d^7 4s^2$	a ^{4}F	9/2	0.000	PT96	M03
			$3d^7(^4F)4s4p(^3P^o)$	z $^4F^o$	7/2	28777.236		
400*	3474.042	0.56	$3d^8(^3F)4s$	b ^{4}F	5/2	4690.141	PT96	FW96
			$3d^8(^3F)4p$	y $^4G^o$	7/2	33466.823		
500	3502.280	0.80	$3d^8(^3F)4s$	b ^{4}F	9/2	3482.780	PT96	FW96
			$3d^8(^3F)4p$	y $^4D^o$	7/2	32027.440		
300	3526.850	0.137	$3d^7 4s^2$	a ^{4}F	9/2	0.000	PT96	M03
			$3d^7(^4F)4s4p(^3P^o)$	z $^4F^o$	9/2	28345.814		
300	3529.808	0.46	$3d^8(^3F)4s$	b ^{4}F	7/2	4142.631	PT96	FW96
			$3d^8(^3F)4p$	y $^4G^o$	9/2	32464.688		
400	3569.376	1.6	$3d^8(^3F)4s$	a ^{6}F	7/2	7442.399	PT96	FW96
			$3d^8(^3F)4p$	y $^2F^o$	7/2	35450.505		

Energy Levels of Neutral Cobalt (Co I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^74s^2$	a ^4F	9/2	0.000	PT96
		7/2	816.000	PT96
		5/2	1406.852	PT96
		3/2	1809.313	PT96
$3d^8(^3F)4s$	b ^4F	9/2	3482.780	PT96
		7/2	4142.631	PT96
		5/2	4690.141	PT96
		3/2	5075.788	PT96
$3d^8(^3F)4s$	a ^6F	7/2	7442.399	PT96
		5/2	8460.783	PT96
$3d^74s^2$	a ^4P	5/2	13795.491	PT96
		3/2	14036.241	PT96
		1/2	14399.220	PT96
$3d^8(^3P)4s$	b ^4P	5/2	15184.013	PT96
		3/2	15774.009	PT96
		1/2	16195.610	PT96
$3d^7(^4F)4s4p(^3P^o)$	z $^4F^o$	9/2	28345.814	PT96
		7/2	28777.236	PT96
		5/2	29216.332	PT96
		3/2	29563.111	PT96
$3d^7(^4F)4s4p(^3P^o)$	z $^4G^o$	11/2	28845.165	PT96
		9/2	29269.675	PT96
		7/2	29735.131	PT96
		5/2	30102.912	PT96
$3d^7(^4F)4s4p(^3P^o)$	z $^4D^o$	7/2	29294.482	PT96
		5/2	29948.730	PT96
		3/2	30443.596	PT96
		1/2	30742.605	PT96
$3d^7(^4F)4s4p(^3P^o)$	z $^2G^o$	9/2	31699.638	PT96
		7/2	32733.008	PT96
$3d^7(^4F)4s4p(^3P^o)$	z $^2F^o$	7/2	31871.118	PT96
		5/2	32781.672	PT96
$3d^8(^3F)4p$	y $^4D^o$	7/2	32027.440	PT96
		5/2	32654.463	PT96
		3/2	33150.616	PT96
		1/2	33449.086	PT96
$3d^8(^3F)4p$	y $^4G^o$	11/2	32430.535	PT96
		9/2	32464.688	PT96
		7/2	33466.823	PT96
		5/2	33674.326	PT96
$3d^8(^3F)4p$	y $^4F^o$	9/2	32841.916	PT96
		7/2	33173.313	PT96
		5/2	33945.846	PT96
		3/2	34196.147	PT96
$3d^8(^3F)4p$	y $^2G^o$	9/2	33439.661	PT96
		7/2	34133.537	PT96
$3d^7(^4F)4s4p(^3P^o)$	z $^2D^o$	5/2	33462.795	PT96
		3/2	34352.358	PT96

Energy Levels of Neutral Cobalt (Co I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^8(^3F)4p$	y $^2F^o$	7/2	35450.505	PT96
		5/2	36329.834	PT96
$3d^8(^3F)4p$	y $^2D^o$	5/2	36092.420	PT96
		3/2	36875.089	PT96
$3d^7(^4F)4s4p(^1P^o)$	x $^4D^o$	7/2	39649.124	PT96
		5/2	40345.908	PT96
		3/2	40827.712	PT96
		1/2	41101.756	PT96
$3d^7(^4P)4s4p(^3P^o)$	z $^4S^o$	3/2	40621.588	PT96
$3d^7(^4P)4s4p(^3P^o)$	$^6P^o$	7/2	41041.348	PT96
		5/2	41104.912	PT96
		3/2	41247.585	PT96
$3d^7(^4F)4s4p(^1P^o)$	x $^4F^o$	9/2	41225.710	PT96
		7/2	41918.353	PT96
		5/2	42434.160	PT96
		3/2	42796.626	PT96
$3d^7(^4F)4s4p(^1P^o)$	x $^4G^o$	11/2	41528.455	PT96
		9/2	42269.229	PT96
		7/2	42811.351	PT96
		5/2	43199.624	PT96
Co II ($^3F_4$)		*Limit*	**63564.6**	PG90

Persistent Lines of Singly-ionized Cobalt (Co II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2286.159	3.3	$3d^7(^4F)4s$	a ^5F	5	3350.494	PRUJ98	FW96
			$3d^7(^4F)4p$	z $^5G^o$	6	47078.491		
800	2307.860	2.6	$3d^7(^4F)4s$	a ^5F	4	4028.988	PRUJ98	FW96
			$3d^7(^4F)4p$	z $^5G^o$	5	47345.842		
500	2311.604	2.8	$3d^7(^4F)4s$	a ^5F	3	4560.789	PRUJ98	FW96
			$3d^7(^4F)4p$	z $^5G^o$	4	47807.490		
500	2314.056	2.8	$3d^7(^4F)4s$	a ^5F	2	4950.062	PRUJ98	FW96
			$3d^7(^4F)4p$	z $^5G^o$	3	48150.937		
200	2347.399		$3d^7(^4F)4s$	a ^5F	2	4950.062	PRUJ98	
			$3d^7(^4F)4p$	z $^5D^o$	2	47537.362		
200	2353.422	1.8	$3d^7(^4F)4s$	a ^5F	3	4560.789	PRUJ98	FW96
			$3d^7(^4F)4p$	z $^5D^o$	3	47039.102		
500	2363.800	2.1	$3d^7(^4F)4s$	a ^5F	4	4028.988	PRUJ98	FW96
			$3d^7(^4F)4p$	z $^5D^o$	4	46320.829		
400	2378.626	1.9	$3d^7(^4F)4s$	a ^5F	5	3350.494	PRUJ98	FW96
			$3d^7(^4F)4p$	z $^5F^o$	4	45378.751		
300	2383.459	1.8	$3d^7(^4F)4s$	a ^5F	4	4028.988	PRUJ98	FW96
			$3d^7(^4F)4p$	z $^5F^o$	3	45972.033		

Persistent Lines of Singly-ionized Cobalt (Co II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
200	2386.370		$3d^7(^4F)4s$	a ^5F	3	4560.789	PRUJ98	
			$3d^7(^4F)4p$	z $^5F^o$	2	46452.697		
500	2388.917	1.5	$3d^7(^4F)4s$	a ^5F	5	3350.494	PRUJ98	FW96
			$3d^7(^4F)4p$	z $^5F^o$	5	45197.708		

Energy Levels of Singly-ionized Cobalt (Co II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^8$	a ^3F	4	0.000	PRUJ98
		3	950.324	PRUJ98
		2	1597.197	PRUJ98
$3d^7(^4F)4s$	a ^5F	5	3350.494	PRUJ98
		4	4028.988	PRUJ98
		3	4560.789	PRUJ98
		2	4950.062	PRUJ98
		1	5204.698	PRUJ98
$3d^7(^4F)4s$	b ^3F	4	9812.859	PRUJ98
		3	10708.330	PRUJ98
		2	11321.859	PRUJ98
$3d^7(^4F)4p$	z $^5F^o$	5	45197.708	PRUJ98
		4	45378.751	PRUJ98
		3	45972.033	PRUJ98
		2	46452.697	PRUJ98
		1	46786.406	PRUJ98
$3d^7(^4F)4p$	z $^5D^o$	4	46320.829	PRUJ98
		3	47039.102	PRUJ98
		2	47537.362	PRUJ98
		1	47848.778	PRUJ98
		0	47995.591	PRUJ98
$3d^7(^4F)4p$	z $^5G^o$	6	47078.491	PRUJ98
		5	47345.842	PRUJ98
		4	47807.490	PRUJ98
		3	48150.937	PRUJ98
		2	48388.439	PRUJ98
Co III ($^4F_{9/2}$)		*Limit*	**137795**	SC85

Copper (Cu)
Atomic number = 29
Atomic weight = 63.546

Isotope	Mass	Abundance	Spin	Mag moment
^{63}Cu	62.939598	69.17%	3/2	+2.2233
^{65}Cu	64.927793	30.83%	3/2	+2.3817

Cu I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s\ ^2S_{1/2}$
Ionization energy: 62 317.44 cm^{-1} (7.726 38 eV)

Cu II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}\ ^1S_0$
Ionization energy: 163 669.2 cm^{-1} (20.2924 eV)

Strong Lines of Copper (Cu)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
400	886.943	Cu II	R69
400	890.567	Cu II	R69
500	893.678	Cu II	R69
400	896.759	Cu II	R69
400	901.073	Cu II	R69
500	914.213	Cu II	R69
400	922.019	Cu II	R69
400	932.939	Cu II	R69
400	935.058	Cu II	R69
400	935.086	Cu II	R69
400	935.898	Cu II	R69
400	943.335	Cu II	R69
400	945.525	Cu II	R69
400	1036.470	Cu II	R69
400	1039.348	Cu II	R69
400	1039.582	Cu II	R69
500	1044.519	Cu II	R69
500	1044.744	Cu II	R69
400	1054.690	Cu II	R69
400	1056.955	Cu II	R69
400	1059.096	Cu II	R69
400	1060.634	Cu II	R69
400	1063.005	Cu II	R69
200 P	1358.773	Cu II	R69
150 P	1367.951	Cu II	R69
500	1488.637	Cu II	R69
400	1519.837	Cu II	R69
500	1541.703	Cu II	R69
400	1593.556	Cu II	R69
400	1621.426	Cu II	R69
300 P	1979.956	Cu II	R69
	Air		
150 P	1999.698	Cu II	R69
200 P	2035.854	Cu II	R69
150 P	2037.127	Cu II	R69
250 P	2043.802	Cu II	R69
600 P	2135.981	Cu II	R69
130 P	2165.09	Cu I	S48
150 P	2178.94	Cu I	S48
500	2179.410	Cu II	R69

Strong Lines of Copper (Cu)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
150 P	2181.72	Cu I	S48
500	2189.630	Cu II	R69
600 P	2192.268	Cu II	R69
150	2199.58	Cu I	S48
500	2210.268	Cu II	R69
150	2214.58	Cu I	S48
500 P	2218.108	Cu II	R69
200 P	2225.70	Cu I	S48
150	2227.78	Cu I	S48
250 P	2230.08	Cu I	S48
600	2242.618	Cu II	R69
250 P	2244.26	Cu I	S48
700 P	2247.002	Cu II	R69
200	2263.08	Cu I	S48
250	2293.84	Cu I	S48
250	2392.63	Cu I	S48
150	2406.66	Cu I	S48
100 P	2441.64	Cu I	S48
200 P	2492.15	Cu I	S48
250	2618.37	Cu I	S48
500	2689.300	Cu II	R69
500	2700.962	Cu II	R69
400	2703.184	Cu II	R69
500	2713.508	Cu II	R69
400	2718.778	Cu II	R69
250	2766.37	Cu I	S48
500	2769.669	Cu II	R69
400	2877.100	Cu II	R69
250	2961.16	Cu I	S48
250	3036.10	Cu I	S48
250	3063.41	Cu I	S48
200	3108.60	Cu I	S48
150	3194.10	Cu I	S48
150 h	3243.16	Cu I	S48
1000 P	3247.54	Cu I	S48
1000 P	3273.96	Cu I	S48
150 h	3290.54	Cu I	S48
250 h	3307.95	Cu I	S48
150	3337.84	Cu I	S48
200	3530.38	Cu I	S48
700	3686.555	Cu II	R69
200	4062.64	Cu I	S48
200	4651.12	Cu I	S48
700	4909.734	Cu II	R69
600	4931.698	Cu II	R69
500	4953.724	Cu II	R69
600	5051.793	Cu II	R69
150 P	5105.54	Cu I	S48
200 P	5153.24	Cu I	S48
250 P	5218.20	Cu I	S48
150	5292.52	Cu I	S48
150	5700.24	Cu I	S48
150	5782.13	Cu I	S48
400	6000.120	Cu II	R69
400	6150.384	Cu II	R69
500	6154.222	Cu II	R69
500	6216.939	Cu II	R69
500	6219.844	Cu II	R69
700	6273.349	Cu II	R69

Strong Lines of Copper (Cu)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
600	6301.009	Cu II	R69
500	6377.840	Cu II	R69
600	6423.884	Cu II	R69
500	6448.559	Cu II	R69
600	6470.168	Cu II	R69
500	6481.437	Cu II	R69
500	6624.292	Cu II	R69
500	6641.396	Cu II	R69
700	7404.354	Cu II	R69
500	7652.333	Cu II	R69
700	7664.648	Cu II	R69
500	7778.738	Cu II	R69
500	7805.184	Cu II	R69
1000	7807.659	Cu II	R69
700	7825.654	Cu II	R69
500	7902.553	Cu II	R69
150	7933.13	Cu I	S48
800	7988.163	Cu II	R69
200	8092.63	Cu I	S48
500	8283.160	Cu II	R69
500	8511.061	Cu II	R69
400	9861.280	Cu II	R69
400	9864.137	Cu II	R69
400	10054.938	Cu II	R69

Persistent Lines of Neutral Copper (Cu I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
130	2165.09	0.547	$3d^{10}(^1S)4s$	^2S	1/2	0.000	S48	M03
			$3d^9(^2D)4s4p(^3P^o)$		3/2	46172.842		
150	2178.94	0.913	$3d^{10}(^1S)4s$	^2S	1/2	0.000	S48	M03
			$3d^9(^2D)4s4p(^3P^o)$	$^2P^o$	3/2	45879.311		
150	2181.72	0.994	$3d^{10}(^1S)4s$	^2S	1/2	0.000	S48	M03
			$3d^9(^2D)4s4p(^3P^o)$	$^2P^o$	1/2	45821.00		
200	2225.70	0.444	$3d^{10}(^1S)4s$	^2S	1/2	0.000	S48	M03
			$3d^9(^2D)4s4p(^3P^o)$	$^4D^o$	1/2	44915.61		
250	2230.08		$3d^94s^2$	^2D	5/2	11202.565	S48	
			$3d^9(^2D)4s4p(^1P^o)$	$^2F^o$	7/2	56029.95		
250	2244.26	0.0185	$3d^{10}(^1S)4s$	^2S	1/2	0.000	S48	M03
			$3d^9(^2D)4s4p(^3P^o)$	$^4D^o$	3/2	44544.153		
100	2441.64	0.0201	$3d^{10}(^1S)4s$	^2S	1/2	0.000	S48	M03
			$3d^9(^2D)4s4p(^3P^o)$	$^4P^o$	1/2	40943.73		
200	2492.15	0.0279	$3d^{10}(^1S)4s$	^2S	1/2	0.000	S48	M03
			$3d^9(^2D)4s4p(^3P^o)$	$^4P^o$	3/2	40113.99		
1000	3247.54	1.37	$3d^{10}(^1S)4s$	^2S	1/2	0.000	S48	M03
			$3d^{10}(^1S)4p$	$^2P^o$	3/2	30783.686		
1000	3273.96	1.36	$3d^{10}(^1S)4s$	^2S	1/2	0.000	S48	M03
			$3d^{10}(^1S)4p$	$^2P^o$	1/2	30535.302		

Persistent Lines of Neutral Copper (Cu I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
150	5105.54	0.020	$3d^94s^2$	^2D	5/2	11202.565	S48	FW96
			$3d^{10}(^1S)4p$	$^2P^o$	3/2	30783.686		
200	5153.24	0.60	$3d^{10}(^1S)4p$	$^2P^o$	1/2	30535.302	S48	FW96
			$3d^{10}(^1S)4d$	^2D	3/2	49935.200		
250	5218.20	0.75	$3d^{10}(^1S)4p$	$^2P^o$	3/2	30783.686	S48	FW96
			$3d^{10}(^1S)4d$	^2D	5/2	49942.057		

Energy Levels of Neutral Copper (Cu I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^{10}(^1S)4s$	^2S	1/2	0.000	SM90
$3d^94s^2$	^2D	5/2	11202.565	SM90
		3/2	13245.423	SM90
$3d^{10}(^1S)4p$	$^2P^o$	1/2	30535.302	SM90
		3/2	30783.686	SM90
$3d^9(^2D)4s4p(^3P^o)$	$^4P^o$	5/2	39018.652	SM90
		3/2	40113.99	SM90
		1/2	40943.73	SM90
$3d^9(^2D)4s4p(^3P^o)$	$^4F^o$	9/2	40909.138	SM90
		7/2	41153.433	SM90
		5/2	41562.895	SM90
		3/2	42302.47	SM90
$3d^{10}(^1S)5s$	^2S	1/2	43137.209	SM90
$3d^9(^2D)4s4p(^3P^o)$	$^4D^o$	7/2	43513.95	SM90
		5/2	44406.268	SM90
		3/2	44544.153	SM90
		1/2	44915.61	SM90
$3d^9(^2D)4s4p(^3P^o)$	$^2P^o$	1/2	45821.00	SM90
		3/2	45879.311	SM90
$3d^9(^2D)4s4p(^3P^o)$		3/2	46172.842	SM90
$3d^{10}(^1S)4d$	^2D	3/2	49935.200	SM90
		5/2	49942.057	SM90
$3d^9(^2D)4s4p(^1P^o)$	$^2F^o$	7/2	56029.95	SM90
		5/2	58119.28	SM90
Cu II $(^1S_0)$		*Limit*	**62317.44**	SM90

Persistent Lines of Singly-ionized Copper (Cu II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
200	1358.773	3.17	$3d^{10}$	^1S	0	0.000	R69	M03
			$3d^94p$	$^1P^o$	1	73595.813		
150	1367.951	2.13	$3d^{10}$	^1S	0	0.000	R69	M03
			$3d^94p$	$^3D^o$	1	73102.038		
300	1979.956		$3d^94s$	^3D	2	22847.131	R69	
			$3d^94p$	$^3D^o$	2	73353.292		
150	1999.698	2.21	$3d^94s$	^3D	3	21928.754	R69	CKNJ94
			$3d^94p$	$^3D^o$	3	71920.102		
200	2035.854		$3d^94s$	^3D	1	23998.381	R69	
			$3d^94p$	$^3D^o$	1	73102.038		
150	2037.127	1.41	$3d^94s$	^3D	2	22847.131	R69	CKNJ94
			$3d^94p$	$^3D^o$	3	71920.102		
250	2043.802		$3d^94s$	^3D	3	21928.754	R69	
			$3d^94p$	$^1F^o$	3	70841.470		
600	2135.981	3.33	$3d^94s$	^3D	3	21928.754	R69	CKNJ94
			$3d^94p$	$^3F^o$	4	68730.893		
600	2192.268	2.54	$3d^94s$	^3D	2	22847.131	R69	CKNJ94
			$3d^94p$	$^3F^o$	3	68447.741		
500	2218.108		$3d^94s$	^3D	2	22847.131	R69	
			$3d^94p$	$^3P^o$	1	67916.555		
700	2247.002	3.27	$3d^94s$	^3D	3	21928.754	R69	CKNJ94
			$3d^94p$	$^3P^o$	2	66418.687		

Energy Levels of Singly-ionized Copper (Cu II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^{10}$	^1S	0	0.000	SM90
$3d^94s$	^3D	3	21928.754	SM90
		2	22847.131	SM90
		1	23998.381	SM90
$3d^94s$	^1D	2	26264.568	SM90
$3d^94p$	$^3P^o$	2	66418.687	SM90
		1	67916.555	SM90
		0	68850.260	SM90
$3d^94p$	$^3F^o$	3	68447.741	SM90
		4	68730.893	SM90
		2	69867.983	SM90
$3d^94p$	$^1F^o$	3	70841.470	SM90
$3d^94p$	$^3D^o$	3	71920.102	SM90
		1	73102.038	SM90
		2	73353.292	SM90
$3d^94p$	$^1P^o$	1	73595.813	SM90
Cu III ($^2D_{5/2}$)		*Limit*	**163669.2**	SM90

Curium (Cm)
Atomic number = 96
Atomic weight = (247)

Isotope	Mass	Abundance	Spin	Mag moment
^{245}Cm	245.058830	0	7/2	0.5
^{246}Cm	246.067218	0	0	
^{247}Cm	247.070347	0	9/2	+0.37
^{248}Cm	248.072343	0	0	

Cm I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^7 6d 7s^2$ $^9\mathrm{D}^{\circ}_2$
Ionization energy: 48 324 cm^{-1} (5.9914 eV)

Cm II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^7 7s^2$ $^8\mathrm{S}^{\circ}_{7/2}$
Ionization energy: not available

Strong Lines of Curium (Cm)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
1000 P	2462.764	Cm II	WHGC76
1000	2617.169	Cm II	WHGC76
1000 P	2636.281	Cm II	WHGC76
1000	2651.171	Cm II	WHGC76
1000	2653.804	Cm II	WHGC76
1000	2725.682	Cm II	WHGC76
1000	2736.892	Cm II	WHGC76
1000	2748.039	Cm II	WHGC76
1000	2784.826	Cm II	WHGC76
1000	2811.618	Cm II	WHGC76
1000 P	2824.204	Cm II	WHGC76
1000 P	2833.580	Cm II	WHGC76
1000	2899.904	Cm II	WHGC76
1000 P	2912.965	Cm II	WHGC76
1000 P	2928.922	Cm II	WHGC76
1000	2996.180	Cm II	WHGC76
1000	2999.385	Cm I	WHGC76
1000 b	3014.867	Cm II	WHGC76
1000 P	3044.848	Cm II	WHGC76
1000 P	3109.690	Cm I	WHGC76
1000 P	3116.411	Cm I	WHGC76
1000	3135.099	Cm I	WHGC76
1000	3137.160	Cm I	WHGC76
1000	3147.325	Cm I	WHGC76
1000	3158.599	Cm I	WHGC76
1000	3169.983	Cm II	WHGC76
1000	3177.554	Cm I	WHGC76
1000	3179.098	Cm I	WHGC76
1000	3186.412	Cm I	WHGC76
1000	3188.109	Cm I	WHGC76
1000	3207.121	Cm II	WHGC76
1000	3207.708	Cm I	WHGC76
1000	3209.892	Cm II	WHGC76
1000	3209.943	Cm I	WHGC76
1000	3210.050	Cm II	WHGC76
1000	3220.759	Cm II	WHGC76
1000 P	3224.226	Cm I	WHGC76
1000 P	3225.108	Cm I	WHGC76

Strong Lines of Curium (Cm)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1000	3226.412	Cm II	WHGC76
1000	3230.278	Cm I	WHGC76
1000	3230.349	Cm II	WHGC76
1000	3236.737	Cm I	WHGC76
1000	3238.548	Cm II	WHGC76
1000 P	3242.657	Cm II	WHGC76
1000	3246.247	Cm I	WHGC76
1000 b	3252.675	Cm I	WHGC76
1000	3265.806	Cm I	WHGC76
1000	3280.450	Cm I	WHGC76
1000	3296.708	Cm II	WHGC76
1000 P	3304.849	Cm I	WHGC76
1000	3317.143	Cm I	WHGC76
1000	3374.696	Cm I	WHGC76
1000 P	3452.922	Cm I	WHGC76
1000 P	3458.338	Cm I	WHGC76
1000	3510.279	Cm I	WHGC76
1000	3522.355	Cm I	WHGC76
1000	3524.938	Cm I	WHGC76
1000	3542.059	Cm I	WHGC76
1000	3547.018	Cm I	WHGC76
1000	3547.922	Cm I	WHGC76
1000	3561.437	Cm I	WHGC76
1000 P	3572.949	Cm II	WHGC76
1000	3600.615	Cm I	WHGC76
1000	3639.944	Cm I	WHGC76
1000	3664.340	Cm I	WHGC76
1000	3709.426	Cm I	WHGC76
1000	3729.004	Cm I	WHGC76
1000	3732.351	Cm I	WHGC76
1000	3747.863	Cm I	WHGC76
1000	3763.045	Cm I	WHGC76
1000	3775.751	Cm I	WHGC76
1000 P	3816.304	Cm I	WHGC76
1000	3825.138	Cm I	WHGC76
1000	3833.315	Cm I	WHGC76
1000	3837.593	Cm I	WHGC76
1000	3842.000	Cm I	WHGC76
1000	3849.924	Cm I	WHGC76
1000	3854.106	Cm I	WHGC76
1000	3900.253	Cm I	WHGC76
1000 P	3904.064	Cm II	WHGC76
1000 P	3908.238	Cm II	WHGC76
1000 P	3936.666	Cm I	WHGC76
1000	3942.025	Cm I	WHGC76
1000	3944.146	Cm I	WHGC76
1000	3948.683	Cm I	WHGC76
1000	3953.362	Cm I	WHGC76
1000	3964.827	Cm I	WHGC76
1000 P	3995.100	Cm I	WHGC76
1000	4016.17	Cm I	WHGC76
1000	4031.76	Cm I	WHGC76
1000	4048.29	Cm I	WHGC76
1000	4049.65	Cm I	WHGC76
1000	4113.29	Cm I	WHGC76
1000	4129.71	Cm I	WHGC76
1000 P	4207.66	Cm II	WHGC76
1000 P	4211.62	Cm I	WHGC76
1000	4266.45	Cm I	WHGC76

Strong Lines of Curium (Cm)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1000	4293.00	Cm I	WHGC76
1000 P	4330.82	Cm I	WHGC76
1000	4345.69	Cm I	WHGC76
1000	4447.77	Cm I	WHGC76
1000 P	4459.16	Cm I	WHGC76
1000 P	4608.40	Cm I	WHGC76
1000	5846.07	Cm I	WHGC76
1000 P	5952.41	Cm I	WHGC76
1000	6058.90	Cm I	WHGC76
1000	6243.35	Cm I	WHGC76
1000 P	6376.71	Cm I	WHGC76
1000	6554.41	Cm I	WHGC76
1000	6640.17	Cm I	WHGC76
1000	6686.87	Cm I	WHGC76
1000 P	6706.85	Cm I	WHGC76
1000	6726.68	Cm I	WHGC76
1000	6793.15	Cm I	WHGC76
1000 P	7162.69	Cm I	WHGC76
1000 P	7720.47	Cm I	WHGC76
1000 P	8392.37	Cm I	WHGC76
1000 P	10542.98	Cm I	WHGC76
1000 P	10792.25	Cm I	WHGC76
1000	11834.28	Cm I	CBV76
1000	12464.99	Cm I	CBV76
1000	13004.56	Cm I	CBV76
1000	13258.18	Cm I	CBV76
1000	13289.84	Cm I	CBV76
1000	13480.54	Cm I	CBV76
1000	13590.01	Cm I	CBV76
1000	13644.77	Cm I	CBV76
1000	13789.52	Cm I	CBV76
1000	13908.46	Cm I	CBV76
1000	14235.27	Cm I	CBV76
1000	14334.52	Cm I	CBV76
1000	14563.41	Cm I	CBV76
1000	14580.23	Cm I	CBV76
1000	15018.13	Cm I	CBV76

Persistent Lines of Neutral Curium (Cm I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3109.690		$5f^87s^2$	^{7}F	6	1214.203	WHGC76	
			$5f^76d7s^2$	o	6	33362.424		
1000	3116.411		$5f^76d7s^2$	^{9}D^o	2	0.000	WHGC76	
			$5f^76d7s7p$	^{5}P	2	32078.886		
1000	3224.226		$5f^76d7s^2$	^{9}D^o	5	1764.268	WHGC76	
			$5f^76d7s7p$		4	32770.516		
1000	3225.108		$5f^76d7s^2$	^{9}D^o	5	1764.268	WHGC76	
			$5f^76d7s7p$		6	32762.036		
1000	3304.849		$5f^87s^2$	^{7}F	6	1214.203	WHGC76	
				o	7	31464.053		
1000	3452.922		$5f^76d7s^2$	^{9}D^o	6	3809.355	WHGC76	
			$5f^76d7s7p$		6	32762.036		

Persistent Lines of Neutral Curium (Cm I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3458.338		$5f^87s^2$	^7F	6	1214.203	WHGC76	
				o	5	30121.545		
1000	3816.304		$5f^87s^2$	^7F	6	1214.203	WHGC76	
				o	7	27410.123		
1000	3936.666		$5f^87s^2$	^7F	6	1214.203	WHGC76	
			$5f^8()7s7p(^1P^o_1)$	$(6,1)^o$	7	26609.213		
1000	3995.100		$5f^76d7s^2$	$^9D^o$	2	0.000	WHGC76	
			$5f^76d7s7p$	^7D	3	25023.578		
1000	4211.62		$5f^87s^2$	^7F	6	1214.203	WHGC76	
			$5f^76d^27s$	$^9F^o$	7	24951.328		
1000	4330.82		$5f^76d7s^2$	$^9D^o$	2	0.000	WHGC76	
			$5f^76d7s7p$	^9D	3	23083.822		
1000	4459.16		$5f^87s^2$	^7F	6	1214.203	WHGC76	
			$5f^8()7s7p(^3P^o_2)$	$(6,2)^o$	6	23633.638		
1000	4608.40		$5f^87s^2$	^7F	6	1214.203	WHGC76	
			$5f^8()7s7p(^3P^o_2)$	$(6,2)^o$	7	22907.611		
1000	5952.41		$5f^87s^2$	^7F	6	1214.203	WHGC76	
			$5f^8(^7F_6)7s7p(^3P^o_1)$	$(6,1)^o$	7	18009.483		
1000	6376.71		$5f^76d7s^2$	$^9D^o$	2	0.000	WHGC76	
			$5f^76d7s7p$	^{11}F	3	15677.750		
1000	6706.85		$5f^76d7s^2$	$^9D^o$	4	815.655	WHGC76	
			$5f^7(^8S^o)7s^27p$	(7/2,3/2)	5	15721.679		
1000	7162.69		$5f^76d7s^2$	$^9D^o$	5	1764.268	WHGC76	
			$5f^7(^8S^o)7s^27p$	(7/2,3/2)	5	15721.679		
1000	7720.47		$5f^76d7s^2$	$^7D^o$	5	9064.880	WHGC76	
			$5f^76d7s7p$	^9F	5	22013.913		
1000	8392.37		$5f^76d7s^2$	$^9D^o$	6	3809.355	WHGC76	
			$5f^7(^8S^o)7s^27p$	(7/2,3/2)	5	15721.679		
1000	10542.98		$5f^76d7s^2$	$^9D^o$	3	302.153	WHGC76	
			$5f^7(^8S^o)7s^27p$	(7/2,1/2)	4	9784.543		
1000	10792.25		$5f^76d7s^2$	$^9D^o$	2	0.000	WHGC76	
			$5f^7(^8S^o)7s^27p$	(7/2,1/2)	3	9263.374		

Energy Levels of Neutral Curium (Cm I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^7 6d7s^2$	$^9D^o$	2	0.000	BW92b
		3	302.153	BW92b
		4	815.655	BW92b
		5	1764.268	BW92b
		6	3809.355	BW92b
$5f^8 7s^2$	^7F	6	1214.203	BW92b
		4	4877.610	BW92b
		5	5136.519	BW92b
		3	7208.827	BW92b
		2	7521.122	BW92b
		1	8696.688	BW92b
		0	8887.265	BW92b
$5f^7 6d7s^2$	$^7D^o$	4	8958.447	BW92b
		5	9064.880	BW92b
		3	9458.053	BW92b
		2	9671.692	BW92b
		1	10133.857	BW92b
$5f^7(^8S^o)7s^2 7p$	(7/2,1/2)	3	9263.374	BW92b
		4	9784.543	BW92b
$5f^7 6d7s7p$	^{11}F	3	15677.750	BW92b
$5f^7(^8S^o)7s^2 7p$	(7/2,3/2)	5	15721.679	BW92b
$5f^8(^7F_6)7s7p(^3P^o_1)$	$(6,1)^o$	7	18009.483	BW92b
$5f^7 6d7s7p$	^9F	5	22013.913	BW92b
$5f^7 6d7s7p$	^9D	3	23083.822	BW92b
$5f^8()7s7p(^3P^o_2)$	$(6,2)^o$	7	22907.611	BW92b
$5f^8()7s7p(^3P^o_2)$	$(6,2)^o$	6	23633.638	BW92b
$5f^7 6d^2 7s$	$^9F^o$	7	24951.328	BW92b
$5f^7 6d7s7p$	^7D	3	25023.578	BW92b
$5f^8()7s7p(^1P^o_1)$	$(6,1)^o$	7	26609.213	BW92b
	^{o}	7	27410.123	BW92b
	^{o}	5	30121.545	BW92b
	^{o}	7	31464.053	BW92b
$5f^7 6d7s7p$	^5P	2	32078.886	BW92b
$5f^7 6d7s7p$		6	32762.036	BW92b
$5f^7 6d7s7p$		4	32770.516	BW92b
$5f^7 6d7s^2$	^{o}	6	33362.424	BW92b
Cm II ($^8S^o_{7/2}$)		*Limit*	**48324**	KDEE97

Persistent Lines of Singly-ionized Curium (Cm II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2462.764		$5f^7 7s^2$	$^8S^o$	7/2	0.000	WHGC76	
			$5f^7(^8S^o)7s7p(^1P^o)$	^8P	5/2	40592.510		
1000	2636.281		$5f^7 6d7s$	$^{10}D^o$	7/2	4411.540	WHGC76	
			$5f^7 6d7p$	^8D	9/2	42332.445		
1000	2824.204		$5f^7 7s^2$	$^8S^o$	7/2	0.000	WHGC76	
			$5f^7(^8S^o)7s7p(^3P^o)$	^8P	9/2	35397.790		
1000	2833.580		$5f^7 7s^2$	$^8S^o$	7/2	0.000	WHGC76	
			$5f^7 6d7p$	^{10}D	5/2	35280.665		
1000	2912.965		$5f^8 7s$	^8F	13/2	2093.870	WHGC76	
				^{o}	13/2	36413.100		
1000	2928.922		$5f^8 7s$	^8F	13/2	2093.870	WHGC76	
				^{o}	15/2	36226.140		
1000	3044.848		$5f^8 7s$	^8F	13/2	2093.870	WHGC76	
			$5f^8(^7F_6)7p_{3/2}$	$(6,3/2)^o$	13/2	34926.680		
1000	3242.657		$5f^8 7s$	^8F	13/2	2093.870	WHGC76	
			$5f^7 6d^2$	^{o}	13/2	32923.880		
1000	3572.949		$5f^7 7s^2$	$^8S^o$	7/2	0.000	WHGC76	
			$5f^7(^8S^o)7s7p(^3P^o)$	^8P	5/2	27980.085		
1000	3904.064		$5f^8 7s$	^8F	13/2	2093.870	WHGC76	
			$5f^8(^7F_6)7p_{1/2}$	$(6,1/2)^o$	13/2	27700.945		
1000	3908.238		$5f^7 7s^2$	$^8S^o$	7/2	0.000	WHGC76	
			$5f^7(^8S^o)7s7p(^3P^o)$	^{10}P	9/2	25579.725		
1000	4207.66		$5f^8 7s$	^6F	11/2	3941.439	WHGC76	
			$5f^8(^7F_6)7p_{1/2}$	$(6,1/2)^o$	13/2	27700.945		

Energy Levels of Singly-ionized Curium (Cm II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^7 7s^2$	$^8S^o$	7/2	0.000	BW92b
$5f^8 7s$	^8F	13/2	2093.870	BW92b
		9/2	5919.263	BW92b
		11/2	6347.900	BW92b
		7/2	7067.133	BW92b
		5/2	8436.099	BW92b
		3/2	9127.846	BW92b
		1/2	9801.305	BW92b
$5f^8 7s$	^6F	11/2	3941.439	BW92b
		9/2	8144.306	BW92b
		7/2	9073.572	BW92b
		5/2	10433.776	BW92b
		3/2	11250.886	BW92b
		1/2	11978.441	BW92b

Energy Levels of Singly-ionized Curium (Cm II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^7 6d7s$	$^{10}D^o$	5/2	4010.645	BW92b
		7/2	4411.540	BW92b
		9/2	5067.900	BW92b
		11/2	6202.430	BW92b
		13/2	8425.360	BW92b
$5f^7 6d7s$	$^8D^o$	3/2	8199.890	BW92b
		5/2	8474.775	BW92b
		7/2	9012.480	BW92b
		9/2	10134.785	BW92b
		11/2	12913.101	BW92b
$5f^7(^8S^o)7s7p(^3P^o)$	^{10}P	9/2	25579.725	BW92b
$5f^8(^7F_6)7p_{1/2}$	$(6,1/2)^o$	13/2	27700.945	BW92b
$5f^7(^8S^o)7s7p(^3P^o)$	^8P	5/2	27980.085	BW92b
$5f^7 6d^2$	^{o}	13/2	32923.880	BW92b
$5f^8(^7F_6)7p_{3/2}$	$(6,3/2)^o$	13/2	34926.680	BW92b
$5f^7 6d7p$	^{10}D	5/2	35280.665	BW92b
$5f^7(^8S^o)7s7p(^3P^o)$	^8P	9/2	35397.790	BW92b
	^{o}	15/2	36226.140	BW92b
	^{o}	13/2	36413.100	BW92b
$5f^7(^8S^o)7s7p(^1P^o)$	^8P	5/2	40592.510	BW92b
$5f^7 6d7p$	^8D	9/2	42332.445	BW92b
Cm III ($5f^8\ ^7F_6$?)		*Limit*		

Dysprosium (Dy)
Atomic number = 66
Atomic weight = 162.50

Isotope	Mass	Abundance	Spin	Mag moment
^{160}Dy	159.925193	2.34%	0	
^{161}Dy	160.926930	18.9%	5/2	−0.48
^{162}Dy	161.926795	25.5%	0	
^{163}Dy	162.928728	24.9%	5/2	+0.673
^{164}Dy	163.929171	28.2%	0	

Dy I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^{10} 6s^2\ {}^5\mathrm{I}_8$
Ionization energy: 47 900 cm^{-1} (5.9389 eV)

Dy II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^9 ({}^5I8) 6s\ (8,1/2)_{17/2}$
Ionization energy: 94 100 cm^{-1} (11.67 eV)

Strong Lines of Dysprosium (Dy)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
25	2623.688	Dy I	NG00
20	2634.803	Dy II	NG00
30	3038.288	Dy II	NG00
40	3135.384	Dy II	NG00
50	3156.521	Dy II	NG00
30	3162.833	Dy II	NG00
50	3169.992	Dy II	NG00
40	3216.627	Dy II	NG00
50	3251.268	Dy II	NG00
40	3280.091	Dy II	NG00
50	3308.883	Dy II	NG00
40	3316.316	Dy II	NG00
50	3319.878	Dy II	NG00
40	3340.993	Dy II	NG00
250 P	3385.014	Dy II	NG00
30	3388.850	Dy II	NG00
150	3393.567	Dy II	NG00
60	3396.156	Dy II	NG00
250 P	3407.792	Dy II	NG00
60	3413.783	Dy II	NG00
40	3419.631	Dy II	NG00
90	3434.367	Dy II	NG00
60	3441.446	Dy II	NG00
150	3445.572	Dy II	NG00
40	3446.992	Dy II	NG00
120	3454.315	Dy II	NG00
60	3456.557	Dy II	NG00
200 P	3460.966	Dy II	NG00
30	3468.429	Dy II	NG00
60	3477.067	Dy II	NG00
200 P	3494.489	Dy II	NG00
40	3498.707	Dy II	NG00
40	3504.528	Dy II	NG00
40	3505.452	Dy II	NG00
60	3506.812	Dy II	NG00
200	3523.979	Dy II	NG00
1000 P	3531.703	Dy II	NG00

Strong Lines of Dysprosium (Dy)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	3534.958	Dy II	NG00
250 P	3536.018	Dy II	NG00
200	3538.516	Dy II	NG00
80	3542.327	Dy II	NG00
60	3546.832	Dy II	NG00
200	3550.217	Dy II	NG00
100	3551.615	Dy II	NG00
100	3563.146	Dy II	NG00
40	3573.830	Dy II	NG00
60	3574.152	Dy II	NG00
200	3576.242	Dy II	NG00
80	3576.865	Dy II	NG00
40	3577.983	Dy II	NG00
150	3585.058	Dy II	NG00
60	3585.778	Dy II	NG00
50	3591.416	Dy II	NG00
80	3595.037	Dy II	NG00
25	3600.374	Dy II	NG00
80	3606.121	Dy II	NG00
50	3629.419	Dy II	NG00
200 P	3630.239	Dy II	NG00
50	3640.249	Dy II	NG00
500 P	3645.396	Dy II	NG00
50	3648.786	Dy II	NG00
30	3664.614	Dy II	NG00
25	3666.838	Dy I	NG00
40	3672.296	Dy II	NG00
60	3674.086	Dy II	NG00
100	3676.586	Dy II	NG00
40	3678.504	Dy I	NG00
50	3684.850	Dy I	NG00
80	3685.777	Dy I	NG00
200 P	3694.811	Dy II	NG00
40	3698.206	Dy II	NG00
70	3724.445	Dy II	NG00
20	3727.996	Dy I	NG00
60	3739.340	Dy I	NG00
50	3747.813	Dy II	NG00
60	3753.504	Dy II	NG00
60	3753.747	Dy II	NG00
80	3757.049	Dy I	NG00
200 P	3757.367	Dy II	NG00
40	3767.625	Dy I	NG00
20	3771.106	Dy I	NG00
40	3773.051	Dy I	NG00
25	3774.714	Dy I	NG00
25	3781.467	Dy I	NG00
150	3786.176	Dy II	NG00
70	3788.438	Dy II	NG00
30	3791.870	Dy II	NG00
25	3806.269	Dy II	NG00
30	3812.272	Dy I	NG00
60	3816.762	Dy II	NG00
30	3825.682	Dy II	NG00
100	3836.504	Dy II	NG00
25	3840.890	Dy I	NG00
60	3841.307	Dy II	NG00
20	3844.361	Dy I	NG00
25	3847.019	Dy I	NG00

Strong Lines of Dysprosium (Dy)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	3853.026	Dy II	NG00
25	3858.402	Dy I	NG00
100	3868.803	Dy I	NG00
40	3869.861	Dy II	NG00
300 P	3872.103	Dy II	NG00
50	3873.986	Dy II	NG00
250 P	3898.528	Dy II	NG00
30	3917.286	Dy I	NG00
25	3927.860	Dy I	NG00
30	3930.147	Dy I	NG00
90	3931.526	Dy II	NG00
25	3936.701	Dy I	NG00
500 P	3944.679	Dy II	NG00
40	3957.791	Dy II	NG00
25	3962.590	Dy I	NG00
600 P	3968.384	Dy II	NG00
120	3978.564	Dy II	NG00
60	3981.926	Dy II	NG00
70	3983.651	Dy II	NG00
40	3984.210	Dy II	NG00
70	3996.688	Dy II	NG00
400 P	4000.449	Dy II	NG00
25	4005.837	Dy I	NG00
30	4013.822	Dy I	NG00
25	4023.715	Dy I	NG00
800 P	4045.970	Dy I	NG00
70	4050.566	Dy II	NG00
110	4073.119	Dy II	NG00
300 P	4077.965	Dy II	NG00
25	4085.336	Dy I	NG00
25	4096.100	Dy I	NG00
200 P	4103.305	Dy II	NG00
50	4103.874	Dy I	NG00
70	4111.340	Dy II	NG00
40	4129.423	Dy II	NG00
20	4130.352	Dy I	NG00
25	4133.850	Dy I	NG00
50	4143.100	Dy II	NG00
60	4146.060	Dy I	NG00
400 P	4167.974	Dy I	NG00
25	4171.931	Dy I	NG00
60	4183.721	Dy I	NG00
800 P	4186.821	Dy I	NG00
140 P	4191.640	Dy I	NG00
400 P	4194.846	Dy I	NG00
50	4198.015	Dy I	NG00
40	4201.301	Dy I	NG00
40	4202.240	Dy I	NG00
30	4211.238	Dy I	NG00
1000 P	4211.714	Dy I	NG00
110	4213.180	Dy I	NG00
250 P	4215.159	Dy I	NG00
300 P	4218.092	Dy I	NG00
300 P	4221.110	Dy I	NG00
30	4222.212	Dy I	NG00
150 P	4225.154	Dy I	NG00
40	4232.024	Dy I	NG00
40	4239.856	Dy I	NG00
30	4245.912	Dy I	NG00

Strong Lines of Dysprosium (Dy)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	4308.630	Dy II	NG00
20	4325.868	Dy I	NG00
30	4449.705	Dy II	NG00
25	4577.775	Dy I	NG00
130 P	4589.364	Dy I	NG00
60	4612.258	Dy I	NG00
20	4957.347	Dy II	NG00
15	6259.087	Dy I	NG00

Persistent Lines of Neutral Dysprosium (Dy I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	4045.970	1.92	$4f^{10}6s^2$	^{5}I	8	0.000	NG00	WLN00
			$4f^{10}(^5I_8)6s6p(^1P^o_1)$	$(8,1)^o$	7	24708.971		
400	4167.974	1.92	$4f^{10}6s^2$	^{5}I	7	4134.222	NG00	WLN00
			$4f^{10}(^5I_7)6s6p(^1P^o_1)$	$(7,1)^o$	6	28119.931		
800	4186.821	1.26	$4f^{10}6s^2$	^{5}I	8	0.000	NG00	WLN00
			$4f^{10}(^5I_8)6s6p(^1P^o_1)$	$(8,1)^o$	8	23877.739		
140	4191.640	0.71	$4f^{10}6s^2$	^{5}I	7	4134.222	NG00	WLN00
			$4f^9(^6H^o)5d^2(^3F)(^8L^o)6s$	^{o}	7	27984.513		
400	4194.846	0.88	$4f^{10}6s^2$	^{5}I	8	0.000	NG00	WLN00
			$4f^9(^6H^o)5d^2(^3F)(^8K^o)6s$	^{o}	8	23832.060		
1000	4211.714	2.08	$4f^{10}6s^2$	^{5}I	8	0.000	NG00	WLN00
			$4f^{10}(^5I_8)6s6p(^1P^o_1)$	$(8,1)^o$	9	23736.610		
250	4215.159	0.81	$4f^{10}6s^2$	^{5}I	7	4134.222	NG00	WLN00
			$4f^9(^6H^o)5d^2(^3P)(^8I^o)6s$	^{o}	8	27851.435		
300	4218.092	1.20	$4f^{10}6s^2$	^{5}I	7	4134.222	NG00	WLN00
			$4f^{10}(^5I_7)6s6p(^1P^o_1)$	$(7,1)^o$	7	27834.933		
300	4221.110	1.28	$4f^{10}6s^2$	^{5}I	7	4134.222	NG00	WLN00
			$4f^{10}(^5I_7)6s6p(^1P^o_1)$	$(7,1)^o$	8	27818.000		
150	4225.154	1.95	$4f^{10}6s^2$	^{5}I	6	7050.603	NG00	WLN00
			$4f^{10}(^5I_6)6s6p(^1P^o_1)$	$(6,1)^o$	7	30711.717		
130	4589.364	0.137	$4f^{10}6s^2$	^{5}I	8	0.000	NG00	WLN00
			$4f^9(^6H^o)5d6s^2$	$^5K^o$	7	21783.407		

Energy Levels of Neutral Dysprosium (Dy I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{10}6s^2$	^5I	8	0.000	NG00
		7	4134.222	NG00
		6	7050.603	NG00
		5	9211.591	NG00
		4	10925.277	NG00
$4f^9(^6H^o)5d6s^2$	$^7H^o$	8	7565.610	NG00
		7	8519.210	NG00
		6	10088.802	NG00
		5	12298.551	NG00
		4	13952.001	NG00
		3	15254.936	NG00
		2	—	
$4f^9(^6H^o)5d6s^2$	$^7I^o$	9	9990.974	NG00
		8	12007.121	NG00
		7	14367.806	NG00
		6	14970.701	NG00
		5	16684.731	NG00
		4	—	
		3	—	
$4f^9(^6H^o)5d6s^2$	$^5K^o$	9	13495.932	NG00
		8	19688.595	NG00
		7	21783.407	NG00
		6	23464.019	NG00
		5	24881.867	NG00
$4f^{10}(^5I_8)6s6p(^1P^o_1)$	$(8,1)^o$	9	23736.610	NG00
		8	23877.739	NG00
		7	24708.971	NG00
$4f^9(^6H^o)5d^2(^3F)(^8K^o)6s$	^{o}	8	23832.060	NG00
$4f^{10}(^5I_7)6s6p(^1P^o_1)$	$(7,1)^o$	8	27818.000	NG00
		7	27834.933	NG00
		6	28119.931	NG00
$4f^9(^6H^o)5d^2(^3P)(^8I^o)6s$	^{o}	8	27851.435	NG00
$4f^9(^6H^o)5d^2(^3F)(^8L^o)6s$	^{o}	7	27984.513	NG00
$4f^{10}(^5I_6)6s6p(^1P^o_1)$	$(6,1)^o$	7	30711.717	NG00
		6	30778.958	NG00
		5	—	
Dy II $(^5I_8)6s_{1/2}$ $(8,1/2)_{17/2}$		*Limit*	**47900**	WSPC78

Persistent Lines of Singly-ionized Dysprosium (Dy II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
250	3385.014	0.539	$4f^{10}(^5I_8)6s_{1/2}$ $4f^{10}(^5I)6p$	(8,1/2) $^4H^o$	15/2 13/2	828.314 30361.810	NG00	WLN00
250	3407.792	0.488	$4f^{10}(^5I_8)6s_{1/2}$ $4f^{10}(^5I)6p$	(8,1/2) $^6I^o$	17/2 17/2	0.000 29336.093	NG00	WLN00
200	3460.966	0.297	$4f^{10}(^5I_8)6s_{1/2}$ $4f^{10}(^5I)6p$	(8,1/2) ^{o}	17/2 15/2	0.000 28885.393	NG00	WLN00
200	3494.489	0.315	$4f^{10}(^5I_8)6s_{1/2}$ $4f^{10}(^5I)6p$	(8,1/2) ^{o}	15/2 15/2	828.314 29436.610	NG00	WLN00
1000	3531.703	1.56	$4f^{10}(^5I_8)6s_{1/2}$ $4f^{10}(^5I)6p$	(8,1/2) $^6K^o$	17/2 19/2	0.000 28306.843	NG00	WLN00
250	3536.018	1.01	$4f^{10}(^5I_7)6s_{1/2}$ $4f^9(^6H^o)5d^2(^3F)$	(7,1/2) ^{o}	15/2 17/2	4341.104 32613.423	NG00	WLN00
200	3630.239	0.305	$4f^{10}(^5I_7)6s_{1/2}$ $4f^{10}(^5I)6p$	(7,1/2) $^6K^o$	15/2 17/2	4341.104 31879.655	NG00	WLN00
500	3645.396	0.620	$4f^{10}(^5I_8)6s_{1/2}$ $4f^9(^6H^o)5d^2(^1G)$	(8,1/2) ^{o}	15/2 17/2	828.314 28252.357	NG00	WLN00
200	3694.811	0.237	$4f^{10}(^5I_8)6s_{1/2}$ $4f^9(^6H^o)5d^2(^3F)$	(8,1/2) ^{o}	15/2 15/2	828.314 27885.593	NG00	WLN00
200	3757.367	0.201	$4f^{10}(^5I_8)6s_{1/2}$ $4f^9(^6H^o)5d^2(^3P)$	(8,1/2) ^{o}	15/2 15/2	828.314 27435.132	NG00	WLN00
300	3872.103	0.254	$4f^{10}(^5I_8)6s_{1/2}$ $4f^{10}(^5I)6p$	(8,1/2) ^{o}	17/2 17/2	0.000 25818.435	NG00	WLN00
250	3898.528	0.469	$4f^{10}(^5I_7)6s_{1/2}$ $4f^9(^6H^o)5d^2(^3F)$	(7,1/2) ^{o}	13/2 15/2	4755.673 30399.107	NG00	WLN00
500	3944.679	0.307	$4f^{10}(^5I_8)6s_{1/2}$ $4f^9(^6H^o)5d^2(^3P)$	(8,1/2) ^{o}	17/2 17/2	0.000 25343.427	NG00	WLN00
600	3968.384	0.455	$4f^{10}(^5I_8)6s_{1/2}$ $4f^{10}(^5I)6p$	(8,1/2) ^{o}	17/2 15/2	0.000 25192.039	NG00	WLN00
400	4000.449	0.254	$4f^{10}(^5I_8)6s_{1/2}$ $4f^{10}(^5I)6p$	(8,1/2) ^{o}	15/2 17/2	828.314 25818.435	NG00	WLN00
300	4077.965	0.202	$4f^{10}(^5I_8)6s_{1/2}$ $4f^9(^6H^o)5d^2(^3P)$	(8,1/2) ^{o}	15/2 17/2	828.314 25343.427	NG00	WLN00
200	4103.305	0.104	$4f^{10}(^5I_8)6s_{1/2}$ $4f^{10}(^5I)6p$	(8,1/2) ^{o}	15/2 15/2	828.314 25192.039	NG00	WLN00

Energy Levels of Singly-ionized Dysprosium (Dy II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{10}(^5I_8)6s_{1/2}$	(8,1/2)	17/2	0.000	NG00
		15/2	828.314	NG00
$4f^{10}(^5I_7)6s_{1/2}$	(7,1/2)	15/2	4341.104	NG00
		13/2	4755.673	NG00
$4f^{10}(^5I_6)6s_{1/2}$	(6,1/2)	11/2	7463.905	NG00
		13/2	7485.117	NG00
$4f^{10}(^5I_5)6s_{1/2}$	(5,1/2)	9/2	9432.105	NG00
		11/2	9871.028	NG00
$4f^9(^6H^o)5d(^7H^o)6s$	$^8H^o$	17/2	10594.197	NG00
		15/2	11394.912	NG00
		13/2	12674.694	NG00
		11/2	14347.205	NG00
		9/2	16015.394	NG00
		7/2	—	
		5/2	—	
		3/2	—	
$4f^{10}(^5I_4)6s_{1/2}$	(4,1/2)	7/2	10953.984	NG00
		9/2	11801.052	NG00
$4f^9 6s^2$	$^6H^o$	15/2	12336.314	NG00
		13/2	15822.169	NG00
		11/2	18121.480	NG00
		9/2	—	
		7/2	—	
		5/2	—	
$4f^{10}(^5I)6p$	^{o}	15/2	25192.039	NG00
$4f^9(^6H^o)5d^2(^3P)$	^{o}	17/2	25343.427	NG00
$4f^{10}(^5I)6p$	^{o}	17/2	25818.435	NG00
$4f^9(^6H^o)5d^2(^3P)$	^{o}	15/2	27435.132	NG00
$4f^9(^6H^o)5d^2(^3F)$	^{o}	15/2	27885.593	NG00
$4f^9(^6H^o)5d^2(^1G)$	^{o}	17/2	28252.357	NG00
$4f^{10}(^5I)6p$	$^6K^o$	19/2	28306.843	NG00
$4f^{10}(^5I)6p$	^{o}	15/2	28885.393	NG00
$4f^{10}(^5I)6p$	$^6I^o$	17/2	29336.093	NG00
$4f^{10}(^5I)6p$	^{o}	15/2	29436.610	NG00
$4f^{10}(^5I)6p$	$^4H^o$	13/2	30361.810	NG00
$4f^9(^6H^o)5d^2(^3F)$	^{o}	15/2	30399.107	NG00
$4f^{10}(^5I)6p$	$^6K^o$	17/2	31879.655	NG00
$4f^9(^6H^o)5d^2(^3F)$	^{o}	17/2	32613.423	NG00
Dy III ($^5I_8$)		*Limit*	**94100**	MZH78

Einsteinium (Es)

Atomic number = 99
Atomic weight = (254)

Isotope	Mass	Abundance	Spin	Mag moment
^{252}Es	252.082944	0	5	
^{253}Es	253.084818	0	7/2	4.10
^{254}Es	254.088019	0	7	
^{255}Es	255.090270	0	7/2	

Es I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^{11} 7s^2\ {}^4\mathrm{I}^{\mathrm{o}}_{15/2}$
Ionization energy: 51 800 cm^{-1} (6.42 eV)

Es II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^{11} ({}^4I_{15/2}) 7s\ (15/2,1/2)^{\mathrm{o}}_{8}$
Ionization energy: [97 000] cm^{-1} (12.0 eV)

Strong Lines of Einsteinium (Es)

Intensity		Wavelength (Å)	Spectrum	Ref
		Air		
1000	P,s	2708.66	Es II	WLGC74
100	s	2724.57	Es II	WLGC74
100	l	2765.76	Es II	WLGC74
300	P,l	2787.10	Es II	WLGC74
100	l	2796.11	Es II	WLGC74
300*	l	2815.15	Es I	WLGC74
300*	P,l	2815.15	Es II	WLGC74
300		2907.03	Es	WLGC74
100	l	3065.40	Es	WLGC74
300		3135.25	Es I	WLGC74
100	l	3154.27	Es II	WLGC74
1000		3413.17	Es	WLGC74
1000	P,s	3428.48	Es I	WLGC74
300	s	3445.25	Es	WLGC74
300		3452.36	Es	WLGC74
300	s	3484.59	Es I	WLGC74
1000	P,s	3498.11	Es I	WLGC74
1000	P,l	3514.33	Es I	WLGC74
1000	P,s	3521.38	Es I	WLGC74
1000	P,s	3523.49	Es I	WLGC74
1000	s	3536.01	Es	WLGC74
1000	P,s	3547.75	Es II	WLGC74
1000	P,l	3555.34	Es I	WLGC74
300	s	3556.65	Es	WLGC74
300	s	3560.92	Es	WLGC74
100	s	3575.68	Es	WLGC74
100	s	3582.95	Es II	WLGC74
300		3590.28	Es	WLGC74
100		3595.47	Es	WLGC74
1000	P,s	3602.43	Es II	WLGC74
100	s	3606.75	Es II	WLGC74
300	l	3631.09	Es	WLGC74
1000	s	3632.87	Es	WLGC74
100	l	3651.94	Es	WLGC74
1000	P,l	3670.01	Es II	WLGC74
100	l	3720.56	Es II	WLGC74
1000	P,l	3728.55	Es II	WLGC74
1000	l	3792.99	Es	WLGC74

Strong Lines of Einsteinium (Es)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
1000	P,l	3801.49	Es I	WLGC74
300		3930.77	Es I	WLGC74
1000	s	4082.24	Es	WLGC74
300	l	4107.59	Es	WLGC74
100	l	4176.94	Es I	WLGC74
100		4789.93	Es	WLGC74
100	h	4802.21	Es	WLGC74
300	h	4958.29	Es	WLGC74
1000	s	5052.08	Es	WLGC74
100	s	5102.93	Es	WLGC74
1000	P,s	5161.74	Es I	WLGC74
1000	P,l	5204.40	Es I	WLGC74
300	P,l	5615.51	Es I	WLGC74

Persistent Lines of Neutral Einsteinium (Es I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3428.48		$5f^{11}7s^2$	$^4I^o$	15/2	0.00	WLGC74	
					15/2,17/2	29159.28		
1000	3498.11		$5f^{11}7s^2$	$^4I^o$	15/2	0.00	WLGC74	
			$5f^{10}6d7s^2$		15/2,17/2	28578.60		
1000	3514.33		$5f^{11}7s^2$	$^4I^o$	15/2	0.00	WLGC74	
			$5f^{11}7s7p$		13/2	28447.02		
1000	3521.38		$5f^{11}7s^2$	^{o}	13/2	10244.29	WLGC74	
					11/2	38634.04		
1000	3523.49		$5f^{11}7s^2$	$^4I^o$	15/2	0.00	WLGC74	
			$5f^{10}6d7s^2$		13/2,15/2,17/2	28372.78		
1000	3555.34		$5f^{11}7s^2$	$^4I^o$	15/2	0.00	WLGC74	
			$5f^{10}6d7s^2$		13/2	28118.65		
1000	3801.49		$5f^{11}7s^2$	$^4F^o$	9/2	7894.54	WLGC74	
					9/2	34192.6		
1000	5161.74		$5f^{11}7s^2$	$^4I^o$	15/2	0.00	WLGC74	
			$5f^{10}6d7s^2$	^6I	17/2	19367.85		
1000	5204.40		$5f^{11}7s^2$	$^4I^o$	15/2	0.00	WLGC74	
			$5f^{11}7s7p$	^6I	17/2	19209.15		
300	5615.51		$5f^{11}7s^2$	$^4I^o$	15/2	0.00	WLGC74	
			$5f^{11}7s7p$	^6I	15/2	17803.09		

Energy Levels of Neutral Einsteinium (Es I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^{11}7s^2$	$^4I^o$	15/2	0.00	BW92b
$5f^{11}7s^2$	$^4F^o$	9/2	7894.54	BW92b
$5f^{11}7s^2$	$^2H^o$	11/2	8759.27	BW92b
$5f^{11}7s^2$	^{o}	13/2	10244.29	BW92b
$5f^{11}7s7p$	^6I	15/2	17803.09	BW92b
$5f^{11}7s7p$	^6I	17/2	19209.15	BW92b
$5f^{10}6d7s^2$	^6I	17/2	19367.85	BW92b
$5f^{11}7s7p$		13/2,15/2	19788.32	BW92b
$5f^{10}6d7s^2$		13/2	28118.65	BW92b
$5f^{10}6d7s^2$		13/2,15/2,17/2	28372.78	BW92b
$5f^{11}7s7p$		13/2	28447.02	BW92b
$5f^{10}6d7s^2$		15/2,17/2	28578.60	BW92b
$5f^{10}6d7s^2$		15/2,17/2	28689.74	BW92b
		15/2,17/2	29159.28	BW92b
$5f^{11}7s7p$		13/2	29204.89	BW92b
		11/2	31829.03	BW92b
$5f^{10}6d7s^2$		13/2	31886.3	BW92b
		13/2	32770.06	BW92b
$5f^{11}(^4I^o_{15/2})7s8s(^3S_1)$	$(15/2,1)^o$	17/2	33829.35	BW92b
$5f^{11}(^4I^o_{15/2})7s8s(^3S_1)$	$(15/2,1)^o$	15/2	34068.94	BW92b
		9/2	34192.6	BW92b
		13/2	35507.74	BW92b
		11/2	38634.04	BW92b
Es II $((15/2,1/2)^o_8)$		*Limit*	**51800**	S74

Persistent Lines of Singly-ionized Einsteinium (Es II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2708.66		$5f^{11}(^4I^o_{15/2})7s$	$(15/2,1/2)^o$	8	0.00	WLGC74	
			$5f^{11}(^4I^o_{15/2})7p$	$(15/2,3/2)$	9	36907.83		
300	2787.10		$5f^{11}(^4I^o_{15/2})7s$	$(15/2,1/2)^o$	7	938.65	WLGC74	
			$5f^{10}6d7s$		7	36807.72		
300*	2815.15		$5f^{11}(^4I^o_{15/2})7s$	$(15/2,1/2)^o$	7	938.65	WLGC74	
			$5f^{11}(^2H^o_{11/2})7p$	$(11/2,1/2)$	6	36450.29		
1000	3547.75		$5f^{11}(^4I^o_{15/2})7s$	$(15/2,1/2)^o$	8	0.00	WLGC74	
			$5f^{11}7p$	$(15/2,1/2)$	8	28178.81		
1000	3602.43		$5f^{11}(^4I^o_{15/2})7s$	$(15/2,1/2)^o$	8	0.00	WLGC74	
			$5f^{11}7p$	$(15/2,1/2)$	7	27751.11		

Persistent Lines of Singly-ionized Einsteinium (Es II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3670.01		$5f^{11}(^4I^o_{15/2})7s$	$(15/2,1/2)^o$	7	938.65	WLGC74	
			$5f^{11}7p$	(15/2,1/2)	8	28178.81		
1000	3728.55		$5f^{11}(^4I^o_{15/2})7s$	$(15/2,1/2)^o$	7	938.65	WLGC74	
			$5f^{11}7p$	(15/2,1/2)	7	27751.11		

Energy Levels of Singly-ionized Einsteinium (Es II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^{11}(^4I^o_{15/2})7s$	$(15/2,1/2)^o$	8	0.00	BW92b
		7	938.65	BW92b
$5f^{11}(^4F^o_{9/2})7s$	$(9/2,1/2)^o$	5	7588.09	BW92b
		4	8123.26	BW92b
$5f^{11}(^2H^o_{11/2})7s$	$(11/2,1/2)^o$	6	9085.30	BW92b
		5	9580.22	BW92b
$5f^{11}(^4I^o_{13/2})7s$	$(13/2,1/2)^o$	7	11335.68	BW92b
		6	11764.95	BW92b
$5f^{11}7p$	(15/2,1/2)	7	27751.11	BW92b
		8	28178.81	BW92b
$5f^{11}(^2H^o_{11/2})7p$	(11/2,1/2)	6	36450.29	BW92b
		5	36803.23	BW92b
$5f^{10}6d7s$		7	36807.72	BW92b
$5f^{11}(^4I^o_{15/2})7p$	(15/2,3/2)	9	36907.83	BW92b
Es III $(^4I^o_{15/2})$		*Limit*	[**97000**]	CNWM70

Erbium (Er)
Atomic number = 68
Atomic weight = 167.26

Isotope	Mass	Abundance	Spin	Mag moment
^{162}Er	161.928775	0.14%	0	
^{164}Er	163.929198	1.61%	0	
^{166}Er	165.930290	33.6%	0	
^{167}Er	166.932046	22.95%	7/2	−0.5665
^{168}Er	167.932368	26.8%	0	
^{170}Er	169.935461	14.9%	0	

Er I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6 4f^{12} 6s^2\ {}^3\mathrm{H}_6$
Ionization energy: 49 262 cm^{-1} (6.1077 eV)

Er II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6 4f^{12}({}^3\mathrm{H}_6)6s\ (6,1/2)_{13/2}$
Ionization energy: 96 200 cm^{-1} (11.93 eV)

Strong Lines of Erbium (Er)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
40	2670.260	Er II	M64b
60	2755.630	Er II	M64b
50	2770.016	Er II	M64b
90	2904.469	Er II	M64b
140	2910.359	Er II	M64b
140	2964.520	Er II	M64b
110	3002.407	Er II	M64b
50	3072.53	Er II	M64b
60	3073.344	Er II	M64b
70	3082.083	Er II	M64b
60	3084.020	Er II	M64b
70	3122.722	Er II	M64b
80	3181.919	Er II	M64b
80	3220.729	Er II	M64b
60	3223.306	Er II	M64b
200 P	3230.582	Er II	M64b
50	3259.050	Er II	M64b
250 P	3264.782	Er II	M64b
70	3279.326	Er II	M64b
70	3280.218	Er II	M64b
200 P	3312.424	Er II	M64b
50	3316.390	Er II	M64b
70	3323.195	Er II	M64b
70	3332.702	Er II	M64b
120	3346.036	Er II	M64b
130	3364.078	Er II	M64b
130 d	3368.022	Er II	M64b
700 P	3372.71	Er II	M64b
90	3374.173	Er II	M64b
150	3385.083	Er II	M64b
200 P	3391.998	Er II	M64b
40	3428.388	Er II	M64b
70	3441.128	Er II	M64b
30	3442.684	Er I	M64b
40	3469.509	Er I	M64b
90	3471.709	Er II	M64b

Strong Lines of Erbium (Er)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
60	3479.413	Er II	M64b
90	3485.854	Er II	M64b
600 P	3499.104	Er II	M64b
40	3502.780	Er I	M64b
40	3514.889	Er II	M64b
60	3524.912	Er II	M64b
30	3539.590	Er I	M64b
70	3549.844	Er II	M64b
110	3558.016	Er I	M64b
40	3558.713	Er I	M64b
90	3559.896	Er II	M64b
20	3565.172	Er I	M64b
70	3570.753	Er I	M64b
20	3578.244	Er I	M64b
90	3580.519	Er II	M64b
25	3586.601	Er I	M64b
40	3590.764	Er I	M64b
30	3595.835	Er I	M64b
60	3599.501	Er II	M64b
90	3599.826	Er II	M64b
50	3604.898	Er II	M64b
30	3607.424	Er I	M64b
300 P	3616.565	Er II	M64b
50	3617.850	Er II	M64b
50	3618.916	Er II	M64b
50	3628.037	Er I	M64b
20	3629.368	Er I	M64b
90	3633.536	Er II	M64b
40	3634.674	Er I	M64b
110	3638.676	Er I	M64b
80	3645.936	Er II	M64b
50	3650.408	Er II	M64b
50	3652.874	Er II	M64b
25	3664.445	Er I	M64b
50	3682.701	Er II	M64b
25	3684.012	Er I	M64b
700 P	3692.650	Er II	M64b
25	3697.679	Er I	M64b
50	3700.719	Er II	M64b
50	3707.637	Er II	M64b
50	3712.391	Er II	M64b
25	3719.351	Er I	M64b
120	3729.524	Er II	M64b
50	3738.162	Er II	M64b
80	3742.640	Er II	M64b
60	3747.430	Er I	M64b
40	3756.050	Er I	M64b
150	3786.836	Er II	M64b
50	3787.858	Er II	M64b
50	3791.829	Er II	M64b
40	3792.794	Er I	M64b
50	3797.058	Er II	M64b
110	3810.330	Er I	M64b
300 P	3830.482	Er II	M64b
40	3849.914	Er I	M64b
50	3855.898	Er I	M64b
50	3858.392	Er II	M64b
500 P	3862.851	Er I	M64b
140	3880.611	Er II	M64b

Strong Lines of Erbium (Er)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
110	3882.886	Er II	M64b
300 P	3892.684	Er I	M64b
500 P	3896.234	Er II	M64b
70	3902.756	Er II	M64b
90	3905.404	Er I	M64b
1000 P	3906.311	Er II	M64b
70	3932.254	Er II	M64b
250 P	3937.014	Er I	M64b
200 P	3938.626	Er II	M64b
250 P	3944.420	Er I	M64b
40	3948.062	Er I	M64b
25	3956.416	Er I	M64b
200 P	3973.036	Er I	M64b
250 P	3973.575	Er I	M64b
130	3974.719	Er II	M64b
60	3977.019	Er I	M64b
80	3982.331	Er I	M64b
60	3987.655	Er I	M64b
1000 P	4007.965	Er I	M64b
80	4012.533	Er I	M64b
200 P	4020.512	Er I	M64b
30	4021.548	Er I	M64b
70	4046.955	Er I	M64b
90	4055.465	Er II	M64b
40	4059.515	Er I	M64b
60	4059.779	Er II	M64b
30	4077.880	Er I	M64b
50	4081.243	Er II	M64b
250 P	4087.632	Er I	M64b
80	4098.099	Er I	M64b
25	4116.361	Er I	M64b
25	4118.546	Er I	M64b
40	4131.504	Er I	M64b
50	4142.914	Er II	M64b
500 P	4151.108	Er I	M64b
70	4190.697	Er I	M64b
100	4218.425	Er I	M64b
50	4286.556	Er I	M64b
25	4298.905	Er I	M64b
20	4386.397	Er I	M64b
60	4409.340	Er I	M64b
50	4419.608	Er II	M64b
25	4424.571	Er I	M64b
25	4426.769	Er I	M64b
70 P	4606.606	Er I	M64b
20	4673.161	Er I	M64b
50	4675.619	Er II	M64b
20	4900.080	Er II	M64b
20	4934.115	Er II	M64b
20	5007.234	Er I	M64b
20	5042.049	Er II	M64b
15	5164.767	Er II	M64b
15	5188.898	Er II	M64b
20	5762.801	Er I	M64b
30 P	5826.786	Er I	M64b
25 P	6221.019	Er I	M64b
9	7469.51	Er I	MCS75

Persistent Lines of Neutral Erbium (Er I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3862.851	1.16	$4f^{12}6s^2$	^{3}H	6	0.000	M64b	M00
			$4f^{12}(^3\mathrm{H})6s6p$	^{o}	6	25880.274		
300	3892.684	0.728	$4f^{12}6s^2$	^{3}H	6	0.000	M64b	M00
			$4f^{11}(^4\mathrm{F}^o)5d6s^2$	^{o}	5	25681.933		
250	3937.014	0.292	$4f^{12}6s^2$	^{3}H	6	0.000	M64b	M00
			$4f^{11}(^4\mathrm{F}^o)5d6s^2$	^{o}	6	25392.779		
250	3944.420		$4f^{12}6s^2$	^{3}F	4	5035.193	M64b	
			$4f^{11}(^4\mathrm{I}^o)5d^2(^3\mathrm{F})(^4\mathrm{F}^o)6s$	^{o}	5	30380.282		
200	3973.036	0.479	$4f^{12}6s^2$	^{3}H	6	0.000	M64b	M00
			$4f^{11}(^4\mathrm{I}^o)5d6s^2$	^{o}	5	25162.553		
250	3973.575	0.366	$4f^{12}6s^2$	^{3}H	6	0.000	M64b	M00
				^{o}	7	25159.143		
1000	4007.965	1.73	$4f^{12}6s^2$	^{3}H	6	0.000	M64b	M00
			$4f^{12}(^3\mathrm{H})6s6p$	^{o}	7	24943.272		
200	4020.512		$4f^{12}6s^2$	^{3}H	5	6958.329	M64b	
			$4f^{12}(^3\mathrm{H})6s6p$	^{o}	6	31823.748		
250	4087.632	0.303	$4f^{12}6s^2$	^{3}H	6	0.000	M64b	M00
			$4f^{11}(^4\mathrm{I}^o)5d6s^2$	^{o}	6	24457.139		
500	4151.108	0.960	$4f^{12}6s^2$	^{3}H	6	0.000	M64b	M00
			$4f^{12}(^3\mathrm{H})6s6p$	^{o}	5	24083.166		
70	4606.606	0.0754	$4f^{12}6s^2$	^{3}H	6	0.000	M64b	M00
			$4f^{11}(^4\mathrm{I}^o_{11/2})5d_{5/2}6s^2$	$(11/2,5/2)^o$	6	21701.885		
30	5826.786	0.0104	$4f^{12}6s^2$	^{3}H	6	0.000	M64b	M00
			$4f^{12}(^3\mathrm{H}_6)6s6p(^3\mathrm{P}^o_1)$	$(6,1)^o$	7	17157.307		
25	6221.019	0.0084	$4f^{12}6s^2$	^{3}H	6	0.000	M64b	M00
			$4f^{11}(^4\mathrm{I}^o_{13/2})5d_{3/2}6s^2$	$(13/2,3/2)^o$	6	16070.095		

Energy Levels of Neutral Erbium (Er I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{12}6s^2$	^{3}H	6	0.000	MZH78
		5	6958.329	MZH78
		4	10750.982	MZH78
$4f^{12}6s^2$	^{3}F	4	5035.193	MZH78
		3	12377.534	MZH78
		2	13097.906	MZH78
$4f^{11}(^4\mathrm{I}^o_{15/2})5d_{3/2}6s^2$	$(15/2,3/2)^o$	6	7176.503	MZH78
		7	7696.956	MZH78
		9	8620.565	MZH78
		8	9350.106	MZH78
$4f^{11}(^4\mathrm{I}^o_{15/2})5d_{5/2}6s^2$	$(15/2,5/2)^o$	10	9655.848	MZH78
		9	10557.916	MZH78
		5	11401.197	MZH78
		8	11557.670	MZH78
		6	11799.778	MZH78
		7	11887.503	MZH78

Energy Levels of Neutral Erbium (Er I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{11}(^4I^o_{13})5d_{3/2}6s^2$	$(13/2,3/2)^o$	8	15083.114	MZH78
		5	15185.352	MZH78
		7	15846.549	MZH78
		6	16070.095	MZH78
$4f^{12}(^3H_6)6s6p(^3P^o_0)$	$(6,0)^o$	6	16321.110	MZH78
$4f^{11}(^4I^o_{15/2})6s^26p_{1/2}$	(15/2,1/2)	7	16464.934	MZH78
		8	16727.479	MZH78
$4f^{12}(^3H_6)6s6p(^3P^o_1)$	$(6,1)^o$	6	17073.800	MZH78
		7	17157.307	MZH78
		5	17347.860	MZH78
$4f^{11}(^4I^o_{11})5d_{5/2}6s^2$	$(11/2,5/2)^o$	3	19269.640	MZH78
		8	20566.805	MZH78
		4	20619.731	MZH78
		7	21168.430	MZH78
		5	21392.817	MZH78
		6	21701.885	MZH78
$4f^{12}(^3H)6s6p$	^{o}	5	24083.166	MZH78
$4f^{11}(^4I^o)5d6s^2$	^{o}	6	24457.139	MZH78
$4f^{12}(^3H)6s6p$	^{o}	7	24943.272	MZH78
	^{o}	7	25159.143	MZH78
$4f^{11}(^4I^o)5d6s^2$	^{o}	5	25162.553	MZH78
$4f^{11}(^4F^o)5d6s^2$	^{o}	6	25392.779	MZH78
$4f^{11}(^4F^o)5d6s^2$	^{o}	5	25681.933	MZH78
$4f^{12}(^3H)6s6p$	^{o}	6	25880.274	MZH78
$4f^{11}(^4I^o)5d^2(^3F)(^4F^o)6s$	^{o}	5	30380.282	MZH78
$4f^{12}(^3H)6s6p$	^{o}	6	31823.748	MZH78
Er II $(^3H_6)6s_{1/2}$ $(6,1/2)_{13/2}$		*Limit*	**49262**	WSPC78

Persistent Lines of Singly-ionized Erbium (Er II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
200	3230.582	1.5	$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	11/2	440.434	M64b	K91
				^{o}	11/2	31385.667		
250	3264.782	0.58	$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	13/2	0.000	M64b	K91
			$4f^{12}(^3H_6)6p_{3/2}$?	$(6,3/2)^o$?	13/2	30621.102		
200	3312.424	0.37	$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	11/2	440.434	M64b	K91
			$4f^{12}(^3H_6)6p_{3/2}$?	$(6,3/2)^o$?	13/2	30621.102		
700	3372.71	1.3	$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	13/2	0.000	M64b	K91
			$4f^{12}(^3H_6)6p_{3/2}$?	$(6,3/2)^o$?	15/2	29640.863		
200	3391.998	0.235	$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	13/2	0.000	M64b	K91
				^{o}	15/2	29472.789		
600	3499.104	0.75	$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	11/2	440.434	M64b	K91
			$4f^{12}(^3H_6)6p_{3/2}$?	$(6,3/2)^o$?	9/2	29011.015		

Persistent Lines of Singly-ionized Erbium (Er II)—Continued

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	3616.565	0.20	$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	13/2	0.000	M64b	K91
				^{o}	11/2	27642.658		
700	3692.650	0.48	$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	11/2	440.434	M64b	K91
				^{o}	13/2	27513.555		
300	3830.482	0.14	$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	13/2	0.000	M64b	K91
			$4f^{12}(^3H_6)6p_{1/2}$?	$(6,1/2)^o$?	13/2	26098.972		
500	3896.234	0.18	$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	11/2	440.434	M64b	K91
			$4f^{12}(^3H_6)6p_{1/2}$?	$(6,1/2)^o$?	13/2	26098.972		
1000	3906.311	0.323	$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	13/2	0.000	M64b	K91
			$4f^{12}(^3H_6)6p_{1/2}$?	$(6,1/2)^o$?	11/2	25592.343		
200	3938.626		$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	13/2	0.000	M64b	
				^{o}	11/2	25382.379		

Energy Levels of Singly-ionized Erbium (Er II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{12}(^3H_6)6s_{1/2}$	(6,1/2)	13/2	0.000	MZH78
		11/2	440.434	MZH78
$4f^{12}(^3F_4)6s_{1/2}$	(4,1/2)	9/2	5132.608	MZH78
		7/2	5403.688	MZH78
$4f^{11}6s^2$	$^4I^o$	15/2	6824.774	MZH78
		13/2	13338.777	MZH78
		11/2	16948.197	MZH78
		9/2	—	
$4f^{12}(^3H_5)6s_{1/2}$	(5,1/2)	11/2	7149.630	MZH78
		9/2	7195.355	MZH78
$4f^{11}(^4I^o)5d6s$	^{o}	13/2	10667.186	MZH78
$4f^{12}(^3H_4)6s_{1/2}$	(4,1/2)	7/2	10893.936	MZH78
		9/2	11042.640	MZH78
	^{o}	11/2	25382.379	MZH78
$4f^{12}(^3H_6)6p_{1/2}$?	$(6,1/2)^o$?	11/2	25592.343	MZH78
		13/2	26098.972	MZH78
	^{o}	13/2	27513.555	MZH78
	^{o}	11/2	27642.658	MZH78
$4f^{12}(^3H_6)6p_{3/2}$?	$(6,1/2)^o$?	9/2	29011.015	MZH78
		11/2	29492.329	MZH78
		15/2	29640.863	MZH78
		13/2	30621.102	MZH78
	^{o}	15/2	29472.789	MZH78
	^{o}	11/2	31385.667	MZH78
Er III ($^3H_6$)		*Limit*	**96200**	SR65

Europium (Eu)
Atomic number = 63
Atomic weight = 151.965

Isotope	Mass	Abundance	Spin	Mag moment
^{151}Eu	150.919847	47.8%	5/2	+3.464
^{153}Eu	152.921225	52.2%	5/2	+1.530

Eu I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^7 6s^2\ {}^8S^o_{7/2}$
Ionization energy: 45 734.74 cm^{-1} (5.670 38 eV)

Eu II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^7 6s\ {}^9S^o_4$
Ionization energy: 90 700 cm^{-1} (11.25 eV)

Strong Lines of Europium (Eu)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
4	2577.14	Eu II	MCS75
15	2638.77	Eu II	MCS75
6	2641.27	Eu II	MCS75
11	2668.34	Eu II	MCS75
4	2678.29	Eu II	MCS75
4	2685.66	Eu II	MCS75
9	2692.03	Eu II	MCS75
12	2701.14	Eu II	MCS75
13	2701.90	Eu II	MCS75
4	2705.28	Eu II	MCS75
15	2709.981	Eu I	ST76
12	2716.98	Eu II	MCS75
70 P	2727.78	Eu II	MCS75
6	2729.44	Eu II	MCS75
8	2781.89	Eu II	MCS75
30	2802.84	Eu II	MCS75
4	2811.75	Eu II	MCS75
60 P	2813.94	Eu II	MCS75
9	2816.18	Eu II	MCS75
30	2820.78	Eu II	MCS75
7 c,w	2828.72	Eu II	MCS75
4	2859.67	Eu II	MCS75
5	2862.57	Eu II	MCS75
20	2892.502	Eu I	ST76
13	2893.013	Eu I	ST76
30	2893.838	Eu I	ST76
50 P	2906.68	Eu II	MCS75
15	2908.993	Eu I	ST76
14	2925.04	Eu II	MCS75
3 c,w	2952.68	Eu II	MCS75
4	2960.21	Eu II	MCS75
5	2991.33	Eu II	MCS75
5 c,w	3054.94	Eu II	MCS75
11	3058.975	Eu I	ST76
4	3077.36	Eu II	MCS75
30	3106.162	Eu I	ST76
90 P	3111.427	Eu I	ST76
40	3210.566	Eu I	ST76
90 P	3212.804	Eu I	ST76
40	3213.745	Eu I	ST76

Strong Lines of Europium (Eu)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
4	3277.78	Eu II	MCS75
90 P	3334.313	Eu I	ST76
10	3350.397	Eu I	ST76
5	3396.58	Eu II	MCS75
8 c,w	3521.09	Eu II	MCS75
110 P	3688.42	Eu II	MCS75
300 P,c,w	3724.94	Eu II	MCS75
6	3741.31	Eu II	MCS75
4	3761.12	Eu II	MCS75
11	3811.33	Eu I	MCS75
600 P,c,w	3819.67	Eu II	MCS75
15	3865.57	Eu I	MCS75
14	3884.75	Eu I	MCS75
500 P,c,w	3907.10	Eu II	MCS75
20	3917.29	Eu I	MCS75
500 P,c,w	3930.48	Eu II	MCS75
500 P,c,w	3971.96	Eu II	MCS75
11	4039.19	Eu I	MCS75
600 P,c,w	4129.70	Eu II	MCS75
10	4182.22	Eu I	MCS75
1000 P,c,w	4205.05	Eu II	MCS75
14	4298.73	Eu I	MCS75
4	4355.09	Eu II	MCS75
250 P,c,w	4435.56	Eu II	MCS75
50 P	4522.57	Eu II	MCS75
1000 P	4594.03	Eu I	MCS75
900 P	4627.22	Eu I	MCS75
800 P	4661.88	Eu I	MCS75
10	4867.62	Eu I	MCS75
14	4907.18	Eu I	MCS75
15	4911.40	Eu I	MCS75
15	5013.17	Eu I	MCS75
15	5022.91	Eu I	MCS75
10	5029.54	Eu I	MCS75
15	5114.37	Eu I	MCS75
15	5129.10	Eu I	MCS75
20	5133.52	Eu I	MCS75
25	5160.07	Eu I	MCS75
20	5166.70	Eu I	MCS75
20	5199.85	Eu I	MCS75
10	5200.96	Eu I	MCS75
11	5206.44	Eu I	MCS75
70 P	5215.10	Eu I	MCS75
25	5223.49	Eu I	MCS75
11	5239.24	Eu I	MCS75
20	5266.40	Eu I	MCS75
40	5271.96	Eu I	MCS75
10	5272.48	Eu I	MCS75
14	5282.82	Eu I	MCS75
11	5291.26	Eu I	MCS75
11	5294.64	Eu I	MCS75
50 P	5357.61	Eu I	MCS75
11	5361.61	Eu I	MCS75
10	5376.94	Eu I	MCS75
11	5392.94	Eu I	MCS75
40	5402.77	Eu I	MCS75
30	5451.51	Eu I	MCS75
25	5452.94	Eu I	MCS75
11	5488.65	Eu I	MCS75

Strong Lines of Europium (Eu)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
11	5510.52	Eu I	MCS75
20	5547.44	Eu I	MCS75
14	5570.33	Eu I	MCS75
20	5577.14	Eu I	MCS75
11	5580.03	Eu I	MCS75
20	5645.80	Eu I	MCS75
30	5765.20	Eu I	MCS75
15	5783.69	Eu I	MCS75
50 P,c,w	5830.98	Eu I	MCS75
6	5966.07	Eu II	MCS75
40 c,w	5967.10	Eu I	MCS75
15	5972.75	Eu I	MCS75
20	5992.83	Eu I	MCS75
10	6012.56	Eu I	MCS75
40	6018.15	Eu I	MCS75
15	6029.00	Eu I	MCS75
7	6049.51	Eu II	MCS75
13	6057.36	Eu I	MCS75
20	6083.84	Eu I	MCS75
20	6099.35	Eu I	MCS75
11	6118.78	Eu I	MCS75
6	6173.05	Eu II	MCS75
10	6178.76	Eu I	MCS75
25 c,w	6188.13	Eu I	MCS75
13	6195.07	Eu I	MCS75
20	6262.25	Eu I	MCS75
15	6299.77	Eu I	MCS75
4	6303.41	Eu II	MCS75
11 c,w	6350.04	Eu I	MCS75
11 c,w	6400.93	Eu I	MCS75
15	6410.04	Eu I	MCS75
13	6411.32	Eu I	MCS75
14	6437.64	Eu II	MCS75
11	6457.96	Eu I	MCS75
25	6645.11	Eu II	MCS75
13	6802.72	Eu I	MCS75
30	6864.54	Eu I	MCS75
11	7040.20	Eu I	MCS75
6	7077.10	Eu II	MCS75
10	7194.81	Eu II	MCS75
10	7217.55	Eu II	MCS75
9	7301.17	Eu II	MCS75
12	7370.22	Eu II	MCS75
5	7426.57	Eu II	MCS75
15	7583.91	Eu I	MCS75

Persistent Lines of Neutral Europium (Eu I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
90	3111.427	0.34	$4f^7 6s^2$	a $^8S^o$	7/2	0.00	ST76	M00
			$4f^6(^7F)5d6s^2$	^8P	9/2	32130.25		
90	3212.804	0.33	$4f^7 6s^2$	a $^8S^o$	7/2	0.00	ST76	M00
			$4f^6(^7F)5d6s^2$	^8P	7/2	31116.38		
90	3334.313	0.39	$4f^7 6s^2$	a $^8S^o$	7/2	0.00	ST76	M00
			$4f^6(^7F)5d6s^2$	^8P	5/2	29982.50		
1000	4594.03	1.60	$4f^7 6s^2$	a $^8S^o$	7/2	0.00	MCS75	M00
			$4f^7(^8S^o)6s6p(^1P^o)$	y ^8P	9/2	21761.26		
900	4627.22	1.53	$4f^7 6s^2$	a $^8S^o$	7/2	0.00	MCS75	M00
			$4f^7(^8S^o)6s6p(^1P^o)$	y ^8P	7/2	21605.17		
800	4661.88	1.45	$4f^7 6s^2$	a $^8S^o$	7/2	0.00	MCS75	M00
			$4f^7(^8S^o)6s6p(^1P^o)$	y ^8P	5/2	21444.58		
70	5215.10	0.40	$4f^7(^8S^o)5d(^9D^o)6s$	a $^{10}D^o$	13/2	13778.68	MCS75	HWL02
			$4f^7(^8S^o)5d(^9D^o)6p$	y ^{10}P	11/2	32948.41		
50	5357.61	0.23	$4f^7(^8S^o)5d(^9D^o)6s$	a $^{10}D^o$	11/2	13457.21	MCS75	HWL02
			$4f^7(^8S^o)5d(^9D^o)6p$	z ^{10}D	13/2	32117.10		
50	5830.98	0.51	$4f^7(^8S^o)5d(^9D^o)6s$	a $^{10}D^o$	13/2	13778.68	MCS75	HWL02
			$4f^7(^8S^o)5d(^9D^o)6p$	z ^{10}F	15/2	30923.71		

Energy Levels of Neutral Europium (Eu I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^7 6s^2$	a $^8S^o$	7/2	0.00	MZH78
$4f^7(^8S^o)5d(^9D^o)6s$	a $^{10}D^o$	5/2	12923.72	MZH78
		7/2	13048.90	MZH78
		9/2	13222.04	MZH78
		11/2	13457.21	MZH78
		13/2	13778.68	MZH78
$4f^7(^8S^o)6s6p(^3P^o)$	z ^{10}P	7/2	14067.86	MZH78
		9/2	14563.57	MZH78
		11/2	15581.58	MZH78
$4f^7(^8S^o)5d(^9D^o)6s$	a $^8D^o$	3/2	15137.72	MZH78
		5/2	15248.76	MZH78
		7/2	15421.25	MZH78
		9/2	15680.28	MZH78
		11/2	16079.76	MZH78
$4f^7(^8S^o)6s6p(^3P^o)$	z ^8P	5/2	15890.53	MZH78
		7/2	15952.31	MZH78
		9/2	16611.79	MZH78
$4f^7(^8S^o)6s6p(^3P^o)$	z ^6P	7/2	17340.65	MZH78
		5/2	17707.42	MZH78
		3/2	17945.49	MZH78
$4f^7(^8S^o)5d(^7D^o)6s$	a $^6D^o$	9/2	19273.24	MZH78
		7/2	19364.50	MZH78
		5/2	19462.05	MZH78
		3/2	19543.69	MZH78
		1/2	19599.16	MZH78

Energy Levels of Neutral Europium (Eu I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^7(^8S^o)5d(^7D^o)6s$	b $^8D^o$	11/2	19447.19	MZH78
		9/2	19631.26	MZH78
		7/2	19712.15	MZH78
		5/2	19763.78	MZH78
		3/2	19794.21	MZH78
$4f^7(^8S^o)6s6p(^1P^o)$	y ^8P	5/2	21444.58	MZH78
		7/2	21605.17	MZH78
		9/2	21761.26	MZH78
$4f^6(^7F)5d6s^2$	^8D	3/2	—	
		5/2	27852.90	MZH78
		7/2	28827.83	MZH78
		9/2	29838.59	MZH78
		11/2	30819.44	MZH78
$4f^7(^8S^o)5d(^9D^o)6p$	z ^{10}F	3/2	28519.97	MZH78
		5/2	28667.39	MZH78
		7/2	28918.17	MZH78
		9/2	29186.32	MZH78
		11/2	29612.69	MZH78
		13/2	30211.09	MZH78
		15/2	30923.71	MZH78
$4f^6(^7F)5d6s^2$	^8P	5/2	29982.50	MZH78
		7/2	31116.38	MZH78
		9/2	32130.25	MZH78
$4f^7(^8S^o)5d(^9D^o)6p$	z ^{10}D	5/2	30945.07	MZH78
		7/2	31138.11	MZH78
		9/2	31382.61	MZH78
		11/2	31725.93	MZH78
		13/2	32117.10	MZH78
$4f^7(^8S^o)5d(^9D^o)6p$	y ^{10}P	7/2	32398.25	MZH78
		9/2	32596.31	MZH78
		11/2	32948.41	MZH78
Eu II ($^9S^o_4$)		*Limit*	**45734.74**	NRCA00

Persistent Lines of Singly-ionized Europium (Eu II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
70	2727.78	0.65	$4f^7(^8S^o)6s$	a $^9S^o$	4	0.00	MCS75	ZLLZ00
			$4f^6(^7F)5d(^8P)6s$	y ^9P	5	36648.95		
60	2813.94	0.55	$4f^7(^8S^o)6s$	a $^9S^o$	4	0.00	MCS75	ZLLZ00
			$4f^6(^7F)5d(^8P)6s$	y ^9P	4	35527.02		
50	2906.68	0.41	$4f^7(^8S^o)6s$	a $^9S^o$	4	0.00	MCS75	ZLLZ00
			$4f^6(^7F)5d(^8P)6s$	y ^9P	3	34393.57		
110	3688.42	0.13	$4f^7(^8S^o)6s$	a $^9S^o$	4	0.00	MCS75	ZLLZ00
			$4f^7(^8S^o_{7/2})6p_{3/2}$	(7/2,3/2)	3	27104.07		
300	3724.94	0.45	$4f^7(^8S^o)6s$	a $^9S^o$	4	0.00	MCS75	K91
			$4f^7(^8S^o_{7/2})6p_{3/2}$	(7/2,3/2)	4	26838.50		

Persistent Lines of Singly-ionized Europium (Eu II)—Continued

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	3819.67	1.27	$4f^7(^8S^o)6s$	a $^9S^o$	4	0.00	MCS75	K91
			$4f^7(^8S^o_{7/2})6p_{3/2}$	(7/2,3/2)	5	26172.83		
500	3907.10	1.37	$4f^7(^8S^o)6s$	a $^7S^o$	3	1669.21	MCS75	K91
			$4f^7(^8S^o_{7/2})6p_{3/2}$	(7/2,3/2)	2	27256.35		
500	3930.48	1.07	$4f^7(^8S^o)6s$	a $^7S^o$	3	1669.21	MCS75	ZLLZ00
			$4f^7(^8S^o_{7/2})6p_{3/2}$	(7/2,3/2)	3	27104.07		
500	3971.96	0.89	$4f^7(^8S^o)6s$	a $^7S^o$	3	1669.21	MCS75	K91
			$4f^7(^8S^o_{7/2})6p_{3/2}$	(7/2,3/2)	4	26838.50		
600	4129.70	0.68	$4f^7(^8S^o)6s$	a $^9S^o$	4	0.00	MCS75	K91
			$4f^7(^8S^o_{7/2})6p_{1/2}$	(7/2,1/2)	4	24207.86		
1000	4205.05	0.71	$4f^7(^8S^o)6s$	a $^9S^o$	4	0.00	MCS75	K91
			$4f^7(^8S^o_{7/2})6p_{1/2}$	(7/2,1/2)	3	23774.28		
250	4435.56	0.31	$4f^7(^8S^o)6s$	a $^7S^o$	3	1669.21	MCS75	K91
			$4f^7(^8S^o_{7/2})6p_{1/2}$	(7/2,1/2)	4	24207.86		
50	4522.57	0.099	$4f^7(^8S^o)6s$	a $^7S^o$	3	1669.21	MCS75	K91
			$4f^7(^8S^o_{7/2})6p_{1/2}$	(7/2,1/2)	3	23774.28		

Energy Levels of Singly-ionized Europium (Eu II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^7(^8S^o)6s$	a $^9S^o$	4	0.00	MZH78
$4f^7(^8S^o)6s$	a $^7S^o$	3	1669.21	MZH78
$4f^7(^8S^o)5d$	a $^9D^o$	2	9923.00	MZH78
		3	10081.65	MZH78
		4	10312.82	MZH78
		5	10643.48	MZH78
		6	11128.22	MZH78
$4f^7(^8S^o)5d$	a $^7D^o$	5	16860.72	MZH78
		4	17004.06	MZH78
		3	17140.87	MZH78
		2	17247.67	MZH78
		1	17324.66	MZH78
$4f^7(^8S^o_{7/2})6p_{1/2}$	(7/2,1/2)	3	23774.28	MZH78
		4	24207.86	MZH78
$4f^7(^8S^o_{7/2})6p_{3/2}$	(7/2,3/2)	5	26172.83	MZH78
		4	26838.50	MZH78
		3	27104.07	MZH78
		2	27256.35	MZH78
$4f^6(^7F)5d(^8D)6s$	z ^9D	2	30189.31	MZH78
		3	31500.82	MZH78
		4	32486.10	MZH78
		5	33420.20	MZH78
		6	34764.97	MZH78
	101	4	33779.95	MZH78
	102	3	33919.70	MZH78
	103	2	33944.49	MZH78

Energy Levels of Singly-ionized Europium (Eu II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^6(^7F)5d(^8P)6s$	y ^9P	3	34393.57	MZH78
		4	35527.02	MZH78
		5	36648.95	MZH78
Eu III ($^8S^o_{7/2}$)		*Limit*	**90700**	SR65

Fluorine (F)

Atomic number = 9
Atomic weight = 18.998 4032

Isotope	Mass	Abundance	Spin	Mag moment
^{19}F	18.9984032	100%	1/2	+2.6887

F I Ground state: $1s^22s^22p^5\ ^2P^o_{3/2}$
Ionization energy: 140 524.5 cm^{-1} (17.4228 eV)

F II Ground state: $1s^22s^22p^4\ ^3P_2$
Ionization energy: 282 058.6 cm^{-1} (34.9708 eV)

Strong Lines of Fluorine (F)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
900 P	484.602	F II	P69
900 P	605.669	F II	P69
800 P	606.288	F II	P69
1000 P	606.804	F II	P69
700 P	606.923	F II	P69
800 P	607.472	F II	P69
900 P	608.062	F II	P69
500 P	951.870	F I	L49
1000 P	954.826	F I	L49
800 P	955.546	F I	L49
500 P	958.525	F I	L49
400	973.895	F I	L49
100	976.217	F I	L49
100	977.743	F I	L49
	Air		
200	3501.388	F II	P69
200	3501.451	F II	P69
200	3501.569	F II	P69
200	3502.840	F II	P69
200	3502.964	F II	P69
200	3503.106	F II	P69
150	3505.369	F II	P69
200	3505.515	F II	P69
200	3505.628	F II	P69
200	3601.393	F II	P69
200	3602.838	F II	P69
200	3704.526	F II	P69
250 P	3847.086	F II	P69
250 P	3849.985	F II	P69
250 P	3851.668	F II	P69
200	3898.825	F II	P69
200	3901.933	F II	P69
250 P	4024.726	F II	P69
200 P	4025.010	F II	P69
250 P	4025.491	F II	P69
200	4103.074	F II	P69
150	4103.216	F II	P69
200	4103.508	F II	P69
200	4103.710	F II	P69
150	4103.870	F II	P69
200	4246.227	F II	P69

Strong Lines of Fluorine (F)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	4246.385	F II	P69
200	4246.590	F II	P69
150	4246.774	F II	P69
150	4246.844	F II	P69
200	4299.170	F II	P69
150	4446.527	F II	P69
150	4446.722	F II	P69
200	4447.188	F II	P69
130 P	6239.651	F I	L49
100 P	6348.508	F I	L49
80	6413.651	F I	L49
20	6690.481	F I	L49
70	6773.984	F I	L49
90	6834.264	F I	L49
500 P	6856.030	F I	L49
80	6870.215	F I	L49
150 P	6902.475	F I	L49
60	6909.816	F I	L49
40	6966.349	F I	L49
500 P	7037.469	F I	L49
300 P	7127.890	F I	L49
130	7179.90	F II	P69
150 P	7202.360	F I	L49
130 h	7211.79	F II	P69
150 P	7311.019	F I	L49
50	7331.957	F I	L49
100 P	7398.688	F I	L49
40	7425.645	F I	L49
20	7482.723	F I	L49
25	7489.155	F I	L49
50	7552.235	F I	L49
50	7573.384	F I	L49
70	7607.170	F I	L49
200 P	7754.696	F I	L49
150 P	7800.212	F I	L49
80	8016.01	F II	P69
6	8129.26	F I	L49
6	8179.339	F I	L49
25	8214.726	F I	L49
30	8230.773	F I	L49
20	8298.581	F I	L49

Persistent Lines of Neutral Fluorine (F I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	951.870	2.55	$2s^22p^5$	$^2P^o$	3/2	0.000	L49	M03
			$2s^22p^4(^3P)3s$	^2P	1/2	105056.283		
1000	954.826	6.32	$2s^22p^5$	$^2P^o$	3/2	0.000	L49	M03
			$2s^22p^4(^3P)3s$	^2P	3/2	104731.048		
800	955.546	5.05	$2s^22p^5$	$^2P^o$	1/2	404.141	L49	M03
			$2s^22p^4(^3P)3s$	^2P	1/2	105056.283		
500	958.525	1.25	$2s^22p^5$	$^2P^o$	1/2	404.141	L49	M03
			$2s^22p^4(^3P)3s$	^2P	3/2	104731.048		

Persistent Lines of Neutral Fluorine (F I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
130	6239.651	0.25	$2s^22p^4(^3P)3s$	^4P	5/2	102405.714	L49	FW96
			$2s^22p^4(^3P)3p$	$^4S^o$	3/2	118427.814		
100	6348.508	0.18	$2s^22p^4(^3P)3s$	^4P	3/2	102680.439	L49	FW96
			$2s^22p^4(^3P)3p$	$^4S^o$	3/2	118427.814		
500	6856.030	0.494	$2s^22p^4(^3P)3s$	^4P	5/2	102405.714	L49	FW96
			$2s^22p^4(^3P)3p$	$^4D^o$	7/2	116987.391		
150	6902.475	0.32	$2s^22p^4(^3P)3s$	^4P	3/2	102680.439	L49	FW96
			$2s^22p^4(^3P)3p$	$^4D^o$	5/2	117164.002		
500	7037.469	0.30	$2s^22p^4(^3P)3s$	^2P	3/2	104731.048	L49	FW96
			$2s^22p^4(^3P)3p$	$^2P^o$	3/2	118936.791		
300	7127.890	0.38	$2s^22p^4(^3P)3s$	^2P	1/2	105056.283	L49	FW96
			$2s^22p^4(^3P)3p$	$^2P^o$	1/2	119081.814		
150	7202.360	0.072	$2s^22p^4(^3P)3s$	^2P	1/2	105056.283	L49	WSG66
			$2s^22p^4(^3P)3p$	$^2P^o$	3/2	118936.791		
150	7311.019	0.39	$2s^22p^4(^3P)3s$	^2P	3/2	104731.048	L49	FW96
			$2s^22p^4(^3P)3p$	$^2S^o$	1/2	118405.256		
100	7398.688	0.285	$2s^22p^4(^3P)3s$	^4P	5/2	102405.714	L49	FW96
			$2s^22p^4(^3P)3p$	$^4P^o$	5/2	115917.904		
200	7754.696	0.382	$2s^22p^4(^3P)3s$	^2P	3/2	104731.048	L49	FW96
			$2s^22p^4(^3P)3p$	$^2D^o$	5/2	117622.917		
150	7800.212	0.21	$2s^22p^4(^3P)3s$	^2P	1/2	105056.283	L49	FW96
			$2s^22p^4(^3P)3p$	$^2D^o$	3/2	117872.917		

Energy Levels of Neutral Fluorine (F I)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^22p^5$	$^2P^o$	3/2	0.000	LB82
		1/2	404.141	LB82
$2s^22p^4(^3P)3s$	^4P	5/2	102405.714	A95
		3/2	102680.439	A95
		1/2	102840.378	A95
$2s^22p^4(^3P)3s$	^2P	3/2	104731.048	A95
		1/2	105056.283	A95
$2s^22p^4(^3P)3p$	$^4P^o$	5/2	115917.904	A95
		3/2	116040.880	A95
		1/2	116143.578	A95
$2s^22p^4(^3P)3p$	$^4D^o$	7/2	116987.391	A95
		5/2	117164.002	A95
		3/2	117308.552	A95
		1/2	117391.945	A95
$2s^22p^4(^3P)3p$	$^2D^o$	5/2	117622.917	A95
		3/2	117872.917	A95

Energy Levels of Neutral Fluorine (F I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^22p^4(^3P)3p$	$^2S^o$	1/2	118405.256	A95
$2s^22p^4(^3P)3p$	$^4S^o$	3/2	118427.814	A95
$2s^22p^4(^3P)3p$	$^2P^o$	3/2	118936.791	A95
		1/2	119081.814	A95
F II ($^3P_2$)		*Limit*	**140524.5**	L49

Persistent Lines of Singly-ionized Fluorine (F II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
900	484.602		$2s^22p^4$	^1D	2	20873.4	P69	
			$2s^22p^3(^2P^o)3s$	$^1P^o$	1	227228.42		
900	605.669	43	$2s^22p^4$	^3P	2	0.00	P69	WSG66
			$2s2p^5$	$^3P^o$	1	165106.66		
800	606.288	100	$2s^22p^4$	^3P	1	341.1400	P69	WSG66
			$2s2p^5$	$^3P^o$	0	165279.19		
1000	606.804	78	$2s^22p^4$	^3P	2	0.00	P69	WSG66
			$2s2p^5$	$^3P^o$	2	164797.88		
700	606.923	26	$2s^22p^4$	^3P	1	341.1400	P69	WSG66
			$2s2p^5$	$^3P^o$	1	165106.66		
800	607.472	33	$2s^22p^4$	^3P	0	489.6845	P69	WSG66
			$2s2p^5$	$^3P^o$	1	165106.66		
900	608.062	25	$2s^22p^4$	^3P	1	341.1400	P69	WSG66
			$2s2p^5$	$^3P^o$	2	164797.88		
250	3847.086	1.3	$2s^22p^3(^4S^o)3s$	$^5S^o$	2	176493.93	P69	WSG66
			$2s^22p^3(^4S^o)3p$	^5P	3	202480.26		
250	3849.985	1.3	$2s^22p^3(^4S^o)3s$	$^5S^o$	2	176493.93	P69	WSG66
			$2s^22p^3(^4S^o)3p$	^5P	2	202460.69		
250	3851.668	1.3	$2s^22p^3(^4S^o)3s$	$^5S^o$	2	176493.93	P69	WSG66
			$2s^22p^3(^4S^o)3p$	^5P	1	202449.35		
250	4024.726	1.2	$2s^22p^3(^4S^o)3s$	$^3S^o$	1	182864.40	P69	WSG66
			$2s^22p^3(^4S^o)3p$	^3P	2	207703.79		
200	4025.010	1.2	$2s^22p^3(^4S^o)3s$	$^3S^o$	1	182864.40	P69	WSG66
			$2s^22p^3(^4S^o)3p$	^3P	0	207702.04		
250	4025.491	1.2	$2s^22p^3(^4S^o)3s$	$^3S^o$	1	182864.40	P69	WSG66
			$2s^22p^3(^4S^o)3p$	^3P	1	207699.07		

Energy Levels of Singly-ionized Fluorine (F II)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^22p^4$	^3P	2	0.00	P69
		1	341.1400	P69,BZE98
		0	489.6845	P69,BZE98
$2s^22p^4$	^1D	2	20873.4	P69
$2s^22p^4$	^1S	0	44918.1	P69
$2s2p^5$	$^3P^o$	2	164797.88	P69
		1	165106.66	P69
		0	165279.19	P69
$2s^22p^3(^4S^o)3s$	$^5S^o$	2	176493.93	P69
$2s^22p^3(^4S^o)3s$	$^3S^o$	1	182864.40	P69
$2s^22p^3(^4S^o)3p$	^5P	1	202449.35	P69
		2	202460.69	P69
		3	202480.26	P69
$2s^22p^3(^4S^o)3p$	^3P	1	207699.07	P69
		0	207702.04	P69
		2	207703.79	P69
$2s^22p^3(^2D^o)3s$	$^3D^o$	3	211866.13	P69
		2	211887.19	P69
		1	211900.26	P69
$2s^22p^3(^2D^o)3s$	$^1D^o$	2	215069.59	P69
$2s^22p^3(^2P^o)3s$	$^1P^o$	1	227228.42	P69
$2s^22p^3(^2P^o)3s$	$^3P^o$	2	229550.11	P69
		1	229551.79	P69
		0	229554.45	P69
F III ($^4S^o_{3/2}$)		*Limit*	**282058.6**	P69

Francium (Fr)

Atomic number = 87
Atomic weight = 223

Isotope	Mass	Abundance	Spin	Mag moment
^{212}Fr	211.996130	0	5	
^{223}Fr	223.019733	*some*	3/2	

Note: Although not occuring naturally, the available spectroscopic data is for ^{212}Fr.

Fr I Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}4f^{14}5s^25p^65d^{10}6s^26p^67s\ ^2S_{1/2}$
Ionization energy: 32 848.872 cm^{-1} (4.072 741 eV)

Fr II Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}4f^{14}5s^25p^65d^{10}6s^26p^6\ ^1S_0$
Ionization energy: not available

Strong Lines of Francium (Fr)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
	4225.655	Fr I	ABDJ90
	4325.361	Fr I	ABDJ90
	7179.866	Fr I	ABDJ90
	8169.418	Fr I	ABDJ90

Persistent Lines of Neutral Francium (Fr I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
	4225.655		7s	^{2}S	1/2	0.000	ABDJ90	
			8p	^{2}P	3/2	23658.306		
	4325.361		7s	^{2}S	1/2	0.000	ABDJ90	
			8p	^{2}P°	1/2	23112.960		
	7179.866		7s	^{2}S	1/2	0.000	ABDJ90	
			7p	^{2}P°	3/2	13923.998		
	8169.418		7s	^{2}S	1/2	0.000	ABDJ90	
			7p	^{2}P°	1/2	12237.409		

Energy Levels of Neutral Francium (Fr I)

Configuration	Term	J	Level (cm^{-1})	Ref
7s	^{2}S	1/2	0.000	ABDJ90
7p	^{2}P°	1/2	12237.409	ABDJ90
		3/2	13923.998	ABDJ90
8p	^{2}P°	1/2	23112.960	ABDJ90
		3/2	23658.306	ABDJ90
Fr II (^{1}S$_0$)		*Limit*	**32848.872**	ABDJ90

Gadolinium (Gd)

Atomic number = 64
Atomic weight = 157.25

Isotope	Mass	Abundance	Spin	Mag moment
^{152}Gd	151.919786	0.20%	0	
^{154}Gd	153.920861	2.18%	0	
^{155}Gd	154.922618	14.80%	3/2	−0.27
^{156}Gd	155.922118	20.47%	0	
^{157}Gd	156.923956	15.65%	3/2	−0.36
^{158}Gd	157.924099	24.84%	0	
^{160}Gd	159.927049	21.86%	0	

Gd I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^7 5d 6s^2\ ^9\mathrm{D}^{\circ}_2$
Ionization energy: 49 601.45 cm^{-1} (6.149 80 eV)

Gd II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^7 5d 6s\ ^{10}\mathrm{D}^{\circ}_{5/2}$
Ionization energy: 97 500 cm^{-1} (12.09 eV)

Strong Lines of Gadolinium (Gd)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
110	2796.93	Gd II	MCS75
90	2809.72	Gd II	MCS75
140	2999.04	Gd II	MCS75
250	3010.13	Gd II	MCS75
200	3027.60	Gd II	MCS75
250	3032.84	Gd II	MCS75
200	3034.05	Gd II	MCS75
110	3068.64	Gd II	MCS75
70	3076.92	Gd II	MCS75
250	3081.99	Gd II	MCS75
400	3100.50	Gd II	MCS75
70	3102.55	Gd II	MCS75
110	3145.00	Gd II	MCS75
110	3156.53	Gd II	MCS75
110	3161.37	Gd II	MCS75
80*	3223.74	Gd II	MCS75
110	3266.73	Gd I	MCS75
90	3291.48	Gd I	MCS75
90	3294.08	Gd I	MCS75
150	3331.38	Gd II	MCS75
90	3332.13	Gd II	MCS75
130	3336.18	Gd II	MCS75
70	3345.98	Gd II	MCS75
600 P	3350.47	Gd II	MCS75
500 P	3358.62	Gd II	MCS75
90	3360.71	Gd II	MCS75
600 P	3362.23	Gd II	MCS75
130	3392.53	Gd II	MCS75
130*	3407.56	Gd II	MCS75
130*	3407.61	Gd II	MCS75
150	3416.95	Gd II	MCS75
150	3418.73	Gd II	MCS75
800 P	3422.47	Gd II	MCS75
250*	3423.90	Gd I	MCS75
250*	3423.92	Gd II	MCS75

Strong Lines of Gadolinium (Gd)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
90		3424.59	Gd II	MCS75
80		3432.99	Gd II	MCS75
200		3439.21	Gd II	MCS75
90		3439.78	Gd II	MCS75
300		3439.99	Gd II	MCS75
150		3450.38	Gd II	MCS75
130		3451.23	Gd II	MCS75
100		3454.90	Gd II	MCS75
300		3463.98	Gd II	MCS75
200		3467.27	Gd II	MCS75
200		3468.99	Gd II	MCS75
150		3473.22	Gd II	MCS75
250		3481.28	Gd II	MCS75
200		3481.80	Gd II	MCS75
110		3491.95	Gd II	MCS75
200		3494.40	Gd II	MCS75
150		3505.51	Gd II	MCS75
90		3512.22	Gd II	MCS75
130		3512.50	Gd II	MCS75
150		3513.65	Gd I	MCS75
110		3524.20	Gd II	MCS75
500	P	3545.80	Gd II	MCS75
400		3549.36	Gd II	MCS75
150		3557.05	Gd II	MCS75
80		3571.93	Gd II	MCS75
110		3581.91	Gd II	MCS75
600	P	3584.96	Gd II	MCS75
130		3592.71	Gd II	MCS75
250		3604.87	Gd I	MCS75
90		3608.75	Gd II	MCS75
90		3610.76	Gd II	MCS75
100		3645.62	Gd II	MCS75
700	P	3646.19	Gd II	MCS75
70		3652.54	Gd II	MCS75
400		3654.62	Gd II	MCS75
400		3656.15	Gd II	MCS75
150		3662.26	Gd II	MCS75
300		3664.60	Gd II	MCS75
250		3671.20	Gd II	MCS75
200		3674.05	Gd I	MCS75
70		3679.21	Gd I	MCS75
400	P	3684.13	Gd I	MCS75
80		3686.33	Gd II	MCS75
400		3687.74	Gd II	MCS75
250		3697.73	Gd II	MCS75
150		3699.73	Gd II	MCS75
300		3712.70	Gd II	MCS75
400	P	3713.57	Gd I	MCS75
150		3716.36	Gd II	MCS75
400	P	3717.48	Gd I	MCS75
200*		3719.45	Gd II	MCS75
200*		3719.53	Gd II	MCS75
150		3730.84	Gd II	MCS75
100		3739.76	Gd I	MCS75
500	P	3743.47	Gd II	MCS75
150		3744.83	Gd I	MCS75
200		3757.94	Gd I	MCS75
150		3758.31	Gd II	MCS75
90		3759.00	Gd II	MCS75

Strong Lines of Gadolinium (Gd)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
70		3760.71	Gd II	MCS75
200		3762.20	Gd I	MCS75
100		3767.04	Gd II	MCS75
1000	P	3768.39	Gd II	MCS75
70		3769.45	Gd II	MCS75
150		3770.69	Gd II	MCS75
110		3782.34	Gd II	MCS75
600	P	3783.05	Gd I	MCS75
130		3787.56	Gd II	MCS75
90		3791.17	Gd II	MCS75
600	P	3796.37	Gd II	MCS75
80		3801.29	Gd II	MCS75
400		3813.97	Gd II	MCS75
90		3816.64	Gd II	MCS75
110		3836.91	Gd II	MCS75
110		3839.64	Gd II	MCS75
140		3842.20	Gd II	MCS75
300		3843.28	Gd I	MCS75
150		3844.58	Gd II	MCS75
400		3850.69	Gd II	MCS75
600	P	3850.97	Gd II	MCS75
500	P	3852.45	Gd II	MCS75
300		3866.99	Gd I	MCS75
150		3894.70	Gd II	MCS75
90		3902.40	Gd II	MCS75
90		3905.65	Gd I	MCS75
250	P	3916.51	Gd II	MCS75
250*		3934.79	Gd I	MCS75
250*		3934.82	Gd II	MCS75
90		3941.80	Gd I	MCS75
120		3942.63	Gd I	MCS75
300		3945.54	Gd I	MCS75
120		3953.37	Gd I	MCS75
140		3957.67	Gd II	MCS75
90*		3959.44	Gd II	MCS75
90*		3959.52	Gd II	MCS75
120		3966.28	Gd I	MCS75
70		3968.26	Gd II	MCS75
150		3969.00	Gd I	MCS75
80		3972.71	Gd I	MCS75
70		3973.98	Gd II	MCS75
150		3979.33	Gd I	MCS75
100		3987.84	Gd I	MCS75
70		3992.69	Gd I	MCS75
70		3994.16	Gd II	MCS75
80		3996.32	Gd II	MCS75
70		4008.33	Gd I	MCS75
90		4017.71	Gd I	MCS75
250		4023.14	Gd I	MCS75
150		4023.35	Gd I	MCS75
250		4028.15	Gd I	MCS75
200		4030.88	Gd I	MCS75
150		4033.49	Gd I	MCS75
70		4035.40	Gd I	MCS75
150		4037.33	Gd II	MCS75
80		4037.90	Gd II	MCS75
90		4043.71	Gd I	MCS75
300		4045.01	Gd I	MCS75
150		4049.43	Gd II	MCS75

Strong Lines of Gadolinium (Gd)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
250	P	4049.86	Gd II	MCS75
90		4053.29	Gd II	MCS75
500	P	4053.64	Gd I	MCS75
150		4054.72	Gd I	MCS75
500	P	4058.22	Gd I	MCS75
140		4059.88	Gd I	MCS75
70		4062.59	Gd II	MCS75
200		4063.39	Gd II	MCS75
110		4068.35	Gd I	MCS75
90*		4070.29	Gd II	MCS75
90*		4070.39	Gd II	MCS75
70		4073.20	Gd II	MCS75
150		4078.44	Gd II	MCS75
600	P	4078.70	Gd I	MCS75
110		4083.70	Gd I	MCS75
150		4085.56	Gd II	MCS75
140		4090.41	Gd I	MCS75
250		4092.71	Gd I	MCS75
300	P	4098.61	Gd II	MCS75
140		4100.26	Gd I	MCS75
250	P	4130.37	Gd II	MCS75
130		4132.28	Gd II	MCS75
150		4134.16	Gd I	MCS75
500	P	4175.54	Gd I	MCS75
300	P	4184.25	Gd II	MCS75
500	P	4190.78	Gd I	MCS75
90		4191.07	Gd II	MCS75
150		4191.63	Gd I	MCS75
70		4204.86	Gd II	MCS75
150		4212.00	Gd II	MCS75
110		4215.02	Gd II	MCS75
70		4217.20	Gd II	MCS75
70		4225.03	Gd I	MCS75
1000	P	4225.85	Gd I	MCS75
70		4238.78	Gd II	MCS75
200		4251.73	Gd II	MCS75
100		4253.37	Gd II	MCS75
70		4253.61	Gd II	MCS75
150		4260.12	Gd I	MCS75
300		4262.09	Gd I	MCS75
140		4266.60	Gd I	MCS75
100		4267.00	Gd I	MCS75
100		4280.49	Gd II	MCS75
90		4285.82	Gd I	MCS75
90		4299.29	Gd I	MCS75
250		4306.34	Gd I	MCS75
400	P	4313.84	Gd I	MCS75
110		4314.40	Gd I	MCS75
80		4320.52	Gd I	MCS75
90*		4321.11	Gd II	MCS75
90*		4321.20	Gd I	MCS75
300*		4325.57	Gd II	MCS75
300*		4325.69	Gd I	MCS75
400	P	4327.12	Gd I	MCS75
80		4329.58	Gd I	MCS75
100		4342.18	Gd II	MCS75
110		4344.30	Gd II	MCS75
500		4346.46	Gd I	MCS75
200		4346.62	Gd I	MCS75

Strong Lines of Gadolinium (Gd)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
200		4373.83	Gd I	MCS75
300	P	4401.86	Gd I	MCS75
110		4403.14	Gd I	MCS75
110		4411.16	Gd I	MCS75
200		4414.16	Gd I	MCS75
150		4414.73	Gd I	MCS75
300	P	4422.41	Gd I	MCS75
250	P	4430.63	Gd I	MCS75
110		4467.08	Gd I	MCS75
150		4474.13	Gd I	MCS75
200		4476.12	Gd I	MCS75
100		4497.13	Gd I	MCS75
90		4506.21	Gd I	MCS75
250	P	4519.66	Gd I	MCS75
200		4537.81	Gd I	MCS75
90		4581.29	Gd I	MCS75
90		4583.07	Gd I	MCS75
90		4598.90	Gd I	MCS75
110		4614.50	Gd I	MCS75
90		4636.64	Gd I	MCS75
90		4653.54	Gd I	MCS75
90		4683.33	Gd I	MCS75
150		4694.33	Gd I	MCS75
90		4697.42	Gd I	MCS75
90		4743.65	Gd I	MCS75
70		4758.70	Gd I	MCS75
100		4767.24	Gd I	MCS75
70		4821.69	Gd I	MCS75
150		5015.04	Gd I	MCS75
200	P	5103.45	Gd I	MCS75
200	P	5155.84	Gd I	MCS75
90		5197.77	Gd I	MCS75
70		5251.18	Gd I	MCS75
80		5696.22	Gd I	MCS75
90		6114.07	Gd I	MCS75

Persistent Lines of Neutral Gadolinium (Gd I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	3684.13	0.91	$4f^7(^8S^o)5d6s^2$	$^9D^o$	2	0.000	MCS75	M00
			$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$	^9P	3	27135.695		
400	3713.57	0.92	$4f^7(^8S^o)5d6s^2$	$^9D^o$	3	215.124	MCS75	M00
			$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$	^9P	3	27135.695		
400	3717.48	0.68	$4f^7(^8S^o)5d6s^2$	$^9D^o$	4	532.977	MCS75	M00
			$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		4	27425.245		
600	3783.05	0.94	$4f^7(^8S^o)5d6s^2$	$^9D^o$	5	999.121	MCS75	M00
			$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		4	27425.245		
500	4053.64	0.62	$4f^7(^8S^o)5d6s^2$	$^9D^o$	5	999.121	MCS75	M00
			$4f^7(^8S^o)5d(^7D^o)6s6p(^3P^o)$		6	25661.340		
500	4058.22	0.57	$4f^7(^8S^o)5d6s^2$	$^9D^o$	3	215.124	MCS75	M00
			$4f^7(^8S^o)5d(^7D^o)6s6p(^3P^o)$		4	24849.514		
600	4078.70	0.59	$4f^7(^8S^o)5d6s^2$	$^9D^o$	4	532.977	MCS75	M00
			$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		5	25043.649		
500	4175.54	0.42	$4f^7(^8S^o)5d6s^2$	$^9D^o$	6	1719.087	MCS75	M00
			$4f^7(^8S^o)5d(^7D^o)6s6p(^3P^o)$		6	25661.340		
500	4190.78	0.30	$4f^7(^8S^o)5d6s^2$	$^9D^o$	5	999.121	MCS75	M00
			$4f^8(^7F)5d(^8G)6s$	^9G	6	24854.297		
1000	4225.85	0.89	$4f^7(^8S^o)5d6s^2$	$^9D^o$	6	1719.087	MCS75	M00
			$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		7	25376.313		
400	4313.84	0.43	$4f^7(^8S^o)5d6s^2$	$^9D^o$	3	215.124	MCS75	M00
			$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		3	23389.782		
400	4327.12	0.52	$4f^7(^8S^o)5d6s^2$	$^9D^o$	2	0.000	MCS75	M00
			$4f^7(^8S^o)5d^2(^3F)(^{10}F^o)6p$		1	23103.660		
500	4346.46		$4f^7(^8S^o)5d6s^2$	$^9D^o$	5	999.121	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		5	23999.912		
300	4401.86	0.38	$4f^7(^8S^o)5d6s^2$	$^9D^o$	6	1719.087	MCS75	M00
			$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		6	24430.425		
300	4422.41	0.28	$4f^7(^8S^o)5d6s^2$	$^9D^o$	3	215.124	MCS75	M00
			$4f^7(^8S^o)5d(^7D^o)6s6p(^3P^o)$	^9D	4	22820.895		
250	4430.63	0.30	$4f^7(^8S^o)5d6s^2$	$^9D^o$	2	0.000	MCS75	M00
			$4f^7(^8S^o)5d(^7D^o)6s6p(^3P^o)$	^9D	3	22563.824		
250	4519.66	0.38	$4f^7(^8S^o)5d6s^2$	$^9D^o$	3	215.124	MCS75	M00
			$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		2	22334.508		
200	5103.45		$4f^7(^8S^o)5d^2(^3F)(^{10}F^o)6s$	$^{11}F^o$	7	7947.294	MCS75	
			$4f^7(^8S^o)5d^2(^3F)(^{10}F^o)6p$	^{11}G	8	27536.397		
200	5155.84		$4f^7(^8S^o)5d^2(^3F)(^{10}F^o)6s$	$^{11}F^o$	6	7480.348	MCS75	
			$4f^7(^8S^o)5d^2(^3F)(^{10}F^o)6p$	^{11}G	7	26870.393		

Energy Levels of Neutral Gadolinium (Gd I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^7(^8S^o)5d6s^2$	$^9D^o$	2	0.000	MZH78
		3	215.124	MZH78
		4	532.977	MZH78
		5	999.121	MZH78
		6	1719.087	MZH78
$4f^7(^8S^o)5d^2(^3F)(^{10}F^o)6s$	$^{11}F^o$	2	6378.146	MZH78
		3	6550.395	MZH78
		4	6786.184	MZH78
		5	7103.420	MZH78
		6	7480.348	MZH78
		7	7947.294	MZH78
		8	8498.434	MZH78
$4f^7(^8S^o)5d6s^2$	$^7D^o$	5	6976.508	MZH78
		4	7234.910	MZH78
		3	7426.710	MZH78
		2	7562.457	MZH78
		1	7653.927	MZH78
$4f^7(^8S^o)5d^2(^3F)(^{10}F^o)6s$	$^9F^o$	1	10222.233	MZH78
		2	10359.905	MZH78
		3	10576.410	MZH78
		4	10883.505	MZH78
		5	11296.465	MZH78
		6	11830.393	MZH78
		7	12486.547	MZH78
$4f^86s^2$	^7F	6	10947.210	MZH78
		5	12519.997	MZH78
		4	13506.051	MZH78
		3	14253.948	MZH78
		2	14777.975	MZH78
		1	15121.220	MZH78
		0	15289.035	MZH78
$4f^7(^8S^o)5d^2(^3P)(^{10}P^o)6s$	$^{11}P^o$	4	11685.594	MZH78
		5	12057.164	MZH78
		6	12345.966	MZH78
$4f^7(^8S^o)6s^26p$	^9P	3	13433.851	MZH78
		4	13926.311	MZH78
		5	15665.424	MZH78
$4f^7(^8S^o)5d(^9D^o)6s6p(^3P^o)$	^{11}F	2	14036.026	MZH78
		3	14298.311	MZH78
		4	14669.148	MZH78
		5	15174.000	MZH78
		6	15852.245	MZH78
		7	16775.024	MZH78
		8	17909.944	MZH78
$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		2	22334.508	MZH78

Energy Levels of Neutral Gadolinium (Gd I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^7(^8S^o)5d(^7D^o)6s6p(^3P^o)$	^9D	3	22563.824	MZH78
		4	22820.895	MZH78
		5	23196.410	MZH78
		6	23229.298	MZH78
		2	24655.639	MZH78
$4f^7(^8S^o)5d^2(^3F)(^{10}F^o)6p$		1	23103.660	MZH78
$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		3	23389.782	MZH78
$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		5	23999.912	MZH78
$4f^8(^7F)5d(^8G)6s$	^9G	7	24255.103	MZH78
		8	—	
		6	24854.297	MZH78
		5	25380.885	MZH78
		4	25820.720	MZH78
		3	26247.609	MZH78
		2	26588.338	MZH78
		1	26834.311	MZH78
		0	27089.815	MZH78
$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		6	24430.425	MZH78
$4f^7(^8S^o)5d(^7D^o)6s6p(^3P^o)$		4	24849.514	MZH78
$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		5	25043.649	MZH78
$4f^7(^8S^o)5d^2(^3F)(^{10}F^o)6p$	^{11}G	1	25069.179	MZH78
		2	25164.640	MZH78
		3	25403.265	MZH78
		4	25571.672*	MZH78
		5	25940.122	MZH78
		6	26337.071	MZH78
		7	26870.393	MZH78
		8	27536.397	MZH78
		9	28432.859	MZH78
$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		7	25376.313	MZH78
$4f^7(^8S^o)5d(^7D^o)6s6p(^3P^o)$		6	25661.340	MZH78
$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$	^9P	3	27135.695	MZH78
$4f^7(^8S^o)5d(^9D^o)6s6p(^1P^o)$		4	27425.245	MZH78
Gd II ($^{10}D^o_{5/2}$)		*Limit*	**49601.45**	MOW98

Persistent Lines of Singly-ionized Gadolinium (Gd II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	3350.47		$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	11/2	1158.943	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}D	13/2	30996.851		
500	3358.62		$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	7/2	261.841	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^8D	9/2	30027.378		
600	3362.23		$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	9/2	633.273	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}D	11/2	30366.818		
800	3422.47		$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	13/2	1935.310	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}F	15/2	31145.651		
500	3545.80		$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	11/2	1158.943	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}F	13/2	29353.344		
600	3584.96		$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	11/2	1158.943	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}D	9/2	29045.291		
700	3646.19		$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	13/2	1935.310	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}F	13/2	29353.344		
500	3743.47		$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	11/2	1158.943	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}F	11/2	27864.534		
1000	3768.39		$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	9/2	633.273	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}F	9/2	27162.224		
600	3796.37		$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	7/2	261.841	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}F	7/2	26595.222		
600	3850.97		$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	5/2	0.000	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}F	3/2	25960.073		
500	3852.45		$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	7/2	261.841	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}F	5/2	26211.912		
250	3916.51		$4f^7(^8S^o)5d(^9D^o)6s$	$^8D^o$	11/2	4841.106	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}D	11/2	30366.818		
250	4049.86		$4f^8(^7F)6s$	^8F	13/2	7992.268	MCS75	
			$4f^8(^7F_6)6p_{1/2}$	$(6,1/2)^o$	13/2	32677.540		
300	4098.61		$4f^7(^8S^o)5d^2(^3F)$	$^{10}F^o$	15/2	6605.154	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}D	13/2	30996.851		
250	4130.37		$4f^7(^8S^o)5d^2(^3F)$	$^{10}F^o$	13/2	5897.264	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$		11/2	30101.366		
300	4184.25		$4f^7(^8S^o)5d(^9D^o)6s$	$^8D^o$	9/2	3972.167	MCS75	
			$4f^7(^8S^o)5d(^9D^o)6p$	^{10}F	11/2	27864.534		

Energy Levels of Singly-ionized Gadolinium (Gd II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^7(^8S^o)5d(^9D^o)6s$	$^{10}D^o$	5/2	0.000	MZH78
		7/2	261.841	MZH78
		9/2	633.273	MZH78
		11/2	1158.943	MZH78
		13/2	1935.310	MZH78
$4f^7(^8S^o)5d(^9D^o)6s$	$^8D^o$	3/2	2856.678	MZH78
		5/2	3082.011	MZH78
		7/2	3427.274	MZH78
		9/2	3972.167	MZH78
		11/2	4841.106	MZH78
$4f^7(^8S^o)6s^2$	$^8S^o$	7/2	3444.235	MZH78
$4f^7(^8S^o)5d^2(^3F)$	$^{10}F^o$	3/2	4027.161	MZH78
		5/2	4212.756	MZH78
		7/2	4483.854	MZH78
		9/2	4852.304	MZH78
		11/2	5339.477	MZH78
		13/2	5897.264	MZH78
		15/2	6605.154	MZH78
$4f^8(^7F)6s$	^8F	13/2	7992.268	MZH78
		11/2	9092.491	MZH78
		9/2	10292.567	MZH78
		7/2	11084.335	MZH78
		5/2	11669.863	MZH78
		3/2	12071.778	MZH78
		1/2	12309.508	MZH78
$4f^7(^8S^o)5d(^7D^o)6s$	$^8D^o$	11/2	8551.049	MZH78
		9/2	8884.809	MZH78
		7/2	9142.904	MZH78
		5/2	9328.864	MZH78
		3/2	9451.697	MZH78
$4f^8(^7F)6s$	^6F	11/2	9943.779	MZH78
		9/2	11343.525	MZH78
		7/2	12318.288	MZH78
		5/2	13030.786	MZH78
		3/2	13515.189	MZH78
		1/2	13800.345	MZH78
$4f^7(^8S^o)5d(^9D^o)6p$	^{10}F	3/2	25960.073	MZH78
		5/2	26211.912	MZH78
		7/2	26595.222	MZH78
		9/2	27162.224	MZH78
		11/2	27864.534	MZH78
		13/2	29353.344	MZH78
		15/2	31145.651	MZH78
$4f^7(^8S^o)5d(^9D^o)6p$	^{10}D	5/2	27297.741	MZH78
		7/2	27988.074	MZH78
		9/2	29045.291	MZH78
		11/2	30366.818	MZH78
		13/2	30996.851	MZH78
$4f^7(^8S^o)5d(^9D^o)6p$	^8D	3/2	29877.937	MZH78
		5/2	29965.752	MZH78
		7/2	30008.894	MZH78
		9/2	30027.378	MZH78
$4f^7(^8S^o)5d(^9D^o)6p$		11/2	30101.366	MZH78
$4f^8(^7F_6)6p_{1/2}$	$(6,1/2)^o$	11/2	32595.348	MZH78
		13/2	32677.540	MZH78
Gd III ($^9D^o_2$)		*Limit*	**97500**	SR73

Gallium (Ga)

Atomic number = 31
Atomic weight = 69.723

Isotope	Mass	Abundance	Spin	Mag moment
^{69}Ga	68.925580	60.11%	3/2	+2.01659
^{71}Ga	70.924700	39.89%	3/2	+2.56227

Ga I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p\ ^2\mathrm{P}^{\mathrm{o}}_{1/2}$
Ionization energy: 48 387.634 cm^{-1} (5.999 301 eV)

Ga II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2\ ^1\mathrm{S}_0$
Ionization energy: 165 465.8 cm^{-1} (20.515 14 eV)

Strong Lines of Gallium (Ga)

Intensity	Wavelength (Å)	Spectrum	Ref.
	Vacuum		
140	829.529	Ga II	IL85
200	1113.708	Ga II	IL85
200	1119.133	Ga II	IL85
300	1130.760	Ga II	IL85
1000 P	1414.401	Ga II	IL85
800 P	1535.309	Ga II	IL85
800 P	1813.878	Ga II	IL85
900 P	1845.199	Ga II	IL85
	Air		
1000 P	2090.771	Ga II	IL85
150	2450.08	Ga I	MM52
200	2500.19	Ga I	MM52
300	2700.491	Ga II	IL85
300	2779.977	Ga II	IL85
400 P	2874.235	Ga I	JL67
600 P	2943.636	Ga I	JL67
200 P	2944.173	Ga I	JL67
600	3374.915	Ga II	IL85
500	3375.948	Ga II	IL85
500	3470.347	Ga II	IL85
300	3735.024	Ga II	IL85
500 P	4032.984	Ga I	ND82
1000 P	4172.042	Ga I	JL67
300	4262.019	Ga II	IL85
500	5219.65	Ga II	IL85
500	5416.36	Ga II	IL85
1000 P	6334.05	Ga II	IL85
100	6396.56	Ga I	JL67
70	6413.45	Ga I	JL67
900 P	6419.23	Ga II	IL85
800 P	6455.89	Ga II	IL85
800	7792.26	Ga II	IL85
50	11949.12	Ga I	JL67
40	12109.78	Ga I	JL67

Persistent Lines of Neutral Gallium (Ga I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	2874.235	1.17	$4s^24p$	$^2P^o$	1/2	0.000	JL67	M03
			$4s^24d$	^2D	3/2	34781.66		
600	2943.636	1.34	$4s^24p$	$^2P^o$	3/2	826.19	JL67	M03
			$4s^24d$	^2D	5/2	34787.85		
200	2944.173	0.261	$4s^24p$	$^2P^o$	3/2	826.19	JL67	M03
			$4s^24d$	^2D	3/2	34781.66		
500	4032.984	0.485	$4s^24p$	$^2P^o$	1/2	0.000	ND82	M03
			$4s^25s$	^2S	1/2	24788.530		
1000	4172.042	0.945	$4s^24p$	$^2P^o$	3/2	826.19	JL67	M03
			$4s^25s$	^2S	1/2	24788.530		

Energy Levels of Neutral Gallium (Ga I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4s^24p$	$^2P^o$	1/2	0.000	JL67
		3/2	826.19	JL67
$4s^25s$	^2S	1/2	24788.530	ND82
$4s^25p$	$^2P^o$	1/2	33044.05	JL67
		3/2	33155.07	JL67
$4s^24d$	^2D	3/2	34781.66	JL67
		5/2	34787.85	JL67
$4s^26s$	^2S	1/2	37584.79	JL67
Ga II ($^1S_0$)		*Limit*	**48387.634**	ND82

Persistent Lines of Singly-ionized Gallium (Ga II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1414.401	19.7	$4s^2$	^1S	0	0.00	IL85	M03
			$4s4p$	$^1P^o$	1	70701.27		
800	1535.309	14.5	$4s4p$	$^3P^o$	2	48749.74	IL85	C00
			$4s4d$	^3D	3	113883.19		
800	1813.878		$4s4p$	$^3P^o$	1	47814.05	IL85	
			$4s5s$	^3S	1	102944.55		
900	1845.199		$4s4p$	$^3P^o$	2	48749.74	IL85	
			$4s5s$	^3S	1	102944.55		
1000	2090.771	0.00409	$4s^2$	^1S	0	0.00	IL85	M03
			$4s4p$	$^3P^o$	1	47814.05		
1000	6334.05		$4s5s$	^3S	1	102944.55	IL85	
			$4s5p$	$^3P^o$	2	118727.89		
900	6419.23		$4s5s$	^3S	1	102944.55	IL85	
			$4s5p$	$^3P^o$	1	118518.47		
800	6455.89		$4s5s$	^3S	1	102944.55	IL85	
			$4s5p$	$^3P^o$	0	118430.02		

Energy Levels of Singly-ionized Gallium (Ga II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4s^2$	^1S	0	0.00	IL85
$4s4p$	$^3P^o$	0	47367.51	IL85
		1	47814.05	IL85
		2	48749.74	IL85
$4s4p$	$^1P^o$	1	70701.27	IL85
$4s5s$	^3S	1	102944.55	IL85
$4s5s$	^1S	0	106662.21	IL85
$4p^2$	^1D	2	107720.56	IL85
$4s4d$	^3D	1	113815.92	IL85
		2	113842.19	IL85
		3	113883.19	IL85
$4s5p$	$^3P^o$	0	118430.02	IL85
		1	118518.47	IL85
		2	118727.89	IL85
Ga III ($^2S_{1/2}$)		*Limit*	**165465.8**	IL85

Germanium (Ge)
Atomic number = 32
Atomic weight = 72.61

Isotope	Mass	Abundance	Spin	Mag moment
^{70}Ge	69.924250	20.5%	0	
^{72}Ge	71.922079	27.4%	0	
^{73}Ge	72.923463	7.8%	9/2	−0.87946
^{74}Ge	73.921177	36.5%	0	
^{76}Ge	75.921401	7.8%	0	

Ge I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^2\ ^3\mathrm{P}_0$
Ionization energy: 63 713.24 cm^{-1} (7.899 43 eV)

Ge II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p\ ^2\mathrm{P}^{\circ}_{1/2}$
Ionization energy: 128 521.3 cm^{-1} (15.934 61 eV)

Strong Lines of Germanium (Ge)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
300	1085.51	Ge II	S63a
500 P	1106.74	Ge II	S63a
500 P	1120.46	Ge II	S63a
500	1181.19	Ge II	S63a
500	1181.65	Ge II	S63a
200 P	1188.73	Ge II	S63a
300	1191.26	Ge II	S63a
500 P	1237.059	Ge II	KE74
500 P	1261.905	Ge II	KE74
500 P	1576.855	Ge II	KE74
80 r	1716.784	Ge I	KE74
80	1750.043	Ge I	KE74
80	1774.176	Ge I	KE74
80	1785.046	Ge I	KE74
80 h	1841.328	Ge I	KE74
80 h	1842.410	Ge I	KE74
80	1853.134	Ge I	KE74
200 r	1860.086	Ge I	KE74
120 r	1874.256	Ge I	KE74
200 r	1904.702	Ge I	KE74
120 r	1917.592	Ge I	KE74
200 r	1929.826	Ge I	KE74
500 P	1938.008	Ge II	KE74
500 P	1938.891	Ge II	KE74
80	1944.731	Ge I	KE74
80	1955.115	Ge I	KE74
200	1962.013	Ge I	KE74
80	1970.880	Ge I	KE74
120 h	1987.849	Ge I	KE74
120 P	1988.267	Ge I	KE74
200 r	1998.887	Ge I	KE74
	Air		
80	2011.29	Ge I	AM59
700 P	2019.068	Ge I	AM59
900 P,r	2041.712	Ge I	AM59
600 P,r	2043.770	Ge I	AM59
150	2054.461	Ge I	AM59

Strong Lines of Germanium (Ge)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
80 h	2057.238	Ge I	AM59
300 r	2065.215	Ge I	AM59
1000 P,r	2068.656	Ge I	AM59
150	2086.021	Ge I	AM59
800 P,r	2094.258	Ge I	AM59
90	2105.824	Ge I	AM59
130 P,r	2198.714	Ge I	AM59
500	2500.54	Ge II	S63a
200 P	2592.534	Ge I	AM59
500 P	2651.172	Ge I	AM59
200 P	2651.568	Ge I	AM59
200 P	2691.341	Ge I	AM59
300 P	2709.624	Ge I	AM59
400	2729.78	Ge II	S63a
250 P	2754.588	Ge I	AM59
1000 P	2831.843	Ge II	S63a
1000 P	2845.527	Ge II	S63a
300 P	3039.067	Ge I	AM59
250	3067.021	Ge I	AM59
40 P	3269.489	Ge I	AM59
300	3499.21	Ge II	S63a
1000 P	4741.806	Ge II	S63a
1000 P	4814.608	Ge II	S63a
1000 P	5893.389	Ge II	S63a
500 P	6021.041	Ge II	S63a
90	11252.83	Ge I	HA64
70	11614.81	Ge I	HA64
250	11714.76	Ge I	HA64
500 P	12069.20	Ge I	HA64
400 P	12391.58	Ge I	HA64
90	13107.61	Ge I	HA64
200	14822.38	Ge I	HA64

Persistent Lines of Neutral Germanium (Ge I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
120	1988.267	0.41	$4s^24p^2$	^3P	2	1409.9609	KE74	M00
			$4s^24p4d$	$^3P^o$	1	51705.020		
200	1998.887	1.24	$4s^24p^2$	^3P	2	1409.9609	KE74	M00
			$4s^24p4d$	$^3P^o$	2	51437.802		
700	2019.068	0.49	$4s^24p^2$	^3P	1	557.1341	AM59	M00
			$4s^24p4d$	$^3F^o$	2	50068.954		
900	2041.712	1.51	$4s^24p^2$	^3P	0	0.0000	AM59	M00
			$4s^24p4d$	$^3D^o$	1	48962.783		
600	2043.770	0.86	$4s^24p^2$	^3P	2	1409.9609	AM59	M00
			$4s^24p4d$	$^3F^o$	3	50323.465		
1000	2068.656	1.2	$4s^24p^2$	^3P	1	557.1341	AM59	M00
			$4s^24p4d$	$^3D^o$	2	48882.263		
800	2094.258	1.70	$4s^24p^2$	^3P	2	1409.9609	AM59	M00
			$4s^24p4d$	$^3D^o$	3	49144.397		
130	2198.714		$4s^24p^2$	^1D	2	7125.2989	AM59	
			$4s^24p4d$	$^1F^o$	3	52592.224		

Persistent Lines of Neutral Germanium (Ge I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
200	2592.534	0.60	$4s^24p^2$	^{3}P	1	557.1341	AM59	BDGL98
			$4s^24p5s$	^{3}P^o	2	39117.9021		
500	2651.172	1.60	$4s^24p^2$	^{3}P	2	1409.9609	AM59	BDGL98
			$4s^24p5s$	^{3}P^o	2	39117.9021		
200	2651.568	0.69	$4s^24p^2$	^{3}P	0	0.0000	AM59	BDGL98
			$4s^24p5s$	^{3}P^o	1	37702.3054		
200	2691.341	0.47	$4s^24p^2$	^{3}P	1	557.1341	AM59	BDGL98
			$4s^24p5s$	^{3}P^o	1	37702.3054		
300	2709.624	2.08	$4s^24p^2$	^{3}P	1	557.1341	AM59	BDGL98
			$4s^24p5s$	^{3}P^o	0	37451.6893		
250	2754.588	0.79	$4s^24p^2$	^{3}P	2	1409.9609	AM59	BDGL98
			$4s^24p5s$	^{3}P^o	1	37702.3054		
300	3039.067	2.04	$4s^24p^2$	^{1}D	2	7125.2989	AM59	BDGL98
			$4s^24p5s$	^{1}P^o	1	40020.5604		
40	3269.489	0.17	$4s^24p^2$	^{1}D	2	7125.2989	AM59	BDGL98
			$4s^24p5s$	^{3}P^o	1	37702.3054		
500	12069.20		$4s^24p5s$	^{3}P^o	1	37702.3054	HA64	
			$4s^24p5p$	^{3}D	1	45985.592		
400	12391.58		$4s^24p5s$	^{1}P^o	1	40020.5604	HA64	
			$4s^24p5p$	^{3}P	1	48088.3504		

Energy Levels of Neutral Germanium (Ge I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4s^24p^2$	^{3}P	0	0.0000	SM93b
		1	557.1341	SM93b
		2	1409.9609	SM93b
$4s^24p^2$	^{1}D	2	7125.2989	SM93b
$4s^24p^2$	^{1}S	0	16367.3332	SM93b
$4s^24p5s$	^{3}P^o	0	37451.6893	SM93b
		1	37702.3054	SM93b
		2	39117.9021	SM93b
$4s^24p5s$	^{1}P^o	1	40020.5604	SM93b
$4s4p^3$	^{5}S^o	2	41926.726	SM93b
$4s^24p5p$	^{3}D	1	45985.592	SM93b
		2	46834.3798	SM93b
		3	48104.1003	SM93b
$4s^24p5p$	^{1}P	1	46765.2705	SM93b
$4s^24p5p$	^{3}P	0	47502.6257	SM93b
		1	48088.3504	SM93b
		2	48726.1143	SM93b
$4s^24p4d$	^{1}D^o	2	48480.048	SM93b

Energy Levels of Neutral Germanium (Ge I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4s^24p4d$	$^3D^o$	2	48882.263	SM93b
		1	48962.783	SM93b
		3	49144.397	SM93b
$4s^24p5p$	^3S	1	49075.8917	SM93b
$4s^24p5p$	^1D	2	49649.5807	SM93b
$4s^24p4d$	$^3F^o$	2	50068.954	SM93b
		3	50323.465	SM93b
		4	50786.79	SM93b
$4s^24p5p$	^1S	0	51011.4392	SM93b
$4s^24p4d$	$^3P^o$	2	51437.802	SM93b
		1	51705.020	SM93b
		0	51978.15	SM93b
$4s^24p4d$	$^1F^o$	3	52592.224	SM93b
$4s^24p4d$	$^1P^o$	1	52847.215	SM93b
Ge II ($^2P^o_{1/2}$)		*Limit*	**63713.24**	SM93b

Persistent Lines of Singly-ionized Germanium (Ge II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	1106.74	48.	$4s^24p$	$^2P^o$	3/2	1767.357	S63a	M00
			$4s4p^2$	^2P	3/2	92122.7		
500	1120.46	24.	$4s^24p$	$^2P^o$	3/2	1767.357	S63a	M00
			$4s4p^2$	^2P	1/2	91016.2		
200	1188.73	7.7	$4s^24p$	$^2P^o$	3/2	1767.357	S63a	M00
			$4s4p^2$	^2S	1/2	85890.55		
500	1237.059	27.	$4s^24p$	$^2P^o$	1/2	0.000	KE74	M00
			$4s^24d$	^2D	3/2	80836.880		
500	1261.905	29.	$4s^24p$	$^2P^o$	3/2	1767.357	KE74	M00
			$4s^24d$	^2D	5/2	81012.598		
500	1576.855		$4s^24p$	$^2P^o$	3/2	1767.357	KE74	
			$4s4p^2$	^2D	5/2	65184.738		
500	1938.008	0.0028	$4s^24p$	$^2P^o$	3/2	1767.357	KE74	M00
			$4s4p^2$	^4P	5/2	53366.738		
500	1938.891	0.0047	$4s^24p$	$^2P^o$	1/2	0.000	KE74	M00
			$4s4p^2$	^4P	1/2	51575.885		
1000	2831.843		$4s4p^2$	^2D	3/2	65015.672	S63a	
			$4s^24f$	$^2F^o$	5/2	100317.976		
1000	2845.527		$4s4p^2$	^2D	5/2	65184.738	S63a	
			$4s^24f$	$^2F^o$	7/2	100317.283		
1000	4741.806	0.46	$4s^25p$	$^2P^o$	1/2	79006.985	S63a	FW96
			$4s^25d$	^2D	3/2	100090.088		
1000	4814.608	0.51	$4s^25p$	$^2P^o$	3/2	79366.627	S63a	FW96
			$4s^25d$	^2D	5/2	100130.936		

Persistent Lines of Singly-ionized Germanium (Ge II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	5893.389	0.92	$4s^25s$	^2S	1/2	62403.15	S63a	FW96
			$4s^25p$	$^2P^o$	3/2	79366.627		
500	6021.041		$4s^25s$	^2S	1/2	62403.15	S63a	
			$4s^25p$	$^2P^o$	1/2	79006.985		

Energy Levels of Singly-ionized Germanium (Ge II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4s^24p$	$^2P^o$	1/2	0.000	SM93b
		3/2	1767.357	SM93b
$4s4p^2$	^4P	1/2	51575.885	SM93b
		3/2	52290.942	SM93b
		5/2	53366.738	SM93b
$4s^25s$	^2S	1/2	62403.028	SM93b
$4s4p^2$	^2D	3/2	65015.672	SM93b
		5/2	65184.738	SM93b
$4s^25p$	$^2P^o$	1/2	79006.853	SM93b
		3/2	79366.494	SM93b
$4s^24d$	^2D	3/2	80836.880	SM93b
		5/2	81012.598	SM93b
$4s4p^2$	^2S	1/2	85890.55	SM93b
$4s4p^2$	^2P	1/2	91016.2	SM93b
		3/2	92122.7	SM93b
$4s^26s$	^2S	1/2	94784.381	SM93b
$4s^25d$	^2D	3/2	100089.970	SM93b
		5/2	100130.812	SM93b
$4s^24f$	$^2F^o$	7/2	100317.283	SM93b
		5/2	100317.976	SM93b
Ge III ($^1S_0$)		*Limit*	**128521.3**	SM93b

Gold (Au)

Atomic number = 79
Atomic weight = 196.966 543

Isotope	Mass	Abundance	Spin	Mag moment
^{197}Au	196.966543	100%	3/2	+0.1457

Au I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s\ ^2S_{1/2}$
Ionization energy: 74 408.88 cm^{-1} (9.225 53 eV)

Au II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10}\ ^1S_0$
Ionization energy: 162 950 cm^{-1} (20.20 eV)

Strong Lines of Gold (Au)

Intensity	Wavelength (Å)	Spectrum	Ref.
	Vacuum		
600 P	1224.592	Au II	RW97
600	1229.901	Au II	RW97
9 h	1328.374	Au I	BG78
400	1355.616	Au II	RW97
400 P	1362.326	Au II	RW97
9	1408.451	Au I	BG78
9	1481.764	Au I	BG78
500	1486.547	Au II	RW97
20	1587.158	Au I	BG78
9	1624.335	Au I	BG78
14 P	1646.674	Au I	BG78
9	1665.755	Au I	BG78
20 P	1699.339	Au I	BG78
600	1740.475	Au II	RW97
600	1783.200	Au II	RW97
9	1879.829	Au I	BG78
	Air		
150	2000.792	Au II	RW97
1000 P	2012.00	Au I	MCS75
250 P	2021.38	Au I	MCS75
150	2044.587	Au II	RW97
400 P	2082.077	Au II	RW97
500 P	2110.685	Au II	RW97
200	2228.915	Au II	RW97
400	2248.562	Au II	RW97
700 P	2263.627	Au II	RW97
250	2304.684	Au II	RW97
15	2352.65	Au I	MCS75
11	2387.75	Au I	MCS75
250 P	2427.95	Au I	MCS75
400	2533.518	Au II	RW97
100	2552.658	Au II	RW97
400	2616.393	Au II	RW97
25	2641.480	Au I	ED71
300 P	2675.954	Au I	ED71
100 P	2748.253	Au I	ED71
9	2780.822	Au I	ED71
600 P	2802.036	Au II	RW97
200	2819.793	Au II	RW97
1000 P	2822.546	Au II	RW97
400 h	2825.437	Au II	RW97

Strong Lines of Gold (Au)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
120	2837.848	Au II	RW97
400	2846.920	Au II	RW97
25	2883.446	Au I	ED71
25	2891.961	Au I	ED71
400 P	2893.247	Au II	RW97
20	2907.042	Au II	RW97
40	2913.517	Au II	RW97
400 P	2918.235	Au II	RW97
200	2954.222	Au II	RW97
200 h	2990.268	Au II	RW97
400 P	2994.800	Au II	RW97
30 P	3029.204	Au I	ED71
25	3065.424	Au I	ED71
150 P	3122.784	Au I	ED71
9	3194.720	Au I	ED71
25	3230.632	Au I	ED71
25	3308.305	Au I	ED71
25	3309.638	Au I	ED71
25	3557.365	Au I	ED71
25	3586.731	Au I	ED71
9	3611.568	Au I	ED71
9 h	3631.311	Au I	ED71
25	3637.905	Au I	ED71
9 h	3645.016	Au I	ED71
9	3650.739	Au I	ED71
9	3709.622	Au I	ED71
9	3796.007	Au I	ED71
40	3897.865	Au I	ED71
25	3909.383	Au I	ED71
40	4040.931	Au I	ED71
60	4065.068	Au I	ED71
20	4315.110	Au I	ED71
11 h	4437.269	Au I	ED71
25	4488.253	Au I	ED71
80 h	4607.512	Au I	ED71
50	4792.583	Au I	ED71
25	5230.259	Au I	ED71
25	5837.374	Au I	ED71
25 h	5956.965	Au I	ED71
50 P	6278.170	Au I	ED71
9	6562.680	Au I	ED71
50	7510.728	Au I	ED71

Persistent Lines of Neutral Gold (Au I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
14	1646.674		$5d^{10}6s$	^2S	1/2	0.000	BG78	
			$5d^{10}7p$	$^2P^o$	3/2	60728.49		
20	1699.339		$5d^{10}6s$	^2S	1/2	0.000	BG78	
			$5d^9(^2D_{3/2})6s6p(^1P^o_1)$	$(3/2,1)^o$	3/2	58845.414		
1000	2012.060		$5d^96s^2$	^2D	5/2	9161.177	ED71	
			$5d^9(^2D_{3/2})6s6p(^1P^o_1)$	$(3/2,1)^o$	3/2	58845.414		
250	2021.364		$5d^96s^2$	^2D	5/2	9161.177	ED71	
			$5d^9(^2D_{3/2})6s6p(^3P^o_1)$	$(3/2,1)^o$	5/2	58616.764		

Persistent Lines of Neutral Gold (Au I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
250	2427.944	1.98	$5d^{10}6s$	^2S	1/2	0.000	ED71	M00
			$5d^{10}6p$	$^2P^o$	3/2	41174.613		
300	2675.954	1.63	$5d^{10}6s$	^2S	1/2	0.000	ED71	M00
			$5d^{10}6p$	$^2P^o$	1/2	37358.991		
100	2748.253		$5d^9 6s^2$	^2D	5/2	9161.177	ED71	
			$5d^9(^2D_{5/2})6s6p(^3P^o_1)$	$(5/2,1)^o$	7/2	45537.195		
30	3029.204		$5d^9 6s^2$	^2D	5/2	9161.177	ED71	
			$5d^9(^2D_{5/2})6s6p(^3P^o_0)$	$(5/2,0)^o$	5/2	42163.530		
150	3122.784	0.190	$5d^9 6s^2$	^2D	5/2	9161.177	ED71	FW96
			$5d^{10}6p$	$^2P^o$	3/2	41174.613		
50	6278.170	0.034	$5d^9 6s^2$	^2D	3/2	21435.191	ED71	FW96
			$5d^{10}6p$	$^2P^o$	1/2	37358.991		

Energy Levels of Neutral Gold (Au I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^{10}6s$	^2S	1/2	0.000	ED71
$5d^9 6s^2$	^2D	5/2	9161.177	ED71
		3/2	21435.191	ED71
$5d^{10}6p$	$^2P^o$	1/2	37358.991	ED71
		3/2	41174.613	ED71
$5d^9(^2D_{5/2})6s6p(^3P^o_0)$	$(5/2,0)^o$	5/2	42163.530	ED71
$5d^9(^2D_{5/2})6s6p(^3P^o_1)$	$(5/2,1)^o$	7/2	45537.195	ED71
		5/2	46174.979	ED71
		3/2	47007.433	ED71
$5d^9(^2D_{5/2})6s6p(^3P^o_2)$	$(5/2,2)^o$	9/2	48697.147	ED71
		7/2	51028.894	ED71
		3/2	51231.530	ED71
		5/2	51653.460	ED71
		1/2	53196.32	BG78
$5d^{10}7s$	^2S	1/2	54485.235	ED71
$5d^9(^2D_{3/2})6s6p(^3P^o_0)$	$(3/2,0)^o$	3/2	56105.748	ED71
$5d^9(^2D_{3/2})6s6p(^3P^o_1)$	$(3/2,1)^o$	5/2	58616.764	ED71
$5d^9(^2D_{3/2})6s6p(^1P^o_1)$	$(3/2,1)^o$	3/2	58845.414	ED71
$5d^{10}7p$	$^2P^o$	1/2	60032.85	BG78
		3/2	60728.49	BG78
Au II ($^1S_0$)		*Limit*	**74408.88**	BG78

Persistent Lines of Singly-ionized Gold (Au II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	1224.592		$5d^{10}$	^1S	0	0.00	RW97	
			$5d^9(^2D_{3/2})6p$	$(3/2,1/2)^o$	1	81659.828		
400	1362.326		$5d^{10}$	^1S	0	0.00	RW97	
			$5d^9(^2D_{5/2})6p$	$(5/2,3/2)^o$	1	73403.839		
400	2082.077		$5d^9(^2D_{5/2})6s$	(5/2,1/2)	3	15039.572	RW97	
			$5d^9(^2D_{5/2})6p$	$(5/2,1/2)^o$	2	63053.318		
500	2110.685		$5d^9(^2D_{5/2})6s$	(5/2,1/2)	2	17640.616	RW97	
			$5d^9(^2D_{5/2})6p$	$(5/2,1/2)^o$	3	65003.594		
700	2263.627		$5d^9(^2D_{3/2})6p$	$(3/2,1/2)^o$	2	76659.700	RW97	
			$5d^9(^2D_{3/2})7s$	(3/2,1/2)	1	120822.927		
600	2802.036		$5d^9(^2D_{5/2})6p$	$(5/2,3/2)^o$	4	72495.129	RW97	
			$5d^9(^2D_{5/2})7s$	(5/2,1/2)	3	108172.952		
1000	2822.546		$5d^9(^2D_{3/2})6p$	$(3/2,3/2)^o$	3	85700.201	RW97	
			$5d^9(^2D_{3/2})7s$	(3/2,1/2)	2	121118.779		
400	2893.247		$5d^9(^2D_{3/2})6p$	$(3/2,3/2)^o$	2	86565.667	RW97	
			$5d^9(^2D_{3/2})7s$	(3/2,1/2)	2	121118.779		
400	2918.235		$5d^9(^2D_{3/2})6p$	$(3/2,3/2)^o$	2	86565.667	RW97	
			$5d^9(^2D_{3/2})7s$	(3/2,1/2)	1	120822.927		
400	2994.800		$5d^9(^2D_{5/2})6p$	$(5/2,3/2)^o$	3	74791.477	RW97	
			$5d^9(^2D_{5/2})7s$	(5/2,1/2)	3	108172.952		

Energy Levels of Singly-ionized Gold (Au II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^{10}$	^1S	0	0.00	RW97
$5d^9(^2D_{5/2})6s$	(5/2,1/2)	3	15039.572	RW97
		2	17640.616	RW97
$5d^9(^2D_{3/2})6s$	(3/2,1/2)	1	27765.758	RW97
		2	29621.249	RW97
$5d^86s^2$	^3F	4	40478.750	RW97
		3	52176.508	RW97
$5d^86s^2$	1	2	48510.894	RW97
$5d^86s^2$	2	2	58191.630	RW97
$5d^86s^2$	^3P	0	58550.226	RW97
		1	61749.419	RW97
$5d^9(^2D_{5/2})6p$	$(5/2,1/2)^o$	2	63053.318	RW97
		3	65003.594	RW97
$5d^9(^2D_{5/2})6p$	$(5/2,3/2)^o$	4	72495.129	RW97
		2	73178.291	RW97
		1	73403.839	RW97
		3	74791.477	RW97
$5d^9(^2D_{3/2})6p$	$(3/2,1/2)^o$	2	76659.700	RW97
		1	81659.828	RW97

Energy Levels of Singly-ionized Gold (Au II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^9(^2D_{3/2})6p$	$(3/2,3/2)^o$	0	82613.781	RW97
		3	85700.201	RW97
		1	85707.570	RW97
		2	86565.667	RW97
$5d^9(^2D_{5/2})7s$	(5/2,1/2)	3	108172.952	RW97
		2	108631.442	RW97
$5d^9(^2D_{5/2})6d$	(5/2,3/2)	1	116050.55	RW97
		4	116946.327	RW97
		2	117065.629	RW97
		3	117511.998	RW97
$5d^9(^2D_{5/2})7p$	$(5/2,1/2)^o$	2	119446.50	RW 97
		3	120257.120	RW97
$5d^9(^2D_{3/2})7s$	(3/2,1/2)	1	120822.927	RW97
		2	121118.779	RW97
Au III ($^2D_{5/2}$)		*Limit*	**162950**	RW97

Hafnium (Hf)
Atomic number = 72
Atomic weight = 178.49

Isotope	Mass	Abundance	Spin	Mag moment
^{176}Hf	175.941406	5.21%	0	
^{177}Hf	176.943217	18.6%	7/2	+0.7935
^{178}Hf	177.943696	27.30%	0	
^{179}Hf	178.945812	13.63%	9/2	−0.6409
^{180}Hf	179.946545	35.10%	0	

Hf I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^2 6s^2\ {}^3F_2$
Ionization energy: 55 047.9 cm^{-1} (6.825 07 eV)

Hf II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d6s^2\ {}^2P^o_{3/2}$
Ionization energy: 120 000 cm^{-1} (15 eV)

Strong Lines of Hafnium (Hf)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
700 P	2012.78	Hf II	MCS75
1000 P	2028.18	Hf II	MCS75
140	2096.18	Hf II	MCS75
60	2210.82	Hf II	MCS75
40	2254.01	Hf II	MCS75
70	2277.16	Hf II	MCS75
70	2322.47	Hf II	MCS75
40	2323.25	Hf II	MCS75
40	2324.89	Hf II	MCS75
40	2347.44	Hf II	MCS75
60	2351.22	Hf II	MCS75
50	2393.36	Hf II	MCS75
80	2393.83	Hf II	MCS75
60	2405.42	Hf II	MCS75
40	2410.14	Hf II	MCS75
40	2417.69	Hf II	MCS75
50	2447.25	Hf II	MCS75
50	2460.49	Hf II	MCS75
50	2464.19	Hf II	MCS75
70	2512.69	Hf II	MCS75
70	2513.03	Hf II	MCS75
100 P	2516.88	Hf II	MCS75
40	2531.19	Hf II	MCS75
40	2551.40	Hf II	MCS75
100	2571.67	Hf II	MCS75
40	2573.90	Hf II	MCS75
40	2576.82	Hf II	MCS75
40	2578.14	Hf II	MCS75
40	2582.54	Hf II	MCS75
50	2606.37	Hf II	MCS75
50	2607.03	Hf II	MCS75
50	2622.74	Hf II	MCS75
130	2638.71	Hf II	MCS75
130 P	2641.41	Hf II	MCS75
80	2647.29	Hf II	MCS75
300	2705.61	Hf I	MCS75
110	2718.59	Hf I	MCS75

Strong Lines of Hafnium (Hf)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
80	2738.76	Hf II	MCS75
40	2751.81	Hf II	MCS75
200	2761.63	Hf I	MCS75
120 P	2773.36	Hf II	MCS75
200	2779.37	Hf I	MCS75
100	2817.68	Hf I	MCS75
140 P	2820.22	Hf II	MCS75
60	2822.68	Hf II	MCS75
200	2845.83	Hf I	MCS75
120	2850.96	Hf I	MCS75
90	2861.01	Hf II	MCS75
90	2861.70	Hf II	MCS75
1000 P	2866.37	Hf I	MCS75
400	2889.62	Hf I	MCS75
800 P	2898.26	Hf I	MCS75
500 P	2904.41	Hf I	MCS75
400	2904.75	Hf I	MCS75
900 P	2916.48	Hf I	MCS75
250	2918.58	Hf I	MCS75
40	2919.59	Hf II	MCS75
60	2929.63	Hf II	MCS75
200	2929.90	Hf I	MCS75
80	2937.80	Hf II	MCS75
900 P	2940.77	Hf I	MCS75
500	2950.68	Hf I	MCS75
500	2954.20	Hf I	MCS75
250	2958.02	Hf I	MCS75
600	2964.88	Hf I	MCS75
300	2966.93	Hf I	MCS75
80	2968.81	Hf II	MCS75
100	2975.88	Hf II	MCS75
500	2980.81	Hf I	MCS75
400	3005.56	Hf I	MCS75
130	3012.90	Hf II	MCS75
250	3016.78	Hf I	MCS75
130	3016.94	Hf II	MCS75
400	3018.31	Hf I	MCS75
500	3020.53	Hf I	MCS75
50	3031.16	Hf II	MCS75
300	3050.76	Hf I	MCS75
500	3057.02	Hf I	MCS75
400	3067.41	Hf I	MCS75
1000 P	3072.88	Hf I	MCS75
110	3074.79	Hf I	MCS75
200	3080.84	Hf I	MCS75
40	3101.40	Hf II	MCS75
80	3109.12	Hf II	MCS75
300	3131.81	Hf I	MCS75
100 P	3134.72	Hf II	MCS75
200	3156.63	Hf I	MCS75
120	3159.82	Hf I	MCS75
80	3162.61	Hf II	MCS75
200	3168.39	Hf I	MCS75
400	3172.94	Hf I	MCS75
50	3176.86	Hf II	MCS75
40	3193.53	Hf II	MCS75
80	3194.19	Hf II	MCS75
140	3206.11	Hf I	MCS75
150	3247.66	Hf I	MCS75

Strong Lines of Hafnium (Hf)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
100	3249.53	Hf I	MCS75
100 P	3253.70	Hf II	MCS75
150	3310.27	Hf I	MCS75
300	3312.86	Hf I	MCS75
400	3332.73	Hf I	MCS75
40	3352.06	Hf II	MCS75
100	3358.91	Hf I	MCS75
90	3389.83	Hf II	MCS75
100	3392.81	Hf I	MCS75
100	3397.26	Hf I	MCS75
100	3397.60	Hf I	MCS75
250 P	3399.80	Hf II	MCS75
100	3417.34	Hf I	MCS75
200	3419.18	Hf I	MCS75
300	3472.40	Hf I	MCS75
60	3479.28	Hf II	MCS75
110	3497.16	Hf I	MCS75
400	3497.49	Hf I	MCS75
140	3505.23	Hf II	MCS75
400	3523.02	Hf I	MCS75
120	3535.54	Hf II	MCS75
300	3536.62	Hf I	MCS75
60	3552.70	Hf II	MCS75
150	3561.66	Hf II	MCS75
120	3567.36	Hf I	MCS75
130	3569.04	Hf II	MCS75
250	3599.87	Hf I	MCS75
400	3616.89	Hf I	MCS75
40	3630.87	Hf II	MCS75
90	3644.36	Hf II	MCS75
150	3649.10	Hf I	MCS75
200	3675.74	Hf I	MCS75
1000 P	3682.24	Hf I	MCS75
130	3696.51	Hf I	MCS75
40	3701.15	Hf II	MCS75
500	3717.80	Hf I	MCS75
80	3719.28	Hf II	MCS75
200	3733.79	Hf I	MCS75
200	3746.80	Hf I	MCS75
600	3777.64	Hf I	MCS75
600	3785.46	Hf I	MCS75
80	3793.37	Hf II	MCS75
400 d	3800.38	Hf I	MCS75
150	3811.78	Hf I	MCS75
600	3820.73	Hf I	MCS75
130	3830.02	Hf I	MCS75
400	3849.18	Hf I	MCS75
250	3858.31	Hf I	MCS75
100	3860.91	Hf I	MCS75
40	3880.82	Hf II	MCS75
300	3899.94	Hf I	MCS75
70	3918.09	Hf II	MCS75
150	3931.38	Hf I	MCS75
200	3951.83	Hf I	MCS75
100	4062.84	Hf I	MCS75
60 P	4093.16	Hf II	MCS75
500 P	4174.34	Hf I	MCS75
150	4294.79	Hf I	MCS75
110	4356.33	Hf I	MCS75

Strong Lines of Hafnium (Hf)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
110	4565.94	Hf I	MCS75
250 d	4598.80	Hf I	MCS75
100	4620.86	Hf I	MCS75
140	4800.50	Hf I	MCS75
100	5181.86	Hf I	MCS75
100	5550.60	Hf I	MCS75
100	5552.12	Hf I	MCS75
250	7131.81	Hf I	MCS75
300 P	7237.10	Hf I	MCS75
200	7240.87	Hf I	MCS75
150	7624.40	Hf I	MCS75
140	7845.35	Hf I	MCS75
110	7994.73	Hf I	MCS75

Persistent Lines of Neutral Hafnium (Hf I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2866.37		$5d^26s^2$	^3F	2	0.00	MCS75	
			$5d^2(^3F)6s(^2F)6p$	$^1F^o$	3	34877.04		
800	2898.26		$5d^26s^2$	^3F	3	2356.68	MCS75	
			$5d^2(^1G)6s(^2G)6p$	$^3G^o$	4	36850.04		
500	2904.41		$5d^26s^2$	^3F	4	4567.64	MCS75	
			$5d^2(^3F)6s(^2F)6p$	$^1G^o$	4	38987.85		
900	2916.48		$5d^26s^2$	^3F	4	4567.64	MCS75	
			$5d^2(^1G)6s(^2G)6p$	$^3G^o$	5	38845.45		
900	2940.77		$5d^26s^2$	^3F	2	0.00	MCS75	
			$5d^2(^1G)6s(^2G)6p$	$^3F^o$	2	33994.86		
1000	3072.88		$5d^26s^2$	^3F	2	0.00	MCS75	
			$5d^2(^3F)6s(^2F)6p$	$^3G^o$	3	32533.32		
1000	3682.24	0.26	$5d^26s^2$	^3F	2	0.00	MCS75	M00
			$5d^2(^3F)6s(^4F)6p$	$^3F^o$	2	27149.64		
500	4174.34	0.046	$5d^26s^2$	^3F	3	2356.68	MCS75	M00
			$5d^2(^3F)6s(^4F)6p$	$^5D^o$	3	26305.78		
300	7237.10		$5d^26s^2$	^3F	4	4567.64	MCS75	
			$5d6s^26p$	$^3D^o$	3	18381.50		

Energy Levels of Neutral Hafnium (Hf I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^2 6s^2$	^{3}F	2	0.00	MM76
		3	2356.68	MM76
		4	4567.64	MM76
$5d^2 6s^2$	^{3}P	0	5521.77	MM76
		1	6572.54	MM76
		2	8983.74	MM76
$5d^2 6s^2$	^{1}D	2	5638.61	MM76
$5d6s^2 6p$	^{3}F^o	2	10508.88	MM76,MS96
		3	14541.66	MM76
		4	18224.97	MM76
$5d^2 6s^2$	^{1}G	4	10532.55	MM76
$5d6s^2 6p$	^{3}D^o	1	14017.81	MM76
		2	16163.35	MM76
		3	18381.50	MM76
$5d6s^2 6p$	^{1}D^o	2	14435.12	MM76,MS96
$5d6s^2 6p$	^{3}P^o	1	18143.39	MM76
		0	18270.12	MM76
		2	19791.29	MM76
$5d^2 6s^2$	^{1}S	0	20328.36	W78
$5d6s^2 6p$	^{1}F^o	3	23644.74	MM76
$5d^2(^3F)6s(^4F)6p$	^{5}D^o	3	26305.78	MM76
$5d6s^2 6p$	^{1}P^o	1	26463.93	MM76
$5d^2(^3F)6s(^4F)6p$	^{3}F^o	2	27149.64	MM76
$5d^2(^3F)6s(^2F)6p$	^{3}G^o	3	32533.32	MM76
$5d^2(^1G)6s(^2G)6p$	^{3}F^o	2	33994.86	MM76
$5d^2(^3F)6s(^2F)6p$	^{1}F^o	3	34877.04	MM76
$5d^2(^1G)6s(^2G)6p$	^{3}G^o	4	36850.04	MM76
		5	38845.45	MM76
$5d^2(^3F)6s(^2F)6p$	^{1}G^o	4	38987.85	MM76
Hf II ($^2D_{3/2}$)		*Limit*	**55047.9**	CHR88b

Persistent Lines of Singly-ionized Hafnium (Hf II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	2012.78		$5d6s^2$	^2D	5/2	3050.88	MCS75	
			$5d^2(^3P)6p$	$^4D^o$	3/2	52717.46		
1000	2028.18		$5d^2(^3P)6s$	^4P	5/2	13485.56	MCS75	
			$5d^2(^1G)6p$	$^2F^o$	5/2	62774.9		
100	2516.88		$5d6s^2$	^2D	5/2	3050.88	MCS75	
			$5d6s(^3D)6p$	$^2P^o$	3/2	42770.6		
130	2641.41		$5d^2(^3F)6s$	^4F	9/2	8361.76	MCS75	
			$5d^2(^3F)6p$	$^4G^o$	11/2	46209.05		
120	2773.36		$5d^2(^3F)6s$	^4F	7/2	6344.34	MCS75	
			$5d^2(^3F)6p$	$^4G^o$	9/2	42391.09		
140	2820.22		$5d6s^2$	^2D	5/2	3050.88	MCS75	
			$5d^2(^3F)6p$	$^4G^o$	7/2	38498.53		
100	3134.72		$5d6s^2$	^2D	5/2	3050.88	MCS75	
			$5d^2(^3F)6p$	$^4G^o$	5/2	34942.36		
100	3253.70	0.21	$5d6s^2$	^2D	5/2	3050.88	MCS75	M00
			$5d6s(^3D)6p$	$^4F^o$	7/2	33776.24		
250	3399.80	0.31	$5d6s^2$	^2D	3/2	0.00	MCS75	M00
			$5d6s(^3D)6p$	$^4F^o$	5/2	29405.12		
60	4093.16		$5d^2(^3F)6s$	^4F	3/2	3644.65	MCS75	
			$5d6s(^3D)6p$	$^4F^o$	3/2	28068.79		

Energy Levels of Singly-ionized Hafnium (Hf II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d6s^2$	^2D	3/2	0.00	M58
		5/2	3050.88	M58
$5d^2(^3F)6s$	^4F	3/2	3644.65	M58
		5/2	4904.85	M58
		7/2	6344.34	M58
		9/2	8361.76	M58
$5d^2(^3P)6s$	^4P	5/2	13485.56	M58
$5d6s(^3D)6p$	$^4F^o$	3/2	28068.79	M58
		5/2	29405.12	M58
		7/2	33776.24	M58
		9/2	38185.67	M58
$5d6s(^3D)6p$	$^2P^o$	3/2	42770.6	M58
$5d^2(^3F)6p$	$^4F^o$	9/2	46124.89	M58
$5d^2(^3F)6p$	$^4G^o$	5/2	34942.36	M58
		7/2	38498.53	M58
		9/2	42391.09	M58
		11/2	46209.05	M58
$5d^2(^3P)6p$	$^4D^o$	3/2	52717.46	M58
$5d^2(^1G)6p$	$^2F^o$	5/2	62774.9	M58
Hf III ($^3F_2$)		*Limit*	**120000**	M58

Helium (He)
Atomic number = 2
Atomic weight = 4.002 602

Isotope	Mass	Abundance	Spin	Mag moment
^{3}He	3.01603	0.000138%	1/2	−2.12762
^{4}He	4.00260	99.999862%	0	

Note: The spectroscopic data below are for the isotope ^{4}He.

He I Ground state: $1s^2\ ^1S_0$
Ionization energy: 198 310.669 cm^{-1} (24.587 387 eV)

He II Ground state: $1s\ ^2S_{1/2}$
Ionization energy: 438 908.8789 cm^{-1} (54.417 760 eV)

Strong Lines of Helium (He)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
15 c	231.4541	He II	GM65
20 c	232.5842	He II	GM65
30 c	234.3472	He II	GM65
50 c	237.3307	He II	GM65
100 c	243.0266	He II	GM65
300 P	256.3166	He II	MK00b
150 P	256.3177	He II	MK00b
1000 P	303.7804	He II	MK00b
500 P	303.7858	He II	MK00b
10	320.293	He I	TW71
2	505.50035	He I	M02
3	505.68433	He I	M02
4	505.91252	He I	M02
5	506.20034	He I	M02
7	506.57057	He I	M02
10	507.05802	He I	M02
15	507.71809	He I	M02
20	508.64338	He I	M02
25	509.99829	He I	M02
35	512.09856	He I	M02
50	515.61684	He I	M02
100 P	522.21309	He I	M02
400 P	537.02992	He I	M02
1000 P	584.33436	He I	M02
50	591.41207	He I	M02
5 c	958.70	He II	GM65
6 c	972.11	He II	GM65
8 c	992.36	He II	GM65
15 c	1025.27	He II	GM65
30 c	1084.94	He II	GM65
35	1215.09	He II	GM65
50 c	1215.17	He II	GM65
120 P	1640.3321	He II	MK00b
50 P	1640.3447	He II	MK00b
7 P	1640.3750	He II	MK00b
25 P	1640.3914	He II	MK00b
180 P	1640.4742	He II	MK00b
25 P	1640.4897	He II	MK00b
15 P	1640.5326	He II	MK00b

Strong Lines of Helium (He)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
		Air		
7	c	2385.40	He II	GM65
9	c	2511.20	He II	GM65
1		2723.19	He I	M60a
12	c	2733.30	He II	GM65
2		2763.80	He I	M60a
10		2818.2	He I	BDD72
4		2829.08	He I	M60a
10		2945.11	He I	M60a
40		3013.7	He I	BDD72
20		3187.74	He I	M60a
15	c	3203.10	He II	GM65
1		3354.55	He I	M60a
2		3447.59	He I	M60a
1		3587.27	He I	M60a
3		3613.64	He I	M60a
2		3634.23	He I	M60a
3		3705.00	He I	M60a
1		3732.86	He I	M60a
10		3819.607	He I	M60a
1		3819.76	He I	M60a
60	P	3888.6046	He I	M02
200	P	3888.6456	He I	M02
300	P	3888.6489	He I	M02
20		3964.729	He I	M60a
1		4009.27	He I	M60a
50		4026.191	He I	M60a
5		4026.36	He I	M60a
12		4120.82	He I	M60a
2		4120.99	He I	M60a
3		4143.76	He I	M60a
10		4387.929	He I	M60a
3		4437.55	He I	M60a
200		4471.479	He I	M60a
25		4471.68	He I	M60a
4	P,c	4685.3769	He II	MK00b
3	P,c	4685.4072	He II	MK00b
15*	P,c	4685.7038	He II	MK00b
15*	P,c	4685.7044	He II	MK00b
12	P,c	4685.8041	He II	MK00b
30		4713.146	He I	M60a
4		4713.38	He I	M60a
20		4921.931	He I	M60a
100		5015.678	He I	M60a
10		5047.74	He I	M60a
5	c	5411.52	He II	GM65
500	P	5875.6148	He I	M02
250	P	5875.6404	He I	M02
120	P	5875.9663	He I	M02
8	c	6560.10	He II	GM65
200	P	6678.1517	He I	M02
3		6867.48	He I	M60a
100	P	7065.1771	He I	M02
60	P	7065.2153	He I	M02
20	P	7065.7086	He I	M02
50		7281.35	He I	M60a
1		7816.15	He I	M60a
2		8361.69	He I	M60a
2		9063.27	He I	M60a

Strong Lines of Helium (He)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
2		9210.34	He I	M60a
10		9463.61	He I	M60a
4		9516.60	He I	M60a
3		9526.17	He I	M60a
1		9529.27	He I	M60a
1		9603.42	He I	M60a
3		9702.60	He I	M60a
6		10027.73	He I	M60a
2		10031.16	He I	M60a
15	c	10123.6	He II	GM65
1		10138.50	He I	M60a
10		10311.23	He I	M60a
2		10311.54	He I	M60a
3		10667.65	He I	M60a
150	P	10829.0911	He I	M02
500	P	10830.2501	He I	M02
1000	P	10830.3398	He I	M02
9		10913.05	He I	L70a
3		10917.10	He I	L70a
4	c	11626.4	He II	GM65
30		11969.12	He I	L70a
20		12527.52	He I	L70a
50		12784.99	He I	L70a
20		12790.57	He I	L70a
7		12845.96	He I	L70a
10		12968.45	He I	L70a
2		12984.89	He I	L70a
12		15083.64	He I	L70a
200		17002.47	He I	L70a
1		18555.55	He I	M60a
6	c	18636.8	He II	GM65
500		18685.34	He I	L70a
200		18697.23	He I	L70a
100		19089.38	He I	L70a
20		19543.08	He I	L70a
500	P	20581.287	He I	M02
80		21120.07	He I	L70a
10		21121.43	He I	L70a
20		21132.03	He I	L70a
3	c	30908.5	He II	GM65
4		40478.90	He I	L70a

Persistent Lines of Neutral Helium (He I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
100	522.21309	2.4356	$1s^2$	^1S	0	0.000	M02	D96
			$1s4p$	$^1P^o$	1	191492.7120		
400	537.02992	5.6634	$1s^2$	^1S	0	0.000	M02	D96
			$1s3p$	$^1P^o$	1	186209.3651		
1000	584.33436	17.989	$1s^2$	^1S	0	0.000	M02	D96
			$1s2p$	$^1P^o$	1	171134.8970		
60	3888.6046	0.0947	$1s2s$	^3S	1	159855.9745	M02	D96
			$1s3p$	$^3P^o$	0	185564.8547		
200	3888.6456	0.0947	$1s2s$	^3S	1	159855.9745	M02	D96
			$1s3p$	$^3P^o$	1	185564.5840		

Persistent Lines of Neutral Helium (He I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	3888.6489	0.0947	$1s2s$	^3S	1	159855.9745	M02	D96
			$1s3p$	$^3P^o$	2	185564.5620		
500	5875.6148	0.7070	$1s2p$	$^3P^o$	2	169086.7666	M02	D96
			$1s3d$	^3D	3	186101.5463		
250	5875.6404	0.5303	$1s2p$	$^3P^o$	1	169086.8430	M02	D96
			$1s3d$	^3D	2	186101.5488		
120	5875.9663	0.3927	$1s2p$	$^3P^o$	0	169087.8309	M02	D96
			$1s3d$	^3D	1	186101.5930		
200	6678.1517	0.6369	$1s2p$	$^1P^o$	1	171134.8970	M02	D96
			$1s3d$	^1D	2	186104.9668		
100	7065.1771	0.1547	$1s2p$	$^3P^o$	2	169086.7666	M02	D96
			$1s3s$	^3S	1	183236.7918		
60	7065.2153	0.0928	$1s2p$	$^3P^o$	1	169086.8430	M02	D96
			$1s3s$	^3S	1	183236.7918		
20	7065.7086	0.0309	$1s2p$	$^3P^o$	0	169087.8309	M02	D96
			$1s3s$	^3S	1	183236.7918		
50	7281.3507	0.1830	$1s2p$	$^1P^o$	1	171134.8970	M02	D96
			$1s3s$	^1S	0	184864.8294		
150	10829.0911	0.1022	$1s2s$	^3S	1	159855.9745	M02	D96
			$1s2p$	$^3P^o$	0	169087.8309		
500	10830.2501	0.1021	$1s2s$	^3S	1	159855.9745	M02	D96
			$1s2p$	$^3P^o$	1	169086.8430		
1000	10830.3398	0.1021	$1s2s$	^3S	1	159855.9745	M02	D96
			$1s2p$	$^3P^o$	2	169086.7666		
500	20581.287	0.0197	$1s2s$	^1S	0	166277.4403	M02	D96
			$1s2p$	$^1P^o$	1	171134.8970		

Energy Levels of Neutral Helium (He I)

Configuration	Term	J	Level (cm^{-1})	Ref
$1s^2$	^1S	0	0.000	M02
$1s2s$	^3S	1	159855.9745	M02
$1s2s$	^1S	0	166277.4403	M02
$1s2p$	$^3P^o$	2	169086.7666	M02
		1	169086.8430	M02
		0	169087.8309	M02
$1s2p$	$^1P^o$	1	171134.8970	M02
$1s3s$	^3S	1	183236.7918	M02
$1s3s$	^1S	0	184864.8294	M02
$1s3p$	$^3P^o$	2	185564.5620	M02
		1	185564.5840	M02
		0	185564.8547	M02

Energy Levels of Neutral Helium (He I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$1s3d$	^3D	3	186101.5463	M02
		2	186101.5488	M02
		1	186101.5930	M02
$1s3d$	^1D	2	186104.9668	M02
$1s3p$	$^1P^o$	1	186209.3651	M02
$1s4p$	$^1P^o$	1	191492.7120	M02
He II ($^2S_{1/2}$)		*Limit*	**198310.6691**	M02

Persistent Lines of Singly-ionized Helium (He II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	256.3166	26.77	$1s$	^2S	1/2	0.0000	MK00b	BM00
			$3p$	$^2P^o$	3/2	390142.5605		
150	256.3177	26.77	$1s$	^2S	1/2	0.0000	MK00b	BM00
			$3p$	$^2P^o$	1/2	390140.8250		
1000	303.7804	100.27	$1s$	^2S	1/2	0.0000	MK00b	BM00
			$2p$	$^2P^o$	3/2	329185.1511		
500	303.7858	100.28	$1s$	^2S	1/2	0.0000	MK00b	BM00
			$2p$	$^2P^o$	1/2	329179.2940		
120	1640.3321	8.624	$2p$	$^2P^o$	1/2	329179.2940	MK00b	BM00
			$3d$	^2D	3/2	390142.5576		
50	1640.3447	3.593	$2s$	^2S	1/2	329179.7623	MK00b	BM00
			$3p$	$^2P^o$	3/2	390142.5605		
7	1640.3750	0.337	$2p$	$^2P^o$	1/2	329179.2940	MK00b	BM00
			$3s$	^2S	1/2	390140.9646		
25	1640.3914	3.594	$2s$	^2S	1/2	329179.7623	MK00b	BM00
			$3p$	$^2P^o$	1/2	390140.8250		
180	1640.4742	10.35	$2p$	$^2P^o$	3/2	329185.1511	MK00b	BM00
			$3d$	^2D	5/2	390143.1361		
25	1640.4897	1.725	$2p$	$^2P^o$	3/2	329185.1511	MK00b	BM00
			$3d$	^2D	3/2	390142.5576		
15	1640.5326	0.674	$2p$	$^2P^o$	3/2	329185.1511	MK00b	BM00
			$3s$	^2S	1/2	390140.9646		
4	4685.3769	0.939	$3p$	$^2P^o$	1/2	390140.8250	MK00b	BM00
			$4d$	^2D	3/2	411477.8537		
3	4685.4072	0.491	$3s$	^2S	1/2	390140.9646	MK00b	BM00
			$4p$	$^2P^o$	3/2	411477.8550		
15*	4685.7038	2.060	$3d$	^2D	3/2	390142.5576	MK00b	BM00
			$4f$	$^2F^o$	5/2	411478.0973		
15*	4685.7044	1.126	$3p$	$^2P^o$	3/2	390142.5605	MK00b	BM00
			$4d$	^2D	5/2	411478.0978		
12	4685.8041	2.207	$3d$	^2D	5/2	390143.1361	MK00b	BM00
			$4f$	$^2F^o$	7/2	411478.2193		

Energy Levels of Singly-ionized Helium (He II)

Configuration	Term	J	Level (cm^{-1})	Ref
$1s$	^2S	1/2	0.0000	MK00b
$2p$	$^2P^o$	1/2	329179.2940	MK00b
		3/2	329185.1511	MK00b
$2s$	^2S	1/2	329179.7623	MK00b
$3p$	$^2P^o$	1/2	390140.8250	MK00b
		3/2	390142.5605	MK00b
$3s$	^2S	1/2	390140.9646	MK00b
$3d$	^2D	3/2	390142.5576	MK00b
		5/2	390143.1361	MK00b
$4p$	$^2P^o$	1/2	411477.1228	MK00b
		3/2	411477.8550	MK00b
$4s$	^2S	1/2	411477.1818	MK00b
$4d$	^2D	3/2	411477.8537	MK00b
		5/2	411478.0978	MK00b
$4f$	$^2F^o$	5/2	411478.0973	MK00b
		7/2	411478.2193	MK00b
He		*Limit*	**438908.8789**	MK00b

Holmium (Ho)
Atomic number = 67
Atomic weight = 164.930 32

Isotope	Mass	Abundance	Spin	Mag moment
^{165}Ho	164.93032	100%	7/2	

Ho I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^{11} 6s^2\ {}^4\mathrm{I}^{\mathrm{o}}_{15/2}$
Ionization energy: 48 567 cm^{-1} (6.0215 eV)

Ho II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^{11} ({}^4\mathrm{I}^{\mathrm{o}}_{15/2}) 6s\ (15/2,1/2)^{\mathrm{o}}_8$
Ionization energy: 95 200 cm^{-1} (11.80 eV)

Strong Lines of Holmium (Ho)

Intensity	Wavelength (Å)	Spectrum	Ref.
	Air		
30	2880.98	Ho II	MCS75
40 c	2909.41	Ho II	MCS75
25	2973.00	Ho II	MCS75
25 c	2979.63	Ho II	MCS75
25	2987.64	Ho II	MCS75
30 c	3049.38	Ho II	MCS75
25 c	3054.00	Ho II	MCS75
30 c	3057.45	Ho II	MCS75
30 c	3082.34	Ho II	MCS75
60	3084.36	Ho II	MCS75
25 c	3086.54	Ho II	MCS75
50	3118.50	Ho II	MCS75
40 c	3166.62	Ho II	MCS75
25 d,l	3171.72	Ho II	MCS75
50	3173.78	Ho II	MCS75
25	3174.84	Ho II	MCS75
50 c	3181.50	Ho II	MCS75
25	3183.84	Ho II	MCS75
25 c	3197.83	Ho II	MCS75
25	3201.76	Ho II	MCS75
25 c	3278.15	Ho II	MCS75
60 c	3281.97	Ho II	MCS75
25	3288.46	Ho II	MCS75
40 c	3337.23	Ho II	MCS75
25 c	3338.86	Ho II	MCS75
60 c	3343.58	Ho II	MCS75
500 P,c	3398.95	Ho II	MZH78
50 c	3410.26	Ho II	MCS75
25 c	3410.65	Ho II	MCS75
90 c	3414.90	Ho II	MCS75
300 P	3416.44	Ho II	MZH78
80	3421.63	Ho II	MCS75
120 c	3425.34	Ho II	MCS75
120 c	3428.13	Ho II	MCS75
40 c	3429.18	Ho II	MCS75
40	3449.35	Ho I	MCS75
200 P	3453.11	Ho II	MZH78
50 c	3455.70	Ho II	MCS75
1000 P,c	3456.02	Ho II	MZH78
100	3461.97	Ho II	MCS75
50 c	3473.91	Ho II	MCS75

Strong Lines of Holmium (Ho)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
300 P,c	3474.25	Ho II	MZH78
400 P	3484.80	Ho II	MZH78
30	3489.58	Ho II	MCS75
40 c	3493.09	Ho II	MCS75
150 c	3494.76	Ho II	MCS75
50 c	3498.88	Ho II	MCS75
25 c	3506.95	Ho II	MCS75
90	3510.73	Ho I	MCS75
250 P,c	3515.56	Ho II	MZH78
25 c	3519.94	Ho II	MCS75
40	3540.76	Ho II	MCS75
100	3546.05	Ho II	MCS75
70 c	3556.78	Ho II	MCS75
25	3560.15	Ho II	MCS75
25 c	3573.24	Ho II	MCS75
40 c	3574.80	Ho II	MCS75
90	3579.12	Ho I	MCS75
25	3580.75	Ho II	MCS75
25	3581.83	Ho II	MCS75
40 c	3592.23	Ho II	MCS75
70 c,w	3598.77	Ho II	MCS75
40	3599.48	Ho I	MCS75
30 c	3600.95	Ho II	MCS75
20	3613.31	Ho II	MCS75
50	3618.43	Ho I	MCS75
25 c	3626.69	Ho II	MCS75
30	3627.25	Ho II	MCS75
25 c	3631.76	Ho II	MCS75
25 c	3638.30	Ho II	MCS75
200 c	3662.29	Ho I	MCS75
50	3662.99	Ho I	MCS75
80	3666.65	Ho I	MCS75
150	3667.97	Ho I	MCS75
50	3669.52	Ho I	MCS75
30 c	3674.77	Ho II	MCS75
80	3679.19	Ho I	MCS75
80	3679.70	Ho I	MCS75
80	3682.65	Ho I	MCS75
25	3685.16	Ho II	MCS75
70	3690.65	Ho I	MCS75
40	3691.95	Ho I	MCS75
50	3700.04	Ho I	MCS75
30 c	3702.35	Ho II	MCS75
40	3709.76	Ho I	MCS75
50	3712.88	Ho I	MCS75
50	3720.72	Ho I	MCS75
120	3731.40	Ho I	MCS75
40	3732.09	Ho I	MCS75
90	3736.35	Ho I	MCS75
200 P,c,w	3748.17	Ho II	MCS75
40	3769.09	Ho I	MCS75
600 P,c	3796.75	Ho II	MZH78
600 P,c	3810.74	Ho II	MZH78
60	3811.86	Ho I	MCS75
60 c	3813.25	Ho II	MCS75
40 P	3829.27	Ho I	MCS75
25 c	3835.35	Ho II	MCS75
80 c,w	3837.51	Ho II	MCS75
25 c	3842.05	Ho II	MCS75

Strong Lines of Holmium (Ho)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
70	3843.86	Ho II	MCS75
30 c	3846.73	Ho II	MCS75
30	3849.88	Ho I	MCS75
110 c	3854.07	Ho II	MCS75
25 c,w	3856.94	Ho II	MCS75
40	3857.72	Ho II	MCS75
150 c	3861.68	Ho II	MCS75
60	3862.62	Ho I	MCS75
40	3874.68	Ho II	MCS75
30	3881.61	Ho II	MCS75
200 P,c	3888.96	Ho II	MZH78
60	3890.42	Ho I	MCS75
800 P,c	3890.94	Ho II	MZH78
30	3896.76	Ho II	MCS75
40	3904.44	Ho I	MCS75
80 c,w	3905.68	Ho II	MCS75
40	3911.80	Ho I	MCS75
40	3919.45	Ho I	MCS75
25	3938.85	Ho I	MCS75
25	3950.56	Ho I	MCS75
70	3955.73	Ho I	MCS75
60	3959.68	Ho I	MCS75
25	3975.88	Ho I	MCS75
40 c	3976.93	Ho I	MCS75
40	3999.58	Ho I	MCS75
25	4003.39	Ho I	MCS75
40	4027.21	Ho I	MCS75
30	4028.86	Ho I	MCS75
25	4037.62	Ho I	MCS75
300 P	4040.81	Ho I	MZH78
300 P,c	4045.47	Ho II	MZH78
25 c	4047.52	Ho I	MCS75
900 P	4053.87	Ho I	MZH78
30	4054.48	Ho II	MCS75
30	4057.55	Ho I	MCS75
25	4060.31	Ho I	MCS75
110	4065.09	Ho II	MCS75
80	4068.05	Ho I	MCS75
30	4071.83	Ho I	MCS75
30	4073.13	Ho I	MCS75
30	4073.51	Ho I	MCS75
25	4083.67	Ho I	MCS75
25	4100.22	Ho I	MCS75
1000 P	4103.80	Ho I	MZH78
30	4106.50	Ho I	MCS75
300 P	4108.62	Ho I	MZH78
30	4112.00	Ho I	MCS75
30	4116.73	Ho I	MCS75
150	4120.20	Ho I	MCS75
150	4125.65	Ho I	MCS75
500 P	4127.16	Ho I	MZH78
30	4134.54	Ho I	MCS75
150	4136.22	Ho I	MCS75
25	4142.19	Ho I	MCS75
30	4148.97	Ho I	MCS75
60 c,w	4152.61	Ho II	MCS75
900 P	4163.03	Ho I	MZH78
300 P	4173.20	Ho I	MZH78
60	4194.35	Ho I	MCS75

Strong Lines of Holmium (Ho)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
30	4222.29	Ho I	MCS75
30	4223.47	Ho I	MCS75
200 P	4227.13	Ho I	MZH78
25	4229.52	Ho II	MCS75
30	4243.78	Ho I	MCS75
150 P,c,w	4254.38	Ho I	MZH78
60	4264.05	Ho I	MCS75
30	4266.04	Ho I	MCS75
150 P	4350.73	Ho I	MZH78
30 P	4939.01	Ho I	MZH78
25	4979.97	Ho I	MCS75
25 P,c	5982.85	Ho I	MZH78
30 P	6604.91	Ho I	MZH78
15	7555.09	Ho I	MCS75

Persistent Lines of Neutral Holmium (Ho I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	4040.81	0.373	$4f^{11}6s^2$	$^4I^o$	15/2	0.00	MZH78	M00
			$4f^{10}5d6s^2$		13/2	24740.52		
900	4053.87	1.62	$4f^{11}6s^2$	$^4I^o$	15/2	0.00	MZH78	M00
			$4f^{11}(^4I^o_{15/2})6s6p(^1P^o_1)$	(15/2,1)	15/2	24660.80		
1000	4103.80	1.55	$4f^{11}6s^2$	$^4I^o$	15/2	0.00	MZH78	M00
			$4f^{11}(^4I^o_{15/2})6s6p(^1P^o_1)$	(15/2,1)	17/2	24360.81		
300	4108.62	2.0	$4f^{11}6s^2$	$^4I^o$	13/2	5419.70	MZH78	HWL99
			$4f^{11}(^4I^o_{13/2})6s6p(^1P^o_1)$	(13/2,1)	13/2	29751.91		
500	4127.16	2.1	$4f^{11}6s^2$	$^4I^o$	13/2	5419.70	MZH78	HWL99
			$4f^{11}(^4I^o_{13/2})6s6p(^1P^o_1)$	(13/2,1)	15/2	29642.60		
900	4163.03	0.897	$4f^{11}6s^2$	$^4I^o$	15/2	0.00	MZH78	M00
			$4f^{11}(^4I^o_{15/2})6s6p(^1P^o_1)$	(15/2,1)	13/2	24014.22		
300	4173.20	0.258	$4f^{11}6s^2$	$^4I^o$	15/2	0.00	MZH78	M00
			$4f^{11}(^4I^o_{13/2})6s6p(^3P^o_2)$	(13/2,2)	13/2	23955.69		
200	4227.13	1.1	$4f^{11}6s^2$	$^4I^o$	13/2	5419.70	MZH78	HWL99
			$4f^{11}(^4I^o_{13/2})6s6p(^1P^o_1)$	(13/2,1)	11/2	29069.78		
150	4254.38	0.115	$4f^{11}6s^2$	$^4I^o$	15/2	0.00	MZH78	M00
			$4f^{11}(^4I^o_{13/2})6s6p(^3P^o_2)$	(13/2,2)	17/2	23498.57		
150	4350.73	0.089	$4f^{11}6s^2$	$^4I^o$	15/2	0.00	MZH78	M00
			$4f^{10}(^5I_5)5d_{5/2}6s^2$	(5,5/2)	13/2	22978.19		
30	4939.01	0.026	$4f^{11}6s^2$	$^4I^o$	15/2	0.00	MZH78	M00
			$4f^{10}(^5I_6)5d_{5/2}6s^2$	(6,5/2)	13/2	20241.31		
25	5982.85	0.0093	$4f^{11}6s^2$	$^4I^o$	15/2	0.00	MZH78	M00
			$4f^{11}(^4I^o_{15/2})6s6p(^3P^o_1)$	(15/2,1)	17/2	16709.82		
30	6604.91		$4f^{11}6s^2$	$^4I^o$	15/2	0.00	MZH78	
			$4f^{10}(^5I_7)5d_{3/2}6s^2$	(7,3/2)	15/2	15136.06		

Energy Levels of Neutral Holmium (Ho I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{11}6s^2$	$^4I^o$	15/2	0.00	MZH78
		13/2	5419.70	MZH78
		11/2	8605.16	MZH78
		9/2	10695.75	MZH78
$4f^{10}(^5I_8)5d_{3/2}6s^2$	(8,3/2)	17/2	8378.91	MZH78
		15/2	8427.11	MZH78
		13/2	9147.08	MZH78
		19/2	9741.50	MZH78
$4f^{10}(^5I_8)5d_{5/2}6s^2$	(8,5/2)	21/2	11322.31	MZH78
		17/2	11530.56	MZH78
		19/2	11689.77	MZH78
		15/2	12339.04	MZH78
		11/2	16937.43	MZH78
$4f^{10}(^5I_7)5d_{3/2}6s^2$	(7,3/2)	13/2	12344.55	MZH78
		11/2	13082.93	MZH78
		17/2	15130.31	MZH78
		15/2	15136.06	MZH78
$4f^{11}6s^2$	$^4F^o$	9/2	13094.42	KWL97
$4f^{10}(^5I)5d6s^2$		13/2	15081.12	MZH78
$4f^{10}(^5I)5d6s^2$		11/2	15792.13	MZH78
$4f^{11}(^4I^o_{15/2})6s6p(^3P^o_0)$	(15/2,0)	15/2	15855.28	MZH78
$4f^{10}5d6s^2$		15/2	16154.21	MZH78
$4f^{10}(^5I_7)5d_{5/2}6s^2$	(7,5/2)	17/2	16438.01	MZH78
$4f^{10}(^5I_7)5d_{5/2}6s^2$	(7,5/2)	19/2	16683.52	MZH78
$4f^{11}(^4I^o_{15/2})6s6p(^3P^o_1)$	(15/2,1)	17/2	16709.82	MZH78
		15/2	16882.28	MZH78
		13/2	17059.35	MZH78
$4f^{10}(^5I_6)5d_{5/2}6s^2$	(6,5/2)	13/2	20241.31	MZH78
$4f^{10}(^5I_5)5d_{5/2}6s^2$	(5,5/2)	13/2	22978.19	MZH78
$4f^{11}(^4I^o_{13/2})6s6p(^3P^o_2)$	(13/2,2)	17/2	23498.57	MZH78
		15/2	23834.94	MZH78
		9/2	23861.17	MZH78
		11/2	23946.16	MZH78
		13/2	23955.69	MZH78
		7/2	—	
$4f^{11}(^4I^o_{15/2})6s6p(^1P^o_1)$	(15/2,1)	13/2	24014.22	MZH78
		17/2	24360.81	MZH78
		15/2	24660.80	MZH78
$4f^{10}5d6s^2$		13/2	24740.52	MZH78
$4f^{11}(^4I^o_{13/2})6s6p(^1P^o_1)$	(13/2,1)	11/2	29069.78	MZH78
		15/2	29642.60	MZH78
		13/2	29751.91	MZH78
Ho II $(^4I^o_{15/2})6s$ $(15/2,1/2)^o_8$		*Limit*	**48567**	WSPC78

Persistent Lines of Singly-ionized Holmium (Ho II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3398.95	0.635	$4f^{11}(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.00	MZH78	M00
			$4f^{11}(^4I^o_{15/2})6p_{3/2}$	(15/2,3/2)	8	29412.38		
300	3416.44		$4f^{11}(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	7	637.40	MZH78	
			$4f^{11}(^4I^o_{15/2})6p_{3/2}$	(15/2,3/2)	7	29899.21		
200	3453.11		$4f^{11}(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	7	637.40	MZH78	
			$4f^{11}(^4I^o_{15/2})6p_{3/2}$	(15/2,3/2)	6	29588.49		
1000	3456.02		$4f^{11}(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.00	MZH78	
			$4f^{11}(^4I^o_{15/2})6p_{3/2}$	(15/2,3/2)	9	28926.70		
300	3474.25	0.487	$4f^{11}(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	7	637.40	MZH78	M00
			$4f^{11}(^4I^o_{15/2})6p_{3/2}$	(15/2,3/2)	8	29412.38		
400	3484.80		$4f^{11}(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	7	637.40	MZH78	
					7	29325.2		
250	3515.56		$4f^{11}(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	7	637.40	MZH78	
					6	29074.26		
200	3748.17						MCS75	
600	3796.75	0.430	$4f^{11}(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.00	MZH78	M00
			$4f^{11}(^4I^o_{15/2})6p_{1/2}$	(15/2,1/2)	8	26330.85		
600	3810.74		$4f^{11}(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.00	MZH78	
			$4f^{11}(^4I^o_{15/2})6p_{1/2}$	(15/2,1/2)	7	26234.19		
200	3888.96		$4f^{11}(^4I^o_{13/2})6s_{1/2}$	$(13/2,1/2)^o$	6	5849.74	MZH78	
			$4f^{11}(^4I^o_{13/2})6p_{1/2}$	(13/2,1/2)	7	31556.3		
800	3890.94	0.699	$4f^{11}(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	7	637.40	MZH78	M00
			$4f^{11}(^4I^o_{15/2})6p_{1/2}$	(15/2,1/2)	8	26330.85		
300	4045.47		$4f^{11}(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.00	MZH78	
					7	24712.0		

Energy Levels of Singly-ionized Holmium (Ho II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{11}(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.00	MZH78
		7	637.40	MZH78
$4f^{11}(^4I^o_{13/2})6s_{1/2}$	$(13/2,1/2)^o$	7	5617.04	MZH78
		6	5849.74	MZH78
$4f^{11}(^4I^o_{11/2})6s_{1/2}$	$(11/2,1/2)^o$	5	8850.55	MZH78
		6	9001.65	MZH78
$4f^{11}(^4I^o_{9/2})6s_{1/2}$	$(9/2,1/2)^o$	4	10838.85	MZH78
		5	11204.50	MZH78
$4f^{11}(^4I^o_{15/2})5d_{3/2}$	$(15/2,3/2)^o$	6	16281.60	MZH78
		7	16748.98	MZH78
		9	17713.75	MZH78
		8	18404.87	MZH78

Energy Levels of Singly-ionized Holmium (Ho II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{11}(^4I^o_{15/2})5d_{5/2}$	$(15/2,5/2)^o$	10	18258.95	MZH78
		9	19111.47	MZH78
		5	19882.92	MZH78
		8	20029.35	MZH78
		6	20314.90	MZH78
		7	20492.00	MZH78
	^{o}	5	19000.54	MZH78
		7,8	21688.7	MZH78
		7	24712.0	MZH78
		7,8	26008.3	MZH78
$4f^{11}(^4I^o_{15/2})6p_{1/2}$	(15/2,1/2)	7	26234.19	MZH78
		8	26330.85	MZH78
$4f^{11}(^4I^o_{15/2})6p_{3/2}$	(15/2,3/2)	9	28926.70	MZH78
		8	29412.38	MZH78
		6	29588.49	MZH78
		7	29899.21	MZH78
		6	29074.26	MZH78
		7,8	29275.0	MZH78
		7,8	29325.2	MZH78
		7	29810.85	MZH78
		7,8	30884.7	MZH78
$4f^{11}(^4I^o_{13/2})6p_{1/2}$	(13/2,1/2)	6	31505.0	MZH78
		7	31556.3	MZH78
Ho III ($^4I^o_{15/2}$)		*Limit*	**95200**	MZH78

Hydrogen (H)

Atomic number = 1

Atomic weight = 1.007 94

Isotope	Mass	Abundance	Spin	Mag moment
^{1}H	1.007825	99.985%	1/2	+2.79284
^{2}H	2.0140	0.015%	1	+0.85743

Notes: The wavelengths and energy levels given below are for the isotope ^{1}H.
Although the tabulated energy levels comprise values for each level through $n = 5$, we give (Ritz) wavelengths for resolved fine structures only for the Lyman-alpha, Balmer-alpha, and Balmer-beta lines (1215, 6562, and 4861 Å). As indicated by the energy-level notations in the persistent-lines table, the other wavelengths represent unresolved multiplets. These wavelengths are from the corresponding weighted-average energies.

H I Ground state: $1s\ ^{2}S_{1/2}$
Ionization energy: 109 678.7717 cm^{-1} (13.598 433 eV)

Strong Lines of Hydrogen (H)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
15	926.2256	H I	MK00a
20	930.7482	H I	MK00a
30	937.8034	H I	MK00a
50 P	949.7430	H I	MK00a
100 P	972.5367	H I	MK00a
300 P	1025.7222	H I	MK00a
1000 P	1215.66824	H I	MK00a
500 P	1215.67364	H I	MK00a
	Air		
5	3835.384	H I	RCWM80
6	3889.049	H I	RCWM80
8	3970.072	H I	RCWM80
15	4101.74	H I	RCWM80
30 P	4340.462	H I	MK00a
30 P	4861.2786	H I	MK00a
10 P	4861.2870	H I	MK00a
60 P	4861.3615	H I	MK00a
90 P	6562.7110	H I	MK00a
30 P	6562.7248	H I	MK00a
180 P	6562.8518	H I	MK00a
5	9545.97	H I	RCWM80
7	10049.4	H I	RCWM80
12	10938.1	H I	RCWM80
20 P	12818.07	H I	MK00a
40 P,c	18751.01	H I	MK00a
5	21655.3	H I	RCWM80
8	26251.5	H I	RCWM80
15	40511.6	H I	RCWM80
4	46525.1	H I	RCWM80
6	74578	H I	RCWM80
3	123685	H I	RCWM80

Persistent Lines of Neutral Hydrogen (H I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
50	949.7430	0.34375	$1s$	^2S	1/2	0.0000	MK00a	BM00
			$5p$	$^2P^o$	1/2,3/2	105291.6443		
100	972.5367	0.6819	$1s$	^2S	1/2	0.0000	MK00a	BM00
			$4p$	$^2P^o$	1/2,3/2	102823.8791		
300	1025.7222	1.6725	$1s$	^2S	1/2	0.0000	MK00a	BM00
			$3p$	$^2P^o$	1/2,3/2	97492.2835		
1000	1215.66824	6.2648	$1s$	^2S	1/2	0.0000	MK00a	BM00
			$2p$	$^2P^o$	3/2	82259.2850		
500	1215.67364	6.2649	$1s$	^2S	1/2	0.0000	MK00a	BM00
			$2p$	$^2P^o$	1/2	82258.9191		
30	4340.462	0.0253	$2s,p$			82259.1109	MK00a	WSG66
			$5s,p,d,f,g$			105291.6587		
30	4861.2786	0.1719	$2p$	$^2P^o$	1/2	82258.9191	MK00a	BM00
			$4d$	^2D	3/2	102823.8942		
10	4861.2870	0.0967	$2s$	^2S	1/2	82258.9544	MK00a	BM00
			$4p$	$^2P^o$	3/2	102823.8943		
60	4861.3615	0.2063	$2p$	$^2P^o$	3/2	82259.2850	MK00a	BM00
			$4d$	^2D	5/2	102823.9095		
90	6562.7110	0.5388	$2p$	$^2P^o$	1/2	82258.9191	MK00a	BM00
			$3d$	^2D	3/2	97492.3195		
30	6562.7248	0.2245	$2s$	^2S	1/2	82258.9544	MK00a	BM00
			$3p$	$^2P^o$	3/2	97492.3196		
180	6562.8518	0.6465	$2p$	$^2P^o$	3/2	82259.2850	MK00a	BM00
			$3d$	^2D	5/2	97492.3556		
20	12818.07	0.0220	$3s,p,d$			97492.3087	MK00a	WSG66
			$5s,p,d,f,g$			105291.6587		
40	18751.01	0.0899	$3s,p,d$			97492.3087	MK00a	WSG66
			$4s,p,d,f$			102823.9002		

Energy Levels of Neutral Hydrogen (H I)

Configuration	Term	J	Level (cm^{-1})	Ref
$1s$	^2S	1/2	0.0000	MK00a
$2p$	$^2P^o$	1/2	82258.9191	MK00a
		3/2	82259.2850	MK00a
$2s$	^2S	1/2	82258.9544	MK00a
$3p$	$^2P^o$	1/2	97492.2112	MK00a
		3/2	97492.3196	MK00a
$3s$	^2S	1/2	97492.2217	MK00a
$3d$	^2D	3/2	97492.3195	MK00a
		5/2	97492.3556	MK00a
$4p$	$^2P^o$	1/2	102823.8486	MK00a
		3/2	102823.8943	MK00a

Energy Levels of Neutral Hydrogen (H I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4s$	^2S	1/2	102823.8530	MK00a
$4d$	^2D	3/2	102823.8942	MK00a
		5/2	102823.9095	MK00a
$4f$	$^2F^o$	5/2	102823.9095	MK00a
		7/2	102823.9171	MK00a
$5p$	$^2P^o$	1/2	105291.6287	MK00a
		3/2	105291.6521	MK00a
$5s$	^2S	1/2	105291.6309	MK00a
$5d$	^2D	3/2	105291.6520	MK00a
		5/2	105291.6599	MK00a
$5f$	$^2F^o$	5/2	105291.6598	MK00a
		7/2	105291.6637	MK00a
$5g$	^2G	7/2	105291.6637	MK00a
		9/2	105291.6661	MK00a
H		*Limit*	**109678.7717**	MK00a

Indium (In)
Atomic number = 49
Atomic weight = 114.82

Isotope	Mass	Abundance	Spin	Mag moment
^{113}In	112.904061	4.3%	9/2	+5.5229
^{115}In	114.903800	95.7%	9/2	+5.534

In I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p\ ^2P^o_{1/2}$
Ionization energy: 46 670.11 cm^{-1} (5.786 36 eV)

In II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2\ ^1S_0$
Ionization energy: 152 199 cm^{-1} (18.8703 eV)

Strong Lines of Indium (In)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
20 P	1586.340	In II	SM02
14 P,w	1711.1	In I	G54
14 P,w	1757.3	In I	G54
6 P	1936.217	In II	B69
6 P	1966.711	In II	B69
11 P	1977.359	In II	B69
	Air		
14 P	2078.608	In II	SM02
6 P,c	2306.046	In II	PC38,B69
1	2306.86	In I	P38
2	2389.54	In I	P38
3	2460.08	In I	P38
2 h	2468.02	In I	P38
6	2521.37	In I	P38
9 P,d	2554.434	In II	PC38
60 P	2560.150	In I	P38
11	2601.76	In I	P38
90 P	2710.265	In I	P38
15	2713.94	In I	P38
40 P	2753.878	In I	P38
2	2775.37	In I	P38
10 c	2836.92	In I	P38
2 c	2858.14	In I	P38
7 P,d	2890.179	In II	PC38
60 P	2932.630	In I	P38
6 P	2941.050	In II	PC38
1 c	2957.01	In I	P38
400 P	3039.356	In I	P38
700 P	3256.089	In I	P38
150 P	3258.565	In I	P38
20 w	3716.14	In II	PC38
13 c	3799.21	In II	PC38
14 c	3834.65	In II	PC38
11 c	3842.18	In II	PC38
14 w	3962.35	In II	PC38
25 w	4056.94	In II	PC38
900 P	4101.7504	In I	DMZ53
1000 P	4511.2972	In I	DMZ53
14 c	4620.14	In II	PC38
20 c	4638.16	In II	PC38

Strong Lines of Indium (In)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
12 c	4644.58	In II	PC38
20 c	4655.62	In II	PC38
20 w	4656.74	In II	PC38
25 w	4684.8	In II	PC38
15 c	5120.80	In II	PC38
11 w	5121.75	In II	PC38
13 c	5175.42	In II	PC38
12 w	5436.70	In II	PC38
20 c	5513.00	In II	PC38
14 w	5523.28	In II	PC38
13 c	5576.90	In II	PC38
11 w	5636.70	In II	PC38
3	5709.91	In I	P38
3	5727.68	In I	P38
12 c	5853.15	In II	PC38
25 w	5903.4	In II	PC38
14 w	5915.4	In II	PC38
14 c	6095.95	In II	PC38
12 c	6108.66	In II	PC38
13 w	6128.7	In II	PC38
13 w	6129.4	In II	PC38
20 w	6132.1	In II	PC38
15 w	6228.3	In II	PC38
15 w	6304.8	In II	PC38
15 w	6362.3	In II	PC38
15 w	6469.0	In II	PC38
12 c	6541.20	In II	PC38
20 P,w	6891.56	In II	PC38
20 P,w	7182.89	In II	PC38
12 c	7276.5	In II	PC38
20 c	7350.6	In II	PC38
12 c	7740.7	In II	PC38
13 c	8227.0	In II	PC38
12 w	9213.0	In II	PC38
3 h	9370.27	In I	JL67
6	9977.86	In I	JL67
11	10257.03	In I	JL67
3 h	10717.42	In I	JL67
6 h	10744.31	In I	JL67
1 P	12912.59	In I	JL67
1 P	13429.96	In I	JL67

Persistent Lines of Neutral Indium (In I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
14	1711.1		$5p$	$^2P^o$	3/2	2212.598	G54	
			$5s5p^2$	^2P	3/2	60654		
14	1757.3		$5p$	$^2P^o$	1/2	0.000	G54	
			$5s5p^2$	^2S	1/2	56905		
60	2560.150	0.20	$5p$	$^2P^o$	1/2	0.000	P38	M00
			$6d$	^2D	3/2	39048.53		
90	2710.265	0.27	$5p$	$^2P^o$	3/2	2212.598	P38	M00
			$6d$	^2D	5/2	39098.38		

Persistent Lines of Neutral Indium (In I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
40	2753.878	0.13	$5p$	$^2P^o$	1/2	0.000	P38	M00
			$7s$	^2S	1/2	36301.84		
60	2932.630	0.23	$5p$	$^2P^o$	3/2	2212.598	P38	M00
			$7s$	^2S	1/2	36301.84		
400	3039.356	1.11	$5p$	$^2P^o$	1/2	0.000	P38	M00
			$5d$	^2D	3/2	32892.21		
700	3256.089	1.30	$5p$	$^2P^o$	3/2	2212.598	P38	M00
			$5d$	^2D	5/2	32915.54		
150	3258.565	0.30	$5p$	$^2P^o$	3/2	2212.598	P38	M00
			$5d$	^2D	3/2	32892.21		
900	4101.7504	0.50	$5p$	$^2P^o$	1/2	0.000	DMZ53	M00
			$6s$	^2S	1/2	24372.956		
1000	4511.2972	0.89	$5p$	$^2P^o$	3/2	2212.598	DMZ53	M00
			$6s$	^2S	1/2	24372.956		
1	12912.59		$6s$	^2S	1/2	24372.956	JL67	
			$6p$	$^2P^o$	3/2	32115.22		
1	13429.96		$6s$	^2S	1/2	24372.956	JL67	
			$6p$	$^2P^o$	1/2	31816.96		

Energy Levels of Neutral Indium (In I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5p$	$^2P^o$	1/2	0.000	JL67,DMZ53
		3/2	2212.598	JL67,DMZ53
$6s$	^2S	1/2	24372.956	JL67,DMZ53
$6p$	$^2P^o$	1/2	31816.96	JL67
		3/2	32115.22	JL67
$5d$	^2D	3/2	32892.21	JL67
		5/2	32915.54	JL67
$5s5p^2$	^4P	1/2	34977.68	P38
		3/2	36020.82	P38
		5/2	37451.94	P38
$7s$	^2S	1/2	36301.84	JL67
$6d$	^2D	3/2	39048.53	JL67
		5/2	39098.38	JL67
In II ($^1S_0$)		*Limit*	**46670.11**	ND81,JL67
$5s5p^2$	^2S	1/2	56905	G54
$5s5p^2$	^2P	1/2	59657	G54
		3/2	60654	G54

Persistent Lines of Singly-ionized Indium (In II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1586.340	12.2	$5s^2$	^1S	0	0.0	SM02	C00
			$5s5p$	$^1P^o$	1	63038.18		
250	1936.217		$5s5p$	$^3P^o$	0	42276.4	B69	
			$5s6s$	^3S	1	93923.40		
250	1966.711	12.9	$5s5p$	$^1P^o$	1	63038.18	B69	C00
			$5s5d$	^1D	2	113884.44		
500	1977.359		$5s5p$	$^3P^o$	1	43350.9	B69	
			$5s6s$	^3S	1	93923.40		
600	2078.608		$5s5p$	$^3P^o$	2	45829.6	SM02	
			$5s6s$	^3S	1	93923.40		
250	2306.046	0.023	$5s^2$	^1S	0	0.0	PC38	C00
			$5s5p$	$^3P^o$	1	43350.9		
400	2554.434	0.01	$5s5p$	$^1P^o$	1	63038.18	PC38	C00
			$5s5d$	^3D	2	102174.00		
300	2890.179		$5s5p$	$^1P^o$	1	63038.18	PC38	
			$5p^2$	^1D	2	97627.98		
250	2941.050	1.4	$5s5p$	$^1P^o$	1	63038.18	PC38	FW96
			$5s6s$	^1S	0	97029.73		
800	6891.56		$5s6s$	^3S	1	93923.40	PC38	
			$5s6p$	$^3P^o$	2	108429.89		
1000	7182.89		$5s6s$	^3S	1	93923.40	PC38	
			$5s6p$	$^3P^o$	1	107841.54		

Energy Levels of Singly-ionized Indium (In II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5s^2$	^1S	0	0.0	SM02
$5s5p$	$^3P^o$	0	42276.4	SM02
		1	43350.9	SM02
		2	45829.6	SM02
$5s5p$	$^1P^o$	1	63038.18	SM02
$5s6s$	^3S	1	93923.40	SM02
$5s6s$	^1S	0	97029.73	SM02
$5p^2$	^1D	2	97627.98	SM02
$5p^2$	^3P	0	101607.7	SM02
		1	103248.84	SM02
		2	105564.56	SM02
$5s5d$	^3D	1	102088.00	SM02
		2	102174.00	SM02
		3	102307.60	SM02
$5s6p$	$^3P^o$	0	107662.24	SM02
		1	107841.54	SM02
		2	108429.89	SM02

Energy Levels of Singly-ionized Indium (In II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5s6p$	$^1P^o$	1	109779.76	SM02
$5s5d$	^1D	2	113884.44	SM02
$5p^2$	^1S	0	121289.08	SM02
In III ($^2S_{1/2}$)		*Limit*	**152199**	SM02

Iodine (I)
Atomic number = 53
Atomic weight = 126.904 47

Isotope	Mass	Abundance	Spin	Mag moment
^{127}I	126.904473	100%	5/2	+2.808

I I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^5\ ^2P_{3/2}$
Ionization energy: 84 295.14 cm^{-1} (10.451 26 eV)

I II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^4\ ^3P_2$
Ionization energy: 154 304 cm^{-1} (19.1313 eV)

Strong Lines of Iodine (I)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
100	879.84	I II	MC60
200	1018.58	I II	MC60
500 P	1034.66	I II	MC60
100	1066.34	I II	MC60
150	1075.21	I II	MC60
250	1105.00	I II	MC60
120	1111.16	I II	MC60
200	1125.25	I II	MC60
100	1131.50	I II	MC60
500 P	1139.80	I II	MC60
500 P	1160.56	I II	MC60
1000 P	1166.48	I II	MC60
250	1175.84	I II	MC60
500 P	1178.65	I II	MC60
800 P	1187.34	I II	MC60
500 P	1190.85	I II	MC60
250	1198.88	I II	MC60
400	1200.22	I II	MC60
1000 P	1220.89	I II	MC60
1000 P	1234.06	I II	MC60
40	1259.51	I I	KC59
40	1289.40	I I	KC59
130	1300.34	I I	KC59
40	1302.98	I I	KC59
40	1313.95	I I	KC59
40	1317.54	I I	KC59
1000 P	1336.52	I II	MC60
70	1355.10	I I	KC59
40	1357.97	I I	KC59
70	1360.97	I I	KC59
40	1361.11	I I	KC59
50	1383.23	I I	KC59
40	1390.75	I I	KC59
110	1425.49	I I	KC59
70	1446.26	I I	KC59
70	1453.18	I I	KC59
	1457.39	I I	KC59
70	1457.47	I I	KC59
130 P	1457.98	I I	KC59
50	1459.15	I I	KC59
70	1492.89	I I	KC59

Strong Lines of Iodine (I)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
70	1507.04	I I	KC59
70	1514.68	I I	KC59
200 P	1518.05	I I	KC59
70	1593.58	I I	KC59
70	1617.60	I I	KC59
200 P	1702.07	I I	KC59
150 P	1782.76	I I	KC59
70	1799.09	I I	KC59
1000 P	1830.38	I I	KC59
200 P	1844.45	I I	KC59
	Air		
25 P	2061.63	I I	KC59
100	2582.79	I II	MC60
250	3078.75	I II	MC60
130 P	5119.29	I I	KC59
150 P,c	5161.20	I II	MC60
150 c	5245.71	I II	MC60
500 P	5338.22	I II	MC60
250 P,c	5345.15	I II	MC60
150	5435.83	I II	MC60
100 P,c	5464.62	I II	MC60
500 P	5625.69	I II	MC60
100 c	5690.91	I II	MC60
200 c	5710.53	I II	MC60
250	5950.25	I II	MC60
100 c	6074.98	I II	MC60
100 c	6127.49	I II	MC60
70	6619.66	I I	KC59
200	6812.57	I II	MC60
70	7402.06	I I	KC59
70	7468.99	I I	KC59
130 P	8043.74	I I	KC59
50	8240.05	I I	KC59
130 c	8393.30	I I	KC59
40	8857.50	I I	KC59
70	9022.40	I I	KC59
200 P	9058.33	I I	KC59
150	9113.91	I I	KC59
50	9426.71	I I	KC59
40	9427.15	I I	KC59
40 d	9653.06	I I	KC59
70	9731.73	I I	KC59
70	10466.54	I I	KC59

Persistent Lines of Neutral Iodine (I I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
130	1457.98		$5p^5$	$^2P^o$	3/2	0.00	KC59	
			$5p^4(^1D_2)6s$	$^2[2]$	5/2	68587.87		
200	1518.05		$5p^5$	$^2P^o$	1/2	7603.15	KC59	
			$5p^4(^3P_1)5d$	$^2[1]$	1/2	73477.24		
200	1702.07	2.05	$5p^5$	$^2P^o$	1/2	7603.15	KC59	M00
			$5p^4(^3P_2)5d$	$^2[1]$	3/2	66355.10		
150	1782.76	2.71	$5p^5$	$^2P^o$	3/2	0.00	KC59	FW96
			$5p^4(^3P_2)6s$	$^2[2]$	3/2	56092.88		

Persistent Lines of Neutral Iodine (I I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1830.38	0.16	$5p^5$	$^2P^o$	3/2	0.00	KC59	FW96
			$5p^4(^3P_2)6s$	$^2[2]$	5/2	54633.46		
200	1844.45	0.070	$5p^5$	$^2P^o$	1/2	7603.15	KC59	M00
			$5p^4(^3P_1)6s$	$^2[1]$	3/2	61819.76		
25	2061.63	0.030	$5p^5$	$^2P^o$	1/2	7603.15	KC59	M00
			$5p^4(^3P_2)6s$	$^2[2]$	3/2	56092.88		
130	5119.29		$5p^4(^3P_2)6s$	$^2[2]$	3/2	56092.88	KC59	
			$5p^4(^3P_2)7p$	$^2[1]$	3/2	75621.41		
130	8043.74		$5p^4(^3P_2)6s$	$^2[2]$	5/2	54633.46	KC59	
			$5p^4(^3P_2)6p$	$^2[1]^o$	3/2	67062.09		
200	9058.33		$5p^4(^3P_2)6s$	$^2[2]$	5/2	54633.46	KC59	
			$5p^4(^3P_2)6p$	$^2[3]^o$	7/2	65669.99		

Energy Levels of Neutral Iodine (I I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5p^5$	$^2P^o$	3/2	0.00	M62
		1/2	7603.15	M62
$5p^4(^3P_2)6s$	$^2[2]$	5/2	54633.46	M62
		3/2	56092.88	M62
$5p^4(^3P_0)6s$	$^2[0]$	1/2	60896.23	M62
$5p^4(^3P_1)6s$	$^2[1]$	3/2	61819.76	M62
		1/2	63186.75	M62
$5p^4(^3P_2)6p$	$^2[2]^o$	5/2	64906.31	M62
		3/2	64990.00	M62
$5p^4(^3P_2)6p$	$^2[3]^o$	5/2	65644.49	M62
		7/2	65669.99	M62
$5p^4(^3P_2)6p$	$^2[1]^o$	1/2	65856.96	M62
		3/2	67062.09	M62
$5p^4(^3P_2)5d$	$^2[1]$	3/2	66355.10	M62
		1/2	67298.33	M62
$5p^4(^1D_2)6s$	$^2[2]$	3/2	68549.75	M62
		5/2	68587.87	M62
$5p^4(^3P_1)6p$	$^2[0]^o$	1/2	71501.47	M62
$5p^4(^3P_0)6p$	$^2[1]^o$	1/2	71813.90	M62
		3/2	71976.72	M62
$5p^4(^3P_1)6p$	$^2[2]^o$	5/2	72529.16	M62
		3/2	72807.13	M62
$5p^4(^3P_1)6p$	$^2[1]^o$	3/2	73054.54	M62
		1/2	73387.15	M62
$5p^4(^3P_1)5d$	$^2[1]$	1/2	73477.24	M62
		3/2	74587.42	M62

Energy Levels of Neutral Iodine (I I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5p^4(^3P_2)7p$	$^2[1]$	1/2	75303.13	M62
		3/2	75621.41	M62
$5p^4(^1D_2)6p$	$^2[1]^o$	3/2	78415.25	M62
		1/2	79701.59	M62
$5p^4(^1D_2)6p$	$^2[3]^o$	5/2	78592.55	M62
		7/2	79003.61	M62
$5p^4(^1D_2)6p$	$^2[2]^o$	3/2	80039.82	M62
		5/2	80125.45	M62
I II ($^3P_2$)		*Limit*	**84295.14**	M62

Persistent Lines of Singly-ionized Iodine (I II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1166.48		$5p^4$	^3P	2	0.0	MC60	
			$5p^3(^4S)5d$	$^5D^o$	3	85727.98		
800	1187.34		$5p^4$	^3P	2	0.0	MC60	
			$5s5p^5$	$^3P^o$	1	84222.19		
1000	1220.89		$5p^4$	^3P	2	0.0	MC60	
			$5s5p^5$	$^3P^o$	2	81907.83		
1000	1234.06		$5p^4$	^3P	2	0.0	MC60	
			$5p^3(^4S)6s$	$^5S^o$	2	81032.70		
1000	1336.52		$5p^4$	^3P	1	7087.0	MC60	
			$5s5p^5$	$^3P^o$	2	81907.83		
150	5161.20		$5p^3(^4S)6s$	$^5S^o$	2	81032.70	MC60	
			$5p^3(^4S)6p$	^5P	3	100402.68		
500	5338.22		$5p^3(^2D^o)6s$	$^3D^o$	2	93691.35	MC60	
			$5p^3(^2D^o)6p$	^3F	3	112419.04		
250	5345.15		$5p^3(^2D^o)6s$	$^3D^o$	3	96650.55	MC60	
			$5p^3(^2D^o)6p$	^3F	4	115353.94		
500	5625.69		$5p^3(^4S)6s$	$^3S^o$	1	84842.87	MC60	
			$5p^3(^4S)6p$	^3P	2	102613.52		

Energy Levels of Singly-ionized Iodine (I II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5p^4$	^3P	2	0.0	MC60
		1	7087.0	MC60
		0	6447.9	MC60
$5p^4$	^1D	2	13727.2	MC60
$5p^4$	^1S	0	29501.3	MC60
$5p^3(^4S)6s$	$^5S^o$	2	81032.70	MC60
$5p^3(^4S)6s$	$^3S^o$	1	84842.87	MC60

Energy Levels of Singly-ionized Iodine (I II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5s5p^5$	$^3P^o$	2	81907.83	MC60
		1	84222.19	MC60
		0	90404.95	MC60
$5p^3(^4S)5d$	$^5D^o$	0	85384.15	MC60
		1	87734.06	MC60
		2	86164.86	MC60
		3	85727.98	MC60
		4	86036.32	MC60
$5p^3(^2D^o)6s$	$^3D^o$	1	94825.33	MC60
		2	93691.35	MC60
		3	96650.55	MC60
$5p^3(^2D^o)6s$	$^1D^o$	2	97700.81	MC60
$5p^3(^4S)6p$	^5P	1	99219.61	MC60
		2	99327.14	MC60
		3	100402.68	MC60
$5p^3(^4S)6p$	^3P	2	102613.52	MC60
		1	101644.21	MC60
		0	103004.04	MC60
$5p^3(^2D^o)6p$	^3F	2	111298.09	MC60
		3	112419.04	MC60
		4	115353.94	MC60
I III $(^4S^o_{3/2})$		*Limit*	**154304**	MC60

Iridium (Ir)
Atomic number = 77
Atomic weight = 192.22

Isotope	Mass	Abundance	Spin	Mag moment
^{191}Ir	190.960584	37.3%	3/2	+0.1461
^{193}Ir	192.962917	62.7%	3/2	+0.1591

Ir I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^7 6s^2\ ^4F_{9/2}$
Ionization energy: 72 323.9 cm^{-1} (8.967 02 eV)

Ir II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^7 6s\ ^5F_5$
Ionization energy: not available

Strong Lines of Iridium (Ir)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
600	2010.65	Ir I	MCS75
500	2022.35	Ir I	MCS75
900 P	2033.57	Ir I	MCS75
400	2052.22	Ir I	MCS75
300	2060.64	Ir I	MCS75
200	2083.22	Ir I	MCS75
200	2085.74	Ir I	MCS75
1000 P	2088.82	Ir I	MCS75
800	2092.63	Ir I	MCS75
150	2112.68	Ir I	MCS75
800 P	2126.81	Ir II	KM78
250	2127.94	Ir I	MCS75
200	2148.22	Ir I	MCS75
150	2150.54	Ir I	MCS75
600 P	2152.68	Ir II	KM78
150	2155.81	Ir I	MCS75
500 P	2158.05	Ir I	MCS75
120	2162.88	Ir I	MCS75
1000 P	2169.42	Ir II	MCS75
250	2175.24	Ir I	MCS75
150	2178.17	Ir I	MCS75
300	2187.43	Ir II	MCS75
200	2190.38	Ir II	MCS75
500 P	2204.96	Ir II	KM78
150	2208.09	Ir II	MCS75
80	2220.37	Ir I	MCS75
400 P	2242.69	Ir II	KM78
120	2253.38	Ir I	MCS75
120	2255.10	Ir I	MCS75
80	2255.81	Ir I	MCS75
80	2258.86	Ir I	MCS75
50	2264.61	Ir I	MCS75
60	2266.33	Ir I	MCS75
60	2268.90	Ir I	MCS75
150 P	2281.02	Ir II	MCS75
50	2298.05	Ir I	MCS75
50	2300.50	Ir I	MCS75
150	2304.22	Ir I	MCS75
50	2308.93	Ir I	MCS75
30	2333.30	Ir I	MCS75
40	2333.84	Ir I	MCS75
30	2334.50	Ir I	MCS75

Strong Lines of Iridium (Ir)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90	2343.18	Ir I	MCS75
40	2343.61	Ir I	MCS75
30	2355.00	Ir I	MCS75
150	2363.04	Ir I	MCS75
60 P	2368.04	Ir II	KM78
200 P	2372.77	Ir I	MCS75
50	2375.09	Ir II	MCS75
30	2381.62	Ir I	MCS75
80	2386.89	Ir I	MCS75
150	2390.62	Ir I	MCS75
150	2391.18	Ir I	MCS75
30	2413.31	Ir I	MCS75
40	2418.11	Ir I	MCS75
30	2426.53	Ir II	MCS75
30	2427.61	Ir I	MCS75
30	2431.24	Ir I	MCS75
80	2431.94	Ir I	MCS75
50	2452.81	Ir I	MCS75
80	2455.61	Ir I	MCS75
50	2467.30	Ir I	MCS75
200 P	2475.12	Ir I	MCS75
120	2481.18	Ir I	MCS75
40	2493.08	Ir I	MCS75
250 P	2502.98	Ir I	MCS75
30	2512.58	Ir II	MCS75
60	2533.13	Ir I	MCS75
60	2534.46	Ir I	MCS75
30	2537.22	Ir I	MCS75
30	2542.02	Ir I	MCS75
500 P	2543.97	Ir I	MCS75
50	2546.03	Ir I	MCS75
50	2564.18	Ir I	MCS75
40	2577.26	Ir I	MCS75
40	2592.06	Ir I	MCS75
40	2599.04	Ir I	MCS75
40	2608.25	Ir I	MCS75
110	2611.30	Ir I	MCS75
40	2634.17	Ir I	MCS75
200 P	2639.71	Ir I	MCS75
110	2661.98	Ir I	MCS75
150 P	2664.79	Ir I	MCS75
30	2669.91	Ir I	MCS75
30	2671.84	Ir I	MCS75
200 P	2694.23	Ir I	MCS75
30	2781.29	Ir I	MCS75
30	2797.35	Ir I	MCS75
90	2797.70	Ir I	MCS75
40	2823.18	Ir I	MCS75
70	2824.45	Ir I	MCS75
50	2836.40	Ir I	MCS75
60	2839.16	Ir I	MCS75
50	2840.22	Ir I	MCS75
200 P	2849.72	Ir I	MCS75
50	2882.64	Ir I	MCS75
40	2897.15	Ir I	MCS75
250 P	2924.79	Ir I	MCS75
70	2934.64	Ir I	MCS75
50	2936.68	Ir I	MCS75
150	2943.15	Ir I	MCS75

Strong Lines of Iridium (Ir)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
70	2951.22	Ir I	MCS75
40	3003.63	Ir I	MCS75
90	3068.89	Ir I	MCS75
30	3100.29	Ir I	MCS75
30	3100.45	Ir I	MCS75
200	3133.32	Ir I	MCS75
40	3212.12	Ir I	MCS75
300 P	3220.78	Ir I	MCS75
30	3368.48	Ir I	MCS75
40	3437.02	Ir I	MCS75
200 P	3513.64	Ir I	MCS75
70	3573.72	Ir I	MCS75
40	3628.67	Ir I	MCS75
30 P	3731.36	Ir II	MCS75
30	3747.20	Ir I	MCS75
200	3800.12	Ir I	MCS75
30	3976.31	Ir I	MCS75
15	4268.10	Ir I	MCS75
13	4311.50	Ir I	MCS75

Persistent Lines of Neutral Iridium (Ir I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
900	2033.57		$5d^76s^2$	^4F	9/2	0.00	MCS75	
				2^o	9/2	49158.63		
1000	2088.82		$5d^76s^2$	^4F	9/2	0.00	MCS75	
				1^o	11/2	47858.45		
500	2158.05		$5d^8(^3F)6s$	^4F	9/2	2834.99	MCS75	
				2^o	9/2	49158.63		
200	2372.77		$5d^76s^2$	^4F	9/2	0.00	MCS75	
			$5d^8(^3F)6p$	$^4G^o$	11/2	42131.84		
200	2475.12	0.21	$5d^76s^2$	^4F	9/2	0.00	MCS75	FW96
			$5d^66s^2(^5D)6p$	$^6F^o$	9/2	40389.83		
250	2502.98	0.32	$5d^76s^2$	^4F	9/2	0.00	MCS75	FW96
			$5d^66s^2(^5D)6p$	$^6F^o$	11/2	39940.37		
500	2543.97		$5d^8(^3F)6s$	^4F	9/2	2834.99	MCS75	
			$5d^8(^3F)6p$	$^4G^o$	11/2	42131.84		
200	2639.71	0.47	$5d^76s^2$	^4F	9/2	0.00	MCS75	FW96
			$5d^7(^4P)6s6p(^3P^o)$	$^6D^o$	9/2	37871.69		
150	2664.79	0.40	$5d^76s^2$	^4F	9/2	0.00	MCS75	FW96
			$5d^7(^4P)6s6p(^3P^o)$	$^6P^o$	7/2	37515.32		
200	2694.23	0.48	$5d^8(^3F)6s$	^4F	9/2	2834.99	MCS75	FW96
			$5d^66s^2(^5D)6p$	$^6F^o$	11/2	39940.37		
200	2849.72	0.22	$5d^76s^2$	^4F	9/2	0.00	MCS75	FW96
			$5d^7(^4F)6s6p(^3P^o)$	$^6G^o$	9/2	35080.70		
250	2924.79	0.142	$5d^76s^2$	^4F	9/2	0.00	MCS75	FW96
			$5d^7(^4F)6s6p(^3P^o)$	$^6G^o$	11/2	34180.46		

Persistent Lines of Neutral Iridium (Ir I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	3220.78	0.24	$5d^8(^3F)6s$	^4F	9/2	2834.99	MCS75	FW96
			$5d^7(^4F)6s6p(^3P^o)$	$^6F^o$	7/2	33874.44		
200	3513.64		$5d^76s^2$	^4F	9/2	0.00	MCS75	
			$5d^7(^4F)6s6p(^3P^o)$	$^6F^o$	11/2	28452.31		

Energy Levels of Neutral Iridium (Ir I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^76s^2$	^4F	9/2	0.00	K57
		7/2	7106.63	K57
		5/2	9877.58	K57
		3/2	11831.13	K57
$5d^8(^3F)6s$	^4F	9/2	2834.99	K57
		7/2	6323.96	K57
		3/2	10578.70	K57
		5/2	12218.50	K57
$5d^76s^2$	^2P	3/2	4078.95	K57
		1/2	12505.75	K57
$5d^8(^3F)6s$	^2D	5/2	5784.63	K57
		3/2	22110.29	K57
$5d^76s^2$	^4P	5/2	12951.73	K57
		3/2	18547.10	K57
		1/2	20236.75	K57
$5d^8(^3F)6s$	^2F	7/2	13087.94	K57
		5/2	19060.68	K57
$5d^76s^2$	^2G	9/2	13939.83	K57
		7/2	17779.30	K57
$5d^8(^3P)6s$	^4P	5/2	16103.37	K57
		3/2	16565.41	K57
		1/2	16681.27	K57
$5d^76s^2$	$^2D2$	3/2	23310.40	K57
		1/2	26229.51	K57
$5d^8(^3F)6s$	^2G	9/2	23505.94	K57
		7/2	26365.19	K57
$5d^76s^2$	^2F	5/2	26404.22	K57
$5d^7(^4F)6s6p(^3P^o)$	$^6D^o$	9/2	26307.49	K57
		7/2	30529.67	K57
		3/2	32463.60	K57
		5/2	33064.84	K57
		1/2	35647.96	K57
$5d^9$	^2D	3/2	27970.06	K57
$5d^7(^4F)6s6p(^3P^o)$	$^6F^o$	11/2	28452.31	K57
		9/2	32513.42	K57
		7/2	33874.44	K57

Energy Levels of Neutral Iridium (Ir I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^7(^4F)6s6p(^3P^o)$	$^6G^o$	11/2	34180.46	K57
		9/2	35080.70	K57
$5d^7(^4P)6s6p(^3P^o)$	$^6P^o$	7/2	37515.32	K57
$5d^7(^4P)6s6p(^3P^o)$	$^6D^o$	9/2	37871.69	K57
$5d^66s^2(^5D)6p$	$^6F^o$	11/2	39940.37	K57
		9/2	40389.83	K57
$5d^8(^3F)6p$	$^4G^o$	11/2	42131.84	K57
	1^o	11/2	47858.45	K57
	2^o	9/2	49158.63	K57
Ir II ($^5F_5$)		*Limit*	**72323.9**	CLS97

Persistent Lines of Singly-ionized Iridium (Ir II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	2126.81		$5d^7(^4F)6s$	^5F	5	0.00	KM78	
			$5d^7(^4F_{9/2})6p_{1/2}$	$(9/2,1/2)^o$	5	47003.98		
600	2152.68		$5d^7(^4F)6s$	^5F	4	4787.93	KM78	
			$5d^7(^4F_{7/2})6p_{1/2}$	$(7/2,1/2)^o$	3	51226.62		
1000	2169.42						MCS75	
500	2204.96		$5d^7(^4F)6s$	^5F	3	8186.96	KM78	
			$5d^7(^4F_{7/2})6p_{1/2}$	$(7/2,1/2)^o$	4	53525.25		
400	2242.69		$5d^7(^4F)6s$	^5F	5	0.00	KM78	
			$5d^7(^4F_{9/2})6p_{1/2}$	$(9/2,1/2)^o$	4	44575.66		
150	2281.02						MCS75	
60	2368.04		$5d^7(^4F)6s$	^5F	4	4787.93	KM78	
			$5d^7(^4F_{9/2})6p_{1/2}$	$(9/2,1/2)^o$	5	47003.98		
30	3731.36						MCS75	

Energy Levels of Singly-ionized Iridium (Ir II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^7(^4F)6s$	^5F	5	0.00	KM78
		4	4787.93	KM78
		3	8186.96	KM78
		2	11307.32	KM78
		1	11957.70	KM78
$5d^8$	^3F	4	2262.75	KM78
		3	9927.83	KM78
		2	17413.24	KM78
	a ^3P	2	3090.17	KM78
		1	9062.14	KM78
		0	11211.93	KM78
	1	2	8975.01	KM78
	2	4	11719.09	KM78

Energy Levels of Singly-ionized Iridium (Ir II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^7(^4P)6s$	^5P	3	12714.64	KM78
		2	15676.35	KM78
		1	18676.50	KM78
$5d^66s^2$	^5D	4	17210.14	KM78
$5d^7(^2G)6s$	^3G	5	17477.92	KM78
$5d^7(^4F)6s$	^3F	3	17499.29	KM78
$5d^7(^4F_{9/2})6p_{1/2}$	$(9/2,1/2)^o$	4	44575.66	KM78
		5	47003.98	KM78
$5d^7(^4F_{7/2})6p_{1/2}$	$(7/2,1/2)^o$	3	51226.62	KM78
		4	53525.25	KM78
Ir III ($^4F_{9/2}$)		*Limit*		

Iron (Fe)
Atomic number = 26
Atomic weight = 55.847

Isotope	Mass	Abundance	Spin	Mag moment
^{54}Fe	53.939612	5.82%	0	
^{56}Fe	55.934939	91.18%	0	
^{57}Fe	56.935396	2.1%	1/2	+0.09044
^{58}Fe	57.933277	0.28%	0	

Fe I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2\ ^5D_4$
Ionization energy: 63 737 cm^{-1} (7.9024 eV)

Fe II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s\ ^6D_{9/2}$
Ionization energy: 130 563 cm^{-1} (16.1877 eV)

Strong Lines of Iron (Fe)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
30	2178.0808	Fe I	NJLT94
30	2259.5103	Fe I	NJLT94
30	2292.5249	Fe I	NJLT94
60	2298.1689	Fe I	NJLT94
30	2300.1418	Fe I	NJLT94
60	2327.3958	Fe II	NLTH91
60	2331.3084	Fe II	NLTH91
200	2332.7990	Fe II	NLTH91
120	2338.0065	Fe II	NLTH91
400 P	2343.4951	Fe II	NLTH91
50	2343.9610	Fe II	NLTH91
90	2344.2816	Fe II	NLTH91
120	2348.1159	Fe II	NLTH91
150	2348.3025	Fe II	NLTH91
120	2359.1322	Fe II	NLTH91
90	2359.9997	Fe II	NLTH91
70	2360.2945	Fe II	NLTH91
40	2363.8612	Fe II	NLTH91
120	2364.8281	Fe II	NLTH91
50	2365.7654	Fe II	NLTH91
50	2368.5964	Fe II	NLTH91
50	2369.9534	Fe II	NLTH91
40	2373.6245	Fe I	NJLT94
60	2373.7357	Fe II	NLTH91
40	2375.1940	Fe II	NLTH91
70	2376.4294	Fe II	NLTH91
50	2379.2765	Fe II	NLTH91
70	2380.7616	Fe II	NLTH91
1000 P	2382.0376	Fe II	NLTH91
40	2383.2452	Fe II	NLTH91
200	2388.6289	Fe II	NLTH91
700 P	2395.6254	Fe II	NLTH91
200	2399.2413	Fe II	NLTH91
500 P	2404.8858	Fe II	NLTH91
150	2406.6612	Fe II	NLTH91
50	2406.9761	Fe II	NLTH91
200	2410.5192	Fe II	NLTH91
120	2411.0677	Fe II	NLTH91

Strong Lines of Iron (Fe)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90	2413.3104	Fe II	NLTH91
50	2417.8707	Fe II	NLTH91
40	2422.6882	Fe II	NLTH91
90	2424.1456	Fe II	NLTH91
70	2428.3638	Fe II	NLTH91
70	2430.0783	Fe II	NLTH91
50	2432.2612	Fe II	NLTH91
40	2432.8732	Fe II	NLTH91
90	2439.3014	Fe II	NLTH91
40	2443.7100	Fe II	NLTH91
60	2444.5154	Fe II	NLTH91
60	2445.5732	Fe II	NLTH91
150	2457.5891	Fe I	NJLT94
90	2458.7838	Fe II	NLTH91
40	2460.4404	Fe II	NLTH91
50	2461.2835	Fe II	NLTH91
60	2461.8610	Fe II	NLTH91
150	2462.6472	Fe I	NJLT94
80	2465.1492	Fe I	NJLT94
40	2466.6713	Fe II	NLTH91
40	2466.8194	Fe II	NLTH91
60	2468.8799	Fe I	NJLT94
40	2469.5147	Fe II	NLTH91
50	2470.6694	Fe II	NLTH91
80	2472.3320	Fe I	NJLT94
100	2472.8713	Fe I	NJLT94
60	2474.8145	Fe I	NJLT94
40	2478.5722	Fe II	NLTH91
120	2479.7764	Fe I	NJLT94
60	2480.1577	Fe II	NLTH91
50	2482.1172	Fe II	NLTH91
60	2482.6577	Fe II	NLTH91
1000 P	2483.2708	Fe I	NJLT94
30	2483.5334	Fe I	NJLT94
100	2484.1875	Fe I	NJLT94
40	2484.2446	Fe II	NLTH91
80	2486.3728	Fe I	NJLT94
600 P	2488.1426	Fe I	NJLT94
50	2489.4833	Fe II	NLTH91
100	2489.7524	Fe I	NJLT94
500 P	2490.6443	Fe I	NJLT94
40	2490.8584	Fe II	NLTH91
200	2491.1550	Fe I	NJLT94
60	2491.3965	Fe II	NLTH91
60	2493.1846	Fe II	NLTH91
300 P	2493.2637	Fe II	NLTH91
60	2496.5337	Fe I	NJLT94
100	2501.1318	Fe I	NJLT94
40	2502.3930	Fe II	NLTH91
40	2503.8745	Fe II	NLTH91
50	2506.0935	Fe II	NLTH91
50	2507.9004	Fe I	NJLT94
100	2510.8350	Fe I	NJLT94
70	2511.7603	Fe II	NLTH91
40	2512.3650	Fe I	NJLT94
30	2517.6611	Fe I	NJLT94
80	2518.1018	Fe I	NJLT94
40	2519.0472	Fe II	NLTH91
400 P	2522.8494	Fe I	NJLT94

Strong Lines of Iron (Fe)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	2524.2925	Fe I	NJLT94
120	2525.3879	Fe II	NLTH91
200	2526.2939	Fe II	NLTH91
200	2527.4351	Fe I	NJLT94
80	2529.1350	Fe I	NJLT94
70	2533.6274	Fe II	NLTH91
60	2534.4186	Fe II	NLTH91
70	2535.4856	Fe II	NLTH91
40	2535.6069	Fe I	NJLT94
40	2536.6726	Fe II	NLTH91
120	2536.80	Fe II	C74
60	2538.7987	Fe II	NLTH91
60	2538.9094	Fe II	NLTH91
90	2538.99	Fe II	C74
120	2540.66	Fe II	C74
60	2540.9722	Fe I	NJLT94
50	2541.1010	Fe II	NLTH91
40	2541.8358	Fe II	NLTH91
30	2542.1013	Fe I	NJLT94
40	2543.3781	Fe II	NLTH91
80	2545.9785	Fe I	NJLT94
50	2546.6701	Fe II	NLTH91
60	2548.7442	Fe II	NLTH91
50	2549.0833	Fe II	NLTH91
50	2549.3947	Fe II	NLTH91
40	2549.4616	Fe II	NLTH91
60	2549.6133	Fe I	NJLT94
40	2550.0274	Fe II	NLTH91
30	2550.6832	Fe II	NLTH91
250	2562.5356	Fe II	NLTH91
120	2563.4755	Fe II	NLTH91
40	2566.9126	Fe II	NLTH91
90	2574.3662	Fe II	NLTH91
30	2576.6902	Fe I	NJLT94
40	2577.9219	Fe II	NLTH91
60	2582.5832	Fe II	NLTH91
150	2584.5359	Fe I	NJLT94
300 P	2585.8758	Fe II	NLTH91
60	2591.5428	Fe II	NLTH91
400 P	2598.3692	Fe II	NLTH91
700 P	2599.3956	Fe II	NLTH91
30	2599.5669	Fe I	NJLT94
200	2606.5162	Fe II	NLTH91
80	2606.8264	Fe I	NJLT94
300 P	2607.0871	Fe II	NLTH91
400 P	2611.8736	Fe II	NLTH91
200	2613.8243	Fe II	NLTH91
200	2617.6174	Fe II	NLTH91
60	2620.41	Fe II	D38
40	2623.5339	Fe I	NJLT94
120	2625.6671	Fe II	NLTH91
90	2628.2931	Fe II	NLTH91
150	2631.0471	Fe II	NLTH91
150	2631.3232	Fe II	NLTH91
30	2635.8088	Fe I	NJLT94
40	2664.6638	Fe II	NLTH91
30	2666.8125	Fe I	NJLT94
60	2679.0242	Fe I	NJLT94
300	2684.7536	Fe II	NLTH91

Strong Lines of Iron (Fe)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	2689.2122	Fe I	NJLT94
40	2692.6019	Fe II	NLTH91
40	2703.9891	Fe II	NLTH91
40	2706.5820	Fe I	NJLT94
50	2714.4129	Fe II	NLTH91
400 P	2719.0273	Fe I	NJLT94
150	2720.9023	Fe I	NJLT94
40	2723.5774	Fe I	NJLT94
50	2727.5392	Fe II	NLTH91
50	2728.90	Fe II	C74
100	2733.5806	Fe I	NJLT94
50	2735.4753	Fe I	NJLT94
50	2737.3091	Fe I	NJLT94
400 P	2739.5474	Fe II	NLTH91
80	2742.4053	Fe I	NJLT94
120	2743.1969	Fe II	NLTH91
200	2746.4838	Fe II	NLTH91
400 P	2749.3216	Fe II	NLTH91
60	2749.4860	Fe II	NLTH91
120	2750.1406	Fe I	NJLT94
50	2753.2877	Fe II	NLTH91
500 P	2755.7365	Fe II	NLTH91
100	2761.81	Fe II	C74
30	2772.0740	Fe I	NJLT94
60	2778.2202	Fe I	NJLT94
300 P	2788.1047	Fe I	NJLT94
40	2804.5203	Fe I	NJLT94
150	2806.9841	Fe I	NJLT94
250	2813.2864	Fe I	NJLT94
30	2823.2756	Fe I	NJLT94
60	2825.5557	Fe I	NJLT94
150	2832.4355	Fe I	NJLT94
20	2838.1194	Fe I	NJLT94
100	2843.9763	Fe I	NJLT94
80	2851.7969	Fe I	NJLT94
120	2936.9033	Fe I	NJLT94
100	2947.8760	Fe I	NJLT94
60	2953.9399	Fe I	NJLT94
150	2966.8982	Fe I	NJLT94
80	2970.0994	Fe I	NJLT94
120	2973.1323	Fe I	NJLT94
50	2973.2354	Fe I	NJLT94
60	2981.4451	Fe I	NJLT94
100	2983.5696	Fe I	NJLT94
100	2994.4268	Fe I	NJLT94
50	2999.5117	Fe I	NJLT94
80	3000.9478	Fe I	NJLT94
50	3008.1382	Fe I	NJLT94
40	3020.01	Fe II	C74
50	3020.4907	Fe I	NJLT94
150	3020.6389	Fe I	NJLT94
60	3021.0728	Fe I	NJLT94
50	3024.0327	Fe I	NJLT94
50	3025.8423	Fe I	NJLT94
80	3037.3887	Fe I	NJLT94
80	3047.6045	Fe I	NJLT94
60	3057.4458	Fe I	NJLT94
100	3059.0857	Fe I	NJLT94
50	3193.2258	Fe I	NJLT94

Strong Lines of Iron (Fe)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
80	3193.2998	Fe I	NJLT94
30	3222.0591	Fe I	NJLT94
60	3225.7871	Fe I	NJLT94
30	3236.2224	Fe I	NJLT94
40	3355.2278	Fe I	NJLT94
50	3407.4597	Fe I	NJLT94
50	3427.1194	Fe I	NJLT94
400 P	3440.6060	Fe I	NJLT94
250	3440.9888	Fe I	NJLT94
100	3443.8765	Fe I	NJLT94
120	3465.8606	Fe I	NJLT94
200	3475.4502	Fe I	NJLT94
50	3476.7019	Fe I	NJLT94
250	3490.5740	Fe I	NJLT94
50	3497.8406	Fe I	NJLT94
30	3521.2612	Fe I	NJLT94
40	3526.0408	Fe I	NJLT94
30	3541.0833	Fe I	NJLT94
40	3554.9246	Fe I	NJLT94
40	3558.5151	Fe I	NJLT94
100	3565.3789	Fe I	NJLT94
120	3570.0977	Fe I	NJLT94
80	3570.2542	Fe I	NJLT94
600 P	3581.1931	Fe I	NJLT94
30	3585.3188	Fe I	NJLT94
40	3586.9849	Fe I	NJLT94
50	3606.6794	Fe I	NJLT94
150	3608.8594	Fe I	NJLT94
150	3618.7678	Fe I	NJLT94
120	3631.4631	Fe I	NJLT94
150	3647.8428	Fe I	NJLT94
150	3679.9133	Fe I	NJLT94
50	3687.4568	Fe I	NJLT94
120	3705.5659	Fe I	NJLT94
30	3707.9199	Fe I	NJLT94
60	3709.2463	Fe I	NJLT94
600 P	3719.9348	Fe I	NJLT94
150	3722.5630	Fe I	NJLT94
50	3727.6189	Fe I	NJLT94
120	3733.3176	Fe I	NJLT94
700 P	3734.8638	Fe I	NJLT94
600 P	3737.1316	Fe I	NJLT94
40	3743.3621	Fe I	NJLT94
600 P	3745.5613	Fe I	NJLT94
120	3745.8994	Fe I	NJLT94
300 P	3748.2622	Fe I	NJLT94
400 P	3749.4854	Fe I	NJLT94
300 P	3758.2329	Fe I	NJLT94
40	3760.0498	Fe I	NJLT94
150	3763.7891	Fe I	NJLT94
40	3765.5388	Fe I	NJLT94
60	3767.1919	Fe I	NJLT94
40	3795.0022	Fe I	NJLT94
40	3799.5476	Fe I	NJLT94
60	3812.9646	Fe I	NJLT94
150	3815.8403	Fe I	NJLT94
500 P	3820.4253	Fe I	NJLT94
250	3824.4436	Fe I	NJLT94
150	3825.8811	Fe I	NJLT94

Strong Lines of Iron (Fe)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
120	3827.8225	Fe I	NJLT94
100	3834.2224	Fe I	NJLT94
50	3840.4375	Fe I	NJLT94
80	3841.0481	Fe I	NJLT94
250	3856.3716	Fe I	NJLT94
500 P	3859.9114	Fe I	NJLT94
150	3878.5732	Fe I	NJLT94
300 P	3886.2822	Fe I	NJLT94
30	3888.5134	Fe I	NJLT94
80	3895.6565	Fe I	NJLT94
120	3899.7075	Fe I	NJLT94
40	3902.9458	Fe I	NJLT94
60	3920.2581	Fe I	NJLT94
120	3922.9119	Fe I	NJLT94
120	3927.9199	Fe I	NJLT94
200	3930.2966	Fe I	NJLT94
40	4005.2419	Fe I	NJLT94
300 P	4045.8125	Fe I	NJLT94
150	4063.5942	Fe I	NJLT94
120	4071.7380	Fe I	NJLT94
40	4132.0581	Fe I	NJLT94
80	4143.8682	Fe I	NJLT94
30	4202.0293	Fe I	NJLT94
40	4216.1836	Fe I	NJLT94
30	4250.7871	Fe I	NJLT94
80	4260.4746	Fe I	NJLT94
120	4271.7607	Fe I	NJLT94
120	4282.4028	Fe I	NJLT94
120	4307.9023	Fe I	NJLT94
150	4325.7622	Fe I	NJLT94
80	4375.9302	Fe I	NJLT94
200 P	4383.5449	Fe I	NJLT94
120	4404.7505	Fe I	NJLT94
30	4415.1226	Fe I	NJLT94
60	4427.2979	Fe I	NJLT94
40	4461.6528	Fe I	NJLT94
50	4920.5029	Fe I	NJLT94
150	4957.5967	Fe I	NJLT94
250	5167.4883	Fe I	NJLT94
50	5171.5962	Fe I	NJLT94
100	5227.1509	Fe I	NJLT94
120	5269.5376	Fe I	NJLT94
80	5270.3564	Fe I	NJLT94
80	5328.0386	Fe I	NJLT94
30	5328.5317	Fe I	NJLT94
50	5341.0239	Fe I	NJLT94
40	5371.4897	Fe I	NJLT94
30	5397.1279	Fe I	NJLT94
50	6247.56	Fe II	RMW44
120	6456.38	Fe II	RMW44
25	11607.5752	Fe I	NJLT94
25	11689.9756	Fe I	NJLT94
60	11882.8467	Fe I	NJLT94
100	11973.0498	Fe I	NJLT94

Persistent Lines of Neutral Iron (Fe I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2483.2708	4.81	$3d^64s^2$	a ^{5}D	4	0.000	NJLT94	OWLW91
			$3d^6(^5D)4s4p(^1P)$	x ^{5}F^o	5	40257.311		
600	2488.1426	4.20	$3d^64s^2$	a ^{5}D	3	415.933	NJLT94	OWLW91
			$3d^6(^5D)4s4p(^1P)$	x ^{5}F^o	4	40594.429		
500	2490.6443	3.45	$3d^64s^2$	a ^{5}D	2	704.007	NJLT94	OWLW91
			$3d^6(^5D)4s4p(^1P)$	x ^{5}F^o	3	40842.151		
400	2522.8494	2.13	$3d^64s^2$	a ^{5}D	4	0.000	NJLT94	OWLW91
			$3d^6(^5D)4s4p(^1P)$	x ^{5}D^o	4	39625.801		
400	2719.0273	1.42	$3d^64s^2$	a ^{5}D	4	0.000	NJLT94	OWLW91
			$3d^6(^5D)4s4p(^1P)$	y ^{5}P^o	3	36766.964		
300	2788.1047	0.59	$3d^7(^4F)4s$	a ^{5}F	5	6928.268	NJLT94	OWLW91
			$3d^6(^3H)4s4p(^3P)$	y ^{5}G^o	6	42784.349		
400	3440.6060	0.171	$3d^64s^2$	a ^{5}D	4	0.000	NJLT94	M03
			$3d^6(^5D)4s4p(^3P)$	z ^{5}P^o	3	29056.322		
600	3581.1931	1.02	$3d^7(^4F)4s$	a ^{5}F	5	6928.268	NJLT94	FW96
			$3d^7(^4F)4p$	z ^{5}G^o	6	34843.955		
600	3719.9348	0.162	$3d^64s^2$	a ^{5}D	4	0.000	NJLT94	FW96
			$3d^6(^5D)4s4p(^3P)$	z ^{5}F^o	5	26874.548		
700	3734.8638	0.902	$3d^7(^4F)4s$	a ^{5}F	5	6928.268	NJLT94	FW96
			$3d^7(^4F)4p$	y ^{5}F^o	5	33695.395		
600	3737.1316	0.141	$3d^64s^2$	a ^{5}D	3	415.933	NJLT94	M03
			$3d^6(^5D)4s4p(^3P)$	z ^{5}F^o	4	27166.818		
600	3745.5613	0.115	$3d^64s^2$	a ^{5}D	2	704.007	NJLT94	FW96
			$3d^6(^5D)4s4p(^3P)$	z ^{5}F^o	3	27394.689		
400	3749.4854	0.764	$3d^7(^4F)4s$	a ^{5}F	4	7376.764	NJLT94	FW96
			$3d^7(^4F)4p$	y ^{5}F^o	4	34039.514		
300	3758.2329	0.634	$3d^7(^4F)4s$	a ^{5}F	3	7728.059	NJLT94	FW96
			$3d^7(^4F)4p$	y ^{5}F^o	3	34328.750		
500	3820.4253	0.668	$3d^7(^4F)4s$	a ^{5}F	5	6928.268	NJLT94	FW96
			$3d^7(^4F)4p$	y ^{5}D^o	4	33095.939		
500	3859.9114	0.0969	$3d^64s^2$	a ^{5}D	4	0.000	NJLT94	M03
			$3d^6(^5D)4s4p(^3P)$	z ^{5}D^o	4	25899.987		
300	4045.8125	0.863	$3d^7(^4F)4s$	a ^{3}F	4	11976.238	NJLT94	FW96
			$3d^7(^4F)4p$	y ^{3}F^o	4	36686.174		
200	4383.5449	0.500	$3d^7(^4F)4s$	a ^{3}F	4	11976.238	NJLT94	FW96
			$3d^7(^4F)4p$	z ^{5}G^o	5	34782.419		

Energy Levels of Neutral Iron (Fe I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^64s^2$	a ^5D	4	0.000	NJLT94
		3	415.933	NJLT94
		2	704.007	NJLT94
		1	888.132	NJLT94
		0	978.074	NJLT94
$3d^7(^4F)4s$	a ^5F	5	6928.268	NJLT94
		4	7376.764	NJLT94
		3	7728.059	NJLT94
		2	7985.784	NJLT94
		1	8154.713	NJLT94
$3d^7(^4F)4s$	a ^3F	4	11976.238	NJLT94
		3	12560.933	NJLT94
		2	12968.553	NJLT94
$3d^7(^4P)4s$	a ^5P	3	17550.180	NJLT94
		2	17726.987	NJLT94
		1	17927.381	NJLT94
$3d^64s^2$	a ^3P	2	18378.185	NJLT94
		1	19552.477	NJLT94
		0	20037.815	NJLT94
$3d^6(^5D)4s4p(^3P)$	z $^7D^o$	5	19350.892	NJLT94
		4	19562.440	NJLT94
		3	19757.033	NJLT94
		2	19912.494	NJLT94
		1	20019.634	NJLT94
$3d^64s^2$	a ^3H	6	19390.167	NJLT94
		5	19621.005	NJLT94
		4	19788.250	NJLT94
$3d^64s^2$	b ^3F	4	20641.109	NJLT94
		3	20874.481	NJLT94
		2	21038.986	NJLT94
$3d^7(^2G)4s$	a ^3G	5	21715.731	NJLT94
		4	21999.129	NJLT94
		3	22249.428	NJLT94
$3d^6(^5D)4s4p(^3P)$	z $^7F^o$	6	22650.414	NJLT94
		5	22845.867	NJLT94
		4	22996.672	NJLT94
		3	23110.937	NJLT94
		2	23192.498	NJLT94
		1	23244.836	NJLT94
		0	23270.382	NJLT94
$3d^7(^4P)4s$	b ^3P	2	22838.321	NJLT94
		1	22946.814	NJLT94
		0	23051.748	NJLT94
$3d^6(^5D)4s4p(^3P)$	z $^7P^o$	4	23711.454	NJLT94
		3	24180.860	NJLT94
		2	24506.915	NJLT94
$3d^64s^2$	b ^3G	5	23783.617	NJLT94
		4	24118.817	NJLT94
		3	24338.765	NJLT94

Energy Levels of Neutral Iron (Fe I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^7(^2P)4s$	c ^3P	2	24335.764	NJLT94
		1	24772.016	NJLT94
		0	25091.597	NJLT94
$3d^7(^2G)4s$	a ^1G	4	24574.653	NJLT94
$3d^6(^5D)4s4p(^3P)$	z $^5D^o$	4	25899.987	NJLT94
		3	26140.177	NJLT94
		2	26339.694	NJLT94
		1	26479.379	NJLT94
		0	26550.477	NJLT94
$3d^7(^2H)4s$	b ^3H	6	26105.906	NJLT94
		5	26351.038	NJLT94
		4	26627.607	NJLT94
$3d^7(a^2D)4s$	a ^3D	3	26224.967	NJLT94
		2	26623.733	NJLT94
		1	26406.463	NJLT94
$3d^6(^5D)4s4p(^3P)$	z $^5F^o$	5	26874.548	NJLT94
		4	27166.818	NJLT94
		3	27394.689	NJLT94
		2	27559.581	NJLT94
		1	27666.346	NJLT94
$3d^7(^2P)4s$	a ^1P	1	27543.001	NJLT94
$3d^7(a^2D)4s$	a ^1D	2	28604.611	NJLT94
$3d^7(^2H)4s$	a ^1H	5	28819.952	NJLT94
$3d^6(^5D)4s4p(^3P)$	z $^5P^o$	3	29056.322	NJLT94
		2	29469.022	NJLT94
		1	29732.734	NJLT94
$3d^64s^2$	a ^1I	6	29313.006	NJLT94
$3d^64s^2$	b ^3D	3	29371.810	NJLT94
		2	29356.742	NJLT94
		1	29320.024	NJLT94
$3d^64s^2$	b ^1G	4	29798.934	NJLT94
$3d^6(^5D)4s4p(^3P)$	z $^3F^o$	4	31307.243	NJLT94
		3	31805.069	NJLT94
		2	32133.989	NJLT94
$3d^6(^5D)4s4p(^3P)$	z $^3D^o$	3	31322.611	NJLT94
		2	31686.349	NJLT94
		1	31937.323	NJLT94
$3d^8$	c ^3F	4	32873.630	NJLT94
		3	33412.715	NJLT94
		2	33765.304	NJLT94
$3d^7(^4F)4p$	y $^5D^o$	4	33095.939	NJLT94
		3	33507.121	NJLT94
		2	33801.570	NJLT94
		1	34017.101	NJLT94
		0	34121.601	NJLT94

Energy Levels of Neutral Iron (Fe I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^7(^4F)4p$	y $^5F^o$	5	33695.395	NJLT94
		4	34039.514	NJLT94
		3	34328.750	NJLT94
		2	34547.209	NJLT94
		1	34692.146	NJLT94
$3d^6(^5D)4s4p(^3P)$	z $^3P^o$	2	33946.931	NJLT94
		1	34362.871	NJLT94
		0	34555.595	NJLT94
$3d^64s^2$	b ^1D	2	34636.790	NJLT94
$3d^7(^4F)4p$	z $^5G^o$	6	34843.955	NJLT94
		5	34782.419	NJLT94
		4	35257.322	NJLT94
		3	35611.623	NJLT94
		2	35856.400	NJLT94
$3d^7(^4F)4p$	z $^3G^o$	5	35379.206	NJLT94
		4	35767.562	NJLT94
		3	36079.370	NJLT94
$3d^7(^4F)4p$	y $^3F^o$	4	36686.174	NJLT94
		3	37162.744	NJLT94
		2	37521.158	NJLT94
$3d^6(^5D)4s4p(^1P)$	y $^5P^o$	3	36766.964	NJLT94
		2	37157.564	NJLT94
		1	37409.552	NJLT94
$3d^7(^2F)4s$	d ^3F	2	36940.588	NJLT94
		3	36975.586	NJLT94
		4	37045.932	NJLT94
$3d^7(^4F)4p$	y $^3D^o$	3	38175.352	NJLT94
		2	38678.036	NJLT94
		1	38995.733	NJLT94
$3d^6(^5D)4s4p(^1P)$	x $^5D^o$	4	39625.801	NJLT94
		3	39969.850	NJLT94
		2	40231.333	NJLT94
		1	40404.515	NJLT94
		0	40491.281	NJLT94
$3d^5(^6S)4s^24p$	y $^7P^o$	4	40421.935	NJLT94
		3	40207.088	NJLT94
		2	40052.032	NJLT94
$3d^6(^5D)4s4p(^1P)$	x $^5F^o$	5	40257.311	NJLT94
		4	40594.429	NJLT94
		3	40842.151	NJLT94
		2	41018.048	NJLT94
		1	41130.596	NJLT94
$3d^8$	c ^3P	2	40871.409	NJLT94
		1	41178.409	NJLT94
		0	41234.502	NJLT94
$3d^6(^3P)4s4p(^3P)$	z $^5S^o$	2	40894.987	NJLT94

Energy Levels of Neutral Iron (Fe I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^6(^3P)4s4p(^3P)$	x $^5P^o$	3	42532.738	NJLT94
		2	42859.775	NJLT94
		1	43079.020	NJLT94
$3d^6(^3H)4s4p(^3P)$	y $^5G^o$	6	42784.349	NJLT94
		5	42911.914	NJLT94
		4	43022.982	NJLT94
		3	43137.484	NJLT94
		2	43210.022	NJLT94
Fe II ($^6D_{9/2}$)		*Limit*	**63737**	SC85

Persistent Lines of Singly-ionized Iron (Fe II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	2343.4951	1.73	$3d^6(^5D)4s$	a ^6D	9/2	0.000	NLTH91	M03
			$3d^6(^5D)4p$	z $^6P^o$	7/2	42658.224		
1000	2382.0376	3.13	$3d^6(^5D)4s$	a ^6D	9/2	0.000	NLTH91	M03
			$3d^6(^5D)4p$	z $^6F^o$	11/2	41968.046		
700	2395.6254	2.67	$3d^6(^5D)4s$	a ^6D	7/2	384.790	NLTH91	M03
			$3d^6(^5D)4p$	z $^6F^o$	9/2	42114.818		
500	2404.8858	2.05	$3d^6(^5D)4s$	a ^6D	5/2	667.683	NLTH91	M03
			$3d^6(^5D)4p$	z $^6F^o$	7/2	42237.033		
300	2493.2637	3.4	$3d^6(^3H)4s$	a ^4H	13/2	21251.608	NLTH91	FW96
			$3d^6(^3H)4p$	z $^4I^o$	15/2	61347.614		
300	2585.8758	0.861	$3d^6(^5D)4s$	a ^6D	9/2	0.000	NLTH91	M03
			$3d^6(^5D)4p$	z $^6D^o$	7/2	38660.043		
400	2598.3692	1.42	$3d^6(^5D)4s$	a ^6D	7/2	384.790	NLTH91	M03
			$3d^6(^5D)4p$	z $^6D^o$	5/2	38858.958		
800	2599.3956	2.36	$3d^6(^5D)4s$	a ^6D	9/2	0.000	NLTH91	M03
			$3d^6(^5D)4p$	z $^6D^o$	9/2	38458.981		
300	2607.0871	1.74	$3d^6(^5D)4s$	a ^6D	5/2	667.683	NLTH91	M03
			$3d^6(^5D)4p$	z $^6D^o$	3/2	39013.206		
400	2611.8736	1.23	$3d^6(^5D)4s$	a ^6D	7/2	384.790	NLTH91	M03
			$3d^6(^5D)4p$	z $^6D^o$	7/2	38660.043		
400	2739.5474	1.9	$3d^6(^5D)4s$	a ^4D	7/2	7955.299	NLTH91	FW96
			$3d^6(^5D)4p$	z $^4D^o$	7/2	44446.878		
400	2749.3216	2.1	$3d^6(^5D)4s$	a ^4D	5/2	8391.938	NLTH91	FW96
			$3d^6(^5D)4p$	z $^4F^o$	7/2	44753.799		
500	2755.7365	2.1	$3d^6(^5D)4s$	a ^4D	7/2	7955.299	NLTH91	FW96
			$3d^6(^5D)4p$	z $^4F^o$	9/2	44232.512		

Energy Levels of Singly-ionized Iron (Fe II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^6(^5D)4s$	a ^6D	9/2	0.000	J78
		7/2	384.790	J78
		5/2	667.683	J78,BKE98
		3/2	862.613	J78,BKE98
		1/2	977.053	J78,BKE98
$3d^7$	a ^4F	9/2	1872.567	J78
		7/2	2430.097	J78
		5/2	2837.950	J78
		3/2	3117.461	J78
$3d^6(^5D)4s$	a ^4D	7/2	7955.299	J78
		5/2	8391.938	J78
		3/2	8680.454	J78
		1/2	8846.768	J78

Energy Levels of Singly-ionized Iron (Fe II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^7$	a ^{4}P	5/2	13474.411	J78
		3/2	13673.185	J78
		1/2	13904.824	J78
$3d^7$	a ^{2}G	9/2	15844.65	J78
		7/2	16369.36	J78
$3d^7$	a ^{2}P	3/2	18360.646	J78
		1/2	18886.780	J78
$3d^7$	a ^{2}H	11/2	20340.30	J78
		9/2	20805.77	J78
$3d^7$	a ^{2}D2	5/2	20516.960	J78
		3/2	21308.04	J78
$3d^6(^3P_2)4s$	b ^{4}P	5/2	20830.582	J78
		3/2	21812.055	J78
		1/2	22409.852	J78
$3d^6(^3H)4s$	a ^{4}H	13/2	21251.608	J78
		11/2	21430.359	J78
		9/2	21581.638	J78
		7/2	21711.917	J78
$3d^6(^3F_2)4s$	b ^{4}F	9/2	22637.205	J78
		7/2	22810.357	J78
		5/2	22939.358	J78
		3/2	23031.300	J78
$3d^54s^2$	a ^{6}S	5/2	23317.633	J78
$3d^6(^3G)4s$	a ^{4}G	11/2	25428.784	J78
		9/2	25805.328	J78
		7/2	25981.629	J78
		5/2	26055.423	J78
$3d^6(^3P_2)4s$	b ^{2}P	3/2	25787.598	J78
		1/2	26932.748	J78
$3d^6(^3H)4s$	b ^{2}H	11/2	26170.181	J78
		9/2	26352.766	J78
$3d^6(^3F_2)4s$	a ^{2}F	7/2	27314.922	J78
		5/2	27620.412	J78
$3d^6(^3G)4s$	b ^{2}G	9/2	30388.542	J78
		7/2	30764.485	J78
$3d^6(^3D)4s$	b ^{4}D	3/2	31364.440	J78
		1/2	31368.450	J78
		5/2	31387.948	J78
		7/2	31483.176	J78
$3d^7$	b ^{2}F	5/2	31811.822	J78
		7/2	31999.048	J78
$3d^6(^1I)4s$	a ^{2}I	13/2	32875.646	J78
		11/2	32909.905	J78
$3d^6(^1G_2)4s$	c ^{2}G	9/2	33466.463	J78
		7/2	33501.253	J78

Energy Levels of Singly-ionized Iron (Fe II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^6(^3D)4s$	b ^2D	3/2	36126.387	J78
		5/2	36252.918	J78
$3d^6(^1S_2)4s$	a ^2S	1/2	37227.326	J78
$3d^6(^1D_2)4s$	c ^2D	5/2	38164.194	J78
		3/2	38214.507	J78
$3d^6(^5D)4p$	z $^6D^o$	9/2	38458.981	J78
		7/2	38660.043	J78
		5/2	38858.958	J78
		3/2	39013.206	J78
		1/2	39109.307	J78
$3d^6(^5D)4p$	z $^6F^o$	11/2	41968.046	J78
		9/2	42114.818	J78
		7/2	42237.033	J78
		5/2	42334.822	J78
		3/2	42401.302	J78
		1/2	42439.822	J78
$3d^6(^5D)4p$	z $^6P^o$	7/2	42658.224	J78
		5/2	43238.586	J78
		3/2	43620.957	J78
$3d^6(^5D)4p$	z $^4F^o$	9/2	44232.512	J78
		7/2	44753.799	J78
		5/2	45079.879	J78
		3/2	45289.801	J78
$3d^6(^5D)4p$	z $^4D^o$	7/2	44446.878	J78
		5/2	44784.761	J78
		3/2	45044.168	J78
		1/2	45206.450	J78
$3d^6(^1F)4s$	c ^2F	7/2	44915.046	J78
		5/2	44929.55	J78
$3d^6(^5D)4p$	z $^4P^o$	5/2	46967.444	J78
		3/2	47389.779	J78
		1/2	47626.076	J78
$3d^7$	d $^2D1$	3/2	47674.721	J78
		5/2	48039.090	J78
$3d^6(^3P_1)4s$	c ^4P	1/2	49100.976	J78
		3/2	49506.934	J78
		5/2	50212.826	J78
$3d^6(^3F_1)4s$	c ^4F	3/2	50075.910	J78
		5/2	50142.786	J78
		9/2	50157.452	J78
		7/2	50187.813	J78
$3d^5(^6S)4s4p(^3P^o)$	z $^8P^o$	5/2	52299.39	J78
		7/2	52582.51	J78
		9/2	52965.82	J78
$3d^6(^3P_1)4s$	c ^2P	1/2	54063.459	J78
		3/2	54902.315	J78

Energy Levels of Singly-ionized Iron (Fe II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^5 4s^2$	b ^{4}G	11/2	54232.195	J78
		9/2	54273.641	J78
		5/2	54275.637	J78
		7/2	54283.220	J78
$3d^6(^3F_1)4s$	d ^{2}F	5/2	54870.528	J78
		7/2	54904.222	J78
$3d^5 4s^2$	d ^{4}P	5/2	57411.065	J78
		3/2	57493.321	J78
		1/2	57578.484	J78
$3d^6(^1G_1)4s$	d ^{2}G	9/2	58631.531	J78
		7/2	58666.258	J78
$3d^6(^3P_2)4p$	z $^4S^o$	3/2	59663.456	J78
$3d^5 4s^2$	c ^{4}D	7/2	60270.339	J78
		1/2	60384.370	J78
		3/2	60441.033	J78
		5/2	60445.275	J78
$3d^6(^3P_2)4p$	y $^4P^o$	5/2	60402.342	J78
		1/2	61035.287	J78
		3/2	61332.764	J78
$3d^6(^3H)4p$	z $^4G^o$	11/2	60625.449	J78
		9/2	60807.230	J78
		7/2	60956.781	J78
		5/2	61041.748	J78
$3d^6(^3H)4p$	z $^4H^o$	13/2	60837.569	J78
		11/2	60887.598	J78
		9/2	60989.444	J78
		7/2	61156.835	J78
$3d^6(^3P_2)4p$	z $^2D^o$	5/2	61093.413	J78
		3/2	62125.600	J78
$3d^6(^3H)4p$	z $^4I^o$	15/2	61347.614	J78
		9/2	61512.634	J78
		13/2	61527.616	J78
		11/2	61587.214	J78
Fe III ($^5D_4$)		*Limit*	**130563**	SC85

Krypton (Kr)
Atomic number = 36
Atomic weight = 83.80

Isotope	Mass	Abundance	Spin	Mag moment
^{78}Kr	77.920400	0.35%	0	
^{80}Kr	79.916380	2.25%	0	
^{82}Kr	81.913482	11.6%	0	
^{83}Kr	82.914135	11.5%	9/2	−0.970
^{84}Kr	83.911507	57.0%	0	
^{86}Kr	85.910616	17.3%	0	

Kr I Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^6\ {}^1S_0$
Ionization energy: 112 914.50 cm^{-1} (13.999 61 eV)

Kr II Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^5\ {}^2P^o_{3/2}$
Ionization energy: 196 475.4 cm^{-1} (24.359 84 eV)

Strong Lines of Krypton (Kr)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
20	729.40	Kr II	MSP69
70	761.18	Kr II	MSP69
30	763.98	Kr II	MSP69
20	766.20	Kr II	MSP69
70	771.03	Kr II	MSP69
20	773.69	Kr II	MSP69
70	782.10	Kr II	MSP69
30	783.72	Kr II	MSP69
20	818.15	Kr II	MSP69
20	830.38	Kr II	MSP69
30 P	844.06	Kr II	MSP69
20	864.82	Kr II	MSP69
20	868.87	Kr II	MSP69
70	884.14	Kr II	MSP69
300 P	886.30	Kr II	MSP69
130	891.01	Kr II	MSP69
70	911.39	Kr II	MSP69
700 P	917.43	Kr II	MSP69
100	945.4414	Kr I	K93
80	946.5443	Kr I	K93
30	951.056	Kr I	K93
80	953.4041	Kr I	K93
80	963.3745	Kr I	K93
700 P	964.97	Kr II	MSP69
150	1001.0606	Kr I	K93
150	1003.5504	Kr I	K93
150	1030.0232	Kr I	K93
300 P	1164.8671	Kr I	K93
1000 P	1235.8378	Kr I	K93
	Air		
30 h	2464.77	Kr II	RCWM80
20	2492.48	Kr II	DHM33
25 h	2712.40	Kr II	DHM33
30	2833.00	Kr II	DHM33
30 h	3607.88	Kr II	DHM33
70	3631.889	Kr II	HP70a

Strong Lines of Krypton (Kr)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
80	3653.928	Kr II	HP70a
13	3665.324	Kr I	KH69
50	3669.01	Kr II	DHM33
15 d	3679.58	Kr I	KH69
25	3686.182	Kr II	HP70a
100 h	3718.02	Kr II	DHM33
70	3718.595	Kr II	HP70a
50	3721.350	Kr II	HP70a
70	3741.638	Kr II	HP70a
50	3744.80	Kr II	DHM33
25	3754.245	Kr II	HP70a
150	3778.046	Kr II	HP70a
150	3783.095	Kr II	HP70a
50 h	3875.44	Kr II	DHM33
50	3906.177	Kr II	HP70a
70	3920.081	Kr II	HP70a
30	3994.840	Kr II	HP70a
30 h	3997.793	Kr II	HP70a
100	4057.037	Kr II	HP70a
100	4065.128	Kr II	HP70a
150	4088.337	Kr II	HP70a
80	4098.729	Kr II	HP70a
30	4109.248	Kr II	HP70a
80	4145.122	Kr II	HP70a
50	4250.580	Kr II	HP70a
150	4273.9694	Kr I	K93
15	4282.9674	Kr I	K93
200	4292.923	Kr II	HP70a
70	4300.49	Kr II	DHM33
150 h	4317.81	Kr II	DHM33
70	4318.5513	Kr I	K93
150	4319.5794	Kr I	K93
50 h	4322.98	Kr II	DHM33
15	4351.3597	Kr I	K93
1000 P	4355.477	Kr II	HP70a
80	4362.6416	Kr I	K93
70	4369.69	Kr II	DHM33
130	4376.1216	Kr I	K93
100 h	4386.54	Kr II	DHM33
30	4399.9663	Kr I	K93
15	4425.1901	Kr I	K93
150	4431.685	Kr II	HP70a
200	4436.812	Kr II	HP70a
100	4453.9175	Kr I	K93
130	4463.6900	Kr I	K93
250	4475.014	Kr II	HP70a
130 h	4489.88	Kr II	DHM33
100	4502.3543	Kr I	K93
130 h	4523.14	Kr II	DHM33
70 h	4556.61	Kr II	DHM33
250	4577.209	Kr II	HP70a
100	4582.978	Kr II	HP70a
50 h	4592.80	Kr II	DHM33
150	4615.292	Kr II	HP70a
300 P	4619.166	Kr II	HP70a
250 P	4633.885	Kr II	HP70a
700 P	4658.876	Kr II	HP70a
150	4680.406	Kr II	HP70a
30	4691.301	Kr II	HP70a

Strong Lines of Krypton (Kr)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
70	4694.360	Kr II	HP70a
1000 P	4739.002	Kr II	HP70a
100	4762.435	Kr II	HP70a
300 P	4765.744	Kr II	HP70a
100	4811.76	Kr II	DHM33
100	4825.18	Kr II	DHM33
250 P	4832.077	Kr II	HP70a
250 P	4846.612	Kr II	HP70a
50	4857.20	Kr II	DHM33
100	4945.59	Kr II	DHM33
70	5022.40	Kr II	DHM33
80	5086.52	Kr II	DHM33
130 h	5125.73	Kr II	DHM33
150	5208.32	Kr II	DHM33
70	5308.66	Kr II	DHM33
150	5333.41	Kr II	DHM33
70	5468.17	Kr II	DHM33
80	5562.2253	Kr I	K93
300 P	5570.2894	Kr I	K93
13	5580.3873	Kr I	K93
15	5649.5618	Kr I	K93
130	5681.89	Kr II	DHM33
70 h	5690.35	Kr II	DHM33
15	5832.8566	Kr I	K93
500 P	5870.9160	Kr I	K93
70	5992.22	Kr II	DHM33
10	5993.8502	Kr I	K93
10	6056.1263	Kr I	K93
100	6420.18	Kr II	DHM33
15	6421.0270	Kr I	K93
30	6456.2889	Kr I	K93
50	6570.07	Kr II	DHM33
10	6699.2296	Kr I	K93
15	6904.6788	Kr I	K93
80	7213.13	Kr II	DHM33
15	7224.104	Kr I	KH69
13	7287.258	Kr I	KH69
130	7289.78	Kr II	DHM33
130	7407.02	Kr II	DHM33
10	7425.541	Kr I	KH69
70	7435.78	Kr II	DHM33
15	7486.862	Kr I	KH69
100	7524.46	Kr II	DHM33
150	7587.4136	Kr I	K93
300	7601.5457	Kr I	K93
50	7641.16	Kr II	DHM33
150	7685.2459	Kr I	K93
200	7694.5401	Kr I	K93
80	7735.69	Kr II	DHM33
25	7746.827	Kr I	KH69
130	7854.8234	Kr I	K93
30	7913.4251	Kr I	K93
30	7928.5988	Kr I	K93
70	7933.22	Kr II	DHM33
40	7973.62	Kr II	DHM33
15	7982.401	Kr I	KH69
250	8059.5048	Kr I	K93
700 P	8104.3655	Kr I	K93
1000 P	8112.9012	Kr I	K93

Strong Lines of Krypton (Kr)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
10	8132.967	Kr I	KH69
500 P	8190.0566	Kr I	K93
70	8202.72	Kr II	DHM33
13	8218.365	Kr I	KH69
500 P	8263.2426	Kr I	K93
15	8272.353	Kr I	KH69
250	8281.0522	Kr I	K93
800 P	8298.1099	Kr I	K93
15	8412.430	Kr I	KH69
500 P	8508.8728	Kr I	K93
25	8764.110	Kr I	KH69
1000 P	8776.7505	Kr I	K93
300	8928.6934	Kr I	K93
150 P	9238.48	Kr II	DHM33
150 P,h,l	9293.82	Kr II	DHM33
70 h	9320.99	Kr II	DHM33
100	9361.95	Kr II	DHM33
15	9362.082	Kr I	KH69
70 h	9402.82	Kr II	DHM33
70 h	9470.93	Kr II	DHM33
150 P	9577.52	Kr II	DHM33
150 P,h	9605.80	Kr II	DHM33
130 h	9619.61	Kr II	DHM33
70	9663.34	Kr II	DHM33
70 h	9711.60	Kr II	DHM33
300	9751.7610	Kr I	K93
150 P	9803.14	Kr II	DHM33
80	9856.314	Kr I	KH69
300 P	10221.46	Kr II	DHM33
15	11187.108	Kr I	KH69
30	11257.711	Kr I	KH69
25	11259.126	Kr I	KH69
80	11457.481	Kr I	KH69
25	11792.425	Kr I	KH69
250	11819.377	Kr I	KH69
100	11997.105	Kr I	KH69
25	12077.224	Kr I	KH69
15	12861.892	Kr I	KH69
200	13177.412	Kr I	KH69
150	13622.415	Kr I	KH69
400 P	13634.220	Kr I	KH69
130	13658.394	Kr I	KH69
30	13711.036	Kr I	KH69
100	13738.851	Kr I	KH69
25	13974.027	Kr I	KH69
90	14045.657	Kr I	KH69
25	14104.298	Kr I	KH69
30	14402.22	Kr I	KH69
300 P	14426.793	Kr I	KH69
15	14517.84	Kr I	KH69
250	14734.436	Kr I	KH69
90	14762.672	Kr I	KH69
80	14765.472	Kr I	KH69
70	14961.894	Kr I	KH69
20	15005.307	Kr I	KH69
25	15209.526	Kr I	KH69
300	15239.615	Kr I	KH69
20	15326.480	Kr I	KH69
250	15334.958	Kr I	KH69

Strong Lines of Krypton (Kr)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
120	15372.037	Kr I	KH69
30	15474.026	Kr I	KH69
30	15681.02	Kr I	KH69
20	15820.09	Kr I	KH69
30	16726.513	Kr I	KH69
300	16785.128	Kr I	KH69
150	16853.488	Kr I	KH69
400 P	16890.441	Kr I	KH69
250	16896.753	Kr I	KH69
300	16935.806	Kr I	KH69
100	17098.771	Kr I	KH69
120	17367.606	Kr I	KH69
20	17404.443	Kr I	KH69
25	17616.854	Kr I	KH69
110	17842.737	Kr I	KH69
120	18002.229	Kr I	KH69
400 P	18167.315	Kr I	KH69
15	18399.786	Kr I	KH69
25	18580.896	Kr I	KH69
50	18696.294	Kr I	KH69
30	18785.460	Kr I	KH69
30	18797.703	Kr I	KH69
25	20209.878	Kr I	KH69
50	20423.964	Kr I	KH69
25	20446.971	Kr I	KH69
100	21165.471	Kr I	KH69
300	21902.513	Kr I	KH69
20	22485.775	Kr I	KH69
30	23340.416	Kr I	KH69
20	24260.506	Kr I	KH69
30	24292.221	Kr I	KH69
100	25233.820	Kr I	KH69
30	28610.55	Kr I	KH69
150	28655.72	Kr I	KH69
25	28769.71	Kr I	KH69
25	28822.49	Kr I	KH69
50	29236.69	Kr I	KH69
50	30663.54	Kr I	KH69
50	30979.16	Kr I	KH69
80	39300.6	Kr I	HPCA67
200	39486.52	Kr I	KH69
40	39557.25	Kr I	KH69
15	39572.60	Kr I	KH69
250	39588.4	Kr I	HPCA67
200	39589.6	Kr I	HPCA67
80	39954.8	Kr I	HPCA67
50	39966.6	Kr I	HPCA67
200	40306.1	Kr I	HPCA67
40	40685.16	Kr I	KH69

Persistent Lines of Neutral Krypton (Kr I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	1164.8671	3.16	$4p^6$	^1S	0	0.000	K93	FW96
			$4p^5(^2P^o_{1/2})5s$	$^2[1/2]^o$	1	85846.7051		
1000	1235.8378	3.12	$4p^6$	^1S	0	0.000	K93	FW96
			$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	1	80916.7685		
300	5570.2894	0.021	$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	2	79971.7422	K93	FW96
			$4p^5(^2P^o_{1/2})5p$	$^2[1/2]$	1	97919.1473		
500	5870.9160	0.018	$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	1	80916.7685	K93	FW96
			$4p^5(^2P^o_{1/2})5p$	$^2[3/2]$	2	97945.1669		
700	8104.3655	0.13	$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	2	79971.7422	K93	FW96
			$4p^5(^2P^o_{3/2})5p$	$^2[5/2]$	2	92307.3791		
1000	8112.9012	0.36	$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	2	79971.7422	K93	FW96
			$4p^5(^2P^o_{3/2})5p$	$^2[5/2]$	3	92294.4017		
500	8190.0566	0.11	$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	1	80916.7685	K93	FW96
			$4p^5(^2P^o_{3/2})5p$	$^2[3/2]$	2	93123.3414		
500	8263.2426	0.35	$4p^5(^2P^o_{1/2})5s$	$^2[1/2]^o$	1	85846.7051	K93	FW96
			$4p^5(^2P^o_{1/2})5p$	$^2[3/2]$	2	97945.1669		
800	8298.1099	0.32	$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	1	80916.7685	K93	FW96
			$4p^5(^2P^o_{3/2})5p$	$^2[3/2]$	1	92964.3948		
500	8508.8728	0.24	$4p^5(^2P^o_{1/2})5s$	$^2[1/2]^o$	1	85846.7051	K93	FW96
			$4p^5(^2P^o_{1/2})5p$	$^2[3/2]$	1	97595.9158		
1000	8776.7505	0.27	$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	1	80916.7685	K93	FW96
			$4p^5(^2P^o_{3/2})5p$	$^2[5/2]$	2	92307.3791		
400	13634.220		$4p^5(^2P^o_{3/2})5p$	$^2[5/2]$	3	92294.4017	KH69	
			$4p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	2	99626.883		
300	14426.793		$4p^5(^2P^o_{3/2})5p$	$^2[3/2]$	1	92964.3948	KH69	
			$4p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	1	99894.048		
400	16890.441		$4p^5(^2P^o_{3/2})5p$	$^2[5/2]$	2	92307.3791	KH69	
			$4p^5(^2P^o_{3/2})4d$	$^2[7/2]^o$	3	98226.268		
400	18167.315		$4p^5(^2P^o_{3/2})5p$	$^2[5/2]$	3	92294.4017	KH69	
			$4p^5(^2P^o_{3/2})4d$	$^2[7/2]^o$	4	97797.287		

Energy Levels of Neutral Krypton (Kr I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4p^6$	^1S	0	0.000	K93
$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	2	79971.7422	K93
		1	80916.7685	K93
$4p^5(^2P^o_{1/2})5s$	$^2[1/2]^o$	0	85191.6171	K93
		1	85846.7051	K93
$4p^5(^2P^o_{3/2})5p$	$^2[1/2]$	1	91168.5155	K93
		0	94092.8631	K93
$4p^5(^2P^o_{3/2})5p$	$^2[5/2]$	3	92294.4017	K93
		2	92307.3791	K93
$4p^5(^2P^o_{3/2})5p$	$^2[3/2]$	1	92964.3948	K93
		2	93123.3414	K93
$4p^5(^2P^o_{1/2})5p$	$^2[3/2]$	1	97595.9158	K93
		2	97945.1669	K93
$4p^5(^2P^o_{1/2})5p$	$^2[1/2]$	1	97919.1473	K93
		0	98855.0703	K93
$4p^5(^2P^o_{3/2})4d$	$^2[7/2]^o$	4	97797.287	K93
		3	98226.268	K93
$4p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	2	99626.883	K93
		1	99894.048	K93
Kr II ($^2P^o_{3/2}$)		*Limit*	**112914.50**	YG94,BHU02

Persistent Lines of Singly-ionized Krypton (Kr II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
30	844.06		$4p^5$	$^2P^o$	3/2	0.00	MSP69	
			$4p^4(^3P)5s$	^2P	3/2	118474.36		
300	886.30		$4p^5$	$^2P^o$	3/2	0.00	MSP69	
			$4p^4(^3P)5s$	^4P	5/2	112828.27		
700	917.43	0.23	$4p^5$	$^2P^o$	3/2	0.00	MSP69	M00
			$4s4p^6$	^2S	1/2	109000.36		
700	964.97	0.098	$4p^5$	$^2P^o$	1/2	5370.10	MSP69	M00
			$4s4p^6$	^2S	1/2	109000.36		
1000	4355.477	1.0	$4p^4(^3P)5s$	^4P	5/2	112828.27	HP70a	FW96
			$4p^4(^3P)5p$	$^4D^o$	7/2	135781.42		
700	4658.876	0.65	$4p^4(^3P)5s$	^4P	5/2	112828.27	HP70a	FW96
			$4p^4(^3P)5p$	$^4P^o$	3/2	134286.67		
1000	4739.002	0.76	$4p^4(^3P)5s$	^4P	5/2	112828.27	HP70a	FW96
			$4p^4(^3P)5p$	$^4P^o$	5/2	133923.86		
300	4765.744	0.67	$4p^4(^3P)5s$	^4P	3/2	115092.01	HP70a	FW96
			$4p^4(^3P)5p$	$^4D^o$	5/2	136069.23		
250	4832.077	0.73	$4p^4(^3P)5s$	^4P	3/2	115092.01	HP70a	FW96
			$4p^4(^3P)5p$	$^4P^o$	1/2	135781.26		

Persistent Lines of Singly-ionized Krypton (Kr II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
250	4846.612		$4p^4(^3P)5s$	^2P	3/2	118474.36	HP70a	
			$4p^4(^3P)5p$	$^2P^o$	1/2	139101.57		
150	9577.52		$4p^4(^3P)4d$	^4F	5/2	129697.19	DHM33	
			$4p^4(^3P)5p$	$^2P^o$	3/2	140135.40		
300	10221.46		$4p^4(^3P)4d$	^4F	9/2	126000.82	DHM33	
			$4p^4(^3P)5p$	$^4D^o$	7/2	135781.42		

Energy Levels of Singly-ionized Krypton (Kr II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4p^5$	$^2P^o$	3/2	0.00	SM91
		1/2	5370.10	SM91
$4s4p^6$	^2S	1/2	109000.36	SM91
$4p^4(^3P)5s$	^4P	5/2	112828.27	SM91
		3/2	115092.01	SM91
		1/2	117603.02	SM91
$4p^4(^3P)5s$	^2P	3/2	118474.36	SM91
		1/2	121002.15	SM91
$4p^4(^3P)4d$	^4D	7/2	120209.87	SM91
		5/2	120426.93	SM91
		3/2	121000.37	SM91
		1/2	121779.54	SM91
$4p^4(^3P)4d$	^4F	9/2	126000.82	SM91
		7/2	127929.52	SM91
		5/2	129697.19	SM91
		3/2	130512.73	SM91
$4p^4(^1D)5s$	^2D	3/2	127597.49	SM91
		5/2	127861.51	SM91
$4p^4(^3P)5p$	$^4P^o$	5/2	133923.86	SM91
		3/2	134286.67	SM91
		1/2	135781.26	SM91
$4p^4(^3P)5p$	$^4D^o$	7/2	135781.42	SM91
		5/2	136069.23	SM91
		3/2	138379.61	SM91
		1/2	140161.46	SM91
$4p^4(^3P)5p$	$^2P^o$	1/2	139101.57	SM91
		3/2	140135.40	SM91
$4p^4(^3P)5p$	$^2D^o$	5/2	140117.23	SM91
		3/2	141993.94	SM91
Kr III ($^3P_2$)		*Limit*	**196475.4**	SM91

Lanthanum (La)
Atomic number = 57
Atomic weight = 138.9055

Isotope	Mass	Abundance	Spin	Mag moment
^{138}La	137.907105	0.09%	5	+3.707
^{139}La	138.906346	99.10%	7/2	+2.778

La I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 5d 6s^2\ {}^2D_{3/2}$
Ionization energy: 44 981 cm^{-1} (5.5769 eV)

La II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 5d^2\ {}^3F_2$
Ionization energy: 89 200 cm^{-1} (11.059 eV)

Strong Lines of Lanthanum (La)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
90	2256.76	La II	MCS75
60	3245.13	La II	MCS75
60	3265.67	La II	MCS75
90	3303.11	La II	MCS75
150	3337.49	La II	MCS75
100	3344.56	La II	MCS75
150	3380.91	La II	MCS75
300 P	3574.43	La I	MCS75
250 d	3641.53	La I	MCS75
110	3645.42	La II	MCS75
250 P	3759.08	La II	MCS75
400 P	3790.83	La II	MCS75
400 P	3794.78	La II	MCS75
200	3849.02	La II	MCS75
400 P	3871.64	La II	MCS75
200	3886.37	La II	MCS75
140	3916.05	La II	MCS75
120	3921.54	La II	MCS75
200	3927.56	La I	MCS75
250	3929.22	La II	MCS75
1000 P	3949.10	La II	MCS75
500 P	3988.52	La II	MCS75
400 P	3995.75	La II	MCS75
250	4015.39	La I	MCS75
300 P	4031.69	La II	MCS75
300 P	4042.91	La II	MCS75
300 P	4060.33	La I	MCS75
300 P	4077.35	La II	MCS75
600 P	4086.72	La II	MCS75
250	4089.61	La I	MCS75
500 P	4123.23	La II	MCS75
120	4151.97	La II	MCS75
400 P	4187.32	La I	MCS75
150	4196.55	La II	MCS75
200	4238.38	La II	MCS75
400 P	4280.27	La I	MCS75
500 P	4333.74	La II	MCS75
200	4423.90	La I	MCS75
200	4429.90	La II	MCS75
90	4522.37	La II	MCS75

Strong Lines of Lanthanum (La)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	4567.91	La I	MCS75
300	4570.02	La I	MCS75
90	4899.92	La II	MCS75
110	4920.98	La II	MCS75
110	4921.79	La II	MCS75
500 P	4949.77	La I	MCS75
80	4999.47	La II	MCS75
300	5050.57	La I	MCS75
250	5056.46	La I	MCS75
300	5106.23	La I	MCS75
600 P	5145.42	La I	MCS75
400	5158.69	La I	MCS75
800 P	5177.31	La I	MCS75
90	5183.42	La II	MCS75
1000 P	5211.86	La I	MCS75
700 P	5234.27	La I	MCS75
500	5253.46	La I	MCS75
500	5271.19	La I	MCS75
700 P	5455.15	La I	MCS75
700 P	5501.34	La I	MCS75
300	5648.25	La I	MCS75
250	5740.66	La I	MCS75
500	5769.34	La I	MCS75
400	5789.24	La I	MCS75
600 P	5791.34	La I	MCS75
400	5930.62	La I	MCS75
1000 P	6249.93	La I	MCS75
600 P	6394.23	La I	MCS75
300	6410.99	La I	MCS75
300	6455.99	La I	MCS75
200	6543.16	La I	MCS75
200	6578.51	La I	MCS75
150 c,w	7334.18	La I	MCS75
120	7539.23	La I	MCS75
100	8086.05	La I	MCS75
120	8324.69	La I	MCS75
130	8346.53	La I	MCS75
90	8545.44	La I	MCS75

Persistent Lines of Neutral Lanthanum (La I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	3574.43		$5d6s^2$	^2D	3/2	0.000	MCS75	
			$4f5d(^3D^o)6s$	^{o}	3/2	27968.54		
300	4060.33		$5d^2(^3F)6s$	^4F	9/2	4121.572	MCS75	
			$4f5d(^3G^o)6s$	$^4G^o$	11/2	28743.24		
400	4187.32		$5d6s^2$	^2D	3/2	0.000	MCS75	
			$5d6s(^3D)6p$	^{o}	5/2	23874.95		
400	4280.27		$5d6s^2$	^2D	5/2	1053.164	MCS75	
			$4f5d(^1G^o)6s$	^{o}	7/2	24409.68		
500	4949.77	0.87	$5d6s^2$	^2D	3/2	0.000	MCS75	M00
			$5d6s(^1D)6p$	^{o}	1/2	20197.34		
600	5145.42		$5d^2(^3F)6s$	^4F	5/2	3010.002	MCS75	
			$5d^2(^3F)6p$	$^4D^o$	3/2	22439.36		

Persistent Lines of Neutral Lanthanum (La I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	5177.31		$5d^2(^3F)6s$	^4F	7/2	3494.526	MCS75	
			$5d^2(^3F)6p$	$^4D^o$	5/2	22804.25		
1000	5211.86		$5d^2(^3F)6s$	^4F	9/2	4121.572	MCS75	
			$5d^2(^3F)6p$	$^4D^o$	7/2	23303.26		
700	5234.27		$5d^2(^3F)6s$	^4F	9/2	4121.572	MCS75	
			$5d6s(^3D)6p$	^{o}	7/2	23221.10		
700	5455.15		$5d6s^2$	^2D	5/2	1053.164	MCS75	
			$5d^2(^3F)6p$	$^2D^o$	5/2	19379.40		
700	5501.34	0.529	$5d6s^2$	^2D	3/2	0.000	MCS75	M00
			$5d^2(^3F)6p$	$^2D^o$	3/2	18172.35		
600	5791.34		$5d^2(^3F)6s$	^4F	9/2	4121.572	MCS75	
			$5d^2(^3F)6p$	$^4F^o$	9/2	21384.00		
1000	6249.93		$5d^2(^3F)6s$	^4F	9/2	4121.572	MCS75	
			$5d^2(^3F)6p$	$^4G^o$	11/2	20117.38		
600	6394.23		$5d^2(^3F)6s$	^4F	7/2	3494.526	MCS75	
			$5d^2(^3F)6p$	$^4G^o$	9/2	19129.31		

Energy Levels of Neutral Lanthanum (La I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d6s^2$	^2D	3/2	0.000	MZH78
		5/2	1053.164	MZH78
$5d^2(^3F)6s$	^4F	3/2	2668.188	MZH78
		5/2	3010.002	MZH78
		7/2	3494.526	MZH78
		9/2	4121.572	MZH78
$5d^2(^3F)6s$	^2F	5/2	7011.909	MZH78
		7/2	8052.162	MZH78
$5d^2(^3P)6s$	^4P	1/2	7231.407	MZH78
		3/2	7490.521	MZH78
		5/2	7679.939	MZH78
$5d^2(^1D)6s$	^2D	3/2	8446.044	MZH78
		5/2	9183.797	MZH78
$5d^2(^3P)6s$	^2P	1/2	9044.214	MZH78
		3/2	9719.439	MZH78
$5d^2(^1G)6s$	^2G	9/2	9919.821	MZH78
		7/2	9960.904	MZH78
$5d^3$	^4F	3/2	12430.609	MZH78
		5/2	12787.404	MZH78
		7/2	13238.323	MZH78
		9/2	13747.276	MZH78
$5d6s(^3D)6p$	$^4F^o$	3/2	13260.38	MZH78
		5/2	14804.08	MZH78
		7/2	15019.51	MZH78
		9/2	16243.17	MZH78

Energy Levels of Neutral Lanthanum (La I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5d6s(^3D)6p$	^{o}	5/2	13631.04	MZH78
$5d6s(^3D)6p$	$^4D^o$	1/2	14095.69	MZH78
		3/2	14708.92	MZH78
		5/2	15503.64	MZH78
		7/2	16099.29	MZH78
$5d6s(^3D)6p$	^{o}	3/2	15031.64	MZH78
$4f6s^2$	$^2F^o$	5/2	15196.83	MZH78
		7/2	16538.39	MZH78
$5d6s(^3D)6p$	^{o}	1/2	15219.89	MZH78
$6s^2(^1S)6p$	^{o}	3/2	16280.26	MZH78
$5d^3$	^4P	1/2	16617.30	MZH78
		3/2	16735.14	MZH78
		5/2	17099.38	MZH78
$5d^2(^3F)6p$	^{o}	5/2	16856.80	MZH78
$5d^2(^1S)6s$	^2S	1/2	16991.42	MZH78
$5d^3$	^2G	7/2	17023.36	MZH78
		9/2	17140.90	MZH78
$5d6s(^3D)6p$	$^4P^o$	1/2	17567.49	MZH78
		3/2	17797.29	MZH78
		5/2	18156.97	MZH78
$5d^2(^3F)6p$	^{o}	7/2	17910.17	MZH78
$5d^2(^3F)6p$	$^4G^o$	5/2	17947.13	MZH78
		7/2	18603.92	MZH78
		9/2	19129.31	MZH78
		11/2	20117.38	MZH78
$5d^2(^3F)6p$	$^2D^o$	3/2	18172.35	MZH78
		5/2	19379.40	MZH78
$5d^2(^3F)6p$	$^4F^o$	3/2	20082.98	MZH78
		5/2	20338.25	MZH78
		7/2	20763.21	MZH78
		9/2	21384.00	MZH78
$5d6s(^1D)6p$	^{o}	1/2	20197.34	MZH78
$5d^2(^3F)6p$	$^4D^o$	1/2	22246.64	MZH78
		3/2	22439.36	MZH78
		5/2	22804.25	MZH78
		7/2	23303.26	MZH78
$5d6s(^3D)6p$	^{o}	7/2	23221.10	MZH78
$5d6s(^3D)6p$	^{o}	5/2	23874.95	MZH78
$4f5d(^1G^o)6s$	^{o}	7/2	24409.68	MZH78
$4f5d(^3G^o)6s$	$^4G^o$	5/2	27022.62	MZH78
		7/2	27455.31	MZH78
		9/2	28089.17	MZH78
		11/2	28743.24	MZH78
$4f5d(^3D^o)6s$	^{o}	3/2	27968.54	MZH78
La II ($^3F_2$)		*Limit*	**44981**	MZH78

Persistent Lines of Singly-ionized Lanthanum (La II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
250	3759.08	0.34	$5d^2$	a ^{3}F	4	1970.70	MCS75	M00
			$5d6p$	x ^{3}F^o	4	28565.40		
400	3790.83		$5d^2$	a ^{3}F	3	1016.10	MCS75	
			$5d6p$	y ^{3}D^o	2	27388.11		
400	3794.78		$5d^2$	a ^{3}F	4	1970.70	MCS75	
			$5d6p$	y ^{3}D^o	3	28315.25		
400	3871.64		$5d^2$	a ^{3}F	3	1016.10	MCS75	
			$5d6p$	x ^{3}F^o	3	26837.66		
1000	3949.10		$5d6s$	a ^{3}D	3	3250.35	MCS75	
			$5d6p$	x ^{3}F^o	4	28565.40		
500	3988.52		$5d6s$	a ^{3}D	3	3250.35	MCS75	
			$5d6p$	y ^{3}D^o	3	28315.25		
400	3995.75		$5d^2$		2	1394.46	MCS75	
			$5d6p$	x ^{3}F^o	2	26414.01		
300	4031.69		$5d6s$	a ^{3}D	2	2591.60	MCS75	
			$5d6p$	y ^{3}D^o	2	27388.11		
300	4042.91		$5d^2$	a ^{1}G	4	7473.32	MCS75	
			$5d6p$	x ^{1}F^o	3	32201.05		
300	4077.35		$5d6s$	a ^{3}D	1	1895.15	MCS75	
			$5d6p$	x ^{3}F^o	2	26414.01		
600	4086.72	0.552	$5d^2$	a ^{3}F	2	0.00	MCS75	M00
			$5d6p$	y ^{1}D^o	2	24462.66		
500	4123.23		$5d6s$	a ^{3}D	2	2591.60	MCS75	
			$5d6p$	x ^{3}F^o	3	26837.66		
500	4333.74		$5d^2$		2	1394.46	MCS75	
			$5d6p$	y ^{1}D^o	2	24462.66		

Energy Levels of Singly-ionized Lanthanum (La II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^2$	a ^{3}F	2	0.00	MZH78
		3	1016.10	MZH78
		4	1970.70	MZH78
$5d^2$		2	1394.46	MZH78
$5d6s$	a ^{3}D	1	1895.15	MZH78
		2	2591.60	MZH78
		3	3250.35	MZH78
$5d^2$	a ^{3}P	0	5249.70	MZH78
		1	5718.12	MZH78
		2	6227.42	MZH78
$6s^2$	a ^{1}S	0	7394.57	MZH78
$5d^2$	a ^{1}G	4	7473.32	MZH78
$5d6s$		2	10094.86	MZH78

Energy Levels of Singly-ionized Lanthanum (La II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f(^2F^o_{5/2})6s_{1/2}$	$(5/2,1/2)^o$	2	14147.98	MZH78
		3	14375.17	MZH78
$4f(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	4	15698.74	MZH78
		3	15773.77	MZH78
$4f5d$	z $^1G^o$	4	16599.17	MZH78
$4f5d$	y $^3F^o$	2	17211.93	MZH78
		3	18235.56	MZH78
		4	19214.54	MZH78
$4f5d$	z $^3H^o$	4	17825.62	MZH78
		5	18580.41	MZH78
		6	19749.62	MZH78
$4f5d$	z $^1D^o$	2	18895.41	MZH78
$4f5d$	z $^3G^o$	3	20402.82	MZH78
		4	21331.60	MZH78
		5	22282.90	MZH78
$4f5d$	z $^3D^o$	1	21441.73	MZH78
		2	22106.02	MZH78
		3	22537.30	MZH78
$4f5d$	z $^3P^o$	0	22683.70	MZH78
		1	22705.15	MZH78
		2	23246.93	MZH78
$5d6p$	y $^1D^o$	2	24462.66	MZH78
$4f5d$	y $^1F^o$	3	24522.70	MZH78
$5d6p$	y $^3D^o$	1	25973.37	MZH78
		2	27388.11	MZH78
		3	28315.25	MZH78
$5d6p$	x $^3F^o$	2	26414.01	MZH78
		3	26837.66	MZH78
		4	28565.40	MZH78
$5d6p$	^{o}	1	27423.91	MZH78
$6s6p$	y $^3P^o$	0	27545.85	MZH78
$6s6p$	^{o}	1	28154.55	MZH78
$4f5d$	z $^1H^o$	5	28525.71	MZH78
$6s6p$	^{o}	2	29498.05	MZH78
$4f5d$	y $^1P^o$	1	30353.33	MZH78
$5d6p$	x $^3P^o$	0	31785.82	MZH78
		1	32160.99	MZH78
$5d6p$	x $^1F^o$	3	32201.05	MZH78
La III ($^2D_{3/2}$)		*Limit*	**89200**	SR65

Lead (Pb)

Atomic number = 82
Atomic weight = 207.2

Isotope	Mass	Abundance	Spin	Mag moment
^{204}Pb	203.973020	1.4%	0	
^{206}Pb	205.974440	24.1%	0	
^{207}Pb	206.975872	22.1%	1/2	+0.5926
^{208}Pb	207.976627	52.4%	0	

Pb I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^2_{1/2}$ $(1/2,1/2)_0$
Ionization energy: 59 819.2 cm^{-1} (7.416 63 eV)

Pb II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p\ ^2\mathrm{P}^o_{1/2}$
Ionization energy: 121 245.14 cm^{-1} (15.032 48 eV)

Strong Lines of Lead (Pb)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
200	1060.619	Pb II	WRSH74
200	1121.325	Pb II	WRSH74
1000 P	1433.906	Pb II	KT96
1000 P	1512.298	Pb II	KT96
500	1671.553	Pb II	KT96
500	1682.127	Pb II	KT96
600 P	1726.802	Pb II	KT96
400	1796.669	Pb II	KT96
1000 P	1822.052	Pb II	KT96
	Air		
200 P	2022.016	Pb I	WA68
200 P	2053.284	Pb I	WA68
150 P,r	2170.005	Pb I	WA68
500 P	2203.534	Pb II	WRSH74
50 P,r	2393.792	Pb I	WA68
20 r	2401.940	Pb I	WA68
4 r	2411.734	Pb I	WA68
15 r	2613.655	Pb I	WA68
200 P,r	2614.175	Pb I	WA68
90	2663.154	Pb I	WA68
300 P,r	2801.995	Pb I	WA68
120 r	2823.189	Pb I	WA68
300 P,r	2833.053	Pb I	WA68
120 r	2873.311	Pb I	WA68
100 c	3016.387	Pb II	WRSH74
2	3220.528	Pb I	WA68
2	3240.186	Pb I	WA68
1	3262.355	Pb I	WA68
30	3572.729	Pb I	WA68
150 P,r	3639.568	Pb I	WA68
10	3671.491	Pb I	WA68
400 P,r	3683.462	Pb I	WA68
50	3713.982	Pb II	WRSH74
80 P	3739.935	Pb I	WA68
12	4019.632	Pb I	WA68
1000 P	4057.807	Pb I	WA68
15 P	4062.136	Pb I	WA68
50	4152.82	Pb II	WRSH74

Strong Lines of Lead (Pb)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
4	4168.033	Pb I	WA68
100 P,c	4244.92	Pb II	WRSH74
50	4352.74	Pb II	WRSH74
100 P,c	4386.46	Pb II	WRSH74
50	4579.051	Pb II	WRSH74
50	4582.27	Pb II	WRSH74
3	5005.416	Pb I	WA68
250 P	5042.58	Pb II	WRSH74
50	5070.58	Pb II	WRSH74
50	5074.53	Pb II	WRSH74
50	5111.64	Pb II	WRSH74
1	5201.437	Pb I	WA68
50	5367.64	Pb II	WRSH74
50	5372.099	Pb II	WRSH74
50 c	5544.25	Pb II	WRSH74
100 P,c	5608.85	Pb II	WRSH74
6	5895.624	Pb I	WA68
5	6001.862	Pb I	WA68
200 P	6075.74	Pb II	WRSH74
200 P	6081.409	Pb II	WRSH74
50	6159.89	Pb II	S75
250 P,c	6660.20	Pb II	WRSH74
100	7193.60	Pb II	S75
4	7228.965	Pb I	WA68
50	7558.97	Pb II	S75
50	7632.56	Pb II	S75
50	8395.68	Pb II	WRSH74
50	9050.82	Pb II	WRSH74
50	9063.43	Pb II	WRSH74
2	10290.458	Pb I	WA68
1	10498.965	Pb I	WA68

Persistent Lines of Neutral Lead (Pb I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
200	2022.016	0.059	$6p_{1/2}^2$	(1/2, 1/2)	0	0.000	WA68	M00
			$6p_{3/2}7s_{1/2}$	$(3/2,1/2)^o$	1	49439.616		
200	2053.284	0.102	$6p_{1/2}^2$	(1/2, 1/2)	0	0.000	WA68	M00
			$6p_{1/2}8s_{1/2}$	$(1/2,1/2)^o$	1	48686.934		
150	2170.005	1.5	$6p_{1/2}^2$	(1/2, 1/2)	0	0.000	WA68	FW96
			$6p_{1/2}6d$	$^2[3/2]^o$	1	46068.438		
50	2393.792		$6p_{1/2}6p_{3/2}$	(1/2, 3/2)	2	10650.327	WA68	
			$6p_{1/2}7d$	$^2[5/2]^o$	3	52412.325		
200	2614.175	1.9	$6p_{1/2}6p_{3/2}$	(1/2, 3/2)	1	7819.263	WA68	FW96
			$6p_{1/2}6d$	$^2[3/2]^o$	2	46060.836		
300	2801.995	1.6	$6p_{1/2}6p_{3/2}$	(1/2, 3/2)	2	10650.327	WA68	FW96
			$6p_{1/2}6d$	$^2[5/2]^o$	3	46328.667		
300	2833.053	0.58	$6p_{1/2}^2$	(1/2, 1/2)	0	0.000	WA68	FW96
			$6p_{1/2}7s_{1/2}$	$(1/2,1/2)^o$	1	35287.224		
150	3639.568	0.34	$6p_{1/2}6p_{3/2}$	(1/2,3/2)	1	7819.263	WA68	FW96
			$6p_{1/2}7s_{1/2}$	$(1/2,1/2)^o$	1	35287.224		

Persistent Lines of Neutral Lead (Pb I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	3683.462	1.5	$6p_{1/2}6p_{3/2}$	(1/2, 3/2)	1	7819.263	WA68	FW96
			$6p_{1/2}7s_{1/2}$	$(1/2,1/2)^o$	0	34959.908		
80	3739.935	0.73	$6p^2_{3/2}$	(3/2, 3/2)	2	21457.798	WA68	FW96
			$6p_{3/2}7s_{1/2}$	$(3/2,1/2)^o$	2	48188.630		
1000	4057.807	0.89	$6p_{1/2}6p_{3/2}$	(1/2, 3/2)	2	10650.327	WA68	FW96
			$6p_{1/2}7s_{1/2}$	$(1/2,1/2)^o$	1	35287.224		
15	4062.136	0.92	$6p^2_{3/2}$	(3/2, 3/2)	2	21457.798	WA68	FW96
			$6p_{1/2}6d$	$^2[3/2]^o$	1	46068.438		

Energy Levels of Neutral Lead (Pb I)

Configuration	Term	J	Level (cm^{-1})	Ref
$6p^2_{1/2}$	(1/2, 1/2)	0	0.000	WA68
$6p_{1/2}6p_{3/2}$	(1/2, 3/2)	1	7819.263	WA68
		2	10650.327	WA68
$6p^2_{3/2}$	(3/2, 3/2)	2	21457.798	WA68
		0	29466.830	WA68
$6p_{1/2}7s_{1/2}$	$(1/2,1/2)^o$	0	34959.908	WA68
		1	35287.224	WA68
$6p_{1/2}7p_{1/2}$	(1/2,1/2)	1	42918.643	WA68
		0	44400.890	WA68
$6p_{1/2}7p_{3/2}$	(1/2, 3/2)	1	44674.986	WA68
		2	44809.364	WA68
$6p_{1/2}6d$	$^2[5/2]^o$	2	45443.171	WA68
		3	46328.667	WA68
$6p_{1/2}6d$	$^2[3/2]^o$	2	46060.836	WA68
		1	46068.438	WA68
$6p_{3/2}7s_{1/2}$	$(3/2,1/2)^o$	2	48188.630	WA68
		1	49439.616	WA68
$6p_{1/2}8s_{1/2}$	$(1/2,1/2)^o$	1	48686.934	WA68
$6p_{1/2}7d$	$^2[5/2]^o$	2	52101.660	WA68
		3	52412.325	WA68
$6p_{1/2}7d$	$^2[3/2]^o$	2	52311.315	WA68
		1	52499.639	WA68
Pb II ($^2P^o_{1/2}$)		*Limit*	**59819.2**	WA68

Persistent Lines of Singly-ionized Lead (Pb II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1433.906	14.1	$6s^26p$	$^2P^o$	1/2	0.000	KT96	M00
			$6s^26d$	^2D	3/2	69739.603		
1000	1512.298		$6s^26p$	$^2P^o$	1/2	0.000	KT96	
			$6s6p^2$	^4P	3/2	66124.53		
600	1726.802		$6s^26p$	$^2P^o$	1/2	0.000	KT96	
			$6s6p^2$	^4P	1/2	57910.48		
1000	1822.052	11.8	$6s^26p$	$^2P^o$	3/2	14081.074	KT96	M00
			$6s^26d$	^2D	5/2	68964.310		
500	2203.534	4.94	$6s^26p$	$^2P^o$	3/2	14081.074	WRSH74	M00
			$6s^27s$	^2S	1/2	59448.56		
100	4244.92		$6s^26d$	^2D	5/2	68964.310	WRSH74	
			$6s^25f$	$^2F^o$	7/2	92515.24		
100	4386.46		$6s^26d$	^2D	3/2	69739.603	WRSH74	
			$6s^25f$	$^2F^o$	5/2	92530.66		
250	5042.58		$6s^27p$	$^2P^o$	1/2	74458.99	WRSH74	
			$6s^27d$	^2D	3/2	94284.58		
100	5608.85		$6s^27s$	^2S	1/2	59448.56	WRSH74	
			$6s^27p$	$^2P^o$	3/2	77272.57		
200	6075.74		$6s^25f$	$^2F^o$	7/2	92515.24	WRSH74	
			$6s^26g$	^2G	9/2	108969.58		
200	6081.409		$6s^25f$	$^2F^o$	5/2	92530.66	WRSH74	
			$6s^26g$	^2G	7/2	108969.67		
250	6660.20		$6s^27s$	^2S	1/2	59448.56	WRSH74	
			$6s^27p$	$^2P^o$	1/2	74458.99		

Energy Levels of Singly-ionized Lead (Pb II)

Configuration	Term	J	Level (cm^{-1})	Ref
$6s^26p$	$^2P^o$	1/2	0.000	WRSH74
		3/2	14081.074	WRSH74
$6s6p^2$	^4P	1/2	57910.48	WRSH74
		3/2	66124.53	WRSH74
		5/2	73905.708	WRSH74
$6s^27s$	^2S	1/2	59448.56	WRSH74
$6s^26d$	^2D	5/2	68964.310	WRSH74
		3/2	69739.603	WRSH74
$6s^27p$	$^2P^o$	1/2	74458.99	WRSH74
		3/2	77272.57	WRSH74
$6s6p^2$	^2D	5/2	88972.16	WRSH74
$6s^28s$	^2S	1/2	89180.18	WRSH74
$6s^25f$	$^2F^o$	7/2	92515.24	WRSH74
		5/2	92530.66	WRSH74

Energy Levels of Singly-ionized Lead (Pb II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$6s^2 7d$	^2D	3/2	94284.58	WRSH74
		5/2	95304.25	WRSH74
$6s^2 6g$	^2G	9/2	108969.58	WRSH74
		7/2	108969.67	WRSH74
Pb III ($^1S_0$)		*Limit*	**121245.14**	RWS76

Lithium (Li)

Atomic number = 3
Atomic weight = 6.941

Isotope	Mass	Abundance	Spin	Mag moment
^{6}Li	6.015121	7.5%	1	+0.822056
^{7}Li	7.016003	92.5%	3/2	+3.25644

Li I Ground state: $1s^2 2s\ ^2S_{1/2}$
Ionization energy: 43 487.150 cm^{-1} (5.391 719 eV)

Li II Ground state: $1s^2\ ^1S_0$
Ionization energy: 610 078 cm^{-1} (75.6400 eV)

Strong Lines of Lithium (Li)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
30	171.575	Li II	R37
300 P	178.014	Li II	R37
1000 P	199.280	Li II	R37
10	944.73	Li II	SO82
10	1017.88	Li II	SO82
30	1131.88	Li II	SO82
10	1166.63	Li II	SO82
50	1198.092	Li II	HM59
20	1237.29	Li II	SO82
10	1253.32	Li II	SO82
60	1420.900	Li II	DM01
15	1492.931	Li II	HM59
30	1492.973	Li II	HM59
6	1493.036	Li II	HM59
15	1653.077	Li II	HM59
30	1653.132	Li II	HM59
6	1653.213	Li II	HM59
40	1681.661	Li II	HM59
50	1755.332	Li II	HM59
	Air		
10	2329.836	Li II	HM59
10	2381.538	Li II	HM59
20	2383.199	Li II	HM59
15	2402.331	Li II	HM59
10	2410.842	Li II	HM59
10	2429.814	Li II	HM59
15	2506.940	Li II	HM59
30	2508.785	Li II	HM59
20	2539.487	Li II	HM59
10	2551.70	Li II	SO82
15	2605.081	Li II	HM59
20	2657.293	Li II	HM59
30	2657.303	Li II	HM59
20	2674.460	Li II	HM59
20	2728.288	Li II	HM59
7	2728.315	Li II	HM59
50*	2730.473	Li II	HM59
50*	2730.551	Li II	HM59
40	2766.989	Li II	HM59
20	2790.313	Li II	HM59

Strong Lines of Lithium (Li)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
20*	3029.121	Li II	HM59
20*	3029.136	Li II	HM59
20*	3155.308	Li II	HM59
20*	3155.330	Li II	HM59
20	3196.330	Li II	HM59
10	3196.356	Li II	HM59
70*	3199.332	Li II	HM59
70*	3199.434	Li II	HM59
2*	3232.633	Li I	REB95
2*	3232.643	Li I	REB95
50	3249.868	Li II	HM59
40	3306.284	Li II	HM59
30	3684.320	Li II	HM59
2*	4132.624	Li I	REB95
2*	4132.625	Li I	REB95
10	4155.946	Li II	DM01
15	4325.419	Li II	HM59
15	4325.471	Li II	HM59
15 P	4602.831	Li I	REB95
30* P	4602.898	Li I	REB95
30*	4602.902	Li I	REB95
30	4671.651	Li II	HM59
10	4671.705	Li II	HM59
80	4678.056	Li II	HM59
25	4678.290	Li II	HM59
80	4788.363	Li II	HM59
15	4881.320	Li II	HM59
15	4881.386	Li II	HM59
5	4881.490	Li II	HM59
5	4971.665	Li I	REB95
10	4971.748	Li I	REB95
15	5037.915	Li II	HM59
300 P	5483.56	Li II	HM59
500 P	5484.50	Li II	HM59
400 P	5485.11	Li II	HM59
300 P	6103.542	Li I	REB95
400* P	6103.654	Li I	REB95
400*	6103.667	Li I	REB95
500 P	6707.775	Li I	REB95
1000 P	6707.926	Li I	REB95
150 P	8126.232	Li I	REB95
300 P	8126.453	Li I	REB95
100 P	9581.42	Li II	SO82
2*	18703.01	Li I	REB95
2*	18703.11	Li I	REB95
2*	18703.14	Li I	REB95
10 P	26877.67	Li I	REB95
5 P	26878.36	Li I	REB95

Persistent Lines of Neutral Lithium (Li I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
15	4602.831	0.223	$2p$	$^2P^o$	1/2	14903.622	REB95	FW96
			$4d$	^2D	3/2	36623.297		
30	4602.898	0.223	$2p$	$^2P^o$	3/2	14903.957	REB95	FW96
			$4d$	^2D	5/2	36623.312		
300	6103.542	0.686	$2p$	$^2P^o$	1/2	14903.622	REB95	FW96
			$3d$	^2D	3/2	31283.018		
400	6103.654	0.686	$2p$	$^2P^o$	3/2	14903.957	REB95	FW96
			$3d$	^2D	5/2	31283.053		
500	6707.775	0.369	$2s$	^2S	1/2	0.000	REB95	FW96
			$2p$	$^2P^o$	3/2	14903.957		
1000	6707.926	0.369	$2s$	^2S	1/2	0.000	REB95	FW96
			$2p$	$^2P^o$	1/2	14903.622		
150	8126.232	0.349	$2p$	$^2P^o$	1/2	14903.622	REB95	WSG66
			$3s$	^2S	1/2	27206.066		
300	8126.453	0.349	$2p$	$^2P^o$	3/2	14903.957	REB95	WSG66
			$3s$	^2S	1/2	27206.066		
10	26877.67	0.038	$3s$	^2S	1/2	27206.066	REB95	WSG66
			$3p$	$^2P^o$	3/2	30925.613		
5	26878.36	0.038	$3s$	^2S	1/2	27206.066	REB95	WSG66
			$3p$	$^2P^o$	1/2	30925.517		

Energy Levels of Neutral Lithium (Li I)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s$	^2S	1/2	0.000	REB95
$2p$	$^2P^o$	1/2	14903.622	REB95
		3/2	14903.957	REB95
$3s$	^2S	1/2	27206.066	REB95
$3p$	$^2P^o$	1/2	30925.517	REB95
		3/2	30925.613	REB95
$3d$	^2D	3/2	31283.018	REB95
		5/2	31283.053	REB95
$4p$	$^2P^o$	1/2	36469.714	REB95
		3/2	36469.754	REB95
$4d$	^2D	3/2	36623.297	REB95
		5/2	36623.312	REB95
Li II $1s^2$ ($^1S_0$)		*Limit*	**43487.150**	K87

Persistent Lines of Singly-ionized Lithium (Li II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	178.014	77.9	$1s^2$	^1S	0	0.	R37	WSG66
			$1s3p$	$^1P^o$	1	561751.50		
1000	199.280	256	$1s^2$	^1S	0	0.	R37	WSG66
			$1s2p$	$^1P^o$	1	501807.59		
300	5483.56	0.228	$1s2s$	^3S	1	476034.24	HM59	WSG66
			$1s2p$	$^3P^o$	0	494265.57		
500	5484.50	0.228	$1s2s$	^3S	1	476034.24	HM59	WSG66
			$1s2p$	$^3P^o$	2	494262.48		
400	5485.11	0.228	$1s2s$	^3S	1	476034.24	HM59	WSG66
			$1s2p$	$^3P^o$	1	494260.32		
100	9581.42	0.0518	$1s2s$	^1S	0	491373.58	TE62	WSG66
			$1s2p$	$^1P^o$	1	501807.59		

Energy Levels of Singly-ionized Lithium (Li II)

Configuration	Term	J	Level (cm^{-1})	Ref
$1s^2$	^1S	0	0.	HM59
$1s2s$	^3S	1	476034.24	HM59
$1s2s$	^1S	0	491373.58	TE62
$1s2p$	$^3P^o$	1	494260.32	HM59
		2	494262.48	HM59
		0	494265.57	HM59
$1s2p$	$^1P^o$	1	501807.59	HM59
$1s3s$	^3S	1	554753.69	HM59
$1s3s$	^1S	0	558776.88	HM59
$1s3p$	$^3P^o$	1	559499.53	HM59
		2	559500.39	HM59
		0	559501.32	HM59
$1s3p$	$^1P^o$	1	561751.50	DM01
Li III $1s$ ($^2S_{1/2}$)		*Limit*	**610078.4**	DM01

Lutetium (Lu)
Atomic number = 17
Atomic weight = 174.967

Isotope	Mass	Abundance	Spin	Mag moment
^{175}Lu	174.940770	97.41%	7/2	+2.2327
^{176}Lu	175.942679	2.59%	7	+3.19

Lu I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6)5d6s^2\ ^2D_{3/2}$
Ionization energy: 43 762.50 cm^{-1} (5.425 86 eV)

Lu II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6)6s^2\ ^1S_0$
Ionization energy: 112 000 cm^{-1} (13.9 eV)

Strong Lines of Lutetium (Lu)

Intensity	Wavelength (Å)	Spectrum	Ref.
	Air		
90 P,h	2195.54	Lu II	MCS75
90	2578.79	Lu II	MCS75
100	2613.40	Lu II	MCS75
1000 P	2615.42	Lu II	MCS75
100	2619.26	Lu II	MCS75
150	2657.80	Lu II	MCS75
80 h	2685.08	Lu I	MCS75
250 P	2701.71	Lu II	MCS75
60 h	2728.95	Lu I	MCS75
200 P	2754.17	Lu II	MCS75
100 h	2765.74	Lu I	MCS75
150	2796.63	Lu II	MCS75
150	2847.51	Lu II	MCS75
80 h	2885.14	Lu I	MCS75
400 P	2894.84	Lu II	MCS75
250 P	2900.30	Lu II	MCS75
500 P	2911.39	Lu II	MCS75
250 P	2963.32	Lu II	MCS75
130	2969.82	Lu II	MCS75
250	2989.27	Lu I	MCS75
150 P	3020.54	Lu II	MCS75
120	3056.72	Lu II	MCS75
400 P	3077.60	Lu II	MCS75
700 P,h	3081.47	Lu I	MCS75
400 P	3118.43	Lu I	MCS75
300	3171.36	Lu I	MCS75
250 P	3254.31	Lu II	MCS75
500 P	3278.97	Lu I	MCS75
1000 P	3281.74	Lu I	MCS75
800 P	3312.11	Lu I	MCS75
1000 P	3359.56	Lu I	MCS75
800 P	3376.50	Lu I	MCS75
120	3385.50	Lu I	MCS75
200	3396.82	Lu I	MCS75
250 P	3397.07	Lu II	MCS75
250 P	3472.48	Lu II	MCS75
500 P,c	3507.39	Lu II	MCS75
200	3508.42	Lu I	MCS75
250 P	3554.43	Lu II	MCS75
600 P	3567.84	Lu I	MCS75

Strong Lines of Lutetium (Lu)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
90	3636.25	Lu I	MCS75
300 P	3647.77	Lu I	MCS75
400 P	3841.18	Lu I	MCS75
60	3968.46	Lu I	MCS75
90	4054.45	Lu I	MCS75
400 P	4124.73	Lu I	MCS75
60	4154.08	Lu I	MCS75
90	4184.25	Lu II	MCS75
400 P	4518.57	Lu I	MCS75
130	4658.02	Lu I	MCS75
60	4904.88	Lu I	MCS75
110	5001.14	Lu I	MCS75
400 P	5135.09	Lu I	MCS75
70	5402.57	Lu I	MCS75
120 P	5476.69	Lu II	MCS75
70	5736.55	Lu I	MCS75
200 P	6004.52	Lu I	MCS75
60	6055.03	Lu I	MCS75
120 P	6221.87	Lu II	MCS75
60	6463.12	Lu II	MCS75

Persistent Lines of Neutral Lutetium (Lu I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	3081.47	2.62	$5d(^2D)6s^2$	^2D	5/2	1993.92	MCS75	FHLP00
			$5d6s(^3D)6p$	$^2P^o$	3/2	34436.49		
400	3118.43	2.03	$5d(^2D)6s^2$	^2D	3/2	0.00	MCS75	FHLP00
			$5d6s(^3D)6p$	$^2P^o$	1/2	32058.1		
500	3278.97	1.00	$5d(^2D)6s^2$	^2D	3/2	0.00	MCS75	FHLP00
			$6s^2(^1S)7p$	$^2P^o$	3/2	30488.62		
1000	3281.74	3.05	$5d(^2D)6s^2$	^2D	5/2	1993.92	MCS75	FHLP00
			$5d6s(^1D)6p$	$^2D^o$	5/2	32456.87		
800	3312.11	1.85	$5d(^2D)6s^2$	^2D	3/2	0.00	MCS75	FHLP00
			$5d6s(^3D)6p$	$^2F^o$	5/2	30183.55		
1000	3359.56	2.44	$5d(^2D)6s^2$	^2D	5/2	1993.92	MCS75	FHLP00
			$5d6s(^3D)6p$	$^2F^o$	7/2	31751.17		
800	3376.50	1.68	$5d(^2D)6s^2$	^2D	3/2	0.00	MCS75	FHLP00
			$5d6s(^1D)6p$	$^2D^o$	3/2	29607.98		
600	3567.84	0.69	$5d(^2D)6s^2$	^2D	3/2	0.00	MCS75	FHLP00
			$5d6s(^1D)6p$	$^2F^o$	5/2	28020.18		
300	3647.77	0.92	$6s^2(^1S)6p$	$^2P^o$	1/2	4136.00	MCS75	FHLP00
			$6s^2(^1S)6d$	^2D	3/2	31542.24		
400	3841.18	0.265	$5d(^2D)6s^2$	^2D	5/2	1993.92	MCS75	FHLP00
			$5d6s(^1D)6p$	$^2F^o$	5/2	28020.18		
400	4124.73	0.89	$6s^2(^1S)6p$	$^2P^o$	3/2	7476.35	MCS75	FHLP00
			$6s^2(^1S)6d$	^2D	5/2	31713.60		
400	4518.57	0.226	$5d(^2D)6s^2$	^2D	3/2	0.00	MCS75	FHLP00
			$5d6s(^3D)6p$	$^2D^o$	3/2	22124.70		

Persistent Lines of Neutral Lutetium (Lu I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	5135.09	0.091	$5d(^2D)6s^2$	^2D	5/2	1993.92	MCS75	FHLP00
			$5d6s(^3D)6p$	$^2D^o$	5/2	21462.35		
200	6004.52	0.49	$6s^2(^1S)6p$	$^2P^o$	3/2	7476.35	MCS75	FHLP00
			$6s^2(^1S)7s$	^2S	1/2	24125.86		

Energy Levels of Neutral Lutetium (Lu I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d(^2D)6s^2$	^2D	3/2	0.00	MZH78
		5/2	1993.92	MZH78
$6s^2(^1S)6p$	$^2P^o$	1/2	4136.00	MZH78
		3/2	7476.35	MZH78
$5d6s(^3D)6p$	$^4F^o$	3/2	17427.28	MZH78
		5/2	18504.56	MZH78
		7/2	20432.53	MZH78
		9/2	22609.46	MZH78
$5d^2(^3F)6s$	^4F	3/2	18851.31	MZH78
		5/2	19403.31	MZH78
		7/2	20247.29	VW78
		9/2	21242.26	VW78
$5d6s(^3D)6p$	$^4D^o$	1/2	20762.42	MZH78
		3/2	21195.37	MZH78
		5/2	22221.64	MZH78
		7/2	23524.24	MZH78
$5d6s(^3D)6p$	$^2D^o$	5/2	21462.35	MZH78
		3/2	22124.70	MZH78
$5d^2(^3P)6s$	^4P	1/2	21472.33	MZH78
		3/2	22467.53	MZH78
		5/2	25860.76	MZH78
$5d6s(^3D)6p$	$^4P^o$	1/2	24108.72	MZH78
		3/2	24308.20	MZH78
		5/2	25191.57	MZH78
$6s^2(^1S)7s$	^2S	1/2	24125.86	MZH78
$5d^2(^1D?)6s$	^2D	3/2	24518.16	MZH78
		5/2	24711.19	MZH78
$5d^2(^1G)6s$	^2G	7/2	26570.40	MZH78
		9/2	26671.32	MZH78
$5d^2(^3F)6s$	^2F	5/2	—	
		7/2	27991.75	MZH78
$5d6s(^1D)6p$	$^2F^o$	5/2	28020.18	MZH78
		7/2	29486.94	MZH78
$5d^2(^3P?)6s$	^2P	1/2	28793.34	MZH78
		3/2	29937.81	MZH78
$6s^2(^1S)7p$	$^2P^o$	1/2	29430.90	MZH78
		3/2	30488.62	MZH78

Energy Levels of Neutral Lutetium (Lu I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5d6s(^1D)6p$	$^2D^o$	3/2	29607.98	MZH78
$5d6s(^3D)6p$	$^2F^o$	5/2	30183.55	MZH78
		7/2	31751.17	MZH78
$5d^2(^1S)6s$	^2S	1/2	30747.18	MZH78
$5d6s(^1D)6p$	$^2P^o$	3/2	31523.14	MZH78
		1/2	33443.20	MZH78
$6s^2(^1S)6d$	^2D	3/2	31542.24	MZH78
		5/2	31713.60	MZH78
$5d6s(^3D)6p$	$^2P^o$	1/2	32058.1	MZH78
		3/2	34436.49	MZH78
$5d6s(^1D)6p$	$^2D^o$	5/2	32456.87	MZH78
Lu II ($^1S_0$)		*Limit*	**43762.50**	CT72,MMMS89

Persistent Lines of Singly-ionized Lutetium (Lu II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
90	2195.54	0.714	$6s^2$	^1S	0	0.00	MCS75	M00
			$5d6p$	$^3D^o$	1	45532.33		
1000	2615.42	4.53	$6s^2$	^1S	0	0.00	MCS75	M00
			$6s6p$	$^1P^o$	1	38223.49		
250	2701.71		$5d6s$	^3D	3	14199.08	MCS75	
			$5d6p$	$^3P^o$	2	51201.66		
200	2754.17	0.92	$5d6s$	^3D	2	12435.32	MCS75	QPBM99
			$5d6p$	$^3D^o$	3	48733.19		
400	2894.84	1.66	$5d6s$	^3D	3	14199.08	MCS75	QPBM99
			$5d6p$	$^3D^o$	3	48733.19		
250	2900.30		$5d6s$	^3D	2	12435.32	MCS75	
			$5d6p$	$^3D^o$	2	46904.38		
500	2911.39	2.42	$5d6s$	^3D	3	14199.08	MCS75	QPBM99
			$5d6p$	$^3F^o$	4	48536.83		
250	2963.32		$5d6s$	^3D	1	11796.24	MCS75	
			$5d6p$	$^3D^o$	1	45532.33		
150	3020.54		$5d6s$	^3D	2	12435.32	MCS75	
			$5d6p$	$^3D^o$	1	45532.33		
400	3077.60	1.24	$5d6s$	^3D	2	12435.32	MCS75	QPBM99
			$5d6p$	$^3F^o$	3	44918.68		
250	3254.31	0.60	$5d6s$	^3D	3	14199.08	MCS75	QPBM99
			$5d6p$	$^3F^o$	3	44918.68		
250	3397.07		$5d6s$	^3D	1	11796.24	MCS75	
			$5d6p$	$^3F^o$	2	41224.96		
250	3472.48		$5d6s$	^3D	2	12435.32	MCS75	
			$5d6p$	$^3F^o$	2	41224.96		

Persistent Lines of Singly-ionized Lutetium (Lu II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3507.39	0.125	$6s^2$	^1S	0	0.00	MCS75	M00
			$6s6p$	$^3P^o$	1	28503.16		
250	3554.43		$5d6s$	^1D	2	17332.58	MCS75	
			$5d6p$	$^1D^o$	2	45458.56		
120	5476.69		$5d6s$	^3D	3	14199.08	MCS75	
			$6s6p$	$^3P^o$	2	32453.26		
120	6221.87	0.099	$5d6s$	^3D	2	12435.32	MCS75	QPBM99
			$6s6p$	$^3P^o$	1	28503.16		

Energy Levels of Singly-ionized Lutetium (Lu II)

Configuration	Term	J	Level (cm^{-1})	Ref
$6s^2$	^1S	0	0.00	MZH78
$5d6s$	^3D	1	11796.24	MZH78
		2	12435.32	MZH78
		3	14199.08	MZH78
$5d6s$	^1D	2	17332.58	MZH78
$6s6p$	$^3P^o$	0	27264.40	MZH78
		1	28503.16	MZH78
		2	32453.26	MZH78
$5d^2$	^3F	2	29406.70	MZH78
		3	30889.09	MZH78
		4	32503.62	MZH78
$5d^2$	^3P	0	35652.1	MZH78
		1	36557.05	MZH78
		2	38574.94	MZH78
$5d^2$		2	36098.18	MZH78
$6s6p$	$^1P^o$	1	38223.49	MZH78
$5d6p$	$^3F^o$	2	41224.96	MZH78
		3	44918.68	MZH78
		4	48536.83	MZH78
$5d6p$	$^1D^o$	2	45458.56	MZH78
$5d6p$	$^3D^o$	1	45532.33	MZH78
		2	46904.38	MZH78
		3	48733.19	MZH78
$5d6p$	$^3P^o$	0	49963.58	MZH78
		1	50049.20	MZH78
		2	51201.66	MZH78
$5d6p$	$^1F^o$	3	53079.33	MZH78
$5d6p$	$^1P^o$	1	59122.4	MZH78
$6s7s$	^3S	1	63774.3	MZH78
$6s7s$	^1S	0	68988.80	MZH78
Lu III ($^2S_{1/2}$)		*Limit*	**112000**	MZH78

Magnesium (Mg)

Atomic number = 12

Atomic weight = 24.3050

Isotope	Mass	Abundance	Spin	Mag moment
^{24}Mg	23.985042	78.99%	0	
^{25}Mg	24.985837	10.00%	5/2	−0.85545
^{26}Mg	25.982593	11.01%	0	

Mg I Ground state: $1s^2 2s^2 2p^6 3s^2\ ^1S_0$
Ionization energy: 61 671.05 cm^{-1} (7.646 235 eV)

Mg II Ground state: $1s^2 2s^2 2p^6 3s\ ^2S_{1/2}$
Ionization energy: 121 267.64 cm^{-1} (15.035 27 eV)

Strong Lines of Magnesium (Mg)

Intensity		Wavelength (Å)	Spectrum	Ref
		Vacuum		
14	P	1025.9681	Mg II	KM91a
12	P	1026.1134	Mg II	KM91a
25	P	1239.9253	Mg II	KM91a
20	P	1240.3946	Mg II	KM91a
15		1367.257	Mg II	KM91a
15		1367.708	Mg II	KM91a
20		1369.423	Mg II	KM91a
20		1476.000	Mg II	KM91a
25		1478.004	Mg II	KM91a
20		1480.880	Mg II	KM91a
30		1482.890	Mg II	KM91a
2		1683.412	Mg I	KM91a
2		1707.061	Mg I	KM91a
40		1734.852	Mg II	KM91a
50		1737.628	Mg II	KM91a
3		1747.794	Mg I	KM91a
40		1750.663	Mg II	KM91a
50		1753.474	Mg II	KM91a
5		1827.934	Mg I	KM91a
		Air		
2	P	2025.824	Mg I	KM91a
2		2736.542	Mg I	KM91a
6		2776.690	Mg I	KM91a
5		2778.270	Mg I	KM91a
15*	P	2779.820	Mg I	KM91a
15*	P	2779.834	Mg I	KM91a
5		2781.416	Mg I	KM91a
6		2782.972	Mg I	KM91a
13	P	2790.776	Mg II	KM91a
1000	P	2795.5301	Mg II	PTW98
15		2797.998	Mg II	KM91a
600	P	2802.7056	Mg II	PTW98
2		2846.716	Mg I	KM91a
2		2848.342	Mg I	KM91a
3		2851.660	Mg I	KM91a
1000	P	2852.1251	Mg I	PTW98
2		2938.473	Mg I	KM91a
3		3091.065	Mg I	KM91a
4		3092.984	Mg I	KM91a

Strong Lines of Magnesium (Mg)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
2	3096.890	Mg I	KM91a
3	3329.919	Mg I	KM91a
25 P	3829.355	Mg I	KM91a
50 P	3832.300	Mg I	KM91a
80 P	3838.292	Mg I	KM91a
2	4167.271	Mg I	KM91a
3	4351.906	Mg I	KM91a
10	4390.572	Mg II	KM91a
14 P	4481.126	Mg II	KM91a
13 P	4481.325	Mg II	KM91a
5	4571.096	Mg I	KM91a
12 P	5167.322	Mg I	KM91a
40 P	5172.684	Mg I	KM91a
70 P	5183.604	Mg I	KM91a
5	5711.088	Mg I	KM91a
10	6346.742	Mg II	KM91a
11 d	6545.973	Mg II	KM91a
2	7387.685	Mg I	KM91a
3	7657.603	Mg I	KM91a
3	7659.152	Mg I	KM91a
3	7659.902	Mg I	KM91a
2	7691.550	Mg I	KM91a
12	7877.054	Mg II	KM91a
13	7896.366	Mg II	KM91a
3	8213.034	Mg I	KM91a
10	8213.987	Mg II	KM91a
11	8234.636	Mg II	KM91a
2	8346.120	Mg I	KM91a
2	8712.689	Mg I	KM91a
2	8717.825	Mg I	KM91a
10	8734.980	Mg II	KM91a
3	8736.021	Mg I	KM91a
11	8745.663	Mg II	KM91a
2	8806.757	Mg I	KM91a
10	8824.318	Mg II	KM91a
11	8835.080	Mg II	KM91a
3	8923.569	Mg I	KM91a
14	9218.250	Mg II	KM91a
13	9244.265	Mg II	KM91a
2	9246.499	Mg I	KM91a
5	9255.778	Mg I	KM91a
10 d	9327.545	Mg II	KM91a
10	9340.542	Mg II	KM91a
4	9414.964	Mg I	KM91a
3	9429.814	Mg I	KM91a
3	9432.764	Mg I	KM91a
3	9438.783	Mg I	KM91a
12	9631.892	Mg II	KM91a
11	9632.431	Mg II	KM91a
2	9983.20	Mg I	KM91a
3	9986.48	Mg I	KM91a
3	9993.21	Mg I	KM91a
14	10092.16	Mg II	KM91a
6	10811.08	Mg I	KM91a
11	10914.23	Mg II	KM91a
10	10951.78	Mg II	KM91a
4	10953.32	Mg I	KM91a
4	10957.30	Mg I	KM91a
5	10965.45	Mg I	KM91a

Strong Lines of Magnesium (Mg)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
2	11032.10	Mg I	KM91a
2	11033.66	Mg I	KM91a
8 P	11828.17	Mg I	KM91a
5	12083.65	Mg I	KM91a
5	14877.53	Mg I	KM91a
6 P	15025.00	Mg I	KM91a
5	15040.25	Mg I	KM91a
4	15047.71	Mg I	KM91a
5	17108.63	Mg I	KM91a

Persistent Lines of Neutral Magnesium (Mg I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
2	2025.824	0.612	$3s^2$	^1S	0	0.000	KM91a	M03
			$3s4p$	$^1P^o$	1	49346.729		
15*	2779.820	1.31	$3s3p$	$^3P^o$	1	21870.464	KM91a	WSM69
			$3p^2$	^3P	1	57833.40		
15*	2779.834	3.92	$3s3p$	$^3P^o$	2	21911.178	KM91a	WSM69
			$3p^2$	^3P	2	57873.94		
1000	2852.1251	5.00	$3s^2$	^1S	0	0.000	PTW98	FW96
			$3s3p$	$^1P^o$	1	35051.264		
25	3829.355	0.940	$3s3p$	$^3P^o$	0	21850.405	KM91a	WSM69
			$3s3d$	^3D	1	47957.058		
50	3832.300	1.27	$3s3p$	$^3P^o$	1	21870.464	KM91a	WSM69
			$3s3d$	^3D	2	47957.027		
		0.703	$3s3p$	$^3P^o$	1	21870.464		WSM69
			$3s3d$	^3D	1	47957.058		
80	3838.292	1.68	$3s3p$	$^3P^o$	2	21911.178	KM91a	WSM69
			$3s3d$	^3D	3	47957.045		
12	5167.322	0.116	$3s3p$	$^3P^o$	0	21850.405	KM91a	FW96
			$3s4s$	^3S	1	41197.403		
40	5172.684	0.346	$3s3p$	$^3P^o$	1	21870.464	KM91a	FW96
			$3s4s$	^3S	1	41197.403		
70	5183.604	0.575	$3s3p$	$^3P^o$	2	21911.178	KM91a	FW96
			$3s4s$	^3S	1	41197.403		
8	11828.17	0.26	$3s3p$	$^1P^o$	1	35051.264	KM91a	WSM69
			$3s4s$	^1S	0	43503.333		
6	15025.00	0.139	$3s4s$	^3S	1	41197.403	KM91a	WSM69
			$3s4p$	$^3P^o$	2	47851.162		

Energy Levels of Neutral Magnesium (Mg I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^2$	^1S	0	0.000	MZ80
$3s3p$	$^3P^o$	0	21850.405	MZ80
		1	21870.464	MZ80
		2	21911.178	MZ80
$3s3p$	$^1P^o$	1	35051.264	MZ80
$3s4s$	^3S	1	41197.403	MZ80
$3s4s$	^1S	0	43503.333	MZ80
$3s3d$	^1D	2	46403.065	MZ80
$3s4p$	$^3P^o$	0	47841.119	MZ80
		1	47844.414	MZ80
		2	47851.162	MZ80
$3s3d$	^3D	2	47957.027	MZ80
		3	47957.045	MZ80
		1	47957.058	MZ80
$3s4p$	$^1P^o$	1	49346.729	MZ80
$3s5s$	^3S	1	51872.526	MZ80
$3s5s$	^1S	0	52556.206	MZ80
$3s4d$	^1D	2	53134.642	MZ80
$3s4d$	^3D	3	54192.256	MZ80
		2	54192.294	MZ80
		1	54192.335	MZ80
$3s5p$	$^3P^o$	0	54248.809	MZ80
		1	54250.086	MZ80
		2	54252.726	MZ80
$3s4f$	$^1F^o$	3	54676.438	MZ80
$3s4f$	$^3F^o$	2	54676.654	MZ80
		3	54676.701	MZ80
		4	54676.755	MZ80
$3s5p$	$^1P^o$	1	54706.536	MZ80
$3s6s$	^3S	1	55891.80	MZ80
$3s6s$	^1S	0	56186.873	MZ80
$3s5d$	^1D	2	56308.381	MZ80
$3s5d$	^3D	3	56968.218	MZ80
		2	56968.248	MZ80
		1	56968.271	MZ80
$3s6p$	$^3P^o$	0	57017.078	MZ80
		1	57017.724	MZ80
		2	57019.025	MZ80
$3s5f$	$^1F^o$	3	57204.163	MZ80

Energy Levels of Neutral Magnesium (Mg I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3s5f$	$^3F^o$	2	57204.228	MZ80
		3	57204.267	MZ80
		4	57204.305	MZ80
$3s6p$	$^1P^o$	1	57214.992	MZ80
$3s5g$	G	3,4	57262.760	MZ80
$3p^2$	^3P	0	57812.77	MZ80
		1	57833.40	MZ80
		2	57873.94	MZ80
Mg II ($^2S_{1/2}$)		*Limit*	**61671.05**	KM91a

Persistent Lines of Singly-ionized Magnesium (Mg II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
14	1025.9681	0.032	$3s$	^2S	1/2	0.00	KM91a	M03
			$5p$	$^2P^o$	3/2	97468.92		
12	1026.1134	0.032	$3s$	^2S	1/2	0.00	KM91a	M03
			$5p$	$^2P^o$	1/2	97455.12		
25	1239.9253	0.014	$3s$	^2S	1/2	0.00	KM91a	M03
			$4p$	$^2P^o$	3/2	80650.02		
20	1240.3946	0.015	$3s$	^2S	1/2	0.00	KM91a	M03
			$4p$	$^2P^o$	1/2	80619.50		
13	2790.7767	4.0	$3p$	$^2P^o$	1/2	35669.31	KM91a	FW96
			$3d$	^2D	3/2	71491.06		
1000	2795.5301	2.6	$3s$	^2S	1/2	0.00	PTW98	FW96
			$3p$	$^2P^o$	3/2	35760.88		
15	2797.998	4.8	$3p$	$^2P^o$	3/2	35760.88	KM91a	FW96
			$3d$	^2D	5/2	71490.19		
600	2802.7056	2.6	$3s$	^2S	1/2	0.00	PTW98	FW96
			$3p$	$^2P^o$	1/2	35669.31		
14	4481.126	2.23	$3d$	^2D	5/2	71490.19	KM91a	FW96
			$4f$	$^2F^o$	7/2	93799.75		
13	4481.325	2.08	$3d$	^2D	3/2	71491.06	KM91a	FW96
			$4f$	$^2F^o$	5/2	93799.63		

Energy Levels of Singly-ionized Magnesium (Mg II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s$	^2S	1/2	0.00	MZ80
$3p$	$^2P^o$	1/2	35669.31	MZ80
		3/2	35760.88	MZ80
$4s$	^2S	1/2	69804.95	MZ80
$3d$	^2D	5/2	71490.19	MZ80
		3/2	71491.06	MZ80

Energy Levels of Singly-ionized Magnesium (Mg II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4p$	$^2P^o$	1/2	80619.50	MZ80
		3/2	80650.02	MZ80
$5s$	^2S	1/2	92790.51	MZ80
$4d$	^2D	5/2	93310.59	MZ80
		3/2	93311.11	MZ80
$4f$	$^2F^o$	5/2	93799.63	MZ80
		7/2	93799.75	MZ80
$5p$	$^2P^o$	1/2	97455.12	MZ80
		3/2	97468.92	MZ80
$6s$	^2S	1/2	103196.75	MZ80
Mg III ($^1S_0$)		*Limit*	**121267.64**	KM91a

Manganese (Mn)
Atomic number = 25
Atomic weight = 54.938 05

Isotope	Mass	Abundance	Spin	Mag moment
^{55}Mn	54.938047	100%	5/2	+ 3.4687

Mn I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2\ ^6S_{5/2}$
Ionization energy: 59 959.4 cm^{-1} (7.434 02 eV)

Mn II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s\ ^7S_3$
Ionization energy: 126 145.0 cm^{-1} (15.6400 eV)

Strong Lines of Manganese (Mn)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
8	1915.10	Mn II	IV64
7	1921.250	Mn II	IV64
400 P	1996.056	Mn I	CMG64
500 P	1999.511	Mn I	CMG64
	Air		
700 P	2003.849	Mn I	CMG64
60	2092.159	Mn I	CMG64
60	2109.585	Mn I	CMG64
11	2208.806	Mn I	CMG64
20	2213.855	Mn I	CMG64
30	2221.837	Mn I	CMG64
7	2534.221	Mn II	IV64
8	2535.658	Mn II	IV64
8	2537.919	Mn II	IV64
8	2548.750	Mn II	IV64
8	2558.605	Mn II	IV64
12	2563.642	Mn II	IV64
20	2572.755	Mn I	CMG64
20	2575.509	Mn I	CMG64
1000 P	2576.103	Mn II	KG00
20	2584.302	Mn I	CMG64
9	2592.944	Mn I	CMG64
500 P	2593.720	Mn II	KG00
9	2595.763	Mn I	CMG64
8	2598.905	Mn II	IV64
400 P	2605.680	Mn II	KG00
15	2610.200	Mn II	IV64
40	2618.145	Mn II	IV64
15	2625.606	Mn II	IV64
15	2632.354	Mn II	IV64
11	2638.173	Mn II	IV64
7	2639.849	Mn II	IV64
9	2672.581	Mn II	IV64
9	2688.247	Mn II	IV64
7	2701.024	Mn II	IV64
13	2701.698	Mn II	IV64
8	2703.98	Mn II	IV64
11	2705.732	Mn II	IV64
7	2707.544	Mn II	IV64
9	2708.452	Mn II	IV64
7	2710.336	Mn II	IV64

Strong Lines of Manganese (Mn)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
9	2711.568	Mn II	IV64
250 P	2794.817	Mn I	CMG64
200 P	2798.270	Mn I	CMG64
140 P	2801.084	Mn I	CMG64
7	2879.482	Mn II	IV64
13	2889.600	Mn II	IV64
7	2900.154	Mn II	IV64
90 P	2933.054	Mn II	KG00
120 P	2939.308	Mn II	KG00
9 h	2940.331	Mn I	CMG64
150 P	2949.205	Mn II	KG00
12	3044.566	Mn I	CMG64
9	3054.362	Mn I	CMG64
40	3228.092	Mn I	CMG64
11	3230.716	Mn I	CMG64
30	3236.778	Mn I	CMG64
12	3243.777	Mn I	CMG64
25	3248.512	Mn I	CMG64
11	3252.949	Mn I	CMG64
11	3256.137	Mn I	CMG64
15	3330.775	Mn II	IV64
8	3336.394	Mn II	IV64
60 P	3441.985	Mn II	KG00
30	3460.314	Mn II	KG00
30 h	3474.038	Mn II	KG00
25	3482.904	Mn II	KG00
15	3488.675	Mn II	KG00
12	3495.833	Mn II	KG00
8	3497.525	Mn II	KG00
13	3531.836	Mn I	CMG64
40	3532.110	Mn I	CMG64
50	3547.794	Mn I	CMG64
40	3548.022	Mn I	CMG64
14	3548.182	Mn I	CMG64
80	3569.494	Mn I	CMG64
25	3569.804	Mn I	CMG64
50	3577.870	Mn I	CMG64
25	3586.540	Mn I	CMG64
11	3595.110	Mn I	CMG64
15	3607.530	Mn I	CMG64
15	3608.485	Mn I	CMG64
13	3610.298	Mn I	CMG64
11	3619.272	Mn I	CMG64
10	3693.671	Mn I	CMG64
10	3790.214	Mn I	CMG64
120 P	3806.715	Mn I	CMG64
25	3809.593	Mn I	CMG64
80	3823.508	Mn I	CMG64
14	3823.891	Mn I	CMG64
20	3833.865	Mn I	CMG64
50	3834.368	Mn I	CMG64
13	3839.779	Mn I	CMG64
25	3841.074	Mn I	CMG64
13	3843.988	Mn I	CMG64
60	4018.106	Mn I	CMG64
1000 P	4030.755	Mn I	CMG64
700 P	4033.068	Mn I	CMG64
400 P	4034.485	Mn I	CMG64
60	4035.729	Mn I	CMG64

Strong Lines of Manganese (Mn)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200 P	4041.357	Mn I	CMG64
40	4048.747	Mn I	CMG64
70	4055.548	Mn I	CMG64
40	4058.936	Mn I	CMG64
25	4061.737	Mn I	CMG64
25	4063.530	Mn I	CMG64
11	4070.280	Mn I	CMG64
25	4079.241	Mn I	CMG64
25	4079.415	Mn I	CMG64
40	4082.945	Mn I	CMG64
40	4083.634	Mn I	CMG64
14	4235.154	Mn I	CMG64
20	4235.300	Mn I	CMG64
11	4257.669	Mn I	CMG64
11	4265.928	Mn I	CMG64
10	4281.100	Mn I	CMG64
4	4326.633	Mn II	IV64
13	4414.887	Mn I	CMG64
30	4451.575	Mn I	CMG64
10	4458.263	Mn I	CMG64
20	4462.033	Mn I	CMG64
11	4464.679	Mn I	CMG64
9	4498.897	Mn I	CMG64
9	4502.223	Mn I	CMG64
40	4754.048	Mn I	CMG64
30	4762.376	Mn I	CMG64
11	4765.856	Mn I	CMG64
20	4766.426	Mn I	CMG64
30	4783.432	Mn I	CMG64
40	4823.528	Mn I	CMG64
11	6021.787	Mn I	CMG64

Persistent Lines of Neutral Manganese (Mn I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	1996.056	0.77	$3d^5 4s^2$	a ^{6}S	5/2	0.00	CMG64	M91
			$3d^5(^4P)4s4p(^3P^o)$	v ^{6}P^o	3/2	50099.03		
500	1999.511	0.76	$3d^5 4s^2$	a ^{6}S	5/2	0.00	CMG64	M91
			$3d^5(^4P)4s4p(^3P^o)$	v ^{6}P^o	5/2	50012.50		
700	2003.849	0.76	$3d^5 4s^2$	a ^{6}S	5/2	0.00	CMG64	M91
			$3d^5(^4P)4s4p(^3P^o)$	v ^{6}P^o	7/2	49888.01		
250	2794.817	3.7	$3d^5 4s^2$	a ^{6}S	5/2	0.00	CMG64	FW96
			$3d^5(^6S)4s4p(^1P^o)$	y ^{6}P^o	7/2	35769.97		
200	2798.270	3.6	$3d^5 4s^2$	a ^{6}S	5/2	0.00	CMG64	FW96
			$3d^5(^6S)4s4p(^1P^o)$	y ^{6}P^o	5/2	35725.85		
140	2801.084	3.7	$3d^5 4s^2$	a ^{6}S	5/2	0.00	CMG64	FW96
			$3d^5(^6S)4s4p(^1P^o)$	y ^{6}P^o	3/2	35689.98		
120	3806.715	0.59	$3d^6(^5D)4s$	a ^{6}D	9/2	17052.29	CMG64	FW96
			$3d^6(^5D)4p$	z ^{6}F^o	11/2	43314.23		
1000	4030.755	0.17	$3d^5 4s^2$	a ^{6}S	5/2	0.00	CMG64	FW96
			$3d^5(^6S)4s4p(^3P^o)$	z ^{6}P^o	7/2	24802.25		

Persistent Lines of Neutral Manganese (Mn I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	4033.068	0.165	$3d^54s^2$	a ^{6}S	5/2	0.00	CMG64	FW96
			$3d^5(^6S)4s4p(^3P^o)$	z ^{6}P^o	5/2	24788.05		
400	4034.485	0.158	$3d^54s^2$	a ^{6}S	5/2	0.00	CMG64	FW96
			$3d^5(^6S)4s4p(^3P^o)$	z ^{6}P^o	3/2	24779.32		
200	4041.357	0.787	$3d^6(^5D)4s$	a ^{6}D	9/2	17052.29	CMG64	FW96
			$3d^6(^5D)4p$	z ^{6}D^o	9/2	41789.48		

Energy Levels of Neutral Manganese (Mn I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^54s^2$	a ^{6}S	5/2	0.00	SC85
$3d^6(^5D)4s$	a ^{6}D	9/2	17052.29	SC85
		7/2	17282.00	SC85
		5/2	17451.52	SC85
		3/2	17568.48	SC85
		1/2	17637.15	SC85
$3d^5(^6S)4s4p(^3P^o)$	z ^{8}P^o	5/2	18402.46	SC85
		7/2	18531.64	SC85
		9/2	18705.37	SC85
$3d^6(^5D)4s$	a ^{4}D	7/2	23296.67	SC85
		5/2	23549.20	SC85
		3/2	23719.52	SC85
		1/2	23818.87	SC85
$3d^5(^6S)4s4p(^3P^o)$	z ^{6}P^o	3/2	24779.32	SC85
		5/2	24788.05	SC85
		7/2	24802.25	SC85
$3d^5(^6S)4s4p(^3P^o)$	z ^{4}P^o	5/2	31001.15	SC85
		3/2	31076.42	SC85
		1/2	31124.95	SC85
$3d^5(^6S)4s4p(^1P^o)$	y ^{6}P^o	3/2	35689.98	SC85
		5/2	35725.85	SC85
		7/2	35769.97	SC85
$3d^6(^5D)4p$	z ^{6}D^o	9/2	41789.48	SC85
		7/2	41932.64	SC85
		5/2	42053.73	SC85
		3/2	42143.57	SC85
		1/2	42198.56	SC85
$3d^6(^5D)4p$	z ^{6}F^o	11/2	43314.23	SC85
		9/2	43428.58	SC85
		7/2	43524.08	SC85
		5/2	43595.50	SC85
		3/2	43644.45	SC85
		1/2	43672.66	SC85
$3d^5(^4P)4s4p(^3P^o)$	v ^{6}P^o	7/2	49888.01	SC85
		5/2	50012.50	SC85
		3/2	50099.03	SC85
Mn II ($^7S_3$)		*Limit*	**59959.4**	SC85

Persistent Lines of Singly-ionized Manganese (Mn II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2576.103	2.82	$3d^5(^6S)4s$	a ^7S	3	0.00	KG00	KG00
			$3d^5(^6S)4p$	z $^7P^o$	4	38806.67		
500	2593.720	2.77	$3d^5(^6S)4s$	a ^7S	3	0.00	KG00	KG00
			$3d^5(^6S)4p$	z $^7P^o$	3	38543.08		
400	2605.680	2.72	$3d^5(^6S)4s$	a ^7S	3	0.00	KG00	KG00
			$3d^5(^6S)4p$	z $^7P^o$	2	38366.18		
90	2933.054	1.94	$3d^5(^6S)4s$	a ^5S	2	9472.97	KG00	KG00
			$3d^5(^6S)4p$	z $^5P^o$	1	43557.14		
120	2939.308	1.95	$3d^5(^6S)4s$	a ^5S	2	9472.97	KG00	KG00
			$3d^5(^6S)4p$	z $^5P^o$	2	43484.64		
150	2949.205	1.94	$3d^5(^6S)4s$	a ^5S	2	9472.97	KG00	KG00
			$3d^5(^6S)4p$	z $^5P^o$	3	43370.51		
60	3441.985	0.36	$3d^6$	a ^5D	4	14325.86	KG00	KG00
			$3d^5(^6S)4p$	z $^5P^o$	3	43370.51		

Energy Levels of Singly-ionized Manganese (Mn II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^5(^6S)4s$	a ^7S	3	0.00	SC85
$3d^5(^6S)4s$	a ^5S	2	9472.97	SC85
$3d^6$	a ^5D	4	14325.86	SC85
		3	14593.82	SC85
		2	14781.19	SC85
		1	14901.18	SC85
		0	14959.84	SC85
$3d^5(^4G)4s$	a ^5G	6	27547.25	SC85
		5	27571.25	SC85
		4	27583.57	SC85
		3	27588.50	SC85
		2	27589.28	SC85
$3d^5(^6S)4p$	z $^7P^o$	2	38366.18	SC85
		3	38543.08	SC85
		4	38806.67	SC85
$3d^5(^6S)4p$	z $^5P^o$	3	43370.51	SC85
		2	43484.64	SC85
		1	43557.14	SC85
Mn III ($^6S_{5/2}$)		*Limit*	**126145.0**	SC85

Mercury (Hg)
Atomic number = 80
Atomic weight = 200.59

Isotope	Mass	Abundance	Spin	Mag moment
^{196}Hg	195.965807	0.15%	0	
^{198}Hg	197.966743	10.1%	0	
^{199}Hg	198.968254	17.0%	1/2	+0.5059
^{200}Hg	199.968300	23.1%	0	
^{201}Hg	200.970277	13.2%	3/2	−0.5602
^{202}Hg	201.970617	29.65%	0	
^{204}Hg	203.973467	6.85%	0	

Hg I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2\ {}^1S_0$
Ionization energy: 84 184.1 cm^{-1} (10.4375 eV)

Hg II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s\ {}^2S_{1/2}$
Ionization energy: 151 284.4 cm^{-1} (18.7568 eV)

Strong Lines of Mercury (Hg)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
20	893.0847	Hg II	SR01
12	915.819	Hg II	SR01
20	942.630	Hg II	SR01
25	962.711	Hg II	SR01
25	969.142	Hg II	SR01
20	1039.6315	Hg II	SR01
20	1062.7802	Hg II	SR01
1000 P	1649.9373	Hg II	SR01
1000 P	1849.499	Hg I	WA63
1000 P	1942.273	Hg II	SR01
15	1973.794	Hg II	SR01
10	1987.841	Hg II	SR01
	Air		
20	2026.860	Hg II	SR01
400 P	2052.828	Hg II	SR01
20	2224.711	Hg II	SR01
10	2252.786	Hg II	SR01
60	2260.294	Hg II	SR01
400 P	2262.223	Hg II	SR01
10	2263.634	Hg II	SR01
1000 P,c	2536.517	Hg I	BAL50
25	2652.039	Hg I	BAL50
40	2653.679	Hg I	BAL50
400 P	2847.675	Hg II	SR01
30	2916.250	Hg II	SR01
25	2947.074	Hg II	SR01
250 P	2967.280	Hg I	BAL50
70	3021.498	Hg I	BAL50
90	3125.668	Hg I	BAL50
80	3131.548	Hg I	BAL50
80	3131.839	Hg I	BAL50
12	3208.169	Hg II	SR01
10	3532.594	Hg II	SR01
10	3605.762	Hg II	SR01
600 P	3650.153	Hg I	BAL50

Strong Lines of Mercury (Hg)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
70	3654.836	Hg I	BAL50
50	3663.279	Hg I	BAL50
1000 P,c	3983.931	Hg II	SR01
400 P	4046.563	Hg I	BAL50
60	4339.223	Hg I	BAL50
100	4347.494	Hg I	BAL50
1000 P	4358.328	Hg I	BAL50
12 c	5128.442	Hg II	SR01
15	5204.768	Hg II	SR01
80 P	5425.253	Hg II	SR01
500 P	5460.735	Hg I	BAL50
200 P	5677.105	Hg II	SR01
50	5769.598	Hg I	BAL50
60	5790.663	Hg I	BAL50
12	5871.279	Hg II	SR01
20 c	5888.939	Hg II	SR01
15	6146.435	Hg II	SR01
250 P,c	6149.475	Hg II	SR01
25	7081.90	Hg I	F54
6	7346.508	Hg II	SR01
250 P	7944.555	Hg II	SR01
6 h	9520.198	Hg II	SR01
200 P	10139.76	Hg I	BAL50
50	13570.21	Hg I	H53
40	13673.51	Hg I	H53
50	15295.82	Hg I	H53
50	17072.79	Hg I	H53
25	23253.07	Hg I	PBT55

Persistent Lines of Neutral Mercury (Hg I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1849.499	7.46	$5d^{10}(^1S)6s^2$	^1S	0	0.000	WA63	M00
			$5d^{10}(^1S)6s6p$	$^1P^o$	1	54068.781		
1000	2536.517	0.080	$5d^{10}(^1S)6s^2$	^1S	0	0.000	BAL50	FW96
			$5d^{10}(^1S)6s6p$	$^3P^o$	1	39412.300		
250	2967.280	0.45	$5d^{10}(^1S)6s6p$	$^3P^o$	0	37645.080	BAL50	FW96
			$5d^{10}(^1S)6s6d$	(1/2,3/2)	1	71336.164		
600	3650.153	1.3	$5d^{10}(^1S)6s6p$	$^3P^o$	2	44042.977	BAL50	FW96
			$5d^{10}(^1S)6s6d$	(1/2,5/2)	3	71431.311		
400	4046.563	0.21	$5d^{10}(^1S)6s6p$	$^3P^o$	0	37645.080	BAL50	FW96
			$5d^{10}(^1S)6s7s$	^3S	1	62350.456		
1000	4358.328	0.557	$5d^{10}(^1S)6s6p$	$^3P^o$	1	39412.300	BAL50	FW96
			$5d^{10}(^1S)6s7s$	^3S	1	62350.456		
500	5460.735	0.487	$5d^{10}(^1S)6s6p$	$^3P^o$	2	44042.977	BAL50	FW96
			$5d^{10}(^1S)6s7s$	^3S	1	62350.456		
200	10139.76	0.271	$5d^{10}(^1S)6s6p$	$^1P^o$	1	54068.781	BAL50	FW96
			$5d^{10}(^1S)6s7s$	^1S	0	63928.243		

Energy Levels of Neutral Mercury (Hg I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^{10}(^1S)6s^2$	^1S	0	0.000	BAL50
$5d^{10}(^1S)6s6p$	$^3P^o$	0	37645.080	BAL50
		1	39412.300	BAL50
		2	44042.977	BAL50
$5d^{10}(^1S)6s6p$	$^1P^o$	1	54068.781	BAL50
$5d^{10}(^1S)6s7s$	^3S	1	62350.456	BAL50
$5d^{10}(^1S)6s7s$	^1S	0	63928.243	BAL50
$5d^9 6s^2 6p$	$^3P^o$	2	68886.60	M58
$5d^{10}(^1S)6s7p$	$^3P^o$	0	69516.66	M58
		1	69661.89	M58
		2	71207.51	M58
$5d^{10}(^1S)6s7p$	$^1P^o$	1	71295.15	M58
$5d^{10}(^1S)6s6d$	(1/2,3/2)	2	71333.182	BAL50
		1	71336.164	BAL50
$5d^{10}(^1S)6s6d$	(1/2,5/2)	2	71396.220	BAL50
		3	71431.311	BAL50
Hg II ($^2S_{1/2}$)		*Limit*	**84184.1**	B83

Persistent Lines of Singly-ionized Mercury (Hg II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1649.9373	5.56	$5d^{10}(^1S)6s$	^2S	1/2	0.000	SR01	M00
			$5d^{10}(^1S)6p$	$^2P^o$	3/2	60608.362		
1000	1942.273	3.44	$5d^{10}(^1S)6s$	^2S	1/2	0.000	SR01	M00
			$5d^{10}(^1S)6p$	$^2P^o$	1/2	51486.070		
400	2052.828		$5d^9 6s^2$	^2D	5/2	35514.624	SR01	
			$5d^9(^2D_{5/2})6s6p(^3P^o_1)$	$(5/2,1)^o$	7/2	84212.404		
400	2262.223		$5d^9 6s^2$	^2D	5/2	35514.624	SR01	
			$5d^9(^2D_{5/2})6s6p(^3P^o_0)$	$(5/2,0)^o$	5/2	79705.262		
400	2847.675		$5d^{10}(^1S)6p$	$^2P^o$	3/2	60608.362	SR01	
			$5d^{10}(^1S)7s$	^2S	1/2	95714.406		
1000	3983.931		$5d^9 6s^2$	^2D	5/2	35514.624	SR01	
			$5d^{10}(^1S)6p$	$^2P^o$	3/2	60608.362		
80	5425.253		$5d^{10}(^1S)6d$	^2D	3/2	104984.138	SR01	
			$5d^{10}(^1S)5f$	$^2F^o$	5/2	123411.351		
200	5677.105		$5d^{10}(^1S)6d$	^2D	5/2	105544.042	SR01	
			$5d^{10}(^1S)5f$	$^2F^o$	7/2	123153.775		
250	6149.475		$5d^{10}(^1S)7s$	^2S	1/2	95714.406	SR01	
			$5d^{10}(^1S)7p$	$^2P^o$	3/2	111971.464		
250	7944.555		$5d^{10}(^1S)7s$	^2S	1/2	95714.406	SR01	
			$5d^{10}(^1S)7p$	$^2P^o$	1/2	108298.183		

Energy Levels of Singly-ionized Mercury (Hg II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^{10}(^1S)6s$	^2S	1/2	0.000	SR01
$5d^9 6s^2$	^2D	5/2	35514.624	SR01
		3/2	50555.567	SR01
$5d^{10}(^1S)6p$	$^2P^o$	1/2	51486.070	SR01
		3/2	60608.362	SR01
$5d^9(^2D_{5/2})6s6p(^3P^o_0)$	$(5/2,0)^o$	5/2	79705.262	SR01
$5d^9(^2D_{5/2})6s6p(^3P^o_1)$	$(5/2,1)^o$	7/2	84212.404	SR01
		5/2	84836.143	SR01
		3/2	86178.478	SR01
$5d^9(^2D_{5/2})6s6p(^3P^o_2)$	$(5/2,2)^o$	9/2	91139.508	SR01
		3/2	94092.834	SR01
		7/2	95187.361	SR01
		5/2	95304.138	SR01
		1/2	96187.932	SR01
$5d^{10}(^1S)7s$	^2S	1/2	95714.406	SR01
$5d^{10}(^1S)6d$	^2D	3/2	104984.138	SR01
		5/2	105544.042	SR01
$5d^{10}(^1S)7p$	$^2P^o$	1/2	108298.183	SR01
		3/2	111971.464	SR01
$5d^{10}(^1S)5f$	$^2F^o$	7/2	123153.775	SR01
		5/2	123411.351	SR01
Hg III ($^1S_0$)		*Limit*	**151284.4**	SR01

Molybdenum (Mo)
Atomic number = 42
Atomic weight = 95.94

Isotope	Mass	Abundance	Spin	Mag moment
^{92}Mo	91.906808	14.84%	0	
^{94}Mo	93.905085	9.25%	0	
^{95}Mo	94.905840	15.92%	5/2	−0.9133
^{96}Mo	95.904678	16.68%	0	
^{97}Mo	96.906020	9.55%	5/2	−0.9133
^{100}Mo	98.907477	9.63%	0	

Mo I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^5 5s\ ^7S_3$
Ionization energy: 57 204.3 cm^{-1} (7.092 43 eV)

Mo II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^5\ ^6S_{5/2}$
Ionization energy: 130 300 cm^{-1} (16.16 eV)

Strong Lines of Molybdenum (Mo)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
500 P	2015.109	Mo II	SPNL01
1000 P	2020.314	Mo II	SPNL01
500 P	2038.452	Mo II	SPNL01
400 P	2045.973	Mo II	SPNL01
120 P	2081.681	Mo II	SPNL01
60 P	2089.52	Mo II	MCS75
60 P	2092.50	Mo II	MCS75
100 P	2093.11	Mo II	MCS75
70 P	2100.84	Mo II	MCS75
40	2104.29	Mo II	MCS75
40	2108.02	Mo II	MCS75
20	2269.69	Mo II	MCS75
30	2538.46	Mo II	MCS75
25	2542.67	Mo II	MCS75
11	2548.225	Mo I	WB88
11	2572.345	Mo I	WB88
20	2593.710	Mo II	SPNL01
20	2602.800	Mo II	SPNL01
10	2613.084	Mo I	WB88
14	2616.786	Mo I	WB88
15	2629.850	Mo I	WB88
25	2636.670	Mo II	SPNL01
50	2638.761	Mo II	SPNL01
14	2640.984	Mo I	WB88
40	2644.348	Mo II	SPNL01
30	2646.486	Mo II	SPNL01
20	2649.458	Mo I	WB88
40	2653.347	Mo II	SPNL01
20	2655.021	Mo I	WB88
10	2658.111	Mo I	WB88
50	2660.576	Mo II	SPNL01
50	2672.843	Mo II	SPNL01
20	2673.27	Mo II	MCS75
30	2679.854	Mo I	WB88
50	2683.234	Mo II	SPNL01
70	2684.140	Mo II	SPNL01

Strong Lines of Molybdenum (Mo)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	2687.992	Mo II	SPNL01
40	2701.416	Mo II	SPNL01
20	2717.35	Mo II	MCS75
25	2732.880	Mo II	SPNL01
20	2746.30	Mo II	MCS75
11	2751.468	Mo I	WB88
15	2763.62	Mo II	MCS75
20	2769.76	Mo II	MCS75
130 P	2775.402	Mo II	SPNL01
70	2780.037	Mo II	SPNL01
30	2784.99	Mo II	MCS75
30	2807.753	Mo II	SPNL01
130 P	2816.158	Mo II	SPNL01
15	2817.44	Mo II	MCS75
130 P	2848.233	Mo II	SPNL01
30	2853.23	Mo II	MCS75
30	2863.81	Mo II	MCS75
15	2866.69	Mo II	MCS75
130 P	2871.512	Mo II	SPNL01
15	2879.05	Mo II	MCS75
100	2890.994	Mo II	SPNL01
70	2894.451	Mo II	SPNL01
20	2903.07	Mo II	MCS75
40	2909.117	Mo II	SPNL01
80	2911.917	Mo II	SPNL01
100	2923.392	Mo II	SPNL01
80	2930.502	Mo II	SPNL01
60	2934.298	Mo II	SPNL01
20	2956.057	Mo II	SPNL01
20	2963.797	Mo II	SPNL01
20	2972.611	Mo II	SPNL01
10	3041.699	Mo I	WB88
30	3064.274	Mo I	WB88
20	3065.04	Mo II	MCS75
30	3074.369	Mo I	WB88
30	3085.616	Mo I	WB88
20	3087.62	Mo II	MCS75
20	3094.663	Mo I	WB88
20	3101.344	Mo I	WB88
50	3112.119	Mo I	WB88
20	3122.00	Mo II	MCS75
500 P	3132.594	Mo I	WB88
15	3152.82	Mo II	MCS75
200 P	3158.167	Mo I	WB88
300 P	3170.344	Mo I	WB88
13	3183.033	Mo I	WB88
13	3185.104	Mo I	WB88
250 P	3193.979	Mo I	WB88
10	3195.960	Mo I	WB88
11	3205.217	Mo I	WB88
30	3205.887	Mo I	WB88
100 P	3208.838	Mo I	WB88
20	3215.072	Mo I	WB88
12	3221.734	Mo I	WB88
30	3228.212	Mo I	WB88
20	3229.795	Mo I	WB88
40	3233.142	Mo I	WB88
30	3237.060	Mo I	WB88
30	3256.208	Mo I	WB88

Strong Lines of Molybdenum (Mo)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
10	3262.626	Mo I	WB88
15	3264.401	Mo I	WB88
30	3270.899	Mo I	WB88
11	3285.355	Mo I	WB88
40	3289.011	Mo I	WB88
30	3290.820	Mo I	WB88
11	3305.563	Mo I	WB88
11	3307.125	Mo I	WB88
20	3323.949	Mo I	WB88
12	3325.674	Mo I	WB88
12	3327.304	Mo I	WB88
40	3344.730	Mo I	WB88
11	3347.004	Mo I	WB88
60	3358.118	Mo I	WB88
30	3363.778	Mo I	WB88
30	3379.965	Mo I	WB88
11	3382.482	Mo I	WB88
70	3384.609	Mo I	WB88
20	3404.335	Mo I	WB88
40	3405.94	Mo I	MCS75
13	3434.788	Mo I	WB88
11	3435.448	Mo I	WB88
20	3437.213	Mo I	WB88
110 P	3447.124	Mo I	WB88
20	3449.074	Mo I	WB88
10	3451.75	Mo I	MCS75
30	3456.386	Mo I	WB88
20	3460.778	Mo I	WB88
11	3466.824	Mo I	WB88
11	3469.219	Mo I	WB88
30	3504.411	Mo I	WB88
20	3508.114	Mo I	WB88
15	3521.413	Mo I	WB88
20	3537.28	Mo I	MCS75
11	3542.166	Mo I	WB88
20	3558.095	Mo I	WB88
14	3563.136	Mo I	WB88
10	3566.052	Mo I	WB88
11	3573.878	Mo I	WB88
50	3581.885	Mo I	WB88
9	3602.938	Mo I	WB88
50	3624.462	Mo I	WB88
11	3626.180	Mo I	WB88
30	3635.43	Mo I	MCS75
14	3657.357	Mo I	WB88
20	3664.811	Mo I	WB88
20	3672.807	Mo I	WB88
40	3680.590	Mo I	WB88
50	3694.939	Mo I	WB88
15	3727.679	Mo I	WB88
11	3732.709	Mo I	WB88
12	3770.445	Mo I	WB88
12	3781.592	Mo I	WB88
1000 P	3798.252	Mo I	WB88
10	3801.840	Mo I	WB88
20	3826.694	Mo I	WB88
30	3828.876	Mo I	WB88
60	3833.747	Mo I	WB88
13	3847.246	Mo I	WB88

Strong Lines of Molybdenum (Mo)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1000 P	3864.104	Mo I	WB88
20	3869.082	Mo I	WB88
20	3886.822	Mo I	WB88
13	3901.770	Mo I	WB88
700 P	3902.953	Mo I	WB88
9	4056.012	Mo I	WB88
50	4062.077	Mo I	WB88
80 P	4069.882	Mo I	WB88
40	4081.44	Mo I	MCS75
30	4084.373	Mo I	WB88
25	4107.462	Mo I	WB88
20	4120.093	Mo I	WB88
100	4143.55	Mo I	MCS75
15	4185.819	Mo I	WB88
90 P	4188.324	Mo I	WB88
50	4232.589	Mo I	WB88
9	4269.279	Mo I	WB88
30	4276.906	Mo I	WB88
40	4277.239	Mo I	WB88
50	4288.631	Mo I	WB88
25	4292.134	Mo I	WB88
30	4293.215	Mo I	WB88
12	4293.880	Mo I	WB88
30	4326.137	Mo I	WB88
70	4381.630	Mo I	WB88
90 P	4411.695	Mo I	WB88
30	4434.949	Mo I	WB88
12	4449.738	Mo I	WB88
15	4457.354	Mo I	WB88
20	4474.570	Mo I	WB88
14	4536.796	Mo I	WB88
12	4609.874	Mo I	WB88
15	4626.464	Mo I	WB88
20	4707.248	Mo I	WB88
25	4731.441	Mo I	WB88
25	4760.183	Mo I	WB88
14	4819.249	Mo I	WB88
14	4830.513	Mo I	WB88
12	4868.018	Mo I	WB88
15	5238.206	Mo I	WB88
20	5360.513	Mo I	WB88
250 P	5506.494	Mo I	WB88
200 P	5533.031	Mo I	WB88
90 P	5570.444	Mo I	WB88
11	5632.463	Mo I	WB88
15	5689.146	Mo I	WB88
20	5751.409	Mo I	WB88
20	5791.839	Mo I	WB88
20	5858.267	Mo I	WB88
30	5888.310	Mo I	WB88
40	6030.645	Mo I	WB88

Persistent Lines of Neutral Molybdenum (Mo I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3132.594	1.79	$4d^5(^6S)5s$	a ^7S	3	0.000	WB88	FW96
			$4d^45s(^6D)5p$	y $^7P^o$	4	31913.171		
200	3158.167	0.463	$4d^5(^6S)5s$	a ^7S	3	0.000	WB88	FW96
			$4d^45s(^6D)5p$	z $^7D^o$	3	31654.786		
300	3170.344	1.37	$4d^5(^6S)5s$	a ^7S	3	0.000	WB88	FW96
			$4d^45s(^6D)5p$	y $^7P^o$	3	31533.206		
250	3193.979	1.53	$4d^5(^6S)5s$	a ^7S	3	0.000	WB88	FW96
			$4d^45s(^6D)5p$	y $^7P^o$	2	31299.876		
100	3208.838	0.277	$4d^5(^6S)5s$	a ^7S	3	0.000	WB88	FW96
			$4d^45s(^6D)5p$	z $^7D^o$	2	31154.935		
110	3447.124	0.875	$4d^45s^2$	a ^5D	4	12346.280	WB88	FW96
			$4d^5(^4G)5p$	y $^5F^o$	5	41347.664		
1000	3798.252	0.690	$4d^5(^6S)5s$	a ^7S	3	0.000	WB88	FW96
			$4d^5(^6S)5p$	z $^7P^o$	4	26320.420		
1000	3864.104	0.624	$4d^5(^6S)5s$	a ^7S	3	0.000	WB88	FW96
			$4d^5(^6S)5p$	z $^7P^o$	3	25871.887		
700	3902.953	0.617	$4d^5(^6S)5s$	a ^7S	3	0.000	WB88	FW96
			$4d^5(^6S)5p$	z $^7P^o$	2	25614.367		
80	4069.882	0.325	$4d^5(^4G)5s$	a ^5G	6	16783.856	WB88	FW96
			$4d^5(^4G)5p$	y $^5F^o$	5	41347.664		
90	4188.324	0.332	$4d^5(^4G)5s$	a ^5G	5	16784.522	WB88	FW96
			$4d^5(^4G)5p$	z $^5H^o$	6	40653.701		
90	4411.695	0.263	$4d^5(^4G)5s$	a ^5G	5	16784.522	WB88	FW96
			$4d^5(^4G)5p$	z $^5G^o$	5	39445.182		
250	5506.494	0.361	$4d^5(^6S)5s$	a ^5S	2	10768.332	WB88	FW96
			$4d^5(^6S)5p$	z $^5P^o$	3	28923.668		
200	5533.031	0.372	$4d^5(^6S)5s$	a ^5S	2	10768.332	WB88	FW96
			$4d^5(^6S)5p$	z $^5P^o$	2	28836.592		
90	5570.444	0.330	$4d^5(^6S)5s$	a ^5S	2	10768.332	WB88	FW96
			$4d^5(^6S)5p$	z $^5P^o$	1	28715.242		

Energy Levels of Neutral Molybdenum (Mo I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^5(^6S)5s$	a ^7S	3	0.000	WB88
$4d^5(^6S)5s$	a ^5S	2	10768.332	WB88
$4d^45s^2$	a ^5D	0	10965.947	WB88
		1	11142.784	WB88
		2	11454.362	WB88
		3	11858.499	WB88
		4	12346.280	WB88

Energy Levels of Neutral Molybdenum (Mo I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^5(^4G)5s$	a ^5G	2	16641.081	WB88
		3	16692.905	WB88
		4	16747.720	WB88
		6	16783.856	WB88
		5	16784.522	WB88
$4d^5(^6S)5p$	z $^7P^o$	2	25614.367	WB88
		3	25871.887	WB88
		4	26320.420	WB88
$4d^5(^6S)5p$	z $^5P^o$	1	28715.242	WB88
		2	28836.592	WB88
		3	28923.668	WB88
$4d^45s(^6D)5p$	z $^7D^o$	1	30846.584	WB88
		2	31154.935	WB88
		3	31654.786	WB88
		4	32123.128	WB88
		5	32611.837	WB88
$4d^45s(^6D)5p$	y $^7P^o$	2	31299.876	WB88
		3	31533.206	WB88
		4	31913.171	WB88
$4d^5(^4G)5p$	z $^5G^o$	5	39445.182	WB88
$4d^5(^4G)5p$	z $^5H^o$	6	40653.701	WB88
$4d^5(^4G)5p$	y $^5F^o$	5	41347.664	WB88
Mo II ($^6S_{5/2}$)		*Limit*	**57204.3**	RMBH87

Persistent Lines of Singly-ionized Molybdenum (Mo II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	2015.109	0.88	$4d^5$	a ^6S	5/2	0.00	SPNL01	SPNL01
			$4d^4(^5D)5p$	z $^6P^o$	5/2	49608.74		
1000	2020.314	2.15	$4d^5$	a ^6S	5/2	0.00	SPNL01	SPNL01
			$4d^4(^5D)5p$	z $^6P^o$	7/2	49481.04		
500	2038.452	1.84	$4d^5$	a ^6S	5/2	0.00	SPNL01	SPNL01
			$4d^4(^5D)5p$	z $^6P^o$	3/2	49040.82		
400	2045.973	1.18	$4d^5$	a ^6S	5/2	0.00	SPNL01	SPNL01
			$4d^4(^5D)5p$	z $^4P^o$	5/2	48860.57		
120	2081.681	0.200	$4d^5$	a ^6S	5/2	0.00	SPNL01	SPNL01
			$4d^4(^5D)5p$	z $^4P^o$	3/2	48022.45		
60	2089.52		$4d^5$	a ^4G	5/2	15199.25	MCS75	
			$4d^4(^3H)5p$	y $^4G^o$	5/2	63041.47		
60	2092.50		$4d^5$	a ^4G	7/2	15330.56	MCS75	
			$4d^4(a^3F)5p$	y $^4F^o$	7/2	63104.63		
100	2093.11		$4d^5$	a ^4G	11/2	15446.97	MCS75	
			$4d^4(^3H)5p$	y $^4G^o$	11/2	63207.43		

Persistent Lines of Singly-ionized Molybdenum (Mo II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
70	2100.84		$4d^5$	a ^{4}G	9/2	15427.73	MCS75	
				1^o	7/2	63012.24		
130	2775.402	2.26	$4d^4(^5D)5s$	a ^{6}D	9/2	13460.70	SPNL01	SPNL01
			$4d^4(^5D)5p$	z $^6P^o$	7/2	49481.04		
130	2816.158	2.33	$4d^4(^5D)5s$	a ^{6}D	9/2	13460.70	SPNL01	SPNL01
			$4d^4(^5D)5p$	z $^6F^o$	11/2	48959.68		
130	2848.233	1.66	$4d^4(^5D)5s$	a ^{6}D	7/2	12900.33	SPNL01	SPNL01
			$4d^4(^5D)5p$	z $^6F^o$	9/2	47999.47		
130	2871.512	1.15	$4d^4(^5D)5s$	a ^{6}D	5/2	12417.28	SPNL01	SPNL01
			$4d^4(^5D)5p$	z $^6F^o$	7/2	47231.98		

Energy Levels of Singly-ionized Molybdenum (Mo II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^5$	a ^{6}S	5/2	0.00	K58
$4d^4(^5D)5s$	a ^{6}D	1/2	11783.36	K58
		3/2	12034.06	K58
		5/2	12417.28	K58
		7/2	12900.33	K58
		9/2	13460.70	K58
$4d^5$	a ^{4}G	5/2	15199.25	K58
		7/2	15330.56	K58
		9/2	15427.73	K58
		11/2	15446.97	K58
$4d^4(^5D)5p$	z $^6F^o$	1/2	45853.08	K58
		3/2	46148.12	K58
		5/2	46614.14	K58
		7/2	47231.98	K58
		9/2	47999.47	K58
		11/2	48959.68	K58
$4d^4(^5D)5p$	z $^4P^o$	1/2	47208.36	K58
		3/2	48022.45	K58
		5/2	48860.57	K58
$4d^4(^5D)5p$	z $^6P^o$	3/2	49040.82	K58
		7/2	49481.04	K58
		5/2	49608.74	K58
$4d^4(^3H)5p$	y $^4G^o$	7/2	62917.94	K58
		9/2	62953.75	K58
		5/2	63041.47	K58
		11/2	63207.43	K58
	1^o	7/2	63012.24	K58
$4d^4(a^3F)5p$	y $^4F^o$	7/2	63104.63	K58
Mo III ($^5D_0$)		*Limit*	**130300**	SM88

Neodymium (Nd)
Atomic number = 60
Atomic weight = 144.24

Isotope	Mass	Abundance	Spin	Mag moment
^{142}Nd	141.907719	27.13%	0	
^{143}Nd	142.909810	12.18%	7/2	−1.08
^{144}Nd	143.910083	23.80%	0	
^{145}Nd	144.912570	8.30%	7/2	−0.66
^{146}Nd	145.913113	17.19%	0	
^{148}Nd	147.916889	5.76%	0	
^{150}Nd	149.920889	5.64%	0	

Nd I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^4 6s^2\ {}^5I_4$
Ionization energy: 44 562 cm^{-1} (5.5250 eV)

Nd II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^4 6s\ {}^6I_{7/2}$
Ionization energy: 86 500 cm^{-1} (10.72 eV)

Strong Lines of Neodymium (Nd)

Intensity		Wavelength (Å)	Spectrum	Ref
		Air		
250	h	3484.88	Nd I	MCS75
100		3665.18	Nd II	MCS75
100		3672.36	Nd II	MCS75
110		3673.54	Nd II	MCS75
200		3685.80	Nd II	MCS75
120	d	3714.73	Nd II	MCS75
140		3723.50	Nd II	MCS75
130		3728.13	Nd II	MCS75
200	d	3735.54	Nd II	MCS75
200		3738.06	Nd II	MCS75
110		3752.49	Nd II	MCS75
90		3757.82	Nd II	MCS75
150		3758.95	Nd II	MCS75
150		3763.47	Nd II	MCS75
90		3769.65	Nd II	MCS75
250		3775.50	Nd II	MCS75
130		3779.47	Nd II	MCS75
110		3780.40	Nd II	MCS75
90		3781.32	Nd II	MCS75
400	P	3784.25	Nd II	MCS75
200		3803.47	Nd II	MCS75
500	P	3805.36	Nd II	MCS75
100		3808.77	Nd II	MCS75
110		3810.49	Nd II	MCS75
130		3814.73	Nd II	MCS75
200		3826.42	Nd II	MCS75
100		3828.85	Nd II	MCS75
90		3830.47	Nd II	MCS75
140		3836.54	Nd II	MCS75
300		3838.98	Nd II	MCS75
300*	d	3848.24	Nd II	MCS75
300*	d	3848.31	Nd II	MCS75
300		3848.52	Nd II	MCS75
400*	P,d	3851.66	Nd II	MCS75
400*	P,d	3851.74	Nd II	MCS75

Strong Lines of Neodymium (Nd)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
700*	P,d	3863.33	Nd II	MCS75
700*	P,d	3863.40	Nd II	MCS75
150		3869.07	Nd II	MCS75
200		3878.58	Nd II	MCS75
200		3879.55	Nd II	MCS75
140		3880.38	Nd II	MCS75
200		3880.78	Nd II	MCS75
100		3887.87	Nd II	MCS75
250		3889.93	Nd II	MCS75
250		3890.58	Nd II	MCS75
250		3890.94	Nd II	MCS75
110		3891.51	Nd II	MCS75
150		3894.63	Nd II	MCS75
400	P	3900.21	Nd II	MCS75
250		3901.84	Nd II	MCS75
300		3905.89	Nd II	MCS75
90		3907.84	Nd II	MCS75
400	P	3911.16	Nd II	MCS75
150		3912.23	Nd II	MCS75
110		3915.95	Nd II	MCS75
200		3920.96	Nd II	MCS75
90		3927.10	Nd II	MCS75
110		3934.82	Nd II	MCS75
90		3938.86	Nd II	MCS75
400	P	3941.51	Nd II	MCS75
400	P	3951.16	Nd II	MCS75
150		3952.20	Nd II	MCS75
110		3958.00	Nd II	MCS75
90		3962.21	Nd II	MCS75
250		3963.12	Nd II	MCS75
200		3973.30	Nd II	MCS75
140		3973.69	Nd II	MCS75
140		3976.85	Nd II	MCS75
140		3979.49	Nd II	MCS75
250		3990.10	Nd II	MCS75
200		3991.74	Nd II	MCS75
200		3994.68	Nd II	MCS75
100		4004.02	Nd II	MCS75
700	P	4012.25	Nd II	MCS75
100		4012.70	Nd II	MCS75
200		4020.87	Nd II	MCS75
200		4021.34	Nd II	MCS75
200		4021.78	Nd II	MCS75
200		4023.00	Nd II	MCS75
200		4031.82	Nd II	MCS75
600	P	4040.80	Nd II	MCS75
150		4051.15	Nd II	MCS75
150		4059.96	Nd II	MCS75
900	P	4061.09	Nd II	MCS75
200		4069.28	Nd II	MCS75
130		4075.12	Nd II	MCS75
250		4109.08	Nd II	MCS75
500	P	4109.46	Nd II	MCS75
90		4110.48	Nd II	MCS75
90		4135.33	Nd II	MCS75
600	P	4156.08	Nd II	MCS75
90		4156.26	Nd II	MCS75
150		4175.61	Nd II	MCS75
400	P	4177.32	Nd II	MCS75

Strong Lines of Neodymium (Nd)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
120		4179.59	Nd II	MCS75
250		4232.38	Nd II	MCS75
400	P	4247.38	Nd II	MCS75
150		4252.44	Nd II	MCS75
130		4284.52	Nd II	MCS75
1000	P	4303.58	Nd II	MCS75
200		4325.76	Nd II	MCS75
90		4327.93	Nd II	MCS75
100		4338.70	Nd II	MCS75
130		4351.29	Nd II	MCS75
150		4358.17	Nd II	MCS75
130		4385.66	Nd II	MCS75
100		4400.83	Nd II	MCS75
90		4411.06	Nd II	MCS75
110		4446.39	Nd II	MCS75
250		4451.57	Nd II	MCS75
140		4462.99	Nd II	MCS75
250		4527.25	Nd I	MCS75
300		4559.67	Nd I	MCS75
200		4586.62	Nd I	MCS75
200		4603.82	Nd I	MCS75
200		4609.87	Nd I	MCS75
600	P	4621.94	Nd I	MCS75
200		4627.98	Nd I	MCS75
1000	P	4634.24	Nd I	MCS75
700	P	4641.10	Nd I	MCS75
400		4646.40	Nd I	MCS75
600	P	4649.67	Nd I	MCS75
400		4654.73	Nd I	MCS75
600	P	4683.45	Nd I	MCS75
200		4684.04	Nd I	MCS75
200		4690.35	Nd I	MCS75
400		4696.44	Nd I	MCS75
250		4706.96	Nd I	MCS75
500	P	4719.02	Nd I	MCS75
250		4731.77	Nd I	MCS75
250		4779.46	Nd I	MCS75
400		4866.74	Nd I	MCS75
700	P	4883.81	Nd I	MCS75
500		4891.07	Nd I	MCS75
500	P	4896.93	Nd I	MCS75
250		4901.53	Nd I	MCS75
400		4901.84	Nd I	MCS75
400		4913.41	Nd I	MCS75
900	P	4924.53	Nd I	MCS75
500	P	4944.83	Nd I	MCS75
600	P	4954.78	Nd I	MCS75
130		5130.60	Nd II	MCS75
90		5191.45	Nd II	MCS75
120		5192.62	Nd II	MCS75
300		5213.23	Nd I	MCS75
130		5249.59	Nd II	MCS75
110		5273.43	Nd II	MCS75
200		5291.67	Nd I	MCS75
130		5293.17	Nd II	MCS75
90		5319.82	Nd II	MCS75
400		5620.54	Nd I	MCS75
250	d	5675.97	Nd I	MCS75
200		5729.29	Nd I	MCS75

Persistent Lines of Neutral Neodymium (Nd I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	4621.94	0.56	$4f^4 6s^2$	^5I	6	2366.597	MCS75	M00
				o	6	23996.513		
1000	4634.24	0.84	$4f^4 6s^2$	^5I	4	0.000	MCS75	M00
			$4f^4 6s6p$	$^5H^o$	3	21572.610		
700	4641.10						MCS75	
600	4649.67						MCS75	
600	4683.45	0.52	$4f^4 6s^2$	^5I	4	0.000	MCS75	M00
				o	4	21345.837		
500	4719.02	0.33	$4f^4 6s^2$	^5I	4	0.000	MCS75	M00
				o	4	21184.881		
700	4883.81	0.88	$4f^4 6s^2$	^5I	8	5048.602	MCS75	K91
			$4f^4 6s6p$	$^5K^o$	9	25518.700		
500	4896.93	0.59	$4f^4 6s^2$	^5I	5	1128.056	MCS75	K91
			$4f^4 6s6p$	$^5K^o$	6	21543.326		
900	4924.53	0.90	$4f^4 6s^2$	^5I	4	0.000	MCS75	M00
			$4f^4 6s6p$	$^5K^o$	5	20300.875		
500	4944.83	0.67	$4f^4 6s^2$	^5I	5	1128.056	MCS75	M00
				o	6	21345.572		
600	4954.78	0.29	$4f^4 6s^2$	^5I	4	0.000	MCS75	M00
				o	5	20176.912		

Energy Levels of Neutral Neodymium (Nd I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^4 6s^2$	^5I	4	0.000	MZH78
		5	1128.056	MZH78
		6	2366.597	MZH78
		7	3681.696	MZH78
		8	5048.602	MZH78
$4f^3(^4I^o)5d6s^2$	$^5L^o$	6	6764.211	MZH78
		7	8402.487	MZH78
		8	10160.612	MZH78
		9	12162.142	MZH78
		10	—	
$4f^3(^4I^o)5d6s^2$	$^5K^o$	5	6853.994	MZH78
		6	8411.900	MZH78
		7	10017.790	MZH78
		8	11704.640	MZH78
		9	—	
$4f^4(^5I)5d6s(^3D)$	^7L	5	8475.355	MZH78
		6	9115.092	MZH78
		7	9939.704	MZH78
		8	10897.998	MZH78
		9	11959.761	MZH78
		10	13101.411	MZH78
		11	14304.110	MZH78

Energy Levels of Neutral Neodymium (Nd I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^3(^4I^o)5d^2(^3F)(^6M^o)6s$	$^7M^o$	6	8800.392	MZH78
		7	9692.277	MZH78
		8	10784.929	MZH78
		9	11887.735	MZH78
		10	—	
		11	—	
		12	—	
$4f^3(^4I^o)5d6s^2$	$^5I^o$	4	9083.813	MZH78
		5	10004.583	MZH78
		6	11179.045	MZH78
		7	12927.232	MZH78
		8	14732.200	MZH78
$4f^4(^5I)5d6s(^3D)$	^7K	4	9814.683	MZH78
		5	10376.842	MZH78
		6	11109.167	MZH78
		7	11918.353	MZH78
		8	12902.422	MZH78
		9	13953.585	MZH78
		10	15073.203	MZH78
$4f^3(^4I^o)5d6s^2$	$^5H^o$	3	9927.387	MZH78
		4	10672.571	MZH78
		5	12394.260	MZH78
		6	14308.080	MZH78
		7	15396.590	MZH78
$4f^46s^2$	^5F	1	10118.968	MZH78
		2	10469.468	MZH78
		3	11118.466	MZH78
		4	11866.108	ABK92
		5	12894.721	ABK92
$4f^4(^5I)5d6s(^3D)$	^5L	6	10774.927	MZH78
		7	12056.824	MZH78
		8	13333.505	MZH78
		9	14687.945	MZH78
		10	16092.06	MZH78
	^{o}	5	20176.912	MZH78
$4f^46s6p$	$^5K^o$	5	20300.875	MZH78
		6	21543.326	MZH78
		7	22761.440	MZH78
		8	24121.478	MZH78
		9	25518.700	MZH78
	^{o}	4	21184.881	MZH78
	^{o}	6	21345.572	MZH78
	^{o}	4	21345.837	MZH78
$4f^46s6p$	$^5H^o$	3	21572.610	MZH78
	^{o}	6	23996.513	MZH78
Nd II ($^6I_{7/2}$)		*Limit*	**44562**	WSPC78

Persistent Lines of Singly-ionized Neodymium (Nd II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	3784.25		$4f^4(^5I)6s$	^4I	11/2	3066.755	MCS75	
			$4f^4(^5I)6p$	$^4I^o$	11/2	29484.605		
500	3805.36	0.31	$4f^4(^5I)6s$	^6I	13/2	2585.460	MCS75	M00
			$4f^4(^5I)6p$	$^6I^o$	15/2	28856.895		
400*	3851.66		$4f^4(^5I)6s$	^6I	13/2	2585.460	MCS75	
				^{o}	15/2	28540.945		
400*	3851.74		$4f^4(^5I)6s$	^6I	11/2	1470.105	MCS75	
			$4f^4(^5I)6p$	$^6H^o$	9/2	27425.000		
700*	3863.33	0.11	$4f^4(^5I)6s$	^6I	7/2	0.000	MCS75	M00
			$4f^4(^5I)6p$	$^6I^o$	9/2	25877.160		
700*	3863.40		$4f^4(^5I)6s$	^6I	7/2	0.000	MCS75	
			$4f^4(^5I)6p$	$^6H^o$	5/2	25876.545		
400	3900.21		$4f^4(^5I)6s$	^6I	15/2	3801.930	MCS75	
			$4f^4(^5I)6p$	$^6H^o$	13/2	29434.255		
400	3911.16		$4f^4(^5I)6s$	^6I	15/2	3801.930	MCS75	
				^{o}	15/2	29362.520		
400	3941.51	0.45	$4f^4(^5I)6s$	^6I	9/2	513.330	MCS75	M00
			$4f^4(^5I)6p$	$^6I^o$	9/2	25877.160		
400	3951.16	0.40	$4f^4(^5I)6s$	^6I	11/2	1470.105	MCS75	M00
			$4f^4(^5I)6p$	$^6I^o$	11/2	26772.080		
700	4012.25	1.25	$4f^4(^5I)6s$	^6I	17/2	5085.640	MCS75	M00
			$4f^4(^5I)6p$	$^6K^o$	19/2	30002.310		
600	4040.80		$4f^4(^5I)6s$	^6I	11/2	1470.105	MCS75	
				^{o}	13/2	26210.740		
900	4061.09	0.72	$4f^4(^5I)6s$	^6I	15/2	3801.930	MCS75	M00
			$4f^4(^5I)6p$	$^6K^o$	17/2	28418.970		
500	4109.46	0.51	$4f^4(^5I)6s$	^6I	13/2	2585.460	MCS75	M00
			$4f^4(^5I)6p$	$^6K^o$	15/2	26912.765		
600	4156.08	0.42	$4f^4(^5I)6s$	^6I	11/2	1470.105	MCS75	M00
			$4f^4(^5I)6p$	$^6K^o$	13/2	25524.470		
400	4177.32		$4f^4(^5I)6s$	^6I	9/2	513.330	MCS75	
			$4f^4(^5I)6p$	$^6K^o$	11/2	24445.380		
400	4247.38		$4f^4(^5I)6s$	^6I	7/2	0.000	MCS75	
				^{o}	9/2	23537.380		
1000	4303.58	0.44	$4f^4(^5I)6s$	^6I	7/2	0.000	MCS75	M00
			$4f^4(^5I)6p$	$^6K^o$	9/2	23229.980		

Energy Levels of Singly-ionized Neodymium (Nd II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^4(^5I)6s$	^6I	7/2	0.000	BWDA84
		9/2	513.330	BWDA84
		11/2	1470.105	BWDA84
		13/2	2585.460	BWDA84
		15/2	3801.930	BWDA84
		17/2	5085.640	BWDA84
$4f^4(^5I)6s$	^4I	9/2	1650.205	BWDA84
		11/2	3066.755	BWDA84
		13/2	4512.495	BWDA84
		15/2	5985.580	BWDA84
$4f^4(^5I)5d$	^6L	11/2	4437.560	BWDA84
		13/2	5487.655	BWDA84
		15/2	6637.430	BWDA84
		17/2	7868.910	BWDA84
		19/2	9166.210	BWDA84
		21/2	10516.790	BWDA84
$4f^4(^5I)5d$	^6K	9/2	6005.270	BWDA84
		11/2	6931.800	BWDA84
		13/2	7950.075	BWDA84
		15/2	9042.760	BWDA84
		17/2	10194.805	BWDA84
		19/2	11392.190	BWDA84
$4f^4(^5I)5d$	^6I	7/2	7524.735	BWDA84
		9/2	8420.320	BWDA84
		11/2	9357.910	BWDA84
		13/2	10337.100	BWDA84
		15/2	11373.475	BWDA84
		17/2	12459.995	BWDA84
$4f^4(^5I)5d$	^6G	3/2	8716.445	BWDA84
		5/2	8796.365	BWDA84
		7/2	9198.395	BWDA84
		9/2	10883.250	BWDA84
		11/2	12021.340	BWDA84
		13/2	12334.230	BWDA84
$4f^3(^4I^o)5d^2(^3F)$	$^6M^o$	13/2	8009.810	BWDA84
		15/2	9448.185	BWDA84
		17/2	10980.540	BWDA84
		19/2	12600.805	BWDA84
		21/2	14299.295	BWDA84
		23/2	16064.085	BWDA84
$4f^4(^5I)5d$	^6H	5/2	9674.835	BWDA84
		7/2	10666.780	BWDA84
		9/2	11709.615	BWDA84
		11/2	12887.085	BWDA84
		13/2	13298.880	BWDA84
		15/2	14481.970	BWDA84

Energy Levels of Singly-ionized Neodymium (Nd II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^4(^5I)6p$	$^6K^o$	9/2	23229.980	BWDA84
		11/2	24445.380	BWDA84
		13/2	25524.470	BWDA84
		15/2	26912.765	BWDA84
		17/2	28418.970	BWDA84
		19/2	30002.310	BWDA84
	^{o}	9/2	23537.380	BWDA84
$4f^4(^5I)6p$	$^6I^o$	7/2	25044.645	BWDA84
		9/2	25877.160	BWDA84
		11/2	26772.080	BWDA84
		13/2	27744.190	BWDA84
		15/2	28856.895	BWDA84
		17/2	30246.770	BWDA84
$4f^4(^5I)6p$	$^6H^o$	5/2	25876.545	BWDA84
		7/2	26640.080	BWDA84
		9/2	27425.000	BWDA84
		11/2	28285.610	BWDA84
		13/2	29434.255	BWDA84
		15/2	30707.280	BWDA84
	^{o}	13/2	26210.740	BWDA84
$4f^4(^5I)6p$	$^4I^o$	9/2	27921.385	BWDA84
		11/2	29484.605	BWDA84
		13/2	31153.855	BWDA84
		15/2	32464.635	BWDA84
	^{o}	15/2	28540.945	BWDA84
	^{o}	15/2	29362.520	BWDA84
Nd III ($^5I_4$)		*Limit*	**86500**	SR65

Neon (Ne)
Atomic number = 10
Atomic weight = 20.1797

Isotope	Mass	Abundance	Spin	Mag moment
^{20}Ne	19.992435	90.48%	0	
^{21}Ne	20.993843	0.27%	3/2	−0.66179
^{22}Ne	21.991383	9.25%	0	

Ne I Ground state: $1s^2 2s^2 2p^6\ ^1S_0$
Ionization energy: 173 929.75 cm^{-1} (21.564 54 eV)

Ne II Ground state: $1s^2 2s^2 2p^5\ ^2P^o_{3/2}$
Ionization energy: 330 388.6 cm^{-1} (40.962 96 eV)

Strong Lines of Neon (Ne)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
90 P	352.9549	Ne II	P71
60 P	354.9620	Ne II	P71
90	361.4321	Ne II	P71
60	362.4544	Ne II	P71
150	405.8538	Ne II	P71
120	407.1377	Ne II	P71
200 P	445.0393	Ne II	P71
300 P	446.2552	Ne II	P71
250 P	446.5902	Ne II	P71
200	447.8146	Ne II	P71
150	454.6540	Ne II	P71
200	455.2730	Ne II	P71
10	456.2728	Ne II	P71
120	456.3485	Ne II	P71
90	456.8962	Ne II	P71
1000 P	460.7284	Ne II	P71
500 P	462.3908	Ne II	P71
30	587.2127	Ne I	SS04
30	587.1792	Ne I	SS04
30	589.9114	Ne I	SS04
70	591.8306	Ne I	SS04
100	595.9200	Ne I	SS04
70	598.7056	Ne I	SS04
30	598.8897	Ne I	SS04
70	600.0365	Ne I	SS04
130	602.7263	Ne I	SS04
170 P	615.6283	Ne I	SS04
170 P	618.6716	Ne I	SS04
130 P	619.1023	Ne I	SS04
200 P	626.8232	Ne I	SS04
200 P	629.7388	Ne I	SS04
1000 P	735.8962	Ne I	SS04
400 P	743.7195	Ne I	SS04
60	993.8825	Ne II	P71
70	1068.6488	Ne II	P71
90	1131.7224	Ne II	P71
100	1131.8490	Ne II	P71
90	1229.8367	Ne II	P71
90	1418.3779	Ne II	P71

Strong Lines of Neon (Ne)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90	1428.5822	Ne II	P71
90	1436.0813	Ne II	P71
120	1681.6840	Ne II	P71
200	1688.3553	Ne II	P71
100	1888.1064	Ne II	P71
100	1889.7120	Ne II	P71
200	1907.4940	Ne II	P71
500 P	1916.0818	Ne II	P71
300 P	1930.0345	Ne II	P71
200	1938.8269	Ne II	P71
100 c	1945.4521	Ne II	P71
	Air		
80	2007.009	Ne II	P71
80	2025.560	Ne II	P71
150	2085.466	Ne II	P71
200	2096.106	Ne II	P71
120	2096.248	Ne II	P71
80	2562.123	Ne II	P71
90 w	2567.121	Ne II	P71
80	2623.107	Ne II	P71
80	2629.885	Ne II	P71
90 w	2636.069	Ne II	P71
80	2638.289	Ne II	P71
80	2644.097	Ne II	P71
80	2762.921	Ne II	P71
90	2792.019	Ne II	P71
80	2794.221	Ne II	P71
100	2809.485	Ne II	P71
80	2906.592	Ne II	P71
80	2906.816	Ne II	P71
90	2910.061	Ne II	P71
90	2910.408	Ne II	P71
80	2911.138	Ne II	P71
80	2915.122	Ne II	P71
80	2925.618	Ne II	P71
80 w	2932.103	Ne II	P71
80	2940.653	Ne II	P71
90	2946.044	Ne II	P71
150	2955.725	Ne II	P71
150	2963.236	Ne II	P71
150	2967.184	Ne II	P71
100	2972.997	Ne II	P71
30	2974.7189	Ne I	SS04
100	2979.461	Ne II	P71
30	2982.6696	Ne I	SS04
150	3001.668	Ne II	P71
120	3017.311	Ne II	P71
300 P	3027.016	Ne II	P71
300 P	3028.864	Ne II	P71
100	3030.787	Ne II	P71
120	3034.461	Ne II	P71
100	3035.923	Ne II	P71
100	3037.720	Ne II	P71
100	3039.586	Ne II	P71
100	3044.088	Ne II	P71
100	3045.556	Ne II	P71
120	3047.556	Ne II	P71
100	3054.345	Ne II	P71
100	3054.677	Ne II	P71

Strong Lines of Neon (Ne)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
30	3057.3907	Ne I	SS04
100	3059.106	Ne II	P71
100	3062.491	Ne II	P71
100	3063.301	Ne II	P71
100	3070.887	Ne II	P71
100	3071.529	Ne II	P71
100	3075.731	Ne II	P71
120	3088.166	Ne II	P71
100	3092.092	Ne II	P71
120	3092.901	Ne II	P71
100	3094.006	Ne II	P71
100	3095.103	Ne II	P71
100	3097.131	Ne II	P71
100	3117.980	Ne II	P71
120	3118.160	Ne II	P71
300	3141.332	Ne II	P71
100	3143.721	Ne II	P71
100	3148.681	Ne II	P71
100	3164.429	Ne II	P71
100	3165.648	Ne II	P71
100	3188.743	Ne II	P71
120	3194.579	Ne II	P71
500 P	3198.586	Ne II	P71
60	3208.965	Ne II	P71
120	3209.356	Ne II	P71
120	3213.735	Ne II	P71
150	3214.329	Ne II	P71
150	3218.193	Ne II	P71
120	3224.818	Ne II	P71
120	3229.573	Ne II	P71
200	3230.070	Ne II	P71
120	3230.419	Ne II	P71
120	3232.022	Ne II	P71
150	3232.372	Ne II	P71
100	3243.396	Ne II	P71
100	3244.095	Ne II	P71
100	3248.345	Ne II	P71
100	3250.355	Ne II	P71
150	3297.726	Ne II	P71
150	3309.740	Ne II	P71
300	3319.722	Ne II	P71
1000 P	3323.745	Ne II	P71
150	3327.153	Ne II	P71
100	3329.158	Ne II	P71
200	3334.836	Ne II	P71
150	3344.395	Ne II	P71
300	3345.453	Ne II	P71
150	3345.829	Ne II	P71
200	3355.016	Ne II	P71
120	3357.820	Ne II	P71
200	3360.597	Ne II	P71
120	3362.161	Ne II	P71
100	3362.707	Ne II	P71
120	3367.218	Ne II	P71
50	3369.8076	Ne I	SS04
70	3369.9072	Ne I	SS04
100	3371.799	Ne II	P71
500 P	3378.216	Ne II	P71
150	3388.417	Ne II	P71

Strong Lines of Neon (Ne)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
120	3388.945	Ne II	P71
300	3392.798	Ne II	P71
100	3404.822	Ne II	P71
120	3406.947	Ne II	P71
100	3413.148	Ne II	P71
120	3416.914	Ne II	P71
120	3417.688	Ne II	P71
50	3417.9031	Ne I	SS04
5	3418.0055	Ne I	SS04
120	3428.687	Ne II	P71
20	3447.7024	Ne I	SS04
10	3454.1944	Ne I	SS04
100	3456.610	Ne II	P71
100	3459.321	Ne II	P71
10	3460.5237	Ne I	SS04
10	3464.3382	Ne I	SS04
20	3466.5781	Ne I	SS04
50	3472.5706	Ne I	SS04
150	3479.519	Ne II	P71
200	3480.718	Ne II	P71
200	3481.933	Ne II	P71
10	3498.0636	Ne I	SS04
20	3501.2159	Ne I	SS04
20	3515.1902	Ne I	SS04
100 P	3520.4711	Ne I	SS04
120	3542.847	Ne II	P71
120	3557.805	Ne II	P71
100	3561.198	Ne II	P71
250	3568.502	Ne II	P71
100	3574.181	Ne II	P71
200	3574.612	Ne II	P71
50	3593.5257	Ne I	SS04
30	3593.6389	Ne I	SS04
10	3600.1685	Ne I	SS04
10	3633.6640	Ne I	SS04
150	3643.927	Ne II	P71
200	3664.073	Ne II	P71
10	3682.2421	Ne I	SS04
10	3685.7352	Ne I	SS04
200	3694.213	Ne II	P71
4	3701.2244	Ne I	SS04
150	3709.622	Ne II	P71
250	3713.079	Ne II	P71
250	3727.107	Ne II	P71
800 P	3766.259	Ne II	P71
1000 P	3777.133	Ne II	P71
100	3818.427	Ne II	P71
120	3829.749	Ne II	P71
150	4219.745	Ne II	P71
100	4233.850	Ne II	P71
120	4250.649	Ne II	P71
120	4369.862	Ne II	P71
70	4379.400	Ne II	P71
150	4379.550	Ne II	P71
100	4385.059	Ne II	P71
200	4391.991	Ne II	P71
150	4397.990	Ne II	P71
150	4409.299	Ne II	P71
100	4413.215	Ne II	P71

Strong Lines of Neon (Ne)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
100	4421.389	Ne II	P71
100	4428.516	Ne II	P71
100	4428.634	Ne II	P71
150	4430.904	Ne II	P71
150	4430.942	Ne II	P71
120	4457.049	Ne II	P71
100	4522.720	Ne II	P71
100	4537.7545	Ne I	SS04
100	4569.057	Ne II	P71
150	4704.3949	Ne I	SS04
120	4708.8594	Ne I	SS04
100	4710.0650	Ne I	SS04
150	4712.0633	Ne I	SS04
150	4715.344	Ne I	SS04
50	4752.7320	Ne I	SS04
100	4788.9258	Ne I	SS04
50	4790.2195	Ne I	SS04
100	4827.338	Ne I	SS04
100	4884.9170	Ne I	SS04
50	5005.1587	Ne I	SS04
50	5037.7512	Ne I	SS04
50	5144.9384	Ne I	SS04
60	5330.7775	Ne I	SS04
100	5341.0938	Ne I	SS04
60	5343.2834	Ne I	SS04
200 P	5400.5618	Ne I	SS04
50	5562.7662	Ne I	SS04
50	5656.6588	Ne I	SS04
50	5719.2248	Ne I	SS04
50	5748.2985	Ne I	SS04
70	5764.4188	Ne I	SS04
50	5804.4496	Ne I	SS04
50	5820.1558	Ne I	SS04
200 P	5852.4879	Ne I	SS04
50	5872.8275	Ne I	SS04
100	5881.8952	Ne I	SS04
5	5902.4623	Ne I	SS04
5	5906.4294	Ne I	SS04
50	5944.8342	Ne I	SS04
50	5965.4710	Ne I	SS04
50	5974.6273	Ne I	SS04
60	5975.5340	Ne I	SS04
15	5987.9074	Ne I	SS04
100 P	6029.9969	Ne I	SS04
100 P	6074.3377	Ne I	SS04
30	6096.1631	Ne I	SS04
10	6128.4499	Ne I	SS04
100 P	6143.0626	Ne I	SS04
100 P	6163.5939	Ne I	SS04
15	6182.1460	Ne I	SS04
100 P	6217.2812	Ne I	SS04
100 P	6266.4950	Ne I	SS04
10	6304.7889	Ne I	SS04
30	6328.1646	Ne I	SS04
100	6334.4278	Ne I	SS04
100 P	6382.9917	Ne I	SS04
200 P	6402.248	Ne I	SS04
150 P	6506.5281	Ne I	SS04
10	6532.8822	Ne I	SS04

Strong Lines of Neon (Ne)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
100 P	6598.9529	Ne I	SS04
15	6652.0927	Ne I	SS04
50	6678.2762	Ne I	SS04
7	6717.0430	Ne I	SS04
1000 P	6929.4673	Ne I	SS04
300	7024.0504	Ne I	SS04
800 P	7032.4131	Ne I	SS04
20	7051.2923	Ne I	SS04
100	7059.1074	Ne I	SS04
800 P	7173.9381	Ne I	SS04
150	7213.200	Ne II	P71
150	7235.188	Ne II	P71
800 P	7245.1666	Ne I	SS04
150	7343.945	Ne II	P71
30	7472.4386	Ne I	SS04
300	7488.8712	Ne I	SS04
100	7492.102	Ne II	P71
150	7522.818	Ne II	P71
300	7535.7741	Ne I	SS04
130	7544.0443	Ne I	SS04
1	7724.6233	Ne I	SS04
120	7740.738	Ne II	P71
2	7839.0529	Ne I	SS04
120	7926.201	Ne II	P71
3	7927.1177	Ne I	SS04
13	7936.9961	Ne I	SS04
80	7943.1814	Ne I	SS04
60	8082.4580	Ne I	SS04
100	8084.345	Ne II	P71
40	8118.5492	Ne I	SS04
12	8128.9108	Ne I	SS04
170	8136.4054	Ne I	SS04
30	8259.3790	Ne I	SS04
100	8264.807	Ne II	P71
70	8266.0772	Ne I	SS04
10	8267.1162	Ne I	SS04
300	8300.3258	Ne I	SS04
100	8314.995	Ne II	P71
50	8365.7466	Ne I	SS04
100	8372.106	Ne II	P71
800 P	8377.6080	Ne I	SS04
30	8417.1606	Ne I	SS04
250	8418.4274	Ne I	SS04
40	8463.3575	Ne I	SS04
13	8484.4435	Ne I	SS04
700	8495.3598	Ne I	SS04
15	8544.6958	Ne I	SS04
30	8571.3524	Ne I	SS04
400	8591.2584	Ne I	SS04
350	8634.6470	Ne I	SS04
60	8647.0411	Ne I	SS04
600 P	8654.3831	Ne I	SS04
80	8655.5220	Ne I	SS04
100	8668.256	Ne II	P71
130	8679.4925	Ne I	SS04
150	8681.9211	Ne I	SS04
30	8704.1116	Ne I	SS04
100	8771.6563	Ne I	SS04
600 P	8780.6226	Ne I	SS04

Strong Lines of Neon (Ne)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400 P	8783.7533	Ne I	SS04
6	8830.9072	Ne I	SS04
300	8853.8668	Ne I	SS04
20	8865.3063	Ne I	SS04
150	8865.7552	Ne I	SS04
60	8919.5006	Ne I	SS04
20	8988.5564	Ne I	SS04
100	9079.462	Ne II	P71
120	9148.6716	Ne I	SS04
90	9201.7591	Ne I	SS04
60	9220.0601	Ne I	SS04
20	9221.5801	Ne I	SS04
20	9226.6903	Ne I	SS04
9	9275.5196	Ne I	SS04
200	9287.563	Ne II	P71
80	9300.8527	Ne I	SS04
8	9310.5839	Ne I	SS04
30	9313.9726	Ne I	SS04
70	9326.5068	Ne I	SS04
15	9373.3078	Ne I	SS04
50	9425.3788	Ne I	SS04
30	9459.2095	Ne I	SS04
50	9486.6818	Ne I	SS04
60	9534.1629	Ne I	SS04
30	9547.4049	Ne I	SS04
120	9577.013	Ne II	P71
180	9665.4197	Ne I	SS04
100	9808.860	Ne II	P71
4	10295.4174	Ne I	SS04
80	10562.4075	Ne I	SS04
60	10798.0429	Ne I	SS04
90	10844.4772	Ne I	SS04
300 P	11143.0200	Ne I	SS04
500 P	11177.5240	Ne I	SS04
150	11390.4339	Ne I	SS04
90	11409.1343	Ne I	SS04
300 P	11522.7459	Ne I	SS04
150	11525.0194	Ne I	SS04
90	11536.3445	Ne I	SS04
30	11601.5366	Ne I	SS04
130	11614.0807	Ne I	SS04
30	11688.0017	Ne I	SS04
150	11766.7924	Ne I	SS04
130	11789.0435	Ne I	SS04
30	11789.8891	Ne I	SS04
70	11984.912	Ne I	SS04
200	12066.334	Ne I	SS04
40	12459.389	Ne I	SS04
60	12689.201	Ne I	SS04
80	12912.014	Ne I	SS04
40	13219.241	Ne I	SS04
50	15230.714	Ne I	SS04
20	17161.929	Ne I	SS04
20	18035.812	Ne I	SS04
40	18083.181	Ne I	SS04
9	18083.263	Ne I	SS04
15	18221.087	Ne I	SS04
13	18227.016	Ne I	SS04
140	18276.642	Ne I	SS04

Strong Lines of Neon (Ne)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
100	18282.614	Ne I	SS04
70	18303.967	Ne I	SS04
20	18359.094	Ne I	SS04
60	18384.826	Ne I	SS04
90	18389.937	Ne I	SS04
40	18402.836	Ne I	SS04
60	18422.402	Ne I	SS04
13	18458.640	Ne I	SS04
40	18475.800	Ne I	SS04
70	18591.541	Ne I	SS04
100	18597.698	Ne I	SS04
16	18618.908	Ne I	SS04
20	18625.159	Ne I	SS04
30	21041.27	Ne I	SS04
30	21708.11	Ne I	SS04
13	22247.36	Ne I	SS04
13	22428.14	Ne I	SS04
80	22530.38	Ne I	SS04
13	22661.79	Ne I	SS04
25	23100.48	Ne I	SS04
40	23260.27	Ne I	SS04
50	23372.96	Ne I	SS04
30	23565.33	Ne I	SS04
170	23636.48	Ne I	SS04
12	23701.66	Ne I	SS04
60	23709.13	Ne I	SS04
110	23951.40	Ne I	SS04
50	23956.43	Ne I	SS04
60	23978.16	Ne I	SS04
11	24098.57	Ne I	SS04
20	24161.43	Ne I	SS04
30	24249.61	Ne I	SS04
70	24365.01	Ne I	SS04
40	24371.61	Ne I	SS04
20	24447.86	Ne I	SS04
30	24459.39	Ne I	SS04
17	24776.49	Ne I	SS04
30	24928.89	Ne I	SS04
13	25161.70	Ne I	SS04
50	25524.33	Ne I	SS04
6	28386.20	Ne I	SS04
6	30200.49	Ne I	SS04
8	33173.09	Ne I	SS04
17	33352.38	Ne I	SS04
5	33899.81	Ne I	SS04
4	33903.02	Ne I	SS04
12	33913.10	Ne I	SS04
4	34131.34	Ne I	SS04
6	34471.43	Ne I	SS04
8	35834.81	Ne I	SS04

Persistent Lines of Neutral Neon (Ne I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
170	615.6283	0.380	$2p^6$ $2p^5(^2P^o_{1/2})3d$	^1S $^2[3/2]^o$	0 1	0.00 162435.6780	SS04	VVF96
170	618.6716	0.929	$2p^6$ $2p^5(^2P^o_{3/2})3d$	^1S $^2[3/2]^o$	0 1	0.00 161636.6175	SS04	VVF96
130	619.1023	0.330	$2p^6$ $2p^5(^2P^o_{3/2})3d$	^1S $^2[1/2]^o$	0 1	0.00 161524.1739	SS04	VVF96
200	626.8232	0.741	$2p^6$ $2p^5(^2P^o_{1/2})4s$	^1S $^2[1/2]^o$	0 1	0.00 159534.6196	SS04	VVF96
200	629.7388	0.480	$2p^6$ $2p^5(^2P^o_{3/2})4s$	^1S $^2[3/2]^o$	0 1	0.00 158795.9924	SS04	VVF96
1000	735.8962	3.16	$2p^6$ $2p^5(^2P^o_{1/2})3s$	^1S $^2[1/2]^o$	0 1	0.00 135888.7173	SS04	VVF96
400	743.7195	0.486	$2p^6$ $2p^5(^2P^o_{3/2})3s$	^1S $^2[3/2]^o$	0 1	0.00 134459.2871	SS04	VVF96
100	3520.4711	0.093	$2p^5(^2P^o_{1/2})3s$ $2p^5(^2P^o_{1/2})4p$	$^2[1/2]^o$ $^2[1/2]$	1 0	135888.7173 164285.8872	SS04	FW96
200	5400.5618	0.0090	$2p^5(^2P^o_{3/2})3s$ $2p^5(^2P^o_{1/2})3p$	$^2[3/2]^o$ $^2[1/2]$	1 0	134459.2871 152970.7328	SS04	FW96
200	5852.4879	0.682	$2p^5(^2P^o_{1/2})3s$ $2p^5(^2P^o_{1/2})3p$	$^2[1/2]^o$ $^2[1/2]$	1 0	135888.7173 152970.7328	SS04	FW96
100	6029.9969	0.0561	$2p^5(^2P^o_{3/2})3s$ $2p^5(^2P^o_{1/2})3p$	$^2[3/2]^o$ $^2[1/2]$	1 1	134459.2871 151038.4524	SS04	FW96
100	6074.3377	0.603	$2p^5(^2P^o_{3/2})3s$ $2p^5(^2P^o_{3/2})3p$	$^2[3/2]^o$ $^2[1/2]$	1 0	134459.2871 150917.4307	SS04	FW96
100	6143.0626	0.282	$2p^5(^2P^o_{3/2})3s$ $2p^5(^2P^o_{3/2})3p$	$^2[3/2]^o$ $^2[3/2]$	2 2	134041.8400 150315.8612	SS04	FW96
100	6163.5939	0.146	$2p^5(^2P^o_{1/2})3s$ $2p^5(^2P^o_{1/2})3p$	$^2[1/2]^o$ $^2[1/2]$	0 1	134818.6405 151038.4524	SS04	FW96
100	6217.2812	0.0637	$2p^5(^2P^o_{3/2})3s$ $2p^5(^2P^o_{3/2})3p$	$^2[3/2]^o$ $^2[3/2]$	2 1	134041.8400 150121.5922	SS04	FW96
100	6266.4950	0.249	$2p^5(^2P^o_{1/2})3s$ $2p^5(^2P^o_{1/2})3p$	$^2[1/2]^o$ $^2[3/2]$	0 1	134818.6405 150772.1118	SS04	FW96
100	6382.9917	0.321	$2p^5(^2P^o_{3/2})3s$ $2p^5(^2P^o_{3/2})3p$	$^2[3/2]^o$ $^2[3/2]$	1 1	134459.2871 150121.5922	SS04	FW96
200	6402.248	0.514	$2p^5(^2P^o_{3/2})3s$ $2p^5(^2P^o_{3/2})3p$	$^2[3/2]^o$ $^2[5/2]$	2 3	134041.8400 149657.0393	SS04	FW96
150	6506.5281	0.300	$2p^5(^2P^o_{3/2})3s$ $2p^5(^2P^o_{3/2})3p$	$^2[3/2]^o$ $^2[5/2]$	1 2	134459.2871 149824.2215	SS04	FW96
100	6598.9529	0.232	$2p^5(^2P^o_{1/2})3s$ $2p^5(^2P^o_{1/2})3p$	$^2[1/2]^o$ $^2[1/2]$	1 1	135888.7173 151038.4524	SS04	FW96
1000	6929.4673	0.174	$2p^5(^2P^o_{1/2})3s$ $2p^5(^2P^o_{3/2})3p$	$^2[1/2]^o$ $^2[3/2]$	1 2	135888.7173 150315.8612	SS04	FW96

Persistent Lines of Neutral Neon (Ne I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	7032.4131	0.253	$2p^5(^2P^o_{3/2})3s$	$^2[3/2]^o$	2	134041.8400	SS04	FW96
			$2p^5(^2P^o_{3/2})3p$	$^2[1/2]$	1	148257.7898		
800	7173.9381	0.0287	$2p^5(^2P^o_{1/2})3s$	$^2[1/2]^o$	1	135888.7173	SS04	FW96
			$2p^5(^2P^o_{3/2})3p$	$^2[5/2]$	2	149824.2215		
800	7245.1666	0.0935	$2p^5(^2P^o_{3/2})3s$	$^2[3/2]^o$	1	134459.2871	SS04	FW96
			$2p^5(^2P^o_{3/2})3p$	$^2[1/2]$	1	148257.7898		
800	8377.6080	0.51	$2p^5(^2P^o_{3/2})3p$	$^2[5/2]$	3	149657.0393	SS04	WSG66
			$2p^5(^2P^o_{3/2})3d$	$^2[7/2]^o$	4	161590.3412		
600	8654.3831	0.445	$2p^5(^2P^o_{1/2})3p$	$^2[3/2]$	2	150858.5079	SS04	WSG66
			$2p^5(^2P^o_{1/2})3d$	$^2[5/2]^o$	3	162410.1736		
600	8780.6226		$2p^5(^2P^o_{3/2})3p$	$^2[3/2]$	2	150315.8612	SS04	
			$2p^5(^2P^o_{3/2})3d$	$^2[5/2]^o$	3	161701.4486		
400	8783.7533	0.313	$2p^5(^2P^o_{1/2})3p$	$^2[1/2]$	1	151038.4524	SS04	FW96
			$2p^5(^2P^o_{1/2})3d$	$^2[3/2]^o$	2	162419.9818		
300	11143.0200		$2p^5(^2P^o_{3/2})3p$	$^2[5/2]$	2	149824.2215	SS04	
			$2p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	1	158795.9924		
500	11177.5240		$2p^5(^2P^o_{3/2})3p$	$^2[5/2]$	3	149657.0393	SS04	
			$2p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	2	158601.1152		
300	11522.7459		$2p^5(^2P^o_{1/2})3p$	$^2[3/2]$	2	150858.5079	SS04	
			$2p^5(^2P^o_{1/2})4s$	$^2[1/2]^o$	1	159534.6196		

Energy Levels of Neutral Neon (Ne I)

Configuration	Term	J	Level (cm^{-1})	Ref
$2p^6$	^1S	0	0.00	SS04
$2p^5(^2P^o_{3/2})3s$	$^2[3/2]^o$	2	134041.8400	SS04
		1	134459.2871	SS04
$2p^5(^2P^o_{1/2})3s$	$^2[1/2]^o$	0	134818.6405	SS04
		1	135888.7173	SS04
$2p^5(^2P^o_{3/2})3p$	$^2[1/2]$	1	148257.7898	SS04
		0	150917.4307	SS04
$2p^5(^2P^o_{3/2})3p$	$^2[5/2]$	3	149657.0393	SS04
		2	149824.2215	SS04
$2p^5(^2P^o_{3/2})3p$	$^2[3/2]$	1	150121.5922	SS04
		2	150315.8612	SS04
$2p^5(^2P^o_{1/2})3p$	$^2[3/2]$	1	150772.1118	SS04
		2	150858.5079	SS04
$2p^5(^2P^o_{1/2})3p$	$^2[1/2]$	1	151038.4524	SS04
		0	152970.7328	SS04
$2p^5(^2P^o_{3/2})4s$	$^2[3/2]^o$	2	158601.1152	SS04
		1	158795.9924	SS04
$2p^5(^2P^o_{1/2})4s$	$^2[1/2]^o$	0	159379.9935	SS04
		1	159534.6196	SS04

Energy Levels of Neutral Neon (Ne I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$2p^5(^2P^o_{3/2})3d$	$^2[1/2]^o$	0	161509.6305	SS04
		1	161524.1739	SS04
$2p^5(^2P^o_{3/2})3d$	$^2[7/2]^o$	4	161590.3412	SS04
		3	161592.1200	SS04
$2p^5(^2P^o_{3/2})3d$	$^2[3/2]^o$	2	161607.2609	SS04
		1	161636.6175	SS04
$2p^5(^2P^o_{3/2})3d$	$^2[5/2]^o$	2	161699.6613	SS04
		3	161701.4486	SS04
$2p^5(^2P^o_{1/2})3d$	$^2[5/2]^o$	2	162408.6536	SS04
		3	162410.1736	SS04
$2p^5(^2P^o_{1/2})3d$	$^2[3/2]^o$	2	162419.9818	SS04
		1	162435.6780	SS04
$2p^5(^2P^o_{1/2})4p$	$^2[1/2]$	0	164285.8872	SS04
$2p^5(^2P^o_{3/2})4d$	$^2[7/2]^o$	4	167000.0317	SS04
Ne II ($^2P^o_{3/2}$)		*Limit*	**173929.75**	KM72

Persistent Lines of Singly-ionized Neon (Ne II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
90	352.9549	6.69	$2s^22p^5$	$^2P^o$	3/2	0.00	P71	VVF96
			$2s^22p^4(^3P)4s$	^2P	3/2	283322.35		
60	354.9620	17.3	$2s^22p^5$	$^2P^o$	3/2	0.00	P71	VVF96
			$2s^22p^4(^3P)3d$	^2P	3/2	281720.28		
200	445.0397	13.1	$2s^22p^5$	$^2P^o$	3/2	0.00	P71	VVF96
			$2s^22p^4(^3P)3s$	^2P	1/2	224699.27		
300	446.2556	32.6	$2s^22p^5$	$^2P^o$	3/2	0.00	P71	VVF96
			$2s^22p^4(^3P)3s$	^2P	3/2	224087.02		
250	446.5901	26.0	$2s^22p^5$	$^2P^o$	1/2	780.34	P71	VVF96
			$2s^22p^4(^3P)3s$	^2P	1/2	224699.27		
1000	460.7284	53.9	$2s^22p^5$	$^2P^o$	3/2	0.00	P71	VVF96
			$2s2p^6$	^2S	1/2	217047.61		
500	462.3908	26.6	$2s^22p^5$	$^2P^o$	1/2	780.34	P71	VVF96
			$2s2p^6$	^2S	1/2	217047.61		
500	1916.083	0.69	$2s^22p^4(^3P)3s$	^2P	3/2	224087.02	P71	FW96
			$2s^22p^4(^1D)3p$	$^2P^o$	3/2	276276.85		
300	1930.028	0.57	$2s^22p^4(^3P)3s$	^2P	1/2	224699.27	P71	FW96
			$2s^22p^4(^1D)3p$	$^2P^o$	1/2	276511.82		
300	3027.016	1.4	$2s^22p^4(^3P)3p$	$^4P^o$	5/2	246192.45	P71	FW96
			$2s^22p^4(^3P)3d$	^4D	5/2	279218.66		
300	3028.864	0.47	$2s^22p^4(^3P)3s$	^4P	1/2	219947.46	P71	FW96
			$2s^22p^4(^3P)3p$	$^4S^o$	3/2	252953.54		

Persistent Lines of Singly-ionized Neon (Ne II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3198.586	1.7	$2s^22p^4(^3P)3p$	$^4D^o$	5/2	249445.99	P71	FW96
			$2s^22p^4(^3P)3d$	^2F	7/2	280700.77		
1000	3323.745	1.6	$2s^22p^4(^3P)3s$	^2P	3/2	224087.02	P71	FW96
			$2s^22p^4(^3P)3p$	$^2P^o$	3/2	254165.01		
500	3378.216	1.7	$2s^22p^4(^3P)3s$	^2P	1/2	224699.27	P71	FW96
			$2s^22p^4(^3P)3p$	$^2P^o$	1/2	254292.19		
800	3766.259	0.29	$2s^22p^4(^3P)3s$	^4P	3/2	219648.44	P71	FW96
			$2s^22p^4(^3P)3p$	$^4P^o$	5/2	246192.45		
1000	3777.133	0.42	$2s^22p^4(^3P)3s$	^4P	1/2	219947.46	P71	FW96
			$2s^22p^4(^3P)3p$	$^4P^o$	3/2	246415.04		

Energy Levels of Singly-ionized Neon (Ne II)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^22p^5$	$^2P^o$	3/2	0.00	P71
		1/2	780.34	P71
$2s2p^6$	^2S	1/2	217047.61	P71
$2s^22p^4(^3P)3s$	^4P	5/2	219130.78	P71
		3/2	219648.44	P71
		1/2	219947.46	P71
$2s^22p^4(^3P)3s$	^2P	3/2	224087.02	P71
		1/2	224699.27	P71
$2s^22p^4(^3P)3p$	$^4P^o$	5/2	246192.45	P71
		3/2	246415.04	P71
		1/2	246597.71	P71
$2s^22p^4(^1D)3s$	^2D	5/2	246394.13	P71
		3/2	246397.49	P71
$2s^22p^4(^3P)3p$	$^4D^o$	7/2	249108.64	P71
		5/2	249445.99	P71
		3/2	249695.53	P71
		1/2	249839.63	P71
$2s^22p^4(^3P)3p$	$^2S^o$	1/2	252798.48	P71
$2s^22p^4(^3P)3p$	$^4S^o$	3/2	252953.54	P71
$2s^22p^4(^3P)3p$	$^2P^o$	3/2	254165.01	P71
		1/2	254292.19	P71
$2s^22p^4(^1D)3p$	$^2P^o$	3/2	276276.85	P71
		1/2	276511.82	P71
$2s^22p^4(^1S)3s$	^2S	1/2	276677.13	P71
$2s^22p^4(^3P)3d$	^4D	5/2	279218.66	P71
$2s^22p^4(^3P)3d$	^2F	7/2	280700.77	P71
$2s^22p^4(^3P)3d$	^2P	3/2	281720.28	P71
$2s^22p^4(^3P)4s$	^2P	3/2	283322.35	P71
Ne III ($^3P_2$)		*Limit*	**330388.6**	P71

Neptunium (Np)

Atomic number = 93

Atomic weight = 237.0482

Isotope	Mass	Abundance	Spin	Mag moment
^{237}Np	237.048167	0	5/2	+3.14

Np I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^4 6d 7s^2$ $^6L_{11/2}$
Ionization energy: 50 536 cm^{-1} (6.2657 eV)

Np II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^4 6d 7s$ $^7L_5$
Ionization energy: not available

Strong Lines of Neptunium (Np)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
300 P	3481.93	Np I	FTBC76
300 P,h	3501.50	Np I	FTBC76
300 P,l	3986.89	Np I	FTBC76
300 P,s	5044.66	Np I	FTBC76
1000 P	5380.98	Np II	FTBC76
300 P,l	5878.04	Np I	FTBC76
300 P,s	6930.31	Np I	FTBC76
1000 P,s	6972.09	Np I	FTBC76
300 P,l	7735.14	Np I	FTBC76
300 P,l	7765.75	Np I	FTBC76
300 P,l	7791.38	Np I	FTBC76
300 P,l	8339.12	Np I	FTBC76
1000 P	8372.88	Np I	FTBC76
1000 P	8529.96	Np I	FTBC76
300 s	8696.23	Np I	FTBC76
300 s	8906.02	Np I	FTBC76
300	8942.70	Np I	FTBC76
300 s	9004.75	Np I	FTBC76
300 l	9006.31	Np I	FTBC76
1000 P,l	9016.18	Np I	FTBC76
300 l	9141.30	Np I	FTBC76
300 P,s	9379.33	Np I	FTBC76
300 P,l	9468.66	Np I	FTBC76
300 s	9679.13	Np I	FTBC76
300 l	9930.55	Np I	FTBC76
300 P,l	10091.99	Np I	FTBC76
300 P,s	10817.45	Np I	FTBC76
300 l	11695.15	Np I	FTBC76
300 P,l	11776.64	Np I	FTBC76
300 s	12148.18	Np I	FTBC76
300 P,s	12377.42	Np I	FTBC76
300 l	12407.99	Np I	FTBC76
300 l	13834.33	Np I	FTBC76

Persistent Lines of Neutral Neptunium (Np I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	3481.93		$5f^4(^5I)6d7s^2$	^6L	11/2	0.000	FTBC76	
				o	13/2	28711.465		
300	3501.50		$5f^4(^5I)6d7s^2$	^6L	11/2	0.000	FTBC76	
				o	13/2	28551.035		
300	3986.89		$5f^4(^5I)6d7s^2$	^6L	11/2	0.000	FTBC76	
				o	13/2	25075.145		
300	5044.66		$5f^4(^5I)6d7s^2$	^6K	9/2	2033.965	FTBC76	
				o	9/2	21851.300		
300	5878.04		$5f^4(^5I)6d7s^2$	^6L	11/2	0.000	FTBC76	
			$5f^46d7s7p$	$^6M^o$	13/2	17007.700		
300	6930.31		$5f^4(^5I)6d7s^2$	^6K	9/2	2033.965	FTBC76	
			$5f^4(^5I)6d7s7p$	$^8L^o$	9/2	16459.340		
1000	6972.09		$5f^4(^5I)6d7s^2$	^6L	11/2	0.000	FTBC76	
			$5f^4(^5I)6d7s7p$	$^8M^o$	11/2	14338.880		
300	7735.14		$5f^4(^5I)6d7s^2$	^6L	15/2	6903.440	FTBC76	
			$5f^4(^5I)6d7s7p$	$^8M^o$	15/2	19827.885		
300	7765.75		$5f^4(^5I)6d^2(^3F)7s$	^8M	11/2	7112.430	FTBC76	
				o	9/2	19985.980		
300	7791.38		$5f^4(^5I)6d7s^2$	^6L	13/2	3502.855	FTBC76	
			$5f^4(^5I)6d7s7p$	$^8M^o$	13/2	16334.010		
300	8339.12		$5f^4(^5I)6d^2(^3F)7s$	^8M	11/2	7112.430	FTBC76	
				o	9/2	19100.810		
1000	8372.88		$5f^4(^5I)6d7s^2$	^6L	11/2	0.000	FTBC76	
			$5f^4(^5I_4)7s^27p_{1/2}$	o	9/2	11940.075		
1000	8529.96		$5f^4(^5I)6d7s^2$	^6G	3/2	6474.180	FTBC76	
			$5f^4(^5I_4)7s^27p_{3/2}$	o	5/2	18194.400		
1000	9016.18		$5f^4(^5I)6d^2(^3F)7s$	^8M	11/2	7112.430	FTBC76	
				o	9/2	18200.530		
300	10091.99		$5f^4(^5I)6d7s^2$	^6K	9/2	2033.965	FTBC76	
			$5f^4(^5I_4)7s^27p_{1/2}$	o	9/2	11940.075		
300	10817.45		$5f^4(^5I)6d7s^2$	^6I	7/2	3450.995	FTBC76	
			$5f^4(^5I_4)7s^27p_{1/2}$	o	7/2	12692.765		
300	11776.64		$5f^4(^5I)6d7s^2$	^6I	7/2	3450.995	FTBC76	
			$5f^4(^5I_4)7s^27p_{1/2}$	o	9/2	11940.075		
300	12377.42		$5f^4(^5I)6d7s^2$	^4G	5/2	4615.670	FTBC76	
			$5f^4(^5I_4)7s^27p_{1/2}$	o	7/2	12692.765		

Energy Levels of Neutral Neptunium (Np I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^4(^5I)6d7s^2$	^6L	11/2	0.000	BW92b
		13/2	3502.855	BW92b
		15/2	6903.440	BW92b
		17/2	10020.990	BW92b
		19/2	12930.155	BW92b
		21/2	16051.925	BW92b
$5f^4(^5I)6d7s^2$	^6K	9/2	2033.965	BW92b
		11/2	5185.015	BW92b
		13/2	7792.035	BW92b
		15/2	10502.850	BW92b
		17/2	12948.015	BW92b
		19/2	15319.605	BW92b
$5f^4(^5I)6d7s^2$	^6I	7/2	3450.995	BW92b
		9/2	6643.510	BW92b
		11/2	9694.045	BW92b
		13/2	11382.815	BW92b
		15/2	13049.900	BW92b
		17/2	14870.460	BW92b
$5f^4(^5I)6d7s^2$	^4G	5/2	4615.670	BW92b
$5f^4(^5I)6d7s^2$	^6G	3/2	6474.180	BW92b
$5f^4(^5I)6d7s^2$		7/2	6892.085	BW92b
$5f^4(^5I)6d7s^2$	^6H	5/2	7015.155	BW92b
$5f^4(^5I)6d^2(^3F)7s$	^8M	11/2	7112.430	BW92b
$5f^4(^5I_4)7s^27p_{1/2}$	^{o}	9/2	11940.075	BW92b
		7/2	12692.765	BW92b
$5f^4(^5I)6d7s7p$	$^8M^o$	11/2	14338.880	BW92b
$5f^4(^5I_4)7s^27p_{1/2}$	^{o}	11/2	15743.235	BW92b
$5f^4(^5I)6d7s7p$	$^8M^o$	13/2	16334.010	BW92b
$5f^4(^5I)6d7s7p$	$^8L^o$	9/2	16459.340	BW92b
$5f^46d7s7p$	$^6M^o$	13/2	17007.700	BW92b
$5f^4(^5I_4)7s^27p_{3/2}$	^{o}	5/2	18194.400	BW92b
	^{o}	9/2	18200.530	BW92b
	^{o}	9/2	19100.810	BW92b
$5f^4(^5I)6d7s7p$	$^8M^o$	15/2	19827.885	BW92b
	^{o}	9/2	19985.980	BW92b
	^{o}	9/2	21851.300	BW92b
	^{o}	13/2	25075.145	BW92b
	^{o}	13/2	28551.035	BW92b
	^{o}	13/2	28711.465	BW92b
Np II ($5f^46d7s$ $^7L_5$)		*Limit*	**50536**	KDEE97

Persistent Lines of Singly-ionized Neptunium (Np II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	5380.98		$5f^4 6d7s$	^7I	4	5451.830	FTBC76	
			$5f^4 7s7p$	^{o}	4	24030.585		

Energy Levels of Singly-ionized Neptunium (Np II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^4 6d7s$	^7L	5	0.000	BW92b
$5f^4 7s^2$	^5I	4	24.270	BW92b
$5f^5(^6H^o_{5/2})7s$	$(5/2,1/2)^o$	2	83.490	BW92b
		3	1053.100	BW92b
$5f^4 6d7s$	^7L	6	1774.150	BW92b
$5f^4 6d7s$	^7K	4	2473.180	BW92b
$5f^4 7s^2$	^5I	5	3836.145	BW92b
$5f^4 6d7s$	^7K	5	4007.270	BW92b
$5f^4 6d7s$	^7I	3	4209.465	BW92b
$5f^4 6d7s$	^7L	7	4797.670	BW92b
$5f^4 6d7s$	^5L	6	5068.225	BW92b
$5f^4 6d7s$	^7I	4	5451.830	BW92b
$5f^4 7s7p$	^{o}	4	24030.585	BW92b
Np III ($5f^5\ ^6H^o_{5/2}$)		*Limit*		

Nickel (Ni)
Atomic number = 28
Atomic weight = 58.69

Isotope	Mass	Abundance	Spin	Mag moment
^{58}Ni	57.935346	68.27%	0	
^{60}Ni	59.930788	26.10%	0	
^{61}Ni	60.931058	1.13%	3/2	−0.75002
^{62}Ni	61.928346	3.59%	0	
^{64}Ni	63.927968	0.91%	0	

Ni I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 4s^2\ {}^3F_4$
Ionization energy: 61 619 cm^{-1} (7.6398 eV)

Ni II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9\ {}^2D_{5/2}$
Ionization energy: 146 541.56 cm^{-1} (18.168 84 eV)

Strong Lines of Nickel (Ni)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
150 P	1741.547	Ni II	S70
	Air		
150 P	2165.553	Ni II	S70
300	2169.096	Ni II	S70
300 P	2174.666	Ni II	S70
250	2175.147	Ni II	S70
130	2180.473	Ni II	S70
130	2184.605	Ni II	S70
400 P	2185.504	Ni II	S70
500 P	2192.090	Ni II	S70
100	2201.409	Ni II	S70
800 P	2205.548	Ni II	S70
700 P	2206.715	Ni II	S70
1000 P	2216.482	Ni II	S70
130	2220.402	Ni II	S70
150	2222.957	Ni II	S70
150	2264.461	Ni II	S70
300 P	2270.214	Ni II	S70
130	2277.282	Ni II	S70
130	2278.770	Ni II	S70
200	2289.987	Ni I	LBT93
80	2300.781	Ni I	LBT93
150	2302.996	Ni II	S70
250 P	2310.961	Ni I	LBT93
200	2312.344	Ni I	LBT93
150	2313.656	Ni I	LBT93
150	2313.983	Ni I	LBT93
150 P	2316.039	Ni II	S70
150	2317.165	Ni I	LBT93
300 P	2320.034	Ni I	LBT93
250	2321.383	Ni I	LBT93
150	2325.802	Ni I	LBT93
110	2329.970	Ni I	LBT93
60	2337.488	Ni I	LBT93
150 P	2345.543	Ni I	LBT93
50	2347.514	Ni I	LBT93
150	2375.418	Ni II	S70

Strong Lines of Nickel (Ni)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
150	2394.519	Ni II	S70
300	2416.134	Ni II	S70
60	2943.912	Ni I	LBT93
70	2981.646	Ni I	LBT93
60	2992.592	Ni I	LBT93
120	2994.453	Ni I	LBT93
500 P	3002.485	Ni I	LBT93
250	3003.621	Ni I	LBT93
500 P	3012.001	Ni I	LBT93
40	3019.143	Ni I	LBT93
200	3037.932	Ni I	LBT93
400 P	3050.816	Ni I	LBT93
200	3054.312	Ni I	LBT93
250	3057.639	Ni I	LBT93
60	3064.618	Ni I	LBT93
50	3080.752	Ni I	LBT93
300 P	3101.557	Ni I	LBT93
150	3101.878	Ni I	LBT93
400 P	3134.104	Ni I	LBT93
130	3232.933	Ni I	LBT93
70	3243.054	Ni I	LBT93
80	3297.600	Ni II	S70
80	3315.663	Ni I	LBT93
40	3320.259	Ni I	LBT93
40	3322.309	Ni I	LBT93
300	3331.875	Ni II	S70
100	3358.676	Ni II	S70
40	3361.554	Ni I	LBT93
40	3365.765	Ni I	LBT93
40	3366.166	Ni I	LBT93
400	3369.566	Ni I	LBT93
50	3371.987	Ni I	LBT93
400	3380.570	Ni I	LBT93
150	3391.043	Ni I	LBT93
400	3392.986	Ni I	LBT93
40	3413.476	Ni I	LBT93
40	3413.936	Ni I	LBT93
1000 P	3414.764	Ni I	LBT93
200	3423.708	Ni I	LBT93
300	3433.556	Ni I	LBT93
120	3437.278	Ni I	LBT93
600 P	3446.259	Ni I	LBT93
150	3452.889	Ni I	LBT93
600 P	3458.460	Ni I	LBT93
600 P	3461.652	Ni I	LBT93
200	3472.545	Ni I	LBT93
70	3483.777	Ni I	LBT93
700 P	3492.956	Ni I	LBT93
80	3500.851	Ni I	LBT93
300	3510.335	Ni I	LBT93
800 P	3515.052	Ni I	LBT93
80	3519.765	Ni I	LBT93
1000 P	3524.536	Ni I	LBT93
40	3548.182	Ni I	LBT93
600 P	3566.372	Ni I	LBT93
120	3571.864	Ni I	LBT93
150	3597.703	Ni I	LBT93
150	3610.462	Ni I	LBT93
60	3612.740	Ni I	LBT93

Strong Lines of Nickel (Ni)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
800 P	3619.391	Ni I	LBT93
70	3775.571	Ni I	LBT93
90	3783.530	Ni I	LBT93
90	3807.144	Ni I	LBT93
150	3858.297	Ni I	LBT93
80	4992.024	Ni II	S70
150	8096.75	Ni II	S70
120	8121.48	Ni II	S70

Persistent Lines of Neutral Nickel (Ni I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
250	2310.961		$3d^8(^3F)4s^2$	^3F	4	0.000	LBT93	
			$3d^8(^3F)4s4p(^1P^o)$	$^3F^o$	4	43258.726		
300	2320.034	6.94	$3d^8(^3F)4s^2$	^3F	4	0.000	LBT93	M03
			$3d^8(^3F)4s4p(^1P^o)$	$^3G^o$	5	43089.578		
150	2345.543	2.23	$3d^8(^3F)4s^2$	^3F	4	0.000	LBT93	M03
			$3d^8(^1D)4s4p(^3P^o)$	$^3D^o$	3	42620.994		
500	3002.485	0.903	$3d^9(^2D)4s$	^3D	3	204.787	LBT93	M03
			$3d^8(^3F)4s4p(^3P^o)$	$^3D^o$	3	33500.822		
500	3012.001	1.3	$3d^9(^2D)4s$	^1D	2	3409.937	LBT93	FW96
			$3d^8(^3F)4s4p(^3P^o)$	$^1D^o$	2	36600.791		
400	3050.816	0.604	$3d^9(^2D)4s$	^3D	3	204.787	LBT93	M03
			$3d^8(^3F)4s4p(^3P^o)$	$^3F^o$	4	32973.376		
300	3101.557	0.699	$3d^9(^2D)4s$	^3D	2	879.816	LBT93	M03
			$3d^8(^3F)4s4p(^3P^o)$	$^3F^o$	3	33112.334		
400	3134.104	0.749	$3d^9(^2D)4s$	^3D	1	1713.087	LBT93	M03
			$3d^8(^3F)4s4p(^3P^o)$	$^3D^o$	2	33610.890		
1000	3414.764	0.615	$3d^9(^2D)4s$	^3D	3	204.787	LBT93	M03
			$3d^9(^2D)4p$	$^3F^o$	4	29480.989		
600	3446.259	0.455	$3d^9(^2D)4s$	^3D	2	879.816	LBT93	M03
			$3d^9(^2D)4p$	$^3D^o$	2	29888.477		
600	3458.460	0.667	$3d^9(^2D)4s$	^3D	1	1713.087	LBT93	M03
			$3d^9(^2D)4p$	$^3F^o$	2	30619.414		
600	3461.652	0.278	$3d^9(^2D)4s$	^3D	3	204.787	LBT93	M03
			$3d^8(^3F)4s4p(^3P^o)$	$^5F^o$	4	29084.456		
700	3492.956	1.02	$3d^9(^2D)4s$	^3D	2	879.816	LBT93	M03
			$3d^9(^2D)4p$	$^3P^o$	1	29500.674		
800	3515.052	0.474	$3d^9(^2D)4s$	^3D	2	879.816	LBT93	M03
			$3d^9(^2D)4p$	$^3F^o$	3	29320.762		
1000	3524.536	1.09	$3d^9(^2D)4s$	^3D	3	204.787	LBT93	M03
			$3d^9(^2D)4p$	$^3P^o$	2	28569.203		
600	3566.372	0.56	$3d^9(^2D)4s$	^1D	2	3409.937	LBT93	FW96
			$3d^9(^2D)4p$	$^1D^o$	2	31441.635		

Persistent Lines of Neutral Nickel (Ni I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	3619.391	0.66	$3d^9(^2D)4s$	^1D	2	3409.937	LBT93	FW96
			$3d^9(^2D)4p$	$^1F^o$	3	31031.020		

Energy Levels of Neutral Nickel (Ni I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^8(^3F)4s^2$	^3F	4	0.000	LBT93
		3	1332.164	LBT93
		2	2216.550	LBT93
$3d^9(^2D)4s$	^3D	3	204.787	LBT93
		2	879.816	LBT93
		1	1713.087	LBT93
$3d^9(^2D)4s$	^1D	2	3409.937	LBT93
$3d^8(^1D)4s^2$	^1D	2	13521.347	LBT93
$3d^{10}$	^1S	0	14728.840	LBT93
$3d^8(^3P)4s^2$	^3P	2	15609.844	LBT93
		1	15734.001	LBT93
		0	16017.306	LBT93
$3d^8(^1G)4s^2$	^1G	4	22102.325	LBT93
$3d^8(^3F)4s4p(^3P^o)$	$^5D^o$	4	25753.553	LBT93
		3	26665.887	LBT93
		2	27414.868	LBT93
		1	27943.524	LBT93
		0	28212.998	LBT93
$3d^8(^3F)4s4p(^3P^o)$	$^5G^o$	6	27260.894	LBT93
		5	27580.391	LBT93
		4	28068.065	LBT93
		3	28578.018	LBT93
		2	29013.206	LBT93
$3d^8(^3F)4s4p(^3P^o)$	$^5F^o$	5	28542.105	LBT93
		4	29084.456	LBT93
		3	29832.779	LBT93
		2	30163.124	LBT93
		1	30392.003	LBT93
$3d^9(^2D)4p$	$^3P^o$	2	28569.203	LBT93
		1	29500.674	LBT93
		0	30192.251	LBT93
$3d^9(^2D)4p$	$^3F^o$	4	29480.989	LBT93
		3	29320.762	LBT93
		2	30619.414	LBT93
$3d^9(^2D)4p$	$^3D^o$	3	29668.893	LBT93
		2	29888.477	LBT93
		1	30912.817	LBT93
$3d^9(^2D)4p$	^{o}	3	29668.918	LBT93
$3d^8(^3F)4s4p(^3P^o)$	$^3G^o$	5	30922.734	LBT93
		4	30979.749	LBT93
		3	31786.162	LBT93

Energy Levels of Neutral Nickel (Ni I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^9(^2D)4p$	$^1F^o$	3	31031.020	LBT93
$3d^9(^2D)4p$	$^1D^o$	2	31441.635	LBT93
$3d^8(^3F)4s4p(^3P^o)$	$^3F^o$	4	32973.376	LBT93
		3	33112.334	LBT93
		2	34163.264	LBT93
$3d^9(^2D)4p$	$^1P^o$	1	32982.260	LBT93
$3d^8(^3F)4s4p(^3P^o)$	$^3D^o$	3	33500.822	LBT93
		2	33610.890	LBT93
		1	34408.555	LBT93
$3d^8(^3F)4s4p(^3P^o)$	$^1G^o$	4	33590.130	LBT93
$3d^8(^3F)4s4p(^3P^o)$	$^1F^o$	3	35639.122	LBT93
$3d^8(^3F)4s4p(^3P^o)$	$^1D^o$	2	36600.791	LBT93
$3d^8(^3P)4s4p(^3P^o)$	$^5P^o$	3	40361.249	LBT93
		2	40484.212	LBT93
		1	40768.996	LBT93
$3d^8(^1D)4s4p(^3P^o)$	$^3F^o$	4	42585.212	LBT93
		3	42767.853	LBT93
		2	42954.203	LBT93
$3d^9(^2D_{5/2})5s$	$^2[5/2]$	3	42605.945	LBT93
		2	42790.010	LBT93
$3d^8(^1D)4s4p(^3P^o)$	$^3D^o$	3	42620.994	LBT93
		2	42653.661	LBT93
		1	42656.289	LBT93
$3d^8(^3F)4s4p(^1P^o)$	$^3G^o$	5	43089.578	LBT93
		4	44314.904	LBT93
		3	44565.037	LBT93
$3d^8(^3F)4s4p(^1P^o)$	$^3F^o$	4	43258.726	LBT93
		3	45281.089	LBT93
		2	45418.804	LBT93
Ni II ($^2D_{5/2}$)		*Limit*	**61619**	PG90

Persistent Lines of Singly-ionized Nickel (Ni II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
150	1741.547	0.939	$3d^9$	^2D	5/2	0.00	S70	M03
			$3d^8(^3F)4p$	$^2D^o$	5/2	57420.16		
150	2165.553	2.36	$3d^8(^3F)4s$	^4F	9/2	8393.90	S70	FL99
			$3d^8(^3F)4p$	$^4F^o$	9/2	54557.05		
300	2174.666	1.56	$3d^8(^3F)4s$	^4F	7/2	9330.04	S70	FL99
			$3d^8(^3F)4p$	$^2G^o$	9/2	55299.65		
400	2185.504		$3d^8(^1D)4s$	^2D	5/2	25036.38	S70	
			$3d^8(^3P)4p$	$^4D^o$	7/2	70778.12		

Persistent Lines of Singly-ionized Nickel (Ni II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	2192.090		$3d^8(^3F)4p$	$^4G^o$	9/2	53365.17	S70	
			$3d^8(^3F)4d$	^2H	11/2	98969.44		
800	2205.548		$3d^8(^3F)4p$	$^4G^o$	11/2	53496.49	S70	
			$3d^8(^3F)4d$	^4H	13/2	98822.55		
700	2206.715	1.52	$3d^8(^3F)4s$	^4F	5/2	10115.66	S70	FL99
			$3d^8(^3F)4p$	$^4F^o$	7/2	55417.83		
1000	2216.482	3.57	$3d^8(^3F)4s$	^4F	9/2	8393.90	S70	FL99
			$3d^8(^3F)4p$	$^4G^o$	11/2	53496.49		
300	2270.214	1.61	$3d^8(^3F)4s$	^4F	7/2	9330.04	S70	FL99
			$3d^8(^3F)4p$	$^4G^o$	9/2	53365.17		
150	2316.039	2.90	$3d^8(^3F)4s$	^4F	9/2	8393.90	S70	FL99
			$3d^8(^3F)4p$	$^4D^o$	7/2	51557.85		

Energy Levels of Singly-ionized Nickel (Ni II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^9$	^2D	5/2	0.00	S70
		3/2	1506.94	S70
$3d^8(^3F)4s$	^4F	9/2	8393.90	S70
		7/2	9330.04	S70
		5/2	10115.66	S70
		3/2	10663.89	S70
$3d^8(^3F)4s$	^2F	7/2	13550.39	S70
		5/2	14995.57	S70
$3d^8(^3P)4s$	^4P	5/2	23108.28	S70
		3/2	24788.20	S70
		1/2	24835.93	S70
$3d^8(^1D)4s$	^2D	3/2	23796.18	S70
		5/2	25036.38	S70
$3d^8(^3P)4s$	^2P	3/2	29070.93	S70
		1/2	29593.46	S70
$3d^8(^1G)4s$	^2G	9/2	32499.53	S70
		7/2	32523.54	S70
$3d^74s^2$	^4F	9/2	51045.46	S70
		7/2	52205.95	S70
		5/2	53037.93	S70
		3/2	53601.19	S70
$3d^8(^3F)4p$	$^4D^o$	7/2	51557.85	S70
		5/2	52738.45	S70
		3/2	53634.62	S70
		1/2	54176.26	S70
$3d^8(^3F)4p$	$^4G^o$	9/2	53365.17	S70
		11/2	53496.49	S70
		7/2	54262.63	S70
		5/2	55018.71	S70

Energy Levels of Singly-ionized Nickel (Ni II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^8(^3F)4p$	$^4F^o$	9/2	54557.05	S70
		7/2	55417.83	S70
		5/2	56075.26	S70
		3/2	56424.49	S70
$3d^8(^3F)4p$	$^2G^o$	9/2	55299.65	S70
		7/2	56371.41	S70
$3d^8(^3F)4p$	$^2F^o$	7/2	57080.55	S70
		5/2	58493.21	S70
$3d^8(^3F)4p$	$^2D^o$	5/2	57420.16	S70
		3/2	58705.95	S70
$3d^8(^3P)4p$	$^4P^o$	5/2	66571.34	S70
		3/2	66579.71	S70
		1/2	67031.02	S70
$3d^8(^1D)4p$	$^2F^o$	5/2	67694.64	S70
		7/2	68131.21	S70
$3d^74s^2$	^4P	5/2	67880.16	S70
		3/2	68156.57	S70
		1/2	68709.76	S70
$3d^8(^1D)4p$	$^2D^o$	3/2	68154.31	S70
		5/2	68735.98	S70
$3d^8(^1D)4p$	$^2P^o$	1/2	68281.62	S70
		3/2	68965.65	S70
$3d^74s^2$	^2G	9/2	70358.94	S70
		7/2	71457.74	S70
$3d^8(^3P)4p$	$^4D^o$	5/2	70635.46	S70
		3/2	70706.77	S70
		1/2	70748.70	S70
		7/2	70778.12	S70
$3d^8(^3F)4d$	^4D	7/2	98467.25	S70
		5/2	99559.33	S70
		1/2	100010.17	S70
		3/2	100078.78	S70
$3d^8(^3F)4d$	^4P	5/2	98561.22	S70
		1/2	100845.41	S70
		3/2	100490.95	S70
$3d^8(^3F)4d$	^4H	13/2	98822.55	S70
		11/2	100309.29	S70
		9/2	100332.09	S70
		7/2	101144.63	S70
$3d^8(^3F)4d$	^2H	11/2	98969.44	S70
		9/2	101357.20	S70
Ni III ($^3F_4$)		*Limit*	**146541.56**	S70

Niobium (Nb)
Atomic number = 41
Atomic weight = 92.906 38

Isotope	Mass	Abundance	Spin	Mag moment
^{93}Nb	92.906377	100%	9/2	+6.1705

Nb I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^4 5s\ ^6D_{1/2}$
Ionization energy: 54 513.8 cm^{-1} (6.758 85 eV)

Nb II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^4\ ^5D_0$
Ionization energy: 113 000 cm^{-1} (14.0 eV)

Strong Lines of Niobium (Nb)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
1000 P	2029.3423	Nb II	RCL00
900 P	2033.0102	Nb II	RCL00
600 P	2109.4384	Nb II	RCL00
500	2125.2164	Nb II	RCL00
300	2126.5498	Nb II	RCL00
500	2131.1832	Nb II	RCL00
110	2295.6800	Nb II	RCL00
120	2544.806	Nb II	RCL00
120	2583.987	Nb II	RCL00
120	2590.943	Nb II	RCL00
15	2592.20	Nb I	MCS75
100	2646.254	Nb II	RCL00
20	2647.50	Nb I	MCS75
20	2654.45	Nb I	MCS75
300 P	2697.060	Nb II	RCL00
100 c	2698.860	Nb II	RCL00
100	2702.194	Nb II	RCL00
140 P	2716.622	Nb II	RCL00
140 P	2721.981	Nb II	RCL00
20	2758.61	Nb I	MCS75
20	2773.20	Nb I	MCS75
150	2868.515	Nb II	RCL00
250 P	2875.390	Nb II	RCL00
150	2877.038	Nb II	RCL00
150 P	2883.174	Nb II	RCL00
140	2897.806	Nb II	RCL00
140	2908.240	Nb II	RCL00
200	2910.587	Nb II	RCL00
140 c	2911.743	Nb II	RCL00
300 P	2927.814	Nb II	RCL00
250	2941.543	Nb II	RCL00
300 P	2950.882	Nb II	RCL00
120	2972.571	Nb II	RCL00
100	2974.094	Nb II	RCL00
100	2990.278	Nb II	RCL00
140	2994.728	Nb II	RCL00
110	3028.440	Nb II	RCL00
120	3076.865	Nb II	RCL00
500 P	3094.176	Nb II	RCL00
500 P	3130.782	Nb II	RCL00
120	3145.403	Nb II	RCL00

Strong Lines of Niobium (Nb)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400 P	3163.401	Nb II	RCL00
120	3180.285	Nb II	RCL00
300 P	3194.975	Nb II	RCL00
120	3215.593	Nb II	RCL00
250 P	3225.467	Nb II	RCL00
120	3236.410	Nb II	RCL00
100	3254.066	Nb II	RCL00
20	3296.01	Nb I	MCS75
25	3312.60	Nb I	MCS75
80 P	3341.97	Nb I	MCS75
80 P	3343.71	Nb I	MCS75
110 P	3349.06	Nb I	MCS75
25	3349.52	Nb I	MCS75
20	3354.74	Nb I	MCS75
110 P	3358.42	Nb I	MCS75
20	3366.96	Nb I	MCS75
20	3374.92	Nb I	MCS75
15	3380.41	Nb I	MCS75
20	3392.34	Nb I	MCS75
15	3408.38	Nb I	MCS75
20	3478.69	Nb I	MCS75
30	3498.63	Nb I	MCS75
30	3507.96	Nb I	MCS75
120 P	3535.30	Nb I	MCS75
80	3537.48	Nb I	MCS75
30	3544.02	Nb I	MCS75
20	3550.45	Nb I	MCS75
60	3554.66	Nb I	MCS75
40	3563.50	Nb I	MCS75
40	3563.62	Nb I	MCS75
90 P	3575.85	Nb I	MCS75
300 P	3580.27	Nb I	MCS75
30	3584.97	Nb I	MCS75
50	3589.11	Nb I	MCS75
30	3589.36	Nb I	MCS75
30	3593.97	Nb I	MCS75
30	3602.56	Nb I	MCS75
25	3649.85	Nb I	MCS75
120	3651.182	Nb II	RCL00
40	3660.37	Nb I	MCS75
60	3664.70	Nb I	MCS75
15	3674.78	Nb I	MCS75
90	3697.85	Nb I	MCS75
20	3711.34	Nb I	MCS75
200	3713.01	Nb I	MCS75
30	3716.99	Nb I	MCS75
150	3726.24	Nb I	MCS75
15	3738.42	Nb I	MCS75
150 P	3739.80	Nb I	MCS75
200	3740.714	Nb II	RCL00
15	3741.78	Nb I	MCS75
110	3742.39	Nb I	MCS75
30	3763.49	Nb I	MCS75
20	3765.08	Nb I	MCS75
30	3771.85	Nb I	MCS75
50	3781.01	Nb I	MCS75
110	3787.06	Nb I	MCS75
80	3790.15	Nb I	MCS75
200	3791.21	Nb I	MCS75

Strong Lines of Niobium (Nb)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
150	3798.12	Nb I	MCS75
15	3801.30	Nb I	MCS75
150	3802.92	Nb I	MCS75
40	3803.88	Nb I	MCS75
30	3804.74	Nb I	MCS75
40	3810.49	Nb I	MCS75
30	3811.03	Nb I	MCS75
30	3815.51	Nb I	MCS75
40	3824.88	Nb I	MCS75
20	3835.18	Nb I	MCS75
20	3858.95	Nb I	MCS75
20	3863.38	Nb I	MCS75
15	3867.92	Nb I	MCS75
30	3877.56	Nb I	MCS75
50	3878.82	Nb I	MCS75
40	3883.14	Nb I	MCS75
70	3885.44	Nb I	MCS75
40	3885.68	Nb I	MCS75
40	3891.30	Nb I	MCS75
40	3914.70	Nb I	MCS75
30	3920.20	Nb I	MCS75
40	3937.44	Nb I	MCS75
30	3943.67	Nb I	MCS75
60 d	3966.09	Nb I	MCS75
70	4032.52	Nb I	MCS75
1000 P,c	4058.94	Nb I	MCS75
20	4060.79	Nb I	MCS75
800 P	4079.73	Nb I	MCS75
15	4084.86	Nb I	MCS75
30	4100.40	Nb I	MCS75
400 P	4100.92	Nb I	MCS75
20	4116.90	Nb I	MCS75
300 P	4123.81	Nb I	MCS75
40	4129.43	Nb I	MCS75
50	4129.93	Nb I	MCS75
140	4137.10	Nb I	MCS75
30	4139.44	Nb I	MCS75
150	4139.71	Nb I	MCS75
20	4143.21	Nb I	MCS75
50	4150.12	Nb I	MCS75
300 P	4152.58	Nb I	MCS75
50	4163.47	Nb I	MCS75
300 P	4163.66	Nb I	MCS75
250 P	4164.66	Nb I	MCS75
200 P	4168.13	Nb I	MCS75
20	4184.44	Nb I	MCS75
80	4190.88	Nb I	MCS75
50	4192.07	Nb I	MCS75
50	4195.09	Nb I	MCS75
80	4195.66	Nb I	MCS75
20	4198.51	Nb I	MCS75
20	4201.52	Nb I	MCS75
50	4205.31	Nb I	MCS75
20	4214.73	Nb I	MCS75
25	4217.94	Nb I	MCS75
25	4229.15	Nb I	MCS75
50	4262.05	Nb I	MCS75
25	4266.02	Nb I	MCS75
20	4270.69	Nb I	MCS75

Strong Lines of Niobium (Nb)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
25	4286.99	Nb I	MCS75
40	4299.60	Nb I	MCS75
40	4300.99	Nb I	MCS75
25	4311.27	Nb I	MCS75
20	4326.33	Nb I	MCS75
25	4331.37	Nb I	MCS75
20	4351.57	Nb I	MCS75
20	4410.21	Nb I	MCS75
20	4447.18	Nb I	MCS75
30	4523.41	Nb I	MCS75
30	4546.82	Nb I	MCS75
25	4564.53	Nb I	MCS75
40	4573.08	Nb I	MCS75
30	4581.62	Nb I	MCS75
80	4606.77	Nb I	MCS75
30	4630.11	Nb I	MCS75
30	4648.95	Nb I	MCS75
30	4663.83	Nb I	MCS75
20	4666.24	Nb I	MCS75
40	4672.09	Nb I	MCS75
30	4675.37	Nb I	MCS75
20	4685.14	Nb I	MCS75
50	5078.96	Nb I	MCS75
25	5095.30	Nb I	MCS75
15	5160.33	Nb I	MCS75
15	5164.38	Nb I	MCS75
15	5271.53	Nb I	MCS75
15	5318.60	Nb I	MCS75
30	5344.17	Nb I	MCS75
20	5350.74	Nb I	MCS75
13 c,w	6660.84	Nb I	MCS75

Persistent Lines of Neutral Niobium (Nb I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
80	3341.97		$4d^35s^2$	a ^{4}F	3/2	1142.79	MCS75	
			$4d^35s(a^5F)5p$	x $^4G^o$	5/2	31056.60		
80	3343.71		$4d^35s^2$	a ^{4}F	5/2	1586.90	MCS75	
			$4d^35s(a^5F)5p$	x $^4G^o$	7/2	31485.20		
110	3349.06		$4d^35s^2$	a ^{4}F	7/2	2154.11	MCS75	
			$4d^35s(a^5F)5p$	x $^4G^o$	9/2	32004.63		
110	3358.42		$4d^35s^2$	a ^{4}F	9/2	2805.36	MCS75	
			$4d^35s(a^5F)5p$	x $^4G^o$	11/2	32572.72		
120	3535.30		$4d^4(a^5D)5s$	a ^{6}D	7/2	695.25	MCS75	
			$4d^35s(a^5P)5p$	y $^6P^o$	7/2	28973.12		
			$4d^4(a^5D)5s$	a ^{6}D	1/2	0.00		
			$4d^35s(a^5P)5p$	y $^6P^o$	3/2	28278.25		
90	3575.85		$4d^4(a^5D)5s$	a ^{6}D	7/2	695.25	MCS75	
			$4d^35s(a^5P)5p$	y $^6P^o$	5/2	28652.66		
300	3580.27		$4d^4(a^5D)5s$	a ^{6}D	9/2	1050.26	MCS75	
			$4d^35s(a^5P)5p$	y $^6P^o$	7/2	28973.12		

Persistent Lines of Neutral Niobium (Nb I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
150	3739.80	0.59	$4d^4(a^5D)5s$	a ^6D	7/2	695.25	MCS75	DHL86
			$4d^4(a^5D)5p$	x $^6D^o$	7/2	27427.07		
1000	4058.94	1.28	$4d^4(a^5D)5s$	a ^6D	9/2	1050.26	MCS75	DHL86
			$4d^4(a^5D)5p$	y $^6F^o$	11/2	25680.36		
			$4d^35s^2$	a ^2D	5/2	10237.51		
			$4d^35s(a^5P)5p$	x $^4P^o$	3/2	34867.68		
800	4079.73	0.99	$4d^4(a^5D)5s$	a ^6D	7/2	695.25	MCS75	DHL86
			$4d^4(a^5D)5p$	y $^6F^o$	9/2	25199.81		
400	4100.92	0.76	$4d^4(a^5D)5s$	a ^6D	5/2	391.99	MCS75	DHL86
			$4d^4(a^5D)5p$	y $^6F^o$	7/2	24769.91		
			$4d^4(b^3F)5s$	b ^4F	9/2	13145.71		
			$4d^4(c^3F)5p$	u $^4G^o$	9/2	37523.53		
300	4123.81	0.58	$4d^4(a^5D)5s$	a ^6D	3/2	154.19	MCS75	DHL86
			$4d^4(a^5D)5p$	y $^6F^o$	5/2	24396.80		
300	4152.58	0.38	$4d^4(a^5D)5s$	a ^6D	7/2	695.25	MCS75	DHL86
			$4d^4(a^5D)5p$	y $^6F^o$	7/2	24769.91		
300	4163.66	0.65	$4d^4(a^5D)5s$	a ^6D	3/2	154.19	MCS75	DHL86
			$4d^4(a^5D)5p$	y $^6F^o$	3/2	24164.79		
250	4164.66	0.50	$4d^4(a^5D)5s$	a ^6D	5/2	391.99	MCS75	DHL86
			$4d^4(a^5D)5p$	y $^6F^o$	5/2	24396.80		
200	4168.13	0.91	$4d^4(a^5D)5s$	a ^6D	1/2	0.00	MCS75	DHL86
			$4d^4(a^5D)5p$	y $^6F^o$	1/2	23984.87		

Energy Levels of Neutral Niobium (Nb I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^4(a^5D)5s$	a ^6D	1/2	0.00	M52
		3/2	154.19	M52
		5/2	391.99	M52
		7/2	695.25	M52
		9/2	1050.26	M52
$4d^35s^2$	a ^4F	3/2	1142.79	M52
		5/2	1586.90	M52
		7/2	2154.11	M52
		9/2	2805.36	M52
$4d^35s^2$	a ^4P	1/2	4998.17	M52
		3/2	5297.92	M52
		5/2	5965.45	M52
$4d^4(a^5D)5s$	a ^4D	1/2	8410.90	M52
		3/2	8705.32	M52
		5/2	9043.14	M52
		7/2	9497.52	M52
$4d^35s^2$	a ^2D	3/2	9439.08	M52
		5/2	10237.51	M52
$4d^4(b^3F)5s$	b ^4F	9/2	13145.71	M52

Energy Levels of Neutral Niobium (Nb I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^4(a^5D)5p$	y $^6F^o$	1/2	23984.87	M52
		3/2	24164.79	M52
		5/2	24396.80	M52
		7/2	24769.91	M52
		9/2	25199.81	M52
		11/2	25680.36	M52
$4d^4(a^5D)5p$	x $^6D^o$	7/2	27427.07	M52
$4d^35s(a^5P)5p$	y $^6P^o$	3/2	28278.25	M52
		5/2	28652.66	M52
		7/2	28973.12	M52
$4d^35s(a^5F)5p$	x $^4G^o$	5/2	31056.60	M52
		7/2	31485.20	M52
		9/2	32004.63	M52
		11/2	32572.72	M52
$4d^35s(a^5P)5p$	x $^4P^o$	3/2	34867.68	M52
$4d^4(c^3F)5p$	u $^4G^o$	9/2	37523.53	M52
Nb II ($^5D_0$)		*Limit*	**54513.8**	RMBH87

Persistent Lines of Singly-ionized Niobium (Nb II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2029.3423		$4d^3(^4F)5s$	^5F	5	4146.036	RCL00	
			$4d^2(^3F)5s5p(^3P)$	$^5D^o$	4	53407.279		
900	2033.0102		$4d^3(^4F)5s$	^5F	4	3542.561	RCL00	
			$4d^2(^3F)5s5p(^3P)$	$^5D^o$	3	52714.892		
600	2109.4384		$4d^3(^4F)5s$	^5F	5	4146.036	RCL00	
			$4d^2(^3F)5s5p(^3P)$	$^5F^o$	5	51537.014		
300	2697.0598	1.0	$4d^4$	^5D	4	1224.823	RCL00	M00
			$4d^3(^4F)5p$	$^5D^o$	4	38291.252		
140	2716.6220	0.43	$4d^4$	^5D	4	1224.823	RCL00	M00
			$4d^3(^4F)5p$	$^5F^o$	5	38024.336		
140	2721.9807	0.43	$4d^4$	^5D	3	801.326	RCL00	M00
			$4d^3(^4F)5p$	$^5F^o$	4	37528.382		
250	2875.3904		$4d^3(^4F)5s$	^5F	3	3029.629	RCL00	
			$4d^3(^4F)5p$	$^5D^o$	2	37797.316		
150	2883.1739		$4d^3(^4F)5s$	^5F	4	3542.561	RCL00	
			$4d^3(^4F)5p$	$^5D^o$	3	38216.387		
300	2927.8137		$4d^3(^4F)5s$	^5F	5	4146.036	RCL00	
			$4d^3(^4F)5p$	$^5D^o$	4	38291.252		
300	2950.8816		$4d^3(^4F)5s$	^5F	5	4146.036	RCL00	
			$4d^3(^4F)5p$	$^5F^o$	5	38024.336		
500	3094.1756		$4d^3(^4F)5s$	^5F	5	4146.036	RCL00	
			$4d^3(^4F)5p$	$^5G^o$	6	36455.457		

Persistent Lines of Singly-ionized Niobium (Nb II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3130.7824		$4d^3(^4F)5s$	^5F	4	3542.561	RCL00	
			$4d^3(^4F)5p$	$^5G^o$	5	35474.197		
400	3163.4006		$4d^3(^4F)5s$	^5F	3	3029.629	RCL00	
			$4d^3(^4F)5p$	$^5G^o$	4	34632.033		
300	3194.9747		$4d^3(^4F)5s$	^5F	2	2629.132	RCL00	
			$4d^3(^4F)5p$	$^5G^o$	3	33919.244		
250	3225.4667		$4d^3(^4F)5s$	^5F	1	2356.816	RCL00	
			$4d^3(^4F)5p$	$^5G^o$	2	33351.090		

Energy Levels of Singly-ionized Niobium (Nb II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^4$	^5D	0	0.000	RCL00
		1	158.984	RCL00
		2	438.361	RCL00
		3	801.326	RCL00
		4	1224.823	RCL00
$4d^3(^4F)5s$	^5F	1	2356.816	RCL00
		2	2629.132	RCL00
		3	3029.629	RCL00
		4	3542.561	RCL00
		5	4146.037	RCL00
$4d^4$	^3P	0	5562.241	RCL00
		1	6192.310	RCL00
		2	7261.324	RCL00
$4d^3(^2P)5s$	^3P	1	14626.199	RCL00
		2	14660.755	RCL00
		0	14678.318	RCL00
$4d^3(^4F)5p$	$^5G^o$	2	33351.090	RCL00
		3	33919.244	RCL00
		4	34632.033	RCL00
		5	35474.197	RCL00
		6	36455.457	RCL00
$4d^3(^4F)5p$	$^5F^o$	1	36731.805	RCL00
		2	36962.774	RCL00
		3	37376.901	RCL00
		4	37528.382	RCL00
		5	38024.336	RCL00
$4d^3(^4F)5p$	$^5D^o$	0	37298.242	RCL00
		1	37480.076	RCL00
		2	37797.316	RCL00
		3	38216.387	RCL00
		4	38291.252	RCL00
$4d^2(^3F)5s5p(^3P)$	$^5F^o$	5	51537.014	RCL00
$4d^2(^3F)5s5p(^3P)$	$^5D^o$	3	52714.892	RCL00
		4	53407.279	RCL00
Nb III ($^4F_{3/2}$)		*Limit*	**113000**	M52

Nitrogen (N)

Atomic number = 7
Atomic weight = 14.006 74

Isotope	Mass	Abundance	Spin	Mag moment
^{14}N	14.003074	99.63%	1	+0.40376
^{15}N	15.000108	0.37%	1/2	−0.28319

N I Ground state: $1s^2 2s^2 2p^3\ ^4S^o_{3/2}$
Ionization energy: 117 225.7 cm^{-1} (14.5341 eV)

N II Ground state: $1s^2 2s^2 2p^2\ ^3P_0$
Ionization energy: 238 750.3 cm^{-1} (29.6013 eV)

Strong Lines of Nitrogen (N)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
200 P	644.635	N II	E83
600 P	644.837	N II	E83
1000 P	645.179	N II	E83
80	692.70	N I	M75a
200 P	775.967	N II	E83
50 P	915.613	N II	E83
50 P	915.963	N II	E83
60 P,d	916.019	N II	E83
200 P,d	916.708	N II	E83
25 P	1083.994	N II	E83
60 P,d	1084.580	N II	E83
15 P	1085.550	N II	E83
100 P	1085.710	N II	E83
90	1134.165	N I	M75a
90	1134.415	N I	M75a
1000 P	1199.550	N I	M75a
700 P	1200.223	N I	M75a
300 P	1200.710	N I	M75a
250 P	1243.179	N I	M75a
90	1411.94	N I	M75a
250 P	1492.625	N I	M75a
120	1492.820	N I	M75a
150	1494.675	N I	M75a
200 P	1742.729	N I	M75a
150	1745.252	N I	M75a
	Air		
20	3955.85	N II	M75a
50 P	3995.00	N II	M75a
30	4041.31	N II	M75a
20	4241.78	N II	M75a
30 P	4447.03	N II	M75a
30	4601.48	N II	M75a
20	4607.16	N II	M75a
20	4621.39	N II	M75a
40 P	4630.54	N II	M75a
30	4643.08	N II	M75a
20	4803.29	N II	M75a
80	4963.98	N I	M75a
20	4994.36	N II	M75a
30	5001.48	N II	M75a

Strong Lines of Nitrogen (N)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40 P	5005.15	N II	M75a
30	5007.32	N II	M75a
20	5010.62	N II	M75a
30	5045.10	N II	M75a
30	5666.63	N II	M75a
30	5676.02	N II	M75a
40 P	5679.56	N II	M75a
20	5686.21	N II	M75a
20	5710.77	N II	M75a
150	5752.50	N I	M75a
30	5931.78	N II	M75a
30 P	5941.65	N II	M75a
40 P	6482.05	N II	M75a
90	6482.70	N I	M75a
40 P	6610.56	N II	M75a
150	7423.64	N I	M75a
200 P	7442.29	N I	M75a
200 P	7468.31	N I	M75a
90	8184.87	N I	M75a
90	8188.02	N I	M75a
140	8216.34	N I	M75a
90	8223.14	N I	M75a
90	8242.39	N I	M75a
30	8438.74	N II	M75a
120	8567.74	N I	M75a
140	8594.00	N I	M75a
150	8629.24	N I	M75a
120	8655.89	N I	M75a
150 P	8680.28	N I	M75a
150 P	8683.40	N I	M75a
120	8686.15	N I	M75a
120	8703.25	N I	M75a
140	8711.70	N I	M75a
120	8718.83	N I	M75a
120	9386.80	N I	M75a
140	9392.79	N I	M75a
80	10112.48	N I	M75a
90	10114.64	N I	M75a
90	12186.82	N I	M75a
200 P	12469.62	N I	M75a
120	13429.61	N I	M75a
200 P	13581.33	N I	M75a

Persistent Lines of Neutral Nitrogen (N I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1199.550	4.07	$2s^22p^3$	$^4S^o$	3/2	0.000	M75a	M03
			$2s^22p^2(^3P)3s$	^4P	5/2	83364.620		
700	1200.223	4.02	$2s^22p^3$	$^4S^o$	3/2	0.000	M75a	M03
			$2s^22p^2(^3P)3s$	^4P	3/2	83317.830		
300	1200.710	4.00	$2s^22p^3$	$^4S^o$	3/2	0.000	M75a	M03
			$2s^22p^2(^3P)3s$	^4P	1/2	83284.070		
250	1243.179	3.21	$2s^22p^3$	$^2D^o$	5/2	19224.464	M75a	WFD96
			$2s^22p^2(^1D)3s$	^2D	5/2	99663.427		

Persistent Lines of Neutral Nitrogen (N I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
250	1492.625	3.13	$2s^22p^3$	$^2D^o$	5/2	19224.464	M75a	WFD96
			$2s^22p^2(^3P)3s$	^2P	3/2	86220.510		
200	1742.729	1.16	$2s^22p^3$	$^2P^o$	3/2	28839.306	M75a	WFD96
			$2s^22p^2(^3P)3s$	^2P	3/2	86220.510		
200	7442.29	0.124	$2s^22p^2(^3P)3s$	^4P	3/2	83317.830	M75a	WFD96
			$2s^22p^2(^3P)3p$	$^4S^o$	3/2	96750.840		
200	7468.31	0.193	$2s^22p^2(^3P)3s$	^4P	5/2	83364.620	M75a	WFD96
			$2s^22p^2(^3P)3p$	$^4S^o$	3/2	96750.840		
150	8680.28	0.246	$2s^22p^2(^3P)3s$	^4P	5/2	83364.620	M75a	WFD96
			$2s^22p^2(^3P)3p$	$^4D^o$	7/2	94881.820		
150	8683.40	0.180	$2s^22p^2(^3P)3s$	^4P	3/2	83317.830	M75a	WFD96
			$2s^22p^2(^3P)3p$	$^4D^o$	5/2	94830.890		
200	12469.62	0.228	$2s^22p^2(^3P)3p$	$^2D^o$	5/2	96864.050	M75a	WFD96
			$2s^22p^2(^3P)3d$	^2F	7/2	104881.350		
200	13581.33	0.0639	$2s^22p^2(^3P)3s$	^2P	3/2	86220.510	M75a	WFD96
			$2s^22p^2(^3P)3p$	$^2S^o$	1/2	93581.550		

Energy Levels of Neutral Nitrogen (N I)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^22p^3$	$^4S^o$	3/2	0.000	M75a
$2s^22p^3$	$^2D^o$	5/2	19224.464	M75a
		3/2	19233.177	M75a
$2s^22p^3$	$^2P^o$	1/2	28838.920	M75a
		3/2	28839.306	M75a
$2s^22p^2(^3P)3s$	^4P	1/2	83284.070	M75a
		3/2	83317.830	M75a
		5/2	83364.620	M75a
$2s^22p^2(^3P)3s$	^2P	1/2	86137.350	M75a
		3/2	86220.510	M75a
$2s2p^4$	^4P	5/2	88107.260	M75a
		3/2	88151.170	M75a
		1/2	88170.570	M75a
$2s^22p^2(^3P)3p$	$^2S^o$	1/2	93581.550	M75a
$2s^22p^2(^3P)3p$	$^4D^o$	1/2	94770.880	M75a
		3/2	94793.490	M75a
		5/2	94830.890	M75a
		7/2	94881.820	M75a
$2s^22p^2(^3P)3p$	$^4P^o$	1/2	95475.310	M75a
		3/2	95493.690	M75a
		5/2	95532.150	M75a
$2s^22p^2(^3P)3p$	$^4S^o$	3/2	96750.840	M75a
$2s^22p^2(^3P)3p$	$^2D^o$	3/2	96787.680	M75a
		5/2	96864.050	M75a

Energy Levels of Neutral Nitrogen (N I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^2 2p^2(^3P)3p$	$^2P^o$	1/2	97770.180	M75a
		3/2	97805.840	M75a
$2s^2 2p^2(^1D)3s$	^2D	5/2	99663.427	M75a
		3/2	99663.912	M75a
$2s^2 2p^2(^3P)4s$	^4P	1/2	103622.51	M75a
		3/2	103667.16	M75a
		5/2	103735.48	M75a
$2s^2 2p^2(^3P)4s$	^2P	1/2	104144.820	M75a
		3/2	104221.630	M75a
$2s^2 2p^2(^3P)3d$	^2P	3/2	104615.470	M75a
		1/2	104654.030	M75a
$2s^2 2p^2(^3P)3d$	^4F	3/2	104664.130	M75a
		5/2	104683.060	M75a
		7/2	104716.950	M75a
		9/2	104765.77	M75a
$2s^2 2p^2(^3P)3d$	^2F	5/2	104810.360	M75a
		7/2	104881.350	M75a
N II ($^3P_0$)		*Limit*	**117225.7**	M75a

Persistent Lines of Singly-ionized Nitrogen (N II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
200	644.635	12.1	$2s^2(^1S)2p^2$	^3P	0	0.00	E83	WFD96
			$2s(^2S)2p^3$	$^3S^o$	1	155126.73		
600	644.837	36.4	$2s^2(^1S)2p^2$	^3P	1	48.67	E83	WFD96
			$2s(^2S)2p^3$	$^3S^o$	1	155126.73		
1000	645.179	60.7	$2s^2(^1S)2p^2$	^3P	2	130.80	E83	WFD96
			$2s(^2S)2p^3$	$^3S^o$	1	155126.73		
400	775.967	30.8	$2s^2(^1S)2p^2$	^1D	2	15316.17	E83	WFD96
			$2s(^2S)2p^3$	$^1D^o$	2	144187.94		
50	915.613	4.38	$2s^2(^1S)2p^2$	^3P	0	0.00	E83	WFD96
			$2s(^2S)2p^3$	$^3P^o$	1	109216.44		
50	915.963	13.2	$2s^2(^1S)2p^2$	^3P	1	48.67	E83	WFD96
			$2s(^2S)2p^3$	$^3P^o$	0	109223.34		
60	916.019	3.26	$2s^2(^1S)2p^2$	^3P	1	48.67	E83	WFD96
			$2s(^2S)2p^3$	$^3P^o$	2	109216.93		
		3.33	$2s^2(^1S)2p^2$	^3P	1	48.67		WFD96
			$2s(^2S)2p^3$	$^3P^o$	1	109216.44		
200	916.708	9.90	$2s^2(^1S)2p^2$	^3P	2	130.80	E83	WFD96
			$2s(^2S)2p^3$	$^3P^o$	2	109216.93		
		5.46	$2s^2(^1S)2p^2$	^3P	2	130.80	E83	WFD96
			$2s(^2S)2p^3$	$^3P^o$	1	109216.44		
25	1083.994	2.18	$2s^2(^1S)2p^2$	^3P	0	0.00	E83	WFD96
			$2s(^2S)2p^3$	$^3D^o$	1	92251.46		

Persistent Lines of Singly-ionized Nitrogen (N II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
60	1084.580	1.61	$2s^2(^1S)2p^2$	^3P	1	48.67	E83	WFD96
			$2s(^2S)2p^3$	$^3D^o$	1	92251.46		
		2.93	$2s^2(^1S)2p^2$	^3P	1	48.67		WFD96
			$2s(^2S)2p^3$	$^3D^o$	2	92249.91		
15	1085.550	0.947	$2s^2(^1S)2p^2$	^3P	2	130.80	E83	WFD96
			$2s(^2S)2p^3$	$^3D^o$	2	92249.91		
			$2s^2(^1S)2p^2$	^3P	2	130.80	E83	WFD96
			$2s(^2S)2p^3$	$^3D^o$	1	92251.46		
100	1085.710	3.87	$2s^2(^1S)2p^2$	^3P	2	130.80	E83	WFD96
			$2s(^2S)2p^3$	$^3D^o$	3	92236.46		
50	3995.00	1.35	$2s^22p(^2P^o)3s$	$^1P^o$	1	149187.80	M75a	WFD96
			$2s^22p(^2P^o)3p$	^1D	2	174212.03		
30	4447.03	1.14	$2s^22p(^2P^o)3p$	^1P	1	164610.76	M75a	WFD96
			$2s^22p(^2P^o)3d$	$^1D^o$	2	187091.37		
40	4630.54	0.772	$2s^22p(^2P^o)3s$	$^3P^o$	2	149076.52	M75a	WFD96
			$2s^22p(^2P^o)3p$	^3P	2	170666.23		
40	5005.15	1.16	$2s^22p(^2P^o)3p$	^3D	3	166678.64	M75a	WFD96
			$2s^22p(^2P^o)3d$	$^3F^o$	4	186652.49		
40	5679.56	0.525	$2s^22p(^2P^o)3s$	$^3P^o$	2	149076.52	M75a	WFD96
			$2s^22p(^2P^o)3p$	^3D	3	166678.64		
30	5941.65	0.554	$2s^22p(^2P^o)3p$	^3P	2	170666.23	M75a	WFD96
			$2s^22p(^2P^o)3d$	$^3D^o$	3	187491.90		
40	6482.05	0.301	$2s^22p(^2P^o)3s$	$^1P^o$	1	149187.80	M75a	WFD96
			$2s^22p(^2P^o)3p$	^1P	1	164610.76		
40	6610.56	0.634	$2s^22p(^2P^o)3p$	^1D	2	174212.03	M75a	WFD96
			$2s^22p(^2P^o)3d$	$^1F^o$	3	189335.16		

Energy Levels of Singly-ionized Nitrogen (N II)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^2(^1S)2p^2$	^3P	0	0.00	BVEC94
		1	48.67	BVEC94
		2	130.80	BVEC94
$2s^2(^1S)2p^2$	^1D	2	15316.17	S95
$2s^2(^1S)2p^2$	^1S	0	32688.64	E83
$2s(^2S)2p^3$	$^5S^o$	2	46784.56	E83
$2s(^2S)2p^3$	$^3D^o$	3	92236.46	E83
		2	92249.91	E83
		1	92251.46	E83
$2s(^2S)2p^3$	$^3P^o$	1	109216.44	E83
		2	109216.93	E83
		0	109223.34	E83
$2s(^2S)2p^3$	$^1D^o$	2	144187.94	M75a

Energy Levels of Singly-ionized Nitrogen (N II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^2 2p(^2P^o)3s$	$^3P^o$	0	148908.59	M75a
		1	148940.17	M75a
		2	149076.52	M75a
$2s^2 2p(^2P^o)3s$	$^1P^o$	1	149187.80	M75a
$2s(^2S)2p^3$	$^3S^o$	1	155126.73	M75a
$2s^2 2p(^2P^o)3p$	^1P	1	164610.76	M75a
$2s^2 2p(^2P^o)3p$	^3D	1	166521.69	M75a
		2	166582.45	M75a
		3	166678.64	M75a
$2s(^2S)2p^3$	$^1P^o$	1	166765.66	M75a
$2s^2 2p(^2P^o)3p$	^3S	1	168892.21	M75a
$2s^2 2p(^2P^o)3p$	^3P	0	170572.61	M75a
		1	170607.89	M75a
		2	170666.23	M75a
$2s^2 2p(^2P^o)3p$	^1D	2	174212.03	M75a
$2s^2 2p(^2P^o)3p$	^1S	0	178273.38	M75a
$2s^2 2p(^2P^o)3d$	$^3F^o$	2	186511.58	M75a
		3	186570.98	M75a
		4	186652.49	M75a
$2s^2 2p(^2P^o)3d$	$^1D^o$	2	187091.37	M75a
$2s^2 2p(^2P^o)3d$	$^3D^o$	1	187437.56	M75a
		2	187461.56	M75a
		3	187491.90	M75a
$2s^2 2p(^2P^o)3d$	$^3P^o$	2	188857.37	M75a
		1	188909.17	M75a
		0	188937.24	M75a
$2s^2 2p(^2P^o)3d$	$^1F^o$	3	189335.16	M75a
N III ($^2P^o_{1/2}$)		*Limit*	**238750.3**	E83

Osmium (Os)
Atomic number=76
Atomic weight=190.2

Isotope	Mass	Abundance	Spin	Mag moment
^{184}Os	183.952488	0.02%	0	
^{186}Os	185.953830	1.58%	0	
^{187}Os	186.955741	1.6%	1/2	+0.0646
^{188}Os	187.955860	13.3%	0	
^{189}Os	188.958137	16.1%	3/2	+0.6599
^{190}Os	189.958436	26.4%	0	
^{192}Os	191.961476	41.0%	0	

Os I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^6 6s^2\ {}^5D_4$
Ionization energy: 68 058.9 cm^{-1} (8.438 23 eV)

Os II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^6 6s\ {}^6D_{9/2}$
Ionization energy: not available

Strong Lines of Osmium (Os)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
300	2001.45	Os I	MCS75
400	2003.73	Os I	MCS75
300	2004.81	Os I	MCS75
600	2010.15	Os I	MCS75
1000 P	2018.14	Os I	MCS75
1000	2020.26	Os	MCS75
500	2022.76	Os I	MCS75
500	2028.23	Os I	MCS75
600 P	2034.44	Os I	MCS75
900 P	2045.36	Os I	MCS75
300*	2058.69	Os I	MCS75
300*	2058.78	Os I	MCS75
400	2061.69	Os I	MCS75
1000 P	2067.21	Os II	MCS75
500 P	2070.67	Os II	MCS75
250	2076.95	Os I	MCS75
250	2078.09	Os	MCS75
500 P	2079.97	Os I	MCS75
100	2082.54	Os I	MCS75
100	2089.03	Os I	MCS75
100	2089.21	Os I	MCS75
200	2097.60	Os I	MCS75
200	2100.63	Os I	MCS75
70	2117.66	Os I	MCS75
150	2117.96	Os I	MCS75
250	2119.79	Os	MCS75
70	2123.84	Os I	MCS75
200	2137.11	Os I	MCS75
80	2149.97	Os	MCS75
90	2154.59	Os I	MCS75
40	2157.84	Os I	MCS75
40	2158.53	Os I	MCS75
80	2161.00	Os	MCS75
110	2166.90	Os I	MCS75
40	2167.75	Os I	MCS75

Strong Lines of Osmium (Os)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
70	2171.65	Os I	MCS75
30	2184.68	Os I	MCS75
110 P	2194.39	Os II	MCS75
40	2234.61	Os I	MCS75
40	2252.15	Os I	MCS75
250 P	2255.85	Os II	MCS75
50	2264.60	Os I	MCS75
30	2270.17	Os I	MCS75
200 P	2282.26	Os II	MCS75
30	2283.67	Os I	MCS75
25	2308.31	Os I	MCS75
25	2313.75	Os II	MCS75
90 P	2336.80	Os II	MCS75
30	2350.23	Os II	MCS75
15	2355.28	Os II	MCS75
30	2362.77	Os I	MCS75
60 P	2367.35	Os II	MCS75
12	2375.06	Os II	MCS75
90	2377.03	Os I	MCS75
30	2379.39	Os I	MCS75
60	2387.29	Os I	MCS75
40	2395.88	Os I	MCS75
30	2401.13	Os I	MCS75
12	2405.08	Os II	MCS75
12	2420.02	Os II	MCS75
25	2423.07	Os II	MCS75
50	2424.97	Os I	MCS75
30	2450.74	Os I	MCS75
14	2454.91	Os II	MCS75
60	2461.42	Os I	MCS75
14	2468.90	Os II	MCS75
30	2476.84	Os I	MCS75
70 P	2486.24	Os II	MCS75
90	2498.41	Os I	MCS75
25	2512.87	Os I	MCS75
80	2513.25	Os I	MCS75
25	2515.04	Os I	MCS75
25	2518.44	Os I	MCS75
100 P	2538.00	Os II	MCS75
30	2542.51	Os I	MCS75
25	2563.16	Os II	MCS75
20	2566.49	Os I	MCS75
20	2578.32	Os II	MCS75
15	2580.03	Os II	MCS75
25	2581.96	Os I	MCS75
30	2590.76	Os I	MCS75
20	2596.00	Os II	MCS75
60	2613.06	Os I	MCS75
30	2619.94	Os I	MCS75
20	2621.82	Os I	MCS75
130 P	2637.13	Os I	MCS75
70	2644.11	Os I	MCS75
70	2658.60	Os I	MCS75
20	2659.83	Os I	MCS75
20	2674.57	Os I	MCS75
70	2689.82	Os I	MCS75
20	2699.59	Os I	MCS75
20	2706.70	Os I	MCS75
100 P	2714.64	Os I	MCS75

Strong Lines of Osmium (Os)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
20	2715.36	Os I	MCS75
40	2720.04	Os I	MCS75
30	2721.86	Os I	MCS75
20	2730.61	Os I	MCS75
20	2732.80	Os I	MCS75
25	2761.42	Os I	MCS75
30	2770.71	Os I	MCS75
25	2782.55	Os I	MCS75
20	2786.31	Os I	MCS75
20	2796.73	Os I	MCS75
100 P	2806.91	Os I	MCS75
25	2814.20	Os I	MCS75
200 P	2838.63	Os I	MCS75
25	2841.60	Os I	MCS75
80	2844.40	Os I	MCS75
50	2850.76	Os I	MCS75
50	2860.96	Os I	MCS75
300 P	2909.06	Os I	MCS75
70	2912.33	Os I	MCS75
20	2917.26	Os I	MCS75
70	2919.79	Os I	MCS75
20	2931.28	Os I	MCS75
40 h	2948.23	Os I	MCS75
50	2949.53	Os I	MCS75
20	2962.15	Os I	MCS75
25	2970.97	Os I	MCS75
20	2982.90	Os I	MCS75
20	3017.25	Os I	MCS75
150 P	3018.04	Os I	MCS75
40	3030.70	Os I	MCS75
100	3040.90	Os I	MCS75
15	3042.74	Os II	MCS75
300 P	3058.66	Os I	MCS75
20	3062.19	Os I	MCS75
40	3077.72	Os I	MCS75
20	3109.38	Os I	MCS75
110	3156.25	Os I	MCS75
25	3173.93	Os II	MCS75
20	3213.31	Os II	MCS75
70	3232.06	Os I	MCS75
110 P	3262.29	Os I	MCS75
110 P	3267.94	Os I	MCS75
20	3269.21	Os I	MCS75
20	3275.20	Os I	MCS75
40	3290.26	Os I	MCS75
250 P	3301.56	Os I	MCS75
20	3310.91	Os I	MCS75
30	3336.15	Os I	MCS75
30	3370.59	Os I	MCS75
20	3387.84	Os I	MCS75
20	3401.86	Os I	MCS75
20	3504.66	Os I	MCS75
40	3528.60	Os I	MCS75
30	3559.79	Os I	MCS75
40	3560.86	Os I	MCS75
20	3598.11	Os I	MCS75
12	3604.48	Os II	MCS75
130	3752.52	Os I	MCS75
70 P	3782.20	Os I	MCS75

Strong Lines of Osmium (Os)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
20	3790.14	Os I	MCS75
25	3876.77	Os I	MCS75
30	3963.63	Os I	MCS75
25	3977.23	Os I	MCS75
30	4066.69	Os I	MCS75
40	4112.02	Os I	MCS75
90	4135.78	Os I	MCS75
40	4173.23	Os I	MCS75
20	4175.63	Os I	MCS75
40	4211.86	Os I	MCS75
150 P	4260.85	Os I	MCS75
20	4293.95	Os I	MCS75
20	4311.40	Os I	MCS75
20	4394.86	Os I	MCS75
150 P	4420.47	Os I	MCS75
20	4550.41	Os I	MCS75
25	4793.99	Os I	MCS75
9	5202.63	Os I	MCS75
9	5523.53	Os I	MCS75
6	5721.93	Os I	MCS75
6	5780.82	Os I	MCS75

Persistent Lines of Neutral Osmium (Os I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2018.14		$5d^66s^2$	^{5}D	4	0.00	MCS75	
				^{o}	5	49534.28		
600	2034.44		$5d^66s^2$	^{5}D	4	0.00	MCS75	
				^{o}	3	49138.11		
900	2045.36		$5d^66s^2$	^{5}D	4	0.00	MCS75	
				^{o}	3	48874.93		
500	2079.97		$5d^66s^2$	^{5}D	4	0.00	MCS75	
				^{o}	5	48062.22		
130	2637.13		$5d^66s^2$	^{5}D	4	0.00	MCS75	
			$5d^66s(^4D)6p$	$^5D^o$	4	37908.77		
100	2714.64		$5d^66s^2$	^{5}D	4	0.00	MCS75	
			$5d^66s(^6D)6p$	$^5D^o$	4	36826.39		
100	2806.91		$5d^66s^2$	^{5}D	4	0.00	MCS75	
			$5d^66s(^6D)6p$	$^5P^o$	3	35615.92		
200	2838.63		$5d^7(^4F)6s$	^{5}F	5	5143.92	MCS75	
			$5d^66s(^4D)6p$	$^3F^o$	4	40361.92		
300	2909.06		$5d^66s^2$	^{5}D	4	0.00	MCS75	
			$5d^66s(^6D)6p$	$^5F^o$	5	34365.33		
150	3018.04		$5d^66s^2$	^{5}D	4	0.00	MCS75	
			$5d^66s(^6D)6p$	$^7P^o$	3	33124.48		
300	3058.66	0.29	$5d^66s^2$	^{5}D	4	0.00	MCS75	M00
			$5d^66s(^6D)6p$	$^7F^o$	4	32684.61		
			$5d^7(^4F)6s$	^{3}F	3	14091.37		
			$5d^7(^4F)6p$	$^3D^o$	3	46776.29		

Persistent Lines of Neutral Osmium (Os I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
110	3262.29		$5d^66s^2$	^5D	3	4159.32	MCS75	
			$5d^66s(^6D)6p$	$^5F^o$	4	34803.82		
110	3267.94	0.058	$5d^66s^2$	^5D	4	0.00	MCS75	M00
			$5d^66s(^6D)6p$	$^7P^o$	4	30591.45		
250	3301.56	0.099	$5d^66s^2$	^5D	4	0.00	MCS75	M00
			$5d^66s(^6D)6p$	$^7F^o$	5	30279.95		
70	3782.20		$5d^66s^2$	^5D	3	4159.32	MCS75	
			$5d^66s(^6D)6p$	$^7P^o$	4	30591.45		
150	4260.85		$5d^66s^2$	^5D	4	0.00	MCS75	
			$5d^66s(^6D)6p$	$^7D^o$	5	23462.90		
150	4420.47		$5d^66s^2$	^5D	4	0.00	MCS75	
			$5d^66s(^6D)6p$	$^7D^o$	4	22615.69		

Energy Levels of Neutral Osmium (Os I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^66s^2$	^5D	4	0.00	KK61
		3	4159.32	KK61
		2	2740.49	KK61
		1	5766.14	KK61
		0	6092.79	KK61
$5d^7(^4F)6s$	^5F	5	5143.92	KK61
		4	8742.83	KK61
		3	11378.00	KK61
		2	12774.38	KK61
		1	13020.07	KK61
$5d^66s^2$	^3P	2	10165.98	KK61
		1	17667.34	KK61
		0	18301.40	KK61
$5d^7(^4F)6s$	^3F	4	11030.58	KK61
		3	14091.37	KK61
		2	13364.83	KK61
$5d^66s(^6D)6p$	$^7D^o$	5	23462.90	KK61
		4	22615.69	KK61
		3	25012.93	KK61
		2	25275.42	KK61
		1	27786.79	KK61
$5d^66s(^6D)6p$	$^7F^o$	5	30279.95	KK61
		4	32684.61	KK61
$5d^66s(^6D)6p$	$^7P^o$	4	30591.45	KK61
		3	33124.48	KK61
$5d^66s(^6D)6p$	$^5F^o$	5	34365.33	KK61
		4	34803.82	KK61
$5d^66s(^6D)6p$	$^5P^o$	3	35615.92	KK61
$5d^66s(^6D)6p$	$^5D^o$	4	36826.39	KK61

Energy Levels of Neutral Osmium (Os I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^66s(^4D)6p$	$^5D^o$	4	37908.77	KK61
$5d^66s(^4D)6p$	$^3F^o$	4	40361.92	KK61
$5d^7(^4F)6p$	$^3D^o$	3	46776.29	KK61
	^{o}	5	48062.22	KK61
	^{o}	3	48874.93	KK61
	^{o}	3	49138.11	KK61
	^{o}	5	49534.28	KK61
Os II ($^6D_{9/2}$)		*Limit*	**68058.9**	CLS97

Persistent Lines of Singly-ionized Osmium (Os II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2067.21		$5d^6(^5D)6s$	^6D	7/2	3593.15	MCS75	
			$5d^6(^5D)6p$	$^6F^o$	9/2	51951.61		
500	2070.67		$5d^6(^5D)6s$	^6D	5/2	3928.94	MCS75	
			$5d^6(^5D)6p$	$^6F^o$	7/2	52206.48		
110	2194.39		$5d^6(^5D)6s$	^6D	7/2	3593.15	MCS75	
			$5d^56s(^7S)6p$	$^6P^o$	7/2	49149.39		
250	2255.85		$5d^6(^5D)6s$	^6D	9/2	0.00	MCS75	
			$5d^6(^5D)6p$	$^6D^o$	9/2	44315.40		
200	2282.26		$5d^6(^5D)6s$	^6D	9/2	0.00	MCS75	
			$5d^6(^5D)6p$	$^6D^o$	7/2	43802.36		
90	2336.80		$5d^6(^5D)6s$	^6D	7/2	3593.15	MCS75	
			$5d^6(^5D)6p$	$^6D^o$	5/2	46373.51		
60	2367.35		$5d^6(^5D)6s$	^6D	5/2	3928.94	MCS75	
			$5d^6(^5D)6p$	$^6D^o$	3/2	46157.19		
70	2486.24		$5d^6(^5D)6s$	^6D	7/2	3593.15	MCS75	
			$5d^6(^5D)6p$	$^6D^o$	7/2	43802.36		
100	2538.00		$5d^6(^5D)6s$	^6D	9/2	0.00	MCS75	
			$5d^56s(^7S)6p$	$^8P^o$	7/2	39389.49		

Energy Levels of Singly-ionized Osmium (Os II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^6(^5D)6s$	^6D	9/2	0.00	KK61
		7/2	3593.15	KK61
		5/2	3928.94	KK61
		3/2	5592.05	KK61
		1/2	6636.57	KK61
$5d^56s^2$	^6S	5/2	7891.93	KK61
$5d^6(^5D)6s$	^4D	7/2	11459.90	KK61
		5/2	11654.08	KK61
		3/2	13136.61	KK61

Energy Levels of Singly-ionized Osmium (Os II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^5 6s(^7S)6p$	$^8P^o$	5/2	37321.53	KK61
		7/2	39389.49	KK61
		9/2	41282.95	KK61
$5d^6(^5D)6p$	$^6D^o$	7/2	43802.36	KK61
		9/2	44315.40	KK61
		3/2	46157.19	KK61
		5/2	46373.51	KK61
$5d^6(^5D)6p$	$^6F^o$	5/2	48798.70	KK61
		9/2	51951.61	KK61
		7/2	52206.48	KK61
$5d^5 6s(^7S)6p$	$^6P^o$	7/2	49149.39	KK61
Os III ($^5D_4$)		*Limit*		

Oxygen (O)
Atomic number = 8
Atomic weight = 15.9994

Isotope	Mass	Abundance	Spin	Mag moment
^{16}O	15.994915	99.76%	0	
^{17}O	16.999311	0.048%	5/2	−1.89379
^{18}O	17.999160	0.20%	0	

O I Ground state: $1s^2 2s^2 2p^4\ ^3P_2$
Ionization energy: 109 837.02 cm^{-1} (13.618 05 eV)

O II Ground state: $1s^2 2s^2 2p^3\ ^4S^o_{3/2}$
Ionization energy: 283 270.9 cm^{-1} (35.1211 eV)

Strong Lines of Oxygen (O)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
400 P	429.918	O II	MKM93
700 P	430.041	O II	MKM93
1000 P	430.177	O II	MKM93
800 P	537.8319	O II	MKM93
1000 P	538.2636	O II	MKM93
600 P	538.318	O II	MKM93
800 P	539.0855	O II	MKM93
700 P	539.5489	O II	MKM93
500 P	539.8544	O II	MKM93
800 P	718.5036	O II	MKM93
500 P	718.5663	O II	MKM93
250	796.664	O II	MKM93
250	796.682	O II	MKM93
250 P	832.7587	O II	MKM93
400 P	833.3302	O II	MKM93
500 P	834.4655	O II	MKM93
50	988.773	O I	M75b
80	1025.762	O I	M75b
50	1039.230	O I	M75b
1000 P	1302.168	O I	M75b
700 P	1304.858	O I	M75b
300 P	1306.029	O I	M75b
	Air		
250	2445.538	O II	MKM93
250	2733.289	O II	MKM93
90	2972.29	O I	HHMR86
400 P	3134.720	O II	MKM93
250	3138.335	O II	MKM93
300	3287.472	O II	MKM93
250	3390.209	O II	MKM93
250	3470.676	O II	MKM93
250	3727.320	O II	MKM93
300	3749.486	O II	MKM93
400 P	3911.957	O II	MKM93
60	3947.29	O I	M75b
50	3947.48	O I	M75b
50	3947.59	O I	M75b
400 P	3973.2562	O II	MKM93
200	3982.7140	O II	MKM93

Strong Lines of Oxygen (O)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
250	4072.157	O II	MKM93
400 P	4075.862	O II	MKM93
250	4119.215	O II	MKM93
250	4185.449	O II	MKM93
400	4189.789	O II	MKM93
250	4317.138	O II	MKM93
250	4349.426	O II	MKM93
400 P	4414.905	O II	MKM93
250	4416.974	O II	MKM93
300	4590.972	O II	MKM93
250	4596.175	O II	MKM93
300 P	4641.810	O II	MKM93
400 P	4649.135	O II	MKM93
300	4661.633	O II	MKM93
250	4676.235	O II	MKM93
250	4705.352	O II	MKM93
130	6155.98	O I	M75b
150	6156.77	O I	M75b
150	6158.18	O I	M75b
130	6455.98	O I	M75b
150	7002.23	O I	M75b
130	7254.15	O I	M75b
150	7254.45	O I	M75b
300 P	7771.94	O I	M75b
250 P	7774.17	O I	M75b
250 P	7775.39	O I	M75b
130	8221.82	O I	M75b
250 P	8446.25	O I	M75b
300 P	8446.36	O I	M75b
300 P	8446.76	O I	M75b
150	9260.81	O I	M75b
150	9260.84	O I	M75b
150	9260.94	O I	M75b
130	9262.58	O I	M75b
200	9262.67	O I	M75b
200	9262.77	O I	M75b
150	9265.94	O I	M75b
200 P	9266.01	O I	M75b
200	11286.34	O I	M75b
200	11286.91	O I	M75b
150	11287.02	O I	M75b
150	11287.32	O I	M75b
150	11295.10	O I	M75b
200	11297.68	O I	M75b
200	11302.38	O I	M75b
150	12464.02	O I	M75b
150	12570.04	O I	M75b
250 P	13163.89	O I	M75b
250 P	13164.85	O I	M75b
200	13165.11	O I	M75b
200	18021.21	O I	M75b
200	18243.63	O I	M75b

Persistent Lines of Neutral Oxygen (O I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1302.168	3.15	$2s^22p^4$	^3P	2	0.000	M75b	M03
			$2s^22p^3(^4S^o)3s$	$^3S^o$	1	76794.978		
700	1304.858	1.87	$2s^22p^4$	^3P	1	158.265	M75b	M03
			$2s^22p^3(^4S^o)3s$	$^3S^o$	1	76794.978		
300	1306.029	0.623	$2s^22p^4$	^3P	0	226.977	M75b	M03
			$2s^22p^3(^4S^o)3s$	$^3S^o$	1	76794.978		
300	7771.94	0.369	$2s^22p^3(^4S^o)3s$	$^5S^o$	2	73768.200	M75b	WFD96
			$2s^22p^3(^4S^o)3p$	^5P	3	86631.454		
250	7774.17	0.369	$2s^22p^3(^4S^o)3s$	$^5S^o$	2	73768.200	M75b	WFD96
			$2s^22p^3(^4S^o)3p$	^5P	2	86627.778		
250	7775.39	0.369	$2s^22p^3(^4S^o)3s$	$^5S^o$	2	73768.200	M75b	WFD96
			$2s^22p^3(^4S^o)3p$	^5P	1	86625.757		
250	8446.25	0.322	$2s^22p^3(^4S^o)3s$	$^3S^o$	1	76794.978	M75b	WFD96
			$2s^22p^3(^4S^o)3p$	^3P	0	88631.303		
300	8446.36	0.322	$2s^22p^3(^4S^o)3s$	$^3S^o$	1	76794.978	M75b	WFD96
			$2s^22p^3(^4S^o)3p$	^3P	2	88631.146		
300	8446.76	0.322	$2s^22p^3(^4S^o)3s$	$^3S^o$	1	76794.978	M75b	WFD96
			$2s^22p^3(^4S^o)3p$	^3P	1	88630.587		
200	9266.01	0.445	$2s^22p^3(^4S^o)3p$	^5P	3	86631.454	M75b	WFD96
			$2s^22p^3(^4S^o)3d$	$^5D^o$	4	97420.630		
250	13163.89	0.0714	$2s^22p^3(^4S^o)3p$	^3P	1	88630.587	M75b	WFD96
			$2s^22p^3(^4S^o)4s$	$^3S^o$	1	96225.049		
250	13164.85	0.119	$2s^22p^3(^4S^o)3p$	^3P	2	88631.146	M75b	WFD96
			$2s^22p^3(^4S^o)4s$	$^3S^o$	1	96225.049		

Energy Levels of Neutral Oxygen (O I)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^22p^4$	^3P	2	0.000	MG93
		1	158.265	MG93
		0	226.977	MG93
$2s^22p^4$	^1D	2	15867.862	MG93
$2s^22p^4$	^1S	0	33792.583	MG93
$2s^22p^3(^4S^o)3s$	$^5S^o$	2	73768.200	MG93
$2s^22p^3(^4S^o)3s$	$^3S^o$	1	76794.978	MG93
$2s^22p^3(^4S^o)3p$	^5P	1	86625.757	MG93
		2	86627.778	MG93
		3	86631.454	MG93
$2s^22p^3(^4S^o)3p$	^3P	2	88631.146	MG93
		1	88630.587	MG93
		0	88631.303	MG93
$2s^22p^3(^4S^o)4s$	$^5S^o$	2	95476.728	MG93

Energy Levels of Neutral Oxygen (O I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^2 2p^3(^4S^o)4s$	$^3S^o$	1	96225.049	MG93
$2s^2 2p^3(^4S^o)3d$	$^5D^o$	4	97420.630	MG93
		3	97420.716	MG93
		2	97420.839	MG93
		1	97420.942	MG93
		0	97420.991	MG93
$2s^2 2p^3(^4S^o)3d$	$^3D^o$	1	97488.378	MG93
		2	97488.448	MG93
		3	97488.538	MG93
O II ($^4S^o_{3/2}$)		*Limit*	**109837.02**	MG93

Persistent Lines of Singly-ionized Oxygen (O II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	429.918	42.5	$2s^2 2p^3$	$^4S^o$	3/2	0.00	MKM93	WFD96
			$2s^2 2p^2(^3P)3d$	^4P	1/2	232602.492		
700	430.041	41.3	$2s^2 2p^3$	$^4S^o$	3/2	0.00	MKM93	WFD96
			$2s^2 2p^2(^3P)3d$	^4P	3/2	232535.949		
1000	430.177	43.6	$2s^2 2p^3$	$^4S^o$	3/2	0.00	MKM93	WFD96
			$2s^2 2p^2(^3P)3d$	^4P	5/2	232462.724		
800	537.8319	57.3	$2s^2 2p^3$	$^2D^o$	3/2	26830.57	MKM93	WFD96
			$2s2p^4$	^2P	1/2	212762.25		
1000	538.2636	51.8	$2s^2 2p^3$	$^2D^o$	5/2	26810.55	MKM93	WFD96
			$2s2p^4$	^2P	3/2	212593.82		
600	538.318	5.87	$2s^2 2p^3$	$^2D^o$	3/2	26830.57	MKM93	WFD96
			$2s2p^4$	^2P	3/2	212593.82		
800	539.0855	9.83	$2s^2 2p^3$	$^4S^o$	3/2	0.00	MKM93	WFD96
			$2s^2 2p^2(^3P)3s$	^4P	5/2	185499.124		
700	539.5489	9.81	$2s^2 2p^3$	$^4S^o$	3/2	0.00	MKM93	WFD96
			$2s^2 2p^2(^3P)3s$	^4P	3/2	185340.577		
500	539.8544	9.81	$2s^2 2p^3$	$^4S^o$	3/2	0.00	MKM93	WFD96
			$2s^2 2p^2(^3P)3s$	^4P	1/2	185235.281		
800	718.5036	19.0	$2s^2 2p^3$	$^2D^o$	5/2	26810.55	MKM93	WFD96
			$2s2p^4$	^2D	5/2	165988.46		
500	718.5663	18.5	$2s^2 2p^3$	$^2D^o$	3/2	26830.57	MKM93	WFD96
			$2s2p^4$	^2D	3/2	165996.50		
250	832.7587	8.67	$2s^2 2p^3$	$^4S^o$	3/2	0.00	MKM93	WFD96
			$2s2p^4$	^4P	1/2	120082.86		
400	833.3302	8.65	$2s^2 2p^3$	$^4S^o$	3/2	0.00	MKM93	WFD96
			$2s2p^4$	^4P	3/2	120000.43		
500	834.4655	8.61	$2s^2 2p^3$	$^4S^o$	3/2	0.00	MKM93	WFD96
			$2s2p^4$	^4P	5/2	119837.21		

Persistent Lines of Singly-ionized Oxygen (O II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	3134.720	1.23	$2s^22p^2(^3P)3p$	$^4D^o$	7/2	207002.482	MKM93	WFD96
			$2s^22p^2(^3P)4s$	^4P	5/2	238893.96		
400	3911.957	1.09	$2s^22p^2(^1D)3s$	^2D	5/2	206971.68	MKM93	WFD96
			$2s^22p^2(^1D)3p$	$^2P^o$	3/2	232527.09		
400	3973.256	1.02	$2s^22p^2(^3P)3s$	^2P	3/2	189068.514	MKM93	WFD96
			$2s^22p^2(^3P)3p$	$^2P^o$	3/2	214229.671		
400	4075.862	1.98	$2s^22p^2(^3P)3p$	$^4D^o$	7/2	207002.482	MKM93	WFD96
			$2s^22p^2(^3P)3d$	^4F	9/2	231530.246		
400	4414.905	0.847	$2s^22p^2(^3P)3s$	^2P	3/2	189068.514	MKM93	WFD96
			$2s^22p^2(^3P)3p$	$^2D^o$	5/2	211712.732		
300	4641.810	0.585	$2s^22p^2(^3P)3s$	^4P	3/2	185340.577	MKM93	WFD96
			$2s^22p^2(^3P)3p$	$^4D^o$	5/2	206877.865		
400	4649.135	0.784	$2s^22p^2(^3P)3s$	^4P	5/2	185499.124	MKM93	WFD96
			$2s^22p^2(^3P)3p$	$^4D^o$	7/2	207002.482		

Energy Levels of Singly-ionized Oxygen (O II)

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^22p^3$	$^4S^o$	3/2	0.00	MKM93
$2s^22p^3$	$^2D^o$	5/2	26810.55	MKM93
		3/2	26830.57	MKM93
$2s^22p^3$	$^2P^o$	3/2	40468.01	MKM93
		1/2	40470.00	MKM93
$2s2p^4$	^4P	5/2	119837.21	MKM93
		3/2	120000.43	MKM93
		1/2	120082.86	MKM93
$2s2p^4$	^2D	5/2	165988.46	MKM93
		3/2	165996.50	MKM93
$2s^22p^2(^3P)3s$	^4P	1/2	185235.281	MKM93
		3/2	185340.577	MKM93
		5/2	185499.124	MKM93
$2s^22p^2(^3P)3s$	^2P	1/2	188888.543	MKM93
		3/2	189068.514	MKM93
$2s2p^4$	^2S	1/2	195710.47	MKM93
$2s^22p^2(^3P)3p$	$^2S^o$	1/2	203942.288	MKM93
$2s^22p^2(^3P)3p$	$^4D^o$	1/2	206730.762	MKM93
		3/2	206786.286	MKM93
		5/2	206877.865	MKM93
		7/2	207002.482	MKM93
$2s^22p^2(^1D)3s$	^2D	5/2	206971.68	MKM93
		3/2	206972.72	MKM93
$2s^22p^2(^3P)3p$	$^4P^o$	1/2	208346.104	MKM93
		3/2	208392.258	MKM93
		5/2	208484.202	MKM93

Energy Levels of Singly-ionized Oxygen (O II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$2s^22p^2(^3P)3p$	$^2D^o$	3/2	211522.117	MKM93
		5/2	211712.732	MKM93
$2s^22p^2(^3P)3p$	$^4S^o$	3/2	212161.881	MKM93
$2s2p^4$	^2P	3/2	212593.82	MKM93
		1/2	212762.25	MKM93
$2s^22p^2(^3P)3p$	$^2P^o$	1/2	214169.920	MKM93
		3/2	214229.671	MKM93
$2s^22p^2(^1D)3p$	$^2F^o$	5/2	228723.84	MKM93
		7/2	228747.45	MKM93
$2s^22p^2(^1D)3p$	$^2D^o$	5/2	229947.07	MKM93
		3/2	229968.44	MKM93
$2s^22p^2(^1S)3s$	^2S	1/2	230609.45	MKM93
$2s^22p^2(^3P)3d$	^4F	3/2	231296.126	MKM93
		5/2	231350.087	MKM93
		7/2	231427.970	MKM93
		9/2	231530.246	MKM93
$2s^22p^2(^3P)3d$	^4P	5/2	232462.724	MKM93
		3/2	232535.949	MKM93
		1/2	232602.492	MKM93
$2s^22p^2(^1D)3p$	$^2P^o$	1/2	232480.44	MKM93
		3/2	232527.09	MKM93
$2s^22p^2(^3P)3d$	^4D	1/2	232711.642	MKM93
		3/2	232745.981	MKM93
		5/2	232747.562	MKM93
		7/2	232753.816	MKM93
$2s^22p^2(^3P)3d$	^2F	5/2	232796.298	MKM93
		7/2	232959.210	MKM93
$2s^22p^2(^3P)3d$	^2P	3/2	233430.53	MKM93
		1/2	233544.59	MKM93
$2s^22p^2(^3P)3d$	^2D	3/2	234402.797	MKM93
		5/2	234454.634	MKM93
$2s^22p^2(^3P)4s$	^4P	1/2	238627.46	MKM93
		3/2	238732.65	MKM93
		5/2	238893.96	MKM93
O III ($^3P_0$)		*Limit*	**283270.9**	MKM93

Palladium (Pd)

Atomic number = 46

Atomic weight = 106.42

Isotope	Mass	Abundance	Spin	Mag moment
^{102}Pd	101.905634	1.02%	0	
^{104}Pd	103.904029	11.14%	0	
^{105}Pd	104.905079	22.33%	5/2	−0.642
^{106}Pd	105.903478	27.33%	0	
^{108}Pd	107.903895	26.46%	0	
^{110}Pd	109.905167	11.72%	0	

Pd I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10}\ {}^1S_0$
Ionization energy: 67 242 cm^{-1} (8.3369 eV)

Pd II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^9\ {}^2D_{5/2}$
Ionization energy: 156 700 cm^{-1} (19.43 eV)

Strong Lines of Palladium (Pd)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
600 P	1162.1700	Pd II	LLTL01
700 P	1183.4003	Pd II	LLTL01
1000 P	1196.4051	Pd II	LLTL01
800 P	1203.9645	Pd II	LLTL01
600	1214.5242	Pd II	LLTL01
700 P	1218.6219	Pd II	LLTL01
600	1225.2684	Pd II	LLTL01
600	1235.1957	Pd II	LLTL01
700 P	1237.0677	Pd II	LLTL01
800 P	1320.0229	Pd II	LLTL01
700 P	1363.6892	Pd II	LLTL01
600	1365.5430	Pd II	LLTL01
800 P	1367.7039	Pd II	LLTL01
900 P	1374.8481	Pd II	LLTL01
	Air		
400 P	2231.5907	Pd II	LLJ94
700 P	2296.5164	Pd II	LLJ94
400 P	2351.3469	Pd II	LLJ94
800	2360.5341	Pd II	LLJ94
300 P	2367.9664	Pd II	LLJ94
500 P	2446.1888	Pd II	LLJ94
300 P	2447.9058	Pd I	ELLW98
250	2469.2517	Pd II	LLJ94
250 P	2476.4127	Pd I	ELLW98
400 P	2486.5260	Pd II	LLJ94
700 P	2488.9146	Pd II	LLJ94
400 P	2498.7769	Pd II	LLJ94
300	2505.7293	Pd II	LLJ94
300	2551.8452	Pd II	LLJ94
150	2565.5045	Pd II	LLJ94
100	2658.7201	Pd II	LLJ94
400 P	2763.0899	Pd I	ELLW98
40	2776.6595	Pd II	LLJ94
40 P	2854.5776	Pd II	LLJ94
100	3114.0380	Pd I	ELLW98
500 P	3242.6983	Pd I	ELLW98

Strong Lines of Palladium (Pd)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
110	3251.6361	Pd I	ELLW98
150	3258.7765	Pd I	ELLW98
150	3302.1262	Pd I	ELLW98
200	3372.9943	Pd I	ELLW98
1000 P	3404.5764	Pd I	ELLW98
500 P	3421.2214	Pd I	ELLW98
500	3433.4278	Pd I	ELLW98
250	3441.3896	Pd I	ELLW98
300 P	3460.7381	Pd I	ELLW98
400 P	3481.1516	Pd I	ELLW98
80	3489.7700	Pd I	ELLW98
500 P	3516.9438	Pd I	ELLW98
500 P	3553.0803	Pd I	ELLW98
200	3571.1489	Pd I	ELLW98
800 P	3609.5547	Pd I	ELLW98
800 P	3634.6884	Pd I	ELLW98
200	3690.3368	Pd I	ELLW98
90	3894.1988	Pd I	ELLW98
100	4212.9537	Pd I	ELLW98

Persistent Lines of Neutral Palladium (Pd I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	2447.9058	0.111	$4d^{10}$	^1S	0	0.000	ELLW98	M00
			$4d^9(^2D_{5/2})5p$	$^2[1/2]^o$	1	40838.874		
250	2476.4127	0.188	$4d^{10}$	^1S	0	0.000	ELLW98	M00
			$4d^9(^2D_{5/2})5p$	$^2[3/2]^o$	1	40368.796		
400	2763.0899	0.169	$4d^{10}$	^1S	0	0.000	ELLW98	M00
			$4d^9(^2D_{5/2})5p$	$^2[3/2]^o$	1	36180.677		
500	3242.6983	0.77	$4d^9(^2D_{5/2})5s$	$^2[5/2]$	3	6564.148	ELLW98	BGKZ82
			$4d^9(^2D_{5/2})5p$	$^2[5/2]^o$	3	37393.762		
1000	3404.5764	1.34	$4d^9(^2D_{5/2})5s$	$^2[5/2]$	3	6564.148	ELLW98	BGKZ82
			$4d^9(^2D_{5/2})5p$	$^2[7/2]^o$	4	35927.948		
500	3421.2214		$4d^9(^2D_{5/2})5s$	$^2[5/2]$	2	7755.025	ELLW98	
			$4d^9(^2D_{5/2})5p$	$^2[5/2]^o$	2	36975.973		
300	3460.7381	0.30	$4d^9(^2D_{5/2})5s$	$^2[5/2]$	3	6564.148	ELLW98	BGKZ82
			$4d^9(^2D_{5/2})5p$	$^2[7/2]^o$	3	35451.443		
400	3481.1516		$4d^9(^2D_{5/2})5s$	$^2[3/2]$	1	10093.992	ELLW98	
			$4d^9(^2D_{5/2})5p$	$^2[5/2]^o$	2	38811.896		
500	3516.9438	1.03	$4d^9(^2D_{5/2})5s$	$^2[5/2]$	2	7755.025	ELLW98	BGKZ82
			$4d^9(^2D_{5/2})5p$	$^2[3/2]^o$	1	36180.677		
500	3553.0803		$4d^9(^2D_{5/2})5s$	$^2[3/2]$	2	11721.809	ELLW98	
			$4d^9(^2D_{5/2})5p$	$^2[5/2]^o$	3	39858.361		
800	3609.5547	0.82	$4d^9(^2D_{5/2})5s$	$^2[5/2]$	2	7755.025	ELLW98	BGKZ82
			$4d^9(^2D_{5/2})5p$	$^2[7/2]^o$	3	35451.443		
800	3634.6884		$4d^9(^2D_{5/2})5s$	$^2[5/2]$	3	6564.148	ELLW98	
			$4d^9(^2D_{5/2})5p$	$^2[3/2]^o$	2	34068.977		

Energy Levels of Neutral Palladium (Pd I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^{10}$	^1S	0	0.000	ELLW98
$4d^9(^2D_{5/2})5s$	$^2[5/2]$	3	6564.148	ELLW98
		2	7755.025	ELLW98
$4d^9(^2D_{3/2})5s$	$^2[3/2]$	1	10093.992	ELLW98
		2	11721.809	ELLW98
$4d^85s^2$	^3F	4	25101.235	ELLW98
		3	28213.767	ELLW98
		2	29711.109	ELLW98
$4d^9(^2D_{5/2})5p$	$^2[3/2]^o$	2	34068.977	ELLW98
		1	36180.677	ELLW98
$4d^9(^2D_{5/2})5p$	$^2[7/2]^o$	3	35451.443	ELLW98
		4	35927.948	ELLW98
$4d^9(^2D_{5/2})5p$	$^2[5/2]^o$	2	36975.973	ELLW98
		3	37393.762	ELLW98
$4d^9(^2D_{3/2})5p$	$^2[1/2]^o$	0	38088.192	ELLW98
		1	40838.874	ELLW98
$4d^9(^2D_{3/2})5p$	$^2[5/2]^o$	2	38811.896	ELLW98
		3	39858.361	ELLW98
$4d^9(^2D_{3/2})5p$	$^2[3/2]^o$	1	40368.796	ELLW98
		2	40771.510	ELLW98
Pd II ($^2D_{5/2}$)		*Limit*	**67242**	CHR88a

Persistent Lines of Singly-ionized Palladium (Pd II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	1162.1700	3.36	$4d^9$	^2D	5/2	0.000	LLTL01	Q96
			$4d^8(^1G)5p$	$^2F^o$	7/2	86046.027		
700	1183.4003	13.9	$4d^9$	^2D	3/2	3539.242	LLTL01	Q96
			$4d^8(^3P)5p$	$^2P^o$	1/2	88041.479		
1000	1196.4051	6.62	$4d^9$	^2D	3/2	3539.242	LLTL01	Q96
			$4d^8(^1G)5p$	$^2F^o$	5/2	87122.977		
800	1203.9645	4.54	$4d^9$	^2D	5/2	0.000	LLTL01	Q96
			$4d^85p$	7^o	7/2	83058.993		
700	1218.6219	2.63	$4d^9$	^2D	5/2	0.000	LLTL01	Q96
			$4d^8(^1D)5p$	$^2D^o$	5/2	82059.859		
700	1237.0677	3.97	$4d^9$	^2D	3/2	3539.242	LLTL01	Q96
			$4d^8(^3P)5p$	$^2D^o$	3/2	84375.505		
800	1320.0229	4.68	$4d^9$	^2D	5/2	0.000	LLTL01	Q96
			$4d^8(^3F)5p$	3^o	5/2	75756.251		
700	1363.6892	0.578	$4d^9$	^2D	5/2	0.000	LLTL01	Q96
			$4d^8(^3F)5p$	$^4F^o$	7/2	73330.436		
800	1367.7039	2.54	$4d^9$	^2D	5/2	0.000	LLTL01	Q96
			$4d^8(^3F)5p$	2^o	5/2	73115.191		

Persistent Lines of Singly-ionized Palladium (Pd II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
900	1374.8481	1.27	$4d^9$	^2D	5/2	0.000	LLTL01	Q96
			$4d^8(^3F)5p$	$^4F^o$	5/2	72735.273		
400	2231.5907		$4d^8(^3F)5s$	^4F	9/2	25084.270	LLJ94	
			$4d^8(^3F)5p$	$^4F^o$	9/2	69881.432		
700	2296.5164		$4d^8(^3F)5s$	^4F	9/2	25084.270	LLJ94	
			$4d^8(^3F)5p$	$^4G^o$	11/2	68615.072		
400	2351.3469		$4d^8(^3F)5s$	^4F	7/2	27097.084	LLJ94	
			$4d^8(^3F)5p$	$^4G^o$	7/2	69612.887		
300	2367.9664		$4d^8(^3F)5s$	^4F	9/2	25084.270	LLJ94	
			$4d^8(^3F)5p$	1^o	9/2	67301.702		
500	2446.1888		$4d^8(^3F)5s$	^4F	7/2	27097.084	LLJ94	
			$4d^8(^3F)5p$	$^4D^o$	5/2	67964.621		
400	2486.5260		$4d^8(^3F)5s$	^4F	7/2	27097.084	LLJ94	
			$4d^8(^3F)5p$	1^o	9/2	67301.702		
700	2488.9146		$4d^8(^3F)5s$	^4F	9/2	25084.270	LLJ94	
			$4d^8(^3F)5p$	$^4D^o$	7/2	65250.309		
400	2498.7769		$4d^8(^3F)5s$	^2F	7/2	32280.538	LLJ94	
			$4d^8(^3F)5p$	$^4G^o$	9/2	72288.057		
40	2854.5776		$4d^8(^3F)5s$	^2F	7/2	32280.538	LLJ94	
			$4d^8(^3F)5p$	1^o	9/2	67301.702		

Energy Levels of Singly-ionized Palladium (Pd II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^9$	^2D	5/2	0.000	LLTL01
		3/2	3539.242	LLTL01
$4d^8(^3F)5s$	^4F	9/2	25084.270	LLTL01
		7/2	27097.084	LLTL01
		5/2	28929.419	LLTL01
		3/2	29948.151	LLTL01
$4d^8(^3F)5s$	^2F	7/2	32280.538	LLTL01
		5/2	34424.689	LLTL01
$4d^8(^3F)5p$	$^4D^o$	7/2	65250.309	LLTL01
		5/2	67964.621	LLTL01
		3/2	70122.300	LLTL01
		1/2	71181.651	LLTL01
$4d^8(^3F)5p$	1^o	9/2	67301.702	LLTL01
$4d^8(^3F)5p$	$^4G^o$	11/2	68615.072	LLTL01
		7/2	69612.887	LLTL01
		5/2	71072.300	LLTL01
		9/2	72288.057	LLTL01
$4d^8(^3F)5p$	$^4F^o$	9/2	69881.432	LLTL01
		3/2	72350.620	LLTL01
		5/2	72735.273	LLTL01
		7/2	73330.436	LLTL01

Energy Levels of Singly-ionized Palladium (Pd II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^8(^3F)5p$	$^2F^o$	7/2	71247.547	LLTL01
$4d^8(^3F)5p$	2^o	5/2	73115.191	LLTL01
$4d^8(^3F)5p$	$^2G^o$	7/2	74321.209	LLTL01
$4d^8(^3F)5p$	$^4F^o$	3/2	75100.265	LLTL01
$4d^8(^3F)5p$	3^o	5/2	75756.251	LLTL01
$4d^8(^3P)5p$	$^4P^o$	3/2	76757.777	LLTL01
		5/2	76770.145	LLTL01
		1/2	76810.059	LLTL01
$4d^8(^1D)5p$	$^2D^o$	5/2	82059.859	LLTL01
$4d^8(^1D)5p$	7^o	7/2	83058.933	LLTL01
$4d^8(^3P)5p$	$^2D^o$	5/2	83805.443	LLTL01
		3/2	84375.505	LLTL01
$4d^8(^3P)5p$	$^2P^o$	3/2	85154.023	LLTL01
		1/2	88041.479	LLTL01
$4d^8(^1G)5p$	$^2F^o$	7/2	86046.027	LLTL01
		5/2	87122.977	LLTL01
Pd III ($^3F_4$)		*Limit*	**156700**	M58

Phosphorus (P)

Atomic number = 15
Atomic weight = 30.973 762

Isotope	Mass	Abundance	Spin	Mag moment
^{31}P	30.973762	100%	1/2	+1.13160

P I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^3\ {}^4S^o_{3/2}$
Ionization energy: 84 580.83 cm^{-1} (10.486 69 eV)

P II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^2\ {}^3P_0$
Ionization energy: 159 451.5 cm^{-1} (19.7695 eV)

Strong Lines of Phosphorus (P)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
200 P	1310.700	P II	SMZ83
80 P	1532.530	P II	SMZ83
130 P	1535.917	P II	SMZ83
80 P	1536.410	P II	SMZ83
130 P	1542.297	P II	SMZ83
800 P	1674.591	P I	S80
1000 P	1679.695	P I	S80
1000 P	1774.951	P I	S80
800 P	1782.838	P I	S80
700 P	1787.656	P I	S80
600	1858.886	P I	S80
400	1859.393	P I	S80
	Air		
200	2032.432	P I	S80
300	2033.477	P I	S80
200 P	2135.465	P I	S80
400 P	2136.182	P I	S80
400 P	2149.145	P I	S80
150 P	2152.940	P I	S80
300 P	2154.080	P I	S80
400 P	2533.987	P I	M59
500 P	2535.606	P I	M59
400 P	2553.253	P I	M59
300	2554.904	P I	M59
80	4420.71	P II	M59
110 P	4588.04	P II	M59
110 P	4589.86	P II	M59
130 P	4602.08	P II	M59
110	4943.53	P II	M59
80	5296.13	P II	M59
80	5425.91	P II	M59
80	5450.74	P II	M59
110 P	6024.18	P II	M59
80	6034.04	P II	M59
110 P	6043.12	P II	M59
70	6087.82	P II	M59
70	6165.59	P II	M59
60	6199.024	P I	S80
130 P	6459.99	P II	M59
130 P	6503.46	P II	M59
130 P	6507.97	P II	M59

Strong Lines of Phosphorus (P)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
30	8741.529	P I	S80
50	9193.85	P I	S80
30	9278.88	P I	S80
70	9304.94	P I	S80
30	9323.50	P I	S80
50	9435.069	P I	S80
50	9441.86	P I	S80
30	9452.83	P I	S80
70	9493.56	P I	S80
90 P	9525.73	P I	S80
80 P	9545.18	P I	S80
90 P	9563.439	P I	S80
40	9609.04	P I	S80
20	9638.939	P I	S80
30	9676.24	P I	S80
80 P	9734.750	P I	S80
80 P	9750.77	P I	S80
30	9790.21	P I	S80
90 P	9796.85	P I	S80
20	9903.68	P I	S80
50	10529.52	P I	S80
70	10581.57	P I	S80
40	11183.23	P I	S80
25	14241.64	P I	S80
40	15711.52	P I	S80
90	16482.92	P I	S80
30	16590.07	P I	S80

Persistent Lines of Neutral Phosphorus (P I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	1674.591	0.773	$3s^23p^3$	$^4S^o$	3/2	0.00	S80	M03
			$3s3p^4$	^4P	3/2	59715.921		
1000	1679.695	0.845	$3s^23p^3$	$^4S^o$	3/2	0.00	S80	M03
			$3s3p^4$	^4P	5/2	59534.549		
1000	1774.951	2.38	$3s^23p^3$	$^4S^o$	3/2	0.00	S80	M03
			$3s^23p^2(^3P)4s$	^4P	5/2	56339.656		
800	1782.838	2.38	$3s^23p^3$	$^4S^o$	3/2	0.00	S80	M03
			$3s^23p^2(^3P)4s$	^4P	3/2	56090.626		
700	1787.656	2.52	$3s^23p^3$	$^4S^o$	3/2	0.00	S80	M03
			$3s^23p^2(^3P)4s$	^4P	1/2	55939.421		
200	2135.465	0.211	$3s^23p^3$	$^2D^o$	3/2	11361.02	S80	FW96
			$3s^23p^2(^3P)4s$	^2P	3/2	58174.366		
400	2136.182	2.83	$3s^23p^3$	$^2D^o$	5/2	11376.63	S80	FW96
			$3s^23p^2(^3P)4s$	^2P	3/2	58174.366		
400	2149.145	3.18	$3s^23p^3$	$^2D^o$	3/2	11361.02	S80	FW96
			$3s^23p^2(^3P)4s$	^2P	1/2	57876.574		
150	2152.940	0.485	$3s^23p^3$	$^2P^o$	1/2	18722.71	S80	FW96
			$3s^23p^2(^1D)4s$	^2D	3/2	65156.242		

Persistent Lines of Neutral Phosphorus (P I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	2154.080	0.58	$3s^23p^3$	$^2P^o$	3/2	18748.01	S80	FW96
			$3s^23p^2(^1D)4s$	^2D	5/2	65157.126		
		0.173	$3s^23p^3$	$^2P^o$	3/2	18748.01		FW96
			$3s^23p^2(^1D)4s$	^2D	3/2	65156.242		
400	2533.987	0.200	$3s^23p^3$	$^2P^o$	1/2	18722.71	M59	FW96
			$3s^23p^2(^3P)4s$	^2P	3/2	58174.366		
500	2535.606	0.95	$3s^23p^3$	$^2P^o$	3/2	18748.01	M59	FW96
			$3s^23p^2(^3P)4s$	^2P	3/2	58174.366		
400	2553.253	0.71	$3s^23p^3$	$^2P^o$	1/2	18722.71	M59	FW96
			$3s^23p^2(^3P)4s$	^2P	1/2	57876.574		
90	9525.73	0.18	$3s^23p^2(^3P)4s$	^4P	5/2	56339.656	S80	BMQZ94
			$3s^23p^2(^3P)4p$	$^4S^o$	3/2	66834.648		
80	9545.18		$3s^23p^2(^3P)4s$	^4P	5/2	56339.656	S80	
			$3s^23p^2(^3P)4p$	$^2D^o$	3/2	66813.271		
90	9563.439		$3s^23p^2(^3P)4s$	^4P	3/2	56090.626	S80	
			$3s^23p^2(^3P)4p$	$^4P^o$	5/2	66544.243		
80	9734.750		$3s^23p^2(^3P)4s$	^4P	3/2	56090.626	S80	
			$3s^23p^2(^3P)4p$	$^4P^o$	3/2	66360.282		
80	9750.77	0.24	$3s^23p^2(^3P)4s$	^4P	3/2	56090.626	S80	BMQZ94
			$3s^23p^2(^3P)4p$	$^4P^o$	1/2	66343.438		
90	9796.85	0.21	$3s^23p^2(^3P)4s$	^4P	5/2	56339.656	S80	BMQZ94
			$3s^23p^2(^3P)4p$	$^4P^o$	5/2	66544.243		

Energy Levels of Neutral Phosphorus (P I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^23p^3$	$^4S^o$	3/2	0.00	MZM85
$3s^23p^3$	$^2D^o$	3/2	11361.02	MZM85
		5/2	11376.63	MZM85
$3s^23p^3$	$^2P^o$	1/2	18722.71	MZM85
		3/2	18748.01	MZM85
$3s^23p^2(^3P)4s$	^4P	1/2	55939.421	MZM85
		3/2	56090.626	MZM85
		5/2	56339.656	MZM85
$3s^23p^2(^3P)4s$	^2P	1/2	57876.574	MZM85
		3/2	58174.366	MZM85
$3s3p^4$	^4P	5/2	59534.549	MZM85
		3/2	59715.921	MZM85
		1/2	59820.371	MZM85
$3s^23p^2(^3P)4p$	$^2S^o$	1/2	64239.591	MZM85
$3s^23p^2(^1D)4s$	^2D	3/2	65156.242	MZM85
		5/2	65157.126	MZM85

Energy Levels of Neutral Phosphorus (P I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^23p^2(^3P)4p$	$^4D^o$	1/2	65373.556	MZM85
		3/2	65450.125	MZM85
		5/2	65585.130	MZM85
		7/2	65788.455	MZM85
$3s^23p^2(^3P)4p$	$^4P^o$	1/2	66343.438	MZM85
		3/2	66360.282	MZM85
		5/2	66544.243	MZM85
$3s^23p^2(^3P)4p$	$^2D^o$	3/2	66813.271	MZM85
		5/2	67113.870	MZM85
$3s^23p^2(^3P)4p$	$^4S^o$	3/2	66834.648	MZM85
P II ($^3P_0$)		*Limit*	**84580.83**	MZM85

Persistent Lines of Singly-ionized Phosphorus (P II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
200	1310.700	0.328	$3s^23p^2$	^3P	2	469.12	SMZ83	M03
			$3s3p^3$	$^3P^o$	2	76764.06		
80	1532.530	0.029	$3s^23p^2$	^3P	0	0.00	SMZ83	M03
			$3s3p^3$	$^3D^o$	1	65251.45		
130	1535.917	0.0385	$3s^23p^2$	^3P	1	164.90	SMZ83	M03
			$3s3p^3$	$^3D^o$	2	65272.35		
80	1536.410	0.018	$3s^23p^2$	^3P	1	164.90	SMZ83	M03
			$3s3p^3$	$^3D^o$	1	65251.45		
130	1542.297	0.048	$3s^23p^2$	^3P	2	469.12	SMZ83	M03
			$3s3p^3$	$^3D^o$	3	65307.17		
110	4588.04	1.7	$3s^23p4p$	^3D	2	103339.14	M59	FW96
			$3s^23p4d$	$^3F^o$	3	125128.87		
110	4589.86	1.6	$3s^23p4p$	^3D	1	103165.61	M59	FW96
			$3s^23p4d$	$^3F^o$	2	124946.73		
130	4602.08	1.9	$3s^23p4p$	^3D	3	103667.86	M59	FW96
			$3s^23p4d$	$^3F^o$	4	125391.13		
110	6024.18	0.51	$3s^23p4s$	$^3P^o$	1	86743.96	M59	FW96
			$3s^23p4p$	^3D	2	103339.14		
110	6043.12	0.68	$3s^23p4s$	$^3P^o$	2	87124.60	M59	FW96
			$3s^23p4p$	^3D	3	103667.86		
130	6459.99		$3s^23p3d$	$^3F^o$	4	88192.13	M59	
			$3s^23p4p$	^3D	3	103667.86		
130	6503.46		$3s^23p3d$	$^3F^o$	3	87966.81	M59	
			$3s^23p4p$	^3D	2	103339.14		
130	6507.97		$3s^23p3d$	$^3F^o$	2	87804.10	M59	
			$3s^23p4p$	^3D	1	103165.61		

Energy Levels of Singly-ionized Phosphorus (P II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^23p^2$	^3P	0	0.00	MZM85
		1	164.90	MZM85
		2	469.12	MZM85
$3s^23p^2$	^1D	2	8882.31	MZM85
$3s^23p^2$	^1S	0	21575.63	MZM85
$3s3p^3$	$^5S^o$	2	45697.02	MZM85
$3s3p^3$	$^3D^o$	1	65251.45	MZM85
		2	65272.35	MZM85
		3	65307.17	MZM85
$3s3p^3$	$^3P^o$	2	76764.06	MZM85
		1	76812.33	MZM85
		0	76823.11	MZM85
$3s^23p3d$	$^1D^o$	2	77710.19	MZM85
$3s^23p4s$	$^3P^o$	0	86597.55	MZM85
		1	86743.96	MZM85
		2	87124.60	MZM85
$3s^23p3d$	$^3F^o$	2	87804.10	MZM85
		3	87966.81	MZM85
		4	88192.13	MZM85
$3s^23p4s$	$^1P^o$	1	88893.22	MZM85
$3s^23p4p$	^1P	1	101635.69	MZM85
$3s^23p3d$	$^1P^o$	1	102798.26	MZM85
$3s^23p4p$	^3D	1	103165.61	MZM85
		2	103339.14	MZM85
		3	103667.86	MZM85
$3s^23p3d$	$^3P^o$	2	103629.70	MZM85
		1	103755.91	MZM85
		0	103940.38	MZM85
$3s^23p3d$	$^3D^o$	3	104050.27	MZM85
		1	104053.81	MZM85
		2	104101.75	MZM85
$3s^23p4p$	^3P	0	105224.06	MZM85
		1	105302.37	MZM85
		2	105549.67	MZM85
$3s^23p4p$	^3S	1	106001.25	MZM85
$3s^23p3d$	$^1F^o$	3	107360.25	MZM85
$3s^23p4p$	^1D	2	107922.93	MZM85
$3s3p^3$	$^3S^o$	1	110254.77	MZM85
$3s^23p4p$	^1S	0	111507.66	MZM85
$3s3p^3$	$^1D^o$	2	112606.86	MZM85
$3s3p^3$	$^1P^o$	1	118341.71	MZM85

Energy Levels of Singly-ionized Phosphorus (P II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^2 3p5s$	$^3P^o$	0	123344.19	MZM85
		1	123455.46	MZM85
		2	123890.81	MZM85
$3s^2 3p5s$	$^1P^o$	1	124432.26	MZM85
$3s^2 3p4d$	$^3F^o$	2	124946.73	MZM85
		3	125128.87	MZM85
		4	125391.13	MZM85
P III ($^2P^o_{1/2}$)		*Limit*	**159451.5**	MZM85

Platinum (Pt)
Atomic number = 78
Atomic weight = 195.08

Isotope	Mass	Abundance	Spin	Mag moment
^{190}Pt	189.959917	0.01%	0	
^{192}Pt	191.961019	0.79%	0	
^{194}Pt	193.962655	32.9%	0	
^{195}Pt	194.964766	33.8%	1/2	+0.6095
^{196}Pt	195.967315	25.3%	0	
^{198}Pt	197.967869	7.2%	0	

Pt I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^9 6s\ ^3D_3$
Ionization energy: 72 257.3 cm^{-1} (8.9588 eV)

Pt II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^9\ ^2D_{5/2}$
Ionization energy: 149 723 cm^{-1} (18.563 eV)

Strong Lines of Platinum (Pt)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
30	1164.4184	Pt II	SRSA92
30	1166.8635	Pt II	SRSA92
90	1169.7477	Pt II	SRSA92
80	1178.9614	Pt II	SRSA92
30	1182.3552	Pt II	SRSA92
60	1186.2203	Pt II	SRSA92
60	1193.4484	Pt II	SRSA92
70	1198.7745	Pt II	SRSA92
110	1219.4931	Pt II	SRSA92
40	1229.0134	Pt II	SRSA92
40	1232.8739	Pt II	SRSA92
90	1238.8499	Pt II	SRSA92
200	1248.6069	Pt II	SRSA92
40	1264.5677	Pt II	SRSA92
40	1271.7939	Pt II	SRSA92
30	1283.6978	Pt II	SRSA92
70	1289.9515	Pt II	SRSA92
30	1290.0131	Pt II	SRSA92
30	1290.0131	Pt II	SRSA92
30	1292.7998	Pt II	SRSA92
50	1302.4578	Pt II	SRSA92
40	1303.1187	Pt II	SRSA92
40	1327.4314	Pt II	SRSA92
40	1348.8300	Pt II	SRSA92
30	1352.9768	Pt II	SRSA92
30	1363.3059	Pt II	SRSA92
30	1364.1171	Pt II	SRSA92
30	1373.1724	Pt II	SRSA92
120	1378.9572	Pt II	SRSA92
100	1382.0460	Pt II	SRSA92
200	1403.9006	Pt II	SRSA92
80	1429.5248	Pt II	SRSA92
40	1447.8030	Pt II	SRSA92
30	1454.2866	Pt II	SRSA92
30	1454.2866	Pt II	SRSA92
40	1461.0786	Pt II	SRSA92

Strong Lines of Platinum (Pt)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	1462.6591	Pt II	SRSA92
60	1475.6306	Pt II	SRSA92
150	1482.8256	Pt II	SRSA92
25	1491.9735	Pt II	SRSA92
200	1494.7256	Pt II	SRSA92
100	1498.1132	Pt II	SRSA92
200	1499.3707	Pt II	SRSA92
140	1505.2462	Pt II	SRSA92
110	1506.2923	Pt II	SRSA92
30	1507.6288	Pt II	SRSA92
600	1509.2920	Pt II	SRSA92
30	1520.7414	Pt II	SRSA92
150	1524.5715	Pt II	SRSA92
900	1524.7295	Pt II	SRSA92
900	1524.7295	Pt II	SRSA92
80	1528.2831	Pt II	SRSA92
60	1530.1969	Pt II	SRSA92
100	1534.9063	Pt II	SRSA92
50	1540.5040	Pt II	SRSA92
60 l	1541.8337	Pt II	SRSA92
30	1542.7098	Pt II	SRSA92
40	1546.8248	Pt II	SRSA92
110	1552.3268	Pt II	SRSA92
200	1554.9285	Pt II	SRSA92
30	1558.3479	Pt II	SRSA92
40	1559.3893	Pt II	SRSA92
40	1561.5450	Pt II	SRSA92
40	1561.5450	Pt II	SRSA92
30	1568.9021	Pt II	SRSA92
30	1573.1802	Pt II	SRSA92
40	1573.8180	Pt II	SRSA92
200	1574.3059	Pt II	SRSA92
80	1579.4357	Pt II	SRSA92
90	1581.3980	Pt II	SRSA92
40	1587.7205	Pt II	SRSA92
40	1589.3735	Pt II	SRSA92
40	1594.0344	Pt II	SRSA92
40	1594.2611	Pt II	SRSA92
9	1604.0102	Pt I	SRSA92
80 l	1621.6590	Pt II	SRSA92
80	1631.0903	Pt II	SRSA92
120	1634.2337	Pt II	SRSA92
25	1636.1647	Pt I	SRSA92
8	1644.4634	Pt I	SRSA92
50	1659.4860	Pt II	SRSA92
200	1669.2312	Pt II	SRSA92
20	1677.8443	Pt I	SRSA92
50	1684.5867	Pt II	SRSA92
50	1684.5867	Pt II	SRSA92
7	1690.7825	Pt I	SRSA92
30	1698.4958	Pt II	SRSA92
80	1707.0710	Pt II	SRSA92
40	1713.8364	Pt II	SRSA92
7	1714.4801	Pt I	SRSA92
150	1723.1314	Pt II	SRSA92
50	1727.6799	Pt II	SRSA92
90	1735.8642	Pt II	SRSA92
14	1737.1732	Pt I	SRSA92
10	1744.4305	Pt I	SRSA92

Strong Lines of Platinum (Pt)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
120	1753.8286	Pt II	SRSA92
120	1753.8286	Pt II	SRSA92
14	1764.5948	Pt I	SRSA92
25	1766.0328	Pt II	SRSA92
120	1767.1612	Pt II	SRSA92
200	1775.0160	Pt II	SRSA92
40	1776.5571	Pt I	SRSA92
600 P	1777.0866	Pt II	SRSA92
20	1777.2783	Pt I	SRSA92
250	1781.8617	Pt II	SRSA92
30	1785.8803	Pt II	SRSA92
25	1786.6480	Pt I	SRSA92
20	1802.9398	Pt I	SRSA92
20	1812.8819	Pt I	SRSA92
15	1817.8736	Pt I	SRSA92
8	1825.3262	Pt I	SRSA92
13	1826.1377	Pt I	SRSA92
25	1833.3875	Pt II	SRSA92
40	1835.0745	Pt II	SRSA92
80	1836.5075	Pt II	SRSA92
30	1838.8246	Pt II	SRSA92
80	1839.5258	Pt II	SRSA92
25	1845.7517	Pt I	SRSA92
13	1849.6831	Pt I	SRSA92
9	1853.4523	Pt I	SRSA92
40	1853.4523	Pt II	SRSA92
80	1867.1302	Pt II	SRSA92
90	1870.4100	Pt II	SRSA92
30	1871.1038	Pt II	SRSA92
70	1879.1031	Pt II	SRSA92
600 P	1883.0587	Pt II	SRSA92
30	1885.8171	Pt II	SRSA92
140	1889.5226	Pt II	SRSA92
30	1895.0088	Pt II	SRSA92
30	1897.5769	Pt II	SRSA92
40	1898.1722	Pt II	SRSA92
30	1899.0445	Pt II	SRSA92
15	1903.2186	Pt I	SRSA92
400 P	1911.7092	Pt II	SRSA92
40	1928.4320	Pt II	SRSA92
250 P	1929.2449	Pt II	SRSA92
40	1929.6829	Pt II	SRSA92
50	1934.3690	Pt I	SRSA92
100	1937.4245	Pt I	SRSA92
130 l	1939.8110	Pt II	SRSA92
20	1940.0319	Pt I	SRSA92
150	1944.4617	Pt II	SRSA92
40	1949.9102	Pt II	SRSA92
30	1954.7436	Pt II	SRSA92
11	1963.1429	Pt I	SRSA92
13	1969.6807	Pt I	SRSA92
30	1971.5374	Pt I	SRSA92
50	1978.8444	Pt II	SRSA92
25	1979.7647	Pt I	SRSA92
40	1983.7486	Pt II	SRSA92
9	1987.7868	Pt I	SRSA92
15	1989.1056	Pt I	SRSA92
80	1990.5751	Pt II	SRSA92
8	1991.5830	Pt I	SRSA92

Strong Lines of Platinum (Pt)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
11	1995.8991	Pt I	SRSA92
	Air		
140	2007.7572	Pt II	SRSA92
200	2014.9330	Pt II	SRSA92
9	2020.5434	Pt I	SRSA92
20	2030.6456	Pt I	SRSA92
30	2032.4256	Pt I	SRSA92
7	2035.7985	Pt I	SRSA92
250 P	2036.4666	Pt II	SRSA92
150	2041.5751	Pt II	SRSA92
30	2049.1689	Pt II	SRSA92
60	2049.3915	Pt I	SRSA92
100	2057.0265	Pt II	SRSA92
9	2060.7621	Pt I	SRSA92
15	2062.7943	Pt I	SRSA92
20	2067.5105	Pt I	SRSA92
8	2070.9443	Pt I	SRSA92
8	2070.9443	Pt I	SRSA92
80	2075.4004	Pt II	SRSA92
50	2084.5960	Pt I	SRSA92
200	2097.4478	Pt II	SRSA92
50	2101.5979	Pt II	SRSA92
10	2101.6839	Pt I	SRSA92
10	2101.6839	Pt I	SRSA92
70	2103.3449	Pt I	SRSA92
30	2103.7804	Pt II	SRSA92
30	2103.7804	Pt II	SRSA92
8	2109.6631	Pt I	SRSA92
60	2115.5823	Pt II	SRSA92
80	2127.4231	Pt II	SRSA92
25	2128.5878	Pt I	SRSA92
90	2128.6340	Pt I	SRSA92
60	2130.7079	Pt II	SRSA92
7	2135.1631	Pt I	SRSA92
130 u	2144.2123	Pt I	SRSA92
900 P	2144.2458	Pt II	SRSA92
20	2165.2108	Pt I	SRSA92
200	2174.6853	Pt I	SRSA92
11	2180.5042	Pt I	SRSA92
100	2190.3216	Pt II	SRSA92
30	2202.2230	Pt I	SRSA92
40	2202.4664	Pt II	SRSA92
40	2209.5043	Pt II	SRSA92
13	2222.6134	Pt I	SRSA92
120	2225.0094	Pt II	SRSA92
40	2232.9725	Pt II	SRSA92
12	2234.9262	Pt I	SRSA92
600 P	2240.8965	Pt II	SRSA92
40	2241.2288	Pt II	SRSA92
14	2244.9773	Pt I	SRSA92
400 P	2245.5244	Pt II	SRSA92
300 P	2246.5216	Pt II	SRSA92
40	2247.4822	Pt II	SRSA92
15	2249.3075	Pt I	SRSA92
60	2249.3075	Pt II	SRSA92
11	2249.8994	Pt I	SRSA92
50	2251.5105	Pt II	SRSA92
30	2251.8084	Pt II	SRSA92
600 P	2262.7185	Pt II	SRSA92

Strong Lines of Platinum (Pt)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	2263.8611	Pt II	SRSA92
15	2268.8384	Pt I	SRSA92
40	2271.6194	Pt II	SRSA92
50	2274.3816	Pt I	SRSA92
12	2274.8409	Pt I	SRSA92
70	2281.1942	Pt II	SRSA92
40	2286.4390	Pt II	SRSA92
60	2287.3643	Pt II	SRSA92
400 P	2288.2050	Pt II	SRSA92
15	2289.2765	Pt I	SRSA92
60	2292.3987	Pt I	SRSA92
30	2302.3068	Pt II	SRSA92
25	2308.0437	Pt I	SRSA92
500 P	2310.9626	Pt II	SRSA92
9	2315.5024	Pt I	SRSA92
40	2318.2969	Pt I	SRSA92
30	2319.8869	Pt II	SRSA92
30	2326.3386	Pt II	SRSA92
30	2339.0741	Pt II	SRSA92
14	2340.1805	Pt I	SRSA92
40	2357.1047	Pt I	SRSA92
30	2366.3729	Pt II	SRSA92
14	2368.2781	Pt I	SRSA92
60	2377.2773	Pt II	SRSA92
8	2383.6432	Pt I	SRSA92
7	2386.8089	Pt I	SRSA92
25	2389.5358	Pt I	SRSA92
11	2403.0918	Pt I	SRSA92
40	2405.7269	Pt II	SRSA92
10	2418.0583	Pt I	SRSA92
40	2420.8161	Pt II	SRSA92
150	2424.8672	Pt II	SRSA92
25	2433.3064	Pt II	SRSA92
40	2434.4610	Pt II	SRSA92
25	2436.6887	Pt I	SRSA92
110	2440.0608	Pt I	SRSA92
80	2450.4390	Pt II	SRSA92
7 c	2450.9670	Pt I	SRSA92
50	2467.4003	Pt I	SRSA92
10	2467.4824	Pt I	SRSA92
40	2478.9449	Pt II	SRSA92
40	2486.9827	Pt II	SRSA92
200 P	2487.1685	Pt I	SRSA92
200 P	2487.1685	Pt I	SRSA92
40	2488.8753	Pt II	SRSA92
25	2490.1265	Pt I	SRSA92
20	2495.8126	Pt I	SRSA92
60	2498.4996	Pt I	SRSA92
40	2498.6806	Pt II	SRSA92
7	2508.4973	Pt I	SRSA92
70	2513.8885	Pt II	SRSA92
40	2515.5770	Pt I	SRSA92
9	2524.3065	Pt I	SRSA92
80	2528.7336	Pt II	SRSA92
30	2539.2067	Pt I	SRSA92
140	2580.8102	Pt II	SRSA92
9	2603.1374	Pt I	SRSA92
200 P	2628.0269	Pt I	SRSA92
15	2639.3454	Pt I	SRSA92

Strong Lines of Platinum (Pt)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
15	2639.3454	Pt I	SRSA92
90	2646.8804	Pt I	SRSA92
300 P	2650.8524	Pt I	SRSA92
500 P	2659.4503	Pt I	SRSA92
9	2674.5700	Pt I	SRSA92
50	2677.1477	Pt I	SRSA92
20	2698.4248	Pt I	SRSA92
200 P	2702.3995	Pt I	SRSA92
150 P	2705.8951	Pt I	SRSA92
130	2719.0333	Pt I	SRSA92
300 P	2719.5239	Pt II	SRSA92
13	2729.9123	Pt I	SRSA92
300 P	2733.9567	Pt I	SRSA92
300 P	2743.2944	Pt II	SRSA92
8	2753.8531	Pt I	SRSA92
30	2754.9122	Pt I	SRSA92
7	2769.8332	Pt I	SRSA92
100	2771.6594	Pt I	SRSA92
20	2803.2357	Pt I	SRSA92
200	2816.9021	Pt II	SRSA92
30	2818.2450	Pt I	SRSA92
40	2823.0513	Pt II	SRSA92
300 P,c	2830.2919	Pt I	SRSA92
15	2834.7107	Pt I	SRSA92
30	2842.4101	Pt II	SRSA92
110	2874.9196	Pt II	SRSA92
1000 P	2875.6314	Pt II	SRSA92
40	2877.2783	Pt II	SRSA92
130 P	2893.8630	Pt I	SRSA92
60	2897.8715	Pt I	SRSA92
40	2899.3861	Pt II	SRSA92
8	2905.8974	Pt I	SRSA92
15	2912.2515	Pt I	SRSA92
15	2913.5386	Pt I	SRSA92
7	2921.3792	Pt I	SRSA92
400 P	2929.7894	Pt I	SRSA92
7	2960.7494	Pt I	SRSA92
60	2991.4665	Pt II	SRSA92
600 P,c	2997.9622	Pt I	SRSA92
40	3002.2641	Pt I	SRSA92
20	3036.4425	Pt I	SRSA92
800 P,c	3042.6318	Pt I	SRSA92
1000 P,c	3064.7110	Pt I	SRSA92
20	3071.9336	Pt I	SRSA92
110	3096.8104	Pt II	SRSA92
25	3100.0252	Pt I	SRSA92
90	3139.3870	Pt I	SRSA92
40	3156.5625	Pt I	SRSA92
90	3167.2244	Pt II	SRSA92
120	3199.5087	Pt II	SRSA92
40	3200.7097	Pt I	SRSA92
80	3204.0364	Pt I	SRSA92
12	3230.2837	Pt I	SRSA92
7	3233.4167	Pt I	SRSA92
30	3251.9787	Pt I	SRSA92
50	3255.9088	Pt I	SRSA92
10	3268.4170	Pt I	SRSA92
11	3281.9670	Pt I	SRSA92
25	3290.2196	Pt I	SRSA92

Strong Lines of Platinum (Pt)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
250 P	3301.8596	Pt I	SRSA92
150 P	3315.0419	Pt I	SRSA92
9	3343.8961	Pt I	SRSA92
25	3345.2555	Pt II	SRSA92
900 P,c	3408.1308	Pt I	SRSA92
30	3417.8034	Pt II	SRSA92
25	3427.9268	Pt I	SRSA92
12	3483.4231	Pt I	SRSA92
60	3485.2641	Pt I	SRSA92
60	3508.8500	Pt II	SRSA92
10	3514.7134	Pt I	SRSA92
9	3528.5348	Pt I	SRSA92
40	3548.5211	Pt II	SRSA92
60	3628.1107	Pt I	SRSA92
13	3628.8660	Pt I	SRSA92
25	3638.7879	Pt I	SRSA92
25	3638.7879	Pt I	SRSA92
40	3643.1667	Pt I	SRSA92
30	3643.6290	Pt II	SRSA92
50	3665.1680	Pt II	SRSA92
15	3671.9990	Pt I	SRSA92
12	3674.0449	Pt I	SRSA92
10	3682.9727	Pt I	SRSA92
20	3687.4152	Pt I	SRSA92
14	3699.9126	Pt I	SRSA92
15	3706.5217	Pt I	SRSA92
40	3708.4731	Pt II	SRSA92
30	3761.1616	Pt II	SRSA92
13 d	3801.0723	Pt I	SRSA92
250	3818.6874	Pt I	SRSA92
15	3868.4209	Pt I	SRSA92
15	3875.7150	Pt I	SRSA92
15 s	3898.7316	Pt I	SRSA92
30 s	3900.7228	Pt I	SRSA92
12	3904.3823	Pt I	SRSA92
13	3910.8955	Pt I	SRSA92
60 c	3922.9559	Pt I	SRSA92
15	3925.3359	Pt I	SRSA92
9	3948.3881	Pt I	SRSA92
100	3966.3570	Pt I	SRSA92
11	3996.5674	Pt I	SRSA92
60	4013.7145	Pt II	SRSA92
30	4065.7046	Pt II	SRSA92
11	4065.9283	Pt I	SRSA92
9 c	4081.4669	Pt I	SRSA92
13	4092.2522	Pt I	SRSA92
60	4118.6745	Pt I	SRSA92
50	4164.5491	Pt I	SRSA92
25	4192.4231	Pt I	SRSA92
11	4327.0533	Pt I	SRSA92
12	4391.83	Pt I	MCS75
50	4442.55	Pt I	MCS75
9	4445.55	Pt I	MCS75
15	4498.76	Pt I	MCS75
8	4520.90	Pt I	MCS75
25	4552.42	Pt I	MCS75
8	4879.53	Pt I	MCS75
9	5044.04	Pt I	MCS75
20	5059.48	Pt I	MCS75

Strong Lines of Platinum (Pt)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
25	5227.66	Pt I	MCS75
25	5301.02	Pt I	MCS75
8	5368.99	Pt I	MCS75
8	5390.79	Pt I	MCS75
9	5475.77	Pt I	MCS75
9	5478.50	Pt I	MCS75
4	5763.57	Pt I	MCS75
13	5840.12	Pt I	MCS75
5	5844.84	Pt I	MCS75
4	6026.04	Pt I	MCS75
5	6318.37	Pt I	MCS75
5	6326.58	Pt I	MCS75
6	6523.45	Pt I	MCS75
7	6710.42	Pt I	MCS75
13	6760.02	Pt I	MCS75
40	6842.60	Pt I	MCS75
13	7113.73	Pt I	MCS75
7	8224.74	Pt I	MCS75

Persistent Lines of Neutral Platinum (Pt I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
200	2487.1685		$5d^96s$	^1D	2	775.892	SRSA92	
			$5d^8(^3F)6s6p(^3P^o)$	$^5G^o$	3	40970.165		
			$5d^96s$	^3D	3	0.000		
			$5d^8(^3F)6s6p(^3P^o)$	$^5F^o$	4	40194.228		
200	2628.0269	0.482	$5d^96s$	^1D	2	775.892	SRSA92	M00
			$5d^8(^1D)6s6p(^3P^o)$	$^3F^o$	2	38815.908		
300	2650.8524	0.0962	$5d^86s^2$	^3F	4	823.678	SRSA92	M00
			$5d^8(^3F)6s6p(^3P^o)$	$^5G^o$	5	38536.160		
500	2659.4503	0.890	$5d^96s$	^3D	3	0.000	SRSA92	M00
			$5d^96p$	$^3F^o$	4	37590.569		
200	2702.3995	0.523	$5d^96s$	^1D	2	775.892	SRSA92	M00
			$5d^96p$	$^3D^o$	3	37769.073		
150	2705.8951	0.380	$5d^86s^2$	^3F	4	823.678	SRSA92	M00
			$5d^96p$	$^3D^o$	3	37769.073		
300	2733.9567	0.672	$5d^96s$	^1D	2	775.892	SRSA92	M00
			$5d^96p$	$^3P^o$	2	37342.101		
300	2830.2919	0.168	$5d^96s$	^3D	3	0.000	SRSA92	M00
			$5d^8(^3F)6s6p(^3P^o)$	$^5D^o$	3	35321.653		
130	2893.8630	0.0647	$5d^96s$	^1D	2	775.892	SRSA92	M00
			$5d^8(^3F)6s6p(^3P^o)$	$^5D^o$	3	35321.653		
400	2929.7894	0.185	$5d^96s$	^3D	3	0.000	SRSA92	M00
			$5d^96p$	$^3F^o$	3	34122.165		
600	2997.9622	0.288	$5d^96s$	^1D	2	775.892	SRSA92	M00
			$5d^96p$	$^3F^o$	3	34122.165		
800	3042.6318	0.0769	$5d^86s^2$	^3F	4	823.678	SRSA92	M00
			$5d^8(^3F)6s6p(^3P^o)$	$^5F^o$	5	33680.402		

Persistent Lines of Neutral Platinum (Pt I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3064.7110	0.644	$5d^96s$	^3D	3	0.000	SRSA92	M00
			$5d^96p$	$^3P^o$	2	32620.018		
250	3301.8596	0.343	$5d^96s$	^3D	2	6567.461	SRSA92	M00
			$5d^96p$	$^3P^o$	1	36844.710		
150	3315.0419	0.00176	$5d^96s$	^3D	3	0.000	SRSA92	M00
			$5d^8(^3F)6s6p(^3P^o)$	$^5D^o$	4	30156.854		
900	3408.1308	0.0129	$5d^86s^2$	^3F	4	823.678	SRSA92	M00
			$5d^8(^3F)6s6p(^3P^o)$	$^5D^o$	4	30156.854		
250	3818.6874		$5d^86s^2$	^3F	3	10116.729	SRSA92	
			$5d^8(^3F)6s6p(^3P^o)$	$^5G^o$	4	36296.310		

Energy Levels of Neutral Platinum (Pt I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^96s$	^3D	3	0.000	BVWE92
		2	6567.461	BVWE92
		1	10131.887	BVWE92
$5d^96s$	^1D	2	775.892	BVWE92
$5d^86s^2$	^3F	4	823.678	BVWE92
		3	10116.729	BVWE92
		2	15501.845	BVWE92
$5d^{10}$	^1S	0	6140.180	BVWE92
$5d^86s^2$	^3P	0	16983.492	BVWE92
		1	18566.558	BVWE92
		2	13496.271	BVWE92
$5d^86s^2$	^1G	4	21967.111	BVWE92
$5d^86s^2$	^1D	2	26638.591	BVWE92
$5d^8(^3F)6s6p(^3P^o)$	$^5D^o$	4	30156.854	BVWE92
		3	35321.653	BVWE92
		2	40516.243	BVWE92
$5d^96p$	$^3P^o$	2	32620.018	BVWE92
		1	36844.710	BVWE92
		2	37342.101	BVWE92
$5d^8(^3F)6s6p(^3P^o)$	$^5F^o$	5	33680.402	BVWE92
		4	40194.228	BVWE92
$5d^96p$	$^3F^o$	3	34122.165	BVWE92
		4	37590.569	BVWE92
$5d^8(^3F)6s6p(^3P^o)$	$^5G^o$	4	36296.310	BVWE92
		6	36781.551	BVWE92
		5	38536.160	BVWE92
		3	40970.165	BVWE92
$5d^96p$	$^3D^o$	3	37769.073	BVWE92
$5d^8(^1D)6s6p(^3P^o)$	$^3F^o$	2	38815.908	BVWE92

Energy Levels of Neutral Platinum (Pt I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^8(^3P)6s6p(^3P^o)$	$^5P^o$	2	40787.857	BVWE92
$5d^8(^1D)6s6p(^3P^o)$	$^3P^o$	0	40873.529	BVWE92
Pt II ($^2D_{5/2}$)		*Limit*	**72257.3**	MMHS95,JS00

Persistent Lines of Singly-ionized Platinum (Pt II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	1777.0866	8.77	$5d^8(^3F)6s$	^4F	9/2	4786.611	SRSA92	WBJ95
			$5d^8(^3F_4)6p_{3/2}$	$(4,3/2)^o$	11/2	61058.490		
600	1883.0587	2.98	$5d^8(^3P)6s$	^4P	5/2	13329.227	SRSA92	WBJ95
			$5d^8(^3P_2)6p_{3/2}$	$(2,3/2)^o$	7/2	66434.315		
400	1911.7092	5.12	$5d^8(^3F)6s$	^4F	7/2	9356.274	SRSA92	WBJ95
			$5d^8(^3F_4)6p_{3/2}$	$(4,3/2)^o$	7/2	61665.485		
250	1929.2449	3.72	$5d^8(^3F)6s$	^4F	7/2	9356.274	SRSA92	WBJ95
			$5d^8(^3F_4)6p_{3/2}$	$(4,3/2)^o$	5/2	61190.026		
250	2036.4666	2.40	$5d^8(^3F)6s$	^4F	9/2	4786.611	SRSA92	WBJ95
			$5d^8(^3F_4)6p_{1/2}$	$(4,1/2)^o$	9/2	53875.493		
900	2144.2458	3.93	$5d^8(^3F)6s$	^4F	9/2	4786.611	SRSA92	WBJ95
			$5d^8(^3F_4)6p_{1/2}$	$(4,1/2)^o$	7/2	51408.370		
600	2240.8965		$5d^8(^3P_2)6p_{1/2}$	$(2,1/2)^o$	3/2	56587.934	SRSA92	
			$5d^8(^1D)7s$	^2D	5/2	101199.085		
400	2245.5244	2.14	$5d^8(^3F)6s$	^4F	7/2	9356.274	SRSA92	WBJ95
			$5d^8(^3F_4)6p_{1/2}$	$(4,1/2)^o$	9/2	53875.493		
300	2246.5216		$5d^8(^3P_2)6p_{1/2}$	$(2,1/2)^o$	5/2	57018.130	SRSA92	
			$5d^8(^1D)7s$	^2D	3/2	101517.59		
600	2262.7185		$5d^8(^3P_2)6p_{1/2}$	$(2,1/2)^o$	5/2	57018.130	SRSA92	
			$5d^8(^1D)7s$	^2D	5/2	101199.085		
400	2288.2050	1.45	$5d^8(^3P)6s$	^4P	5/2	13329.227	SRSA92	WBJ95
			$5d^8(^3P_2)6p_{1/2}$	$(2,1/2)^o$	5/2	57018.130		
500	2310.9626	2.01	$5d^8(^3P)6s$	^4P	5/2	13329.227	SRSA92	WBJ95
			$5d^8(^3P_2)6p_{1/2}$	$(2,1/2)^o$	3/2	56587.934		
300	2719.5239		$5d^8(^3F_3)6p_{1/2}$	$(3,1/2)^o$	5/2	64757.343	SRSA92	
			$5d^8(^1D)7s$	^2D	3/2	101517.59		
300	2743.2944		$5d^8(^3F_3)6p_{1/2}$	$(3,1/2)^o$	5/2	64757.343	SRSA92	
			$5d^8(^1D)7s$	^2D	5/2	101199.085		
1000	2875.6314		$5d^8(^3P_2)6p_{3/2}$	$(2,3/2)^o$	7/2	66434.315	SRSA92	
			$5d^8(^1D)7s$	^2D	5/2	101199.085		

Energy Levels of Singly-ionized Platinum (Pt II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^9$	^2D	5/2	0.000	BW92a
		3/2	8419.822	BW92a
$5d^8(^3F)6s$	^4F	9/2	4786.611	BW92a
		7/2	9356.274	BW92a
		5/2	16820.894	BW92a
		3/2	21168.684	BW92a
$5d^8(^3P)6s$	^4P	5/2	13329.227	BW92a
		1/2	21717.260	BW92a
		3/2	23875.553	BW92a
$5d^8(^1D)6s$	^2D	3/2	15791.276	BW92a
$5d^8(^3F)6s$	^2F	7/2	18097.715	BW92a
		5/2	23461.503	BW92a
$5d^76s^2$	^4F	9/2	24879.480	BW92a
		7/2	34647.221	BW92a
		5/2	36484.028	BW92a
		3/2	37877.792	BW92a
$5d^8(^3P)6s$	^2P	1/2	27255.687	BW92a
$5d^8(^1G)6s$	^2G	7/2	29030.479	BW92a
		9/2	29261.967	BW92a
$5d^8(^1D)6s$	^2D	3/2	32237.007	BW92a
		5/2	32918.561	BW92a
$5d^8(^3F_4)6p_{1/2}$	$(4,1/2)^o$	7/2	51408.370	BW92a
		9/2	53875.493	BW92a
$5d^8(^3P_2)6p_{1/2}$	$(2,1/2)^o$	3/2	56587.934	BW92a
		5/2	57018.130	BW92a
$5d^8(^3F_4)6p_{3/2}$	$(4,3/2)^o$	9/2	60907.688	BW92a
		11/2	61058.490	BW92a
		5/2	61190.026	BW92a
		7/2	61665.485	BW92a
$5d^8(^3P_2)6p_{3/2}$	$(2,3/2)^o$	1/2	62781.658	BW92a
		5/2	65351.069	BW92a
		3/2	66028.014	BW92a
		7/2	66434.315	BW92a
$5d^7(^4F_{9/2})6s6p(^3P^o_0)$	$(9/2,0)^o$	9/2	62820.489	BW92a
$5d^7(^4F_{9/2})6s6p(^3P^o_1)$	$(9/2,1)^o$	11/2	65046.23	BW92a
$5d^8(^3F_3)6p_{1/2}$	$(3,1/2)^o$	7/2	63738.841	BW92a
		5/2	64757.343	BW92a
$5d^8(^3F_2)6p_{1/2}$	$(2,1/2)^o$	3/2	64388.642	BW92a
$5d^8(^3P_0)6p_{1/2}$	$(0,1/2)^o$	1/2	65587.115	BW92a
$5d^8(^1D)7s$	^2D	5/2	101199.085	BW92a
		3/2	101517.59	BW92a
Pt III ($^3F_4$)		*Limit*	**149723**	S38b

Plutonium (Pu)
Atomic number = 94
Atomic weight = (244)

Isotope	Mass	Abundance	Spin	Mag moment
^{239}Pu	239.052157	0	1/2	+0.203
^{242}Pu	242.058737	0	0	
^{244}Pu	244.064199	0	0	

Pu I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^6 7s^2\ {}^7F_0$
Ionization energy: 48 603 cm^{-1} (6.0260 eV)

Pu II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^6 7s\ {}^8F_{1/2}$
Ionization energy: [90 000] cm^{-1} (11.2 eV)

Strong Lines of Plutonium (Pu)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
500	2933.298	Pu II	BFG84
700 P	2933.602	Pu II	BFG84
700 P	2951.820	Pu II	BFG84
700 P	2964.644	Pu II	BFG84
700	2966.843	Pu II	BFG84
700 P	2969.035	Pu II	BFG84
700 P	2972.500	Pu II	BFG84
700	2980.227	Pu II	BFG84
700	2994.046	Pu II	BFG84
700	2996.406	Pu II	BFG84
700	3000.572	Pu II	BW92b
700	3029.924	Pu II	BFG84
700	3159.201	Pu II	BFG84
700	3174.488	Pu II	BFG84
700	3175.152	Pu II	BFG84
700 P	3198.467	Pu II	BFG84
700 P	3220.942	Pu II	BFG84
700 P	3224.873	Pu II	BFG84
500 d	3232.224	Pu I	BFG84
500	3244.162	Pu I	BFG84
700 P	3245.206	Pu II	BFG84
500	3252.070	Pu I	BFG84
700 d	3260.539	Pu II	BFG84
500	3265.177	Pu I	BFG84
700 P	3273.111	Pu II	BFG84
700 P	3275.125	Pu II	BFG84
500	3275.236	Pu I	BFG84
700 P	3279.326	Pu II	BFG84
700 P	3289.977	Pu II	BFG84
700 P	3290.345	Pu II	BFG84
500	3292.560	Pu I	BFG84
500	3301.754	Pu I	BFG84
700 P	3312.647	Pu II	BFG84
500	3320.607	Pu I	BFG84
500	3320.834	Pu I	BFG84
700 P	3337.708	Pu II	BFG84
500	3338.942	Pu I	BFG84
700 P	3350.330	Pu II	BFG84
700 P	3391.405	Pu II	BFG84

Strong Lines of Plutonium (Pu)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
700 d	3401.09	Pu II	BFG84
700	3632.210	Pu II	BFG84
500	3632.210	Pu I	BFG84
800	3720.243	Pu I	BFG84
1000	3720.243	Pu II	BFG84
500 P	3753.628	Pu I	BFG84
500 P	3755.940	Pu I	BFG84
500 P	3758.338	Pu I	BFG84
500 P	3774.384	Pu I	BFG84
500	3792.220	Pu I	BFG84
500	3799.368	Pu I	BFG84
500	3805.923	Pu I	BFG84
500	3811.396	Pu I	BFG84
500	3835.520	Pu I	BFG84
500 P	3851.007	Pu I	BFG84
400	3851.849	Pu I	BFG84
500 P	3878.540	Pu I	BFG84
400	3895.888	Pu I	BFG84
500	4133.005	Pu I	BFG84
500	4140.041	Pu I	BFG84
500	4151.091	Pu I	BFG84
500	4151.443	Pu I	BFG84
1000 P	4206.481	Pu I	BFG84
500	4208.234	Pu I	BFG84
500	4261.886	Pu I	BFG84
500	4404.894	Pu I	BFG84
1000 P	4536.146	Pu II	BFG84
500	5712.382	Pu I	BFG84
500	6192.798	Pu I	BFG84
800 P	6304.661	Pu I	BFG84
500	6449.744	Pu I	BFG84
800 P	6486.707	Pu I	BFG84
1000 P	6488.853	Pu I	BFG84
500	6535.271	Pu I	BFG84
500	6544.207	Pu I	BFG84
500	6608.947	Pu I	BFG84
800 P	6887.710	Pu I	BFG84
500	7258.049	Pu I	BFG84
500	7572.923	Pu I	BFG84
500	8309.602	Pu I	BFG84
1000 P	8630.189	Pu I	BFG84
150	9533.071	Pu I	BFG84
150	12231.212	Pu I	BFG84
150	16897.369	Pu I	BFG84

Persistent Lines of Neutral Plutonium (Pu I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3753.628		$5f^67s^2$	^7F	0	0.000	BFG84	
			$5f^67s7p$		1	26633.288		
500	3755.940		$5f^67s^2$	^7F	1	2203.606	BFG84	
			$5f^67s7p$		0	28820.548		
500	3758.338		$5f^67s^2$	^7F	6	10238.473	BFG84	
					6	36838.42		
500	3774.384		$5f^67s^2$	^7F	1	2203.606	BFG84	
					1	28690.480		

Persistent Lines of Neutral Plutonium (Pu I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3851.007		$5f^67s^2$	^{7}F	0	0.000	BFG84	
			$5f^56d^27s$		1	25959.849		
500	3878.540		$5f^67s^2$	^{7}F	1	2203.606	BFG84	
			$5f^67s7p$		2	27979.161		
1000	4206.481		$5f^67s^2$	^{7}F	0	0.000	BFG84	
			$5f^57s7p$	^{7}D^o	1	23766.139		
800	6304.661		$5f^67s^2$	^{7}F	0	0.000	BFG84	
			$5f^5(^6$F$^o)6d7s^2$	^{7}G^o	1	15856.888		
800	6486.707		$5f^67s^2$	^{7}F	1	2203.606	BFG84	
			$5f^5(^6$F$^o)6d7s^2$	^{7}F^o	2	17615.482		
1000	6488.853		$5f^67s^2$	^{7}F	0	0.000	BFG84	
			$5f^5(^6$H$^o)6d7s^2$	^{7}G^o	1	15406.760		
800	6887.710		$5f^5(^6$H$^o)6d7s^2$	^{7}K^o	4	6313.866	BFG84	
			$5f^56d7s(^8$K$^o)7p$	^{9}L	4	20828.477		
1000	8630.189		$5f^5(^6$H$^o)6d7s^2$	^{7}K^o	4	6313.866	BFG84	
			$5f^5(^6$H$^o_{5/2})7s^27p_{1/2}$	(5/2,1/2)	3	17897.919		

Energy Levels of Neutral Plutonium (Pu I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^67s^2$	^{7}F	0	0.000	BW92b
		1	2203.606	BW92b
		2	4299.659	BW92b
		3	6144.515	BW92b
		4	7774.653	BW92b
		5	9179.262	BW92b
		6	10238.473	BW92b
$5f^5(^6$H$^o)6d7s^2$	^{7}K^o	4	6313.866	BW92b
		5	9386.801	BW92b
		6	12351.522	BW92b
		7	15074.958	BW92b
		8	17554.704	BW92b
		9	19872.154	BW92b
		10	22710.37	BW92b
$5f^5(^6$H$^o)6d7s^2$	^{7}H^o	2	8768.139	BW92b
		3	11840.715	BW92b
		4	14025.007	BW92b
		5	16155.109	BW92b
		6	18672.411	BW92b
		7	20697.436	BW92b
		8	22160.184	BW92b
$5f^5(^6$H$^o)6d7s^2$	^{7}I^o	3	9724.351	BW92b
		4	12159.465	BW92b
		5	14292.176	BW92b
		6	16888.909	BW92b
		7	19236.116	BW92b
		8	20830.616	BW92b
		9	22719.717	BW92b

Energy Levels of Neutral Plutonium (Pu I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^5(^6H^o)6d7s^2$	$^7G^o$	1	15406.760	BW92b
$5f^5(^6F^o)6d7s^2$	$^7G^o$	1	15856.888	BW92b
$5f^5(^6F^o)6d7s^2$	$^7F^o$	2	17615.482	BW92b
$5f^5(^6H^o_{5/2})7s^27p_{1/2}$	(5/2,1/2)	3	17897.919	BW92b
$5f^56d7s(^8K^o)7p$	^9L	4	20828.477	BW92b
$5f^57s7p$	$^7D^o$	1	23766.139	BW92b
$5f^56d^27s$		1	25959.849	BW92b
$5f^67s7p$		1	26633.288	BW92b
$5f^67s7p$		2	27979.161	BW92b
		1	28690.480	BW92b
$5f^67s7p$		0	28820.548	BW92b
		6	36838.42	BW92b
Pu II ($^8F_{1/2}$)		*Limit*	**48603**	WCJP93,KDEE97

Persistent Lines of Singly-ionized Plutonium (Pu II)

Inten	Wavelength (Å)	$A_{ki}(10^8$ s$^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	2933.602		$5f^67s$ $5f^67p$	^8F o	1/2 3/2	0.000 34077.84	BFG84	
700	2951.820		$5f^67s$	^8F o	1/2 3/2	0.000 33867.55	BFG84	
700	2964.644		$5f^67s$	^8F o	1/2 3/2	0.000 33721.06	BFG84	
700	2969.035		$5f^67s$	^8F o	5/2 5/2	3969.850 37641.00	BFG84	
700	2972.500		$5f^67s$	^8F o	13/2 15/2	9707.985 43339.89	BFG84	
700	3198.467		$5f^67s$	^8F o	1/2 3/2	0.000 31255.97	BFG84	
700	3220.942		$5f^67s$	^8F o	3/2 1/2	2014.970 33052.83	BFG84	
700	3224.873		$5f^67s$ $5f^56d7s$	^8F o	1/2 3/2	0.000 31000.03	BFG84	
700	3245.206		$5f^67s$ $5f^67p$	^8F o	3/2 5/2	2014.970 32820.810	BFG84	
700	3273.111		$5f^67s$	^8F o	3/2 1/2	2014.970 32558.12	BFG84	
700	3275.125		$5f^67s$	^6F o	3/2 5/2	5502.070 36026.44	BFG84	
700	3279.326		$5f^67s$	^6F o	1/2 3/2	3235.775 33721.06	BFG84	

Persistent Lines of Singly-ionized Plutonium (Pu II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	3289.977		$5f^67s$	^8F	9/2	7278.870	BFG84	
				o	9/2	37665.47		
700	3290.345		$5f^67s$	^8F	3/2	2014.970	BFG84	
			$5f^57s^2$	$^6P^o$	5/2	32398.17		
700	3312.647		$5f^67s$	^8F	13/2	9707.985	BFG84	
				o	11/2	39886.62		
700	3337.708		$5f^67s$	^8F	1/2	0.000	BFG84	
				o	3/2	29952.07		
700	3350.330		$5f^67s$	^6F	7/2	9242.365	BFG84	
				o	9/2	39081.59		
700	3391.405		$5f^67s$	^8F	13/2	9707.985	BFG84	
				o	11/2	39185.84		
1000	4536.146		$5f^67s$	^8F	1/2	0.000	BFG84	
			$5f^67p$	$^8G^o$	1/2	22038.970		

Energy Levels of Singly-ionized Plutonium (Pu II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^67s$	^8F	1/2	0.000	BW92b
		3/2	2014.970	BW92b
		5/2	3969.850	BW92b
		7/2	5717.985	BW92b
		9/2	7278.870	BW92b
		11/2	8638.250	BW92b
		13/2	9707.985	BW92b
$5f^67s$	^6F	1/2	3235.775	BW92b
		3/2	5502.070	BW92b
		5/2	7498.380	BW92b
		7/2	9242.365	BW92b
		9/2	10726.330	BW92b
		11/2	11799.245	BW92b
$5f^57s^2$	$^6H^o$	5/2	8198.665	BW92b
$5f^56d7s$	$^8K^o$	7/2	8709.640	BW92b
$5f^56d7s$	$^8K^o$	9/2	10436.770	BW92b
$5f^57s^2$	$^6H^o$	7/2	11504.095	BW92b
$5f^67p$	$^8G^o$	1/2	22038.970	BW92b
	o	3/2	29952.07	BW92b
$5f^56d7s$	o	3/2	31000.03	BW92b
	o	3/2	31255.97	BW92b
$5f^57s^2$	$^6P^o$	5/2	32398.17	BW92b
	o	1/2	32558.12	BW92b

Energy Levels of Singly-ionized Plutonium (Pu II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^67p$	^{o}	5/2	32820.810	BW92b
	^{o}	1/2	33052.83	BW92b
	^{o}	3/2	33721.06	BW92b
	^{o}	3/2	33867.55	BW92b
$5f^67p$	^{o}	3/2	34077.84	BW92b
	^{o}	5/2	36026.44	BW92b
	^{o}	5/2	37641.00	BW92b
	^{o}	9/2	37665.47	BW92b
	^{o}	9/2	39081.59	BW92b
	^{o}	11/2	39185.84	BW92b
	^{o}	11/2	39886.62	BW92b
	^{o}	15/2	43339.89	BW92b
Pu III ($^7F_0$)		*Limit*	**[90000]**	CNWM70

Polonium (Po)
Atomic number = 84
Atomic weight = 209

Isotope	Mass	Abundance	Spin	Mag moment
^{210}Po	209.982848	Trace	0	
^{211}Po	210.986627	Trace	9/2	
^{216}Po	216.001889	Trace	0	
^{218}Po	218.0089	Trace	0	

Po I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^4\ {}^3P_2$
Ionization energy: 67 860 cm^{-1} (8.414 eV)

Po II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^3\ {}^4S^o_{3/2}$
Ionization energy: not available

Strong Lines of Polonium (Po)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
600 P,w	2450.08	Po I	C66a
300	2483.94	Po I	C66a
300	2490.53	Po I	C66a
600 P,w	2558.01	Po I	C66a
300 h	2663.33	Po	CHPT55
250	2761.92	Po I	C66a
250	2958.92	Po I	C66a
1000 P,w	3003.21	Po I	C66a
250	3328.60	Po I	C66a
500 P	4170.52	Po I	C66a
300	4493.21	Po I	C66a
250	7962.62	Po I	C66a

Persistent Lines of Neutral Polonium (Po I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	2450.08		$6p^4$	^{3}P	2	0.00	C66a	
			$6p^3(^4S^o)7s$	^{3}S^o	1	40802.70		
600	2558.01		$6p^4$	^{3}P	2	0.00	C66a	
			$6p^3(^4S^o)7s$	^{5}S^o	2	39081.19		
1000	3003.21		$6p^4$	^{3}P	0	7514.69	C66a	
			$6p^3(^4S^o)7s$	^{3}S^o	1	40802.70		
500	4170.52		$6p^4$	^{3}P	1	16831.61	C66a	
			$6p^3(^4S^o)7s$	^{3}S^o	1	40802.70		

Energy Levels of Neutral Polonium (Po I)

Configuration	Term	J	Level (cm^{-1})	Ref
$6p^4$	^{3}P	2	0.00	C66a
		0	7514.69	C66a
		1	16831.61	C66a
$6p^4$	^{1}D	2	21679.11	C66a
$6p^3(^4S^o)7s$	^{5}S^o	2	39081.19	C66a
$6p^3(^4S^o)7s$	^{3}S^o	1	40802.70	C66a
Po II ($^4S^o_{3/2}$)		*Limit*	**67860**	C66a

Potassium (K)
Atomic number = 19
Atomic weight = 39.0983

Isotope	Mass	Abundance	Spin	Mag moment
^{39}K	38.963707	93.2581%	3/2	+0.39146
^{40}K	39.963999	0.012%	4	−1.298
^{41}K	40.961825	6.7302%	3/2	+0.21487

K I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 4s\ ^2S_{1/2}$
Ionization energy: 35 009.8140 cm^{-1} (4.340 6633 eV)

K II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6\ ^1S_0$
Ionization energy: 255 100 cm^{-1} (31.63 eV)

Strong Lines of Potassium (K)

Intensity	Wavelength (Å)	Spectrum	Ref.
	Vacuum		
800	441.81	K II	E31
150	465.08	K II	E31
	469.50	K II	E31
300	476.03	K II	E31
1000	495.14	K II	E31
1000 P	600.77	K II	E31
800 P	607.93	K II	E31
1000 P	612.62	K II	E31
	Air		
200	2190.00	K II	D26
200	2550.02	K II	D26
	2992.12	K I	R56
	2992.22	K I	R56
	3034.76	K I	R56
	3034.92	K I	R56
150	3101.79	K I	R56
120	3102.04	K I	R56
200	3105.00	K II	D26
300	3217.16	K I	R56
250	3217.62	K I	R56
250	3440.05	K II	D26
400	3446.37	K I	R56
400	3447.38	K I	R56
250	3530.75	K II	D26
200	3618.49	K II	D26
120	3648.84	K I	R56
150	3648.98	K I	R56
200	3681.54	K II	D26
200	3816.56	K II	D26
250	3817.50	K II	D26
250	3897.92	K II	D26
250	4001.24	K II	D26
700 P	4044.14	K I	R56
700 P	4047.21	K I	R56
250	4134.72	K II	D26
250	4149.19	K II	D26
250	4186.24	K II	D26
250	4222.97	K II	D26
250	4225.67	K II	D26

Strong Lines of Potassium (K)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
250	4263.40	K II	D26
250	4305.00	K II	D26
250	4309.10	K II	D26
250	4388.16	K II	D26
250	4608.45	K II	D26
400	4641.88	K I	R56
400	4642.37	K I	R56
150	4740.91	K I	R56
250	4744.35	K I	R56
200	4753.93	K I	R56
300	4757.39	K I	R56
200	4786.49	K I	R56
300	4791.05	K I	R56
250	4799.75	K I	R56
300	4804.35	K I	R56
300	4829.23	K II	D26
300	4849.86	K I	R56
300	4856.09	K I	R56
300	4863.48	K I	R56
400	4869.76	K I	R56
300	4942.02	K I	R56
400	4950.82	K I	R56
400	4956.15	K I	R56
400	4965.03	K I	R56
250	5005.60	K II	D26
250	5056.27	K II	D26
400	5084.23	K I	R56
400	5097.17	K I	R56
400	5099.20	K I	R56
500	5112.25	K I	R56
500	5323.28	K I	R56
500	5339.69	K I	R56
500	5342.97	K I	R56
600	5359.57	K I	R56
600	5782.38	K I	R56
700	5801.75	K I	R56
600	5812.15	K I	R56
700	5831.89	K I	R56
250	6120.27	K II	D26
250	6307.29	K II	D26
800	6911.08	K I	R56
500	6936.28	K I	R56
800	6938.77	K I	R56
300	6964.18	K I	R56
500	6964.67	K I	R56
1000 P	7664.8991	K I	E99
1000 P	7698.9645	K I	E99
200	7955.37	K I	R56
150	7956.83	K I	R56
300	8078.11	K I	R56
250	8079.62	K I	R56
400	8250.18	K I	R56
300	8251.74	K I	R56
120	8390.22	K I	R56
	8391.44	K I	R56
80	8417.54	K I	R56
40	8420.00	K I	R56
400	8503.45	K I	R56
400	8505.11	K I	R56

Strong Lines of Potassium (K)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
150	8763.96	K I	R56
120	8767.05	K I	R56
500	8902.19	K I	R56
500	8904.02	K I	R56
200	8923.31	K I	R56
150	8925.44	K I	R56
300	9347.24	K I	R56
120	9349.25	K I	R56
250	9351.59	K I	R56
600	9595.70	K I	R56
600	9597.83	K I	R56
250	9949.67	K I	R56
200	9954.14	K I	R56
400	10479.63	K I	R56
200	10482.15	K I	R56
300	10487.11	K I	R56
700	11019.87	K I	R56
600	11022.67	K I	R56
700 P	11690.21	K I	R56
600 P	11769.62	K I	R56
700 P	11772.83	K I	R56
	12432.24	K I	R56
	12522.11	K I	R56
	13377.86	K I	R56
	13397.09	K I	R56
	15163.08	K I	R56
	15168.40	K I	R56
	40158.37	K I	L70b

Persistent Lines of Neutral Potassium (K I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	4044.14	0.0116	$4s$	^2S	1/2	0.000	R56	M03
			$5p$	$^2P^o$	3/2	24720.139		
700	4047.21	0.0107	$4s$	^2S	1/2	0.000	R56	M03
			$5p$	$^2P^o$	1/2	24701.382		
1000	7664.8991	0.379	$4s$	^2S	1/2	0.000	E99	M03
			$4p$	$^2P^o$	3/2	13042.876		
1000	7698.9645	0.374	$4s$	^2S	1/2	0.000	E99	M03
			$4p$	$^2P^o$	1/2	12985.170		
700	11690.21	0.220	$4p$	$^2P^o$	1/2	12985.170	R56	WSM69
			$3d$	^2D	3/2	21536.988		
600	11769.62	0.0434	$4p$	$^2P^o$	3/2	13042.876	R56	WSM69
			$3d$	^2D	3/2	21536.988		
700	11772.83	0.259	$4p$	$^2P^o$	3/2	13042.876	R56	WSM69
			$3d$	^2D	5/2	21534.680		

Energy Levels of Neutral Potassium (K I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4s$	^2S	1/2	0.000	E99
$4p$	$^2P^o$	1/2	12985.186	E99
		3/2	13042.896	E99
$3d$	^2D	5/2	21534.700	SC85
		3/2	21537.004	SC85
$5p$	$^2P^o$	1/2	24701.382	SC85
		3/2	24720.139	SC85
K II ($^1S_0$)		*Limit*	**35009.8140**	SC85

Persistent Lines of Singly-ionized Potassium (K II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	600.77		$3p^6$	^1S	0	0.0	E31	
			$3p^54s$	$^1P^o$	1	166461.5		
800	607.93	0.013	$3p^6$	^1S	0	0.0	E31	FW96
			$3p^53d$	$^3P^o$	1	164496.1		
1000	612.62		$3p^6$	^1S	0	0.0	E31	
			$3p^54s$	$^3P^o$	1	163237.0		

Energy Levels of Singly-ionized Potassium (K II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3p^6$	^1S	0	0.0	SC85
$3p^54s$	$^3P^o$	2	162507.0	SC85
		1	163237.0	SC85
		0	165149.5	SC85
$3p^53d$	$^3P^o$	0	163436.3	SC85
		1	164496.1	SC85
		2	164932.3	SC85
$3p^54s$	$^1P^o$	1	166461.5	SC85
K III ($^2P^o_{3/2}$)		*Limit*	**255100**	K87

Praseodymium (Pr)
Atomic number = 59
Atomic weight = 140.907 65

Isotope	Mass	Abundance	Spin	Mag moment
^{141}Pr	140.907647	100%	5/2	+4.3

Pr I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6)4f^3 6s^2\ ^4\mathrm{I}^{\circ}_{9/2}$
Ionization energy: 44 140 cm^{-1} (5.473 eV)

Pr II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6)4f^3(^4\mathrm{I}^{\circ}_{9/2})6s\ (9/2,1/2)^{\circ}_4$
Ionization energy: 85 100 cm^{-1} (10.55 eV)

Strong Lines of Praseodymium (Pr)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
80	2579.31	Pr I	MCS75
130	2881.60	Pr I	MCS75
70	3668.83	Pr II	MCS75
60	3714.05	Pr II	MCS75
80	3739.18	Pr II	MCS75
130	3761.87	Pr II	MCS75
130	3800.30	Pr II	MCS75
60	3804.84	Pr II	MCS75
80	3811.84	Pr II	MCS75
250 h	3816.02	Pr II	MCS75
130	3818.28	Pr II	MCS75
60	3821.80	Pr II	MCS75
200	3830.72	Pr II	MCS75
90	3840.99	Pr II	MCS75
110	3846.59	Pr II	MCS75
250	3850.79	Pr II	MCS75
140 c	3851.55	Pr II	MCS75
200	3852.80	Pr II	MCS75
90 c	3865.45	Pr II	MCS75
90	3876.19	Pr II	MCS75
300 c	3877.18	Pr II	MCS75
130	3880.47	Pr II	MCS75
80 c	3885.19	Pr II	MCS75
80 c	3889.34	Pr II	MCS75
150 c	3908.05	Pr II	MCS75
120	3912.90	Pr II	MCS75
60	3913.55	Pr II	MCS75
250 c	3918.85	Pr II	MCS75
80	3919.63	Pr II	MCS75
200	3925.47	Pr II	MCS75
90	3927.46	Pr II	MCS75
70	3929.29	Pr II	MCS75
70	3935.82	Pr II	MCS75
140 c	3947.63	Pr II	MCS75
150 c	3949.43	Pr II	MCS75
150 c	3953.51	Pr II	MCS75
70	3956.75	Pr II	MCS75
500 P	3959.44	Pr I	MCS75
90	3962.45	Pr II	MCS75
110	3964.26	Pr II	MCS75
300 c	3964.81	Pr II	MCS75

Strong Lines of Praseodymium (Pr)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
110	c	3966.57	Pr II	MCS75
100		3971.16	Pr II	MCS75
60		3971.67	Pr II	MCS75
120	c	3972.14	Pr II	MCS75
60		3974.85	Pr II	MCS75
250	c	3989.68	Pr II	MCS75
70		3992.16	Pr II	MCS75
300		3994.79	Pr II	MCS75
110	c	3997.04	Pr II	MCS75
60		3999.12	Pr II	MCS75
120	c	4000.173	Pr II	G90
140		4004.702	Pr II	G90
400		4008.691	Pr II	G90
120		4010.601	Pr II	G90
140		4015.391	Pr II	G90
120		4020.96	Pr II	MCS75
90		4022.712	Pr II	G90
70		4025.54	Pr II	MCS75
70	c	4029.72	Pr II	MCS75
140	c	4031.753	Pr II	MCS75
200		4033.827	Pr II	G90
140		4038.455	Pr II	G90
90		4039.341	Pr II	G90
250		4044.813	Pr II	G90
70		4047.082	Pr II	G90
90		4051.13	Pr II	MCS75
400		4054.860	Pr II	G90
400		4056.537	Pr II	G90
90		4058.800	Pr II	G90
700	P	4062.804	Pr II	G90
700*	P	4062.806	Pr II	G90
100	c	4079.77	Pr II	MCS75
100	c	4080.980	Pr II	G90
150		4081.85	Pr II	MCS75
100		4083.341	Pr II	G90
110		4096.820	Pr II	G90
70		4098.400	Pr II	G90
600	P,c	4100.717	Pr II	G90
300	c	4118.457	Pr II	G90
70		4130.771	Pr II	G90
300	c	4141.224	Pr II	G90
500	P	4143.112	Pr II	G90
300	c	4164.156	Pr II	G90
120		4171.822	Pr II	G90
140		4172.246	Pr II	G90
1000	P	4179.391	Pr II	G90
500	P	4189.479	Pr II	G90
110	c	4191.605	Pr II	G90
60		4201.17	Pr II	MCS75
500	P,c	4206.719	Pr II	G90
100		4208.315	Pr II	G90
60		4211.862	Pr II	G90
60		4217.810	Pr II	G90
700	P	4222.931	Pr II	G90
700	P	4225.346	Pr II	G90
60		4233.114	Pr II	G90
60	c	4236.153	Pr II	G90
200		4241.010	Pr II	G90
70		4243.507	Pr II	G90

Strong Lines of Praseodymium (Pr)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
150	c	4247.631	Pr II	G90
100		4254.402	Pr II	G90
60		4269.093	Pr II	G90
150	c	4272.273	Pr II	G90
90	c	4280.07	Pr II	MCS75
150	c	4282.456	Pr II	G90
90	c	4298.965	Pr II	G90
60		4303.61	Pr II	MCS75
300		4305.764	Pr II	G90
250		4333.973	Pr II	G90
70		4338.702	Pr II	G90
120	c,w	4344.30	Pr II	MCS75
90	c	4347.491	Pr II	G90
70		4350.399	Pr II	G90
90		4354.91	Pr II	MCS75
80	c	4359.788	Pr II	G90
250		4368.334	Pr II	G90
60		4371.62	Pr II	MCS75
80		4405.825	Pr II	G90
300		4408.820	Pr II	G90
80		4413.770	Pr II	G90
250	c	4429.128	Pr II	G90
140		4449.826	Pr II	G90
200		4468.663	Pr II	G90
200		4496.456	Pr II	G90
150		4510.153	Pr II	G90
70	c	4534.154	Pr II	G90
70		4535.923	Pr II	G90
400		4632.28	Pr I	MCS75
400		4635.68	Pr I	MCS75
500	P	4639.55	Pr I	MCS75
500	P	4687.80	Pr I	MCS75
800	P	4695.77	Pr I	MCS75
400		4709.52	Pr I	MCS75
500	P	4730.67	Pr I	MCS75
700	P	4736.69	Pr I	MCS75
250		4744.16	Pr I	MCS75
300		4906.99	Pr I	MCS75
400		4914.02	Pr I	MCS75
500	P	4924.60	Pr I	MCS75
400		4936.00	Pr I	MCS75
800	P	4939.74	Pr I	MCS75
400		4940.30	Pr I	MCS75
1000	P	4951.37	Pr I	MCS75
300		4975.75	Pr I	MCS75
300		5018.59	Pr I	MCS75
500	P	5019.76	Pr I	MCS75
500	P	5026.96	Pr I	MCS75
250		5033.38	Pr I	MCS75
300		5043.83	Pr I	MCS75
800	P	5045.52	Pr I	MCS75
400		5053.40	Pr I	MCS75
500	P	5087.12	Pr I	MCS75
70		5110.384	Pr II	G90
110		5110.763	Pr II	G90
80		5129.536	Pr II	G90
700	P	5133.44	Pr I	MCS75
250		5139.81	Pr I	MCS75
120		5173.905	Pr II	G90

Strong Lines of Praseodymium (Pr)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
300		5194.43	Pr I	MCS75
70		5206.561	Pr II	G90
70		5219.048	Pr II	G90
110		5220.108	Pr II	G90
300		5227.97	Pr I	MCS75
130		5259.737	Pr II	G90
70	c	5292.024	Pr II	G90
70		5292.620	Pr II	G90
80		5322.772	Pr II	G90
120		5531.16	Pr I	MCS75
120	c	5562.06	Pr I	MCS75
90	h	5661.57	Pr I	MCS75
150	c	5668.46	Pr I	MCS75
150		5707.61	Pr I	MCS75
250		5779.28	Pr I	MCS75
110		5835.13	Pr I	MCS75
90		5874.72	Pr I	MCS75
90		5878.10	Pr I	MCS75
90		5879.04	Pr I	MCS75
90	c	5884.72	Pr I	MCS75
110		5920.76	Pr I	MCS75
110		5986.14	Pr I	MCS75
120*	c	5987.14	Pr I	MCS75
120*	c	5987.29	Pr II	MCS75
90		6049.26	Pr I	MCS75
400		6055.13	Pr I	MCS75
150*		6148.23	Pr I	MCS75
150*		6148.24	Pr II	MCS75
120	c	6322.36	Pr I	MCS75
140	c	6359.03	Pr I	MCS75
110		6393.18	Pr I	MCS75
140		6411.23	Pr I	MCS75
120		6486.55	Pr I	MCS75
110	h	6491.75	Pr I	MCS75
140		6616.67	Pr I	MCS75
90	c	6747.09	Pr I	MCS75
140	c,w	6798.60	Pr I	MCS75

Persistent Lines of Neutral Praseodymium (Pr I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3959.44						MCS75	
500	4639.55		$4f^36s^2$	$^4I^o$	11/2	1376.60	MCS75	
					9/2	22924.39		
500	4687.80						MCS75	
800	4695.77						MCS75	
500	4730.67	0.34	$4f^36s^2$	$^4I^o$	11/2	1376.60	MCS75	M00
					9/2	22509.40		
700	4736.69	0.53	$4f^36s^2$	$^4I^o$	9/2	0.00	MCS75	M00
					7/2	21105.88		
500	4924.60	0.59	$4f^36s^2$	$^4I^o$	11/2	1376.60	MCS75	M00
					11/2	21677.15		
800	4939.74		$4f^36s^2$	$^4I^o$	13/2	2846.75	MCS75	
			$4f^36s6p$?	^4I?	13/2	23085.08		
1000	4951.37	0.83	$4f^36s^2$	$^4I^o$	9/2	0.00	MCS75	M00
			$4f^3(^4I^o)6s6p(^1P^o)$?	^4I?	9/2	20190.85		
500	5019.76		$4f^36s^2$	$^4I^o$	13/2	2846.75	MCS75	
			$4f^36s6p$?	^4K?	15/2	22762.55		
500	5026.96	0.40	$4f^36s^2$	$^4I^o$	11/2	1376.60	MCS75	M00
			$4f^3(^4I^o)6s6p$?	^4K?	13/2	21263.71		
800	5045.52	0.71	$4f^36s^2$	$^4I^o$	15/2	4381.10	MCS75	M00
			$4f^36s6p$?	^4K?	17/2	24195.13		
500	5087.12	0.44	$4f^36s^2$	$^4I^o$	13/2	2846.75	MCS75	M00
					15/2	22498.81		
700	5133.44	0.38	$4f^36s^2$	$^4I^o$	9/2	0.00	MCS75	M00
			$4f^36s6p$?	^4I?	11/2	19474.75		

Energy Levels of Neutral Praseodymium (Pr I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^36s^2$	$^4I^o$	9/2	0.00	MZH78
		11/2	1376.60	MZH78
		13/2	2846.75	MZH78
		15/2	4381.10	MZH78
$4f^2(^3H)5d6s^2$	^4I	9/2	4432.22	MZH78
		11/2	6313.23	MZH78
		13/2	7951.31	MZH78
		15/2	—	
$4f^2(^3H)5d6s^2$	^4K	11/2	4866.54	MZH78
		13/2	6603.60	MZH78
		15/2	8363.91*	MZH78
		17/2	—	
$4f^2(^3H)5d6s^2$	^2H	9/2	5822.87	MZH78
		11/2	6892.95	MZH78

Energy Levels of Neutral Praseodymium (Pr I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^2(^3\mathrm{H})5d6s^2$	$^4\mathrm{H}$	7/2	6535.51	MZH78
		9/2	8029.24	MZH78
		11/2	9675.01	MZH78
		13/2	—	
$4f^2(^3\mathrm{H})5d^2(^3\mathrm{F})(^5\mathrm{L})6s$	$^6\mathrm{L}$	11/2	6714.22	MZH78
		13/2	7630.16	MZH78
		15/2	—	
		17/2	—	
		19/2	—	
		21/2	—	
$4f^36s6p$?	$^4\mathrm{I}$?	11/2	19474.75	MZH78
$4f^3(^4\mathrm{I}^o)6s6p(^1\mathrm{P}^o)$?	$^4\mathrm{I}$?	9/2	20190.85	MZH78
		7/2	21105.88	MZH78
$4f^3(^4\mathrm{I}^o)6s6p$?	$^4\mathrm{K}$?	13/2	21263.71	MZH78
		11/2	21677.15	MZH78
		15/2	22498.81	MZH78
		9/2	22509.40	MZH78
$4f^36s6p$?	$^4\mathrm{K}$?	15/2	22762.55	MZH78
		9/2	22924.39	MZH78
$4f^36s6p$?	$^4\mathrm{I}$?	13/2	23085.08	MZH78
$4f^36s6p$?	$^4\mathrm{K}$?	17/2	24195.13	MZH78
Pr II $(^4\mathrm{I}^o_{9/2})6s\ (9/2,1/2)^o_4$		*Limit*	**44140**	WSPC78

Persistent Lines of Singly-ionized Praseodymium (Pr II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ \mathrm{s}^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700*	4062.804	0.34	$4f^3(^4\mathrm{I}^o_{13/2})6s_{1/2}$	$(13/2,1/2)^o$	6	3403.21	G90	GKQW91
			$4f^3(^4\mathrm{I}^o)6p$	$^3\mathrm{K}$	7	28009.80		
700*	4062.806		$4f^3(^4\mathrm{I}^o_{13/2})6s_{1/2}$	$(13/2,1/2)^o$	7	2998.36	G90	
			$4f^25d^2$		6	27604.94		
600	4100.717	0.71	$4f^3(^4\mathrm{I}^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	4437.14	G90	GKQW91
			$4f^3(^4\mathrm{I}^o)6p$	$^5\mathrm{K}$	9	28816.25		
500	4143.112	0.54	$4f^3(^4\mathrm{I}^o_{13/2})6s_{1/2}$	$(13/2,1/2)^o$	7	2998.36	G90	GKQW91
			$4f^3(^4\mathrm{I}^o)6p$	$^5\mathrm{K}$	8	27128.00		
1000	4179.391	0.54	$4f^3(^4\mathrm{I}^o_{11/2})6s_{1/2}$	$(11/2,1/2)^o$	6	1649.01	G90	GKQW91
			$4f^3(^4\mathrm{I}^o)6p$	$^5\mathrm{K}$	7	25569.19		
500	4189.479	0.30	$4f^3(^4\mathrm{I}^o_{13/2})6s_{1/2}$	$(13/2,1/2)^o$	7	2998.36	G90	GKQW91
			$4f^3(^4\mathrm{I}^o)6p$	$^5\mathrm{I}$	7	26860.95		
500	4206.719	0.45	$4f^3(^4\mathrm{I}^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	4437.14	G90	GKQW91
			$4f^3(^4\mathrm{I}^o)6p$	$^5\mathrm{I}$	8	28201.95		
700	4222.931	0.34	$4f^3(^4\mathrm{I}^o_{9/2})6s_{1/2}$	$(9/2,1/2)^o$	5	441.95	G90	GKQW91
			$4f^3(^4\mathrm{I}^o)6p$	$^5\mathrm{K}$	6	24115.48		
700	4225.346	0.55	$4f^3(^4\mathrm{I}^o_{9/2})6s_{1/2}$	$(9/2,1/2)^o$	4	0.00	G90	GKQW91
			$4f^3(^4\mathrm{I}^o)6p$	$^5\mathrm{I}$	4	23660.08		

Energy Levels of Singly-ionized Praseodymium (Pr II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^3(^4I^o_{9/2})6s_{1/2}$	$(9/2,1/2)^o$	4	0.00	MZH78
		5	441.95	MZH78
$4f^3(^4I^o_{11/2})6s_{1/2}$	$(11/2,1/2)^o$	6	1649.01	MZH78
		5	1743.72	MZH78
$4f^3(^4I^o_{13/2})6s_{1/2}$	$(13/2,1/2)^o$	7	2998.36	MZH78
		6	3403.21	MZH78
$4f^3(^4I^o)5d$	$^5L^o$	6	3893.46	G89
		7	5108.40	G89
		8	6417.83	G89
		9	7805.61	G89
		10	9255.19	G89
$4f^3(^4I^o)5d$	$^5K^o$	5	4097.58	G89
		6	5226.52	G89
		7	6413.93	G89
		8	7659.72	G89
		9	8958.44	G89
$4f^3(^4I^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	4437.14	MZH78
		7	5079.34	MZH78
$4f^2(^3H)5d^2(^3F)$	^5L	6	5854.54	G89
$4f^2(^3H)5d^2(^3F)$	^5I	4	7228.00	G89
$4f^3(^4I^o)6p$	^5K	5	22675.44	G89
		6	24115.48	G89
		7	25569.19	G89
		8	27128.00	G89
		9	28816.25	G89
$4f^3(^4I^o)6p$	^5I	4	23660.08	G89
		5	24716.04	G89
		6	25656.69	G89
		7	26860.95	G89
		8	28201.95	G89
$4f^25d^2$		6	27604.94	G89
$4f^3(^4I^o)6p$	^3K	7	28009.80	G89
Pr III ($^4I^o_{9/2}$)		*Limit*	**85100**	SR65

Promethium (Pm)
Atomic number = 61
Atomic weight = 145

Isotope	Mass	Abundance	Spin	Mag moment
^{145}Pm	144.912743	0	5/2	
^{146}Pm	145.914708	0	3	
^{147}Pm	146.915135	0	7/2	+2.7
^{149}Pm	148.918332	0	7/2	±3.3
^{151}Pm	150.921203	0	5/2	±1.8

Pm I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^5 6s^2\ ^6\mathrm{H}^o_{5/2}$
Ionization energy: 45 020 cm^{-1} (5.582 eV)

Pm II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^5 6s\ ^7\mathrm{H}^o_2$
Ionization energy: 87 900 cm^{-1} (10.90 eV)

Strong Lines of Promethium (Pm)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
300	3072.41	Pm II	RCWM80
500	3427.40	Pm II	RCWM80
400	3449.80	Pm II	RCWM80
300	3634.20	Pm II	RCWM80
300	3659.39	Pm II	RCWM80
400	3689.79	Pm II	RCWM80
300	3692.50	Pm II	RCWM80
300	3697.50	Pm II	RCWM80
400	3702.63	Pm II	RCWM80
800	3711.72	Pm II	RCWM80
150	3726.01	Pm I	RD67
300	3742.52	Pm II	RCWM80
500	3745.86	Pm II	RCWM80
300	3747.09	Pm II	RCWM80
500	3750.09	Pm II	RCWM80
400	3795.66	Pm II	RCWM80
300	3820.53	Pm II	RCWM80
300	3842.98	Pm II	RCWM80
800	3877.62	Pm II	RCWM80
1000 P	3892.15	Pm II	RCWM80
400	3899.78	Pm II	RCWM80
1000 P	3910.26	Pm II	RCWM80
1000 P	3919.10	Pm II	RCWM80
800 P	3936.48	Pm II	RCWM80
300	3944.21	Pm II	RCWM80
1000 P	3957.74	Pm II	RCWM80
500	3980.74	Pm II	RCWM80
300	3995.05	Pm II	RCWM80
1000 P,r	3998.96	Pm II	RCWM80
500	4009.96	Pm II	RCWM80
300	4051.54	Pm II	RCWM80
600 r	4055.20	Pm II	RCWM80
600 P	4075.84	Pm II	RCWM80
500 P	4086.10	Pm II	RCWM80
300	4192.92	Pm II	RCWM80
600 P	4297.78	Pm II	RCWM80
300	4336.54	Pm II	RCWM80

Strong Lines of Promethium (Pm)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
300	4342.12	Pm II	RCWM80
150 r	4369.64	Pm I	RD67
150 r	4388.49	Pm I	RD67
100 r	4412.47	Pm I	RD67
1000 P	4417.96	Pm II	RCWM80
400	4432.51	Pm II	RCWM80
500	4445.41	Pm II	RCWM80
600	4446.90	Pm II	RCWM80
800 P	4453.95	Pm II	RCWM80
300	4473.23	Pm II	RCWM80
150 r	4481.60	Pm I	RD67
600	4500.15	Pm II	RCWM80
600	4525.20	Pm II	RCWM80
150 r	4527.70	Pm I	RD67
800 P	4529.21	Pm II	RCWM80
150 r	4575.27	Pm I	RD67
100	4597.55	Pm I	RD67
100 r	4600.25	Pm I	RD67
200 r	4605.66	Pm I	RD67
100 r	4609.85	Pm I	RD67
150 r	4617.02	Pm I	RD67
100 r	4619.75	Pm I	RD67
100	4621.57	Pm I	RD67
200 r	4623.68	Pm I	RD67
100	4624.41	Pm I	RD67
200 r	4625.29	Pm I	RD67
150 r	4633.45	Pm I	RD67
150 r	4643.36	Pm I	RD67
100 r	4643.76	Pm I	RD67
100 r	4647.03	Pm I	RD67
150 r	4653.41	Pm I	RD67
100 r	4660.79	Pm I	RD67
150 r	4663.46	Pm I	RD67
300 r	4665.19	Pm I	RD67
150 r	4671.23	Pm I	RD67
100 r	4677.92	Pm I	RD67
150 r	4678.09	Pm I	RD67
200 r	4682.92	Pm I	RD67
100 r	4696.80	Pm I	RD67
300 r	4728.36	Pm I	RD67
150 r	4728.68	Pm I	RD67
400 P,r	4734.27	Pm I	RD67
150 r	4745.13	Pm I	RD67
150 r	4757.73	Pm I	RD67
700 P,r	4759.00	Pm I	RD67
1000 P,r	4762.57	Pm I	RD67
400 P,r	4773.46	Pm I	RD67
200 r	4781.29	Pm I	RD67
600 P,r	4798.98	Pm I	RD67
500 P,r	4801.36	Pm I	RD67
200 r	4809.54	Pm I	RD67
350 P,r	4811.85	Pm I	RD67
350 P,r	4837.66	Pm I	RD67
700 P,r	4860.74	Pm I	RD67
300 r	4865.72	Pm I	RD67
150 r	4872.42	Pm I	RD67
100 r	4887.02	Pm I	RD67
350 P,r	4892.52	Pm I	RD67
350 P,r	4932.99	Pm I	RD67

Strong Lines of Promethium (Pm)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500 P,r	4959.46	Pm I	RD67
1000 P,r	4997.10	Pm I	RD67
1000 P,r	5058.31	Pm I	RD67
400 r	5094.83	Pm I	RD67
300 r	5100.77	Pm I	RD67
1000 P,r	5127.34	Pm I	RD67
700 P,r	5146.30	Pm I	RD67
400	5153.86	Pm II	RCWM80
300	5169.71	Pm II	RCWM80
500	5171.58	Pm II	RCWM80
300	5194.05	Pm II	RCWM80
500	5208.09	Pm II	RCWM80
500	5236.26	Pm II	RCWM80
300	5236.66	Pm II	RCWM80
400	5246.33	Pm II	RCWM80
500	5270.64	Pm II	RCWM80
800 P	5546.08	Pm II	RCWM80
800 P	5576.02	Pm II	RCWM80
500	5823.93	Pm II	RCWM80
300 c	5868.79	Pm II	RCWM80
400 c	5946.49	Pm II	RCWM80
150	5956.42	Pm I	RCWM80
100	6043.39	Pm I	RCWM80
50	6069.06	Pm I	RCWM80
300 P	6100.21	Pm I	RCWM80
200 h	6151.76	Pm I	RCWM80
50	6229.64	Pm I	RCWM80
100	6286.06	Pm I	RCWM80
50	6308.29	Pm I	RCWM80
100	6323.84	Pm I	RCWM80
50	6390.31	Pm I	RCWM80
500 h	6431.93	Pm I	RCWM80
50	6517.25	Pm I	RCWM80
300 P,d	6520.45	Pm I	RCWM80
50	6542.20	Pm I	RCWM80
400 P	6598.15	Pm I	RCWM80
80	6598.66	Pm I	RCWM80
70	6606.37	Pm I	RCWM80
80 w	6625.23	Pm I	RCWM80
70	6649.81	Pm I	RCWM80
400	6659.05	Pm II	RCWM80
50	6661.68	Pm I	RCWM80
80 c	6667.51	Pm I	RCWM80
70 h	6677.47	Pm I	RCWM80
50	6685.55	Pm I	RCWM80
50	6685.68	Pm I	RCWM80
60	6700.33	Pm I	RCWM80
70	6714.67	Pm I	RCWM80
50	6717.26	Pm I	RCWM80
50	6720.71	Pm I	RCWM80
70	6727.50	Pm I	RCWM80
60	6743.71	Pm I	RCWM80
90	6749.91	Pm I	RCWM80
90	6750.48	Pm I	RCWM80
300	6772.29	Pm II	RCWM80
80	6833.30	Pm I	RCWM80

Persistent Lines of Neutral Promethium (Pm I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	4734.27		$4f^56s^2$	$^6H^o$	7/2	803.82	RD67	
					9/2	21920.49		
700	4759.00		$4f^56s^2$	$^6H^o$	15/2	5089.79	RD67	
					17/2	26096.75		
1000	4762.57		$4f^56s^2$	$^6H^o$	15/2	5089.79	RD67	
					17/2	26080.99		
400	4773.46		$4f^56s^2$	$^6H^o$	11/2	2797.10	RD67	
					13/2	23740.42		
600	4798.98		$4f^56s^2$	$^6H^o$	11/2	2797.10	RD67	
					13/2	23629.06		
500	4801.36		$4f^56s^2$	$^6H^o$	7/2	803.82	RD67	
					9/2	21625.45		
350	4811.85		$4f^56s^2$	$^6F^o$	9/2	7497.99	RD67	
					9/2	28274.21		
350	4837.66		$4f^56s^2$	$^6H^o$	9/2	1748.78	RD67	
					11/2	22414.17		
700	4860.74		$4f^56s^2$	$^6H^o$	7/2	803.82	RD67	
					7/2	21371.05		
350	4892.52		$4f^56s^2$	$^6H^o$	7/2	803.82	RD67	
					9/2	21237.49		
350	4932.99		$4f^56s^2$	$^6H^o$	5/2	0.00	RD67	
					5/2	20265.98		
500	4959.46		$4f^56s^2$	$^6H^o$	5/2	0.00	RD67	
					7/2	20157.85		
1000	4997.10		$4f^56s^2$	$^6H^o$	5/2	0.00	RD67	
					3/2	20006.04		
1000	5058.31		$4f^56s^2$	$^6H^o$	7/2	803.82	RD67	
					5/2	20567.76		
1000	5127.34		$4f^56s^2$	$^6H^o$	11/2	2797.10	RD67	
					9/2	22294.96		
700	5146.30		$4f^56s^2$	$^6H^o$	13/2	3919.03	RD67	
					11/2	23345.07		
300	6100.21						RCWM80	
300	6520.45						RCWM80	
400	6598.15						RCWM80	

Energy Levels of Neutral Promethium (Pm I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^5 6s^2$	$^6H^o$	5/2	0.00	RD67
		7/2	803.82	RD67
		9/2	1748.78	RD67
		11/2	2797.10	RD67
		13/2	3919.03	RD67
		15/2	5089.79	RD67
$4f^5 6s^2$	$^6F^o$	1/2	5249.48	RD67
		3/2	5460.50	RD67
		5/2	5872.84	RD67
		7/2	6562.86	RD67
		9/2	7497.99	RD67
		11/2	8609.21	RD67
		7/2	17104.72	RD67
		3/2	20006.04	RD67
		7/2	20157.85	RD67
		5/2	20265.98	RD67
		5/2	20567.76	RD67
		9/2	21237.49	RD67
		7/2	21371.05	RD67
		9/2	21625.45	RD67
		9/2	21920.49	RD67
		9/2	22294.96	RD67
		11/2	22414.17	RD67
		11/2	23345.07	RD67
		13/2	23629.06	RD67
		13/2	23740.42	RD67
		11/2	24912.34	RD67
		17/2	26096.75	RD67
		9/2	28274.21	RD67
Pm II ($^7H^o_2$)		*Limit*	**45020**	WSPC78

Persistent Lines of Singly-ionized Promethium (Pm II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3892.15						RCMW80	
1000	3910.26		$4f^5(^6H^o)6s$	$^7H^o$	6	2950.31	RCMW80	
					7	28516.85		
1000	3919.10						RCMW80	
800	3936.48		$4f^5(^6H^o)6s$	$^7H^o$	5	1983.52	RCMW80	
					6	27379.79		

PersistentLinesofSingly-ionizedPromethium(PmII)—Continued

Wavelength(Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level(cm^{-1})	Wl Ref	A Ref
3957.74						RCMW80	
3998.96		$4f^5(^6H^o)6s$	$^7H^o$	4	1133.45	RCMW80	
				5	26132.87		
4075.84		$4f^5(^6H^o)6s$	$^7H^o$	2	0.00	RCMW80	
				3	24527.89		
4086.10		$4f^5(^6H^o)6s$	$^7H^o$	2	0.00	RCMW80	
				3	24466.32		
4297.78		$4f^5(^6H^o)6s$	$^7H^o$	2	0.00	RCMW80	
		$4f^5(^6H^o)6p$	^7I	3	23261.30		
4417.96		$4f^5(^6H^o)6s$	$^7H^o$	4	1133.45	RCMW80	
				3	23761.98		
4453.95						RCMW80	
4529.21						RCMW80	
5546.08		$4f^5(^6H^o)5d$	$^7K^o$	5	6131.47	RCMW80	
		$4f^5(^6H^o)6p$	^7I	4	24157.20		
5576.02		$4f^5(^6H^o)5d$	$^7K^o$	4	5332.36	RCMW80	
		$4f^5(^6H^o)6p$	^7I	3	23261.30		

Energy Levels of Singly-ionized Promethium (Pm II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^5(^6H^o)6s$	$^7H^o$	2	0.00	MZH78
		3	446.45	MZH78
		4	1133.45	MZH78
		5	1983.52	MZH78
		6	2950.31	MZH78
		7	4000.15	MZH78
		8	—	
$4f^5(^6H^o)6s$	$^5H^o$	3	1602.97	MZH78
		4	2666.76	MZH78
		5	3812.31	MZH78
		6	5017.77	MZH78
		7	—	
$4f^5(^6F^o)6s$	$^7F^o$	0	5280.88	MZH78
		1	5391.46	MZH78
		2	5632.40	MZH78
		3	6048.50	MZH78
		4	6705.18	MZH78
		5	—	
		6	—	
$4f^5(^6H^o)5d$	$^7K^o$	4	5332.36	OHRW95
		5	6131.47	OHRW95
		6	7040.66	OHRW95
		7	8041.72	OHRW95
		8	9119.34	OHRW95
		9	—	
		10	—	

Energy Levels of Singly-ionized Promethium (Pm II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^5(^6F^o)6s$	$^5F^o$	1	6629.40	MZH78
		2	7012.87	MZH78
		3	7701.09	MZH78
		4	—	
		5	—	
$4f^5(^6H^o)6p$	^7I	3	23261.30	MZH78
		4	24157.20	MZH78
		5	25015.69	MZH78
		6	26027.56	MZH78
		7	27110.08	MZH78
		3	23761.98	MZH78
		3	24466.32	MZH78
		3	24527.89	MZH78
		5	26132.87	MZH78
		6	27379.79	MZH78
		7	28516.85	MZH78
Pm III ($^6H^o_{5/2}$)		*Limit*	**87900**	SR65

Protactinium (Pa)

Atomic number = 91
Atomic weight = 231.035 88

Isotope	Mass	Abundance	Spin	Mag moment
^{231}Pa	231.035880	Trace	3/2	+2.01
^{234}Pa	234.043303	Trace	4	

Pa I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^2 6d 7s^2$ $^4K_{11/2}$
Ionization energy: 47 500 cm^{-1} (5.89 eV)

Pa II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^2 7s^2$ $^3H_4$
Ionization energy: not available

Strong Lines of Protactinium (Pa)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
300 h	2492.85	Pa II	BW92b
300	2599.16	Pa II	BW92b
300	2699.22	Pa II	BW92b
300	2822.792	Pa II	G67
300 l	2832.14	Pa II	BW92b
300	2870.005	Pa II	G67
300 h	2871.413	Pa II	G67
300 h	2891.139	Pa II	G67
300 h	2906.93	Pa II	BW92b
300 l	3011.10	Pa II	BW92b
300 s	3033.59	Pa II	BW92b
300 l	3071.24	Pa II	BW92b
300 l	3093.23	Pa II	BW92b
300 l	3126.23	Pa II	BW92b
300 l	3146.28	Pa II	BW92b
300 l	3170.89	Pa II	BW92b
300 l	3171.54	Pa II	BW92b
300 l	3240.58	Pa II	BW92b
300	3274.46	Pa II	BW92b
300 l	3332.69	Pa II	BW92b
300 s	3346.661	Pa II	G67
300 l	3394.49	Pa II	BW92b
300 l	3452.82	Pa II	BW92b
300	3504.97	Pa I	BW92b
300 s	3530.65	Pa II	BW92b
300	3570.56	Pa I	BW92b
300	3571.82	Pa I	BW92b
300	3618.07	Pa I	BW92b
1000 P	3636.52	Pa I	BW92b
300	3702.74	Pa I	BW92b
300	3752.67	Pa I	BW92b
300	3873.35	Pa I	BW92b
300	3931.83	Pa I	BW92b
300 s	3952.62	Pa II	BW92b
1000 P,l	3957.85	Pa II	BW92b
300 s	3970.07	Pa II	BW92b
300	3981.82	Pa I	BW92b
1000 P	3982.23	Pa I	BW92b
300 l	4012.96	Pa II	BW92b
300 s	4018.21	Pa II	BW92b

Strong Lines of Protactinium (Pa)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
300	4030.16	Pa II	BW92b
300 s	4046.93	Pa II	BW92b
1000 P,s	4056.20	Pa II	BW92b
1000 P,s	4070.40	Pa II	BW92b
300	4117.62	Pa I	BW92b
300 l	4176.18	Pa II	BW92b
1000 P,l	4217.23	Pa II	BW92b
1000 P,s	4248.083	Pa II	G67
300 s	4291.345	Pa II	G67
300	4400.77	Pa I	BW92b
300	4436.13	Pa I	BW92b
300 s	4601.43	Pa II	BW92b
300	4628.19	Pa I	BW92b
300	4820.34	Pa I	BW92b
300 s	4861.49	Pa I	BW92b
300 l	6035.78	Pa I	BW92b
300	6162.56	Pa I	BW92b
300	6216.35	Pa I	BW92b
300 l	6358.61	Pa I	BW92b
300	6379.25	Pa I	BW92b
300 l	6438.97	Pa I	BW92b
300 h	6792.75	Pa I	BW92b
1000 P	6945.72	Pa I	BW92b
300	6960.09	Pa I	BW92b
300 h	6961.78	Pa I	BW92b
300 s	6992.73	Pa I	BW92b
300	7076.27	Pa I	BW92b
300 h	7100.94	Pa I	BW92b
1000 P,s	7114.89	Pa I	BW92b
300 h	7171.55	Pa I	BW92b
300	7227.13	Pa I	BW92b
300	7318.79	Pa I	BW92b
1000 P,l	7368.25	Pa I	BW92b
300 h	7471.89	Pa I	BW92b
1000 P,h	7493.15	Pa I	BW92b
300 h	7558.26	Pa I	BW92b
1000 P,h	7608.20	Pa I	BW92b
1000 P	7626.79	Pa I	BW92b
1000 P,s	7635.18	Pa I	BW92b
1000 P	7669.34	Pa I	BW92b
300	7679.20	Pa I	BW92b
1000 P,h	7749.19	Pa I	BW92b
300	7872.95	Pa I	BW92b
300 l	7945.56	Pa I	BW92b
1000 P	8039.34	Pa I	BW92b
1000 P,h	8099.84	Pa I	BW92b
1000 P	8199.04	Pa I	BW92b
1000 P	8271.87	Pa I	BW92b
300 s	8358.98	Pa I	BW92b
300 s	8369.60	Pa I	BW92b
300 h	8441.04	Pa I	BW92b
1000 P,h	8532.66	Pa I	BW92b
1000 P,s	8572.96	Pa I	BW92b
300 h	8639.91	Pa I	BW92b
300 h	8653.51	Pa I	BW92b
1000 P	8735.27	Pa I	BW92b
300	10594.38	Pa I	BW92b
300	10923.32	Pa I	BW92b
300	11646.78	Pa I	BW92b

Strong Lines of Protactinium (Pa)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1000 P	11791.73	Pa I	BW92b
300	12279.01	Pa I	BW92b
300	13234.09	Pa I	BW92b
1000 P	13522.40	Pa I	BW92b
1000 P	14344.76	Pa I	BW92b
300	18478.61	Pa I	BW92b

Persistent Lines of Neutral Protactinium (Pa I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3636.52		$5f^2(^3H)6d7s^2$	^4I	9/2	825.415	BW92b	
				o	9/2	28316.365		
1000	3982.23		$5f^2(^3H)6d7s^2$	^4K	11/2	0.000	BW92b	
				o	11/2	25104.455		
1000	6945.72		$5f^2(^3H)6d7s^2$	^4K	11/2	0.000	BW92b	
			$5f^26d7s7p$	$^6L^o$	11/2	14393.410		
1000	7114.89		$5f^2(^3H)6d7s^2$	^4I	9/2	825.415	BW92b	
				o	9/2	14876.545		
1000	7368.25		$5f^2(^3H)6d7s^2$	^4I	9/2	825.415	BW92b	
			$5f^26d7s7p$	$^6L^o$	11/2	14393.410		
1000	7493.15		$5f^2(^3H)6d7s^2$		9/2	3323.860	BW92b	
				o	7/2	16665.690		
1000	7608.20		$5f^2(^3H)6d7s^2$		9/2	3323.860	BW92b	
				o	9/2	16463.970		
1000	7626.79		$5f^2(^3H)6d7s^2$	^4K	13/2	3711.625	BW92b	
				o	11/2	16819.670		
1000	7635.18		$5f^2(^3H)6d7s^2$	^4K	15/2	7512.695	BW92b	
				o	13/2	20606.365		
1000	7669.34		$5f^2(^3H)6d7s^2$	^4I	11/2	4121.450	BW92b	
			$5f^26d7s7p$	$^6K^o$	11/2	17156.785		
1000	7749.19		$5f^26d7s^2$	a ^4G	5/2	1618.325	BW92b	
				o	5/2	14519.355		
1000	8039.34		$5f^2(^3H)6d7s^2$	^4K	13/2	3711.625	BW92b	
			$5f^37s^2$	$^4I^o$	11/2	16147.025		
1000	8099.84		$5f^2(^3H)6d7s^2$	^4I	11/2	4121.450	BW92b	
				o	9/2	16463.970		
1000	8199.04		$5f^2(^3H)6d7s^2$	^4I	9/2	825.415	BW92b	
			$5f^37s^2$	$^4I^o$	9/2	13018.610		
1000	8271.87		$5f^2(^3H)6d7s^2$	^4I	9/2	825.415	BW92b	
				o	7/2	12911.260		
1000	8532.66		$5f^26d7s^2$	a ^4H	7/2	2966.530	BW92b	
				o	5/2	14683.005		
1000	8735.27		$5f^2(^3H)6d7s^2$	^4K	11/2	0.000	BW92b	
			$5f^27s^27p_{1/2}$	$(4,1/2)^o$	9/2	11444.705		

Persistent Lines of Neutral Protactinium (Pa I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	11791.73		$5f^2 6d7s^2$	a ^{4}H	7/2	2966.530	BW92b	
			$5f^2 7s^2 7p_{1/2}$	(4,1/2)^o	9/2	11444.705		
1000	13522.40		$5f^2(^3H)6d^2(^3F)(^5L)7s$	^{6}L	11/2	7000.290	BW92b	
			$5f^2 6d7s7p$	^{6}L^o	11/2	14393.410		
1000	14344.76		$5f^2 6d7s^2$	b ^{4}H	7/2	5149.465	BW92b	
			$5f^2 7s^2 7p_{1/2}$	(4,1/2)^o	7/2	12118.750		

Energy Levels of Neutral Protactinium (Pa I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^2(^3H)6d7s^2$	^{4}K	11/2	0.000	BW92b
		13/2	3711.625	BW92b
		15/2	7512.695	BW92b
		17/2	11198.270	BW92b
$5f^2(^3H)6d7s^2$	^{4}I	9/2	825.415	BW92b
		11/2	4121.450	BW92b
		13/2	7383.295	BW92b
		15/2	10049.875	BW92b
$5f^2 6d7s^2$	a ^{4}G	5/2	1618.325	BW92b
		7/2	4713.870	BW92b
		9/2	7330.815	BW92b
$5f(^2F)6d^2(^3F)7s^2$	^{4}H^o	7/2	1978.220	BW92b
		9/2	5335.730	BW92b
		11/2	8419.075	BW92b
		13/2	11498.725	BW92b
$5f(^2F)6d^2(^3F)7s^2$	^{4}I^o	9/2	2659.405	BW92b
$5f^2 6d7s^2$	a ^{4}H	7/2	2966.530	BW92b
$5f^2(^3H)6d7s^2$		9/2	3323.860	BW92b
$5f^2(^3H)6d7s^2$		11/2	4576.005	BW92b
$5f^2 6d7s^2$	b ^{4}H	7/2	5149.465	BW92b
$5f^2(^3H)6d7s^2$		5/2	5938.650	BW92b
$5f^2 6d7s^2$	a ^{4}H	9/2	6149.805	BW92b
$5f(^2F)6d^2(^3F)7s^2$	^{4}I^o	11/2	6302.230	BW92b
	^{o}	7/2	6425.830	BW92b
$5f^2 6d7s^2$	b ^{4}G	5/2	6708.56	BW92b
$5f^2(^3H)6d^2(^3F)(^5L)7s$	^{6}L	11/2	7000.290	BW92b
$5f^2 7s^2 7p_{1/2}$	(4,1/2)^o	9/2	11444.705	BW92b
		7/2	12118.750	BW92b
	^{o}	7/2	12911.260	BW92b
$5f^3 7s^2$	^{4}I^o	9/2	13018.610	BW92b

Energy Levels of Neutral Protactinium (Pa I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^26d7s7p$	$^6L^o$	11/2	14393.410	BW92b
	^{o}	5/2	14519.355	BW92b
	^{o}	5/2	14683.005	BW92b
	^{o}	9/2	14876.545	BW92b
$5f^37s^2$	$^4I^o$	11/2	16147.025	BW92b
	^{o}	9/2	16463.970	BW92b
	^{o}	7/2	16665.690	BW92b
	^{o}	11/2	16819.670	BW92b
$5f^26d7s7p$	$^6K^o$	11/2	17156.785	BW92b
	^{o}	9/2	18661.700	BW92b
	^{o}	13/2	20606.365	BW92b
	^{o}	11/2	25104.455	BW92b
	^{o}	9/2	28316.365	BW92b
Pa II ($5f^27s^2$ $^3H_4$)		*Limit*	**47500**	S74

Persistent Lines of Singly-ionized Protactinium (Pa II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3957.85		$5f^26d7s$	^5K	7	5458.850	BW92b	
				^{o}	7	30717.935		
1000	4056.20		$5f^26d7s$	^5K	5	823.265	BW92b	
				^{o}	5	25469.955		
1000	4070.40						BW92b	
1000	4217.23		$5f^26d7s$	^5K	6	1764.365	BW92b	
				^{o}	5	25469.955		
1000	4248.083		$5f^27s^2$	^3H	4	0.000	G67	
				^{o}	5	23533.415		

Energy Levels of Singly-ionized Protactinium (Pa II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^27s^2$	^3H	4	0.000	BW92b
$5f^26d7s$	^5K	5	823.265	BW92b
$5f^26d7s$	^5I	4	1744.800	BW92b
$5f^26d7s$	^5K	6	1764.365	BW92b
$5f^26d7s$	^5G	2	2232.135	BW92b
$5f^26d7s$	^5I	5	2555.865	BW92b
$5f^26d7s$	^5H?	3	3078.285	BW92b
$5f^27s^2$	^3F	2	3150.950	BW92b

Energy Levels of Singly-ionized Protactinium (Pa II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^2 6d 7s$	^5H	3	4011.455	BW92b
$5f^2 7s^2$	^3H	5	4447.575	BW92b
$5f^2 6d 7s$	^5H	4	4555.030	BW92b
$5f^2 6d 7s$	^3I?	5	4716.445	BW92b
$5f 6d^2 7s$	$^5I^o$	4	4751.660	BW92b
$5f^2 6d 7s$		4	4895.130	BW92b
$5f^2 6d 7s$	^3K	6	4924.960	BW92b
$5f 6d^2 7s$	^{o}	3	5088.230	BW92b
$5f^2 6d 7s$	^5K	7	5458.850	BW92b
	^{o}	5	23533.415	BW92b
	^{o}	5	25469.955	BW92b
	^{o}	7	30717.935	BW92b
Pa III ($5f^2(^3H)6d\ ^4I^o_{11/2}$)		*Limit*		

Radium (Ra)

Atomic number = 88
Atomic weight = 226.0254

Isotope	Mass	Abundance	Spin	Mag moment
^{223}Ra	223.018501	*Some*	1/2	
^{224}Ra	224.020186	*Some*	0	
^{226}Ra	226.025402	*Some*	0	
^{228}Ra	228.031064	*Some*	0	

Ra I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 7s^2\ {}^1S_0$
Ionization energy: 42 573.36 cm^{-1} (5.278 423 eV)

Ra II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 7s\ {}^2S_{1/2}$
Ionization energy: 81 842.31 cm^{-1} (10.147 15 eV)

Strong Lines of Radium (Ra)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
100	2708.96	Ra II	R34a
150 P	2813.76	Ra II	R34a
500 P	3649.55	Ra II	R34a
1000 P	3814.42	Ra II	R34a
500 P	4340.64	Ra II	R34a
100	4436.27	Ra II	R34a
150 P	4533.11	Ra II	R34a
500 P	4682.28	Ra II	R34a
1000 P	4825.91	Ra I	R34b
200	5400.23	Ra I	R34b
200	5406.81	Ra I	R34b
200	5555.85	Ra I	R34b
500 P	5660.81	Ra I	R34b
100	5813.63	Ra II	R34a
300 P	6200.30	Ra I	R34b
200	6446.20	Ra I	R34b
200	6487.32	Ra I	R34b
200	6980.22	Ra I	R34b
200	7118.50	Ra I	R34b
500 P	7141.21	Ra I	R34b
200	7225.16	Ra I	R34b
200	7838.12	Ra I	R34b
250 P	8019.70	Ra II	R34a

Persistent Lines of Neutral Radium (Ra I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	4825.91		$7s^2$	^1S	0	0.00	R34b	
			$7s7p$	$^1P^o$	1	20715.71		
500	5660.81		$7s6d$	^3D	3	14707.35	R34b	
			$6d7p$	$^3F^o$	4	32367.78		
300	6200.30		$7s6d$	^3D	2	13993.97	R34b	
			$6d7p$	$^3F^o$	3	30117.78		
500	7141.21		$7s^2$	^1S	0	0.00	R34b	
			$7s7p$	$^3P^o$	1	13999.38		

Energy Levels of Neutral Radium (Ra I)

Configuration	Term	J	Level (cm^{-1})	Ref
$7s^2$	^1S	0	0.00	M58
$7s7p$	$^3P^o$	0	13078.44	M58
		1	13999.38	M58
		2	16688.54	M58
$7s6d$	^3D	1	13715.85	M58
		2	13993.97	M58
		3	14707.35	M58
$7s6d$	^1D	2	17081.45	M58
$7s7p$	$^1P^o$	1	20715.71	M58
$7s8s$	^3S	1	26754.05	M58
$6d7p$	$^3F^o$	2	28038.05	M58
		3	30117.78	M58
		4	32367.78	M58
$6d7p$	$^1D^o$	2	30918.14	M58
$7s8p$	$^3P^o$	0	31085.88	M58
		1	31563.29	M58
		2	31874.44	M58
Ra II ($^2S_{1/2}$)		*Limit*	**42573.36**	AWT80

Persistent Lines of Singly-ionized Radium (Ra II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
150	2813.76		$6d$	^2D	5/2	13743.11	R34a	
			$5f$	$^2F^o$	7/2	49272.31		
500	3649.55		$7p$	$^2P^o$	1/2	21351.20	R34a	
			$7d$	^2D	3/2	48744.04		
1000	3814.42		$7s$	^2S	1/2	0.00	R34a	
			$7p$	$^2P^o$	3/2	26208.86		
500	4340.64		$7p$	$^2P^o$	3/2	26208.86	R34a	
			$7d$	^2D	5/2	49240.48		
150	4533.11		$7p$	$^2P^o$	1/2	21351.20	R34a	
			$8s$	^2S	1/2	43405.01		
500	4682.28		$7s$	^2S	1/2	0.00	R34a	
			$7p$	$^2P^o$	1/2	21351.20		
250	8019.70		$6d$	^2D	5/2	13743.11	R34a	
			$7p$	$^2P^o$	3/2	26208.86		

Energy Levels of Singly-ionized Radium (Ra II)

Configuration	Term	J	Level (cm^{-1})	Ref
$7s$	^2S	1/2	0.00	M58
$6d$	^2D	3/2	12084.38	M58
		5/2	13743.11	M58
$7p$	$^2P^o$	1/2	21351.20	M58
		3/2	26208.86	M58
$8s$	^2S	1/2	43405.01	M58
$7d$	^2D	3/2	48744.04	M58
		5/2	49240.48	M58
$5f$	$^2F^o$	5/2	48987.98	M58
		7/2	49272.31	M58
$8p$	$^2P^o$	1/2	50606.01	M58
		3/2	52392.05	M58
$9s$	^2S	1/2	59165.23	M58
Ra III ($^1S_0$)		*Limit*	**81842.31**	M58

Radon (Rn)
Atomic number=86
Atomic weight=(222)

Isotope	Mass	Abundance	Spin	Mag moment
^{219}Rn	219.009479	Trace	5/2	
^{220}Rn	220.011368	Trace	0	
^{222}Rn	222.017570	Trace	0	

Rn I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6\ {}^1S_0$
Ionization energy: 86 692.5 cm^{-1} (10.7485 eV)

Rn II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^5\ {}^2P^o_{3/2}$
Ionization energy: not available

Strong Lines of Radon (Rn)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
P	1451.56	Rn I	R30
P	1786.07	Rn I	R30
	Air		
70	3753.65	Rn I	R33
250	4307.76	Rn I	R33
300 P	4349.60	Rn I	R33
150	4459.25	Rn I	R33
150	4508.48	Rn I	R33
150	4577.72	Rn I	R33
150	4609.38	Rn I	R33
100	4721.76	Rn I	R33
50	6627.23	Rn I	R33
70	6751.81	Rn I	R33
700 P	7055.42	Rn I	R33
300 P	7268.11	Rn I	R33
70	7291.00	Rn I	R33
1000 P	7450.00	Rn I	R33
70	7746.64	Rn I	R33
300 P	7809.82	Rn I	R33
70	8049.00	Rn I	R33
300 P	8099.51	Rn I	R33
300 P	8270.96	Rn I	R33
70	8520.95	Rn I	R33
300 P	8600.07	Rn I	R33
50	8675.83	Rn I	R33
150	9327.02	Rn I	R33

Persistent Lines of Neutral Radon (Rn I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
	1451.56		$6p^6$	^{1}S	0	0.0	R30	
			$6p^5(^2P^o_{3/2})6d$	$^2[1/2]^o$	1	68891.34		
	1786.07		$6p^6$	^{1}S	0	0.0	R30	
			$6p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	1	55989.03		
300	4349.60		$6p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	2	54620.35	R33	
			$6p^5(^2P^o_{3/2})8p$	$^2[5/2]$	3	77604.53		
700	7055.42		$6p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	2	54620.35	R33	
			$6p^5(^2P^o_{3/2})7p$	$^2[3/2]$	2	68789.93		

Persistent Lines of Neutral Radon (Rn I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	7268.11		$6p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	1	55989.03	R33	
			$6p^5(^2P^o_{3/2})7p$	$^2[1/2]$	0	69743.98		
1000	7450.00		$6p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	2	54620.35	R33	
			$6p^5(^2P^o_{3/2})7p$	$^2[5/2]$	3	68039.48		
300	7809.82		$6p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	1	55989.03	R33	
			$6p^5(^2P^o_{3/2})7p$	$^2[3/2]$	2	68789.93		
300	8099.51		$6p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	1	55989.03	R33	
			$6p^5(^2P^o_{3/2})7p$	$^2[3/2]$	1	68332.10		
300	8270.96		$6p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	2	54620.35	R33	
			$6p^5(^2P^o_{3/2})7p$	$^2[5/2]$	2	66707.53		
300	8600.07		$6p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	2	54620.35	R33	
			$6p^5(^2P^o_{3/2})7p$	$^2[1/2]$	1	66244.97		

Energy Levels of Neutral Radon (Rn I)

Configuration	Term	J	Level (cm^{-1})	Ref
$6p^6$	^1S	0	0.0	M58
$6p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	2	54620.35	M58
		1	55989.03	M58
$6p^5(^2P^o_{3/2})7p$	$^2[1/2]$	1	66244.97	M58
		0	69743.98	M58
$6p^5(^2P^o_{3/2})7p$	$^2[5/2]$	2	66707.53	M58
		3	68039.48	M58
$6p^5(^2P^o_{3/2})6d$	$^2[1/2]^o$	0	67906.52	M58
		1	68891.34	M58
$6p^5(^2P^o_{3/2})7p$	$^2[3/2]$	1	68332.10	M58
		2	68789.93	M58
$6p^5(^2P^o_{1/2})7s$	$^2[1/2]^o$	0	85976	M58
		1	87053	M58
Rn II $(^2P^o_{3/2})$		*Limit*	**86692.5**	R33

Rhenium (Re)
Atomic number = 75
Atomic weight = 186.207

Isotope	Mass	Abundance	Spin	Mag moment
^{185}Re	184.952951	37.40%	5/2	+3.172
^{187}Re	186.955744	62.60%	5/2	+3.2197

Re I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^5 6s^2\ {}^6S_{5/2}$
Ionization energy: 63 181.6 cm^{-1} (7.833 52 eV)

Re II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^5 6s\ {}^7S_3$
Ionization energy: not available

Strong Lines of Rhenium (Re)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
800 P,c	1973.1340	Re II	WJLG97
	Air		
500 P	2003.53	Re I	MCS75
300 P	2017.87	Re I	MCS75
500 P	2049.08	Re I	MCS75
80 P	2074.70	Re I	MCS75
200 P	2085.59	Re I	MCS75
200 P	2097.12	Re I	MCS75
50	2109.22	Re I	MCS75
600 P	2139.04	Re II	MCS75
250 P	2142.74	Re II	MCS75
70	2156.67	Re I	MCS75
90 P	2167.94	Re I	MCS75
60	2176.21	Re I	MCS75
1000 P,c	2214.2749	Re II	WJLG97
40	2214.58	Re I	MCS75
30	2226.42	Re I	MCS75
15	2235.44	Re I	MCS75
8	2255.73	Re I	MCS75
15	2256.19	Re I	MCS75
40	2264.39	Re I	MCS75
40	2274.62	Re I	MCS75
900 P,c	2275.2532	Re II	WJLG97
30	2281.62	Re I	MCS75
50	2287.51	Re I	MCS75
50	2294.49	Re I	MCS75
60	2298.09	Re II	MCS75
7	2299.77	Re I	MCS75
11	2302.99	Re I	MCS75
12	2306.54	Re I	MCS75
15	2322.49	Re I	MCS75
15	2344.78	Re I	MCS75
12	2352.07	Re I	MCS75
20	2365.90	Re I	MCS75
10	2367.68	Re I	MCS75
9	2369.27	Re I	MCS75
40	2370.76	Re II	MCS75
25	2405.06	Re I	MCS75
13	2405.60	Re I	MCS75
20	2419.81	Re I	MCS75

Strong Lines of Rhenium (Re)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	2428.58	Re I	MCS75
9	2431.54	Re I	MCS75
8	2432.18	Re I	MCS75
11	2446.98	Re I	MCS75
11	2449.71	Re I	MCS75
30	2455.83	Re II	MCS75
7	2461.20	Re I	MCS75
130 c	2461.84	Re II	MCS75
30	2467.57	Re II	MCS75
20	2483.92	Re I	MCS75
7	2485.81	Re I	MCS75
20	2487.33	Re I	MCS75
90 P	2502.35	Re II	MCS75
40	2504.60	Re II	MCS75
30 c	2508.99	Re I	MCS75
10	2520.01	Re I	MCS75
10	2521.50	Re I	MCS75
10	2540.51	Re I	MCS75
13 d	2544.74	Re I	MCS75
60	2554.63	Re II	MCS75
20	2556.51	Re I	MCS75
90 P	2568.64	Re II	MCS75
60	2571.81	Re II	MCS75
7	2586.79	Re I	MCS75
110 P	2608.50	Re II	MCS75
11 d	2611.54	Re I	MCS75
50	2635.83	Re II	MCS75
10	2636.64	Re I	MCS75
12	2651.90	Re I	MCS75
7	2654.12	Re I	MCS75
15	2674.34	Re I	MCS75
25	2715.47	Re I	MCS75
30	2731.56	Re II	MCS75
100 P	2733.04	Re II	MCS75
10	2783.57	Re I	MCS75
15	2819.95	Re I	MCS75
50	2887.68	Re I	MCS75
15 c	2902.48	Re I	MCS75
10	2909.82	Re I	MCS75
15 c	2927.42	Re I	MCS75
8	2943.14	Re I	MCS75
13	2965.11	Re I	MCS75
25	2965.76	Re I	MCS75
30	2992.36	Re I	MCS75
100 P	2999.60	Re I	MCS75
9	3016.02	Re I	MCS75
7	3030.45	Re I	MCS75
30	3067.40	Re I	MCS75
6	3069.94	Re I	MCS75
10	3082.43	Re I	MCS75
13	3100.67	Re I	MCS75
13	3108.81	Re I	MCS75
8	3128.94	Re I	MCS75
8	3151.64	Re I	MCS75
13	3168.37	Re I	MCS75
11	3182.87	Re I	MCS75
20	3184.76	Re I	MCS75
20	3185.57	Re I	MCS75
20 c	3204.25	Re I	MCS75

Strong Lines of Rhenium (Re)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
7	3235.94	Re I	MCS75
11	3258.85	Re I	MCS75
11	3259.55	Re I	MCS75
50	3303.21	Re II	MCS75
11	3322.48	Re I	MCS75
40	3338.18	Re I	MCS75
30	3342.24	Re I	MCS75
15	3344.32	Re I	MCS75
50	3379.06	Re II	MCS75
70 P	3399.30	Re I	MCS75
12	3404.72	Re I	MCS75
12	3405.89	Re I	MCS75
15	3419.41	Re I	MCS75
150 P	3424.62	Re I	MCS75
7	3426.19	Re I	MCS75
300 P,c	3451.88	Re I	MCS75
1000 P,c	3460.46	Re I	MCS75
700 P,c	3464.73	Re I	MCS75
7	3467.96	Re I	MCS75
7	3480.38	Re I	MCS75
10	3503.06	Re I	MCS75
140 P,c	3580.15	Re II	MCS75
12	3580.97	Re I	MCS75
15	3583.02	Re I	MCS75
15	3637.84	Re I	MCS75
8	3651.97	Re I	MCS75
15 c	3689.50	Re I	MCS75
25 c	3691.48	Re I	MCS75
9	3703.24	Re I	MCS75
70 P	3725.76	Re I	MCS75
15	3735.31	Re I	MCS75
15	3740.10	Re I	MCS75
13	3787.52	Re I	MCS75
10	3929.85	Re I	MCS75
30	4136.45	Re I	MCS75
13	4144.36	Re I	MCS75
12	4221.08	Re I	MCS75
70 c	4227.46	Re I	MCS75
7	4358.69	Re I	MCS75
50	4513.31	Re I	MCS75
9	4522.73	Re I	MCS75
40 c,w	4889.14	Re I	MCS75
25	5270.95	Re I	MCS75
30 c,w	5275.56	Re I	MCS75
10	5834.31	Re I	MCS75

Persistent Lines of Neutral Rhenium (Re I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	2003.53		$5d^5 6s^2$	^{6}S	5/2	0.00	MCS75	
				16^o	3/2	49895.57		
300	2017.87		$5d^5 6s^2$	^{6}S	5/2	0.00	MCS75	
				15^o	5/2	49540.96		
500	2049.08		$5d^5 6s^2$	^{6}S	5/2	0.00	MCS75	
				14°	7/2	48786.35		
80	2074.70		$5d^5 6s^2$	^{6}S	5/2	0.00	MCS75	
				13^o	7/2	48184.20		
200	2085.59		$5d^5 6s^2$	^{6}S	5/2	0.00	MCS75	
			$5d^6(^5D)6p$	^{6}F^o	7/2	47932.55		
200	2097.12		$5d^5 6s^2$	^{6}S	5/2	0.00	MCS75	
				12^o	7/2	47669.01		
90	2167.94		$5d^5 6s^2$	^{6}S	5/2	0.00	MCS75	
				11^o	5/2	46112.24		
100	2999.60		$5d^6(^5D)6s$	^{6}D	9/2	11754.52	MCS75	
			$5d^6(^5D)6p$	^{6}F^o	11/2	45082.63		
70	3399.30		$5d^6(^5D)6s$	^{6}D	9/2	11754.52	MCS75	
				10^o	7/2	41163.91		
150	3424.62		$5d^6(^5D)6s$	^{6}D	9/2	11754.52	MCS75	
			$5d^5 6s(^5P)6p$	^{6}D^o	7/2	40946.53		
300	3451.88	0.174	$5d^5 6s^2$	^{6}S	5/2	0.00	MCS75	FMW88
			$5d^5 6s(^7S)6p$	^{6}P^o	3/2	28961.55		
1000	3460.46	0.313	$5d^5 6s^2$	^{6}S	5/2	0.00	MCS75	FMW88
			$5d^5 6s(^7S)6p$	^{6}P^o	7/2	28889.72		
700	3464.73	0.249	$5d^5 6s^2$	^{6}S	5/2	0.00	MCS75	FMW88
			$5d^5 6s(^7S)6p$	^{6}P^o	5/2	28854.18		

Energy Levels of Neutral Rhenium (Re I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^5 6s^2$	^{6}S	5/2	0.00	KMVC57
$5d^5 6s^2$	1	5/2	11583.96	KMVC57
$5d^6(^5D)6s$	^{6}D	9/2	11754.52	KMVC57
		7/2	14216.86	KMVC57
		5/2	15770.42	KMVC57
		3/2	16327.51	KMVC57
		1/2	17238.30	KMVC57
$5d^5 6s^2$	2	3/2	13826.12	KMVC57
$5d^5 6s^2$	3	5/2	14621.46	KMVC57
$5d^5 6s^2$	^{4}G	7/2	15058.19	KMVC57
		11/2	16307.15	KMVC57
		9/2	16619.28	KMVC57
$5d^5 6s^2$	4	1/2	15165.89	KMVC57

Energy Levels of Neutral Rhenium (Re I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^56s^2$	5	7/2	17330.82	KMVC57
$5d^56s(^7S)6p$	$^8P^o$	5/2	18950.1	KMVC57
		7/2	20447.8	KMVC57
		9/2	23631.82	KMVC57
$5d^56s^2$	6	5/2	19457.89	KMVC57
$5d^56s^2$	7	1/2	19757.91	KMVC57
$5d^56s^2$	8	3/2	20481.73	KMVC57
$5d^56s(^7S)6p$	$^6P^o$	5/2	28854.18	KMVC57
		7/2	28889.72	KMVC57
		3/2	28961.55	KMVC57
$5d^56s(^5P)6p$	$^6D^o$	7/2	40946.53	KMVC57
	10^o	7/2	41163.91	KMVC57
$5d^6(^5D)6p$	$^6F^o$	11/2	45082.63	KMVC57
	11^o	5/2	46112.24	KMVC57
	12^o	7/2	47669.01	KMVC57
$5d^6(^5D)6p$	$^6F^o$	7/2	47932.55	KMVC57
	13^o	7/2	48184.20	KMVC57
	14^o	7/2	48786.35	KMVC57
	15^o	5/2	49540.96	KMVC57
	16^o	3/2	49895.57	KMVC57
Re II ($^7S_3$)		*Limit*	**63181.6**	CS96

Persistent Lines of Singly-ionized Rhenium (Re II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800 c	1973.1340		$5d^5(^6S)6s$	^7S	3	0.000	WJLG97	
			$5d^46s(^6D)6p$	$^7P^o$	4	50680.795		
1000 c	2214.2749		$5d^5(^6S)6s$	^7S	3	0.000	WJLG97	
			$5d^46s(^6D)6p$	$^7P^o$	3	45147.445		
900 c	2275.2532	1.34	$5d^5(^6S)6s$	^7S	3	0.000	WJLG97	WJLG97
			$5d^46s(^6D)6p$	$^7P^o$	2	43937.578		
90	2502.35		$5d^5(^4G)6s$	^5G	5	20976.4	MCS75	
				12^o	5	60926.8		
90	2568.64		$5d^6$	^5D	4	14882.6	MCS75	
				11^o	3	53802.1		
110	2608.50		$5d^5(^4D)6s$	2	2	14352.2	MCS75	
				10^o	2	52677.0		
100	2733.04		$5d^5(^6S)6s$	^5S	2	17223.5	MCS75	
				11^o	3	53802.1		
140	3580.15		$5d^5(^6S)6s$	^5S	2	17223.5	MCS75	
			$5d^46s(^6D)6p$	$^7P^o$	3	45147.5		

Energy Levels of Singly-ionized Rhenium (Re II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^5(^6S)6s$	^7S	3	0.000	WJLG97
$5d^46s^2$	1	0	13777.3	MCS58
$5d^5(^4D)6s$	2	2	14352.2	MCS58
$5d^5(^4D)6s$	3	1	14824.0	MCS58
$5d^6$	^5D	4	14882.6	MCS58
$5d^5(^4D)6s$	4	3	14930.5	MCS58
$5d^5(^6S)6s$	^5S	2	17223.5	MCS58
$5d^5(^4G)6s$	^5G	2	18845.8	MCS58
		3	19139.7	MCS58
		4	20463.2	MCS58
		6	20781.5	MCS58
		5	20976.4	MCS58
$5d^46s(^6D)6p$	$^7P^o$	2	43937.578	WJLG97
		3	45147.445	WJLG97
		4	50680.795	WJLG97
	10^o	2	52677.0	MCS58
	11^o	3	53802.1	MCS58
	12^o	5	60926.8	MCS58
Re III ($^6S_{5/2}$)		*Limit*		

Rhodium (Rh)
Atomic number = 45
Atomic weight = 102.905 50

Isotope	Mass	Abundance	Spin	Mag moment
^{103}Rh	102.905500	100%	1/2	−0.0884

Rh I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^8 5s\ ^4F_{9/2}$
Ionization energy: 60 160.1 cm^{-1} (7.458 90 eV)

Rh II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^8\ ^3F_4$
Ionization energy: 145 800 cm^{-1} (18.08 eV)

Strong Lines of Rhodium (Rh)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
1000 P	1604.45	Rh II	S58
400 P	1624.47	Rh II	S58
1000 P	1628.94	Rh II	S58
400 P	1634.72	Rh II	S58
400 P	1637.88	Rh II	S58
	Air		
40	2322.58	Rh I	MCS75
800 P	2334.77	Rh II	S58
30	2361.92	Rh I	MCS75
30	2382.89	Rh I	MCS75
25	2383.40	Rh I	MCS75
300 P	2415.84	Rh II	S58
25	2429.52	Rh I	MCS75
40	2440.34	Rh I	MCS75
400 P	2461.03	Rh II	S58
400 P	2490.79	Rh II	S58
40	2509.70	Rh I	MCS75
20	2515.75	Rh I	MCS75
500 P	2520.52	Rh II	S58
40	2545.70	Rh I	MCS75
60	2555.36	Rh I	MCS75
25	2625.88	Rh I	MCS75
40	2652.66	Rh I	MCS75
40	2703.73	Rh I	MCS75
400 P	2715.27	Rh II	S58
20	2718.54	Rh I	MCS75
15	2728.94	Rh I	MCS75
20	2826.68	Rh I	MCS75
30	2862.94	Rh I	MCS75
15	2907.21	Rh I	MCS75
300 P	2910.15	Rh II	S58
20	2924.02	Rh I	MCS75
25	2968.66	Rh I	MCS75
15	2977.68	Rh I	MCS75
50	2986.20	Rh I	MCS75
20	3083.96	Rh I	MCS75
25	3123.70	Rh I	MCS75
50	3191.19	Rh I	MCS75
20	3197.13	Rh I	MCS75
60	3263.14	Rh I	MCS75
60	3271.61	Rh I	MCS75

Strong Lines of Rhodium (Rh)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
250	3280.55	Rh I	MCS75
250	3283.57	Rh I	MCS75
30	3289.14	Rh I	MCS75
20	3294.28	Rh I	MCS75
30	3300.46	Rh I	MCS75
400 P	3323.09	Rh I	MCS75
40	3338.54	Rh I	MCS75
30	3360.80	Rh I	MCS75
40	3368.38	Rh I	MCS75
120	3372.25	Rh I	MCS75
600 P	3396.82	Rh I	MCS75
90	3399.70	Rh I	MCS75
15	3406.55	Rh I	MCS75
90	3412.27	Rh I	MCS75
40	3421.22	Rh I	MCS75
900 P	3434.89	Rh I	MCS75
150	3440.53	Rh I	MCS75
40	3455.22	Rh I	MCS75
20	3457.07	Rh I	MCS75
25	3457.93	Rh I	MCS75
600	3462.04	Rh I	MCS75
20	3469.62	Rh I	MCS75
500	3470.66	Rh I	MCS75
500	3474.78	Rh I	MCS75
200	3478.91	Rh I	MCS75
130	3498.73	Rh I	MCS75
600 P	3502.52	Rh I	MCS75
300 P	3507.32	Rh I	MCS75
900 P	3528.02	Rh I	MCS75
90 d	3538.14	Rh I	MCS75
30	3541.91	Rh I	MCS75
130	3543.95	Rh I	MCS75
200	3549.54	Rh I	MCS75
25	3564.13	Rh I	MCS75
130	3570.18	Rh I	MCS75
500	3583.10	Rh I	MCS75
500	3596.19	Rh I	MCS75
600	3597.15	Rh I	MCS75
30	3605.86	Rh I	MCS75
300	3612.47	Rh I	MCS75
25	3614.78	Rh I	MCS75
20	3620.46	Rh I	MCS75
200	3626.59	Rh I	MCS75
30	3639.51	Rh I	MCS75
40	3654.87	Rh I	MCS75
900 P	3657.99	Rh I	MCS75
30	3661.86	Rh I	MCS75
140	3666.22	Rh I	MCS75
20	3666.91	Rh I	MCS75
60	3681.04	Rh I	MCS75
200	3690.70	Rh I	MCS75
1000 P	3692.36	Rh I	MCS75
100	3695.52	Rh I	MCS75
30	3698.26	Rh I	MCS75
40	3698.60	Rh I	MCS75
800 P	3700.91	Rh I	MCS75
100	3713.02	Rh I	MCS75
70	3735.28	Rh I	MCS75
40	3737.27	Rh I	MCS75

Strong Lines of Rhodium (Rh)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	3744.17	Rh I	MCS75
130	3748.22	Rh I	MCS75
25	3754.12	Rh I	MCS75
40	3754.27	Rh I	MCS75
50	3755.58	Rh I	MCS75
110	3760.40	Rh I	MCS75
250	3765.08	Rh I	MCS75
50	3769.97	Rh I	MCS75
40	3778.13	Rh I	MCS75
110	3788.47	Rh I	MCS75
140	3792.18	Rh I	MCS75
400	3793.22	Rh I	MCS75
500	3799.31	Rh I	MCS75
80	3805.92	Rh I	MCS75
140	3806.76	Rh I	MCS75
50	3815.01	Rh I	MCS75
80	3816.47	Rh I	MCS75
140	3818.19	Rh I	MCS75
400	3822.26	Rh I	MCS75
250	3828.48	Rh I	MCS75
200	3833.89	Rh I	MCS75
600	3856.52	Rh I	MCS75
50	3870.01	Rh I	MCS75
40	3877.34	Rh I	MCS75
25	3922.19	Rh I	MCS75
200	3934.23	Rh I	MCS75
60	3942.72	Rh I	MCS75
400	3958.86	Rh I	MCS75
40	3975.31	Rh I	MCS75
25	3984.40	Rh I	MCS75
25	3995.61	Rh I	MCS75
40	3996.15	Rh I	MCS75
60	4082.78	Rh I	MCS75
120	4121.68	Rh I	MCS75
150	4128.87	Rh I	MCS75
200	4135.27	Rh I	MCS75
25	4154.37	Rh I	MCS75
40	4196.50	Rh I	MCS75
400	4211.14	Rh I	MCS75
90	4288.71	Rh I	MCS75
400 P	4374.80	Rh I	MCS75
15	4675.03	Rh I	MCS75
14	5354.40	Rh I	MCS75
15	5599.42	Rh I	MCS75
14	5983.60	Rh I	MCS75

Persistent Lines of Neutral Rhodium (Rh I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	3323.09	0.63	$4d^8(^3F)5s$	a ^4F	7/2	1529.97	MCS75	DL85
			$4d^8(^3F)5p$	z $^2G^o$	9/2	31613.78		
600	3396.82	0.65	$4d^8(^3F)5s$	a ^4F	9/2	0.00	MCS75	DL85
			$4d^8(^3F)5p$	z $^4F^o$	9/2	29430.86		
900	3434.89		$4d^8(^3F)5s$	a ^4F	9/2	0.00	MCS75	
			$4d^8(^3F)5p$	z $^4G^o$	11/2	29104.71		
600	3502.52	0.43	$4d^8(^3F)5s$	a ^4F	9/2	0.00	MCS75	DL85
			$4d^8(^3F)5p$	z $^4G^o$	9/2	28542.69		
300	3507.32	0.34	$4d^8(^3F)5s$	a ^4F	5/2	2598.03	MCS75	DL85
			$4d^8(^3F)5p$	z $^4G^o$	7/2	31101.75		
900	3528.02	0.85	$4d^8(^3F)5s$	a ^4F	7/2	1529.97	MCS75	DL85
			$4d^8(^3F)5p$	z $^4F^o$	7/2	29866.34		
900	3657.99	0.88	$4d^8(^3F)5s$	a ^4F	7/2	1529.97	MCS75	DL85
			$4d^8(^3F)5p$	z $^4D^o$	5/2	28859.64		
1000	3692.36	0.91	$4d^8(^3F)5s$	a ^4F	9/2	0.00	MCS75	DL85
			$4d^8(^3F)5p$	z $^4D^o$	7/2	27075.26		
800	3700.91	0.39	$4d^8(^3F)5s$	a ^4F	7/2	1529.97	MCS75	DL85
			$4d^8(^3F)5p$	z $^4G^o$	9/2	28542.69		
400	4374.80	0.164	$4d^8(^3F)5s$	a ^2F	7/2	5690.97	MCS75	DL85
			$4d^8(^3F)5p$	z $^4G^o$	9/2	28542.69		

Energy Levels of Neutral Rhodium (Rh I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^8(^3F)5s$	a ^4F	9/2	0.00	M58
		7/2	1529.97	M58
		5/2	2598.03	M58
		3/2	3472.68	M58
$4d^9$	a ^2D	5/2	3309.86	M58
		3/2	5657.97	M58
$4d^8(^3F)5s$	a ^2F	7/2	5690.97	M58
		5/2	7791.23	M58
$4d^8(^3F)5p$	z $^4D^o$	7/2	27075.26	M58
		5/2	28859.64	M58
		3/2	30397.27	M58
		1/2	31146.68	M58
$4d^8(^3F)5p$	z $^4G^o$	9/2	28542.69	M58
		11/2	29104.71	M58
		7/2	31101.75	M58
		5/2	32243.32	M58
$4d^8(^3F)5p$	z $^4F^o$	9/2	29430.86	M58
		7/2	29866.34	M58
		5/2	31474.50	M58
		3/2	32277.43	M58

Energy Levels of Neutral Rhodium (Rh I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^8(^3F)5p$	z $^2G^o$	9/2	31613.78	M58
		7/2	33043.91	M58
Rh II ($^3F_4$)		*Limit*	**60160.1**	CHR88a

Persistent Lines of Singly-ionized Rhodium (Rh II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1604.45		$4d^8$	a ^3F	4	0.0	S58	
			$4d^7(^4F)5p$	z $^3F^o$	4	62326.1		
400	1624.47		$4d^8$	a ^3F	3	2401.3	S58	
			$4d^7(^4F)5p$	z $^3G^o$	4	63959.5		
1000	1628.94		$4d^8$	a ^3F	2	3580.7	S58	
			$4d^7(^4F)5p$	z $^3F^o$	2	64970.4		
400	1634.72		$4d^8$	a ^3F	4	0.0	S58	
			$4d^7(^4F)5p$	z $^5G^o$	4	61173.1		
400	1637.88		$4d^8$	a ^3F	3	2401.3	S58	
			$4d^7(^4F)5p$	z $^3F^o$	3	63454.9		
800	2334.77		$4d^7(^4F)5s$	a ^5F	5	16884.8	S58	
			$4d^7(^4F)5p$	z $^5G^o$	6	59702.4		
300	2415.84		$4d^7(^4F)5s$	a ^5F	3	19792.4	S58	
			$4d^7(^4F)5p$	z $^5G^o$	4	61173.1		
400	2461.03		$4d^7(^4F)5s$	a ^5F	4	18540.4	S58	
			$4d^7(^4F)5p$	z $^5D^o$	4	59161.5		
400	2490.79		$4d^7(^4F)5s$	a ^5F	5	16884.8	S58	
			$4d^7(^4F)5p$	z $^5F^o$	5	57020.8		
500	2520.52		$4d^7(^4F)5s$	a ^5F	5	16884.8	S58	
			$4d^7(^4F)5p$	z $^5F^o$	4	56547.3		
400	2715.27		$4d^7(^4F)5s$	b ^3F	4	25376.9	S58	
			$4d^7(^4F)5p$	z $^3G^o$	5	62194.4		
300	2910.15		$4d^7(^4F)5s$	b ^3F	4	25376.9	S58	
			$4d^7(^4F)5p$	z $^5G^o$	5	59729.4		

Energy Levels of Singly-ionized Rhodium (Rh II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^8$	a ^3F	4	0.0	S58
		3	2401.3	S58
		2	3580.7	S58
$4d^8$	a ^3P	2	8164.4	S58
		1	10515.0	S58
		0	10760.8	S58
$4d^8$	a ^1D	2	11643.7	S58
$4d^8$	a ^1G	4	14855.4	S58

Energy Levels of Singly-ionized Rhodium (Rh II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^7(^4F)5s$	a ^5F	5	16884.8	S58
		4	18540.4	S58
		3	19792.4	S58
		2	20646.9	S58
		1	21180.0	S58
$4d^7(^4F)5s$	b ^3F	4	25376.9	S58
		3	27439.4	S58
		2	28834.6	S58
$4d^7(^4F)5p$	z $^5F^o$	4	56547.3	S58
		5	57020.8	S58
		3	58358.5	S58
		2	59698.6	S58
		1	60573.2	S58
$4d^7(^4F)5p$	z $^5D^o$	4	59161.5	S58
		3	60448.4	S58
		2	61355.9	S58
		1	61881.1	S58
		0	62012.5	S58
$4d^7(^4F)5p$	z $^5G^o$	6	59702.4	S58
		5	59729.4	S58
		4	61173.1	S58
		3	61939.8	S58
		2	62288.3	S58
$4d^7(^4F)5p$	z $^3G^o$	5	62194.4	S58
		4	63959.5	S58
		3	65321.2	S58
$4d^7(^4F)5p$	z $^3F^o$	4	62326.1	S58
		3	63454.9	S58
		2	64970.4	S58
Rh III ($^4F_{9/2}$)		*Limit*	**145800**	M58

Rubidium (Rb)
Atomic number = 37
Atomic weight = 85.4678

Isotope	Mass	Abundance	Spin	Mag moment
^{85}Rb	84.911794	72.17%	5/2	+1.35302
^{87}Rb	86.909187	27.83%	3/2	+2.7512

Rb I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s\ ^2S_{1/2}$
Ionization energy: 33 690.81 cm^{-1} (4.177 128 eV)

Rb II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6\ ^1S_0$
Ionization energy: 220 105.0 cm^{-1} (27.2895 eV)

Strong Lines of Rubidium (Rb)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
2	513.266	Rb II	R75
3	530.173	Rb II	R75
30 P	589.419	Rb II	R75
15	643.878	Rb II	R75
30 P	697.049	Rb II	R75
70 P	711.187	Rb II	R75
110 P	741.456	Rb II	R75
11	1604.12	Rb II	R75
60	1760.50	Rb II	R75
	Air		
20	2068.92	Rb II	R75
11	2071.50	Rb II	R75
110	2075.95	Rb II	R75
11	2090.29	Rb II	R75
11	2125.25	Rb II	R75
300	2143.83	Rb II	R75
110	2217.08	Rb II	R75
60	2291.71	Rb II	R75
20	2333.39	Rb II	R75
20	2385.34	Rb II	R75
600	2472.20	Rb II	R75
20	2496.38	Rb II	R75
11	2524.24	Rb II	R75
11	2684.10	Rb II	R75
11	2711.76	Rb II	R75
11	3051.36	Rb II	R75
60 c	3148.90	Rb II	R75
13	3161.00	Rb II	R75
1	3227.98	Rb I	RE80
20	3270.99	Rb II	R75
15	3321.49	Rb II	R75
13	3340.55	Rb II	R75
1	3348.72	Rb I	RE80
1	3350.82	Rb I	RE80
13	3393.03	Rb II	R75
11	3434.18	Rb II	R75
15	3461.50	Rb II	R75
30	3521.39	Rb II	R75
30 l	3531.55	Rb II	R75
11	3541.15	Rb II	R75

Strong Lines of Rubidium (Rb)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1	3587.05	Rb I	RE80
60	3600.60	Rb II	R75
110	3600.64	Rb II	R75
11 c	3662.74	Rb II	R75
30 c	3699.58	Rb II	R75
40	3796.81	Rb II	R75
30	3801.90	Rb II	R75
11	3826.66	Rb II	R75
30 l	3926.44	Rb II	R75
300 P	3940.51	Rb II	R75
11 c	3978.15	Rb II	R75
20	4029.49	Rb II	R75
30 c	4083.88	Rb II	R75
20 c	4104.28	Rb II	R75
20 c	4136.11	Rb II	R75
40	4193.08	Rb II	R75
11 P	4201.80	Rb I	RE80
6 P	4215.53	Rb I	RE80
1000 P	4244.40	Rb II	R75
150	4273.14	Rb II	R75
30 c	4287.97	Rb II	R75
15	4293.97	Rb II	R75
11	4346.96	Rb II	R75
30	4377.12	Rb II	R75
11	4469.47	Rb II	R75
30	4530.34	Rb II	R75
200	4571.77	Rb II	R75
30 c	4622.42	Rb II	R75
110	4648.57	Rb II	R75
11	4730.45	Rb II	R75
11	4755.30	Rb II	R75
300 P	4775.95	Rb II	R75
60 c	4782.83	Rb II	R75
15 c	4885.59	Rb II	R75
110 P	5152.08	Rb II	R75
1	5431.532	Rb I	B59
60	5522.78	Rb II	R75
60 c	5635.99	Rb II	R75
30 d	5699.15	Rb II	R75
1	5724.121	Rb I	B59
1	6070.755	Rb I	B59
11 c	6199.08	Rb II	R75
1 c	6206.309	Rb I	B59
1 c	6298.325	Rb I	B59
110 P	6458.33	Rb II	R75
11	6555.62	Rb II	R75
60	6560.81	Rb II	R75
30 l	6775.07	Rb II	R75
1 l	7279.997	Rb I	B59
2	7408.173	Rb I	B59
2 l	7618.933	Rb I	B59
3	7757.651	Rb I	B59
1	7759.436	Rb I	B59
1000 c,P	7800.27	Rb I	J61b
500 c,P	7947.60	Rb I	J61b
20	8603.96	Rb II	R75
11	9479.32	Rb II	R75
20 c	9689.05	Rb II	R75
1	13235.17	Rb I	J61b

Strong Lines of Rubidium (Rb)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1	13665.01	Rb I	J61b
11 P	14752.41	Rb I	J61b
9 P	15288.43	Rb I	J61b
2	15289.48	Rb I	J61b

Persistent Lines of Neutral Rubidium (Rb I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
11	4201.80	0.018	$5s$	^2S	1/2	0.000	RE80	FW96
			$6p$	$^2P^o$	3/2	23792.591		
6	4215.53	0.015	$5s$	^2S	1/2	0.000	RE80	FW96
			$6p$	$^2P^o$	1/2	23715.081		
1000	7800.27	0.370	$5s$	^2S	1/2	0.000	J61b	FW96
			$5p$	$^2P^o$	3/2	12816.545		
500	7947.60	0.340	$5s$	^2S	1/2	0.000	J61b	FW96
			$5p$	$^2P^o$	1/2	12578.950		
11	14752.41		$5p$	$^2P^o$	1/2	12578.950	J61b	
			$4d$	^2D	3/2	19355.649		
9	15288.43		$5p$	$^2P^o$	3/2	12816.545	J61b	
			$4d$	^2D	3/2	19355.649		

Energy Levels of Neutral Rubidium (Rb I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5s$	^2S	1/2	0.000	J61b
$5p$	$^2P^o$	1/2	12578.950	J61b
		3/2	12816.545	J61b
$4d$	^2D	5/2	19355.203	J61b
		3/2	19355.649	J61b
$6s$	^2S	1/2	20132.510	J61b
$6p$	$^2P^o$	1/2	23715.081	J61b
		3/2	23792.591	J61b
Rb II ($^1S_0$)		*Limit*	**33690.81**	J61b

Persistent Lines of Singly-ionized Rubidium (Rb II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
30	589.419		$4p^6$	^1S	0	0.00	R75	
			$4p^54d$	$^1P^o$	1	169658.536		
30	697.049		$4p^6$	^1S	0	0.00	R75	
			$4p^54d$	$^3P^o$	1	143461.977		
70	711.187		$4p^6$	^1S	0	0.00	R75	
			$4p^5(^2P^o_{1/2})5s$	$^2[1/2]^o$	1	140610.047		
110	741.456		$4p^6$	^1S	0	0.00	R75	
			$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	1	134869.751		

Persistent Lines of Singly-ionized Rubidium (Rb II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	3940.51		$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	2	133341.607	R75	
			$4p^5(^2P^o_{3/2})5p$	$^2[3/2]$	2	158711.854		
1000	4244.40		$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	2	133341.607	R75	
			$4p^5(^2P^o_{3/2})5p$	$^2[5/2]$	3	156895.486		
11	4755.30		$4p^5(^2P^o_{3/2})5p$	$^2[3/2]$	2	158711.854	R75	
			$4p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	2	179735.123		
110	5152.08		$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	1	134869.751	R75	
			$4p^5(^2P^o_{3/2})5p$	$^2[1/2]$	1	154273.980		
110	6458.33		$4p^5(^2P^o_{1/2})5s$	$^2[1/2]^o$	0	138794.380	R75	
			$4p^5(^2P^o_{3/2})5p$	$^2[1/2]$	1	154273.980		

Energy Levels of Singly-ionized Rubidium (Rb II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4p^6$	^1S	0	0.00	R75
$4p^5(^2P^o_{3/2})5s$	$^2[3/2]^o$	2	133341.607	R75
		1	134869.751	R75
$4p^5(^2P^o_{1/2})5s$	$^2[1/2]^o$	0	138794.380	R75
		1	140610.047	R75
$4p^54d$	$^3P^o$	0	143022.335	R75
		1	143461.977	R75
		2	143955.871	R75
$4p^5(^2P^o_{3/2})5p$	$^2[1/2]$	1	154273.980	R75
		0	161200.171	R75
$4p^5(^2P^o_{3/2})5p$	$^2[5/2]$	2	156737.011	R75
		3	156895.486	R75
$4p^5(^2P^o_{3/2})5p$	$^2[3/2]$	1	158151.666	R75
		2	158711.854	R75
$4p^5(^2P^o_{1/2})5p$	$^2[3/2]$	1	163924.55	R75
		2	164968.007	R75
$4p^5(^2P^o_{1/2})5p$	$^2[1/2]$	1	165089.580	R75
		0	167632.436	R75
$4p^54d$	$^1P^o$	1	169658.536	R75
$4p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	2	179735.123	R75
		1	180168.372	R75
Rb III ($^2P^o_{3/2}$)		*Limit*	**220105.0**	R75

Ruthenium (Ru)
Atomic number = 44
Atomic weight = 101.07

Isotope	Mass	Abundance	Spin	Mag moment
^{96}Ru	95.907599	5.53%	0	
^{98}Ru	97.905287	1.87%	0	
^{99}Ru	98.905939	12.7%	5/2	−6.413
^{100}Ru	99.904219	12.6%	0	
^{101}Ru	100.905582	17.1%	5/2	−0.7188
^{102}Ru	101.904348	31.6%	0	
^{104}Ru	103.905424	18.6%	0	

Ru I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^7 5s\ ^5F_5$
Ionization energy: 59 366.4 cm^{-1} (7.360 50 eV)

Ru II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^7\ ^4F_{9/2}$
Ionization energy: 135 200 cm^{-1} (16.76 eV)

Strong Lines of Ruthenium (Ru)

Intensity	Wavelength (Å)	Spectrum	Ref.
	Vacuum		
600 P	1875.564	Ru II	CHR88a
600 P	1888.043	Ru II	JJLL94
600 P	1903.221	Ru II	JJLL94
250 P	1916.816	Ru II	JJLL94
250 P	1939.043	Ru II	JJLL94
250 P	1939.505	Ru II	JJLL94
	Air		
200	2076.43	Ru I	K59
250	2083.78	Ru I	K59
200	2090.22	Ru I	K59
60	2255.53	Ru I	K59
70	2272.091	Ru I	K59
70	2279.582	Ru I	K59
40	2317.784	Ru I	K59
200 P	2357.916	Ru II	JJLL94
1000 P	2402.72	Ru II	MCS75
250	2455.531	Ru II	JJ93
200 P	2456.438	Ru II	JJLL94
500 P	2456.57	Ru II	MCS75
400 P	2478.93	Ru II	MCS75
200	2498.42	Ru II	MCS75
200	2498.57	Ru II	MCS75
300 P	2507.01	Ru II	MCS75
50	2549.56	Ru I	K59
30	2609.062	Ru I	K59
80	2612.06	Ru I	K59
40	2642.946	Ru I	K59
40	2659.617	Ru I	K59
400 P	2661.61	Ru II	MCS75
900 P	2678.76	Ru II	MCS75
400	2692.06	Ru II	MCS75
250 P	2712.41	Ru II	MCS75
60	2719.51	Ru I	K59
400 P	2734.35	Ru II	MCS75
150	2735.727	Ru I	K59

Strong Lines of Ruthenium (Ru)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
150	2810.551	Ru I	K59
40	2829.149	Ru I	K59
60	2854.075	Ru I	K59
40	2861.408	Ru I	K59
50	2866.653	Ru I	K59
150	2874.984	Ru I	K59
70	2886.528	Ru I	K59
30	2908.883	Ru I	K59
100	2916.251	Ru I	K59
250	2945.67	Ru II	MCS75
30	2949.492	Ru I	K59
50	2965.166	Ru I	K59
200	2965.55	Ru II	MCS75
200 P	2976.584	Ru II	JJLL94
50	2976.923	Ru I	K59
130	2988.945	Ru I	K59
40	2994.967	Ru I	K59
40	3006.588	Ru I	K59
40	3064.834	Ru I	K59
30	3096.565	Ru I	K59
80	3099.284	Ru I	K59
70	3100.836	Ru I	K59
40	3294.109	Ru I	K59
30	3301.593	Ru I	K59
80	3339.555	Ru I	K59
30	3368.455	Ru I	K59
30	3392.533	Ru I	K59
300	3417.332	Ru I	K59
400	3428.319	Ru I	K59
40	3430.764	Ru I	K59
600 P	3436.737	Ru I	K59
800 P	3498.944	Ru I	K59
60	3514.491	Ru I	K59
70	3539.368	Ru I	K59
60	3570.606	Ru I	K59
40	3587.204	Ru I	K59
600 P	3589.220	Ru I	K59
600 P	3593.029	Ru I	K59
600 P	3596.185	Ru I	K59
120	3599.769	Ru I	K59
30	3626.740	Ru I	K59
300	3634.931	Ru I	K59
600	3661.364	Ru I	K59
80	3663.378	Ru I	K59
60	3669.546	Ru I	K59
40	3716.998	Ru I	K59
50	3726.096	Ru I	K59
800 P	3726.926	Ru I	K59
1000 P	3728.026	Ru I	K59
600 P	3730.432	Ru I	K59
40	3739.470	Ru I	K59
300	3742.287	Ru I	K59
80	3742.798	Ru I	K59
40	3744.396	Ru I	K59
250	3745.592	Ru I	K59
70	3753.546	Ru I	K59
80	3755.937	Ru I	K59
110	3759.838	Ru I	K59
30	3760.019	Ru I	K59

Strong Lines of Ruthenium (Ru)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
50	3761.511	Ru I	K59
50	3767.353	Ru I	K59
140	3777.588	Ru I	K59
40	3781.171	Ru I	K59
50	3782.749	Ru I	K59
400	3786.065	Ru I	K59
500	3790.521	Ru I	K59
70	3798.054	Ru I	K59
700 P	3798.899	Ru I	K59
700 P	3799.353	Ru I	K59
50	3812.739	Ru I	K59
70	3817.293	Ru I	K59
70	3819.039	Ru I	K59
60	3822.091	Ru I	K59
50	3824.938	Ru I	K59
70	3831.795	Ru I	K59
80	3839.699	Ru I	K59
40	3846.672	Ru I	K59
70	3850.441	Ru I	K59
40	3856.458	Ru I	K59
120	3857.551	Ru I	K59
60	3862.690	Ru I	K59
120	3867.844	Ru I	K59
60	3892.230	Ru I	K59
70	3909.085	Ru I	K59
140	3923.486	Ru I	K59
300	3925.930	Ru I	K59
50	3931.787	Ru I	K59
70	3945.586	Ru I	K59
40	3950.230	Ru I	K59
50	3978.449	Ru I	K59
50	3979.420	Ru I	K59
80	3984.862	Ru I	K59
140	4022.168	Ru I	K59
50	4023.832	Ru I	K59
130	4051.402	Ru I	K59
60	4054.050	Ru I	K59
30	4064.456	Ru I	K59
70	4068.367	Ru I	K59
90	4076.730	Ru I	K59
500	4080.599	Ru I	K59
80	4097.787	Ru I	K59
150	4112.741	Ru I	K59
200	4144.160	Ru I	K59
60	4145.737	Ru I	K59
80	4167.514	Ru I	K59
50	4197.572	Ru I	K59
50	4198.864	Ru I	K59
700 P	4199.892	Ru I	K59
140	4206.020	Ru I	K59
500	4212.062	Ru I	K59
70	4214.445	Ru I	K59
80	4217.263	Ru I	K59
30	4220.675	Ru I	K59
50	4230.309	Ru I	K59
70	4241.058	Ru I	K59
70	4243.058	Ru I	K59
30	4246.736	Ru I	K59
70	4284.330	Ru I	K59

Strong Lines of Ruthenium (Ru)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
50	4295.932	Ru I	K59
300	4297.714	Ru I	K59
80	4307.604	Ru I	K59
30	4318.441	Ru I	K59
50	4319.871	Ru I	K59
50	4342.073	Ru I	K59
60	4354.130	Ru I	K59
80	4361.204	Ru I	K59
200	4372.200	Ru I	K59
80	4385.393	Ru I	K59
120	4385.650	Ru I	K59
150	4390.440	Ru I	K59
150	4410.028	Ru I	K59
40	4439.745	Ru I	K59
40	4449.322	Ru I	K59
100	4460.031	Ru I	K59
500	4554.514	Ru I	K59
150	4584.440	Ru I	K59
70	4647.594	Ru I	K59
130	4709.482	Ru I	K59
50	4757.844	Ru I	K59
50	4869.163	Ru I	K59
40	4903.066	Ru I	K59
40	5057.340	Ru I	K59
50	5136.558	Ru I	K59
50	5155.140	Ru I	K59
80	5171.026	Ru I	K59
25	5636.233	Ru I	K59

Persistent Lines of Neutral Ruthenium (Ru I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	3436.737	0.728	$4d^7(a^4F)5s$	a ^5F	4	1190.64	K59	WSL94
			$4d^7(a^4F)5p$	z $^5G^o$	5	30279.68		
800	3498.944	0.861	$4d^7(a^4F)5s$	a ^5F	5	0.00	K59	WSL94
			$4d^7(a^4F)5p$	z $^5G^o$	6	28571.89		
600	3589.220	0.911	$4d^7(a^4F)5s$	a ^5F	1	3105.49	K59	WSL94
			$4d^7(a^4F)5p$	z $^5G^o$	2	30958.80		
600	3593.029	0.817	$4d^7(a^4F)5s$	a ^5F	2	2713.24	K59	WSL94
			$4d^7(a^4F)5p$	z $^5G^o$	3	30537.06		
600	3596.185	0.420	$4d^7(a^4F)5s$	a ^5F	3	2091.54	K59	WSL94
			$4d^7(a^4F)5p$	z $^3G^o$	4	29890.91		
800	3726.926	0.753	$4d^7(a^4F)5s$	a ^5F	4	1190.64	K59	WSL94
			$4d^7(a^4F)5p$	z $^5F^o$	4	28014.79		
1000	3728.026	0.820	$4d^7(a^4F)5s$	a ^5F	5	0.00	K59	WSL94
			$4d^7(a^4F)5p$	z $^5F^o$	5	26816.23		
600	3730.432	0.706	$4d^7(a^4F)5s$	a ^5F	3	2091.54	K59	WSL94
			$4d^7(a^4F)5p$	z $^5F^o$	3	28890.47		
700	3798.899	0.598	$4d^7(a^4F)5s$	a ^5F	4	1190.64	K59	WSL94
			$4d^7(a^4F)5p$	z $^5D^o$	3	27506.59		

Persistent Lines of Neutral Ruthenium (Ru I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	3799.353	0.533	$4d^7(a^4F)5s$	a ^5F	5	0.00	K59	WSL94
			$4d^7(a^4F)5p$	z $^5D^o$	4	26312.83		
700	4199.892	0.399	$4d^7(a^4F)5s$	a ^3F	4	6545.03	K59	WSL94
			$4d^7(a^4F)5p$	z $^3F^o$	4	30348.45		

Energy Levels of Neutral Ruthenium (Ru I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^7(a^4F)5s$	a ^5F	5	0.00	M58
		4	1190.64	M58
		3	2091.54	M58
		2	2713.24	M58
		1	3105.49	M58
$4d^7(a^4F)5s$	a ^3F	4	6545.03	M58
		3	8084.12	M58
		2	9183.66	M58
$4d^65s^2$	a ^5D	4	7483.07	M58
		3	8575.42	M58
		2	9057.64	M58
		1	9072.98	M58
		0	9492.37	M58
$4d^7(a^4P)5s$	a ^5P	2	8043.69	M58
		3	8770.93	M58
		1	9620.29	M58
$4d^7(a^4F)5p$	z $^5D^o$	4	26312.83	M58
		3	27506.59	M58
		2	28465.69	M58
		1	29118.49	M58
		0	29569.90	M58
$4d^7(a^4F)5p$	z $^5F^o$	5	26816.23	M58
		4	28014.79	M58
		3	28890.47	M58
		2	29427.32	M58
		1	29693.57	M58
$4d^7(a^4F)5p$	z $^3G^o$	5	28495.10	M58
		4	29890.91	M58
		3	31852.90	M58
$4d^7(a^4F)5p$	z $^5G^o$	6	28571.89	M58
		5	30279.68	M58
		3	30537.06	M58
		2	30958.80	M58
		4	31345.79	M58
$4d^7(a^4F)5p$	z $^3F^o$	4	30348.45	M58
		3	32391.95	M58
		2	33172.02	M58
Ru II ($^4F_{9/2}$)		*Limit*	**59366.4**	CHR88a

Persistent Lines of Singly-ionized Ruthenium (Ru II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	1875.564		$4d^7$	a ^4F	9/2	0.0	SM58	
			$4d^6(^5D)5p$	z $^4D^o$	7/2	53317.1		
600	1888.045	0.548	$4d^7$	a ^4F	9/2	0.0	SM58	JJLL94
			$4d^6(^5D)5p$	z $^4F^o$	9/2	52964.4		
600	1903.227	1.00	$4d^7$	a ^4F	7/2	1523.1	SM58	JJLL94
			$4d^6(^5D)5p$	z $^4D^o$	5/2	54065.4		
250	1916.829	1.14	$4d^7$	a ^4F	5/2	2493.9	SM58	JJLL94
			$4d^6(^5D)5p$	z $^4D^o$	3/2	54663.4		
250	1939.043	0.497	$4d^7$	a ^4F	5/2	2493.9	JJ93	JJLL94
			$4d^6(^5D)5p$	z $^4D^o$	5/2	54065.4		
250	1939.505	0.665	$4d^7$	a ^4F	3/2	3104.2	JJ93	JJLL94
			$4d^6(^5D)5p$	z $^4D^o$	3/2	54663.4		
200	2357.916	0.84	$4d^6(^5D)5s$	a ^6D	9/2	9151.4	JJLL94	JJLL94
			$4d^6(^5D)5p$	z $^6P^o$	7/2	51548.8		
1000	2402.72		$4d^6(^5D)5s$	a ^6D	9/2	9151.4	MCS75	
			$4d^6(^5D)5p$	z $^6F^o$	11/2	50758.3		
200	2456.438	1.59	$4d^6(^5D)5s$	a ^6D	5/2	10851.7	JJLL94	JJLL94
			$4d^6(^5D)5p$	z $^6P^o$	7/2	51548.8		
500	2456.57		$4d^6(^5D)5s$	a ^6D	7/2	10150.4	MCS75	
			$4d^6(^5D)5p$	z $^6F^o$	9/2	50845.3		
400	2478.93		$4d^6(^5D)5s$	a ^6D	5/2	10851.7	MCS75	
			$4d^6(^5D)5p$	z $^6F^o$	5/2	51179.7		
300	2507.01		$4d^6(^5D)5s$	a ^6D	3/2	11303.8	MCS75	
			$4d^6(^5D)5p$	z $^6F^o$	5/2	51179.7		
400	2661.61		$4d^6(^5D)5s$	a ^6D	9/2	9151.4	MCS75	
			$4d^6(^5D)5p$	z $^6D^o$	7/2	46711.5		
900	2678.76		$4d^6(^5D)5s$	a ^6D	9/2	9151.4	MCS75	
			$4d^6(^5D)5p$	z $^6D^o$	9/2	46471.0		
250	2712.41		$4d^6(^5D)5s$	a ^6D	5/2	10851.7	MCS75	
			$4d^6(^5D)5p$	z $^6D^o$	3/2	47708.6		
400	2734.35		$4d^6(^5D)5s$	a ^6D	7/2	10150.4	MCS75	
			$4d^6(^5D)5p$	z $^6D^o$	7/2	46711.5		
200	2976.584	1.08	$4d^6(^5D)5s$	a ^4D	7/2	19378.7	JJLL94	JJLL94
			$4d^6(^5D)5p$	z $^4F^o$	9/2	52964.4		

Energy Levels of Singly-ionized Ruthenium (Ru II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^7$	a ^4F	9/2	0.0	SM58
		7/2	1523.1	SM58
		5/2	2493.9	SM58
		3/2	3104.2	SM58
$4d^7$	a ^4P	5/2	8256.7	SM58
		3/2	8477.7	SM58
		1/2	9373.9	SM58
$4d^6(^5D)5s$	a ^6D	9/2	9151.4	SM58
		7/2	10150.4	SM58
		5/2	10851.7	SM58
		3/2	11303.8	SM58
		1/2	11604.0	SM58
$4d^6(^5D)5s$	a ^4D	7/2	19378.7	SM58
		5/2	20515.0	SM58
		3/2	21246.4	SM58
		1/2	21645.6	SM58
$4d^6(^5D)5p$	z $^6D^o$	9/2	46471.0	SM58
		7/2	46711.5	SM58
		5/2	47285.1	SM58
		3/2	47708.6	SM58
		1/2	47983.8	SM58
$4d^6(^5D)5p$	z $^6F^o$	11/2	50758.3	SM58
		9/2	50845.3	SM58
		7/2	50862.5	SM58
		5/2	51179.7	SM58
		3/2	51317.0	SM58
		1/2	51380.1	SM58
$4d^6(^5D)5p$	z $^6P^o$	7/2	51548.8	SM58
		5/2	52820.3	SM58
		3/2	53685.2	SM58
$4d^6(^5D)5p$	z $^4F^o$	9/2	52964.4	SM58
		7/2	54225.5	SM58
		5/2	54794.3	SM58
		3/2	55224.2	SM58
$4d^6(^5D)5p$	z $^4D^o$	7/2	53317.1	SM58
		5/2	54065.4	SM58
		3/2	54663.4	SM58
		1/2	54981.5	SM58
Ru III ($^5D_4$)		*Limit*	**135200**	SM58

Samarium (Sm)
Atomic number=62
Atomic weight=150.36

Isotope	Mass	Abundance	Spin	Mag moment
^{144}Sm	143.911998	3.1%	0	
^{147}Sm	146.914895	15.0%	7/2	−0.813
^{148}Sm	147.914820	11.3%	0	
^{149}Sm	148.917181	13.8%	7/2	−0.670
^{150}Sm	149.917273	7.4%	0	
^{152}Sm	151.919729	26.6%	0	
^{154}Sm	153.922206	22.6%	0	

Sm I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^6 6s^2\ {}^7\mathrm{F}_0$
Ionization energy: 45 519.6 cm^{-1} (5.6437 eV)

Sm II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^6 6s\ {}^8\mathrm{F}_{1/2}$
Ionization energy: 89 300 cm^{-1} (11.07 eV)

Strong Lines of Samarium (Sm)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
200	3254.377	Sm II	K35
400	3306.388	Sm II	K35
200	3307.017	Sm II	K35
200	3310.661	Sm II	K35
300	3321.179	Sm II	K35
200	3340.579	Sm II	K35
300	3365.863	Sm II	K35
300	3382.399	Sm II	K35
200	3408.676	Sm II	K35
1000 P	3568.271	Sm II	K35
1000 P	3592.603	Sm II	K35
400	3604.285	Sm II	K35
800 P	3609.491	Sm II	K35
400	3621.229	Sm II	K35
200	3627.014	Sm II	K35
200	3631.126	Sm II	K35
800 P	3634.290	Sm II	K35
500	3661.365	Sm II	K35
500	3670.840	Sm II	K35
250 P	3693.989	Sm II	K35
200	3708.654	Sm II	K35
200	3718.877	Sm II	K35
200	3721.847	Sm II	K35
400	3728.469	Sm II	K35
500	3731.258	Sm II	K35
400	3735.980	Sm II	K35
200	3737.141	Sm II	K35
700* P	3739.117	Sm II	K35
700* P	3739.197	Sm II	K35
200	3741.288	Sm II	K35
300	3743.868	Sm II	K35
600* P	3745.465	Sm I	K35
600* P	3745.605	Sm II	K35
200	3755.276	Sm II	K35
500	3756.411	Sm I	K35

Strong Lines of Samarium (Sm)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
300	3757.529	Sm II	K35
500	3760.694	Sm II	K35
250	3764.370	Sm II	K35
250* d	3773.331	Sm I	K35
250* d	3773.422	Sm II	K35
250	3778.135	Sm II	K35
400	3788.125	Sm II	K35
400	3793.971	Sm II	K35
400	3797.730	Sm II	K35
200	3800.887	Sm II	K35
400	3826.202	Sm II	K35
250	3831.501	Sm II	K35
400	3834.476	Sm I	K35
400	3843.500	Sm II	K35
300	3853.295	Sm I	K35
600	3854.209	Sm II	K35
300	3854.556	Sm I	K35
200	3855.901	Sm II	K35
250	3858.737	Sm I	K35
200	3871.778	Sm II	K35
200	3880.766	Sm II	K35
900 P	3885.286	Sm II	K35
400	3896.977	Sm II	K35
300	3903.417	Sm II	K35
600 P	3922.397	Sm II	K35
500	3928.279	Sm II	K35
300	3941.874	Sm II	K35
200	3948.113	Sm II	K35
300	3951.887	Sm I	K35
400*	3962.98	Sm II	RAVS90
400*	3963.03	Sm II	RAVS90
200	3970.528	Sm II	K35
400	3971.397	Sm II	K35
400	3974.665	Sm I	K35
250	3976.270	Sm II	K35
250	3976.430	Sm II	K35
250	3979.200	Sm II	K35
200	3983.138	Sm II	K35
200	3986.682	Sm II	K35
400*	3990.002	Sm II	K35
400* P	3990.025	Sm I	K35
200	3993.308	Sm II	K35
200	4023.231	Sm II	K35
200	4035.110	Sm II	K35
200	4042.723	Sm II	K35
200	4042.905	Sm II	K35
200	4047.160	Sm II	K35
300*	4064.55	Sm II	RAVS90
300*	4064.57	Sm II	RAVS90
200	4066.737	Sm II	K35
200	4075.845	Sm II	K35
250	4092.266	Sm II	K35
200*	4107.277	Sm II	K35
200*	4107.387	Sm II	K35
500	4118.551	Sm II	K35
200	4149.831	Sm II	K35
300	4152.209	Sm II	K35
200	4169.478	Sm II	K35
250	4188.128	Sm II	K35

Strong Lines of Samarium (Sm)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
250	4203.051	Sm II	K35
200	4220.659	Sm II	K35
250	4225.328	Sm II	K35
200	4229.704	Sm II	K35
300	4236.745	Sm II	K35
500 P	4256.393	Sm II	K35
300	4262.677	Sm II	K35
300*	4279.678	Sm II	K35
300*	4279.747	Sm II	K35
500 P	4280.789	Sm II	K35
400	4282.208	Sm I	K35
300	4282.833	Sm I	K35
1000 P	4296.743	Sm I	K35
200	4309.012	Sm II	K35
500	4318.936	Sm II	K35
300	4319.530	Sm I	K35
400	4329.016	Sm II	K35
300	4330.016	Sm I	K35
300	4334.153	Sm II	K35
600 P	4336.137	Sm I	K35
250	4347.801	Sm II	K35
200	4362.040	Sm II	K35
300 P	4362.912	Sm I	K35
200	4378.236	Sm II	K35
300	4380.423	Sm I	K35
400	4390.858	Sm II	K35
200	4397.341	Sm I	K35
250	4401.174	Sm I	K35
200* d	4403.06	Sm II	K35
200* d	4403.13	Sm I	K35
200	4411.585	Sm I	K35
300	4419.332	Sm I	K35
400	4420.526	Sm II	K35
250	4421.138	Sm II	K35
700 P	4424.339	Sm II	K35
300	4429.664	Sm I	K35
400	4433.885	Sm II	K35
400	4434.323	Sm II	K35
300	4441.812	Sm I	K35
300	4442.276	Sm I	K35
400	4445.153	Sm I	K35
300	4452.727	Sm II	K35
300	4454.629	Sm II	K35
250	4458.517	Sm II	K35
500 P	4467.342	Sm II	K35
500 P	4470.886	Sm I	K35
200	4478.657	Sm II	K35
250	4499.108	Sm I	K35
200	4519.633	Sm II	K35
200	4533.799	Sm I	K35
200	4543.948	Sm II	K35
200	4581.581	Sm I	K35
300	4581.729	Sm I	K35
200	4642.235	Sm II	K35
200	4645.405	Sm I	K35
250	4649.491	Sm I	K35
200	4663.556	Sm I	K35
200	4669.396	Sm II	K35
300	4670.747	Sm I	K35

Strong Lines of Samarium (Sm)—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
250		4674.599	Sm II	K35
250		4688.733	Sm I	K35
500	P	4716.097	Sm I	K35
500	P	4728.423	Sm I	K35
500	P	4760.27	Sm I	K35
400		4783.103	Sm I	K35
200		4785.864	Sm I	K35
600	P	4841.701	Sm I	K35
500	P	4883.971	Sm I	K35
400		4910.400	Sm I	K35
250		4918.986	Sm I	K35
250		5044.279	Sm I	K35
300		5071.200	Sm I	K35
300		5117.162	Sm I	K35
200		5122.136	Sm I	K35
300		5175.419	Sm I	K35
250		5271.403	Sm I	K35

Persistent Lines of Neutral Samarium (Sm I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600*	3745.465	0.27	$4f^66s^2$	^7F	3	1489.55	K35	M00
			$4f^5(^6F^o)5d6s^2$	$^7F^o$	4	28180.95		
400*	3990.025	0.43	$4f^66s^2$	^7F	5	3125.46	K35	M00
			$4f^5(^6F^o)5d6s^2$	$^7F^o$	4	28180.95		
1000	4296.743	1.00	$4f^66s^2$	^7F	6	4020.66	K35	M00
			$4f^6(^7F)6s6p(^1P^o)$	$^7G^o$	7	27287.58		
600	4336.137		$4f^66s^2$	^7F	5	3125.46	K35	
				^{o}	6	26180.92		
300	4362.912	0.49	$4f^66s^2$	^7F	0	0.00	K35	M00
			$4f^6(^7F)6s6p(^1P^o)$	$^7G^o$	1	22914.07		
500	4470.886		$4f^66s^2$	^7F	4	2273.09	K35	
			$4f^5(^6F^o)5d6s^2$	^{o}	4	24633.75		
500	4716.097		$4f^66s^2$	^7F	5	3125.46	K35	
			$4f^6(^7F)6s6p(^1P^o)$	$^7D^o$	5	24323.51		
500	4728.423	0.49	$4f^66s^2$	^7F	3	1489.55	K35	M00
			$4f^6(^7F)6s6p(^1P^o)$	$^7D^o$	3	22632.30		
500	4760.27	0.13	$4f^66s^2$	^7F	2	811.92	K35	M00
			$4f^6(^7F)6s6p(^1P^o)$	$^7D^o$	2	21813.22		
600	4841.701	0.87	$4f^66s^2$	^7F	6	4020.66	K35	M00
			$4f^6(^7F)6s6p(^1P^o)$	^{o}	5	24668.79		
500	4883.971		$4f^66s^2$	^7F	5	3125.46	K35	
			$4f^6(^7F)6s6p(^1P^o)$	$^7D^o$	4	23594.84		

Energy Levels of Neutral Samarium (Sm I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^6 6s^2$	^7F	0	0.00	MZH78
		1	292.58	MZH78
		2	811.92	MZH78
		3	1489.55	MZH78
		4	2273.09	MZH78
		5	3125.46	MZH78
		6	4020.66	MZH78
$4f^6(^7F)5d(^8H)6s$	^9H	1	10801.10	MZH78
		2	11044.90	MZH78
		3	11406.50	MZH78
		4	11877.50	MZH78
		5	12445.35	MZH78
		6	13095.75	MZH78
		7	13814.90	MZH78
		8	14591.70	MZH78
		9	15418.65	MZH78
$4f^6(^7F)5d(^8D)6s$	^9D	2	12313.11	MZH78
		3	12846.64	MZH78
		4	13458.46	MZH78
		5	14202.85	MZH78
		6	15082.94	MZH78
$4f^6(^7F)5d(^8H)6s$	^7H	2	13050.05	MZH78
		3	13542.80	MZH78
		4	14154.30	MZH78
		5	14856.20	MZH78
		6	15617.45	MZH78
		7	16392.93	MZH78
		8	17270.96	MZH78
$4f^6(^7F)6s6p(^1P^o)$	$^7D^o$	1	21193.68	MZH78
		2	21813.22	MZH78
		3	22632.30	MZH78
		4	23594.84	MZH78
		5	24323.51	MZH78
$4f^6(^7F)6s6p(^1P^o)$	$^7G^o$	1	22914.07	MZH78
$4f^5(^6F^o)5d6s^2$	^{o}	4	24633.75	MZH78
$4f^6(^7F)6s6p(^1P^o)$	^{o}	5	24668.79	MZH78
	^{o}	6	26180.92	MZH78
$4f^5(^6F^o)5d6s^2$	$^7F^o$	0	—	
		1	26281.09	MZH78
		2	26786.80	MZH78
		3	27425.50	MZH78
		4	28180.95	MZH78
		5	29023.96	MZH78
		6	30092.53	MZH78
$4f^6(^7F)6s6p(^1P^o)$	$^7G^o$	7	27287.58	MZH78
Sm II ($^8F_{1/2}$)		*Limit*	**45519.6**	JRB00

Persistent Lines of Singly-ionized Samarium (Sm II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3568.271	0.64	$4f^6(^7F)6s$	^8F	13/2	3909.62	K35	M00
			$4f^55d6s$?	^{o}	15/2	31926.40		
1000	3592.603	0.66	$4f^6(^7F)6s$	^8F	11/2	3052.65	K35	M00
			$4f^55d6s$?	^{o}	13/2	30879.74		
800	3609.491	0.58	$4f^6(^7F)6s$	^8F	9/2	2237.97	K35	M00
			$4f^55d6s$?	^{o}	11/2	29934.80		
800	3634.290	0.56	$4f^6(^7F)6s$	^8F	7/2	1489.16	K35	M00
			$4f^55d6s$?	^{o}	9/2	28997.14		
250	3693.989	0.091	$4f^6(^7F)6s$	^8F	1/2	0.00	K35	M00
			$4f^55d6s$?	^{o}	3/2	27063.30		
700*	3739.117	0.17	$4f^6(^7F)6s$	^8F	3/2	326.64	K35	M00
			$4f^55d6s$?	^{o}	3/2	27063.30		
700*	3739.197		$4f^6(^7F)6s$	^6F	9/2	4386.03	K35	
				^{o}	11/2	31122.17		
600*	3745.605	0.066	$4f^6(^7F)6s$	^8F	1/2	0.00	K35	M00
			$4f^55d6s$?	$^8G^o$	1/2	26690.30		
900	3885.286		$4f^6(^7F)6s$	^8F	13/2	3909.62	K35	
			$4f^6(^7F)6p$?	^{o}	13/2	29640.51		
600	3922.397		$4f^6(^7F)6s$	^8F	11/2	3052.65	K35	
			$4f^6(^7F)6p$	^{o}	11/2	28540.12		
500	4256.393		$4f^6(^7F)6s$	^8F	11/2	3052.65	K35	
			$4f^55d6s$	^{o}	13/2	26540.12		
500	4280.789		$4f^6(^7F)6s$	^8F	13/2	3909.62	K35	
			$4f^55d6s$	^{o}	15/2	27263.25		
700	4424.339		$4f^6(^7F)6s$	^8F	13/2	3909.62	K35	
			$4f^6(^7F)6p$	^{o}	11/2	26505.53		
500	4467.342		$4f^6(^7F)6s$	^6F	11/2	5317.56	K35	
			$4f^55d6s$?	^{o}	13/2	27695.96		

Energy Levels of Singly-ionized Samarium (Sm II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^6(^7F)6s$	^8F	1/2	0.00	MZH78
		3/2	326.64	MZH78
		5/2	838.22	MZH78
		7/2	1489.16	MZH78
		9/2	2237.97	MZH78
		11/2	3052.65	MZH78
		13/2	3909.62	MZH78
$4f^6(^7F)6s$	^6F	1/2	1518.29	MZH78
		3/2	2003.23	MZH78
		5/2	2688.69	MZH78
		7/2	3499.12	MZH78
		9/2	4386.03	MZH78
		11/2	5317.56	MZH78

Energy Levels of Singly-ionized Samarium (Sm II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^6(^7F)5d$	^8H	3/2	7135.06	MZH78
		5/2	7524.86	MZH78
		7/2	8046.00	MZH78
		9/2	8679.23	MZH78
		11/2	9406.63	MZH78
		13/2	10214.38	MZH78
		15/2	11094.06	MZH78
		17/2	12045.10	MZH78
$4f^6(^7F)5d$	^8D	3/2	8578.70	MZH78
		5/2	9410.00	MZH78
		7/2	10180.70	MZH78
		9/2	10960.16	MZH78
		11/2	11791.05	MZH78
$4f^6(^7F)6p$	^{o}	11/2	26505.53	MZH78,RAVS90
$4f^55d6s$	^{o}	13/2	26540.12	MZH78,RAVS90
$4f^55d6s$?	$^8G^o$	1/2	26690.30	MZH78
$4f^55d6s$?	^{o}	3/2	27063.30	MZH78
$4f^55d6s$	^{o}	15/2	27263.25	MZH78,RAVS90
$4f^55d6s$?	^{o}	13/2	27695.96	MZH78
$4f^6(^7F)6p$	^{o}	11/2	28540.12	MZH78,RAVS90
$4f^55d6s$?	^{o}	9/2	28997.14	MZH78
$4f^6(^7F)6p$?	^{o}	13/2	29640.51	MZH78
$4f^55d6s$?	^{o}	11/2	29934.80	MZH78
$4f^55d6s$?	^{o}	13/2	30879.74	MZH78
	^{o}	11/2	31122.17	MZH78
$4f^55d6s$?	^{o}	15/2	31926.40	MZH78
Sm III ($^7F_0$)		*Limit*	**89300**	SR65

Scandium (Sc)
Atomic number = 21
Atomic weight = 44.955 910

Isotope	Mass	Abundance	Spin	Mag moment
^{45}Sc	44.955910	100%	7/2	+4.756

Sc I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d4s^2\ ^2D_{3/2}$
Ionization energy: 52 922.0 cm^{-1} (6.561 49 eV)

Sc II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d4s\ ^3D_1$
Ionization energy: 103 237.1 cm^{-1} (12.799 77 eV)

Strong Lines of Scandium (Sc)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
100	2552.350	Sc II	JL80
80	2560.232	Sc II	JL80
15	2706.738	Sc I	AV77
25	2711.341	Sc I	AV77
15	2965.879	Sc I	AV77
50	2974.010	Sc I	AV77
60	2980.755	Sc I	AV77
15	2988.965	Sc I	AV77
90	3015.367	Sc I	AV77
120	3019.349	Sc I	AV77
15	3030.759	Sc I	AV77
70	3255.676	Sc I	AV77
200 P	3269.897	Sc I	AV77
250 P	3273.628	Sc I	AV77
400 P	3353.724	Sc II	JL80
70	3359.668	Sc II	JL80
60	3361.257	Sc II	JL80
60	3361.926	Sc II	JL80
140	3368.936	Sc II	JL80
250 P	3372.150	Sc II	JL80
12	3431.351	Sc I	AV77
25	3435.541	Sc I	AV77
12	3457.442	Sc I	AV77
100	3535.713	Sc II	JL80
250	3558.534	Sc II	JL80
200	3567.702	Sc II	JL80
500 P	3572.530	Sc II	JL80
400 P	3576.340	Sc II	JL80
300 P	3580.928	Sc II	JL80
140	3589.633	Sc II	JL80
140	3590.474	Sc II	JL80
1000 P	3613.831	Sc II	JL80
700 P	3630.742	Sc II	JL80
500 P	3642.782	Sc II	JL80
250	3645.308	Sc II	JL80
200	3651.798	Sc II	JL80
900 P	3907.484	Sc I	AV77
1000 P	3911.812	Sc I	AV77
200 P	3933.375	Sc I	AV77
250 P	3996.601	Sc I	AV77
900 P	4020.387	Sc I	AV77

Strong Lines of Scandium (Sc)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
900 P	4023.678	Sc I	AV77
10	4030.622	Sc I	AV77
10	4043.803	Sc I	AV77
120	4047.797	Sc I	AV77
250 P	4054.544	Sc I	AV77
10	4056.593	Sc I	AV77
250 P	4082.387	Sc I	AV77
15	4087.150	Sc I	AV77
20 h	4132.984	Sc I	AV77
25 h	4140.272	Sc I	AV77
30	4152.341	Sc I	AV77
50 h	4165.187	Sc I	AV77
15	4238.053	Sc I	AV77
500 P	4246.820	Sc II	JL80
150	4314.082	Sc II	JL80
120	4320.745	Sc II	JL80
90	4324.998	Sc II	JL80
70	4374.462	Sc II	JL80
20	4729.209	Sc I	AV77
25	4734.109	Sc I	AV77
30	4737.647	Sc I	AV77
30	4741.024	Sc I	AV77
50	4743.821	Sc I	AV77
10	4779.354	Sc I	AV77
11	5064.306	Sc I	AV77
25	5070.257	Sc I	AV77
11	5075.820	Sc I	AV77
90	5081.561	Sc I	AV77
50	5083.721	Sc I	AV77
50	5085.549	Sc I	AV77
15	5087.123	Sc I	AV77
12	5089.930	Sc I	AV77
15	5096.721	Sc I	AV77
25	5099.274	Sc I	AV77
15	5101.119	Sc I	AV77
14	5116.648	Sc I	AV77
15	5210.547	Sc I	AV77
12	5219.634	Sc I	AV77
12	5258.364	Sc I	AV77
15	5349.342	Sc I	AV77
25	5356.097	Sc I	AV77
12	5375.373	Sc I	AV77
15	5392.058	Sc I	AV77
12	5446.195	Sc I	AV77
30	5482.012	Sc I	AV77
25	5484.628	Sc I	AV77
25	5514.230	Sc I	AV77
30	5520.519	Sc I	AV77
25	5526.785	Sc II	JL80
70	5671.828	Sc I	AV77
50	5686.856	Sc I	AV77
50	5700.186	Sc I	AV77
40	5711.793	Sc I	AV77
10	5717.314	Sc I	AV77
25	6210.66	Sc I	AV77
14	6239.80	Sc I	AV77
11	6258.90	Sc I	AV77
30	6305.65	Sc I	AV77
40	22052.1	Sc I	AV77
40	22065.4	Sc I	AV77

Persistent Lines of Neutral Scandium (Sc I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
200	3269.897	3.13	$3d4s^2$	^{2}D	3/2	0.00	AV77	FW96
			$3d4s(^3D)4p$	$^2P^o$	1/2	30573.17		
250	3273.628	2.81	$3d4s^2$	^{2}D	5/2	168.34	AV77	FW96
			$3d4s(^3D)4p$	$^2P^o$	3/2	30706.66		
900	3907.484	1.66	$3d4s^2$	^{2}D	3/2	0.00	AV77	FW96
			$3d4s(^3D)4p$	$^2F^o$	5/2	25584.64		
1000	3911.812	1.79	$3d4s^2$	^{2}D	5/2	168.34	AV77	FW96
			$3d4s(^3D)4p$	$^2F^o$	7/2	25724.68		
200	3933.375	0.162	$3d4s^2$	^{2}D	5/2	168.34	AV77	FW96
			$3d4s(^3D)4p$	$^2F^o$	5/2	25584.64		
250	3996.601	0.165	$3d4s^2$	^{2}D	3/2	0.00	AV77	FW96
			$3d4s(^3D)4p$	$^2D^o$	5/2	25014.21		
900	4020.387	1.63	$3d4s^2$	^{2}D	3/2	0.00	AV77	FW96
			$3d4s(^3D)4p$	$^2D^o$	3/2	24866.17		
900	4023.678	1.65	$3d4s^2$	^{2}D	5/2	168.34	AV77	FW96
			$3d4s(^3D)4p$	$^2D^o$	5/2	25014.21		
250	4054.544	0.441	$3d4s^2$	^{2}D	3/2	0.00	AV77	M03
			$3d4s(^1D)4p$	$^2P^o$	1/2	24656.72		
250	4082.387	0.410	$3d4s^2$	^{2}D	5/2	168.34	AV77	M03
			$3d4s(^1D)4p$	$^2P^o$	3/2	24656.88		

Energy Levels of Neutral Scandium (Sc I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d4s^2$	^{2}D	3/2	0.00	SC85
		5/2	168.34	SC85
$3d^2(^3F)4s$	^{4}F	3/2	11519.99	SC85
		5/2	11557.69	SC85
		7/2	11610.28	SC85
		9/2	11677.38	SC85
$3d^2(^3F)4s$	^{2}F	5/2	14926.07	SC85
		7/2	15041.92	SC85
$3d4s(^3D)4p$	$^4F^o$	3/2	15672.58	SC85
		5/2	15756.57	SC85
		7/2	15881.75	SC85
		9/2	16026.62	SC85
$3d4s(^3D)4p$	$^4D^o$	1/2	16009.77	SC85
		3/2	16021.82	SC85
		5/2	16141.06	SC85
		7/2	16210.85	SC85
$3d4s(^1D)4p$	$^2D^o$	5/2	16022.73	SC85
		3/2	16096.90	SC85
$3d4s(^3D)4p$	$^4P^o$	1/2	18504.06	SC85
		3/2	18515.69	SC85
		5/2	18571.41	SC85

Energy Levels of Neutral Scandium (Sc I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4s^24p$	$^2P^o$	1/2	18711.02	SC85
		3/2	18855.74	SC85
$3d4s(^1D)4p$	$^2F^o$	5/2	21032.75	SC85
		7/2	21085.85	SC85
$3d4s(^1D)4p$	$^2P^o$	1/2	24656.72	SC85
		3/2	24656.88	SC85
$3d4s(^3D)4p$	$^2D^o$	3/2	24866.17	SC85
		5/2	25014.21	SC85
$3d4s(^3D)4p$	$^2F^o$	5/2	25584.64	SC85
		7/2	25724.68	SC85
$3d^2(^3F)4p$	$^4G^o$	5/2	29022.82	SC85
		7/2	29096.18	SC85
		9/2	29189.84	SC85
		11/2	29303.51	SC85
$3d4s(^3D)4p$	$^2P^o$	1/2	30573.17	SC85
		3/2	30706.66	SC85
Sc II ($^3D_1$)		*Limit*	**52922.0**	SC85

Persistent Lines of Singly-ionized Scandium (Sc II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	3353.724	1.51	$3d4s$	^1D	2	2540.95	JL80	FW96
			$3d4p$	$^1F^o$	3	32349.98		
250	3372.150	0.99	$3d4s$	^5D	3	177.76	JL80	FW96
			$3d4p$	$^3P^o$	2	29823.93		
500	3572.530	1.38	$3d4s$	^3D	3	177.76	JL80	FW96
			$3d4p$	$^3D^o$	3	28161.17		
400	3576.340	1.06	$3d4s$	^3D	2	67.72	JL80	FW96
			$3d4p$	$^3D^o$	2	28021.29		
300	3580.928	1.23	$3d4s$	^3D	1	0.00	JL80	FW96
			$3d4p$	$^3D^o$	1	27917.78		
1000	3613.831	1.48	$3d4s$	^3D	3	177.76	JL80	FW96
			$3d4p$	$^3F^o$	4	27841.35		
700	3630.742	1.20	$3d4s$	^3D	2	67.72	JL80	FW96
			$3d4p$	$^3F^o$	3	27602.45		
500	3642.782	1.13	$3d4s$	^3D	1	0.00	JL80	FW96
			$3d4p$	$^3F^o$	2	27443.71		
500	4246.820	1.29	$3d4s$	^1D	2	2540.95	JL80	FW96
			$3d4p$	$^1D^o$	2	26081.34		

Energy Levels of Singly-ionized Scandium (Sc II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d4s$	^5D	1	0.00	SC85
		2	67.72	SC85
		3	177.76	SC85
$3d4s$	^1D	2	2540.95	SC85
$3d^2$	^3F	2	4802.87	SC85
		3	4883.57	SC85
		4	4987.79	SC85
$3d^2$	^1D	2	10944.56	SC85
$4s^2$	^1S	0	11736.36	SC85
$3d^2$	^3P	0	12074.10	SC85
		1	12101.50	SC85
		2	12154.42	SC85
$3d^2$	^1G	4	14261.32	SC85
$3d^2$	^1S	0	25955.2	SC85
$3d4p$	$^1D^o$	2	26081.34	SC85
$3d4p$	$^3F^o$	2	27443.71	SC85
		3	27602.45	SC85
		4	27841.35	SC85
$3d4p$	$^3D^o$	1	27917.78	SC85
		2	28021.29	SC85
		3	28161.17	SC85
$3d4p$	$^3P^o$	0	29736.27	SC85
		1	29742.16	SC85
		2	29823.93	SC85
$3d4p$	$^1P^o$	1	30815.70	SC85
$3d4p$	$^1F^o$	3	32349.98	SC85
Sc III ($^2D_{3/2}$)		*Limit*	**103237.1**	SC85

Selenium (Se)
Atomic number = 34
Atomic weight = 78.96

Isotope	Mass	Abundance	Spin	Mag moment
^{74}Se	73.922475	0.9%	0	
^{76}Se	75.919212	9.2%	0	
^{77}Se	76.919212	7.6%	1/2	+0.535506
^{78}Se	77.9173	23.7%	0	
^{80}Se	79.916520	49.8%	0	
^{82}Se	81.916698	8.8%	0	

Se I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^4\ ^3P_2$
Ionization energy: 78 658.35 cm^{-1} (9.752 39 eV)

Se II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^3\ ^4S^o_{3/2}$
Ionization energy: 170 900 cm^{-1} (21.19 eV)

Strong Lines of Selenium (Se)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
800	832.62	Se II	G62
800	912.69	Se II	G62
800 P	1013.40	Se II	G62
800	1013.99	Se II	G62
1000 P	1033.56	Se II	G62
1000 P	1049.65	Se II	G62
800	1057.41	Se II	G62
800	1141.97	Se II	G62
1000 P	1192.24	Se II	G62
300	1795.28	Se I	RG34
300	1855.20	Se I	RG34
400	1898.55	Se I	RG34
400	1913.79	Se I	RG34
300	1919.19	Se I	RG34
600 P	1960.894	Se I	LP77
150 P	1995.111	Se I	LP77
	Air		
600 P	2039.842	Se I	LP77
400 P	2062.779	Se I	LP77
600 P	2074.784	Se I	LP77
600 P	2164.188	Se I	LP77
700 P	2413.535	Se I	LP77
300	2547.98	Se I	RG34
800	4175.28	Se II	G62
1000 P	4180.90	Se II	G62
600 P	4730.78	Se I	RG34
400	4739.03	Se I	RG34
300	4742.25	Se I	RG34
800	4844.941	Se II	G62
1000 P	5227.533	Se II	G62
800	5305.347	Se II	G62
1000 P	6055.84	Se II	G62
800	6444.29	Se II	G62
300	7062.065	Se I	E72
300	8000.96	Se I	RG34
300	8918.86	Se I	MV74

Strong Lines of Selenium (Se)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400	10307.45	Se I	MV74
1000 P	10327.26	Se I	MV74
700 P	10386.36	Se I	MV74
400	14817.93	Se I	MV74
500	14917.47	Se I	MV74
600	15151.44	Se I	MV74
400	15471.00	Se I	MV74
400	15618.40	Se I	MV74
400	16659.44	Se I	MV74
600	16813.78	Se I	MV74
800 P	21442.56	Se I	MV74
500	21473.48	Se I	MV74
400	24385.99	Se I	MV74
600	25127.43	Se I	MV74

Persistent Lines of Neutral Selenium (Se I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	1960.894	2.13	$4p^4$	^{3}P	2	0.00	LP77	M00
			$4p^3(^4S^o)5s$	^{3}S^o	1	50997.161		
150	1995.111		$4p^4$	^{1}S	0	22446.202	LP77	
			$4p^3(^2P^o)5s$	^{1}P^o	1	72568.72		
600	2039.842	0.98	$4p^4$	^{3}P	1	1989.497	LP77	M00
			$4p^3(^4S^o)5s$	^{3}S^o	1	50997.161		
400	2062.779	0.33	$4p^4$	^{3}P	0	2534.36	LP77	M00
			$4p^3(^4S^o)5s$	^{3}S^o	1	50997.161		
600	2074.784	0.017	$4p^4$	^{3}P	2	0.00	LP77	M00
			$4p^3(^4S^o)5s$	^{5}S^o	2	48182.420		
600	2164.188	0.0032	$4p^4$	^{3}P	1	1989.497	LP77	M00
			$4p^3(^4S^o)5s$	^{5}S^o	2	48182.420		
700	2413.535		$4p^4$	^{1}D	2	9576.149	LP77	
			$4p^3(^4S^o)5s$	^{3}S^o	1	50997.161		
600	4730.78		$4p^3(^4S^o)5s$	^{5}S^o	2	48182.420	RG34	
			$4p^3(^4S^o)6p$	^{5}P	3	69314.635		
1000	10327.26		$4p^3(^4S^o)5s$	^{3}S^o	1	50997.161	MV74	
			$4p^3(^4S^o)5p$	^{3}P	2	60677.618		
700	10386.36		$4p^3(^4S^o)5s$	^{3}S^o	1	50997.161	MV74	
			$4p^3(^4S^o)5p$	^{3}P	1	60622.532		
800	21442.56		$4p^3(^4S^o)5p$	^{3}P	2	60677.618	MV74	
			$4p^3(^4S^o)4d$	^{3}D^o	3	65339.968		

Energy Levels of Neutral Selenium (Se I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4p^4$	^3P	2	0.00	E72
		1	1989.497	E72
		0	2534.36	E72
$4p^4$	^1D	2	9576.149	E72
$4p^4$	^1S	0	22446.202	E72
$4p^3(^4S^o)5s$	$^5S^o$	2	48182.420	MV74,LP77
$4p^3(^4S^o)5s$	$^3S^o$	1	50997.161	MV74,LP77
$4p^3(^4S^o)5p$	^5P	1	59243.028	MV74,LP77
		2	59288.048	MV74,LP77
		3	59391.536	MV74,LP77
$4p^3(^4S^o)5p$	^3P	1	60622.532	MV74,LP77
		2	60677.618	MV74,LP77
		0	60696.219	MV74,LP77
$4p^3(^2D^o)5s$	$^3D^o$	1	61681.493	MV74,LP77
		2	61828.723	MV74,LP77
		3	62247.832	MV74,LP77
$4p^3(^4S^o)4d$	$^5D^o$	4	63370.165	MV74,LP77
		2	63373.374	MV74,LP77
		0	63381.104	MV74,LP77
		1	63382.996	MV74,LP77
		3	63387.646	MV74,LP77
$4p^3(^2D^o)5s$	$^1D^o$	2	63479.487	MV74,LP77
$4p^3(^4S^o)4d$	$^3D^o$	2	65278.169	MV74,LP77
		1	65299.784	MV74,LP77
		3	65339.968	MV74,LP77
$4p^3(^4S^o)6p$	^5P	1	69263.466	MV74,LP77
		2	69277.846	MV74,LP77
		3	69314.635	MV74,LP77
$4p^3(^2P^o)5s$	$^1P^o$	1	72568.72	LP77
Se II ($^4S^o_{3/2}$)		*Limit*	**78658.35**	MV74,LP77

Persistent Lines of Singly-ionized Selenium (Se II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	1013.40	11.4	$4s^24p^3$	$^4S^o$	3/2	0.0	G62	M00
			$4s^24p^2(^3P)5s$	^4P	5/2	98674.4		
1000	1033.56	10.3	$4s^24p^3$	$^4S^o$	3/2	0.0	G62	M00
			$4s^24p^2(^3P)5s$	^4P	3/2	96753.3		
1000	1049.65	9.96	$4s^24p^3$	$^4S^o$	3/2	0.0	G62	M00
			$4s^24p^2(^3P)5s$	^4P	1/2	95270.0		
1000	1192.24		$4s^24p^3$	$^4S^o$	3/2	0.0	G62	
			$4s4p^4$	^4P	5/2	83876.7		

Persistent Lines of Singly-ionized Selenium (Se II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	4180.90		$4s^24p^2(^3P)5p$	$^4D^o$	7/2	117798.7	G62	
			$4s^24p^2(^3P)5d$	^4F	9/2	141710.1		
1000	5227.533		$4s^24p^2(^3P)5s$	^4P	5/2	98674.4	G62	
			$4s^24p^2(^3P)5p$	$^4D^o$	7/2	117798.7		
1000	6055.84			7	3/2	104873.7	G62	
			$4s^24p^2(^3P)5p$	$^2P^o$	3/2	121381.9		

Energy Levels of Singly-ionized Selenium (Se II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4s^24p^3$	$^4S^o$	3/2	0.0	M35
$4s^24p^3$	$^2D^o$	3/2	13168.2	M35
		5/2	13784.4	M35
$4s^24p^3$	$^2P^o$	1/2	23038.3	M35
		3/2	23894.8	M35
$4s4p^4$	^4P	5/2	83876.7	M35
		3/2	85579.5	M35
		1/2	86437.7	M35
$4s^24p^2(^3P)5s$	^4P	1/2	95270.0	M35
		3/2	96753.3	M35
		5/2	98674.4	M35
	7	3/2	104873.7	M35
$4s^24p^2(^3P)5p$	$^4D^o$	1/2	114299.0	M35
		3/2	114711.7	M35
		5/2	116068.1	M35
		7/2	117798.7	M35
$4s^24p^2(^3P)5p$	^2P	1/2	121273.2	M35
		3/2	121381.9	M35
$4s^24p^2(^3P)5d$	^4F	9/2	141710.1	M35
Se III ($^3P_0$)		*Limit*	**170900**	CR58

Silicon (Si)
Atomic number = 14
Atomic weight = 28.0855

Isotope	Mass	Abundance	Spin	Mag moment
^{28}Si	27.976927	92.23%	0	
^{29}Si	28.976495	4.67%	1/2	−0.5553
^{30}Si	29.973770	3.10%	0	

Si I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^2\ {}^3P_0$
Ionization energy: 65 747.76 cm^{-1} (8.15168 eV)

Si II Ground state: $1s^2 2s^2 2p^6 3s^2 3p\ {}^2P^o_{1/2}$
Ionization energy: 131 838.14 cm^{-1} (16.345 84 eV)

Strong Lines of Silicon (Si)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
70	892.001	Si II	RA65
70	992.684	Si II	RA65
300 P	1190.4160	Si II	KE74
700 P	1193.2898	Si II	KE74
800 P	1194.5004	Si II	KE74
70	1228.746	Si II	S61b
100	1229.388	Si II	S61b
100	1248.426	Si II	S61b
70	1250.433	Si II	S61b
130	1251.164	Si II	S61b
500 P	1260.4223	Si II	KE74
1000 P	1264.7379	Si II	KE74
100	1309.2766	Si II	KE74
70	1350.057	Si II	S61b
150	1526.70698	Si II	GK00
300 P	1533.4318	Si II	KE74
70	1594.5655	Si I	RAKL67
70	1594.9493	Si I	RAKL67
90	1622.8806	Si I	RAKL67
100	1629.441	Si I	KRA66
100	1629.9477	Si I	RAKL67
200	1675.2052	Si I	RAKL67
200	1696.2065	Si I	RAKL67
250	1697.9409	Si I	RAKL67
300	1770.9223	Si I	RAKL67
30	1808.01288	Si II	GK00
250	1814.0794	Si I	RAKL67
40	1816.9290	Si II	KE74
200	1836.5102	Si I	RAKL67
400	1841.4490	Si I	RAKL67
200	1843.7700	Si I	RAKL67
200	1845.5203	Si I	RAKL67
200	1846.1118	Si I	RAKL67
300	1847.4737	Si I	RAKL67
200	1848.1504	Si I	RAKL67
250	1848.7480	Si I	RAKL67
400 P	1850.6719	Si I	RAKL67
250	1852.4717	Si I	RAKL67
200	1874.8423	Si I	RAKL67

Strong Lines of Silicon (Si)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400 P	1901.3377	Si I	RAKL67
400 P	1977.5978	Si I	RAKL67
400 P	1979.2056	Si I	RAKL67
300 P	1980.6185	Si I	RAKL67
300 P	1983.2330	Si I	RAKL67
500 P	1986.3640	Si I	RAKL67
1000 P	1988.9937	Si I	RAKL67
	Air		
600 P	2058.1323	Si I	KRA66
20	2072.016	Si II	S61b
30	2072.701	Si II	S61b
400 P	2207.978	Si I	RA65
500 P	2210.894	Si I	RA65
300 P	2211.744	Si I	RA65
500 P	2216.669	Si I	RA65
400 P	2218.057	Si I	RA65
300	2435.154	Si I	RA65
400 P	2506.897	Si I	RA65
400 P	2514.316	Si I	RA65
500 P	2516.112	Si I	RA65
400 P	2519.202	Si I	RA65
400 P	2524.108	Si I	RA65
400 P	2528.509	Si I	RA65
200	2631.282	Si I	RA65
1000 P	2881.5771	Si I	BE93
50	2904.283	Si II	S61b
80	2905.692	Si II	S61b
150	2987.645	Si I	RA65
15 h	3053.184	Si II	S61b
15	3188.97	Si II	S61b
15	3193.09	Si II	S61b
7	3199.514	Si II	S61b
20 h	3203.872	Si II	S61b
30 h	3210.020	Si II	RA65
20	3333.139	Si II	S61b
30	3339.819	Si II	S61b
100 P,h	3856.017	Si II	S61b
40 h	3862.595	Si II	S61b
200	3905.523	Si I	RA65
50 P,h	4128.067	Si II	S61b
70 P,h	4130.893	Si II	S61b
20	4621.721	Si II	S61b
130 P	5041.026	Si II	S61b
130 P	5055.981	Si II	S61b
25 h	5192.86	Si II	S61b
70 h	5202.41	Si II	S61b
70 h	5466.432	Si II	S61b
70 h	5466.868	Si II	S61b
25 h	5496.45	Si II	S61b
20 h	5576.66	Si II	S61b
25 h	5639.48	Si II	S61b
20 h	5660.66	Si II	S61b
130 P,h	5669.562	Si II	S61b
60	5684.484	Si I	RA65
40 h	5688.81	Si II	S61b
25 h	5701.37	Si II	S61b
80	5708.397	Si I	RA65
25 h	5800.47	Si II	S61b
30	5806.74	Si II	S61b

Strong Lines of Silicon (Si)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50 h	5868.40	Si II	S61b
25	5915.22	Si II	S61b
50 P	5948.545	Si I	RA65
80	5957.561	Si II	S61b
80	5978.929	Si II	S61b
40	6155.134	Si I	RA65
40	6237.320	Si I	RA65
30	6243.813	Si I	RA65
30	6244.468	Si I	RA65
40	6254.188	Si I	RA65
130 P	6347.103	Si II	S61b
100 P	6371.359	Si II	S61b
40	7003.567	Si I	RA65
40	7005.883	Si I	RA65
60	7034.903	Si I	RA65
50	7165.545	Si I	RA65
40	7250.625	Si I	RA65
40	7275.294	Si I	RA65
100 P	7289.1730	Si I	MKMD94
90 P	7405.7740	Si I	MKMD94
50	7409.082	Si I	RA65
60	7415.946	Si I	RA65
100 P	7423.497	Si I	RA65
50	7848.80	Si II	S61b
70	7849.72	Si II	S61b
25	7932.349	Si I	RA65
30	7944.001	Si I	RA65
25	8556.7803	Si I	BE93
20	10585.140	Si I	BE93
20	10603.427	Si I	BE93
20	10660.970	Si I	BE93
20	10827.088	Si I	BE93
20	10869.539	Si I	BE93
50 P	11984.201	Si I	BE93
30	11991.562	Si I	BE93
60 P	12031.503	Si I	BE93
20	12103.535	Si I	BE93
15	12270.692	Si I	BE93
25	15888.431	Si I	BE93

Persistent Lines of Neutral Silicon (Si I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	1850.6719	3.14	$3s^23p^2$	^3P	2	223.157	RAKL67	M03
			$3s^23p3d$	$^3D^o$	3	54257.574		
400	1901.3377		$3s^23p^2$	^1D	2	6298.847	RAKL67	
			$3s^23p4d$	$^1F^o$	3	58893.362		
400	1977.5978	0.279	$3s^23p^2$	^3P	0	0.000	RAKL67	M03
			$3s^23p3d$	$^3P^o$	1	50566.414		
400	1979.2056	0.870	$3s^23p^2$	^3P	1	77.112	RAKL67	M03
			$3s^23p3d$	$^3P^o$	0	50602.435		
300	1980.6185	0.207	$3s^23p^2$	^3P	1	77.112	RAKL67	M03
			$3s^23p3d$	$^3P^o$	1	50566.414		

Persistent Lines of Neutral Silicon (Si I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	1983.2330	0.218	$3s^23p^2$	^{3}P	1	77.112	RAKL67	M03
			$3s^23p3d$	^{3}P^o	2	50499.843		
500	1986.3640	0.365	$3s^23p^2$	^{3}P	2	223.157	RAKL67	M03
			$3s^23p3d$	^{3}P^o	1	50566.414		
1000	1988.9937	0.657	$3s^23p^2$	^{3}P	2	223.157	RAKL67	M03
			$3s^23p3d$	^{3}P^o	2	50499.843		
600	2058.1323		$3s^23p^2$	^{1}D	2	6298.847	KRA66	
			$3s^23p5s$	^{1}P^o	1	54871.027		
400	2207.978	0.262	$3s^23p^2$	^{3}P	0	0.000	RA65	M03
			$3s3p^3$	^{3}D^o	1	45276.187		
500	2210.894	0.345	$3s^23p^2$	^{3}P	1	77.112	RA65	M03
			$3s3p^3$	^{3}D^o	2	45293.623		
300	2211.744	0.181	$3s^23p^2$	^{3}P	1	77.112	RA65	M03
			$3s3p^3$	^{3}D^o	1	45276.187		
500	2216.669	0.454	$3s^23p^2$	^{3}P	2	223.157	RA65	M03
			$3s3p^3$	^{3}D^o	3	45321.848		
400	2218.057	0.109	$3s^23p^2$	^{3}P	2	223.157	RA65	M03
			$3s3p^3$	^{3}D^o	2	45293.623		
400	2506.897	0.547	$3s^23p^2$	^{3}P	1	77.112	RA65	M03
			$3s^23p4s$	^{3}P^o	2	39955.051		
400	2514.316	0.740	$3s^23p^2$	^{3}P	0	0.000	RA65	M03
			$3s^23p4s$	^{3}P^o	1	39760.285		
500	2516.112	1.68	$3s^23p^2$	^{3}P	2	223.157	RA65	M03
			$3s^23p4s$	^{3}P^o	2	39955.051		
400	2519.202	0.549	$3s^23p^2$	^{3}P	1	77.112	RA65	M03
			$3s^23p4s$	^{3}P^o	1	39760.285		
400	2524.108	2.22	$3s^23p^2$	^{3}P	1	77.112	RA65	M03
			$3s^23p4s$	^{3}P^o	0	39683.158		
400	2528.509	0.904	$3s^23p^2$	^{3}P	2	223.157	RA65	M03
			$3s^23p4s$	^{3}P^o	1	39760.285		
1000	2881.5771	1.89	$3s^23p^2$	^{1}D	2	6298.847	BE93	FW96
			$3s^23p4s$	^{1}P^o	1	40991.888		
50	5948.545	0.022	$3s^23p4s$	^{1}P^o	1	40991.888	RA65	FW96
			$3s^23p5p$	^{1}D	2	57798.080		
100	7289.173		$3s3p^3$	^{3}D^o	3	45321.848	RA65	
			$3s^23p(^2P^o_{3/2})4f$	^{2}[7/2]	4	59037.043		
80	7405.774	0.037	$3s3p^3$	^{3}D^o	1	45276.187	RA65	FW96
			$3s^23p(^2P^o_{1/2})4f$	^{2}[5/2]	2	58775.442		
100	7423.497		$3s3p^3$	^{3}D^o	3	45321.848	RA65	
			$3s^23p(^2P^o_{1/2})4f$	^{2}[7/2]	4	58788.878		

Persistent Lines of Neutral Silicon (Si I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
50	11984.201		$3s^23p4s$	$^3P^o$	1	39760.285	BE93	
			$3s^23p4p$	^3D	2	48102.321		
60	12031.503		$3s^23p4s$	$^3P^o$	2	39955.051	BE93	
			$3s^23p4p$	^3D	3	48264.290		

Energy Levels of Neutral Silicon (Si I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^23p^2$	^3P	0	0.000	MKMD94
		1	77.112	MKMD94
		2	223.157	MKMD94
$3s^23p^2$	^1D	2	6298.847	MKMD94
$3s^23p^2$	^1S	0	15394.362	MKMD94
$3s3p^3$	$^5S^o$	2	33326.040	MKMD94
$3s^23p4s$	$^3P^o$	0	39683.158	MKMD94
		1	39760.285	MKMD94
		2	39955.051	MKMD94
$3s^23p4s$	$^1P^o$	1	40991.888	MKMD94
$3s3p^3$	$^3D^o$	1	45276.187	MKMD94
		2	45293.623	MKMD94
		3	45321.848	MKMD94
$3s^23p4p$	^1P	1	47284.057	MKMD94
$3s^23p3d$	$^1D^o$	2	47351.553	MKMD94
$3s^23p4p$	^3D	1	48020.074	MKMD94
		2	48102.321	MKMD94
		3	48264.290	MKMD94
$3s^23p4p$	^3P	0	49028.291	MKMD94
		1	49060.599	MKMD94
		2	49188.615	MKMD94
$3s^23p4p$	^3S	1	49399.669	MKMD94
$3s^23p3d$	$^3F^o$	2	49850.832	MKMD94
		3	49933.783	MKMD94
		4	50054.811	MKMD94
$3s^23p4p$	^1D	2	50189.391	MKMD94
$3s^23p3d$	$^3P^o$	2	50499.843	MKMD94
		1	50566.414	MKMD94
		0	50602.435	MKMD94
$3s^23p4p$	^1S	0	51612.009	MKMD94
$3s^23p3d$	$^1F^o$	3	53362.258	MKMD94
$3s^23p3d$	$^1P^o$	1	53387.342	MKMD94
$3s^23p3d$	$^3D^o$	1	54185.257	MKMD94
		2	54205.083	MKMD94
		3	54257.574	MKMD94

Energy Levels of Neutral Silicon (Si I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^23p5s$	$^3P^o$	0	54245.021	MKMD94
		1	54313.817	MKMD94
		2	54528.218	MKMD94
$3s^23p5s$	$^1P^o$	1	54871.027	MKMD94
$3s^23p4d$	$^1D^o$	2	56503.348	MKMD94
$3s^23p4d$	$^3P^o$	2	56690.902	MKMD94
		1	56700.225	MKMD94
		0	56733.370	MKMD94
$3s^23p5p$	^1P	1	56780.429	MKMD94
$3s^23p5p$	^3D	1	56978.251	MKMD94
		2	57017.502	MKMD94
		3	57198.013	MKMD94
$3s^23p5p$	^3P	0	57295.880	MKMD94
		1	57328.785	MKMD94
		2	57468.244	MKMD94
$3s^23p4d$	$^3F^o$	2	57372.302	MKMD94
		3	57450.583	MKMD94
		4	57583.657	MKMD94
$3s^23p5p$	^3S	1	57541.915	MKMD94
$3s^23p5p$	^1D	2	57798.080	MKMD94
$3s^23p5p$	^1S	0	58311.667	MKMD94
$3s^23p(^2P^o_{1/2})4f$	$^2[5/2]$	3	58774.365	MKMD94
		2	58775.442	MKMD94
$3s^23p(^2P^o_{1/2})4f$	$^2[7/2]$	3	58786.852	MKMD94
		4	58788.878	MKMD94
$3s^23p4d$	$^1P^o$	1	58801.525	MKMD94
$3s^23p4d$	$^1F^o$	3	58893.362	MKMD94
$3s^23p4d$	$^3D^o$	2	59032.174	MKMD94
		1	59056.494	MKMD94
		3	59117.991	MKMD94
$3s^23p(^2P^o_{3/2})4f$	$^2[7/2]$	3	59034.988	MKMD94
		4	59037.043	MKMD94
$3s^23p(^2P^o_{3/2})4f$	$^2[5/2]$	3	59109.956	MKMD94
		2	59110.890	MKMD94
$3s^23p(^2P^o_{3/2})4f$	$^2[9/2]$	5	59128.407	MKMD94
		4	59131.908	MKMD94
$3s^23p(^2P^o_{3/2})4f$	$^2[3/2]$	1	59190.444	MKMD94
		2	59191.066	MKMD94
Si II ($^2P^o_{1/2}$)		*Limit*	**65747.76**	MKMD94

Persistent Lines of Singly-ionized Silicon (Si II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	1190.4160	6.86	$3s^2(^1S)3p$	$^2P^o$	1/2	0.00	KE74	M03
			$3s3p^2$	^2P	3/2	84004.26		
700	1193.2898	27.3	$3s^2(^1S)3p$	$^2P^o$	1/2	0.00	KE74	M03
			$3s3p^2$	^2P	1/2	83801.95		
800	1194.5004	34.0	$3s^2(^1S)3p$	$^2P^o$	3/2	287.24	KE74	M03
			$3s3p^2$	^2P	3/2	84004.26		
500	1260.4223	24.7	$3s^2(^1S)3p$	$^2P^o$	1/2	0.00	KE74	M03
			$3s^2(^1S)3d$	$^2D^o$	3/2	79338.50		
1000	1264.7379	29.3	$3s^2(^1S)3p$	$^2P^o$	3/2	287.24	KE74	M03
			$3s^2(^1S)3d$	^2D	5/2	79355.02		
300	1533.4318	7.50	$3s^2(^1S)3p$	$^2P^o$	3/2	287.24	KE74	M03
			$3s^2(^1S)4s$	^2S	1/2	65500.47		
100	3856.017		$3s3p^2$	^2D	5/2	55325.18	S61b	
			$3s^2(^1S)4p$	$^2P^o$	3/2	81251.32		
50	4128.067		$3s^2(^1S)3d$	^2D	3/2	79338.50	S61b	
			$3s^2(^1S)4f$	$^2F^o$	5/2	103556.16		
70	4130.893		$3s^2(^1S)3d$	^2D	5/2	79355.02	S61b	
			$3s^2(^1S)4f$	$^2F^o$	7/2	103556.03		
130	5041.026	0.98	$3s^2(^1S)4p$	$^2P^o$	1/2	81191.34	S61b	FW96
			$3s^2(^1S)4d$	^2D	3/2	101023.05		
130	5055.981	1.26	$3s^2(^1S)4p$	$^2P^o$	3/2	81251.32	S61b	BBC95
			$3s^2(^1S)4d$	^2D	5/2	101024.35		
130	5669.562	0.50	$3s3p(^3P^o)3d$	$^4F^o$	9/2	114529.14	S61b	BBC95
			$3s3p(^3P^o)4p$	^4D	7/2	132162.29		
130	6347.103	0.66	$3s^2(^1S)4s$	^2S	1/2	65500.47	S61b	BBC95
			$3s^2(^1S)4p$	$^2P^o$	3/2	81251.32		
100	6371.359	0.77	$3s^2(^1S)4s$	^2S	1/2	65500.47	S61b	BBC95
			$3s^2(^1S)4p$	$^2P^o$	1/2	81191.34		

Energy Levels of Singly-ionized Silicon (Si II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^2(^1S)3p$	$^2P^o$	1/2	0.00	MZ83
		3/2	287.24	MZ83
$3s3p^2$	^4P	1/2	42824.29	MZ83
		3/2	42932.62	MZ83
		5/2	43107.91	MZ83
$3s3p^2$	^2D	3/2	55309.35	MZ83
		5/2	55325.18	MZ83
$3s^2(^1S)4s$	^2S	1/2	65500.47	MZ83
$3s3p^2$	^2S	1/2	76665.35	MZ83
$3s^2(^1S)3d$	^2D	3/2	79338.50	MZ83
		5/2	79355.02	MZ83

Energy Levels of Singly-ionized Silicon (Si II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^2(^1S)4p$	$^2P^o$	1/2	81191.34	MZ83
		3/2	81251.32	MZ83
$3s3p^2$	^2P	1/2	83801.95	MZ83
		3/2	84004.26	MZ83
$3s^2(^1S)5s$	^2S	1/2	97972.09	MZ83
$3s^2(^1S)4d$	^2D	3/2	101023.05	MZ83
		5/2	101024.35	MZ83
$3s^2(^1S)4f$	$^2F^o$	7/2	103556.03	MZ83
		5/2	103556.16	MZ83
$3s^2(^1S)5p$	$^2P^o$	1/2	103860.74	MZ83
		3/2	103885.25	MZ83
$3s3p(^3P^o)3d$	$^2D^o$	3/2	108778.7	MZ83
		5/2	108820.6	MZ83
$3s^2(^1S)5d$	^2D	3/2	112394.56	MZ83
		5/2	112394.72	MZ83
$3s^2(^1S)5f$	$^2F^o$	7/2	113760.15	MZ83
		5/2	113760.32	MZ83
$3s^2(^1S)5g$	^2G	7/2,9/2	114177.1	MZ83
$3s3p(^3P^o)3d$	$^4F^o$	3/2	114265.64	MZ83
		5/2	114327.15	MZ83
		7/2	114414.58	MZ83
		9/2	114529.14	MZ83
$3s3p(^3P^o)4s$	$^4P^o$	1/2	116862.38	MZ83
		3/2	116978.38	MZ83
		5/2	117178.06	MZ83
$3s3p(^3P^o)4s$	$^2P^o$	1/2	121444.12	MZ83
		3/2	121590.19	MZ83
$3p^3$	$^4S^o$	3/2	123033.5	MZ83
$3s3p(^3P^o)3d$	$^4D^o$	5/2	124316.9	MZ83
		3/2	124325.3	MZ83
		1/2	124337.3	MZ83
		7/2	124449.5	MZ83
$3s3p(^3P^o)3d$	$^4P^o$	5/2	124567.4	MZ83
		3/2	124615.6	MZ83
		1/2	124638.9	MZ83
$3s3p(^3P^o)3d$	$^2P^o$	3/2	126236.4	MZ83
		1/2	126279.0	MZ83
$3s3p(^3P^o)3d$	$^2F^o$	5/2	131677.1	MZ83
		7/2	131918.8	MZ83
$3s3p(^3P^o)4p$	^4D	1/2	131784.9	MZ83
		3/2	131861.93	MZ83
		5/2	131988.05	MZ83
		7/2	132162.29	MZ83
Si III ($^1S_0$)		*Limit*	**131838.14**	MZ83

Silver (Ag)
Atomic number = 47
Atomic weight = 107.8682

Isotope	Mass	Abundance	Spin	Mag moment
^{107}Ag	106.905092	51.84%	1/2	−0.1135
^{109}Ag	108.904757	48.16%	1/2	−0.1305

Ag I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s\ ^2S_{1/2}$
Ionization energy: 61 106.45 cm^{-1} (7.576 23 eV)

Ag II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10}\ ^1S_0$
Ionization energy: 173 227.4 cm^{-1} (21.477 46 eV)

Strong Lines of Silver (Ag)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
1000 P	1106.9931	Ag II	KLLT02
600 P	1112.4006	Ag II	KLLT02
700 P	1195.8092	Ag II	KLLT02
9 r	1515.63	Ag I	S40
300	1644.4958	Ag II	KLLT02
400	1665.3513	Ag II	KLLT02
5	1651.52	Ag I	S40
300	1682.8353	Ag II	KLLT02
300	1723.6119	Ag II	KLLT02
300	1994.3173	Ag II	KLLT02
	Air		
20	2061.162	Ag I	PZ01
9	2069.844	Ag I	PZ01
300 P,r	2113.8250	Ag II	KLLT02
300	2243.4485	Ag II	KLLT02
700 P,r	2246.4120	Ag II	KLLT02
300 P,r	2248.7490	Ag II	KLLT02
300 P	2279.9812	Ag II	KLLT02
200	2317.0342	Ag II	KLLT02
400 P,r	2320.2451	Ag II	KLLT02
300 P,r	2324.6670	Ag II	KLLT02
500 P,r	2331.3665	Ag II	KLLT02
1000 P,r	2413.1883	Ag II	KLLT02
1000 P,r	2437.7832	Ag II	KLLT02
200	2477.1279	Ag II	KLLT02
200	2711.8732	Ag II	KLLT02
5	2721.77	Ag I	S40
9 h	2824.39	Ag I	S40
60	2934.0209	Ag II	KLLT02
1000 P,r	3280.680	Ag I	PZ01
500 P,r	3382.887	Ag I	PZ01
20	3810.941	Ag I	PZ01
9 h	3840.750	Ag I	PZ01
9 h	3981.580	Ag I	PZ01
9 h	4055.476	Ag I	PZ01
8 h	4210.960	Ag I	PZ01
9	4212.814	Ag I	PZ01
50	4620.0361	Ag II	KLLT02
5 h	4668.477	Ag I	PZ01
100	4788.3968	Ag II	KLLT02

Strong Lines of Silver (Ag)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
9	4874.10	Ag I	S40
50	5027.3433	Ag II	KLLT02
90 P	5209.078	Ag I	PZ01
90 P	5465.497	Ag I	PZ01
9	5471.555	Ag I	PZ01
9	5667.34	Ag I	S40
30 P	7687.772	Ag I	PZ01
50 P	8273.509	Ag I	PZ01
5	16819.5	Ag I	S40

Persistent Lines of Neutral Silver (Ag I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	3280.680	1.47	$4d^{10}(^1S)5s$	^2S	1/2	0.000	PZ01	M00
			$4d^{10}(^1S)5p$	$^2P^o$	3/2	30472.703		
500	3382.887	1.35	$4d^{10}(^1S)5s$	^2S	1/2	0.000	PZ01	M00
			$4d^{10}(^1S)5p$	$^2P^o$	1/2	29552.061		
90	5209.078	0.75	$4d^{10}(^1S)5p$	$^2P^o$	1/2	29552.061	PZ01	FW96
			$4d^{10}(^1S)5d$	^2D	3/2	48743.969		
90	5465.497	0.86	$4d^{10}(^1S)5p$	$^2P^o$	3/2	30472.703	PZ01	FW96
			$4d^{10}(^1S)5d$	^2D	5/2	48764.219		
30	7687.772		$4d^{10}(^1S)5p$	$^2P^o$	1/2	29552.061	PZ01	
			$4d^{10}(^1S)6s$	^2S	1/2	42556.152		
50	8273.509		$4d^{10}(^1S)5p$	$^2P^o$	3/2	30472.703	PZ01	
			$4d^{10}(^1S)6s$	^2S	1/2	42556.152		

Energy Levels of Neutral Silver (Ag I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^{10}(^1S)5s$	^2S	1/2	0.000	PZ01
$4d^{10}(^1S)5p$	$^2P^o$	1/2	29552.061	PZ01
		3/2	30472.703	PZ01
$4d^9 5s^2$	^2D	5/2	30242.291	PZ01
		3/2	34714.305	PZ01
$4d^{10}(^1S)6s$	^2S	1/2	42556.152	PZ01
$4d^{10}(^1S)6p$	$^2P^o$	1/2	48297.402	PZ01
		3/2	48500.805	PZ01
$4d^{10}(^1S)5d$	^2D	3/2	48743.969	PZ01
		5/2	48764.219	PZ01
$4d^{10}(^1S)7s$	^2S	1/2	51886.971	PZ01
$4d^{10}(^1S)7p$	$^2P^o$	1/2	54040.99	M58
		3/2	54121.129	PZ01
$4d^{10}(^1S)6d$	^2D	3/2	54203.119	PZ01
		5/2	54213.570	PZ01
$4d^{10}(^1S)4f$	$^2F^o$	5/2,3/2	54204.73	M58
Ag II ($^1S_0$)		*Limit*	**61106.45**	LBS99

Persistent Lines of Singly-ionized Silver (Ag II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1106.9931	6.93	$4d^{10}$	^1S	0	0.000	KLLT02	BPKR97
			$4d^9(^2D)5p$	$^3D^o$	1	90334.836		
600	1112.4006	7.71	$4d^{10}$	^1S	0	0.000	KLLT02	BPKR97
			$4d^9(^2D)5p$	$^1P^o$	1	89895.502		
700	1195.8092	0.57	$4d^{10}$	^1S	0	0.000	KLLT02	BPKR97
			$4d^9(^2D)5p$	$^3P^o$	1	83625.479		
300	2113.8250	3.26	$4d^9(^2D)5s$	^3D	3	39168.032	KLLT02	BPKR97
			$4d^9(^2D)5p$	$^3D^o$	3	86460.650		
700	2246.4120	3.91	$4d^9(^2D)5s$	^3D	3	39167.986	KLLT02	BPKR97
			$4d^9(^2D)5p$	$^3F^o$	4	83669.614		
300	2248.7490	2.95	$4d^9(^2D)5s$	^3D	2	40745.335	KLLT02	BPKR97
			$4d^9(^2D)5p$	$^3F^o$	2	85200.721		
300	2279.9812	1.39	$4d^9(^2D)5s$	^1D	2	46049.029	KLLT02	BPKR97
			$4d^9(^2D)5p$	$^1P^o$	1	89895.502		
400	2320.2451	2.74	$4d^9(^2D)5s$	^1D	2	46049.029	KLLT02	BPKR97
			$4d^9(^2D)5p$	$^1F^o$	3	89134.688		
300	2324.6670	0.72	$4d^9(^2D)5s$	^3D	3	39167.986	KLLT02	BPKR97
			$4d^9(^2D)5p$	$^3F^o$	3	82171.697		
500	2331.3665	2.54	$4d^9(^2D)5s$	^3D	2	40745.335	KLLT02	BPKR97
			$4d^9(^2D)5p$	$^3P^o$	1	83625.479		
1000	2413.1883	2.21	$4d^9(^2D)5s$	^3D	2	40745.335	KLLT02	BPKR97
			$4d^9(^2D)5p$	$^3F^o$	3	82171.697		
1000	2437.7832	2.88	$4d^9(^2D)5s$	^3D	3	39167.986	KLLT02	BPKR97
			$4d^9(^2D)5p$	$^3P^o$	2	80176.425		

Energy Levels of Singly-ionized Silver (Ag II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^{10}$	^1S	0	0.000	KLLT02
$4d^9(^2D)5s$	^3D	3	39167.986	KLLT02
		2	40745.335	KLLT02
		1	43742.702	KLLT02
$4d^9(^2D)5s$	^1D	2	46049.029	KLLT02
$4d^9(^2D)5p$	$^3P^o$	2	80176.425	KLLT02
		1	83625.479	KLLT02
		0	86140.050	KLLT02
$4d^9(^2D)5p$	$^3F^o$	3	82171.697	KLLT02
		4	83669.614	KLLT02
		2	85200.721	KLLT02
$4d^9(^2D)5p$	$^3D^o$	3	86460.616	KLLT02
		1	90334.836	KLLT02
		2	90887.806	KLLT02
$4d^9(^2D)5p$	$^1D^o$	2	86888.063	KLLT02

Energy Levels of Singly-ionized Silver (Ag II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^9(^2D)5p$	$^1F^o$	3	89134.688	KLLT02
$4d^9(^2D)5p$	$^1P^o$	1	89895.502	KLLT02
Ag III ($^2D_{5/2}$)		*Limit*	**173227.4**	BJK75

Sodium (Na)
Atomic number = 11
Atomic weight = 22.989 768

Isotope	Mass	Abundance	Spin	Mag moment
^{23}Na	22.989767	100%	3/2	2.21752

Na I Ground state: $1s^22s^22p^63s\ ^2S_{1/2}$
Ionization energy: 41 449.451 cm^{-1} (5.139 076 eV)

Na II Ground state: $1s^22s^22p^6\ ^1S_0$
Ionization energy: 381 390.2 cm^{-1} (47.2864 eV)

Strong Lines of Sodium (Na)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
90 P	300.15	Na II	W71
90	300.20	Na II	W71
50	301.32	Na II	W71
60	301.44	Na II	W71
30	302.45	Na II	W71
150 P	372.08	Na II	W71
200	376.38	Na II	W71
50	1374.69	Na II	W71
50	1404.68	Na II	W71
40	1506.41	Na II	W71
50	1776.57	Na II	W71
40	1787.19	Na II	W71
40	1798.41	Na II	W71
50	1807.09	Na II	W71
40	1835.22	Na II	W71
40	1853.17	Na II	W71
90	1881.91	Na II	W71
	Air		
150	2315.65	Na II	W71
150	2420.99	Na II	W71
150	2424.73	Na II	W71
600	2493.15	Na II	W71
300	2515.46	Na II	W71
300	2531.54	Na II	W71
300	2586.31	Na II	W71
300	2594.96	Na II	W71
500	2611.81	Na II	W71
500	2661.00	Na II	W71
600	2671.83	Na II	W71
500	2678.09	Na II	W71
2	2680.34	Na I	R56
1	2680.43	Na I	R56
500	2809.52	Na II	W71
400	2839.56	Na II	W71
600	2841.72	Na II	W71
5 P	2852.81	Na I	R56
2 P	2853.01	Na I	R56
400	2859.49	Na II	W71
400	2871.28	Na II	W71
500	2881.15	Na II	W71
500	2886.26	Na II	W71

Strong Lines of Sodium (Na)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500	2901.14	Na II	W71
400	2904.72	Na II	W71
600	2904.92	Na II	W71
600	2917.52	Na II	W71
600	2919.05	Na II	W71
700	2919.85	Na II	W71
700	2920.95	Na II	W71
600	2923.49	Na II	W71
500	2937.74	Na II	W71
500	2947.50	Na II	W71
700	2951.24	Na II	W71
600	2952.40	Na II	W71
600	2977.13	Na II	W71
600	2979.66	Na II	W71
600	2980.63	Na II	W71
700	2984.19	Na II	W71
300	3004.15	Na II	W71
400	3007.44	Na II	W71
400	3009.14	Na II	W71
300	3015.40	Na II	W71
500	3053.67	Na II	W71
600	3056.16	Na II	W71
400	3060.25	Na II	W71
400	3061.35	Na II	W71
600 P	3092.73	Na II	W71
400	3094.45	Na II	W71
400	3095.55	Na II	W71
900	3124.42	Na II	W71
1000	3135.48	Na II	W71
900	3137.86	Na II	W71
500	3145.71	Na II	W71
1000	3149.28	Na II	W71
1000	3163.74	Na II	W71
600	3179.06	Na II	W71
900	3189.79	Na II	W71
900	3212.19	Na II	W71
800	3257.96	Na II	W71
500	3274.22	Na II	W71
1000 P	3285.60	Na II	W71
900	3301.35	Na II	W71
15 P	3302.37	Na I	R56
8 P	3302.98	Na I	R56
800	3304.96	Na II	W71
600	3318.04	Na II	W71
500	3327.69	Na II	W71
1	3426.86	Na I	R56
800	3533.05	Na II	W71
700	3631.27	Na II	W71
500	3711.07	Na II	W71
150	4113.70	Na II	W71
1	4324.62	Na I	R56
1	4390.03	Na I	R56
600	4392.81	Na II	W71
1	4393.34	Na I	R56
400	4405.12	Na II	W71
500	4455.23	Na II	W71
400	4490.87	Na II	W71
1	4494.18	Na I	R56
1	4497.66	Na I	R56

Strong Lines of Sodium (Na)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
2	4664.811	Na I	R56
2	4668.560	Na I	R56
2	4978.541	Na I	R56
5	4982.813	Na I	R56
1	5148.838	Na I	R56
1	5153.402	Na I	R56
50	5414.55	Na II	W71
4	5682.633	Na I	R56
1	5688.193	Na I	R56
7	5688.205	Na I	R56
1000 P	5889.950	Na I	R56
500 P	5895.924	Na I	R56
2	6154.225	Na I	R56
3	6160.747	Na I	R56
50	6514.21	Na II	W71
70	6530.70	Na II	W71
70	6544.04	Na II	W71
70	6545.75	Na II	W71
1	7809.78	Na I	R56
60 P	8183.256	Na I	R56
10 P	8194.790	Na I	R56
110 P	8194.824	Na I	R56
1	8649.92	Na I	R56
1	8650.89	Na I	R56
1	9153.88	Na I	R56
1	9465.94	Na I	R56
1	9961.28	Na I	R56
1	10572.28	Na I	R56
2	10746.44	Na I	R56
1	10749.29	Na I	R56
2	10834.87	Na I	R56
1	11197.21	Na I	R56
5 P	11381.45	Na I	R56
12 P	11403.78	Na I	R56
5	12679.17	Na I	R56
1	14767.48	Na I	R56
1	14779.73	Na I	R56
1	16373.85	Na I	R56
1	16388.85	Na I	R56
5 P	18465.25	Na I	R56
1	22056.44	Na I	R56
1	23348.41	Na I	R56
1	23379.13	Na I	R56

Persistent Lines of Neutral Sodium (Na I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
5	2852.81	0.00554	3s	^{2}S	1/2	0.000	R56	M03
			5p	^{2}P^o	3/2	35042.85		
2	2853.01	0.00554	3s	^{2}S	1/2	0.000	R56	M03
			5p	^{2}P^o	1/2	35040.38		
15	3302.37	0.0281	3s	^{2}S	1/2	0.000	R56	M03
			4p	^{2}P^o	3/2	30272.58		
8	3302.98	0.0281	3s	^{2}S	1/2	0.000	R56	M03
			4p	^{2}P^o	1/2	30266.99		
1000	5889.950	0.616	3s	^{2}S	1/2	0.000	R56	M03
			3p	^{2}P^o	3/2	16973.368		
500	5895.924	0.614	3s	^{2}S	1/2	0.000	R56	M03
			3p	^{2}P^o	1/2	16956.172		
60	8183.256	0.453	3p	^{2}P^o	1/2	16956.172	R56	FW96
			3d	^{2}D	3/2	29172.889		
10	8194.790	0.090	3p	^{2}P^o	3/2	16973.368	R56	FW96
			3d	^{2}D	3/2	29172.889		
110	8194.824	0.54	3p	^{2}P^o	3/2	16973.368	R56	FW96
			3d	^{2}D	5/2	29172.839		
5	11381.45	0.090	3p	^{2}P^o	1/2	16956.172	R56	FW96
			4s	^{2}S	1/2	25739.991		
12	11403.78	0.176	3p	^{2}P^o	3/2	16973.368	R56	FW96
			4s	^{2}S	1/2	25739.991		
5	18465.25	0.140	3d	^{2}D	5/2	29172.839	R56	WSM69
			4f	^{2}F^o	7/2	34586.92		
		0.00933	3d	^{2}D	5/2	29172.839		WSM69
			4f	^{2}F^o	5/2	34586.92		

Energy Levels of Neutral Sodium (Na I)

Configuration	Term	J	Level (cm^{-1})	Ref
3s	^{2}S	1/2	0.000	MZ81
3p	^{2}P^o	1/2	16956.172	MZ81
		3/2	16973.368	MZ81
4s	^{2}S	1/2	25739.991	MZ81
3d	^{2}D	5/2	29172.839	MZ81
		3/2	29172.889	MZ81
4p	^{2}P^o	1/2	30266.99	MZ81
		3/2	30272.58	MZ81
4f	^{2}F^o	5/2,7/2	34586.92	MZ81
5p	^{2}P^o	1/2	35040.38	MZ81
		3/2	35042.85	MZ81
Na II 2s^2 2p^6 ($^1S_0$)		*Limit*	**41449.451**	BBLB98

Persistent Lines of Singly-ionized Sodium (Na II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
90	300.15	30.	$2p^6$	^1S	0	0.00	W71	FW96
			$2p^5(^2P^o_{1/2})4s$	$^2[1/2]^o$	1	333162.94		
150	372.08	34.	$2p^6$	^1S	0	0.00	W71	FW96
			$2p^53s$	$^1P^o$	1	268762.96		
600	3092.73		$2p^53s$	$^3P^o$	2	264924.32	W71	
			$2p^53p$	^3D	3	297248.82		
1000	3285.60		$2p^53s$	$^1P^o$	1	268762.96	W71	
			$2p^53p$	^1D	2	299189.96		

Energy Levels of Singly-ionized Sodium (Na II)

Configuration	Term	J	Level (cm^{-1})	Ref
$2p^6$	^1S	0	0.00	MZ81
$2p^53s$	$^3P^o$	2	264924.32	MZ81
		1	265689.62	MZ81
		0	266281.62	MZ81
$2p^53s$	$^1P^o$	1	268762.96	MZ81
$2p^53p$	^3S	1	293220.33	MZ81
$2p^53p$	^3D	3	297248.82	MZ81
		2	297635.61	MZ81
		1	298165.44	MZ81
$2p^53p$	^1D	2	299189.96	MZ81
$2p^5(^2P^o_{1/2})4s$	$^2[1/2]^o$	1	333162.94	MZ81
Na III ($^2P^o_{3/2}$)		*Limit*	**381390.2**	MZ81

Strontium (Sr)
Atomic number = 38
Atomic weight = 87.62

Isotope	Mass	Abundance	Spin	Mag moment
^{84}Sr	83.913430	0.56%	0	
^{86}Sr	85.909267	9.86%	0	
^{87}Sr	86.908884	7.00%	9/2	−1.093
^{88}Sr	87.905619	82.58%	0	

Sr I Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^65s^2\ {}^1S_0$
Ionization energy: 45 932.09 cm^{-1} (5.694 85 eV)

Sr II Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^65s\ {}^2S_{1/2}$
Ionization energy: 88 964.0 cm^{-1} (11.0301 eV)

Strong Lines of Strontium (Sr)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
30 P	2152.84	Sr II	MCS75
30 P	2165.96	Sr II	MCS75
14 P	3380.71	Sr II	MCS75
20 P	3464.46	Sr II	MCS75
20	4030.38	Sr I	MCS75
1000 P	4077.71	Sr II	MCS75
4	4161.80	Sr II	MCS75
700 P	4215.52	Sr II	MCS75
7 P	4305.45	Sr II	MCS75
1000 P	4607.33	Sr I	MCS75
50	4722.28	Sr I	MCS75
30	4741.92	Sr I	MCS75
20	4784.32	Sr I	MCS75
70 P	4811.88	Sr I	MCS75
60	4832.08	Sr I	MCS75
50 P	4872.49	Sr I	MCS75
30	4876.32	Sr I	MCS75
120 P	4962.26	Sr I	MCS75
20 P	4967.94	Sr I	MCS75
20	5222.20	Sr I	MCS75
30	5225.11	Sr I	MCS75
30	5229.27	Sr I	MCS75
40	5238.55	Sr I	MCS75
70 P	5256.90	Sr I	MCS75
25	5450.84	Sr I	MCS75
110 P	5480.84	Sr I	MCS75
50	5504.17	Sr I	MCS75
40	5521.83	Sr I	MCS75
30	5534.81	Sr I	MCS75
30	5540.05	Sr I	MCS75
140 P	6408.47	Sr I	MCS75
80 P	6504.00	Sr I	MCS75
25	6550.26	Sr I	MCS75
50	6617.26	Sr I	MCS75
30 P	6791.05	Sr I	MCS75
70 P	6878.38	Sr I	MCS75
20 P	6892.59	Sr I	MCS75
80 P	7070.10	Sr I	MCS75

Strong Lines of Strontium (Sr)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	7309.41	Sr I	MCS75
4	8688.91	Sr II	NOL73
7	10036.66	Sr II	S38a
20 P	10327.31	Sr II	S38a
4	10914.88	Sr II	S38a

Persistent Lines of Neutral Strontium (Sr I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	4607.33	2.01	$5s^2$	^1S	0	0.000	MCS75	FW96
			$5s5p$	$^1P^o$	1	21698.482		
70	4811.88		$5s5p$	$^3P^o$	2	14898.563	MCS75	
			$5p^2$	^3P	2	35674.668		
50	4872.49		$5s5p$	$^3P^o$	1	14504.351	MCS75	
			$5s5d$	^3D	2	35022.015		
120	4962.26		$5s5p$	$^3P^o$	2	14898.563	MCS75	
			$5s5d$	^3D	3	35045.055		
20	4967.94		$5s5p$	$^3P^o$	2	14898.563	MCS75	
			$5s5d$	^3D	2	35022.015		
70	5256.90		$5s4d$	^3D	3	18319.267	MCS75	
			$4d5p$	$^3P^o$	2	37336.616		
110	5480.84		$5s4d$	^3D	3	18319.267	MCS75	
			$4d5p$	$^3D^o$	3	36559.514		
140	6408.47		$5s4d$	^3D	3	18319.267	MCS75	
			$4d5p$	$^3F^o$	4	33919.330		
80	6504.00		$5s4d$	^3D	2	18218.795	MCS75	
			$4d5p$	$^3F^o$	3	33589.724		
30	6791.05		$5s5p$	$^3P^o$	0	14317.520	MCS75	
			$5s6s$	^3S	1	29038.795		
70	6878.38		$5s5p$	$^3P^o$	1	14504.351	MCS75	
			$5s6s$	^3S	1	29038.795		
20	6892.59	0.00048	$5s^2$	^1S	0	0.000	MCS75	M00
			$5s5p$	$^3P^o$	1	14504.351		
80	7070.10		$5s5p$	$^3P^o$	2	14898.563	MCS75	
			$5s6s$	^3S	1	29038.795		

Energy Levels of Neutral Strontium (Sr I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5s^2$	^1S	0	0.000	M52
$5s5p$	$^3P^o$	0	14317.520	M52
		1	14504.351	M52
		2	14898.563	M52
$5s4d$	^3D	1	18159.056	M52
		2	18218.795	M52
		3	18319.267	M52

Energy Levels of Neutral Strontium (Sr I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5s4d$	^1D	2	20149.700	M52
$5s5p$	$^1P^o$	1	21698.482	M52
$5s6s$	^3S	1	29038.795	M52
$5s6s$	^1S	0	30591.80	M52
$4d5p$	$^3F^o$	2	33266.872	M52
		3	33589.724	M52
		4	33919.330	M52
$4d5p$	$^1D^o$	2	33826.927	M52
$5s5d$	^1D	2	34727.483	M52
$5s5d$	^3D	1	35006.943	M52
		2	35022.015	M52
		3	35045.055	M52
$5p^2$	^3P	0	35193.47	M52
		1	35400.138	M52
		2	35674.668	M52
$4d5p$	$^3D^o$	1	36264.181	M52
		2	36381.769	M52
		3	36559.514	M52
$4d5p$	$^3P^o$	0	37292.106	M52
		1	37302.760	M52
		2	37336.616	M52
Sr II ($^2S_{1/2}$)		*Limit*	**45932.09**	RB78

Persistent Lines of Singly-ionized Strontium (Sr II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
30	2152.84		$4d$	^2D	3/2	14555.90	MCS75	
			$4f$	$^2F^o$	5/2	60991.7		
30	2165.96		$4d$	^2D	5/2	14836.24	MCS75	
			$4f$	$^2F^o$	5/2	60991.7		
14	3380.71		$5p$	$^2P^o$	1/2	23715.19	MCS75	
			$5d$	^2D	3/2	53286.31		
20	3464.46	3.1	$5p$	$^2P^o$	3/2	24516.65	MCS75	FW96
			$5d$	^2D	5/2	53372.97		
1000	4077.71	1.42	$5s$	^2S	1/2	0.00	MCS75	FW96
			$5p$	$^2P^o$	3/2	24516.65		
700	4215.52	1.27	$5s$	^2S	1/2	0.00	MCS75	FW96
			$5p$	$^2P^o$	1/2	23715.19		
7	4305.45	1.4	$5p$	$^2P^o$	3/2	24516.65	MCS75	FW96
			$6s$	^2S	1/2	47736.53		
20	10327.31		$4d$	^2D	5/2	14836.24	S38a	
			$5p$	$^2P^o$	3/2	24516.65		

Energy Levels of Singly-ionized Strontium (Sr II)

Configuration	Term	J	Level (cm^{-1})	Ref
5*s*	^2S	1/2	0.00	M52
4*d*	^2D	3/2	14555.90	M52
		5/2	14836.24	M52
5*p*	$^2P^o$	1/2	23715.19	M52
		3/2	24516.65	M52
6*s*	^2S	1/2	47736.53	M52
5*d*	^2D	3/2	53286.31	M52
		5/2	53372.97	M52
6*p*	$^2P^o$	1/2	55769.7	M52
		3/2	56057.9	M52
4*f*	$^2F^o$	5/2	60991.7	M52
		7/2	—	M52
7*s*	^2S	1/2	64964.10	M52
Sr III ($^1S_0$)		*Limit*	**88964.0**	M52

Sulfur (S)
Atomic number = 16
Atomic weight = 32.066

Isotope	Mass	Abundance	Spin	Mag moment
^{32}S	31.972070	95.02%	0	
^{33}S	32.971456	0.75%	3/2	+0.64382
^{34}S	33.967866	4.21%	0	
^{36}S	35.967080	0.02%	0	

S I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^4\ {}^3P_2$
Ionization energy: 83 559.1 cm^{-1} (10.360 01 eV)

S II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^3\ {}^4S^o_{3/2}$
Ionization energy: 188 232.7 cm^{-1} (23.337 88 eV)

Strong Lines of Sulfur (S)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
400	906.885	S II	KM93
300	910.484	S II	KM93
250	912.735	S II	KM93
250	937.421	S II	KM93
300	937.684	S II	KM93
250	1014.449	S II	KM93
400 P	1250.578	S II	KM93
900 P	1253.805	S II	KM93
1000 P	1259.518	S II	KM93
200	1388.435	S I	KM93
120	1392.588	S I	KM93
250	1396.112	S I	KM93
150	1401.514	S I	KM93
1000 P	1425.030	S I	KM93
600 P	1433.280	S I	KM93
200 P	1433.310	S I	KM93
250	1436.968	S I	KM93
1000 P	1473.995	S I	KM93
700	1483.039	S I	KM93
900 P	1666.688	S I	KM93
800 P	1687.530	S I	KM93
1000 P	1807.311	S I	KM93
900 P	1820.343	S I	KM93
800 P	1826.245	S I	KM93
200	1900.286	S I	KM93
100	1914.698	S I	KM93
	Air		
200	4153.064	S II	KM93
250	4162.665	S II	KM93
40	4694.13	S I	KM93
140 P	5428.667	S II	KM93
250 P	5432.815	S II	KM93
400 P	5453.828	S II	KM93
150 P	5473.620	S II	KM93
150 P	5509.718	S II	KM93
150 P	5606.151	S II	KM93
150 P	5639.972	S II	KM93
120	5659.985	S II	KM93

Strong Lines of Sulfur (S)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	6757.16	S I	KM93
150 P	7578.909	S II	KM93
120 P	7629.740	S II	KM93
100	7923.90	S I	KM93
80 P	7967.371	S II	KM93
120 P	8314.594	S II	KM93
40	8694.71	S I	KM93
150 P	9212.865	S I	KM93
100 P	9228.092	S I	KM93
80 P	9237.538	S I	KM93
200 P	10455.451	S I	KM93
30 P	10456.757	S I	KM93
130 P	10459.406	S I	KM93

Persistent Lines of Neutral Sulfur (S I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1425.030	2.92	$3s^23p^4$	^{3}P	2	0.000	KM93	M03
			$3s^23p^3(^4S^o)3d$	$^3D^o$	3	70173.968		
600	1433.280	2.16	$3s^23p^4$	^{3}P	1	396.055	KM93	M03
			$3s^23p^3(^4S^o)3d$	$^3D^o$	2	70166.195		
200	1433.310	1.20	$3s^23p^4$	^{3}P	1	396.055	KM93	M03
			$3s^23p^3(^4S^o)3d$	$^3D^o$	1	70164.650		
1000	1473.995	1.82	$3s^23p^4$	^{3}P	2	0.000	KM93	M03
			$3s^23p^3(^2D^o)4s$	$^3D^o$	3	67842.867		
900	1666.688	6.3	$3s^23p^4$	^{1}D	2	9238.609	KM93	FW96
			$3s^23p^3(^2D^o)4s$	$^1D^o$	2	69237.886		
800	1687.530	0.94	$3s^23p^4$	^{1}S	0	22179.954	KM93	FW96
			$3s^23p^3(^2D^o)3d$	$^1P^o$	1	81438.30		
1000	1807.311	3.08	$3s^23p^4$	^{3}P	2	0.000	KM93	M03
			$3s^23p^3(^4S^o)4s$	$^3S^o$	1	55330.811		
900	1820.343	1.70	$3s^23p^4$	^{3}P	1	396.055	KM93	M03
			$3s^23p^3(^4S^o)4s$	$^3S^o$	1	55330.811		
800	1826.245	0.549	$3s^23p^4$	^{3}P	0	573.640	KM93	M03
			$3s^23p^3(^4S^o)4s$	$^3S^o$	1	55330.811		
150	9212.865	0.30	$3s^23p^3(^4S^o)4s$	$^5S^o$	2	52623.640	KM93	WSM69
			$3s^23p^3(^4S^o)4p$	^{5}P	3	63475.051		
100	9228.092	0.28	$3s^23p^3(^4S^o)4s$	$^5S^o$	2	52623.640	KM93	WSM69
			$3s^23p^3(^4S^o)4p$	^{5}P	2	63457.142		
80	9237.538	0.28	$3s^23p^3(^4S^o)4s$	$^5S^o$	2	52623.640	KM93	WSM69
			$3s^23p^3(^4S^o)4p$	^{5}P	1	63446.065		
200	10455.451	0.22	$3s^23p^3(^4S^o)4s$	$^3S^o$	1	55330.811	KM93	WSM69
			$3s^23p^3(^4S^o)4p$	^{3}P	2	64892.582		
30	10456.757	0.22	$3s^23p^3(^4S^o)4s$	$^3S^o$	1	55330.811	KM93	WSM69
			$3s^23p^3(^4S^o)4p$	^{3}P	0	64891.386		
130	10459.406	0.22	$3s^23p^3(^4S^o)4s$	$^3S^o$	1	55330.811	KM93	WSM69
			$3s^23p^3(^4S^o)4p$	^{3}P	1	64888.964		

Energy Levels of Neutral Sulfur (S I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^2 3p^4$	^3P	2	0.000	MZM90
		1	396.055	MZM90
		0	573.640	MZM90
$3s^2 3p^4$	^1D	2	9238.609	MZM90
$3s^2 3p^4$	^1S	0	22179.954	MZM90
$3s^2 3p^3(^4S^o)4s$	$^5S^o$	2	52623.640	MZM90
$3s^2 3p^3(^4S^o)4s$	$^3S^o$	1	55330.811	MZM90
$3s^2 3p^3(^4S^o)4p$	^5P	1	63446.065	MZM90
		2	63457.142	MZM90
		3	63475.051	MZM90
$3s^2 3p^3(^4S^o)4p$	^3P	1	64888.964	MZM90
		0	64891.386	MZM90
		2	64892.582	MZM90
$3s^2 3p^3(^2D^o)4s$	$^3D^o$	1	67816.351	MZM90
		2	67825.188	MZM90
		3	67842.867	MZM90
$3s^2 3p^3(^4S^o)3d$	$^5D^o$	4	67877.635	MZM90
		0	67884.158	MZM90
		1	67885.535	MZM90
		2	67887.805	MZM90
		3	67890.016	MZM90
$3s^2 3p^3(^2D^o)4s$	$^1D^o$	2	69237.886	MZM90
$3s^2 3p^3(^4S^o)3d$	$^3D^o$	1	70164.650	MZM90
		2	70166.195	MZM90
		3	70173.968	MZM90
$3s^2 3p^3(^4S^o)5s$	$^5S^o$	2	70702.790	MZM90
$3s^2 3p^3(^4S^o)5s$	$^3S^o$	1	71351.399	MZM90
$3s3p^5$	$^3P^o$	2	72023.495	MZM90
		1	72382.328	MZM90
		0	72571.630	MZM90
$3s^2 3p^3(^4S^o)5p$	^5P	1	73911.259	MZM90
		2	73914.928	MZM90
		3	73920.961	MZM90
$3s^2 3p^3(^4S^o)5p$	^3P	2	74268.547	MZM90
		1	74269.600	MZM90
		0	74271.651	MZM90
$3s^2 3p^3(^4S^o)4d$	$^5D^o$	4	74973.14	MZM90
		3	74974.10	MZM90
		2	74975.19	MZM90
		1	74976.06	MZM90
		0	74976.61	MZM90
$3s^2 3p^3(^4S^o)4d$	$^3D^o$	1	75951.95	MZM90
		2	75952.35	MZM90
		3	75956.53	MZM90
$3s^2 3p^3(^4S^o)6s$	$^5S^o$	2	76464.06	MZM90

Energy Levels of Neutral Sulfur (S I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^23p^3(^4S^o)4f$	^5F	4	76654.767	MZM90
		5	76654.769	MZM90
		3	76654.794	MZM90
		2	76654.811	MZM90
		1	76654.847	MZM90
$3s^23p^3(^4S^o)4f$	^3F	4	76656.324	MZM90
		3	76656.330	MZM90
		2	76656.358	MZM90
$3s^23p^3(^4S^o)6s$	$^3S^o$	1	76720.65	MZM90
$3s^23p^3(^2P^o)4s$	$^3P^o$	0	77135.52	MZM90
		1	77150.14	MZM90
		2	77181.15	MZM90
$3s^23p^3(^2D^o)4p$	^1P	1	77854.906	MZM90
$3s^23p^3(^2D^o)4p$	^3D	2	78152.071	MZM90
		1	78152.336	MZM90
		3	78203.180	MZM90
$3s^23p^3(^2P^o)4s$	$^1P^o$	1	78288.44	MZM90
$3s^23p^3(^2D^o)4p$	^3F	2	78409.89	MZM90
		3	78435.81	MZM90
		4	78463.04	MZM90
$3s^23p^3(^2D^o)4p$	^1F	3	78639.923	MZM90
$3s^23p^3(^2D^o)4p$	^3P	2	79375.80	MZM90
		1	79405.30	MZM90
		0	79418.01	MZM90
$3s^23p^3(^2D^o)3d$	$^1P^o$	1	81438.30	MZM90
S II ($^4S^o_{3/2}$)		*Limit*	**83559.1**	MZM90

Persistent Lines of Singly-ionized Sulfur (S II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	1250.578	0.463	$3s^23p^3$	$^4S^o$	3/2	0.00	KM93	M03
			$3s3p^4$	^4P	1/2	79962.61		
900	1253.805	0.462	$3s^23p^3$	$^4S^o$	3/2	0.00	KM93	M03
			$3s3p^4$	^4P	3/2	79756.83		
1000	1259.518	0.465	$3s^23p^3$	$^4S^o$	3/2	0.00	KM93	M03
			$3s3p^4$	^4P	5/2	79395.39		
140	5428.667	0.42	$3s^23p^2(^3P)4s$	^4P	1/2	109560.69	KM93	FW96
			$3s^23p^2(^3P)4p$	$^4D^o$	3/2	127976.34		
250	5432.815	0.68	$3s^23p^2(^3P)4s$	^4P	3/2	109831.59	KM93	FW96
			$3s^23p^2(^3P)4p$	$^4D^o$	5/2	128233.20		
400	5453.828	0.85	$3s^23p^2(^3P)4s$	^4P	5/2	110268.60	KM93	FW96
			$3s^23p^2(^3P)4p$	$^4D^o$	7/2	128599.16		

Persistent Lines of Singly-ionized Sulfur (S II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
150	5473.620	0.73	$3s^23p^2(^3P)4s$	^4P	1/2	109560.69	KM93	FW96
			$3s^23p^2(^3P)4p$	$^4D^o$	1/2	127825.08		
150	5509.718	0.40	$3s^23p^2(^3P)4s$	^4P	3/2	109831.59	KM93	FW96
			$3s^23p^2(^3P)4p$	$^4D^o$	3/2	127976.34		
150	5606.151	0.54	$3s^23p^2(^3P)3d$	^4F	9/2	110766.56	KM93	FW96
			$3s^23p^2(^3P)4p$	$^4D^o$	7/2	128599.16		
150	5639.972	0.66	$3s^23p^2(^3P)4s$	^2P	3/2	113461.54	KM93	FW96
			$3s^23p^2(^3P)4p$	$^2D^o$	5/2	131187.19		
150	7578.909		$3s^23p^2(^1D)3d$	^2G	9/2	127128.35	KM93	
			$3s^23p^2(^1D)4p$	$^2F^o$	7/2	140319.23		
120	7629.740		$3s^23p^2(^1D)3d$	^2G	7/2	127127.10	KM93	
			$3s^23p^2(^1D)4p$	$^2F^o$	5/2	140230.10		
80	7967.371	0.080	$3s^23p^2(^3P)4s$	^2P	1/2	112937.57	KM93	WSM69
			$3s^23p^2(^3P)4p$	$^2S^o$	1/2	125485.29		
120	8314.594	0.16	$3s^23p^2(^3P)4s$	^2P	3/2	113461.54	KM93	WSM69
			$3s^23p^2(^3P)4p$	$^2S^o$	1/2	125485.29		

Energy Levels of Singly-ionized Sulfur (S II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^23p^3$	$^4S^o$	3/2	0.00	MZM90
$3s^23p^3$	$^2D^o$	3/2	14852.94	MZM90
		5/2	14884.73	MZM90
$3s^23p^3$	$^2P^o$	1/2	24524.83	MZM90
		3/2	24571.54	MZM90
$3s3p^4$	^4P	5/2	79395.39	MZM90
		3/2	79756.83	MZM90
		1/2	79962.61	MZM90
$3s3p^4$	^2D	3/2	97890.74	MZM90
		5/2	97918.86	MZM90
$3s^23p^2(^3P)3d$	^2P	3/2	105599.06	MZM90
		1/2	106044.24	MZM90
$3s^23p^2(^3P)4s$	^4P	1/2	109560.69	MZM90
		3/2	109831.59	MZM90
		5/2	110268.60	MZM90
$3s^23p^2(^3P)3d$	^4F	3/2	110177.02	MZM90
		5/2	110313.40	MZM90
		7/2	110508.71	MZM90
		9/2	110766.56	MZM90
$3s^23p^2(^3P)4s$	^2P	1/2	112937.57	MZM90
		3/2	113461.54	MZM90
$3s^23p^2(^3P)3d$	^4D	1/2	114162.30	MZM90
		3/2	114200.54	MZM90
		5/2	114231.04	MZM90
		7/2	114279.33	MZM90

Energy Levels of Singly-ionized Sulfur (S II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3s^23p^2(^3P)3d$	^2F	5/2	114804.37	MZM90
		7/2	115285.61	MZM90
$3s3p^4$	^2S	1/2	119783.77	MZM90
$3s^23p^2(^1D)4s$	^2D	3/2	121528.72	MZM90
		5/2	121530.02	MZM90
$3s^23p^2(^3P)4p$	$^2S^o$	1/2	125485.29	MZM90
$3s^23p^2(^1D)3d$	^2G	7/2	127127.10	MZM90
		9/2	127128.35	MZM90
$3s^23p^2(^3P)4p$	$^4D^o$	1/2	127825.08	MZM90
		3/2	127976.34	MZM90
		5/2	128233.20	MZM90
		7/2	128599.16	MZM90
$3s^23p^2(^3P)4p$	$^4P^o$	1/2	129787.83	MZM90
		3/2	129858.18	MZM90
		5/2	130134.16	MZM90
$3s^23p^2(^3P)3d$	^4P	5/2	130602.21	MZM90
		3/2	130818.85	MZM90
		1/2	130948.94	MZM90
$3s^23p^2(^3P)4p$	$^2D^o$	3/2	130641.11	MZM90
		5/2	131187.19	MZM90
$3s^23p^2(^3P)4p$	$^4S^o$	3/2	131028.85	MZM90
$3s^23p^2(^3P)4p$	$^2P^o$	1/2	133268.68	MZM90
		3/2	133399.97	MZM90
$3s^23p^2(^3P)3d$	^2D	3/2	133360.86	MZM90
		5/2	133814.84	MZM90
$3s^23p^2(^1S)4s$	^2S	1/2	136328.79	MZM90
$3s^23p^2(^1D)3d$	^2F	5/2	138509.17	MZM90
		7/2	138527.98	MZM90
$3s^23p^2(^1D)3d$	^2P	1/2	139844.99	MZM90
		3/2	140016.77	MZM90
$3s^23p^2(^1D)4p$	$^2F^o$	5/2	140230.10	MZM90
		7/2	140319.23	MZM90
S III ($^3P_0$)		*Limit*	**188232.7**	MZM90

Tantalum (Ta)
Atomic number = 73
Atomic weight = 180.9479

Isotope	Mass	Abundance	Spin	Mag moment
^{180}Ta	179.947462	0.012%	9	
^{181}Ta	220.011368	99.998%	7/2	+2.370

Ta I Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}4f^{14}5s^25p^65d^36s^2\ ^4F_{3/2}$
Ionization energy: 60 891.4 cm^{-1} (7.549 57 eV)

Ta II Ground state: $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}4f^{14}5s^25p^65d^36s\ ^5F_1$
Ionization energy: not available

Strong Lines of Tantalum (Ta)

Intensity		Wavelength (Å)	Spectrum	Ref
		Air		
500		2140.13	Ta II	MCS75
600	P	2146.87	Ta II	MCS75
300		2150.62	Ta II	MCS75
250		2165.01	Ta II	MCS75
300		2178.03	Ta II	MCS75
500		2182.71	Ta II	MCS75
200		2193.20	Ta II	MCS75
500		2193.88	Ta II	MCS75
600	P	2196.03	Ta II	MCS75
600	P	2199.67	Ta II	MCS75
200		2207.14	Ta II	MCS75
600*	P,d	2210.03	Ta II	MCS75
600*	P	2210.19	Ta II	MCS75
600	P	2239.48	Ta II	MCS75
200		2249.79	Ta II	MCS75
500		2250.76	Ta II	MCS75
200		2258.71	Ta II	MCS75
400		2261.42	Ta II	MCS75
400		2262.30	Ta II	MCS75
300		2271.85	Ta II	MCS75
400		2272.59	Ta II	MCS75
80		2279.85	Ta I	MCS75
300		2285.25	Ta II	MCS75
250		2286.59	Ta II	MCS75
400		2289.16	Ta II	MCS75
300		2331.98	Ta II	MCS75
250		2332.19	Ta II	MCS75
100		2357.30	Ta I	MCS75
100		2361.09	Ta I	MCS75
250		2364.24	Ta II	MCS75
120		2371.58	Ta I	MCS75
600	P	2387.06	Ta II	MCS75
1000	P	2400.63	Ta II	MCS75
140		2427.64	Ta I	MCS75
200		2432.70	Ta II	MCS75
250		2474.62	Ta I	MCS75
200		2484.95	Ta I	MCS75
250		2488.70	Ta II	MCS75
200		2490.46	Ta I	MCS75
250		2504.45	Ta I	MCS75

Strong Lines of Tantalum (Ta)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
250	2507.45	Ta I	MCS75
90	2512.65	Ta I	MCS75
500 d	2526.35	Ta I	MCS75
250	2532.12	Ta II	MCS75
90	2546.80	Ta I	MCS75
200 d	2551.07	Ta I	MCS75
200	2554.62	Ta II	MCS75
90	2555.05	Ta I	MCS75
500 P	2559.43	Ta I	MCS75
200	2562.10	Ta I	MCS75
150	2573.54	Ta I	MCS75
150	2573.79	Ta I	MCS75
250	2577.37	Ta II	MCS75
130	2577.78	Ta I	MCS75
150	2593.08	Ta I	MCS75
200	2595.26	Ta I	MCS75
250	2603.49	Ta II	MCS75
500 P	2608.63	Ta I	MCS75
120 d	2611.34	Ta I	MCS75
130	2615.46	Ta I	MCS75
120	2615.66	Ta I	MCS75
500 P	2635.58	Ta II	MCS75
200	2636.67	Ta I	MCS75
300	2636.90	Ta I	MCS75
200	2646.22	Ta I	MCS75
250	2646.37	Ta I	MCS75
900 P	2647.47	Ta I	MCS75
110	2651.22	Ta II	MCS75
1000 P	2653.27	Ta I	MCS75
700 P	2656.61	Ta I	MCS75
600 P	2661.34	Ta I	MCS75
250	2668.62	Ta I	MCS75
300	2675.90	Ta II	MCS75
250	2684.28	Ta I	MCS75
600 P	2685.17	Ta II	MCS75
130	2691.31	Ta I	MCS75
100	2692.40	Ta I	MCS75
200	2694.52	Ta II	MCS75
90	2696.81	Ta I	MCS75
400 P	2698.30	Ta I	MCS75
200	2706.69	Ta I	MCS75
500	2710.13	Ta I	MCS75
1000 P	2714.67	Ta I	MCS75
90	2717.18	Ta I	MCS75
200	2720.76	Ta I	MCS75
200	2727.44	Ta II	MCS75
150	2727.78	Ta I	MCS75
200	2746.68	Ta I	MCS75
500	2748.78	Ta I	MCS75
300	2749.83	Ta I	MCS75
400 P	2758.31	Ta I	MCS75
200	2761.68	Ta II	MCS75
300	2775.88	Ta I	MCS75
150	2787.69	Ta I	MCS75
250	2796.34	Ta I	MCS75
300	2797.76	Ta II	MCS75
150	2802.07	Ta I	MCS75
150	2806.30	Ta I	MCS75
200	2806.58	Ta I	MCS75

Strong Lines of Tantalum (Ta)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
100	2842.82	Ta I	MCS75
250	2844.25	Ta I	MCS75
110 c	2845.35	Ta I	MCS75
200	2848.52	Ta I	MCS75
600 P	2850.49	Ta I	MCS75
700 P	2850.98	Ta I	MCS75
140	2861.98	Ta I	MCS75
120	2868.65	Ta I	MCS75
200	2871.42	Ta I	MCS75
100	2873.36	Ta I	MCS75
100	2873.56	Ta I	MCS75
150	2880.02	Ta I	MCS75
300	2891.84	Ta I	MCS75
100	2899.04	Ta I	MCS75
200	2902.05	Ta I	MCS75
120	2915.49	Ta I	MCS75
150	2925.19	Ta I	MCS75
120	2932.70	Ta I	MCS75
700 P	2933.55	Ta I	MCS75
200	2940.06	Ta I	MCS75
500	2940.22	Ta I	MCS75
90	2942.14	Ta I	MCS75
200	2951.92	Ta I	MCS75
130	2953.56	Ta I	MCS75
600 P	2963.32	Ta I	MCS75
300	2965.13	Ta II	MCS75
300	2965.54	Ta I	MCS75
130	2969.47	Ta I	MCS75
150	2975.56	Ta I	MCS75
800 P	3012.54	Ta II	MCS75
110 d	3027.48	Ta I	MCS75
200	3049.56	Ta I	MCS75
200	3069.24	Ta I	MCS75
140	3077.24	Ta I	MCS75
200	3103.25	Ta I	MCS75
150	3124.97	Ta I	MCS75
150	3130.58	Ta I	MCS75
100	3132.64	Ta I	MCS75
120	3170.29	Ta I	MCS75
100	3173.59	Ta I	MCS75
250	3180.95	Ta I	MCS75
90	3184.55	Ta I	MCS75
400 P	3311.16	Ta I	MCS75
250	3318.84	Ta I	MCS75
140 d	3330.99	Ta II	MCS75
250	3371.54	Ta I	MCS75
140	3385.05	Ta I	MCS75
150	3406.94	Ta I	MCS75
200	3480.52	Ta I	MCS75
150	3497.85	Ta I	MCS75
90	3503.87	Ta I	MCS75
200	3511.04	Ta I	MCS75
300	3607.41	Ta I	MCS75
400	3626.62	Ta I	MCS75
200	3642.06	Ta I	MCS75
90	3833.74	Ta II	MCS75
150	4061.40	Ta I	MCS75
120	4067.91	Ta I	MCS75
120	4205.88	Ta I	MCS75

Strong Lines of Tantalum (Ta)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
140 d	4510.98	Ta I	MCS75
130	4574.31	Ta I	MCS75
100	4619.51	Ta I	MCS75
150 P	4681.88	Ta I	MCS75
130 P	5156.56	Ta I	MCS75
90	5877.36	Ta I	MCS75
90	5944.02	Ta I	MCS75
100	6045.39	Ta I	MCS75
100	6430.79	Ta I	MCS75
80	6450.36	Ta I	MCS75
150	6485.37	Ta I	MCS75
80	6866.23	Ta I	MCS75

Persistent Lines of Neutral Tantalum (Ta I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	2559.43		$5d^36s^2$	^4F	3/2	0.00	MCS75	
				17^o	5/2	39059.52		
500	2608.63		$5d^36s^2$	^4F	5/2	2010.10	MCS75	
				19^o	7/2	40333.03		
900	2647.47		$5d^36s^2$	^4F	3/2	0.00	MCS75	
				15^o	3/2	37760.67		
1000	2653.27		$5d^36s^2$	^4F	5/2	2010.10	MCS75	
				18^o	5/2	39688.20		
700	2656.61		$5d^36s^2$	^4F	3/2	0.00	MCS75	
				14^o	5/2	37630.09		
600	2661.34		$5d^36s^2$	^4F	9/2	5621.04	MCS75	
				20^o	11/2	43185.09		
400	2698.30		$5d^36s^2$	^4F	5/2	2010.10	MCS75	
				17^o	5/2	39059.52		
1000	2714.67		$5d^36s^2$	^4F	3/2	0.00	MCS75	
				13^o	5/2	36825.97		
400	2758.31		$5d^36s^2$	^4F	5/2	2010.10	MCS75	
				16^o	5/2	38253.39		
700	2850.98		$5d^36s^2$	^4F	9/2	5621.04	MCS75	
			$5d^36s(^3G)6p$	$^4G^o$	9/2	40686.42		
700	2933.55		$5d^36s^2$	^4F	3/2	0.00	MCS75	
				10^o	3/2	34078.42		
600	2963.32		$5d^36s^2$	^4F	5/2	2010.10	MCS75	
				11^o	7/2	35746.18		
400	3311.16		$5d^36s^2$	^4F	9/2	5621.04	MCS75	
				12^o	11/2	35813.47		
150	4681.88	0.015	$5d^36s^2$	^4F	5/2	2010.10	MCS75	FW96
			$5d^36s(^5F)6p$	$^4F^o$	5/2	23363.09		
130	5156.56		$5d^36s^2$	^4F	9/2	5621.04	MCS75	
			$5d^36s(^5F)6p$	$^6G^o$	11/2	25008.83		

Energy Levels of Neutral Tantalum (Ta I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^36s^2$	^4F	3/2	0.00	M58
		5/2	2010.10	M58
		7/2	3963.92	M58
		9/2	5621.04	M58
$5d^36s^2$	^4P	1/2	6049.42	M58
		3/2	6068.91	M58
		5/2	9253.43	M58
$5d^36s^2$	^2G	7/2	9705.38	M58
		9/2	10690.32	M58
	1	3/2	10950.22	M58
$5d^36s^2$	^2P	1/2	11792.13	M58
		3/2	15903.77	M58
$5d^36s^2$	$^2D2$	5/2	12865.97	M58
		3/2	25876.05	DAGW97
$5d^36s^2$	^2H	11/2	15114.14	M58
		9/2	15391.01	M58
$5d^36s^2$	^2F	5/2	17224.47	M58
		7/2	17383.12	M58
$5d^36s(^5F)6p$	$^4F^o$	5/2	23363.09	M58
$5d^36s(^5F)6p$	$^6G^o$	11/2	25008.83	M58
	10^o	3/2	34078.42	M58
$5d^36s(^5P)6p$	$^6D^o$	7/2	34094.66	M58
	11^o	7/2	35746.18	M58
	12^o	11/2	35813.47	M58
	13^o	5/2	36825.97	M58
	14^o	5/2	37630.09	M58
	15^o	3/2	37760.67	M58
	16^o	5/2	38253.39	M58
	17^o	5/2	39059.52	M58
	18^o	5/2	39688.20	M58
	19^o	7/2	40333.03	M58
$5d^36s(^3G)6p$?	$^4G^o$?	9/2	40686.42	M58
	20^o	11/2	43185.09	M58
Ta II ($^5F_1$)		*Limit*	**60891.4**	SKJ94

Persistent Lines of Singly-ionized Tantalum (Ta II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	2146.87		$5d^3(^4F)6s$	^5F	2	1031.36	MCS75	
				9^o	1	47595.98		
600	2196.03		$5d^3(^4F)6s$	^5F	4	4415.79	MCS75	
				13^o	4	49937.74		
600	2199.67		$5d^3(^4F)6s$	^5F	1	0.00	MCS75	
				6^o	2	45446.85		
600*	2210.03		$5d^3(^4F)6s$	^5F	1	0.00	MCS75	
				5^o	1	45233.91		
600*	2210.19		$5d^3(^4F)6s$	^5F	4	4415.79	MCS75	
				12^o	3	49646.62		
600	2239.48		$5d^3(^4F)6s$	^5F	4	4415.79	MCS75	
				11^o	5	49055.18		
			$5d^3(^4F)6s$	^5F	3	2642.26		
				8^o	4	47280.89		
600	2387.06		$5d^3(^4F)6s$	^5F	4	4415.79	MCS75	
				7^o	5	46295.03		
1000	2400.63		$5d^3(^4F)6s$	^5F	5	6186.81	MCS75	
				10^o	6	47829.75		
500	2635.58		$5d^3(^4F)6s$	^5F	2	1031.36	MCS75	
				3^o	3	38962.32		
600	2685.17		$5d^26s^2$	^3P	0	4124.85	MCS75	
				4^o	1	41355.11		
			$5d^3(^4F)6s$	^5F	1	0.00		
				1^o	2	37230.75		
800	3012.54		$5d^26s^2$	^3P	1	5330.77	MCS75	
				2^o	2	38515.55		

Energy Levels of Singly-ionized Tantalum (Ta II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^3(^4F)6s$	^5F	1	0.00	K62a
		2	1031.36	K62a
		3	2642.26	K62a
		4	4415.79	K62a
		5	6186.81	K62a
$5d^26s^2$	^3F	2	3180.04	K62a
		3	6831.31	K62a
		4	9746.28	K62a
$5d^26s^2$	^3P	0	4124.85	K62a
		1	5330.77	K62a
		2	5657.90	K62a

Energy Levels of Singly-ionized Tantalum (Ta II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^3(^4F)6s$	^3F	2	9690.47	K62a
		3	14581.07	K62a
		4	18493.66	K62a
	1^o	2	37230.75	K62a
	2^o	2	38515.55	K62a
	3^o	3	38962.32	K62a
	4^o	1	41355.11	K62a
	5^o	1	45233.91	K62a
	6^o	2	45446.85	K62a
	7^o	5	46295.03	K62a
	8^o	4	47280.89	K62a
	9^o	1	47595.98	K62a
	10^o	6	47829.75	K62a
	11^o	2	49055.18	K62a
	12^o	3	49646.62	K62a
	13^o	4	49937.74	K62a
Ta III ($^4F_{3/2}$)		*Limit*		

Technetium (Tc)

Atomic number = 43
Atomic weight = 98.9062

Isotope	Mass	Abundance	Spin	Mag moment
^{97}Tc	96.906364	0	9/2	
^{98}Tc	97.907215	0	6	
^{99}Tc	98.906254	0	9/2	+ 5.6847

Tc I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^5 5s^2$ $^6S_{5/2}$
Ionization energy: 58 700 cm^{-1} (7.28 eV)

Tc II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^5 5s$ $^7S_3$
Ionization energy: 123 100 cm^{-1} (15.26 eV)

Strong Lines of Technetium (Tc)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
200	2496.77	Tc II	BMC67
1000 P	2543.23	Tc II	BMC67
1000 P,c	2609.99	Tc II	BMC67
150	2614.23	Tc I	BMC67
100	2615.87	Tc I	BMC67
200	2634.91	Tc II	BMC67
1000 P,c	2647.01	Tc II	BMC67
100	2652.35	Tc II	BMC67
70	2707.90	Tc II	BMC67
100	2708.78	Tc I	BMC67
100	2726.69	Tc I	BMC67
100	2782.05	Tc I	BMC67
130	2795.78	Tc II	BMC67
100	2802.81	Tc I	BMC67
300	2811.61	Tc II	BMC67
70	2821.35	Tc II	BMC67
200 c	2859.11	Tc I	BMC67
100	2887.73	Tc I	BMC67
100	2896.34	Tc I	BMC67
100	2913.15	Tc I	BMC67
100	2928.20	Tc I	BMC67
100	3099.10	Tc I	BMC67
70	3122.64	Tc I	BMC67
150	3131.23	Tc I	BMC67
300 P	3173.30	Tc I	BMC67
200 P	3182.37	Tc I	BMC67
200 P	3183.11	Tc I	BMC67
500 P,c	3195.20	Tc II	BMC67
700 P	3212.02	Tc II	BMC67
700 P	3237.02	Tc II	BMC67
500 P,c	3466.28	Tc I	BMC67
100	3475.59	Tc I	BMC67
100 c	3486.23	Tc I	BMC67
100	3500.70	Tc I	BMC67
80 c	3502.70	Tc I	BMC67
80	3525.83	Tc I	BMC67
80	3538.68	Tc I	BMC67
200 c	3541.77	Tc I	BMC67
600 c	3549.72	Tc I	BMC67

Strong Lines of Technetium (Tc)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400 c	3550.64	Tc I	BMC67
80	3560.32	Tc I	BMC67
80	3568.85	Tc I	BMC67
100	3580.06	Tc I	BMC67
60	3581.26	Tc I	BMC67
80	3582.08	Tc I	BMC67
200	3582.63	Tc I	BMC67
400	3587.94	Tc I	BMC67
100 c	3595.66	Tc I	BMC67
100 c	3607.32	Tc I	BMC67
200 c	3608.27	Tc I	BMC67
100 c	3627.36	Tc I	BMC67
300 c	3635.15	Tc I	BMC67
1000 P,c	3636.07	Tc I	BMC67
100	3638.22	Tc I	BMC67
90	3639.38	Tc I	BMC67
100 c	3648.04	Tc I	BMC67
60	3651.47	Tc I	BMC67
100 c	3658.59	Tc I	BMC67
100	3679.15	Tc I	BMC67
500	3684.74	Tc I	BMC67
70	3703.83	Tc I	BMC67
80	3712.26	Tc I	BMC67
800 P	3718.86	Tc I	BMC67
120	3723.67	Tc I	BMC67
150	3724.40	Tc I	BMC67
400	3726.35	Tc I	BMC67
100	3746.15	Tc I	BMC67
500	3746.84	Tc I	BMC67
100	3752.13	Tc I	BMC67
400	3754.37	Tc I	BMC67
100	3758.54	Tc I	BMC67
200	3761.81	Tc I	BMC67
500	3768.77	Tc I	BMC67
300	3771.03	Tc I	BMC67
200	3779.37	Tc I	BMC67
300 c	3780.68	Tc I	BMC67
100	3797.77	Tc I	BMC67
60	3832.82	Tc I	BMC67
150	3837.56	Tc I	BMC67
80	3841.31	Tc I	BMC67
80	3845.97	Tc I	BMC67
100	3868.24	Tc I	BMC67
60 c	3880.72	Tc I	BMC67
60	3899.83	Tc I	BMC67
400 c	3946.57	Tc I	BMC67
200	3947.09	Tc I	BMC67
500 P,c	3984.97	Tc I	BMC67
100	3994.51	Tc I	BMC67
50	4012.00	Tc I	BMC67
30	4017.22	Tc I	BMC67
100	4020.76	Tc I	BMC67
1000 P,c	4031.63	Tc I	BMC67
50	4039.25	Tc I	BMC67
500 c	4049.11	Tc I	BMC67
500	4088.71	Tc I	BMC67
700 P	4095.67	Tc I	BMC67
50	4110.22	Tc I	BMC67
500	4115.08	Tc I	BMC67

Strong Lines of Technetium (Tc)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
30	4119.27	Tc I	BMC67
400	4124.22	Tc I	BMC67
50	4128.27	Tc I	BMC67
40	4139.85	Tc I	BMC67
300	4144.95	Tc I	BMC67
150	4145.08	Tc I	BMC67
500	4165.61	Tc I	BMC67
50	4169.68	Tc I	BMC67
200	4170.27	Tc I	BMC67
250	4172.53	Tc I	BMC67
50	4176.28	Tc I	BMC67
40	4186.51	Tc I	BMC67
500 P,c	4238.19	Tc I	BMC67
800 P	4262.27	Tc I	BMC67
40	4262.69	Tc I	BMC67
200	4274.97	Tc II	BMC67
30	4278.90	Tc I	BMC67
1000 P	4297.06	Tc I	BMC67
40	4429.59	Tc I	BMC67
40	4481.53	Tc I	BMC67
120	4487.06	Tc I	BMC67
40	4515.98	Tc I	BMC67
400	4522.84	Tc I	BMC67
80	4539.53	Tc I	BMC67
30	4552.85	Tc I	BMC67
40	4557.05	Tc I	BMC67
80	4564.54	Tc I	BMC67
40	4578.45	Tc I	BMC67
40	4593.35	Tc I	BMC67
40	4616.86	Tc I	BMC67
40	4630.57	Tc I	BMC67
120	4637.50	Tc I	BMC67
80	4648.33	Tc I	BMC67
80 c	4660.21	Tc I	BMC67
80	4669.30	Tc I	BMC67
40	4706.92	Tc I	BMC67
80	4717.77	Tc I	BMC67
150 c	4719.28	Tc I	BMC67
400	4740.61	Tc I	BMC67
40	4752.72	Tc I	BMC67
150	4771.54	Tc I	BMC67
400	4820.74	Tc I	BMC67
40	4834.37	Tc I	BMC67
40	4835.39	Tc I	BMC67
800 P	4853.59	Tc I	BMC67
400	4866.73	Tc I	BMC67
300	4891.92	Tc I	BMC67
40	4908.51	Tc I	BMC67
80	4909.57	Tc I	BMC67
250	4976.34	Tc I	BMC67
300	5096.28	Tc I	BMC67
150	5161.81	Tc I	BMC67
150	5174.81	Tc I	BMC67
80	5275.51	Tc I	BMC67
70	5285.07	Tc I	BMC67
50	5320.20	Tc I	BMC67
300 c	5589.02	Tc I	BMC67
200 c	5620.45	Tc I	BMC67
150	5642.13	Tc I	BMC67

Strong Lines of Technetium (Tc)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
80	5644.94	Tc I	BMC67
70	5725.31	Tc I	BMC67
100 c	5924.47	Tc I	BMC67
60 c	5931.93	Tc I	BMC67
80	6085.23	Tc I	BMC67
100	6120.68	Tc I	BMC67
100	6130.80	Tc I	BMC67
80	6192.66	Tc I	BMC67
60 c	6244.18	Tc I	BMC67
100	6455.90	Tc I	BMC67
60 c	6461.93	Tc I	BMC67
60	7452.49	Tc I	BMC67
80	7540.26	Tc I	BMC67
80 c	7793.04	Tc I	BMC67
80	7817.72	Tc I	BMC67

Persistent Lines of Neutral Technetium (Tc I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ \mathrm{s}^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	3173.30	0.86	$4d^55s^2$	a ^{6}S	5/2	0.00	BMC67	PW99
			$4d^6(^5\mathrm{D})5p$	y ^{4}P^o	3/2	31503.93		
200	3182.37	0.39	$4d^55s^2$	a ^{6}S	5/2	0.00	BMC67	PW99
			$4d^6(^5\mathrm{D})5p$	y ^{4}P^o	7/2	31414.05		
200	3183.11	0.56	$4d^55s^2$	a ^{6}S	5/2	0.00	BMC67	PW99
			$4d^6(^5\mathrm{D})5p$	y ^{4}P^o	5/2	31406.74		
500	3466.28	1.22	$4d^6(^5\mathrm{D})5s$	a ^{6}D	9/2	2572.89	BMC67	PW99
			$4d^6(^5\mathrm{D})5p$	y ^{4}P^o	7/2	31414.05		
1000	3636.07	1.57	$4d^6(^5\mathrm{D})5s$	a ^{6}D	9/2	2572.89	BMC67	PW99
			$4d^6(^5\mathrm{D})5p$	z ^{6}F^o	11/2	30067.29		
800	3718.86	1.05	$4d^6(^5\mathrm{D})5s$	a ^{6}D	7/2	3250.91	BMC67	PW99
			$4d^6(^5\mathrm{D})5p$	z ^{6}F^o	9/2	30133.26		
500	3984.97	0.42	$4d^6(^5\mathrm{D})5s$	a ^{6}D	9/2	2572.89	BMC67	PW99
			$4d^6(^5\mathrm{D})5p$	z ^{6}D^o	7/2	27660.10		
1000	4031.63	1.01	$4d^6(^5\mathrm{D})5s$	a ^{6}D	9/2	2572.89	BMC67	PW99
			$4d^6(^5\mathrm{D})5p$	z ^{6}D^o	9/2	27369.79		
700	4095.67	0.49	$4d^6(^5\mathrm{D})5s$	a ^{6}D	7/2	3250.91	BMC67	PW99
			$4d^6(^5\mathrm{D})5p$	z ^{6}D^o	7/2	27660.10		
500	4238.19	0.38	$4d^55s^2$	a ^{6}S	5/2	0.00	BMC67	PW99
			$4d^55s(^7\mathrm{S})5s$	z ^{6}P^o	3/2	23588.40		
800	4262.27	0.40	$4d^55s^2$	a ^{6}S	5/2	0.00	BMC67	PW99
			$4d^55s(^7\mathrm{S})5s$	z ^{6}P^o	5/2	23455.21		
1000	4297.06	0.42	$4d^55s^2$	a ^{6}S	5/2	0.00	BMC67	PW99
			$4d^55s(^7\mathrm{S})5s$	z ^{6}P^o	7/2	23265.32		
800	4853.59	0.49	$4d^6(^5\mathrm{D})5s$	a ^{4}D	7/2	10516.53	BMC67	PW99
			$4d^6(^5\mathrm{D})5p$	z ^{4}F^o	9/2	31114.08		

Energy Levels of Neutral Technetium (Tc I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^5 5s^2$	a ^{6}S	5/2	0.00	BCT68
$4d^6(^5D)5s$	a ^{6}D	9/2	2572.89	BCT68
		7/2	3250.91	BCT68
		5/2	3700.54	BCT68
		3/2	4002.57	BCT68
		1/2	4178.75	BCT68
$4d^6(^5D)5s$	a ^{4}D	7/2	10516.53	BCT68
		5/2	11063.07	BCT68
		3/2	11578.60	BCT68
		1/2	11890.70	PW99
$4d^5 5s(^7S)5p$	z ^{8}P^o	5/2	16428.71	BCT68
		7/2	16874.51	BCT68
		9/2	17522.92	BCT68
$4d^5 5s(^7S)5p$	z ^{6}P^o	7/2	23265.32	BCT68
		5/2	23455.21	BCT68
		3/2	23588.40	BCT68
$4d^6(^5D)5p$	z ^{6}D^o	9/2	27369.79	BCT68
		7/2	27660.10	BCT68
		5/2	27940.73	BCT68
		3/2	28151.28	BCT68
		1/2	28296.67	BCT68
$4d^6(^5D)5p$	z ^{6}F^o	11/2	30067.29	BCT68
		9/2	30133.26	BCT68
		7/2	30382.06	BCT68
		5/2	30528.86	BCT68
		3/2	30630.62	BCT68
		1/2	30689.12	BCT68
$4d^6(^5D)5p$	z ^{4}F^o	9/2	31114.08	BCT68
		5/2	31605.00	BCT68
		5/2	32014.81	BCT68
		3/2	32253.65	BCT68
$4d^6(^5D)5p$	y ^{6}P^o	5/2	31406.74	BCT68
		7/2	31414.05	BCT68
		3/2	31503.93	BCT68
Tc II ($^7S_3$)		*Limit*	**58700**	M58

Persistent Lines of Singly-ionized Technetium (Tc II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2543.23	4.1	$4d^5(^6S)5s$	a ^7S	3	0.00	BMC67	B88
			$4d^5(^6S)5p$	z $^7P^o$	4	39308.38		
1000	2609.99	3.8	$4d^5(^6S)5s$	a ^7S	3	0.00	BMC67	B88
			$4d^5(^6S)5p$	z $^7P^o$	3	38302.80		
1000	2647.01	3.7	$4d^5(^6S)5s$	a ^7S	3	0.00	BMC67	B88
			$4d^5(^6S)5p$	z $^7P^o$	2	37767.21		
500	3195.20	2.0	$4d^5(^6S)5s$	a ^5S	2	12617.20	BMC67	B88
			$4d^5(^6S)5p$	z $^5P^o$	1	43905.00		
700	3212.02	1.9	$4d^5(^6S)5s$	a ^5S	2	12617.20	BMC67	B88
			$4d^5(^6S)5p$	z $^5P^o$	2	43741.33		
700	3237.02	1.9	$4d^5(^6S)5s$	a ^5S	2	12617.20	BMC67	B88
			$4d^5(^6S)5p$	z $^5P^o$	3	43500.96		

Energy Levels of Singly-ionized Technetium (Tc II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^5(^6S)5s$	a ^7S	3	0.00	M58
$4d^6$	a ^5D	4	3461.27	M58
		3	4217.17	M58
		2	4669.22	M58
		1	4961.14	M58
		0	5100.98	M58
$4d^5(^6S)5s$	a ^5S	2	12617.20	M58
$4d^5(^6S)5p$	z $^7P^o$	2	37767.21	M58
		3	38302.80	M58
		4	39308.38	M58
$4d^5(^6S)5p$	z $^5P^o$	3	43500.96	M58
		2	43741.33	M58
		1	43905.00	M58
Tc III ($^6S_{5/2}$)		*Limit*	**123100**	M58

Tellurium (Te)
Atomic number = 52
Atomic weight = 127.60

Isotope	Mass	Abundance	Spin	Mag moment
^{122}Te	121.903054	2.57%	0	
^{123}Te	122.904271	0.89%	1/2	−0.7359
^{124}Te	123.902823	4.76%	0	
^{125}Te	124.904433	7.10%	1/2	−0.8871
^{126}Te	125.903314	18.89%	0	
^{128}Te	127.904463	31.73%	0	
^{130}Te	129.906229	33.97%	0	

Te I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^4\ {}^3\mathrm{P}_2$
Ionization energy: 72 667 cm^{-1} (9.0096 eV)

Te II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^3\ {}^4\mathrm{S}^{\mathrm{o}}_{3/2}$
Ionization energy: 150 000 cm^{-1} (18.6 eV)

Strong Lines of Tellurium (Te)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
40	802.28	Te II	HM64
40	1059.51	Te II	HM64
40 P	1077.66	Te II	HM64
50 P	1174.34	Te II	HM64
60 P	1175.79	Te II	HM64
40	1208.54	Te II	HM64
40	1220.98	Te II	HM64
40	1253.62	Te II	HM64
40	1270.52	Te II	HM64
50 P	1324.92	Te II	HM64
40	1363.24	Te II	HM64
50	1374.80	Te II	HM64
50	1608.41	Te II	HM64
50	1613.15	Te II	HM64
500 P	1822.155	Te I	MV75
500 P	1857.296	Te I	MV75
500 P	1994.839	Te I	MV75
	Air		
1000 P	2002.028	Te I	MV75
250 P	2081.172	Te I	MV75
700 P	2142.822	Te I	MV75
120 P	2147.260	Te I	MV75
14	2159.864	Te I	MV75
15	2215.630	Te I	MV75
5	2255.507	Te I	MV75
20 P	2259.034	Te I	MV75
5	2265.536	Te I	MV75
100	2373.06	Te II	HM64
50 P	2383.277	Te I	MV75
60 P	2385.792	Te I	MV75
250	2438.69	Te II	HM64
5	2530.738	Te I	MV75
100	2567.82	Te II	HM64
50	2574.96	Te II	HM64
50	2591.12	Te II	HM64

Strong Lines of Tellurium (Te)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	2592.85	Te II	HM64
50	2605.72	Te II	HM64
50	2624.86	Te II	HM64
500	2649.66	Te II	HM64
4	2677.13	Te I	MCS75
500	2858.29	Te II	HM64
800	2895.41	Te II	HM64
400	2967.29	Te II	HM64
400	3047.00	Te II	HM64
4	3175.147	Te I	MV75
800	3406.79	Te II	HM64
250 P	3521.11	Te II	HM64
500	3611.78	Te II	HM64
250 P	4006.52	Te II	HM64
500	4169.77	Te II	HM64
500	4261.11	Te II	HM64
800	4364.00	Te II	HM64
800	4478.63	Te II	HM64
500	4557.78	Te II	HM64
500	4641.12	Te II	HM64
900 P	4654.37	Te II	HM64
1000	4686.91	Te II	HM64
500	4696.38	Te II	HM64
500	4706.53	Te II	HM64
500	4766.05	Te II	HM64
500	4784.87	Te II	HM64
500	4827.14	Te II	HM64
800	4831.28	Te II	HM64
800	4842.90	Te II	HM64
600	4865.12	Te II	HM64
1000	4866.24	Te II	HM64
800	5576.35	Te II	HM64
800 P	5649.26	Te II	HM64
500	5666.20	Te II	HM64
1000 P	5708.12	Te II	HM64
800	5755.85	Te II	HM64
500	5974.68	Te II	HM64
120	8758.183	Te I	MV75
200 P	9722.742	Te I	MV75
20	9868.92	Te I	MV75
25	9956.30	Te I	MV75
250 P	10051.41	Te I	MV75
150	10091.01	Te I	MV75
30	10493.57	Te I	MV75
70	10918.34	Te I	MV75
400 P	11089.56	Te I	MV75
250 P	11487.23	Te I	MV75
60	13247.75	Te I	MV75
40	14513.51	Te I	MV75
60	15452.45	Te I	MV75
90	15546.23	Te I	MV75
140	16403.90	Te I	MV75
80	17303.54	Te I	MV75
110	18291.59	Te I	MV75
40	21043.73	Te I	MV75

Persistent Lines of Neutral Tellurium (Te I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	1822.155		$5p^4$	^3P	2	0.000	MV75	
			$5p^3(^2D)6s$	$^3D^o$	2	54880.070		
500	1857.296		$5p^4$	^3P	1	4750.712	MV75	
			$5p^3(^4S)5d$	$^3D^o$	2	58592.434		
500	1994.839		$5p^4$	^3P	1	4750.712	MV75	
			$5p^3(^2D)6s$	$^3D^o$	2	54880.070		
1000	2002.028		$5p^4$	^3P	1	4750.712	MV75	
			$5p^3(^2D)6s$	$^3D^o$	1	54683.886		
250	2081.172		$5p^4$	^1D	2	10557.877	MV75	
			$5p^3(^4S)5d$	$^3D^o$	2	58592.434		
700	2142.822	3.11	$5p^4$	^3P	2	0.000	MV75	M00
			$5p^3(^4S)6s$	$^3S^o$	1	46652.738		
120	2147.260		$5p^4$	^1D	2	10557.877	MV75	
			$5p^3(^2D)6s$	$^1D^o$	2	57114.206		
20	2259.034	0.13	$5p^4$	^3P	2	0.000	MV75	M00
			$5p^3(^4S)6s$	$^5S^o$	2	44253.000		
50	2383.277	0.40	$5p^4$	^3P	0	4706.500	MV75	M00
			$5p^3(^4S)6s$	$^3S^o$	1	46652.738		
60	2385.792	0.81	$5p^4$	^3P	1	4750.712	MV75	M00
			$5p^3(^4S)6s$	$^3S^o$	1	46652.738		
200	9722.742		$5p^3(^4S)6s$	$^5S^o$	2	44253.000	MV75	
			$5p^3(^4S)6p$	^5P	3	54535.345		
250	10051.41		$5p^3(^4S)6s$	$^5S^o$	2	44253.000	MV75	
			$5p^3(^4S)6p$	^5P	2	54199.122		
400	11089.56		$5p^3(^4S)6s$	$^3S^o$	1	46652.738	MV75	
			$5p^3(^4S)6p$	^3P	2	55667.758		
250	11487.23		$5p^3(^4S)6s$	$^3S^o$	1	46652.738	MV75	
			$5p^3(^4S)6p$	^3P	1	55355.672		

Energy Levels of Neutral Tellurium (Te I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5p^4$	^3P	2	0.000	MV75
		0	4706.500	MV75
		1	4750.712	MV75
$5p^4$	^1D	2	10557.877	MV75
$5p^4$	^1S	0	23198.392	MV75
$5p^3(^4S)6s$	$^5S^o$	2	44253.000	MV75
$5p^3(^4S)6s$	$^3S^o$	1	46652.738	MV75
$5p^3(^4S)6p$	^5P	1	54160.094	MV75
		2	54199.122	MV75
		3	54535.345	MV75

Energy Levels of Neutral Tellurium (Te I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5p^3(^2D)6s$	$^3D^o$	1	54683.886	MV75
		2	54880.070	MV75
$5p^3(^4S)6p$	^3P	1	55355.672	MV75
		2	55667.758	MV75
		0	55809.132	MV75
$5p^3(^4S)5d$	$^5D^o$	3	55677.722	MV75
		4	55816.219	MV75
		2	55817.311	MV75
		0	55826.538	MV75
		1	55851.533	MV75
$5p^3(^2D)6s$	$^1D^o$	2	57114.206	MV75
$5p^3(^4S)5d$	$^3D^o$	2	58592.434	MV75
		1	58746.074	MV75
		3	58826.951	MV75
Te II ($^4S^o_{3/2}$)		*Limit*	**72667**	M58

Persistent Lines of Singly-ionized Tellurium (Te II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
40	1077.66		$5s^25p^3$	$^4S^o$	3/2	0.000	HM64	
				17	5/2	92793.22		
50	1174.34		$5s^25p^3$	$^4S^o$	3/2	0.000	HM64	
				7	3/2	85159.66		
60	1175.79		$5s^25p^3$	$^4S^o$	3/2	0.000	HM64	
				6	5/2	85049.41		
50	1324.92		$5s^25p^3$	$^2D^o$	5/2	12421.854	HM64	
				11	7/2	87899.86		
250	3521.11		$5s5p^4$	^4P	5/2	71192.53	HM64	
			$5s^25p^2(^3P)6p$	20^o	3/2	99584.59		
250	4006.52		$5s5p^4$	^4P	5/2	71192.53	HM64	
			$5s^25p^2(^3P)6p$	$^4D^o$	3/2	96144.74		
900	4654.37			1	1/2	76300.87	HM64	
			$5s^25p^2(^3P)6p$	$^2S^o$	1/2	97780.09		
800	5649.26			2	1/2	78448.22	HM64	
			$5s^25p^2(^3P)6p$	$^4D^o$	3/2	96144.74		
1000	5708.12			8	5/2	85591.83	HM64	
			$5s^25p^2(^3P)6p$	$^4D^o$	7/2	103105.86		

Energy Levels of Singly-ionized Tellurium (Te II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5s^25p^3$	$^4S^o$	3/2	0.000	E74
$5s^25p^3$	$^2D^o$	3/2	10222.385	E74
		5/2	12421.854	E74
$5s^25p^3$	$^2P^o$	1/2	20546.591	E74
		3/2	24032.095	E74
$5s5p^4$	^4P	5/2	71192.53	E74
		3/2	74893.40	E74
	1	1/2	76300.87	HM64
	2	1/2	78448.22	HM64
	3	3/2	81895.43	HM64
	4	3/2	82743.33	HM64
	5	1/2	83577.41	HM64
	6	5/2	85049.41	HM64
	7	3/2	85159.66	HM64
	8	5/2	85591.83	HM64
	9	3/2	86759.90	HM64
	10	5/2	87404.54	HM64
	11	7/2	87899.86	HM64
	12	1/2	88796.16	HM64
	13	9/2	90519.67	HM64
	14	7/2	90797.21	HM64
	15	3/2	92191.47	HM64
	16	1/2	92691.51	HM64
	17	5/2	92793.22	HM64
$5s^25p^2(^3P)6p$	$^4D^o$	1/2	93978.93	HM64
		3/2	96144.74	HM64
		5/2	100112.10	HM64
		7/2	103105.86	HM64
$5s^25p^2(^3P)6p$	$^2S^o$	1/2	97780.09	HM64
$5s^25p^2(^3P)6p$	20^o	3/2	99584.59	HM64
$5s^25p^2(^3P)6p$	21^o	3/2	101220.97	HM64
$5s^25p^2(^3P)6p$	$^4P^o$	1/2	101370.86	HM64
$5s^25p^2(^3P)6p$	22^o	5/2	102324.49	HM64
$5s^25p^2(^3P)6p$	23^o	3/2	103935.90	HM64
$5s^25p^2(^3P)6p$	$^2P^o$	3/2	105006.08	HM64
$5s^25p^2(^3P)6p$	24^o	5/2	105583.02	HM64
$5s^25p^2(^3P)6p$	$^2P^o$	1/2	106119.20	HM64
Te III ($^3P_0$)		*Limit*	**150000**	M58

Terbium (Tb)
Atomic number = 65
Atomic weight = 158.92534

Isotope	Mass	Abundance	Spin	Mag moment
^{159}Tb	158.925342	100%	3/2	+ 1.95

Tb I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^9 6s^2$ $^6\mathrm{H}^{\circ}_{15/2}$
Ionization energy: 47 294 cm^{-1} (5.8638 eV)

Tb II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^9$ $(^6\mathrm{H}^{\circ}_{15/2}) 6s$ $(15/2,1/2)^{\circ}_8$
Ionization energy: 92 900 cm^{-1} (11.52 eV)

Strong Lines of Terbium (Tb)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
120	3078.905	Tb II	B01
200	3218.925	Tb II	B01
200	3219.982	Tb II	B01
200	3285.030	Tb II	B01
250	3293.065	Tb II	B01
700 P	3324.413	Tb II	B01
1000 P	3509.146	Tb II	B01
250	3523.679	Tb II	B01
200	3540.270	Tb II	B01
600 P	3561.708	Tb II	B01
700 P	3568.513	Tb II	B01
300	3568.970	Tb II	B01
200	3579.227	Tb II	B01
300	3600.410	Tb II	B01
400 P	3650.421	Tb II	B01
400 P	3658.891	Tb II	B01
700 P	3676.363	Tb II	B01
800 P	3702.856	Tb II	B01
400 P	3703.930	Tb II	B01
200 d	3711.768	Tb II	B01
200	3755.251	Tb II	B01
300 P	3765.136	Tb II	B01
400 P	3776.489	Tb II	B01
500 P	3830.261	Tb I	B01
150 d	3842.471	Tb II	B01
600 P	3848.740	Tb II	B01
600 P,w	3874.172	Tb II	B01
400 P	3899.197	Tb II	B01
500 P	3901.325	Tb I	B01
400 P,d	3976.845	Tb II	B01
300	3981.875	Tb II	B01
300	4005.474	Tb II	B01
300 P	4032.284	Tb I	B01
400 P	4033.027	Tb II	B01
400 P	4061.558	Tb I	B01
200	4144.412	Tb II	B01
200	4203.749	Tb I	B01
200	4266.340	Tb I	B01
700 P	4318.847	Tb I	B01
200	4322.224	Tb I	B01
1000 P	4326.472	Tb I	B01

Strong Lines of Terbium (Tb)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	4332.117	Tb I	B01
300 P	4336.455	Tb I	B01
200	4337.646	Tb I	B01
600 P	4338.435	Tb I	B01
250	4340.609	Tb I	B01
300 P	4356.837	Tb I	B01
140	4493.077	Tb I	B01
40	4578.69	Tb II	MCS75
40	4641.98	Tb II	MCS75
50 P	4645.31	Tb II	MCS75
40	4702.41	Tb II	MCS75
70 P	4752.53	Tb II	MCS75
60	4786.78	Tb I	MCS75
40	5228.12	Tb I	MCS75
50 P	5354.88	Tb I	MCS75
25	6794.58	Tb II	MCS75
30	8212.57	Tb I	MCS75

Persistent Lines of Neutral Terbium (Tb I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3830.261		$4f^8(^7F)5d6s^2$	^8G	13/2	285.530	B01	
				^{o}	15/2	26386.005		
500	3901.325		$4f^8(^7F)5d6s^2$	^8G	15/2	462.120	B01	
			$4f^85d6s6p$?	^{o}	17/2	26087.175		
300	4032.284		$4f^8(^7F)5d6s^2$	^8D	11/2	2310.120	B01	
				^{o}	11/2	27102.955		
400	4061.558		$4f^8(^7F)5d6s^2$	^8G	15/2	462.120	B01	
				^{o}	15/2	25076.265		
700	4318.847		$4f^96s^2$	$^6H^o$	15/2	0.000	B01	
			$4f^9(^6H^o_{15/2})6s6p(^1P^o_1)$	(15/2,1)	15/2	23147.820		
1000	4326.472		$4f^96s^2$	$^6H^o$	15/2	0.000	B01	
			$4f^9(^6H^o_{15/2})6s6p(^1P^o_1)$	(15/2,1)	17/2	23107.025		
300	4336.455		$4f^96s^2$	$^6H^o$	13/2	2771.675	B01	
			$4f^9(^6H^o_{13/2})6s6p(^1P^o_1)$	(13/2,1)	15/2	25825.505		
600	4338.435		$4f^96s^2$	$^6H^o$	15/2	0.000	B01	
			$4f^9(^6H^o_{15/2})6s6p(^1P^o_1)$	(15/2,1)	13/2	23043.310		
300	4356.837		$4f^96s^2$	$^6H^o$	13/2	2771.675	B01	
			$4f^9(^6H^o_{13/2})6s6p(^1P^o_1)$	(13/2,1)	13/2	25717.655		
50	5354.88		$4f^8(^7F)5d6s^2$	^8G	15/2	462.120	MCS75	
			$4f^85d6s6p$?	^{o}	17/2	19131.480		

Energy Levels of Neutral Terbium (Tb I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^9 6s^2$	$^6H^o$	15/2	0.000	B01
		13/2	2771.675	B01
		11/2	4670.450	B01
		9/2	6174.920	B01
		7/2	—	
		5/2	—	
$4f^8(^7F)5d6s^2$	^8G	13/2	285.530	B01
		15/2	462.120	B01
		11/2	509.855	B01
		7/2	2419.470	B01
		9/2	2840.170	B01
		5/2	3174.575	B01
		3/2	3705.790	B01
		1/2	4018.160	B01
$4f^8(^7F)5d6s^2$		9/2	1371.050	B01
$4f^8(^7F)5d6s^2$	^8D	11/2	2310.120	B01
		7/2	3819.850	B01
		5/2	4695.495	B01
		3/2	5483.985	B01
$4f^8(^7F)5d6s^2$	^8F	13/2	3719.720	B01
		11/2	5353.370	B01
		9/2	5829.845	B01
		1/2	6259.095	B01
		7/2	6488.275	B01
		5/2	6801.175	B01
		3/2	6849.725	B01
$4f^8(^7F)5d6s^2$	^8H	17/2	4646.825	B01
		15/2	5425.065	B01
		13/2	6351.750	B01
		11/2	6988.795	B01
		9/2	7441.020	B01
		7/2	7839.820	B01
		5/2	8130.685	B01
		3/2	8336.310	B01
$4f^8 5d6s6p$?	^{o}	17/2	19131.480	B01
$4f^9(^6H^o_{15/2})6s6p(^1P^o_1)$	(15/2,1)	13/2	23043.310	B01
		17/2	23107.025	B01
		15/2	23147.820	B01
	^{o}	15/2	25076.265	B01
$4f^9(^6H^o_{13/2})6s6p(^1P^o_1)$	(13/2,1)	11/2	25637.845	B01
		13/2	25717.655	B01
		15/2	25825.505	B01
$4f^8 5d6s6p$?	^{o}	17/2	26087.175	B01
	^{o}	15/2	26386.005	B01
	^{o}	11/2	27102.955	B01
Tb II $(15/2,1/2)^o_8$		*Limit*	**47296**	WSPC78

Persistent Lines of Singly-ionized Terbium (Tb II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	3324.413		$4f^8(^7F)5d(^8G)6s$	^9G	8	3423.295	B01	
				^{o}	9	33495.130		
1000	3509.146	0.537	$4f^9(^6H^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.000	B01	M00
			$4f^9(^6H^o_{15/2})6p_{3/2}$	(15/2,3/2)	9	28488.810		
600	3561.708		$4f^9(^6H^o_{13/2})6s_{1/2}$	$(13/2,1/2)^o$	7	3010.050	B01	
			$4f^9(^6H^o_{13/2})6p_{3/2}$	(13/2,3/2)	8	31078.460		
700	3568.513	1.13	$4f^9(^6H^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.000	B01	M00
			$4f^9(^6H^o_{15/2})6p_{3/2}$	(15/2,3/2)	8	28014.875		
400	3650.421		$4f^8(^7F)5d(^8G)6s$	^9G	8	3423.295	B01	
			$4f^8 5d6p$?	^{o}	8	30809.590		
400	3658.891	1.71	$4f^9(^6H^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	7	1016.380	B01	M00
			$4f^9(^6H^o_{15/2})6p_{3/2}$	(15/2,3/2)	6	28339.285		
700	3676.363	1.19	$4f^9(^6H^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	7	1016.380	B01	M00
			$4f^9(^6H^o_{15/2})6p_{3/2}$	(15/2,3/2)	7	28209.430		
800	3702.856	0.619	$4f^9(^6H^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	7	1016.380	B01	M00
			$4f^9(^6H^o_{15/2})6p_{3/2}$	(15/2,3/2)	8	28014.875		
400	3703.930		$4f^8(^7F)5d(^8G)6s$	^9G	7	3235.190	B01	
			$4f^8 5d6p$?	^{o}	7	30225.865		
300	3765.136		$4f^8(^7F)5d(^8G)6s$		6	3440.825	B01	
				^{o}	5	29992.75		
400	3776.489		$4f^8(^7F)5d(^8G)6s$		6	3440.825	B01	
			$4f^8 5d6p$?	^{o}	6	29912.930		
600	3848.740	0.543	$4f^9(^6H^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.000	B01	M00
			$4f^9(^6H^o_{15/2})6p_{1/2}$	(15/2,1/2)	8	25975.160		
600	3874.172	1.00	$4f^9(^6H^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.000	B01	M00
			$4f^9(^6H^o_{15/2})6p_{1/2}$	(15/2,1/2)	7	25804.650		
400	3899.197		$4f^9(^6H^o_{13/2})6s_{1/2}$	$(13/2,1/2)^o$	7	3010.050	B01	
			$4f^9(^6H^o_{13/2})6p_{1/2}$	(13/2,1/2)	7	28649.095		
400	3976.845		$4f^9(^6H^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.000	B01	
					8	25138.450		
400	4033.027	0.374	$4f^9(^6H^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	7	1016.380	B01	M00
			$4f^9(^6H^o_{15/2})6p_{1/2}$	(15/2,1/2)	7	25804.650		
50	4645.31		$4f^9(^6H^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.000	MCS75	
					7	21521.040		
70	4752.53		$4f^9(^6H^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.000	MCS75	
					8	21035.530		

Energy Levels of Singly-ionized Terbium (Tb II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^9(^6H^o_{15/2})6s_{1/2}$	$(15/2,1/2)^o$	8	0.000	B01
		7	1016.380	B01
$4f^9(^6H^o_{13/2})6s_{1/2}$	$(13/2,1/2)^o$	7	3010.050	B01
		6	3542.400	B01
$4f^8(^7F)5d(^8G)6s$	^9G	7	3235.190	B01
		8	3423.295	B01
$4f^8(^7F)5d(^8G)6s$		6	3440.825	B01
$4f^8(^7F)5d(^8G)6s$		5	4158.785	B01
		8	21035.56	B01
		7	21521.06	B01
		8	25138.450	B01
$4f^9(^6H^o_{15/2})6p_{1/2}$	(15/2,1/2)	7	25804.650	B01
		8	25975.160	B01
$4f^9(^6H^o_{15/2})6p_{3/2}$	(15/2,3/2)	8	28014.875	B01
		7	28209.430	B01
		6	28339.285	B01
		9	28488.810	B01
$4f^9(^6H^o_{13/2})6p_{1/2}$	(13/2,1/2)	7	28649.095	B01
$4f^85d6p$?	^{o}	6	29912.930	B01
	^{o}	5	29992.75	B01
$4f^85d6p$?	^{o}	7	30225.865	B01
$4f^85d6p$?	^{o}	8	30809.590	B01
$4f^9(^6H^o_{13/2})6p_{3/2}$	(13/2,3/2)	8	31078.460	B01
	^{o}	9	33495.130	B01
Tb III ($^6H^o_{15/2}$)		*Limit*	**92900**	SR65

Thallium (Tl)

Atomic number = 81

Atomic weight = 204.3833

Isotope	Mass	Abundance	Spin	Mag moment
^{203}Tl	202.972320	29.52%	1/2	+1.6223
^{205}Tl	204.974401	70.48%	1/2	+1.6382

Tl I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p$ $^2P_{1/2}$
Ionization energy: 49 265.91 cm^{-1} (6.108 194 eV)

Tl II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2$ $^1S_0$
Ionization energy: 16 4765 cm^{-1} (20.4283 eV)

Strong Lines of Thallium (Tl)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
500 r	696.30	Tl II	ES36
300 r	817.18	Tl II	ES36
500 r	1162.55	Tl II	ES36
500 r	1307.50	Tl II	ES36
800 P,r	1321.644	Tl II	JKBL96
500 r	1561.58	Tl II	ES36
300 P,r	1792.827	Tl II	JKBL96
400 P,r	1814.776	Tl II	JKBL96
700	1881.121	Tl II	JKBL96
800 P,r	1908.617	Tl II	JKBL96
	Air		
5 r	2007.56	Tl I	C52
5 r	2210.71	Tl I	C52
1000 P	2298.058	Tl II	JKBL96
7	2315.98	Tl I	MCS75
40 P,h	2379.69	Tl I	MCS75
700 P	2530.740	Tl II	JKBL96
40 P	2580.14	Tl I	MCS75
20	2709.23	Tl I	MCS75
200 P,d	2767.87	Tl I	MCS75
14	2826.16	Tl I	MCS75
140 P	2918.32	Tl I	MCS75
20	2921.52	Tl I	MCS75
700 P	3091.570	Tl II	JKBL96
500	3185.51	Tl II	ES36
500	3186.56	Tl II	ES36
500	3187.74	Tl II	ES36
60 P	3229.75	Tl I	MCS75
500	3291.01	Tl II	ES36
500	3369.15	Tl II	ES36
1000 P	3519.24	Tl I	MCS75
250 P	3529.43	Tl I	MCS75
600 P,c,w	3775.72	Tl I	MCS75
700	4274.98	Tl II	ES36
1000	4306.80	Tl II	ES36
700	4737.05	Tl II	ES36
500	4981.35	Tl II	ES36
800 P	5078.54	Tl II	ES36
800 P	5152.14	Tl II	ES36
900 P	5350.46	Tl I	MCS75

Strong Lines of Thallium (Tl)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500 d	5384.85	Tl II	ES36
800 P	5949.48	Tl II	ES36
700	9130.	Tl II	ES36
1	9130.5	Tl I	MM52
50 P	11512.82	Tl I	MM52
40 P	13013.2	Tl I	MM52

Persistent Lines of Neutral Thallium (Tl I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
40	2379.69	0.44	$5d^{10}6s^26p$	$^2P^o$	1/2	0.0	MCS75	FW96
			$5d^{10}6s^27d$	^2D	3/2	42011.4		
40	2580.14	0.18	$5d^{10}6s^26p$	$^2P^o$	1/2	0.0	MCS75	FW96
			$5d^{10}6s^28s$	^2S	1/2	38745.9		
200	2767.87	1.26	$5d^{10}6s^26p$	$^2P^o$	1/2	0.0	MCS75	FW96
			$5d^{10}6s^26d$	^2D	3/2	36117.9		
140	2918.32	0.42	$5d^{10}6s^26p$	$^2P^o$	3/2	7792.7	MCS75	FW96
			$5d^{10}6s^27d$	^2D	5/2	42049.0		
60	3229.75	0.173	$5d^{10}6s^26p$	$^2P^o$	3/2	7792.7	MCS75	FW96
			$5d^{10}6s^28s$	^2S	1/2	38745.9		
1000	3519.24	1.24	$5d^{10}6s^26p$	$^2P^o$	3/2	7792.7	MCS75	FW96
			$5d^{10}6s^26d$	^2D	5/2	36199.9		
250	3529.43	0.220	$5d^{10}6s^26p$	$^2P^o$	3/2	7792.7	MCS75	FW96
			$5d^{10}6s^26d$	^2D	3/2	36117.9		
600	3775.72	0.625	$5d^{10}6s^26p$	$^2P^o$	1/2	0.0	MCS75	FW96
			$5d^{10}6s^27s$	^2S	1/2	26477.5		
900	5350.46	0.795	$5d^{10}6s^26p$	$^2P^o$	3/2	7792.7	MCS75	FW96
			$5d^{10}6s^27s$	^2S	1/2	26477.5		
50	11512.82		$5d^{10}6s^27s$	^2S	1/2	26477.5	MM52	
			$5d^{10}6s^27p$	$^2P^o$	3/2	35161.1		
40	13013.2		$5d^{10}6s^27s$	^2S	1/2	26477.5	MM52	
			$5d^{10}6s^27p$	$^2P^o$	1/2	34159.9		

Energy Levels of Neutral Thallium (Tl I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^{10}6s^26p$	$^2P^o$	1/2	0.0	M58
		3/2	7792.7	M58
$5d^{10}6s^27s$	^2S	1/2	26477.5	M58
$5d^{10}6s^27p$	$^2P^o$	1/2	34159.9	M58
		3/2	35161.1	M58
$5d^{10}6s^26d$	^2D	3/2	36117.9	M58
		5/2	36199.9	M58
$5d^{10}6s^28s$	^2S	1/2	38745.9	M58

Energy Levels of Neutral Thallium (Tl I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^{10}6s^{2}8p$	$^2P^o$	1/2	41368.1	M58
		3/2	41740.8	M58
$5d^{10}6s^{2}7d$	^2D	3/2	42011.4	M58
		5/2	42049.0	M58
Tl II ($^1S_0$)		*Limit*	**49265.91**	BC85

Persistent Lines of Singly-ionized Thallium (Tl II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	1321.644	16.9	$5d^{10}6s^{2}$	^1S	0	0.00	JKBL96	C00
			$5d^{10}6s6p$	$^1P^o$	1	75663.33		
300	1792.827		$5d^{10}6s6p$	$^3P^o$	0	49451.45	JKBL96	
			$5d^{10}6s7s$	^3S	1	105229.28		
400	1814.776		$5d^{10}6s6p$	$^3P^o$	2	61727.68	JKBL96	
			$5d^{10}6s6d$	^3D	3	116830.90		
800	1908.617	0.26	$5d^{10}6s^{2}$	^1S	0	0.00	JKBL96	C00
			$5d^{10}6s6p$	$^3P^o$	1	52393.96		
1000	2298.058		$5d^{10}6s6p$	$^3P^o$	2	61727.68	JKBL96	
			$5d^{10}6s7s$	^3S	1	105229.28		
700	2530.740	1.18	$5d^{10}6s6p$	$^1P^o$	1	75663.33	JKBL96	C00
			$5d^{10}6s6d$	^1D	2	115165.60		
700	3091.570		$5d^{10}6s6p$	$^1P^o$	1	75663.33	JKBL96	
			$5d^{10}6s7s$	^1S	0	107999.96		

Energy Levels of Singly-ionized Thallium (Tl II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^{10}6s^{2}$	^1S	0	0.00	JKBL96
$5d^{10}6s6p$	$^3P^o$	0	49451.45	JKBL96
		1	52393.96	JKBL96
		2	61727.68	JKBL96
$5d^{10}6s6p$	$^1P^o$	1	75663.33	JKBL96
$5d^{10}6s7s$	^3S	1	105229.28	JKBL96
$5d^{10}6s7s$	^1S	0	107999.96	JKBL96
$5d^{10}6s6d$	^1D	2	115165.60	JKBL96
$5d^{10}6s6d$	^3D	1	116152.00	JKBL96
		2	116436.16	JKBL96
		3	116830.90	JKBL96
$5d^{10}6s7p$	$^3P^o$	0	119361.	ES36
		1	119576.	ES36
		2	122029.	ES36
$5d^{10}6s5f$	$^3F^o$	3	136115.	ES36
		2	136216.	ES36
		4	136230.	ES36
Tl III ($^2S_{1/2}$)		*Limit*	**164765**	M58

Thorium (Th)
Atomic number = 90
Atomic weight = 232.0381

Isotope	Mass	Abundance	Spin	Mag moment
^{232}Th	232.038054	100%	0	

Th I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 6d^2 7s^2\ ^3F_2$
Ionization energy: 50 867 cm^{-1} (6.3067 eV)

Th II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 6d^2 7s_{3/2}$
Ionization energy: 96 000 cm^{-1} (11.9 eV)

Strong Lines of Thorium (Th)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
120	2565.593	Th II	GSZ70
90	2684.288	Th II	GSZ70
110	2692.415	Th II	Z79
120	2747.156	Th II	Z79
100	2752.166	Th II	GSZ70
200	2832.3154	Th II	PE83
300 P	2837.2954	Th II	PE83
80	2842.8127	Th II	PE83
150	2848.0839	Th I	PE83
130	2870.4066	Th II	PE83
80	2884.2897	Th II	PE83
90	2885.0491	Th II	PE83
90	2887.8176	Th II	PE83
150	2936.0846	Th I	PE83
80	2942.8600	Th II	PE83
150	2943.7288	Th I	PE83
90	2988.2318	Th II	PE83
90	3034.0654	Th II	PE83
100	3049.0924	Th II	PE83
110	3067.7294	Th II	PE83
90	3072.1150	Th II	PE83
150	3078.8280	Th II	PE83
110	3080.2170	Th II	PE83
120	3108.2968	Th II	PE83
150	3116.2630	Th I	PE83
120	3119.5262	Th II	PE83
120	3122.9634	Th II	PE83
90	3124.3874	Th II	PE83
110	3125.5071	Th II	PE83
150	3136.2161	Th I	PE83
100	3139.3066	Th II	PE83
100	3142.8356	Th II	PE83
70	3146.0434	Th II	PE83
70	3154.3009	Th II	PE83
100	3175.7257	Th II	PE83
250 P	3180.1937	Th II	PE83
70	3184.9492	Th II	PE83
200	3188.2329	Th II	PE83
90	3192.5856	Th I	PE83
90	3195.6891	Th I	PE83
90	3214.3801	Th I	PE83

Strong Lines of Thorium (Th)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
130	3221.2912	Th II	PE83
130	3229.0096	Th II	PE83
110	3235.8400	Th II	PE83
140	3238.1157	Th II	PE83
200	3244.4488	Th I	PE83
70	3251.9159	Th II	PE83
200	3256.2738	Th II	PE83
300	3257.3667	Th I	PE83
200	3262.6684	Th II	PE83
200	3272.0268	Th I	PE83
200	3285.7525	Th I	PE83
150	3287.7893	Th II	PE83
200	3291.7394	Th II	PE83
150	3292.5209	Th II	PE83
400	3301.6511	Th I	PE83
800 P	3304.2383	Th I	PE83
200	3309.3654	Th I	PE83
120	3321.4508	Th II	PE83
90	3324.7527	Th II	PE83
200	3325.1207	Th II	PE83
400	3330.4770	Th I	PE83
150	3334.6041	Th II	PE83
150	3337.8703	Th II	PE83
500 P	3348.7684	Th I	PE83
250 P	3351.2286	Th II	PE83
70	3354.1796	Th II	PE83
150	3358.6020	Th II	PE83
90	3367.8189	Th II	PE83
400	3374.9749	Th I	PE83
90	3378.5734	Th II	PE83
200	3380.8595	Th I	PE83
70	3385.5316	Th II	PE83
70	3386.5006	Th II	PE83
200	3387.9205	Th I	PE83
300 P	3392.0349	Th II	PE83
300	3396.7278	Th I	PE83
400	3398.5448	Th I	PE83
300	3405.5584	Th I	PE83
400	3413.0130	Th I	PE83
700 P	3421.2100	Th I	PE83
500	3423.9897	Th I	PE83
250 P	3433.9988	Th II	PE83
200	3435.9771	Th II	PE83
80	3438.9503	Th II	PE83
200	3442.5790	Th I	PE83
200	3451.7023	Th I	PE83
80	3462.8505	Th II	PE83
90	3468.2198	Th II	PE83
300 P	3469.9208	Th II	PE83
300	3471.2186	Th I	PE83
120	3480.0525	Th I	PE83
300	3486.5512	Th I	PE83
150	3489.1841	Th I	PE83
120	3496.8107	Th I	PE83
200	3498.6210	Th I	PE83
120	3503.7859	Th I	PE83
200	3511.1574	Th I	PE83
250	3518.4040	Th I	PE83
120	3521.0595	Th I	PE83

Strong Lines of Thorium (Th)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
120	3526.6342	Th I	PE83
250	3531.4505	Th I	PE83
150	3539.5872	Th II	PE83
300	3544.0179	Th I	PE83
300	3549.5959	Th I	PE83
250	3551.4019	Th I	PE83
300	3555.0135	Th I	PE83
130	3559.4500	Th II	PE83
200	3563.3756	Th I	PE83
120	3569.8204	Th I	PE83
300	3576.5574	Th I	PE83
150	3583.1022	Th I	PE83
300	3589.7495	Th I	PE83
500	3592.7794	Th I	PE83
500	3598.1199	Th I	PE83
90	3601.0344	Th II	PE83
300	3608.3779	Th I	PE83
250 P	3609.4452	Th II	PE83
300	3612.4275	Th I	PE83
110	3615.1327	Th II	PE83
90	3617.1173	Th II	PE83
90	3625.6280	Th II	PE83
250	3632.8303	Th I	PE83
500	3635.9433	Th I	PE83
120	3638.6444	Th I	PE83
400	3642.2490	Th I	PE83
300	3649.7349	Th I	PE83
150	3659.6294	Th I	PE83
400	3663.2025	Th I	PE83
250	3668.1398	Th I	PE83
500	3669.9684	Th I	PE83
150	3675.5675	Th II	PE83
250	3682.4863	Th I	PE83
150	3690.6238	Th I	PE83
300	3692.5664	Th I	PE83
300	3698.1061	Th I	PE83
600 P	3706.7672	Th I	PE83
70	3711.3041	Th II	PE83
1000 P	3719.4347	Th I	PE83
200	3721.8254	Th II	PE83
200	3727.9027	Th I	PE83
300 P	3741.1830	Th II	PE83
70	3747.5390	Th II	PE83
150	3752.5689	Th II	PE83
250	3757.6941	Th I	PE83
200	3765.2401	Th I	PE83
300	3770.0560	Th I	PE83
140	3776.2711	Th I	PE83
80	3785.6002	Th II	PE83
150	3789.1679	Th I	PE83
140	3795.3858	Th I	PE83
1000 P	3803.0750	Th I	PE83
80	3813.0676	Th II	PE83
130	3825.1331	Th I	PE83
800 P	3828.3846	Th I	PE83
120	3836.5851	Th I	PE83
200	3839.7475	Th II	PE83
70	3841.9601	Th II	PE83
150	3846.8876	Th I	PE83

Strong Lines of Thorium (Th)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
140	3852.1353	Th I	PE83
90	3854.5108	Th II	PE83
110	3863.4059	Th II	PE83
150	3869.6633	Th I	PE83
400	3875.3731	Th I	PE83
250	3879.6441	Th I	PE83
150	3886.9159	Th I	PE83
600 P	3895.4192	Th I	PE83
200	3903.1024	Th I	PE83
140	3911.9091	Th I	PE83
200	3919.0234	Th I	PE83
250	3925.0934	Th I	PE83
140	3929.6693	Th II	PE83
300	3932.9113	Th I	PE83
200	3959.3000	Th I	PE83
700 P	3967.3921	Th I	PE83
300	3972.1545	Th I	PE83
250	3980.0896	Th I	PE83
200	3991.7309	Th I	PE83
130	3994.5494	Th II	PE83
400	4008.2102	Th I	PE83
400	4009.0573	Th I	PE83
500 P	4012.4952	Th I	PE83
1000 P	4019.1289	Th II	PE83
250	4027.0091	Th I	PE83
400	4030.8424	Th I	PE83
400	4036.0479	Th I	PE83
90	4048.2876	Th I	PE83
200	4050.8872	Th I	PE83
250	4059.2529	Th I	PE83
400	4063.4071	Th I	PE83
70	4069.2014	Th II	PE83
150	4069.4612	Th I	PE83
90	4075.5030	Th I	PE83
200	4081.3678	Th I	PE83
140	4085.4341	Th I	PE83
150	4086.5205	Th II	PE83
120	4088.7264	Th I	PE83
150	4094.7470	Th II	PE83
250	4100.3414	Th I	PE83
200	4108.4198	Th II	PE83
400 P	4112.7545	Th I	PE83
500 P	4115.7589	Th I	PE83
250 P	4116.7137	Th II	PE83
300	4127.4120	Th I	PE83
200	4131.0021	Th I	PE83
80	4132.7533	Th II	PE83
300	4134.0681	Th I	PE83
110	4149.9870	Th II	PE83
200	4158.5352	Th I	PE83
250	4165.7661	Th I	PE83
150	4178.0597	Th II	PE83
200	4193.0164	Th I	PE83
150	4208.8907	Th II	PE83
200	4210.9232	Th I	PE83
90	4220.0651	Th I	PE83
90	4227.3872	Th I	PE83
140	4235.4636	Th I	PE83
200	4253.5385	Th I	PE83

Strong Lines of Thorium (Th)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
120	4256.2537	Th I	PE83
200	4260.3330	Th I	PE83
70	4273.3574	Th II	PE83
110	4277.3139	Th II	PE83
150	4282.0413	Th II	PE83
90	4297.3066	Th I	PE83
140	4299.8393	Th I	PE83
150	4307.1762	Th I	PE83
90	4315.2543	Th I	PE83
200	4318.4157	Th I	PE83
200	4337.2774	Th I	PE83
90	4349.0722	Th I	PE83
90	4354.4824	Th I	PE83
140	4359.3719	Th I	PE83
140	4365.9301	Th I	PE83
140	4374.1239	Th I	PE83
300 P	4381.8616	Th II	PE83
250 P	4391.1105	Th II	PE83
90	4392.9740	Th I	PE83
90	4401.5812	Th I	PE83
140	4408.8828	Th I	PE83
140	4458.0015	Th I	PE83
130	4482.1693	Th I	PE83
200	4498.9401	Th I	PE83
90	4505.2167	Th I	PE83
70	4510.5259	Th II	PE83
120	4521.1939	Th I	PE83
120	4555.8127	Th I	PE83
110	4570.9722	Th I	PE83
130	4595.4206	Th I	PE83
110	4676.0555	Th I	PE83
150	4723.4382	Th I	PE83
70	4863.1724	Th II	PE83
60	4919.8157	Th II	PE83
60	5017.2540	Th II	PE83
60	5049.7960	Th II	PE83
200 P	5067.9737	Th I	PE83
140	5158.6041	Th I	PE83
120	5160.7309	Th I	PE83
150	5199.1637	Th I	PE83
200 P	5231.1597	Th I	PE83
100	5343.5812	Th I	PE83
100	5587.0263	Th I	PE83
120 P	5760.5508	Th I	PE83
100 P	6169.8221	Th I	PE83
80	6182.6217	Th I	PE83
100 P	6457.2824	Th I	PE83
80	6462.6131	Th I	PE83
80 h	6531.3418	Th I	PE83
90 P	6989.6553	Th I	PE83
50	7168.8952	Th I	PE83
60	7208.0063	Th I	PE83
40	7428.9405	Th I	PE83
50	7647.3794	Th I	PE83
40	7978.9731	Th I	PE83
50	8330.4494	Th I	PE83
70 P	8967.6403	Th I	PE83
40	9048.2501	Th I	PE83
50	11230.2547	Th I	PE83

Strong Lines of Thorium (Th)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
30	12127.3016	Th I	PE83
30	12231.9446	Th I	PE83
30	12646.5347	Th I	PE83
25	15429.78	Th I	GBCZ74
25	15831.75	Th I	GBCZ74
25	17307.66	Th I	GBCZ74
25	17381.91	Th I	GBCZ74
25	17481.04	Th I	GBCZ74
25	17584.52	Th I	GBCZ74
25	18811.88	Th I	GBCZ74

Persistent Lines of Neutral Thorium (Th I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	3304.2383		$6d^27s^2$	^3F	2	0.000	PE83	
				o	3	30255.452		
500	3348.7684		$6d^27s^2$	^3F	2	0.000	PE83	
				o	2	29853.143		
700	3421.2100		$6d^27s^2$	^3F	4	4961.659	PE83	
				o	5	34182.708		
600	3706.7672		$6d^27s^2$	^1G	4	8111.005	PE83	
				o	5	35081.017		
1000	3719.4347		$6d^27s^2$	^3F	2	0.000	PE83	
			$6d^27s7p$	$^3G^o$	3	26878.162		
1000	3803.0750		$6d^27s^2$	^3F	2	0.000	PE83	
			$6d^27s7p$	$^3D^o$	1	26287.049		
800	3828.3846		$6d^27s^2$	^3F	2	0.000	PE83	
				o	2	26113.270		
600	3895.4192		$5f6d7s^2$	$^3H^o$	4	7795.275	PE83	
			$5f6d7s7p$	^3H	4	33459.180		
700	3967.3921		$6d^27s^2$	^3F	4	4961.659	PE83	
				o	4	30160.003		
500	4012.4952		$6d^27s^2$	^3F	3	2869.259	PE83	
				o	2	27784.366		
400	4112.7545		$6d^27s^2$	^3F	2	0.000	PE83	
				o	2	24307.749		
500	4115.7589		$6d^3(^4F)7s$	^5F	1	5563.142	PE83	
				o	2	29853.143		
200	5067.9737		$5f6d7s^2$	$^3H^o$	4	7795.275	PE83	
					4	27521.527		
200	5231.1597		$6d^27s^2$	^3P	0	2558.057	PE83	
			$6d^27s7p$	$^5P^o$	1	21668.956		
120	5760.5508		$6d^27s^2$	^3F	2	0.000	PE83	
			$5f6d7s^2$	$^3D^o$	1	17354.639		

Persistent Lines of Neutral Thorium (Th I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
100	6169.8221		$6d^27s^2$	^3F	4	4961.659	PE83	
			$5f6d7s^2$	$^3D^o$	3	21165.096		
100	6457.2824		$5f6d7s^2$	$^3H^o$	4	7795.275	PE83	
			$5f6d7s7p$	^5I	5	23277.387		
90	6989.6553		$5f6d7s^2$	$^3H^o$	4	7795.275	PE83	
			$5f6d7s7p$	^5I	4	22098.187		
70	8967.6403		$6d^3(^4F)7s$	^5F	4	8800.251	PE83	
			$6d^27s7p$	$^5F^o$	4	19948.395		

Energy Levels of Neutral Thorium (Th I)

Configuration	Term	J	Level (cm^{-1})	Ref
$6d^27s^2$	^3F	2	0.000	BW92b
		3	2869.259	BW92b
		4	4961.659	BW92b
$6d^27s^2$	^3P	0	2558.057	BW92b
		2	3687.987	BW92b
		1	3865.475	BW92b
$6d^3(^4F)7s$	^5F	1	5563.142	BW92b
		2	6362.396	BW92b
		3	7502.288	BW92b
		4	8800.251	BW92b
		5	9804.807	BW92b
$6d^27s^2$	^1D	2	7280.124	BW92b
$5f6d7s^2$	$^3H^o$	4	7795.275	BW92b
		5	11197.031	BW92b
		6	14481.869	BW92b
$6d^27s^2$	^1G	4	8111.005	BW92b
$5f6d7s^2$	$^3F^o$	2	8243.601	BW92b
		3	11241.730	BW92b
		4	14206.917	BW92b
$5f6d7s^2$	$^1G^o$	4	10414.136	BW92b
$5f6d7s^2$	$^3G^o$	3	10526.544	BW92b
		4	13175.113	BW92b
		5	15490.077	BW92b
$6d7s^27p$	$^3F^o$	2	10783.154	BW92b
		3	13945.307	BW92b
$6d^3(^4P)7s$	^5P	1	11601.031	BW92b
		2	11802.934	BW92b
		3	12847.971	BW92b
$5f6d7s^2$	$^3D^o$	1	17354.639	BW92b
$6d^27s7p$	$^5F^o$	4	19948.395	BW92b
$5f6d7s^2$	$^3D^o$	3	21165.096	BW92b

Energy Levels of Neutral Thorium (Th I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$6d^2 7s7p$	$^5P^o$	1	21668.956	BW92b
$5f6d7s7p$	^5I	4	22098.187	BW92b
		5	23277.387	BW92b
		6	26997.247	BW92b
	^{o}	2	24307.749	BW92b
	^{o}	2	26113.270	BW92b
$6d^2 7s7p$	$^3D^o$	1	26287.049	BW92b
$6d^2 7s7p$	$^3G^o$	3	26878.162	BW92b
		4	27521.527	BW92b
	^{o}	2	27784.366	BW92b
	^{o}	2	29853.143	BW92b
	^{o}	4	30160.003	BW92b
	^{o}	3	30255.452	BW92b
$5f6d7s7p$	^3H	4	33459.180	BW92b
	^{o}	5	34182.708	BW92b
	^{o}	5	35081.017	BW92b
Th II (3/2)		*Limit*	**50867**	KDEE97

Persistent Lines of Singly-ionized Thorium (Th II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	2837.2954		$6d^2(^3F)7s$	^4F	9/2	6213.490	PE83	
			$6d^2(^3F)7p$	$^4G^o$	11/2	41447.959		
250	3180.1937	0.88	$6d^2(^3F)7s$	^4F	5/2	1521.896	PE83	NZLJ02
			$6d^2(^3F)7p$	$^4G^o$	7/2	32957.429		
250	3351.2286	0.37	$6d^2(^3F)7s$	^4F	5/2	1521.896	PE83	NZLJ02
			$6d7s(^3D)7p$	^{o}	3/2	31353.125		
300	3392.0349		$6d^2(^3F)7s$	^4F	5/2	1521.896	PE83	
			$6d7s(^3D)7p$	$^4F^o$	7/2	30994.266		
250	3433.9988	0.27	$6d^2(^3F)7s$	^4F	3/2	1859.938	PE83	NZLJ02
			$6d^2(^3F)7p$	^{o}	5/2	30972.162		
300	3469.9208	0.51	$6d^2(^3F)7s$	^4F	7/2	4146.576	PE83	NZLJ02
			$6d^2(^3F)7p$	$^4G^o$	7/2	32957.429		
250	3609.4452		$6d(^2D)7s^2$		5/2	4113.359	PE83	
			$6d7s(^3D)7p$	^{o}	5/2	31810.548		
300	3741.1830	0.54	$6d^2(^3F)7s$	^4F	5/2	1521.896	PE83	NZLJ02
			$6d7s(^3D)7p$	^{o}	5/2	28243.812		
1000	4019.1289	0.41	$6d^2(^3F)7s$		3/2	0.000	PE83	NZLJ02
			$6d7s(^3D)7p$	^{o}	5/2	24873.983		

Persistent Lines of Singly-ionized Thorium (Th II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
250	4116.7137		$5f6d(^3H^o)7s$	$^4H^o$	7/2	6168.356	PE83	
			$5f6d(^3H^o)7p$		9/2	30452.725		
300	4381.8601		$5f6d(^3H^o)7s$	^{o}	9/2	6700.186	PE83	
			$5f^2(^3F)7s$		9/2	29515.134		
250	4391.1105		$5f(^2F^o)7s^2$	$^2F^o$	5/2	4490.262	PE83	
			$5f7s(^3F^o)7p$		7/2	27257.149		

Energy Levels of Singly-ionized Thorium (Th II)

Configuration	Term	J	Level (cm^{-1})	Ref
$6d^2(^3F)7s$		3/2	0.000	BW92b
$6d^2(^3F)7s$	^4F	5/2	1521.896	BW92b
		3/2	1859.938	BW92b
		7/2	4146.576	BW92b
		9/2	6213.490	BW92b
$6d(^2D)7s^2$		5/2	4113.359	BW92b
$5f(^2F^o)7s^2$	$^2F^o$	5/2	4490.262	BW92b
		7/2	8378.859	BW92b
$5f6d(^3H^o)7s$	$^4H^o$	7/2	6168.356	BW92b
		11/2	10189.067	BW92b
		9/2	10572.041	BW92b
		13/2	13406.433	BW92b
$6d^2(^3P)7s$	^4P	1/2	6244.294	BW92b
		3/2	8018.192	BW92b
		5/2	9061.103	BW92b
$5f6d(^3F^o)7s$	$^4F^o$	3/2	6691.387	BW92b
		5/2	7331.485	BW92b
		7/2	9720.297	BW92b
		9/2	12488.287	BW92b
$5f6d(^3H^o)7s$	^{o}	9/2	6700.186	BW92b
$6d^3$		3/2	7001.420	BW92b
$6d^2(^1P)7s$		1/2	7828.560	BW92b
$5f(^2F^o)7s^2$	$^2F^o$	7/2	8378.859	BW92b
$6d^3$	^4F	3/2	8460.352	BW92b
		5/2	9400.964	BW92b
		7/2	10855.323	BW92b
		9/2	13248.708	BW92b
$6d^2(^1F)7s$	^2F	5/2	8605.841	BW92b
$5f6d(^1G^o)7s$	$^2G^o$	7/2	9202.265	BW92b
		9/2	9238.020	BW92b
$5f6d(^3G^o)7s$	$^4G^o$	5/2	9585.404	BW92b
		7/2	11116.584	BW92b
		9/2	13468.967	BW92b
		11/2	15349.879	BW92b

Energy Levels of Singly-ionized Thorium (Th II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$6d^2(^1G)7s$	^2G	7/2	9711.962	BW92b
$6d7s(^3D)7p$	^{o}	5/2	24873.983	BW92b
$5f7s(^3F^o)7p$		7/2	27257.149	BW92b
$6d7s(^3D)7p$	^{o}	5/2	28243.812	BW92b
$5f^2(^3F)7s$		9/2	29515.134	BW92b
$5f6d(^3H^o)7p$		9/2	30452.725	BW92b
$6d^2(^3F)7p$	^{o}	5/2	30972.162	BW92b
$6d7s(^3D)7p$	$^4F^o$	7/2	30994.266	BW92b
$6d7s(^3D)7p$	^{o}	3/2	31353.125	BW92b
$6d7s(^3D)7p$	^{o}	5/2	31810.548	BW92b
$6d^2(^3F)7p$	$^4G^o$	7/2	32957.429	BW92b
$6d^2(^3F)7p$	$^4G^o$	11/2	41447.959	BW92b
Th III ($^3H^o_4$)		*Limit*	**96000**	MCS75

Thulium (Tm)
Atomic number = 69
Atomic weight = 168.934 21

Isotope	Mass	Abundance	Spin	Mag moment
^{169}Tm	168.93421	100%	1/2	−0.2316

Tm I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^{13} 6s^2\ ^2F^o_{7/2}$
Ionization energy: 49 879.8 cm^{-1} (6.184 31 eV)

Tm II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^{13} (^2F^o_{7/2}) 6s\ (7/2,1/2)^o_4$
Ionization energy: 97 200 cm^{-1} (12.05 eV)

Strong Lines of Thulium (Tm)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
90	2480.13	Tm II	MCS75
150	2509.08	Tm II	MCS75
40	2552.764	Tm I	SMC73
60	2561.65	Tm II	MCS75
15	2596.489	Tm I	SMC73
90	2607.06	Tm II	MCS75
80	2624.33	Tm II	MCS75
60	2721.19	Tm II	MCS75
80	2794.60	Tm II	MCS75
80	2797.27	Tm II	MCS75
70	2827.92	Tm II	MCS75
20	2854.166	Tm I	SMC73
200	2869.23	Tm II	MCS75
70	2890.94	Tm II	MCS75
80	2926.74	Tm II	MCS75
70	2935.99	Tm II	MCS75
50	2973.218	Tm I	SMC73
60	2981.48	Tm II	MCS75
70	2990.54	Tm II	MCS75
150	3015.30	Tm II	MCS75
70	3073.08	Tm II	MCS75
40	3081.121	Tm I	SMC73
80	3098.60	Tm II	MCS75
800 P	3131.26	Tm II	MCS75
250	3133.89	Tm II	MCS75
200	3151.04	Tm II	MCS75
150	3157.34	Tm II	MCS75
40	3172.654	Tm I	SMC73
250	3172.83	Tm II	MCS75
130	3236.81	Tm II	MCS75
200	3240.23	Tm II	MCS75
250	3241.54	Tm II	MCS75
30	3246.963	Tm I	SMC73
200	3258.05	Tm II	MCS75
200	3266.64	Tm II	MCS75
130	3267.40	Tm II	MCS75
90	3268.99	Tm II	MCS75
120	3276.81	Tm II	MCS75
130	3283.40	Tm II	MCS75
130	3285.61	Tm II	MCS75
250	3291.00	Tm II	MCS75

Strong Lines of Thulium (Tm)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	3302.46	Tm II	MCS75
130	3309.80	Tm II	MCS75
25	3349.987	Tm I	SMC73
400 P	3362.61	Tm II	MCS75
200	3397.50	Tm II	MCS75
80	3410.048	Tm I	SMC73
30	3412.590	Tm I	SMC73
30	3416.588	Tm I	SMC73
700 P	3425.08	Tm II	MCS75
110	3425.63	Tm II	MCS75
30	3429.332	Tm I	SMC73
90	3429.96	Tm II	MCS75
600 P	3441.50	Tm II	MCS75
600 P	3453.66	Tm II	MCS75
1000 P	3462.20	Tm II	MCS75
20	3467.513	Tm I	SMC73
30	3476.692	Tm I	SMC73
30	3480.975	Tm I	SMC73
40	3487.379	Tm I	SMC73
30	3499.948	Tm I	SMC73
25	3517.598	Tm I	SMC73
200	3535.52	Tm II	MCS75
90	3536.58	Tm II	MCS75
40	3537.910	Tm I	SMC73
20	3555.818	Tm I	SMC73
30	3560.916	Tm I	SMC73
40	3563.876	Tm I	SMC73
150	3566.47	Tm II	MCS75
40	3567.356	Tm I	SMC73
30	3586.067	Tm I	SMC73
250	3608.77	Tm II	MCS75
40	3638.408	Tm I	SMC73
110	3643.65	Tm II	MCS75
120	3668.09	Tm II	MCS75
500 P	3700.26	Tm II	MCS75
400 P	3701.36	Tm II	MCS75
800 P	3717.914	Tm I	SMC73
100	3725.06	Tm II	MCS75
250	3734.12	Tm II	MCS75
500 P	3744.064	Tm I	SMC73
150	3751.806	Tm I	SMC73
700 P	3761.33	Tm II	MCS75
500 P	3761.91	Tm II	MCS75
800 P	3795.75	Tm II	MCS75
80	3798.541	Tm I	SMC73
60	3807.719	Tm I	SMC73
60	3817.39	Tm II	MCS75
30	3826.386	Tm I	SMC73
150	3838.20	Tm II	MCS75
30	3840.869	Tm I	SMC73
1000 P	3848.02	Tm II	MCS75
700 P	3883.132	Tm I	SMC73
200	3883.44	Tm II	MCS75
500 P	3887.348	Tm I	SMC73
40	3896.617	Tm I	SMC73
80	3900.79	Tm II	MCS75
400 P	3916.477	Tm I	SMC73
60	3929.58	Tm II	MCS75
150	3949.270	Tm I	SMC73

Strong Lines of Thulium (Tm)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
150	3958.10	Tm II	MCS75
200	3996.52	Tm II	MCS75
20	4024.230	Tm I	SMC73
40	4044.474	Tm I	SMC73
1000 P	4094.187	Tm I	SMC73
1000 P	4105.841	Tm I	SMC73
110	4138.334	Tm I	SMC73
900 P	4187.615	Tm I	SMC73
60	4199.92	Tm II	MCS75
600 P	4203.727	Tm I	SMC73
40	4222.671	Tm I	SMC73
300 P	4242.15	Tm II	MCS75
25	4271.716	Tm I	SMC73
15	4298.365	Tm I	SMC73
250 P	4359.928	Tm I	SMC73
140 P	4386.434	Tm I	SMC73
20	4394.420	Tm I	SMC73
14	4396.495	Tm I	SMC73
60	4481.26	Tm II	MCS75
15	4519.595	Tm I	SMC73
30	4522.57	Tm II	MCS75
25	4599.017	Tm I	SMC73
30	4615.94	Tm II	MCS75
15	4681.920	Tm I	SMC73
70 P	4733.335	Tm I	SMC73
14	4957.175	Tm I	SMC73
20	5009.77	Tm II	MCS75
20	5034.22	Tm II	MCS75
15	5060.895	Tm I	SMC73
60 P	5307.116	Tm I	SMC73
25	5631.406	Tm I	SMC73
50 P	5675.835	Tm I	SMC73
20	5764.287	Tm I	SMC73
14	5971.264	Tm I	SMC73
20	6460.261	Tm I	SMC73
14	7558.33	Tm I	SMC73

Persistent Lines of Neutral Thulium (Tm I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	3717.914	1.44	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	WL97
			$4f^{12}(^3H_5)5d_{5/2}6s^2$	(5,5/2)	9/2	26889.125		
500	3744.064	0.990	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	WL97
			$4f^{13}(^2F^o_{7/2})6s6p(^1P^o_1)$		7/2	26701.325		
700	3883.132	1.06	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	WL97
			$4f^{13}(^2F^o_{7/2})6s6p(^1P^o_1)$		5/2	25745.117		
500	3887.348	0.372	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	WL97
			$4f^{12}(^3H_5)5d_{5/2}6s^2$	(5,5/2)	7/2	25717.197		
400	3916.477	1.98	$4f^{13}(^2F^o)6s^2$	$^2F^o$	5/2	8771.243	SMC73	WL97
			$4f^{13}(^2F^o_{5/2})6s6p(^1P^o_1)$	(5/2,1)	7/2	34297.17		
1000	4094.187	0.979	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	WL97
			$4f^{13}(^2F^o_{7/2})6s6p(^1P^o_1)$	(7/2,1)	5/2	24418.018		

Persistent Lines of Neutral Thulium (Tm I)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	4105.841	0.636	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	WL97
			$4f^{12}(^3H_5)5d_{3/2}6s^2$	(5,3/2)	9/2	24348.692		
900	4187.615	0.640	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	WL97
			$4f^{12}(^3F_4)5d_{5/2}6s^2$		7/2	23873.207		
600	4203.727	0.243	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	WL97
			$4f^{12}(^3F_4)5d_{5/2}6s^2$	(4,5/2)	9/2	23781.698		
250	4359.928	0.120	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	WL97
			$4f^{12}(^3H_5)5d_{5/2}6s^2$		5/2	22929.717		
140	4386.434	0.037	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	WL97
			$4f^{12}(^3H_5)5d_{3/2}6s^2$	(5,3/2)	7/2	22791.176		
70	4733.335	0.020	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	WL97
			$4f^{12}(^3F_4)5d_{3/2}6s^2$	(4,3/2)	7/2	21120.836		
60	5307.116	0.022	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	WL97
			$4f^{12}(^3H_6)5d_{5/2}6s^2$	(6,5/2)	9/2	18837.385		
50	5675.835	0.013	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	SMC73	M00
			$4f^{13}(^2F^o_{7/2})6s6p(^3P^o_1)$	(7/2,1)	9/2	17613.659		

Energy Levels of Neutral Thulium (Tm I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	0.000	MZH78
		5/2	8771.243	MZH78
$4f^{12}(^3H_6)5d_{3/2}6s^2$	(6,3/2)	9/2	13119.610	MZH78
		15/2	15271.002	MZH78
		11/2	15587.811	MZH78
		13/2	17454.818	MZH78
$4f^{12}(^3H_6)5d_{5/2}6s^2$	(6,5/2)	17/2	16456.913	MZH78
		7/2	16957.006	MZH78
		15/2	18693.074	MZH78
		9/2	18837.385	MZH78
		11/2	18853.823	MZH78
		13/2	19466.663	MZH78
$4f^{13}(^2F^o_{7/2})6s6p(^3P^o_0)$	(7/2,0)	7/2	16742.237	MZH78
$4f^{13}(^2F^o_{7/2})6s6p(^3P^o_1)$	(7/2,1)	7/2	17343.374	MZH78
		9/2	17613.659	MZH78
		5/2	17752.634	MZH78
$4f^{13}(^2F^o_{7/2})6s6p(^3P^o_2)$	(7/2,2)	11/2	18990.406	MZH78
		3/2	19132.245	MZH78
		5/2	19548.834	MZH78
		9/2	19748.543	MZH78
		7/2	19753.830	MZH78
$4f^{13}(^2F^o_{7/2})5d6s(^3D)$	$^3[3/2]^o$	5/2	20406.840	MZH78
		3/2	21799.380	MZH78
		1/2	24160.63	MZH78

Energy Levels of Neutral Thulium (Tm I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{12}(^3F_4)5d_{3/2}6s^2$	(4,3/2)	7/2	21120.836	MZH78
		5/2	21161.401	MZH78
		9/2	21737.685	MZH78
		11/2	21997.473	MZH78
$4f^{13}(^2F^o_{7/2})5d6s(^3D)$	$^3[11/2]^o$	9/2	22419.764	MZH78
		11/2	22559.502	MZH78
		13/2	22742.777	MZH78
$4f^{12}(^3H_6)6s^26p_{1/2}$	$(6,1/2)^o$	11/2	22468.046	MZH78
		13/2	22902.127	MZH78
$4f^{12}(^3H_5)5d_{3/2}6s^2$	(5,3/2)	7/2	22791.176	MZH78
		13/2	23374.681	MZH78
		9/2	24348.692	MZH78
		11/2	25488.545	MZH78
$4f^{12}(^3H_5)5d_{5/2}6s^2$		5/2	22929.717	MZH78
$4f^{12}(^3F_4)5d_{5/2}6s^2$	(4,5/2)	11/2	23309.979	MZH78
$4f^{13}(^2F^o_{7/2})5d6s(^3D)$	$^3[5/2]^o$	7/2	23335.111	MZH78
		5/2	23431.844	MZH78
		3/2	23574.415	MZH78
$4f^{12}(^3F_4)5d_{5/2}6s^2$	(4,5/2)	9/2	23781.698	MZH78
$4f^{12}(^3F_4)5d_{5/2}6s^2$		7/2	23873.207	MZH78
$4f^{12}(^3F_4)5d_{5/2}6s^2$		3/2	23882.41	MZH78
$4f^{13}(^2F^o_{7/2})5d6s(^3D)$	$^3[7/2]^o$	9/2	23941.071	MZH78
		5/2	24611.303	MZH78
		7/2	24708.041	MZH78
$4f^{12}(^3F_4)5d_{5/2}6s^2$		13/2	24137.196	MZH78
$4f^{13}(^2F^o_{7/2})5d6s(^3D)$	$^3[9/2]^o$	7/2	24246.425	MZH78
		9/2	24701.058	MZH78
		11/2	24957.469	MZH78
$4f^{13}(^2F^o_{7/2})6s6p(^1P^o_1)$	(7/2,1)	5/2	24418.018	MZH78
$4f^{12}(^3H_5)5d_{5/2}6s^2$	(5,5/2)	15/2	25130.453	MZH78
		7/2	25717.197	MZH78
		9/2	26889.125	MZH78
		13/2	27377.13	MZH78
		11/2	27491.31	MZH78
$4f^{13}(^2F^o_{7/2})6s6p(^1P^o_1)$		5/2	25745.117	MZH78
$4f^{13}(^2F^o_{7/2})6s6p(^1P^o_1)$		7/2	26701.325	MZH78
$4f^{13}(^2F^o_{5/2})6s6p(^1P^o_1)$	(5/2,1)	7/2	34297.17	MZH78
Tm II $(^2F^o_{7/2})6s_{1/2}$ $(7/2,1/2)^o_4$		*Limit*	**49879.8**	C71

Persistent Lines of Singly-ionized Thulium (Tm II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
800	3131.26	1.06	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	4	0.00	MCS75	WL97
			$4f^{12}5d6s$		5	31926.82		
400	3362.61	0.934	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	3	236.95	MCS75	WL97
			$4f^{12}5d6s$		2	29967.17		
700	3425.08	0.652	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	3	236.95	MCS75	WL97
			$4f^{12}5d6s$		3	29424.98		
600	3441.50	0.560	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	3	236.95	MCS75	WL97
			$4f^{13}6p$		2	29285.72		
600	3453.66	0.266	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	3	236.95	MCS75	WL97
			$4f^{12}5d6s$		4	29183.39		
1000	3462.20	0.540	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	4	0.00	MCS75	WL97
			$4f^{12}5d6s$		5	28875.12		
500	3700.26	0.223	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	3	236.95	MCS75	WL97
			$4f^{12}5d6s$		4	27254.42		
400	3701.36	0.157	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	4	0.00	MCS75	WL97
			$4f^{12}5d6s$		4	27009.39		
700	3761.33	0.351	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	4	0.00	MCS75	WL97
			$4f^{12}(^3F)6s^2$	^3F	3	26578.77		
500	3761.91	0.194	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	4	0.00	MCS75	WL97
			$4f^{12}5d6s$		4	26574.66		
800	3795.75	0.300	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	3	236.95	MCS75	WL97
			$4f^{12}5d6s$		4	26574.66		
1000	3848.02	0.466	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	4	0.00	MCS75	WL97
			$4f^{13}6p$		3	25980.02		
300	4242.15	0.0465	$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	3	236.95	MCS75	WL97
			$4f^{12}5d6s$		4	23803.28		

Energy Levels of Singly-ionized Thulium (Tm II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{13}(^2F^o_{7/2})6s_{1/2}$	$(7/2,1/2)^o$	4	0.00	MZH78
		3	236.95	MZH78
$4f^{13}(^2F^o_{5/2})6s_{1/2}$	$(5/2,1/2)^o$	2	8769.68	MZH78
		3	8957.47	MZH78
$4f^{12}(^3H)6s^2$	^3H	6	12457.29	MZH78
		5	20619.05	MZH78
		4	24932.00	MZH78
$4f^{12}(^3H_6)5d6s(^3D_1)$	(6,1)	5	16567.47	MZH78
		7	19619.08	MZH78
		6	22355.43	MZH78
$4f^{13}(^2F^o_{7/2})5d_{3/2}$	$(7/2,3/2)^o$	2	17624.65	MZH78
		5	20228.75	MZH78
		3	21713.74	MZH78
		4	22457.51	MZH78

Energy Levels of Singly-ionized Thulium (Tm II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{12}(^3F)6s^2$	^3F	4	17974.30	MZH78
		3	26578.77	MZH78
		2	—	
$4f^{12}(^3H_6)5d6s(^3D_2)$	(6,2)	4	18291.37	MZH78
		6	19526.82	MZH78
		8	19682.97	MZH78
		7	22052.39	MZH78
$4f^{12}(^3H_6)5d6s(^3D_3)$	(6,3)	9	20465.82	MZH78
		3	21608.26	MZH78
		8	23024.29	MZH78
		5	23768.84	MZH78
		6	23904.43	MZH78
		7	23961.60	MZH78
$4f^{12}5d6s$		5	21021.98	MZH78
$4f^{13}(^2F^o_{7/2})5d_{5/2}$	$(7/2,5/2)^o$	6	21133.68	MZH78
		2	21978.77	MZH78
		1	22141.96	MZH78
		4	23524.09	MZH78
		3	23934.73	MZH78
		5	24273.20	MZH78
$4f^{12}5d6s$		4	22308.82	MZH78
$4f^{12}5d6s$		4	23803.28	MZH78
$4f^{13}6p$		3	25980.02	MZH78
$4f^{12}5d6s$		4	26574.66	MZH78
$4f^{12}5d6s$		4	27009.39	MZH78
$4f^{12}5d6s$		4	27254.42	MZH78
$4f^{12}5d6s$		5	28875.12	MZH78
$4f^{12}5d6s$		4	29183.39	MZH78
$4f^{13}6p$		2	29285.72	MZH78
$4f^{12}5d6s$		3	29424.98	MZH78
$4f^{12}5d6s$		2	29967.17	MZH78
$4f^{12}5d6s$		5	31926.82	MZH78
Tm III ($^2F^o_{7/2}$)		*Limit*	**92700**	SR65

Tin (Sn)
Atomic number = 50
Atomic weight = 118.710

Isotope	Mass	Abundance	Spin	Mag moment
^{112}Sn	111.904826	0.97%	0	
^{114}Sn	113.902784	0.65%	0	
^{115}Sn	114.903348	0.36%	1/2	−0.918
^{116}Sn	115.901747	14.53%	0	
^{117}Sn	116.902956	7.68%	1/2	−1.000
^{118}Sn	117.901609	24.22%	0	
^{119}Sn	118.903310	8.58%	1/2	−1.046
^{120}Sn	119.902220	32.59%	0	
^{122}Sn	121.903440	4.63%	0	
^{124}Sn	123.905724	5.79%	0	

Sn I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^2\ ^3P_0$
Ionization energy: 59 232.7 cm^{-1} (7.343 92 eV)

Sn II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p\ ^2P^o_{1/2}$
Ionization energy: 118 017.0 cm^{-1} (14.6322 eV)

Strong Lines of Tin (Sn)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
600	1223.721	Sn II	B64
500	1242.926	Sn II	B64
1000	1290.880	Sn II	B64
1000	1316.576	Sn II	B64
1000 P	1400.440	Sn II	B64
1000 P	1474.997	Sn II	B64
300	1811.201	Sn II	B64
140	1860.330	Sn I	B64
300 P	1899.881	Sn II	B64
	Air		
200 P	2091.590	Sn I	B64
80 P	2150.844	Sn II	B64
200 P	2199.346	Sn I	B64
300 P	2209.660	Sn I	B64
300 P	2246.057	Sn I	B64
80 P	2266.016	Sn II	B64
300 P	2268.930	Sn I	B64
300	2286.681	Sn I	B64
400	2317.230	Sn I	B64
400	2334.812	Sn I	B64
700 P	2354.850	Sn I	B64
80 P	2368.226	Sn II	B64
600 P	2421.694	Sn I	B64
700 P	2429.495	Sn I	B64
25	2448.908	Sn II	B64
200	2483.410	Sn I	B64
60	2486.967	Sn II	B64
140	2495.724	Sn I	B64
300	2546.549	Sn I	B64
400	2571.594	Sn I	B64
140	2594.421	Sn I	B64
140 P	2661.244	Sn I	B64

Strong Lines of Tin (Sn)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500 P	2706.505	Sn I	B64
1000 P	2839.976	Sn I	B64
700 P	2863.315	Sn I	B64
140	2913.559	Sn I	B64
500 P	3009.133	Sn I	B64
140	3032.778	Sn I	B64
600 P	3034.115	Sn I	B64
400 P	3175.035	Sn I	B64
400 P	3262.331	Sn I	B64
50 P	3283.140	Sn II	B64
60 P	3351.952	Sn II	B64
200 P	3801.011	Sn I	B64
110 P	4524.734	Sn I	B64
30 P	5332.339	Sn II	B64
30 P	5561.910	Sn II	B64
30 P	5588.815	Sn II	B64
60	5631.676	Sn I	B64
30 P	5798.860	Sn II	B64
30	6054.674	Sn I	B64
40	6069.117	Sn I	B64
40	6149.604	Sn I	B64
20	6154.446	Sn I	B64
50 P	6453.542	Sn II	B64
30 P	6844.186	Sn II	B64
20	7190.776	Sn II	B64
15	7741.425	Sn II	B64
20	8114.030	Sn I	B64
20	8422.624	Sn I	B64
30	8552.531	Sn I	B64
20 h	9805.184	Sn I	B64
40	9850.381	Sn I	B64
11	11454.407	Sn I	B64
9	11616.152	Sn I	B64
11	11739.591	Sn I	B64
9	11932.82	Sn I	B64
14	12981.01	Sn I	B64
14	13459.2	Sn I	B64

Persistent Lines of Neutral Tin (Sn I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
200	2091.590		$5p^2$	^3P	1	1691.806	B64	
			$5p5d$	$^3P^o$	0	49487.127		
200	2199.346	0.29	$5p^2$	^3P	1	1691.806	B64	FW96
			$5p5d$	$^3F^o$	2	47145.684		
300	2209.660	0.56	$5p^2$	^3P	2	3427.673	B64	FW96
			$5p5d$	$^3P^o$	2	48669.409		
300	2246.057	1.48	$5p^2$	^3P	0	0.000	B64	M00
			$5p5d$	$^3D^o$	1	44508.677		
300	2268.930	1.14	$5p^2$	^3P	2	3427.673	B64	M00
			$5p5d$	$^3F^o$	3	47487.696		
700	2354.850	1.85	$5p^2$	^3P	1	1691.806	B64	M00
			$5p5d$	$^3D^o$	2	44144.368		

Persistent Lines of Neutral Tin (Sn I)—Continued

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	2421.694	2.5	$5p^2$	^{1}D	2	8612.955	B64	FW96
			$5p5d$	^{1}F^o	3	49893.823		
700	2429.495	1.5	$5p^2$	^{3}P	2	3427.673	B64	FW96
			$5p5d$	^{3}D^o	3	44576.006		
140	2661.244	0.153	$5p^2$	^{3}P	1	1691.806	B64	M00
			$5p6s$	^{1}P^o	1	39257.053		
500	2706.505	0.539	$5p^2$	^{3}P	1	1691.806	B64	M00
			$5p6s$	^{3}P^o	2	38628.876		
1000	2839.976	1.57	$5p^2$	^{3}P	2	3427.673	B64	M00
			$5p6s$	^{3}P^o	2	38628.876		
700	2863.315	0.544	$5p^2$	^{3}P	0	0.000	B64	M00
			$5p6s$	^{3}P^o	1	34914.282		
500	3009.133	0.355	$5p^2$	^{3}P	1	1691.806	B64	M00
			$5p6s$	^{3}P^o	1	34914.282		
600	3034.115	1.89	$5p^2$	^{3}P	1	1691.806	B64	M00
			$5p6s$	^{3}P^o	0	34640.758		
400	3175.035	0.893	$5p^2$	^{3}P	2	3427.673	B64	M00
			$5p6s$	^{3}P^o	1	34914.282		
400	3262.331	2.7	$5p^2$	^{1}D	2	8612.955	B64	FW96
			$5p6s$	^{1}P^o	1	39257.053		
200	3801.011	0.28	$5p^2$	^{1}D	2	8612.955	B64	FW96
			$5p6s$	^{3}P^o	1	34914.282		
110	4524.734	0.26	$5p^2$	^{1}S	0	17162.499	B64	FW96
			$5p6s$	^{1}P^o	1	39257.053		

Energy Levels of Neutral Tin (Sn I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5p^2$	^{3}P	0	0.000	B64
		1	1691.806	B64
		2	3427.673	B64
$5p^2$	^{1}D	2	8612.955	B64
$5p^2$	^{1}S	0	17162.499	B64
$5p6s$	^{3}P^o	0	34640.758	B64
		1	34914.282	B64
		2	38628.876	B64
$5p6s$	^{1}P^o	1	39257.053	B64
$5s5p^3$	^{5}S^o	2	39625.506	B64
$5p6p$	^{3}D	1	42342.216	B64
		2	43430.135	B64
		3	47006.830	B64
$5p6p$	^{1}P	1	43368.634	B64
$5p5d$	^{1}D^o	2	43682.737	B64

Energy Levels of Neutral Tin (Sn I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5p6p$	^{3}P	0	43799.085	B64
		1	46603.517	B64
		2	47235.221	B64
$5p5d$	^{3}D^o	2	44144.368	B64
		1	44508.677	B64
		3	44576.006	B64
$5p5d$	^{3}F^o	2	47145.684	B64
		3	47487.696	B64
		4	48107.27	B64
$5p6p$	^{3}S	1	47805.840	B64
$5p6p$	^{1}D	2	48189.791	B64
$5p5d$	^{3}P^o	2	48669.409	B64
		1	48981.934	B64
		0	49487.127	B64
$5p6p$	^{1}S	0	49406.162	B64
$5p5d$	^{1}F^o	3	49893.823	B64
$5p5d$	^{1}P^o	1	50125.971	B64
Sn II (^{2}P$^o_{1/2}$)		*Limit*	**59232.7**	BTG77

Persistent Lines of Singly-ionized Tin (Sn II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1400.440	17.5	$5s^2(^1S)5p$	^{2}P^o	1/2	0.000	B64	M00
			$5s^2(^1S)5d$	^{2}D	3/2	71406.139		
1000	1474.997	19.5	$5s^2(^1S)5p$	^{2}P^o	3/2	4251.494	B64	M00
			$5s^2(^1S)5d$	^{2}D	5/2	72048.257		
300	1899.881	5.90	$5s^2(^1S)5p$	^{2}P^o	3/2	4251.494	B64	M00
			$5s^2(^1S)6s$	^{2}S	1/2	56886.365		
80	2150.844		$5s^2(^1S)5p$	^{2}P^o	3/2	4251.494	B64	
			$5s5p^2$	^{4}P	5/2	50730.255		
80	2266.016		$5s^2(^1S)5p$	^{2}P^o	3/2	4251.494	B64	
			$5s5p^2$	^{4}P	3/2	48368.188		
80	2368.226	0.0044	$5s^2(^1S)5p$	^{2}P^o	3/2	4251.494	B64	FW96
			$5s5p^2$	^{4}P	1/2	46464.291		
50	3283.140	1.0	$5s5p^2$	^{2}D	3/2	58844.182	B64	FW96
			$5s^2(^1S)4f$	^{2}F^o	5/2	89294.052		
60	3351.952	1.0	$5s5p^2$	^{2}D	5/2	59463.482	B64	FW96
			$5s^2(^1S)4f$	^{2}F^o	7/2	89288.248		
30	5332.339	0.86	$5s^2(^1S)6p$	^{2}P^o	1/2	71493.275	B64	FW96
			$5s^2(^1S)6d$	^{2}D	3/2	90241.555		
30	5561.910	1.2	$5s^2(^1S)6p$	^{2}P^o	3/2	72377.450	B64	FW96
			$5s^2(^1S)6d$	^{2}D	5/2	90351.894		

Persistent Lines of Singly-ionized Tin (Sn II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
30	5588.815	0.85	$5s^2(^1S)5d$	^2D	3/2	71406.139	B64	FW96
			$5s^2(^1S)4f$	$^2F^o$	5/2	89294.052		
30	5798.860	0.81	$5s^2(^1S)5d$	^2D	5/2	72048.257	B64	FW96
			$5s^2(^1S)4f$	$^2F^o$	7/2	89288.248		
50	6453.542	1.2	$5s^2(^1S)6s$	^2S	1/2	56886.365	B64	FW96
			$5s^2(^1S)6p$	$^2P^o$	3/2	72377.450		
30	6844.186	0.66	$5s^2(^1S)6s$	^2S	1/2	56886.365	B64	FW96
			$5s^2(^1S)6p$	$^2P^o$	1/2	71493.275		

Energy Levels of Singly-ionized Tin (Sn II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5s^2(^1S)5p$	$^2P^o$	1/2	0.000	B64
		3/2	4251.494	B64
$5s5p^2$	^4P	1/2	46464.291	B64
		3/2	48368.188	B64
		5/2	50730.255	B64
$5s^2(^1S)6s$	^2S	1/2	56886.365	B64
$5s5p^2$	^2D	3/2	58844.182	B64
		5/2	59463.482	B64
$5s^2(^1S)5d$	^2D	3/2	71406.139	B64
		5/2	72048.257	B64
$5s^2(^1S)6p$	$^2P^o$	1/2	71494.275	B64
		3/2	72377.450	B64
$5s^2(^1S)4f$	$^2F^o$	7/2	89288.248	B64
		5/2	89294.052	B64
$5s^2(^1S)6d$	^2D	3/2	90241.555	B64
		5/2	90351.894	B64
Sn III $(^1S_0)$		*Limit*	**118017.0**	M58

Titanium (Ti)
Atomic number = 22
Atomic weight = 47.88

Isotope	Mass	Abundance	Spin	Mag moment
^{46}Ti	45.952629	8.0%	0	
^{47}Ti	46.951764	7.43%	5/2	−0.7885
^{48}Ti	47.947947	73.8%	0	
^{49}Ti	48.947871	5.5%	7/2	−1.0417
^{50}Ti	49.944792	5.4%	0	

Ti I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2\ ^3F_2$
Ionization energy: 55 072.5 cm^{-1} (6.828 12 eV)

Ti II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s\ ^4F_{3/2}$
Ionization energy: 109 494 cm^{-1} (13.5755 eV)

Strong Lines of Titanium (Ti)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
25	2279.967	Ti I	F91
25	2305.674	Ti I	F91
30	2525.586	Ti II	HJLW82
25	2529.871	Ti I	F91
25	2541.908	Ti I	F91
25	2593.640	Ti I	F91
30	2599.904	Ti I	F91
40	2605.133	Ti I	F91
70	2611.285	Ti I	F91
40	2619.933	Ti I	F91
80	2641.087	Ti I	F91
100	2644.253	Ti I	F91
120	2646.625	Ti I	F91
30	2802.494	Ti I	F91
60	2912.083	Ti I	F91
40	2928.327	Ti I	F91
150	2948.242	Ti I	F91
200	2956.123	Ti I	F91
25	2967.225	Ti I	F91
110 d	3066.229	Ti II	HJLW82
50	3072.117	Ti II	HJLW82
90	3072.986	Ti II	HJLW82
130	3075.231	Ti II	HJLW82
200 P	3078.651	Ti II	HJLW82
300 P	3088.042	Ti II	HJLW82
90	3119.723	Ti I	F91
25	3123.073	Ti I	F91
40	3161.231	Ti II	HJLW82
60	3161.798	Ti II	HJLW82
80	3162.586	Ti II	HJLW82
130	3168.550	Ti II	HJLW82
300	3186.451	Ti I	F91
80	3190.914	Ti II	HJLW82
400	3191.993	Ti I	F91
500	3199.915	Ti I	F91
60	3202.559	Ti II	HJLW82
30	3203.825	Ti I	F91

Strong Lines of Titanium (Ti)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
30	3214.237	Ti I	F91
90	3217.073	Ti II	HJLW82
110	3222.839	Ti II	HJLW82
40	3228.618	Ti II	HJLW82
60	3229.194	Ti II	HJLW82
40	3229.430	Ti II	HJLW82
600 P	3234.513	Ti II	HJLW82
400 P	3236.581	Ti II	HJLW82
300 P	3239.038	Ti II	HJLW82
200	3241.994	Ti II	HJLW82
100	3248.605	Ti II	HJLW82
80	3251.909	Ti II	HJLW82
100	3252.916	Ti II	HJLW82
100	3254.251	Ti II	HJLW82
100	3261.585	Ti II	HJLW82
40	3287.657	Ti II	HJLW82
40	3292.076	Ti I	F91
30	3309.497	Ti I	F91
110	3314.421	Ti I	F91
30	3318.021	Ti II	HJLW82
50	3321.697	Ti II	HJLW82
250	3322.939	Ti II	HJLW82
30	3326.765	Ti II	HJLW82
200	3329.458	Ti II	HJLW82
50	3332.112	Ti II	HJLW82
150	3335.182	Ti II	HJLW82
90	3340.341	Ti II	HJLW82
700	3341.874	Ti I	F91
30	3346.745	Ti II	HJLW82
400 P	3349.029	Ti II	HJLW82
1000 P	3349.405	Ti II	HJLW82
500	3354.633	Ti I	F91
40	3358.271	Ti I	F91
40	3360.989	Ti I	F91
600 P	3361.227	Ti II	HJLW82
40	3361.266	Ti I	F91
140	3370.434	Ti I	F91
600	3371.452	Ti I	F91
500 P	3372.798	Ti II	HJLW82
150	3377.486	Ti I	F91
400	3377.575	Ti I	F91
40	3379.211	Ti I	F91
120	3380.277	Ti II	HJLW82
500 P	3383.769	Ti II	HJLW82
20	3385.660	Ti I	F91
200	3385.941	Ti I	F91
120	3387.840	Ti II	HJLW82
90	3394.578	Ti II	HJLW82
70	3444.322	Ti II	HJLW82
50	3461.507	Ti II	HJLW82
50	3477.187	Ti II	HJLW82
30	3480.525	Ti I	F91
40	3491.072	Ti II	HJLW82
70	3504.900	Ti II	HJLW82
50	3510.862	Ti II	HJLW82
25	3547.028	Ti I	F91
25	3598.713	Ti I	F91
80	3610.153	Ti I	F91
600 P	3635.462	Ti I	F91

Strong Lines of Titanium (Ti)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
800 P	3642.674	Ti I	F91
25	3646.196	Ti I	F91
900 P	3653.495	Ti I	F91
40	3654.590	Ti I	F91
80	3658.095	Ti I	F91
50	3660.629	Ti I	F91
50	3668.963	Ti I	F91
80	3671.671	Ti I	F91
250 P	3685.205	Ti II	HJLW82
80	3689.914	Ti I	F91
40	3709.957	Ti I	F91
60	3717.391	Ti I	F91
40	3722.570	Ti I	F91
80	3724.569	Ti I	F91
400	3729.806	Ti I	F91
400	3741.060	Ti I	F91
30	3741.644	Ti II	HJLW82
700 P	3752.858	Ti I	F91
80	3753.633	Ti I	F91
300 P	3759.300	Ti II	HJLW82
250 P	3761.326	Ti II	HJLW82
80	3771.651	Ti I	F91
110	3786.042	Ti I	F91
30	3866.439	Ti I	F91
30	3875.257	Ti I	F91
60	3882.891	Ti I	F91
40	3900.559	Ti II	HJLW82
25	3900.959	Ti I	F91
300	3904.784	Ti I	F91
40	3913.477	Ti II	HJLW82
60	3914.334	Ti I	F91
40	3921.422	Ti I	F91
140	3924.526	Ti I	F91
110	3929.874	Ti I	F91
140	3947.769	Ti I	F91
600 P	3948.670	Ti I	F91
600 P	3956.334	Ti I	F91
700 P	3958.201	Ti I	F91
120	3962.851	Ti I	F91
120	3964.269	Ti I	F91
600 P	3981.761	Ti I	F91
70	3982.480	Ti I	F91
700 P	3989.758	Ti I	F91
1000 P	3998.636	Ti I	F91
120	4008.927	Ti I	F91
25	4009.656	Ti I	F91
150	4024.571	Ti I	F91
25 h	4030.511	Ti I	F91
40	4055.011	Ti I	F91
50	4060.262	Ti I	F91
25	4064.209	Ti I	F91
25	4065.095	Ti I	F91
110	4078.470	Ti I	F91
40	4082.455	Ti I	F91
30	4112.708	Ti I	F91
50	4186.117	Ti I	F91
40	4263.133	Ti I	F91
30	4274.588	Ti I	F91
30	4282.698	Ti I	F91

Strong Lines of Titanium (Ti)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
110	4286.003	Ti I	F91
110	4287.402	Ti I	F91
120	4289.070	Ti I	F91
110	4290.929	Ti I	F91
110	4295.748	Ti I	F91
250	4298.665	Ti I	F91
25	4299.202	Ti I	F91
25	4299.629	Ti I	F91
400	4300.554	Ti I	F91
500	4301.079	Ti I	F91
800 P	4305.907	Ti I	F91
150	4314.800	Ti I	F91
50	4318.629	Ti I	F91
25	4325.126	Ti I	F91
20	4393.922	Ti I	F91
30	4395.004	Ti II	HJLW82
30	4417.273	Ti I	F91
110	4427.098	Ti I	F91
110	4449.143	Ti I	F91
70	4450.894	Ti I	F91
110	4453.312	Ti I	F91
40	4453.698	Ti I	F91
120	4455.317	Ti I	F91
140	4457.426	Ti I	F91
40	4465.805	Ti I	F91
30	4471.236	Ti I	F91
70	4481.258	Ti I	F91
30	4489.087	Ti I	F91
30	4496.145	Ti I	F91
100	4512.733	Ti I	F91
130	4518.021	Ti I	F91
130	4522.796	Ti I	F91
100	4527.305	Ti I	F91
800	4533.239	Ti I	F91
500	4534.775	Ti I	F91
300	4535.567	Ti I	F91
150	4535.918	Ti I	F91
150	4536.039	Ti I	F91
90	4544.687	Ti I	F91
120	4548.763	Ti I	F91
120	4552.453	Ti I	F91
90	4555.483	Ti I	F91
120	4617.268	Ti I	F91
60	4623.097	Ti I	F91
25	4629.336	Ti I	F91
30	4639.360	Ti I	F91
30	4639.660	Ti I	F91
25	4639.939	Ti I	F91
90	4656.468	Ti I	F91
110	4667.584	Ti I	F91
120	4681.908	Ti I	F91
25	4691.331	Ti I	F91
25	4698.760	Ti I	F91
40	4758.118	Ti I	F91
40	4759.269	Ti I	F91
25	4820.410	Ti I	F91
60	4840.873	Ti I	F91
40	4856.010	Ti I	F91
25	4868.259	Ti I	F91

Strong Lines of Titanium (Ti)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
30	4870.127	Ti I	F91
50	4885.081	Ti I	F91
50	4899.908	Ti I	F91
40	4913.615	Ti I	F91
700 P	4981.730	Ti I	F91
600 P	4991.066	Ti I	F91
500	4999.501	Ti I	F91
30	5000.988	Ti I	F91
500 P	5007.206	Ti I	F91
30	5013.281	Ti I	F91
400 P	5014.186	Ti I	F91
300	5014.275	Ti I	F91
70	5016.160	Ti I	F91
110	5020.024	Ti I	F91
110	5022.866	Ti I	F91
70	5024.843	Ti I	F91
40	5025.569	Ti I	F91
150	5035.902	Ti I	F91
110	5036.463	Ti I	F91
90	5038.396	Ti I	F91
150 P	5039.955	Ti I	F91
200 P	5064.651	Ti I	F91
25	5113.439	Ti I	F91
30	5120.415	Ti I	F91
30	5145.459	Ti I	F91
30	5147.477	Ti I	F91
25	5152.184	Ti I	F91
140 P	5173.740	Ti I	F91
150 P	5192.969	Ti I	F91
200 P	5210.384	Ti I	F91
30	5224.304	Ti I	F91
25	5224.933	Ti I	F91
40	5512.523	Ti I	F91
30	5514.343	Ti I	F91
40	5514.531	Ti I	F91
30	5644.132	Ti I	F91
25	5662.147	Ti I	F91
50	5866.448	Ti I	F91
30	5899.291	Ti I	F91
40	5953.156	Ti I	F91
25	5965.824	Ti I	F91
30	5978.538	Ti I	F91
40	5999.008	Ti I	F91
50	6258.099	Ti I	F91
50	6258.705	Ti I	F91
40	6261.096	Ti I	F91
30	7209.434	Ti I	F91
20	8426.504	Ti I	F91
60	8434.959	Ti I	F91
30	8435.648	Ti I	F91

Persistent Lines of Neutral Titanium (Ti I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	3635.462	0.909	$3d^24s^2$	a ^3F	2	0.000	F91	M03
			$3d^2(^3F)4s4p(^1P^o)$	y $^3G^o$	3	27498.983		
800	3642.674	0.895	$3d^24s^2$	a ^3F	3	170.134	F91	M03
			$3d^2(^3F)4s4p(^1P^o)$	y $^3G^o$	4	27614.678		
900	3653.495	0.869	$3d^24s^2$	a ^3F	4	386.875	F91	M03
			$3d^2(^3F)4s4p(^1P^o)$	y $^3G^o$	5	27750.136		
700	3752.858	0.581	$3d^24s^2$	a ^3F	4	386.875	F91	M03
			$3d^2(^1D)4s4p(^3P^o)$	x $^3F^o$	4	27025.658		
600	3948.670	0.560	$3d^24s^2$	a ^3F	2	0.000	F91	M03
			$3d^3(^4F)4p$	y $^3D^o$	1	25317.815		
600	3956.334	0.346	$3d^24s^2$	a ^3F	3	170.134	F91	M03
			$3d^3(^4F)4p$	y $^3D^o$	2	25438.906		
700	3958.201	0.488	$3d^24s^2$	a ^3F	4	386.875	F91	M03
			$3d^3(^4F)4p$	y $^3D^o$	3	25643.699		
600	3981.761	0.442	$3d^24s^2$	a ^3F	2	0.000	F91	M03
			$3d^2(^3F)4s4p(^1P^o)$	y $^3F^o$	2	25107.410		
700	3989.758	0.448	$3d^24s^2$	a ^3F	3	170.134	F91	M03
			$3d^2(^3F)4s4p(^1P^o)$	y $^3F^o$	3	25227.220		
1000	3998.636	0.481	$3d^24s^2$	a ^3F	4	386.875	F91	M03
			$3d^2(^3F)4s4p(^1P^o)$	y $^3F^o$	4	25388.331		
800	4305.907		$3d^3(^4F)4s$	a ^5F	5	6842.965	F91	
			$3d^3(^4F)4p$	x $^5D^o$	4	30060.338		
700	4981.730	0.660	$3d^3(^4F)4s$	a ^5F	5	6842.965	F91	FW96
			$3d^3(^4F)4p$	y $^5G^o$	6	26910.712		
600	4991.066	0.584	$3d^3(^4F)4s$	a ^5F	4	6742.755	F91	FW96
			$3d^3(^4F)4p$	y $^5G^o$	5	26772.969		
400	5007.206	0.492	$3d^3(^4F)4s$	a ^5F	2	6598.764	F91	FW96
			$3d^3(^4F)4p$	y $^5G^o$	3	26564.398		
400	5014.186	0.0611	$3d^24s^2$	a ^3F	2	0.000	F91	M03
			$3d^2(^3F)4s4p(^3P^o)$	z $^3D^o$	1	19937.852		
200	5064.651	0.0437	$3d^24s^2$	a ^3F	4	386.875	F91	M03
			$3d^2(^3F)4s4p(^3P^o)$	z $^3D^o$	3	20126.060		
200	5210.384	0.0411	$3d^24s^2$	a ^3F	4	386.875	F91	M03
			$3d^2(^3F)4s4p(^3P^o)$	z $^3F^o$	4	19573.973		

Energy Levels of Neutral Titanium (Ti I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^24s^2$	a ^{3}F	2	0.000	F91
		3	170.134	F91
		4	386.875	F91
$3d^3(^4F)4s$	a ^{5}F	1	6556.833	F91
		2	6598.764	F91
		3	6661.004	F91
		4	6742.755	F91
		5	6842.965	F91
$3d^24s^2$	a ^{1}D	2	7255.354	F91
$3d^24s^2$	a ^{3}P	0	8436.617	F91
		1	8492.421	F91
		2	8602.342	F91
$3d^3(^4F)4s$	b ^{3}F	2	11531.759	F91
		3	11639.810	F91
		4	11776.811	F91
$3d^24s^2$	a ^{1}G	4	12118.394	F91
$3d^2(^3F)4s4p(^3P^o)$	z ^{5}G^o	2	15877.080	F91
		3	15975.630	F91
		4	16106.075	F91
		5	16267.481	F91
		6	16458.672	F91
$3d^2(^3F)4s4p(^3P^o)$	z ^{5}F^o	1	16817.160	F91
		2	16875.121	F91
		3	16961.441	F91
		4	17075.258	F91
		5	17215.389	F91
$3d^2(^3F)4s4p(^3P^o)$	z ^{5}D^o	0	18462.721	F91
		1	18482.772	F91
		2	18525.059	F91
		3	18593.946	F91
		4	18695.133	F91
$3d^2(^3F)4s4p(^3P^o)$	z ^{3}F^o	2	19322.984	F91
		3	19421.580	F91
		4	19573.973	F91
$3d^2(^3F)4s4p(^3P^o)$	z ^{3}D^o	1	19937.852	F91
		2	20006.042	F91
		3	20126.060	F91
$3d^2(^3F)4s4p(^3P^o)$	z ^{3}G^o	3	21469.487	F91
		4	21588.494	F91
		5	21739.707	F91
$3d^2(^3F)4s4p(^3P^o)$	z ^{1}D^o	2	22081.187	F91
$3d^2(^3F)4s4p(^3P^o)$	z ^{1}F^o	3	22404.740	F91
$3d^2(^3F)4s4p(^3P^o)$	z ^{1}G^o	4	24694.892	F91
$3d^2(^3P)4s4p(^3P^o)$	z ^{3}S^o	1	24921.115	F91

Energy Levels of Neutral Titanium (Ti I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^2(^3P)4s4p(^3P^o)$	z $^5S^o$	2	25102.874	F91
$3d^2(^3F)4s4p(^1P^o)$	y $^3F^o$	2	25107.410	F91
		3	25227.220	F91
		4	25388.331	F91
$3d^3(^4F)4p$	y $^3D^o$	1	25317.815	F91
		2	25438.906	F91
		3	25643.699	F91
$3d^2(^1D)4s4p(^3P^o)$	z $^3P^o$	2	25493.734	F91
		1	25537.284	F91
		0	25574.909	F91
$3d^2(^3P)4s4p(^3P^o)$	y $^5D^o$	0	25612.387	F91
		1	25635.723	F91
		2	25699.984	F91
		3	25797.594	F91
		4	25926.766	F91
$3d^3(^4F)4p$	y $^5G^o$	2	26494.330	F91
		3	26564.398	F91
		4	26657.416	F91
		5	26772.969	F91
		6	26910.712	F91
$3d^2(^1D)4s4p(^3P^o)$	x $^3F^o$	2	26803.420	F91
		3	26892.935	F91
		4	27025.658	F91
$3d^2(^1D)4s4p(^3P^o)$	x $^3D^o$	1	27355.059	F91
		2	27418.030	F91
		3	27480.066	F91
$3d^2(^3F)4s4p(^1P^o)$	y $^3G^o$	3	27498.983	F91
		4	27614.678	F91
		5	27750.136	F91
$3d^3(^4F)4p$	x $^5D^o$	0	29829.111	F91
		1	29855.255	F91
		2	29907.286	F91
		3	29986.197	F91
		4	30060.338	F91
Ti II ($^4F_{3/2}$)		*Limit*	**55072.5**	SZK90

Persistent Lines of Singly-ionized Titanium (Ti II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
200	3078.651	1.34	$3d^2(^3F)4s$	a ^4F	7/2	225.73	SC85	M03
			$3d^2(^3F)4p$	z $^4D^o$	5/2	32697.99		
300	3088.042	1.50	$3d^2(^3F)4s$	a ^4F	9/2	393.44	SC85	M03
			$3d^2(^3F)4p$	z $^4D^o$	7/2	32767.07		
600	3234.513	1.71	$3d^2(^3F)4s$	a ^4F	9/2	393.44	SC85	M03
			$3d^2(^3F)4p$	z $^4F^o$	9/2	31301.01		

Persistent Lines of Singly-ionized Titanium (Ti II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
400	3236.581	1.37	$3d^2(^3F)4s$	a ^4F	7/2	225.73	SC85	M03
			$3d^2(^3F)4p$	z $^4F^o$	7/2	31113.65		
300	3239.038	1.26	$3d^2(^3F)4s$	a ^4F	5/2	94.10	SC85	M03
			$3d^2(^3F)4p$	z $^4F^o$	5/2	30958.50		
400	3349.029		$3d^2(^3F)4s$	a ^2F	7/2	4897.65	SC85	
			$3d^2(^3F)4p$	z $^2G^o$	9/2	34748.40		
1000	3349.405	1.68	$3d^2(^3F)4s$	a ^4F	9/2	393.44	SC85	M03
			$3d^2(^3F)4p$	z $^4G^o$	11/2	30240.88		
600	3361.227	1.58	$3d^2(^3F)4s$	a ^4F	7/2	225.73	SC85	M03
			$3d^2(^3F)4p$	z $^4G^o$	9/2	29968.30		
500	3372.798	1.41	$3d^2(^3F)4s$	a ^4F	5/2	94.10	SC85	M03
			$3d^2(^3F)4p$	z $^4G^o$	7/2	29734.54		
500	3383.769	1.39	$3d^2(^3F)4s$	a ^4F	3/2	0.00	SC85	M03
			$3d^2(^3F)4p$	z $^4G^o$	5/2	29544.37		
250	3685.205		$3d^2(^3F)4s$	a ^2F	7/2	4897.65	SC85	
			$3d^2(^3F)4p$	z $^2D^o$	5/2	32025.47		
			$3d^2(^3F)4s$	a ^2F	5/2	4628.58		
			$3d^2(^3F)4p$	z $^2D^o$	3/2	31756.51		
300	3759.300	0.94	$3d^2(^3F)4s$	a ^2F	7/2	4897.65	SC85	FW96
			$3d^2(^3F)4p$	z $^2F^o$	7/2	31490.82		
250	3761.326	0.99	$3d^2(^3F)4s$	a ^2F	5/2	4628.58	SC85	FW96
			$3d^2(^3F)4p$	z $^2F^o$	5/2	31207.42		

Energy Levels of Singly-ionized Titanium (Ti II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^2(^3F)4s$	a ^4F	3/2	0.00	SC85
		5/2	94.10	SC85
		7/2	225.73	SC85
		9/2	393.44	SC85
$3d^3$	b ^4F	3/2	908.02	SC85
		5/2	983.89	SC85
		7/2	1087.32	SC85
		9/2	1215.84	SC85
$3d^2(^3F)4s$	a ^2F	5/2	4628.58	SC85
		7/2	4897.65	SC85
$3d^2(^1D)4s$	a ^2D	3/2	8710.44	SC85
		5/2	8744.25	SC85
$3d^3$	a ^2G	7/2	8997.71	SC85
		9/2	9118.26	SC85
$3d^3$	a ^4P	1/2	9363.62	SC85
		3/2	9395.71	SC85
		5/2	9518.06	SC85
$3d^3$	a ^2P	1/2	9850.90	SC85
		3/2	9975.92	SC85

Energy Levels of Singly-ionized Titanium (Ti II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^2(^3P)4s$	b ^4P	1/2	9872.73	SC85
		3/2	9930.69	SC85
		5/2	10024.73	SC85
$3d^3$	b ^2D	3/2	12628.73	SC85
		5/2	12758.11	SC85
$3d^3$	a ^2H	9/2	12676.97	SC85
		11/2	12774.69	SC85
$3d^2(^1G)4s$	b ^2G	9/2	15257.43	SC85
		7/2	15265.62	SC85
$3d^2(^3P)4s$	b ^2P	1/2	16515.86	SC85
		3/2	16625.11	SC85
$3d^3$	b ^2F	7/2	20891.66	SC85
		5/2	20951.62	SC85
$3d4s^2$	c ^2D	3/2	24961.03	SC85
		5/2	25192.79	SC85
$3d^2(^3F)4p$	z $^4G^o$	5/2	29544.37	SC85
		7/2	29734.54	SC85
		9/2	29968.30	SC85
		11/2	30240.88	SC85
$3d^2(^3F)4p$	z $^4F^o$	3/2	30836.32	SC85
		5/2	30958.50	SC85
		7/2	31113.65	SC85
		9/2	31301.01	SC85
$3d^2(^3F)4p$	z $^2F^o$	5/2	31207.42	SC85
		7/2	31490.82	SC85
$3d^2(^3F)4p$	z $^2D^o$	3/2	31756.51	SC85
		5/2	32025.47	SC85
$3d^2(^1D)4s$	a ^2S	1/2	31787.75	SC85
$3d^3$	d $^2D1$	3/2	32275.32	SC85
		5/2	32332.73	SC85
$3d^2(^3F)4p$	z $^4D^o$	1/2	32532.21	SC85
		3/2	32602.55	SC85
		5/2	32697.99	SC85
		7/2	32767.07	SC85
$3d^2(^3F)4p$	z $^2G^o$	7/2	34543.26	SC85
		9/2	34748.40	SC85
Ti III ($^3F_2$)		*Limit*	**109494**	SC85

Tungsten (W)
Atomic number = 74
Atomic weight = 183.85

Isotope	Mass	Abundance	Spin	Mag moment
^{180}W	79.946701	0.12%	0	
^{182}W	81.948202	26.3%	0	
^{183}W	82.950220	14.28%	1/2	+0.11778
^{184}W	83.950928	30.7%	0	
^{186}W	85.954357	28.6%	0	

W I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^4 6s^2\ {}^5D_0$
Ionization energy: 63 427.7 cm^{-1} (7.864 03 eV)

W II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^4 6s\ {}^6D_{1/2}$
Ionization energy: 130 000 cm^{-1} (16.1 eV)

Strong Lines of Tungsten (W)

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
1000 P	1951.051	W II	EKM00
900 P	1962.140	W II	EKM00
600	1977.524	W II	EKM00
600	1982.907	W II	EKM00
900 P	1989.394	W II	EKM00
500	1990.863	W II	EKM00
	Air		
400 P	2001.712	W II	EKM00
800 P	2008.095	W II	EKM00
300 P	2009.982	W II	EKM00
250	2010.236	W II	EKM00
250	2014.238	W II	EKM00
500 P	2026.088	W II	EKM00
900 P	2029.995	W II	EKM00
150	2035.043	W II	EKM00
300	2049.636	W II	EKM00
140	2065.573	W II	EKM00
200	2071.208	W II	EKM00
140	2075.590	W II	EKM00
600 P	2079.118	W II	EKM00
600 P	2079.120	W II	EKM00
200	2088.204	W II	EKM00
140	2089.156	W II	EKM00
200	2090.48	W I	MCS75
400 P	2094.751	W II	EKM00
150	2098.602	W II	EKM00
140	2100.675	W II	EKM00
150	2101.54	W I	MCS75
90	2106.187	W II	EKM00
80	2110.323	W II	EKM00
130	2118.874	W II	EKM00
150	2121.576	W II	EKM00
50	2153.558	W II	EKM00
50	2157.796	W II	EKM00
90	2166.316	W II	EKM00
60	2182.90	W I	MCS75
30	2194.528	W II	EKM00

Strong Lines of Tungsten (W)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
80 P	2204.483	W II	EKM00
30 P	2248.758	W II	EKM00
50	2249.80	W I	MCS75
60	2277.58	W I	MCS75
60 d	2294.49	W I	MCS75
50	2313.17	W I	MCS75
50	2321.63	W I	MCS75
70	2360.44	W I	MCS75
100	2363.07	W I	MCS75
60	2374.47	W I	MCS75
80	2384.82	W I	MCS75
50	2397.107	W II	EKM00
70	2397.73	W I	MCS75
70	2397.98	W I	MCS75
200 d	2405.58	W I	MCS75
70	2415.68	W I	MCS75
100	2424.21	W I	MCS75
70	2431.08	W I	MCS75
70	2433.98	W I	MCS75
200	2435.96	W I	MCS75
70	2444.06	W I	MCS75
50	2451.476	W II	EKM00
100	2452.00	W I	MCS75
50	2454.72	W I	MCS75
70	2454.98	W I	MCS75
90	2455.51	W I	MCS75
90	2456.53	W I	MCS75
130	2459.30	W I	MCS75
60	2462.79	W I	MCS75
150	2466.85	W I	MCS75
60	2472.51	W I	MCS75
140	2474.15	W I	MCS75
100	2480.13	W I	MCS75
50	2480.96	W I	MCS75
150	2481.44	W I	MCS75
60 d	2482.10	W I	MCS75
70	2484.74	W I	MCS75
50	2487.50	W I	MCS75
25	2489.231	W II	EKM00
70	2495.26	W I	MCS75
80	2504.70	W I	MCS75
90	2521.32	W I	MCS75
90	2523.41	W I	MCS75
50	2527.76	W I	MCS75
90	2533.64	W I	MCS75
70	2545.34	W I	MCS75
140	2547.14	W I	MCS75
90	2550.38	W I	MCS75
300 P	2551.35	W I	MCS75
50	2553.82	W I	MCS75
25 P	2554.853	W II	EKM00
40 P	2555.095	W II	EKM00
80	2561.97	W I	MCS75
30	2571.444	W II	EKM00
100	2580.49	W I	MCS75
25	2589.160	W II	EKM00
80	2606.39	W I	MCS75
110	2613.08	W I	MCS75
60	2613.82	W I	MCS75

Strong Lines of Tungsten (W)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	2620.25	W I	MCS75
50	2622.21	W I	MCS75
50	2625.22	W I	MCS75
50	2632.48	W I	MCS75
50	2632.70	W I	MCS75
90	2633.13	W I	MCS75
50 d	2638.62	W I	MCS75
80	2646.18	W I	MCS75
50	2646.73	W I	MCS75
200	2656.54	W I	MCS75
50	2657.38	W I	MCS75
25 d	2658.032	W II	EKM00
90	2662.84	W I	MCS75
90	2671.47	W I	MCS75
80	2677.28	W I	MCS75
50	2678.88	W I	MCS75
250 P	2681.42	W I	MCS75
80	2695.67	W I	MCS75
13	2697.710	W II	EKM00
80	2699.59	W I	MCS75
50	2700.01	W I	MCS75
50	2706.58	W I	MCS75
50	2708.59	W I	MCS75
50 d	2708.80	W I	MCS75
50	2715.50	W I	MCS75
250	2718.91	W I	MCS75
300 P	2724.35	W I	MCS75
50	2725.03	W I	MCS75
80	2748.84	W I	MCS75
50	2762.34	W I	MCS75
25 P	2764.261	W II	EKM00
50	2769.74	W I	MCS75
90	2770.88	W I	MCS75
90	2774.00	W I	MCS75
90	2774.48	W I	MCS75
90	2792.70	W I	MCS75
50	2799.93	W I	MCS75
90	2818.06	W I	MCS75
200 P	2831.38	W I	MCS75
90	2833.63	W I	MCS75
50	2841.57	W I	MCS75
90	2848.02	W I	MCS75
80	2856.03	W I	MCS75
80	2866.06	W I	MCS75
70	2879.11	W I	MCS75
70	2879.40	W I	MCS75
50	2896.01	W I	MCS75
150 P	2896.44	W I	MCS75
80	2935.00	W I	MCS75
300 P	2944.40	W I	MCS75
300 P	2946.99	W I	MCS75
60	2947.39	W I	MCS75
13	2952.268	W II	EKM00
50	2964.52	W I	MCS75
60	2977.11	W I	MCS75
80 d	2979.71	W I	MCS75
50	2993.61	W I	MCS75
60	3016.47	W I	MCS75
90	3017.44	W I	MCS75

Strong Lines of Tungsten (W)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50 d	3041.73	W I	MCS75
50	3046.44	W I	MCS75
90	3049.69	W I	MCS75
60	3207.25	W I	MCS75
120 P	3215.56	W I	MCS75
80	3300.82	W I	MCS75
50	3311.38	W I	MCS75
50	3326.20	W I	MCS75
50	3331.69	W I	MCS75
50	3373.75	W I	MCS75
50	3495.24	W I	MCS75
80	3545.22	W I	MCS75
200 P	3617.52	W I	MCS75
15	3641.408	W II	EKM00
80	3682.08	W I	MCS75
50	3683.30	W I	MCS75
70	3688.06	W I	MCS75
90	3707.92	W I	MCS75
60	3757.92	W I	MCS75
80	3760.13	W I	MCS75
120	3768.45	W I	MCS75
120	3780.77	W I	MCS75
150	3817.48	W I	MCS75
130	3835.06	W I	MCS75
80	3846.22	W I	MCS75
200	3867.99	W I	MCS75
80	3881.41	W I	MCS75
1000 P	4008.75	W I	MCS75
60	4015.22	W I	MCS75
110	4045.59	W I	MCS75
80	4069.95	W I	MCS75
600 P	4074.36	W I	MCS75
120	4102.70	W I	MCS75
60	4137.46	W I	MCS75
50	4171.17	W I	MCS75
60	4244.36	W I	MCS75
150	4269.38	W I	MCS75
500 P	4294.61	W I	MCS75
250 P	4302.11	W I	MCS75
70	4484.19	W I	MCS75
70	4659.87	W I	MCS75
70	4680.51	W I	MCS75
90	4843.81	W I	MCS75
90	5053.28	W I	MCS75
90	5224.66	W I	MCS75

Persistent Lines of Neutral Tungsten (W I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	2551.35	1.78	$5d^46s^2$	^5D	0	0.00	MCS75	M00
				391^o	1	39183.20		
250	2681.42		$5d^5(^6S)6s$	^7S	3	2951.29	MCS75	
				402^o	4	40233.97		
300	2724.35		$5d^5(^6S)6s$	^7S	3	2951.29	MCS75	
				396^o	3	39646.41		
200	2831.38		$5d^5(^6S)6s$	^7S	3	2951.29	MCS75	
				382^o	4	38259.40		
150	2896.44		$5d^5(^6S)6s$	^7S	3	2951.29	MCS75	
				374^o	2	37466.30		
300	2944.40		$5d^5(^6S)6s$	^7S	3	2951.29	MCS75	
				369^o	2	36904.16		
300	2946.99		$5d^5(^6S)6s$	^7S	3	2951.29	MCS75	
				368^o	3	36874.36		
120	3215.56	0.21	$5d^46s^2$	^5D	4	6219.33	MCS75	FW96
				373^o	5	37309.16		
200	3617.52	0.11	$5d^5(^6S)6s$	^7S	3	2951.29	MCS75	FW96
			$5d^4(^5D)6s6p(^3P^o)$	$^5P^o$	3	30586.64		
1000	4008.75	0.163	$5d^5(^6S)6s$	^7S	3	2951.29	MCS75	FW96
			$5d^5(^6S)6p$	$^7P^o$	4	27889.68		
600	4074.36	0.10	$5d^5(^6S)6s$	^7S	3	2951.29	MCS75	FW96
			$5d^5(^6S)6p$	$^7P^o$	3	27488.11		
500	4294.61	0.12	$5d^5(^6S)6s$	^7S	3	2951.29	MCS75	FW96
			$5d^5(^6S)6p$	$^7P^o$	2	26229.77		
250	4302.11	0.036	$5d^5(^6S)6s$	^7S	3	2951.29	MCS75	FW96
			$5d^4(^5D)6s6p(^3P^o)$	$^7D^o$	3	26189.20		

Energy Levels of Neutral Tungsten (W I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^46s^2$	^5D	0	0.00	LC68
		1	1670.29	LC68
		2	3325.53	LC68
		3	4830.00	LC68
		4	6219.33	LC68
$5d^5(^6D)6s$	^7S	3	2951.29	LC68
$5d^46s^2$	a ^3P	0	9258.06	LC68
		1	13307.10	LC68
		2	19253.56	LC68
$5d^4(^5D)6s6p(^3P^o)$	$^7D^o$	3	26189.20	LC68
$5d^5(^6D)6p$	$^7P^o$	2	26229.77	LC68
		3	27488.11	LC68
		4	27889.68	LC68

Energy Levels of Neutral Tungsten (W I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^4(^5D)6s6p(^3P^o)$	$^5P^o$	3	30586.64	LC68
	368^o	3	36874.36	LC68
	369^o	2	36904.16	LC68
	373^o	5	37309.16	LC68
	374^o	2	37466.30	LC68
	382^o	4	38259.40	LC68
	391^o	1	39183.20	LC68
	396^o	3	39646.41	LC68
	402^o	4	40233.97	LC68
W II ($^6D_{1/2}$)		*Limit*	**63427.7**	CS96

Persistent Lines of Singly-ionized Tungsten (W II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	1951.051	2.16	$5d^4(^5D)6s$	^6D 5^o	1/2 3/2	0.000 51254.429	EKM00	EKM00
900	1962.140	3.38	$5d^4(^5D)6s$	^6D 8^o	5/2 3/2	3172.473 54137.225	EKM00	EKM00
900	1989.394	1.97	$5d^4(^5D)6s$	^6D 12^o	9/2 9/2	6147.085 56413.649	EKM00	EKM00
400	2001.712	0.50	$5d^4(^5D)6s$	^6D 6^o	5/2 5/2	3172.473 53113.533	EKM00	EKM00
800	2008.095	1.68	$5d^4(^5D)6s$	^6D 10^o	7/2 7/2	4716.278 54498.608	EKM00	EKM00
300	2009.982	0.65	$5d^4(^5D)6s$	^6D 5^o	3/2 3/2	1518.829 51254.429	EKM00	EKM00
500	2026.088	1.18	$5d^4(^5D)6s$	^6D 7^o	7/2 9/2	4716.278 54056.594	EKM00	EKM00
900	2029.995	2.38	$5d^4(^5D)6s$	^6D 11^o	9/2 9/2	6147.085 55392.446	EKM00	EKM00
600*	2079.118	3.80	$5d^4(^5D)6s$	^6D 9^o	9/2 11/2	6147.085 54229.082	EKM00	EKM00
600*	2079.120	0.63	$5d^4(^5D)6s$	^6D 5^o	5/2 3/2	3172.473 51254.429	EKM00	EKM00
400	2094.751	2.03	$5d^4(^5D)6s$	^6D 4^o	3/2 5/2	1518.829 49242.042	EKM00	EKM00
80	2204.483	1.66	$5d^4(^5D)6s$ $5d^4(^5D)6p$	^6D $^6F^o$	9/2 11/2	6147.085 51495.054	EKM00	EKM00
30	2248.758	2.84	$5d^4(^5D)6s$ $5d^3(^4F)6s6p$	^6D $^6F^o$	1/2 1/2	0.000 44455.212	EKM00	EKM00

Persistent Lines of Singly-ionized Tungsten (W II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
25	2554.853	0.22	$5d^4(^5D)6s$	^6D	1/2	0.000	EKM00	EKM00
				2^o	3/2	39129.460		
40	2555.095	0.50	$5d^4(^5D)6s$	^6D	5/2	3172.473	EKM00	EKM00
			$5d^4(^5D)6p$	3^o	3/2	42298.223		
25	2764.261	0.54	$5d^4(^5D)6s$	^6D	1/2	0.000	EKM00	EKM00
			$5d^46p$	1^o	1/2	36165.356		

Energy Levels of Singly-ionized Tungsten (W II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5d^4(^5D)6s$	^6D	1/2	0.000	EKM00
		3/2	1518.829	EKM00
		5/2	3172.473	EKM00
		7/2	4716.278	EKM00
		9/2	6147.085	EKM00
$5d^5$	^6S	5/2	7420.261	EKM00
$5d^4(a^3F)6s$	^4F	3/2	8711.274	EKM00
		5/2	11301.024	EKM00
		7/2	13411.939	EKM00
	1	9/2	14857.160	EKM00
$5d^46p$	1^o	1/2	36165.356	EKM00
	2^o	3/2	39129.460	EKM00
$5d^4(^5D)6p$	3^o	3/2	42298.223	EKM00
$5d^3(^4F)6s6p$	$^6F^o$	1/2	44455.212	EKM00
	4^o	5/2	49242.042	EKM00
	5^o	3/2	51254.429	EKM00
$5d^4(^5D)6p$	$^6F^o$	11/2	51495.054	EKM00
	6^o	5/2	53113.533	EKM00
	7^o	9/2	54056.594	EKM00
	8^o	3/2	54137.225	EKM00
	9^o	11/2	54229.082	EKM00
	10^o	7/2	54498.608	EKM00
	11^o	9/2	55392.446	EKM00
	12^o	9/2	56413.649	EKM00
W III ($^5D_0$)		*Limit*	**130000**	MH84

Uranium (U)
Atomic number=92
Atomic weight=238.0289

Isotope	Mass	Abundance	Spin	Mag moment
^{234}U	34.040946	0.005%	0	
^{235}U	35.043924	0.720%	7/2	−0.35
^{238}U	38.050784	99.275%	0	

U I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^3 6d 7s^2\ {}^5\mathrm{L}^{\circ}_6$
Ionization energy: 49 958.4 cm^{-1} (6.1941 eV)

U II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^6 5f^3 7s^2\ {}^4\mathrm{I}^{\circ}_{9/2}$
Ionization energy: 85 000 cm^{-1} (10.6 eV)

Strong Lines of Uranium (U)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
120	2635.529	U II	BW92b
150	2793.934	U II	BW92b
200	2802.560	U II	BW92b
130	2807.119	U II	BW92b
130	2817.958	U II	BW92b
200	2821.121	U II	BW92b
140	2828.935	U II	BW92b
200	2832.061	U II	BW92b
200	2865.681	U II	BW92b
250	2889.624	U II	BW92b
150	2906.794	U II	BW92b
150	2908.272	U II	BW92b
120	2931.414	U II	BW92b
250	2941.916	U II	BW92b
150	2943.896	U II	BW92b
120	2956.060	U II	BW92b
120	2967.936	U II	BW92b
120	2971.066	U II	BW92b
130	3022.210	U II	BW92b
130	3031.987	U II	BW92b
120	3050.197	U II	BW92b
130	3057.939	U II	BW92b
130	3062.537	U II	BW92b
120	3072.783	U II	BW92b
120	3093.005	U II	BW92b
120	3102.422	U II	BW92b
200	3111.618	U II	BW92b
140	3124.952	U II	BW92b
140	3149.240	U II	BW92b
150	3229.499	U II	BW92b
140	3232.156	U II	BW92b
150	3291.332	U II	BW92b
200	3305.8912	U II	SPMR72
120	3357.8437	U I	SPMR72
250	3390.3775	U I	SPMR72
120	3424.5566	U II	SPMR72
200	3435.4913	U I	SPMR72
110	3459.9191	U I	SPMR72
100	3462.2200	U I	SPMR72

Strong Lines of Uranium (U)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
140	3463.5479	U I	SPMR72
200	3466.3010	U I	SPMR72
100	3473.4269	U I	SPMR72
110	3480.3634	U I	SPMR72
140	3482.4900	U II	SPMR72
500 P	3489.3672	U I	SPMR72
110	3493.9963	U I	SPMR72
200	3500.0760	U I	SPMR72
100	3504.0089	U I	SPMR72
250	3507.3442	U I	SPMR72
100	3513.6742	U I	SPMR72
500 P	3514.6107	U I	SPMR72
130	3533.5659	U II	SPMR72
100	3534.3346	U I	SPMR72
100	3542.5704	U I	SPMR72
100	3549.2018	U I	SPMR72
250	3550.8223	U II	SPMR72
200	3555.3188	U I	SPMR72
100	3561.4110	U I	SPMR72
400 P	3561.8038	U I	SPMR72
120	3563.6559	U I	SPMR72
700 P	3566.5909	U I	SPMR72
150	3569.0781	U I	SPMR72
100	3574.7602	U I	SPMR72
110	3577.9162	U I	SPMR72
130	3578.7211	U II	SPMR72
1000 P	3584.8774	U I	SPMR72
120	3591.7443	U I	SPMR72
140	3605.2742	U I	SPMR72
100	3616.3305	U I	SPMR72
100	3620.0838	U I	SPMR72
100	3622.6987	U I	SPMR72
250	3638.1986	U I	SPMR72
130	3644.2422	U I	SPMR72
200	3651.5366	U I	SPMR72
150	3652.0641	U I	SPMR72
300 P	3659.1548	U I	SPMR72
600 P	3670.0701	U II	SPMR72
200	3701.5161	U II	SPMR72
110	3713.5546	U I	SPMR72
120	3738.0405	U II	SPMR72
140	3746.4190	U II	SPMR72
200	3748.6758	U II	SPMR72
200	3751.1746	U I	SPMR72
150	3758.3480	U I	SPMR72
100	3763.2643	U I	SPMR72
130	3766.8864	U I	SPMR72
150	3773.4339	U I	SPMR72
400 P	3782.8407	U II	SPMR72
120	3793.1002	U II	SPMR72
120	3793.2638	U I	SPMR72
120	3808.9207	U I	SPMR72
600 P	3811.9911	U I	SPMR72
150	3826.5084	U II	SPMR72
400 P	3831.4593	U II	SPMR72
400 P	3839.6255	U I	SPMR72
200	3854.2202	U I	PKE80
500 P	3854.6448	U II	PKE80
1000 P	3859.5716	U II	PKE80

Strong Lines of Uranium (U)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400 P	3865.9176	U II	PKE80
500 P	3871.0353	U I	PKE80
130	3874.0387	U II	PKE80
130	3878.0847	U II	PKE80
200	3881.4546	U II	PKE80
400 P	3890.3615	U II	PKE80
130	3892.6810	U II	PKE80
150	3894.1206	U I	PKE80
130	3899.7775	U II	PKE80
120	3906.4530	U I	PKE80
100	3926.2078	U I	PKE80
100	3926.7153	U I	PKE80
400 P	3932.0221	U II	PKE80
400 P	3943.8161	U I	PKE80
110	3964.2064	U I	PKE80
120	3966.5211	U II	SPMR72
250	3985.7924	U II	PKE80
130	4005.2094	U I	PKE80
120	4017.7163	U II	PKE80
300 P	4042.7496	U I	PKE80
130	4047.6117	U I	PKE80
300 P	4050.0412	U II	PKE80
200	4062.5440	U II	PKE80
400 P	4090.1319	U II	PKE80
150	4116.0974	U II	PKE80
300 P	4153.9710	U I	PKE80
120 P	4156.6483	U I	PKE80
300 P	4171.5886	U II	PKE80
110	4222.3677	U I	PKE80
200 P	4241.6646	U II	PKE80
140 P	4341.6865	U II	PKE80
130 P,h	4355.7400	U I	PKE80
130 P	4362.0510	U I	PKE80
100	4393.5858	U I	PKE80
120	4472.3297	U II	PKE80
130 P	4543.6255	U II	PKE80
50	4756.8059	U I	PKE80
50	5027.3841	U I	PKE80
70 P	5915.385	U I	PKE80
30	6826.913	U I	PKE80
25	8607.950	U I	PKE80
7	8691.282	U I	PKE80
9	8757.760	U I	PKE80
15	10157.91	U I	BW92b
13	10259.55	U I	BW92b
30	10554.93	U I	BW92b
10	11167.84	U I	BW92b
15	11384.13	U I	BW92b
15	11859.42	U I	BW92b
30	11908.83	U I	BW92b
25	13185.16	U I	BW92b
10	13961.58	U I	BW92b

Persistent Lines of Neutral Uranium (U I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3489.3672	0.13	$5f^3(^4I^o)6d7s^2$	$^5L^o$	6	0.000	SPMR72	M00
					5	28650.294		
500	3514.6107	0.12	$5f^3(^4I^o)6d7s^2$	$^5L^o$	6	0.000	SPMR72	M00
					5	28444.517		
400	3561.8038	0.057	$5f^3(^4I^o)6d7s^2$	$^5L^o$	6	0.000	SPMR72	M00
					5	28067.646		
700	3566.5909	0.24	$5f^3(^4I^o)6d7s^2$	$^5K^o$	5	620.323	SPMR72	M00
					5	28650.294		
1000	3584.8774	0.19	$5f^3(^4I^o)6d7s^2$	$^5L^o$	6	0.000	SPMR72	M00
			$5f^36d^27p$	^7N	7	27886.995		
300	3659.1548		$5f^3(^4I^o)6d7s^2$	$^5K^o$	5	620.323	SPMR72	
					6	27941.253		
600	3811.9911	0.16	$5f^3(^4I^o)6d7s^2$	$^5L^o$	6	0.000	SPMR72	M00
					6	26225.569		
400	3839.6255		$5f^3(^4I^o)6d7s^2$	$^5L^o$	7	3800.829	SPMR72	
					7	29837.643		
500	3871.0353	0.19	$5f^3(^4I^o)6d7s^2$	$^5L^o$	6	0.000	PKE80	M00
					6	25825.565		
400	3943.8161	0.21	$5f^3(^4I^o)6d7s^2$	$^5L^o$	6	0.000	PKE80	M00
					6	25348.977		
300	4042.7496		$5f^3(^4I^o)6d7s^2$	$^5K^o$	5	620.323	PKE80	
					6	25348.977		
300	4153.9710	0.12	$5f^3(^4I^o)6d7s^2$	$^5L^o$	6	0.000	PKE80	M00
					7	24066.566		
120	4156.6483		$5f^3(^4I^o)6d7s^2$	$^5K^o$	5	620.323	PKE80	
					6	24671.388		
130	4355.7400		$5f^3(^4I^o)6d7s^2$	$^5K^o$	5	620.323	PKE80	
					6	23572.086		
130	4362.0510	0.11	$5f^3(^4I^o)6d7s^2$	$^5L^o$	6	0.000	PKE80	M00
			$5f^36d7s7p$	^5L	7	22918.553		
70	5915.385	0.045	$5f^3(^4I^o)6d7s^2$	$^5L^o$	6	0.000	PKE80	M00
			$5f^36d7s7p$	^7M	7	16900.386		

Energy Levels of Neutral Uranium (U I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^3(^4I^o)6d7s^2$	$^5L^o$	6	0.000	BW92b
		7	3800.829	BW92b
		8	7645.645	BW92b
		9	11308.153	BW92b
		10	14845.326	BW92b
$5f^3(^4I^o)6d7s^2$	$^5K^o$	5	620.323	BW92b
		6	4275.707	BW92b
		7	7326.118	BW92b
		8	10685.787	BW92b
		9	13535.186	BW92b
$5f^3(^4I^o)6d7s^2$	^{o}	3	3868.486	BW92b
$5f^3(^4I^o)6d7s^2$	$^5I^o$	4	4453.419	BW92b
$5f^3(^4I^o)6d7s^2$	^{o}	5	5762.079	BW92b
$5f^3(^4F^o)6d7s^2$	^{o}	0	5988.061	BW92b
$5f^3(^4I^o)6d7s^2$	$^5H^o$	4	5991.314	BW92b
$5f^3(^4I^o)6d^2(^2F)7s$	$^7M^o$	6	6249.029	BW92b
$5f^3(^4I^o)6d7s^2$	^{o}	6	7005.532	BW92b
$5f^47s^2$	^5I	4	7020.709	BW92b
		5	10051.312	BW92b
		6	12643.378	BW92b
		7	14858.786	BW92b
		8	16862.069	BW92b
$5f^3(^4I^o)6d7s^2$	^{o}	3	7103.921	BW92b
$5f^3(^4I^o)6d7s^2$	$^5G^o$	2	7191.682	BW92b
$5f^3(^4I^o)6d7s^2$	$^5K^o$	7	7326.118	BW92b
$5f^3(^4I^o)6d7s^2$	$^5L^o$	8	7645.645	BW92b
$5f^3(^4I^o)6d7s^2$	$^5I^o$	5	7864.204	BW92b
$5f^3(^4I^o)6d^2(^2F)7s$	$^7M^o$	7	8118.632	BW92b
$5f^36d7s^2$	$^5H^o$	4	8133.291	BW92b
$5f^3(^4F^o)6d7s^2$	^{o}	2	8856.992	BW92b
$5f^3(^4F^o)6d7s^2$	^{o}	3	8878.547	BW92b
$5f^36d7s7p$	^7M	7	16900.386	BW92b
$5f^36d7s7p$	^5L	7	22918.553	BW92b
		6	23572.086	BW92b
		7	24066.566	BW92b
		6	24671.388	BW92b
		6	25348.977	BW92b
		6	25825.565	BW92b
		6	26225.569	BW92b

Energy Levels of Neutral Uranium (U I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^36d^27p$	^{7}N	7	27886.995	BW92b
		6	27941.253	BW92b
		5	28444.517	BW92b
		5	28650.294	BW92b
		7	29837.643	BW92b
		6	31871.569	BW92b
U II (^{4}I$^o_{9/2}$)		*Limit*	**49958.4**	CABC82

Persistent Lines of Singly-ionized Uranium (U II)

Inten	Wavelength (Å)	A_{ki}(10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	3670.0701	0.26	$5f^3(^4I^o)6d7s$	^{6}K^o	9/2	914.765	SPMR72	NIJL02
			$5f^36d7p$	^{6}L	11/2	28154.450		
400	3782.8407		$5f^3(^4I^o)6d7s$	^{6}L^o	11/2	289.041	SPMR72	
					13/2	26716.697		
400	3831.4593		$5f^4(^5I)7s$	^{6}I	7/2	4663.803	SPMR72	
			$5f^47p$	^{o}	9/2	30756.116		
500	3854.6448		$5f^4(^5I)7s$	^{6}I	7/2	4663.803	PKE80	
			$5f^4(^5I^o)7p$	^{6}K^o	9/2	30599.179		
1000	3859.5716	0.27	$5f^3(^4I^o)6d7s$	^{6}L^o	11/2	289.041	PKE80	NIJL02
			$5f^36d7p$	^{6}M	13/2	26191.309		
400	3865.9176	0.14	$5f^3(^4I^o)6d7s$	^{o}	11/2	2294.696	PKE80	NIJL02
			$5f^36d7p$	^{6}L	11/2	28154.450		
400	3890.3615		$5f^3(^4I^o)6d7s$	^{6}L^o	11/2	289.041	PKE80	
					13/2	25986.312		
400	3932.0221		$5f^3(^4I^o)6d7s$	^{6}L^o	11/2	289.041	PKE80	
					13/2	25714.049		
300	4050.0412	0.080	$5f^3(^4I^o)7s^2$	^{4}I^o	9/2	0.000	PKE80	NIJL02
			$5f^37s7p$	^{6}I	9/2	24684.132		
400	4090.1319	0.19	$5f^3(^4I^o)6d7s$	^{6}L^o	13/2	1749.123	PKE80	NIJL02
			$5f^36d7p$	^{6}M	13/2	26191.309		
300	4171.5886	0.092	$5f^3(^4I^o)6d7s$	^{6}L^o	13/2	1749.123	PKE80	NIJL02
					13/2	25714.049		
200	4241.6646	0.24	$5f^3(^4I^o)6d^2(^3F)$	^{o}	13/2	4585.434	PKE80	NIJL02
			$5f^36d7p$	^{6}L	11/2	28154.450		
140	4341.6865	0.070	$5f^3(^4I^o)6d7s$	^{6}L^o	11/2	289.041	PKE80	NIJL02
			$5f^37s7p$	^{6}K	9/2	23315.090		
130	4543.6255		$5f^3(^4I^o)6d7s$	^{6}K^o	9/2	914.765	PKE80	
				^{6}L	11/2	22917.451		

Energy Levels of Singly-ionized Uranium (U II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^3(^4I^o)7s^2$	$^4I^o$	9/2	0.000	BW92b
		11/2	4420.870	BW92b
		13/2	8276.733	BW92b
		15/2	11708.483	BW92b
$5f^3(^4I^o)6d7s$	$^6L^o$	11/2	289.041	BW92b
		13/2	1749.123	BW92b
		15/2	5259.652	BW92b
		17/2	8853.748	BW92b
		19/2	12350.355	BW92b
		21/2	—	
$5f^3(^4I^o)6d7s$	$^6K^o$	9/2	914.765	BW92b
$5f^3(^4I^o)6d7s$	^{o}	11/2	2294.696	BW92b
$5f^3(^4I^o)6d^2(^3F)$	^{o}	13/2	4585.434	BW92b
$5f^4(^5I)7s$	^6I	7/2	4663.803	BW92b
$5f^3(^4I^o)6d7s$	^{o}	5/2	4706.272	BW92b
$5f^36d7s$	^{o}	7/2	5401.504	BW92b
$5f^3(^4I^o)6d7s$	$^6K^o$	13/2	5526.748	BW92b
$5f^3(^4I^o)6d7s$	$^6I^o$	7/2	5667.331	BW92b
$5f^4(^5I)7s$		9/2	5716.449	BW92b
$5f^3(^4I^o)6d7s$	^{o}	11/2	5790.641	BW92b
$5f^3(^4I^o)6d7s$	$^4L^o$	13/2	6283.431	BW92b
$5f^3(^4I^o)6d7s$	^{o}	9/2	6445.035	BW92b
$5f^3(^4F^o)7s^2$	$^4F^o$	3/2	7017.172	BW92b
$5f^36d7s$	^{o}	9/2	7166.630	BW92b
$5f^3(^4I^o)6d7s$	^{o}	7/2	7547.373	BW92b
$5f^36d7s$	^{o}	11/2	7598.355	BW92b
$5f^4(^5I)7s$	^6I	11/2	8347.689	BW92b
$5f^3(^4I^o)6d7s$	^{o}	9/2	8379.696	BW92b
$5f^3(^4I^o)6d^2$	$^6M^o$	15/2	8394.362	BW92b
$5f^3(^4I^o)6d7s$	^{o}	3/2	8400.125	BW92b
$5f^4(^5I)7s$		9/2	8423.417	BW92b
$5f^3(^4I^o)6d7s$	^{o}	5/2	8430.185	BW92b
$5f^36d7s$	^{o}	11/2	8510.866	BW92b
$5f^3(^4I^o)6d7s$	$^6K^o$	15/2	8521.922	BW92b
$5f^36d7s$	^{o}	13/2	8755.640	BW92b
$5f^36d7s$	^{o}	7/2	9075.731	BW92b
$5f^36d7s$	^{o}	9/2	9241.971	BW92b
$5f^36d7s$	^{o}	5/2	9344.624	BW92b

Energy Levels of Singly-ionized Uranium (U II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5f^3(^4I^o)6d7s$	$^6I^o$	11/2	9553.185	BW92b
$5f^3(^4I^o)6d7s$	^{o}	13/2	9626.113	BW92b
$5f^3(^2H^o)7s^2$	^{o}	9/2	9690.665	BW92b
$5f^3(^4F^o)6d7s$	^{o}	3/2	9881.618	BW92b
$5f^3(^4I^o)6d7s$	^{o}	9/2	9882.725	BW92b
$5f^36d7s$	^{o}	7/2	9933.224	BW92b
	^6L	11/2	22917.451	BW92b
$5f^37s7p$	^6K	9/2	23315.090	BW92b
$5f^37s7p$	^6I	9/2	24684.132	BW92b
		13/2	25714.049	BW92b
		13/2	25986.312	BW92b
$5f^36d7p$	^6M	13/2	26191.309	BW92b
		13/2	26716.697	BW92b
$5f^36d7p$	^6L	11/2	28154.450	BW92b
$5f^4(^5I^o)7p$	$^6K^o$	9/2	30599.179	BW92b
$5f^47p$	^{o}	9/2	30756.116	BW92b
U III ($^5I_4$)		*Limit*	**85000**	SRC71

Vanadium (V)
Atomic number = 23
Atomic weight = 50.9415

Isotope	Mass	Abundance	Spin	Mag moment
^{50}V	49.947161	0.25%	6	+3.34745
^{51}V	50.943962	99.75%	7/2	+5.1574

V I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2\ {}^4\mathrm{F}_{3/2}$
Ionization energy: 54 411.7 cm^{-1} (6.746 19 eV)

V II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4\ {}^5\mathrm{D}_0$
Ionization energy: 117 900 cm^{-1} (14.618 eV)

Strong Lines of Vanadium (V)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
20	2507.782	V I	DA78
20	2519.622	V I	DA78
30	2526.221	V I	DA78
20	2530.183	V I	DA78
20	2574.018	V I	DA78
300 P	2687.954	V II	ICL88
200 P	2700.937	V II	ICL88
140	2706.174	V II	ICL88
150	2715.664	V II	ICL88
20	2864.361	V I	DA78
20	2868.095	V I	DA78
250	2891.644	V II	ICL88
140	2892.433	V II	ICL88
250	2892.652	V II	ICL88
400 P	2893.307	V II	ICL88
250	2906.454	V II	ICL88
130	2907.462	V II	ICL88
600 P	2908.810	V II	ICL88
200	2910.016	V II	ICL88
140	2910.385	V II	ICL88
150	2911.058	V II	ICL88
30	2914.926	V I	DA78
60	2923.619	V I	DA78
600 P	2924.017	V II	ICL88
400 P	2924.630	V II	ICL88
200	2930.805	V II	ICL88
250	2941.372	V II	ICL88
120	2941.499	V II	ICL88
20	2942.319	V I	DA78
20	2942.388	V I	DA78
20	2943.189	V I	DA78
300	2944.569	V II	ICL88
20	2949.629	V I	DA78
150	2952.068	V II	ICL88
30	2962.781	V I	DA78
150	2968.374	V II	ICL88
20	2977.540	V I	DA78
20	3043.119	V I	DA78
20	3043.548	V I	DA78
20	3044.933	V I	DA78

Strong Lines of Vanadium (V)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	3053.653	V I	DA78
100	3056.334	V I	DA78
120	3060.456	V I	DA78
200	3066.374	V I	DA78
1000 P	3093.102	V II	ICL88
800 P	3102.292	V II	ICL88
700 P	3110.709	V II	ICL88
500 P	3118.376	V II	ICL88
400 P	3125.282	V II	ICL88
140	3130.272	V II	ICL88
110	3133.339	V II	ICL88
250 P	3183.412	V I	D76
400 P	3183.992	V I	D76
300 P	3185.385	V I	DA78
110	3187.717	V II	ICL88
140	3188.522	V II	ICL88
200 P	3190.686	V II	ICL88
40	3198.012	V I	DA78
60	3202.389	V I	DA78
40	3205.577	V I	DA78
40	3207.408	V I	DA78
30	3212.432	V I	DA78
300	3267.702	V II	ICL88
250	3271.124	V II	ICL88
200 P	3276.130	V II	ICL88
150	3517.296	V II	ICL88
20	3529.733	V I	DA78
50	3533.676	V I	DA78
150	3545.195	V II	ICL88
150	3556.800	V II	ICL88
150	3589.763	V II	ICL88
130	3592.021	V II	ICL88
50	3592.530	V I	DA78
20	3663.604	V I	DA78
20	3667.741	V I	DA78
25	3673.406	V I	DA78
25	3675.699	V I	DA78
25	3680.119	V I	DA78
50	3683.118	V I	DA78
40	3687.498	V I	DA78
110	3688.069	V I	DA78
80	3690.282	V I	DA78
120	3692.222	V I	DA78
40	3695.342	V I	DA78
80	3695.864	V I	DA78
300 P	3703.574	V I	DA78
150	3704.703	V I	DA78
50	3705.038	V I	DA78
20	3778.675	V I	DA78
40	3790.325	V I	DA78
90	3794.962	V I	DA78
50	3799.907	V I	DA78
50	3803.475	V I	DA78
25	3807.502	V I	DA78
40	3808.517	V I	DA78
20	3809.596	V I	DA78
80	3813.485	V I	DA78
110	3818.240	V I	DA78
20	3819.960	V I	DA78

Strong Lines of Vanadium (V)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
20	3821.483	V I	DA78
50	3822.002	V I	DA78
40	3822.886	V I	DA78
25	3823.209	V I	DA78
140	3828.555	V I	DA78
25	3834.216	V I	DA78
50	3840.429	V I	DA78
200	3840.750	V I	DA78
30	3844.434	V I	DA78
25	3847.326	V I	DA78
100	3855.363	V I	DA78
250 P	3855.845	V I	DA78
110	3864.856	V I	DA78
20	3867.601	V I	DA78
120	3875.071	V I	DA78
40	3875.898	V I	DA78
50	3876.082	V I	DA78
60	3890.179	V I	DA78
40	3892.858	V I	DA78
200 P	3902.256	V I	DA78
60	3909.888	V I	DA78
20	3922.431	V I	DA78
20	3924.651	V I	DA78
20	3930.022	V I	DA78
20	3934.010	V I	DA78
40	3990.570	V I	DA78
20	3992.802	V I	DA78
40	3998.726	V I	DA78
30	4050.955	V I	DA78
30	4051.347	V I	DA78
25	4057.064	V I	DA78
20	4063.928	V I	DA78
20	4071.536	V I	DA78
90	4090.571	V I	DA78
150	4092.684	V I	DA78
70	4095.477	V I	DA78
250	4099.784	V I	DA78
50	4102.151	V I	DA78
20	4104.382	V I	DA78
20	4104.767	V I	DA78
250	4105.155	V I	DA78
200	4109.778	V I	DA78
700 P	4111.780	V I	DA78
20	4113.506	V I	DA78
400 P	4115.180	V I	DA78
150	4116.473	V I	DA78
20	4119.446	V I	DA78
150	4123.503	V I	DA78
250 P	4128.064	V I	DA78
250 P	4131.989	V I	DA78
200	4134.485	V I	DA78
20	4179.408	V I	DA78
20	4209.853	V I	DA78
30	4232.458	V I	DA78
50	4268.638	V I	DA78
40	4271.550	V I	DA78
40	4276.953	V I	DA78
40	4284.047	V I	DA78
30	4291.82	V I	MCS75

Strong Lines of Vanadium (V)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	4330.026	V I	DA78
40	4332.825	V I	DA78
60	4341.008	V I	DA78
80	4352.871	V I	DA78
1000 P	4379.230	V I	DA78
600 P	4384.710	V I	DA78
400 P	4389.980	V I	DA78
300 P	4395.223	V I	DA78
120	4400.572	V I	DA78
200	4406.638	V I	DA78
250	4407.633	V I	DA78
300 P	4408.195	V I	DA78
400 P	4408.501	V I	DA78
50	4416.469	V I	DA78
50	4421.566	V I	DA78
40	4426.002	V I	DA78
25	4428.517	V I	DA78
20	4429.800	V I	DA78
40	4436.133	V I	DA78
50	4437.830	V I	DA78
70	4441.68	V I	MCS75
50	4444.192	V I	DA78
50	4452.006	V I	DA78
30	4457.470	V I	DA78
80	4459.752	V I	DA78
150	4460.331	V I	DA78
50	4462.360	V I	DA78
30	4469.705	V I	DA78
30	4488.889	V I	DA78
30	4545.395	V I	DA78
25	4560.716	V I	DA78
40	4577.178	V I	DA78
50	4580.403	V I	DA78
70	4586.370	V I	DA78
110	4594.119	V I	DA78
20	4619.777	V I	DA78
25	4851.489	V I	DA78
40	4864.733	V I	DA78
50	4875.486	V I	DA78
60	4881.555	V I	DA78
30	5627.631	V I	DA78
25	5670.847	V I	DA78
100	5698.529	V I	DA78
80	5703.586	V I	DA78
50	5706.997	V I	DA78
70	5727.046	V I	DA78
20	5731.248	V I	DA78
20	5737.065	V I	DA78
40	6039.728	V I	DA78
40	6081.440	V I	DA78
110 P	6090.208	V I	DA78
25	6111.650	V I	DA78
50	6119.528	V I	DA78
25	6135.363	V I	DA78
40	6199.191	V I	DA78
40	6216.370	V I	DA78
40	6230.803	V I	DA78
60	6243.110	V I	DA78
25	6251.823	V I	DA78

Persistent Lines of Neutral Vanadium (V I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
250	3183.412	2.4	$3d^34s^2$	a ^4F	5/2	137.382	D76	FW96
			$3d^3(^4F)4s4p(^1P^o)$	x $^4G^o$	7/2	31541.147		
400	3183.992	2.5	$3d^34s^2$	a ^4F	7/2	323.457	D76	FW96
			$3d^3(^4F)4s4p(^1P^o)$	x $^4G^o$	9/2	31721.708		
300	3185.385	2.8	$3d^34s^2$	a ^4F	9/2	552.961	DA78	M03
			$3d^3(^4F)4s4p(^1P^o)$	x $^4G^o$	11/2	31937.266		
300	3703.574	0.92	$3d^4(^5D)4s$	a ^6D	9/2	2424.783	DA78	FW96
			$3d^3(^4P)4s4p(^3P^o)$	y $^6P^o$	7/2	29418.073		
250	3855.845	0.578	$3d^34s^2$	a ^4F	9/2	552.961	DA78	FW96
			$3d^4(^5D)4p$	y $^4D^o$	7/2	26480.291		
200	3902.256	0.268	$3d^34s^2$	a ^4F	9/2	552.961	DA78	FW96
			$3d^4(^5D)4p$	y $^4F^o$	9/2	26171.916		
700	4111.780	1.01	$3d^4(^5D)4s$	a ^6D	9/2	2424.783	DA78	FW96
			$3d^4(^5D)4p$	y $^6D^o$	9/2	26738.318		
400	4115.180	0.58	$3d^4(^5D)4s$	a ^6D	7/2	2311.355	DA78	FW96
			$3d^4(^5D)4p$	y $^6D^o$	7/2	26604.796		
250	4128.064	0.77	$3d^4(^5D)4s$	a ^6D	5/2	2220.106	DA78	FW96
			$3d^4(^5D)4p$	y $^6D^o$	3/2	26437.640		
250	4131.989	0.55	$3d^4(^5D)4s$	a ^6D	7/2	2311.355	DA78	FW96
			$3d^4(^5D)4p$	y $^6D^o$	5/2	26505.932		
1000	4379.230	1.1	$3d^4(^5D)4s$	a ^6D	9/2	2424.783	DA78	FW96
			$3d^4(^5D)4p$	y $^6F^o$	11/2	25253.432		
600	4384.710	1.1	$3d^4(^5D)4s$	a ^6D	7/2	2311.355	DA78	FW96
			$3d^4(^5D)4p$	y $^6F^o$	9/2	25111.467		
400	4389.980	0.69	$3d^4(^5D)4s$	a ^6D	5/2	2220.106	DA78	FW96
			$3d^4(^5D)4p$	y $^6F^o$	7/2	24992.884		
300	4395.223	0.55	$3d^4(^5D)4s$	a ^6D	3/2	2153.207	DA78	FW96
			$3d^4(^5D)4p$	y $^6F^o$	5/2	24898.771		
300	4408.195	0.60	$3d^4(^5D)4s$	a ^6D	5/2	2220.106	DA78	FW96
			$3d^4(^5D)4p$	y $^6F^o$	5/2	24898.771		
400	4408.501		$3d^4(^5D)4s$	a ^6D	3/2	2153.207	DA78	
			$3d^4(^5D)4p$	y $^6F^o$	3/2	24830.228		
			$3d^4(^5D)4s$	a ^6D	1/2	2112.282		
			$3d^4(^5D)4p$	y $^6F^o$	1/2	24789.385		
110	6090.208	0.26	$3d^4(^5D)4s$	a ^4D	7/2	8715.761	DA78	FW96
			$3d^4(^5D)4p$	z $^4P^o$	5/2	25131.005		

Energy Levels of Neutral Vanadium (V I)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^34s^2$	a ^{4}F	3/2	0.00	DA78
		5/2	137.38	DA78
		7/2	323.46	DA78
		9/2	552.96	DA78
$3d^4(^5D)4s$	a ^{6}D	1/2	2112.28	DA78
		3/2	2153.21	DA78
		5/2	2220.11	DA78
		7/2	2311.36	DA78
		9/2	2424.78	DA78
$3d^4(^5D)4s$	a ^{4}D	1/2	8413.00	DA78
		3/2	8476.23	DA78
		5/2	8578.53	DA78
		7/2	8715.76	DA78
$3d^34s^2$	a ^{4}P	1/2	9544.63	DA78
		3/2	9637.03	DA78
		5/2	9824.61	DA78
$3d^4(^5D)4p$	z ^{6}P^o	3/2	24648.11	DA78
		5/2	24727.86	DA78
		7/2	24838.55	DA78
$3d^4(^5D)4p$	z ^{4}P^o	1/2	24770.68	DA78
		3/2	24915.14	DA78
		5/2	25131.00	DA78
$3d^4(^5D)4p$	y ^{6}F^o	1/2	24789.38	DA78
		3/2	24830.23	DA78
		5/2	24898.77	DA78
		7/2	24992.88	DA78
		9/2	25111.47	DA78
		11/2	25253.43	DA78
$3d^4(^5D)4p$	y ^{4}F^o	3/2	25930.55	DA78
		5/2	26004.23	DA78
		7/2	26122.08	DA78
		9/2	26171.92	DA78
$3d^4(^5D)4p$	y ^{4}D^o	1/2	26182.63	DA78
		3/2	26249.48	DA78
		5/2	26352.65	DA78
		7/2	26480.29	DA78
$3d^4(^5D)4p$	y ^{6}D^o	1/2	26397.54	DA78
		3/2	26437.64	DA78
		5/2	26505.93	DA78
		7/2	26604.80	DA78
		9/2	26738.32	DA78
$3d^3(^4P)4s4p(^3P^o)$	y ^{6}P^o	3/2	29202.75	DA78
		5/2	29296.38	DA78
		7/2	29418.07	DA78
$3d^3(^2G)4s4p(^3P^o)$	x ^{4}F^o	3/2	31200.15	DA78
		5/2	31229.03	DA78
		7/2	31268.11	DA78
		9/2	31317.44	DA78

Energy Levels of Neutral Vanadium (V I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^3(^4F)4s4p(^1P^o)$	x $^4G^o$	5/2	31397.83	DA78
		7/2	31541.15	DA78
		9/2	31721.71	DA78
		11/2	31937.27	DA78
V II ($^5D_0$)		*Limit*	**54411.7**	JKLC94

Persistent Lines of Singly-ionized Vanadium (V II)

Inten	Wavelength (Å)	$A_{ki}(10^8$ s$^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	2687.954	0.767	$3d^4$	a ^5D	4	339.21	ICL88	M03
			$3d^3(^4F)4p$	z $^5D^o$	4	37531.08		
200	2700.937	0.345	$3d^4$	a ^5D	4	339.21	ICL88	M03
			$3d^3(^4F)4p$	z $^5F^o$	5	37352.45		
400	2893.307	1.1	$3d^3(^4F)4s$	a ^5F	4	2968.27	ICL88	BGFM89
			$3d^3(^4F)4p$	z $^5D^o$	3	37520.57		
600	2908.810	1.54	$3d^3(^4F)4s$	a ^5F	5	3162.80	ICL88	BGFM89
			$3d^3(^4F)4p$	z $^5D^o$	4	37531.08		
600	2924.017	1.73	$3d^3(^4F)4s$	a ^5F	5	3162.80	ICL88	BGFM89
			$3d^3(^4F)4p$	z $^5F^o$	5	37352.45		
400	2924.630	1.21	$3d^3(^4F)4s$	a ^5F	4	2968.27	ICL88	BGFM89
			$3d^3(^4F)4p$	z $^5F^o$	4	37150.51		
1000	3093.102	2.1	$3d^3(^4F)4s$	a ^5F	5	3162.80	ICL88	BGFM89
			$3d^3(^4F)4p$	z $^5G^o$	6	35483.39		
800	3102.292	1.77	$3d^3(^4F)4s$	a ^5F	4	2968.27	ICL88	BGFM89
			$3d^3(^4F)4p$	z $^5G^o$	5	35193.13		
700	3110.709	1.68	$3d^3(^4F)4s$	a ^5F	3	2808.82	ICL88	BGFM89
			$3d^3(^4F)4p$	z $^5G^o$	4	34946.55		
500	3118.376	1.54	$3d^3(^4F)4s$	a ^5F	2	2687.11	ICL88	BGFM89
			$3d^3(^4F)4p$	z $^5G^o$	3	34745.72		
400	3125.282	1.51	$3d^3(^4F)4s$	a ^5F	1	2604.88	ICL88	BGFM89
			$3d^3(^4F)4p$	z $^5G^o$	2	34592.75		
200	3190.686	0.33	$3d^3(^4F)4s$	a ^3F	4	9097.83	ICL88	BGFM89
			$3d^3(^4F)4p$	z $^3F^o$	4	40430.04		
200	3276.130	0.52	$3d^3(^4F)4s$	a ^3F	4	9097.83	ICL88	BGFM89
			$3d^3(^4F)4p$	z $^3G^o$	5	39612.96		

Energy Levels of Singly-ionized Vanadium (V II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^4$	a ^5D	0	0.00	ICL88
		1	36.05	ICL88
		2	106.63	ICL88
		3	208.89	ICL88
		4	339.21	ICL88
$3d^3(^4F)4s$	a ^5F	1	2604.88	ICL88
		2	2687.11	ICL88
		3	2808.82	ICL88
		4	2968.27	ICL88
		5	3162.80	ICL88
$3d^3(^4F)4s$	a ^3F	2	8640.31	ICL88
		3	8841.97	ICL88
		4	9097.83	ICL88
$3d^3(^4F)4p$	z $^5G^o$	2	34592.75	ICL88
		3	34745.72	ICL88
		4	34946.55	ICL88
		5	35193.13	ICL88
		6	35483.39	ICL88
$3d^3(^4F)4p$	z $^5F^o$	2	36673.48	ICL88
		3	36919.21	ICL88
		1	36954.63	ICL88
		4	37150.51	ICL88
		5	37352.45	ICL88
$3d^3(^4F)4p$	z $^5D^o$	0	37201.35	ICL88
		1	37259.39	ICL88
		2	37368.96	ICL88
		3	37520.57	ICL88
		4	37531.08	ICL88
$3d^3(^4F)4p$	z $^3G^o$	3	39234.05	ICL88
		4	39403.74	ICL88
		5	39612.96	ICL88
$3d^3(^4F)4p$	z $^3F^o$	2	40001.70	ICL88
		3	40195.52	ICL88
		4	40430.04	ICL88
V III ($^4F_{3/2}$)		*Limit*	**117900**	ICL88

Xenon (Xe)
Atomic number = 54
Atomic weight = 131.29

Isotope	Mass	Abundance	Spin	Mag moment
^{128}Xe	127.903531	1.91%	0	
^{129}Xe	128.904780	26.4%	1/2	−0.7768
^{130}Xe	129.903509	4.1%	0	
^{131}Xe	130.905072	21.2%	3/2	
^{132}Xe	131.904144	26.9%	0	
^{134}Xe	133.905395	10.4%	0	
^{136}Xe	135.907214	8.9%	0	

Xe I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6\ {}^1S_0$
Ionization energy: 97 833.79 cm^{-1} (12.129 84 eV)

Xe II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^5\ {}^2P^o_{3/2}$
Ionization energy: 169 175 cm^{-1} (20.9750 eV)

Strong Lines of Xenon (Xe)

Intensity	Wavelength (Å)	Spectrum	Ref.
	Vacuum		
120	740.41	Xe II	B36
120	803.07	Xe II	B36
200	880.80	Xe II	B36
120	885.54	Xe II	B36
200	925.87	Xe II	B36
80	935.40	Xe II	B36
250 P	972.77	Xe II	B36
250	976.68	Xe II	B36
150	1032.44	Xe II	B36
250	1037.68	Xe II	B36
400 P	1041.31	Xe II	B36
300 P	1048.27	Xe II	B36
400 P	1051.92	Xe II	B36
700 P	1074.48	Xe II	B36
200	1083.86	Xe II	B36
400 P	1100.43	Xe II	B36
200	1158.47	Xe II	B36
80	1169.63	Xe II	B36
250 P	1183.05	Xe II	B36
25 P	1192.0376	Xe I	BVHU01
200 P	1244.76	Xe II	B36
25 P	1250.2091	Xe I	BVHU01
100 P	1295.5878	Xe I	BVHU01
60 P	1469.6123	Xe I	BVHU01
	Air		
70	2864.73	Xe II	H39
50 h	2895.22	Xe II	H39
130	2979.32	Xe II	H39
30 h	3017.43	Xe II	H39
100	3121.87	Xe II	H39
70 h	3366.72	Xe II	H39
30 h	3461.26	Xe II	H39
1	3506.74	Xe I	HM33
1	3549.86	Xe I	HM33
1	3554.04	Xe I	HM33

Strong Lines of Xenon (Xe)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
2	3610.32	Xe I	HM33
1	3613.06	Xe I	HM33
1	3633.06	Xe I	HM33
1	3669.91	Xe I	HM33
4	3685.90	Xe I	HM33
4	3693.49	Xe I	HM33
30 l	3907.91	Xe II	H39
30	4037.59	Xe II	H39
70 l	4057.46	Xe II	H39
30 h	4098.89	Xe II	H39
70 l	4158.04	Xe II	H39
300 h	4180.10	Xe II	H39
150 h	4193.15	Xe II	H39
100 h	4208.48	Xe II	H39
30 h	4209.47	Xe II	H39
100 h	4213.72	Xe II	H39
30	4215.60	Xe II	H39
100 h	4223.00	Xe II	H39
130 h	4238.25	Xe II	H39
150 h	4245.38	Xe II	H39
30 l	4251.57	Xe II	H39
150 h	4296.40	Xe II	H39
150 h	4310.51	Xe II	H39
300 l	4330.52	Xe II	H39
70 h	4369.20	Xe II	H39
30 l	4373.78	Xe II	H39
150 h	4393.20	Xe II	H39
150 l	4395.77	Xe II	H39
70 l	4406.88	Xe II	H39
50 l	4416.07	Xe II	H39
150 h	4448.13	Xe II	H39
300 h	4462.19	Xe II	H39
150 l	4480.86	Xe II	H39
30 l	4521.86	Xe II	H39
60	4734.152	Xe I	HM33
15	4792.619	Xe I	HM33
50	4807.02	Xe I	HM33
40	4829.71	Xe I	HM33
30	4843.29	Xe I	HM33
700 P	4844.33	Xe II	HP87
50	4916.51	Xe I	HM33
50	4923.152	Xe I	HM33
70 l	4971.71	Xe II	H39
130	4972.71	Xe II	H39
100	4988.77	Xe II	H39
30 l	4991.17	Xe II	H39
20	5028.280	Xe I	HM33
70	5044.92	Xe II	H39
300	5080.62	Xe II	H39
100	5122.42	Xe II	H39
30	5125.70	Xe II	H39
30	5178.82	Xe II	H39
100	5188.04	Xe II	H39
130	5191.37	Xe II	H39
30	5192.10	Xe II	H39
150	5260.44	Xe II	H39
150	5261.95	Xe II	H39
700 P	5292.22	Xe II	H39
100	5309.27	Xe II	H39

Strong Lines of Xenon (Xe)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
300	5313.87	Xe II	H39
700	5339.33	Xe II	H39
70	5363.20	Xe II	H39
70	5368.07	Xe II	H39
150	5372.39	Xe II	H39
10	5392.80	Xe I	HM33
1000 P	5419.15	Xe II	H39
250	5438.96	Xe II	H39
100	5445.45	Xe II	H39
70	5450.45	Xe II	H39
130	5460.39	Xe II	H39
300	5472.61	Xe II	H39
30 l	5494.86	Xe II	H39
70	5525.53	Xe II	H39
200	5531.07	Xe II	H39
10	5566.62	Xe I	HM33
100	5616.67	Xe II	H39
100	5659.38	Xe II	H39
200	5667.56	Xe II	H39
50	5670.91	Xe II	H39
10	5695.75	Xe I	HM33
70	5699.61	Xe II	H39
70	5716.10	Xe II	H39
150	5726.91	Xe II	H39
150	5751.03	Xe II	H39
100	5758.65	Xe II	H39
100	5776.39	Xe II	H39
30	5815.96	Xe II	H39
30	5823.89	Xe I	HM33
15	5824.80	Xe I	HM33
10	5875.02	Xe I	HM33
100	5893.29	Xe II	H39
10	5894.99	Xe I	HM33
70	5905.13	Xe II	H39
10	5934.17	Xe I	HM33
150	5945.53	Xe II	H39
100	5971.13	Xe II	H39
700 P	5976.46	Xe II	H39
70	6008.92	Xe II	H39
300	6036.20	Xe II	H39
700 P	6051.15	Xe II	H39
200	6093.50	Xe II	H39
500 P	6097.59	Xe II	H39
130	6101.43	Xe II	H39
30	6115.08	Xe II	H39
30	6146.45	Xe II	H39
15	6178.30	Xe I	HM33
12	6179.66	Xe I	HM33
30	6182.42	Xe I	HM33
150	6194.07	Xe II	H39
10	6198.26	Xe I	HM33
150	6270.82	Xe II	H39
130	6277.54	Xe II	H39
30	6284.41	Xe II	H39
10	6286.01	Xe I	HM33
80	6300.86	Xe II	H39
50	6318.06	Xe I	HM33
130	6343.96	Xe II	H39
200	6356.35	Xe II	H39

Strong Lines of Xenon (Xe)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
70	6375.28	Xe II	H39
30	6397.99	Xe II	H39
30	6469.70	Xe I	HM33
15	6472.84	Xe I	HM33
12	6487.76	Xe I	HM33
10	6498.72	Xe I	HM33
20 h	6504.18	Xe I	HM33
100	6512.83	Xe II	H39
70	6528.65	Xe II	H39
10	6533.16	Xe I	HM33
300	6595.01	Xe II	H39
10	6595.56	Xe I	HM33
130	6597.25	Xe II	H39
30	6598.84	Xe II	H39
15	6668.92	Xe I	HM33
100	6694.32	Xe II	H39
20	6728.01	Xe I	HM33
50	6788.71	Xe II	H39
30	6790.37	Xe II	H39
300	6805.74	Xe II	H39
20	6827.32	Xe I	HM33
10	6872.11	Xe I	HM33
30	6882.16	Xe I	HM33
25	6910.22	Xe II	H39
10	6925.53	Xe I	HM33
250 h	6942.11	Xe II	H39
10	6976.18	Xe I	HM33
700	6990.88	Xe II	H39
50	7082.15	Xe II	H39
50	7119.60	Xe I	HM33
15 s	7147.50	Xe II	H39
70	7149.03	Xe II	H39
150	7164.83	Xe II	H39
30	7284.34	Xe II	H39
70	7301.80	Xe II	H39
70	7339.30	Xe II	H39
10	7386.00	Xe I	HM33
15	7393.79	Xe I	HM33
100	7548.45	Xe II	H39
20	7584.68	Xe I	HM33
25	7618.57	Xe II	H39
50	7642.02	Xe I	HM33
10	7643.91	Xe I	HM33
70	7670.66	Xe II	H39
20	7787.04	Xe II	H39
10	7802.65	Xe I	HM33
10	7881.32	Xe I	HM33
30	7887.40	Xe I	HM33
50	7967.34	Xe I	HM33
10	8029.67	Xe I	HM33
20	8057.26	Xe I	HM33
15	8061.34	Xe I	HM33
10	8101.98	Xe I	HM33
50 h	8151.80	Xe II	H39
10	8171.02	Xe I	HM33
70	8206.34	Xe I	HM33
1000 P	8231.635	Xe I	HP70b
50	8266.52	Xe I	HM33
700 P	8280.117	Xe I	HP70b

Strong Lines of Xenon (Xe)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
200	8346.823	Xe I	HP70b
30	8347.24	Xe II	H39
200	8409.191	Xe I	HP70b
15 h	8515.19	Xe II	H39
20	8576.01	Xe I	HM33
15 h	8604.23	Xe II	H39
25	8648.54	Xe I	HM33
10	8692.20	Xe I	HM33
20	8696.86	Xe I	HM33
15 h	8716.19	Xe II	H39
30	8739.39	Xe I	HM33
10	8758.20	Xe I	HM33
500 P	8819.411	Xe I	HP70b
30	8862.32	Xe I	HM33
20	8908.73	Xe I	HM33
20	8930.83	Xe I	HM33
100	8952.252	Xe I	HP70b
10	8981.05	Xe I	HM33
20	8987.57	Xe I	HM33
40	9045.45	Xe I	HM33
50	9162.65	Xe I	HM33
10	9167.52	Xe I	HM33
10	9374.76	Xe I	HM33
20	9513.38	Xe I	HM33
15 h	9591.35	Xe II	H39
15	9685.32	Xe I	HM33
15 l	9698.68	Xe II	H39
10	9718.16	Xe I	HM33
200	9799.700	Xe I	HP70b
300 P	9923.190	Xe I	HP70b
10	10838.37	Xe I	HM33
9	11742.01	Xe I	H73
40	12235.24	Xe I	H73
10	12257.76	Xe I	H73
30	12590.20	Xe I	H73
250 P	12623.399	Xe I	HP70b
25	13544.15	Xe I	H73
200	13657.06	Xe I	H73
120	14142.44	Xe I	H73
80	14240.96	Xe I	H73
40	14364.99	Xe I	H73
14	14660.81	Xe I	H73
300 P	14732.816	Xe I	HP70b
10	15099.72	Xe I	H73
250	15418.39	Xe I	H73
15	15557.13	Xe I	H73
25	15979.54	Xe I	H73
10	16039.90	Xe I	H73
100	16053.28	Xe I	H73
12	16554.49	Xe I	H73
150	16728.15	Xe I	H73
150	17325.77	Xe I	H73
40	18788.13	Xe I	H73
15	20187.19	Xe I	H73
300	20262.24	Xe I	H73
25	21470.09	Xe I	H73
120	23193.33	Xe I	H73
11	23279.54	Xe I	H73
200	24824.71	Xe I	H73

Strong Lines of Xenon (Xe)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
20	25145.84	Xe I	H73
200	26269.08	Xe I	H73
250	26510.86	Xe I	H73
25	28381.54	Xe I	H73
80	28582.25	Xe I	H73
30	29384.41	Xe I	H73
15	29448.06	Xe I	H73
10	29649.58	Xe I	H73
10	29813.62	Xe I	H73
60	30253.14	Xe I	H73
150	30475.46	Xe I	H73
10	30504.12	Xe I	H73
50	30794.18	Xe I	H73
600 P	31069.23	Xe I	HP70b
12	31336.01	Xe I	H73
60	31607.91	Xe I	H73
10	32293.08	Xe I	H73
200	32739.26	Xe I	H73
400	33666.69	Xe I	H73
15	34014.67	Xe I	H73
40	34335.27	Xe I	H73
15	34744.00	Xe I	H73
500 P	35070.26	Xe I	HP70b
11	35246.92	Xe I	H73
25	36209.21	Xe I	H73
15	36231.74	Xe I	H73
40	36508.36	Xe I	H73
80	36788.83	Xe I	H73
14	38685.98	Xe I	H73
20	38737.82	Xe I	H73
25	38939.60	Xe I	H73
12	39955.14	Xe I	H73

Persistent Lines of Neutral Xenon (Xe I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
25	1192.0376	5.93	$5p^6$	^1S	0	0.000	BVHU01	M00
			$5p^5(^2P^o_{3/2})5d$	$^2[3/2]^o$	1	83889.971		
25	1250.2091	0.149	$5p^6$	^1S	0	0.000	BVHU01	M00
			$5p^5(^2P^o_{3/2})5d$	$^2[1/2]^o$	1	79986.619		
100	1295.5878	2.53	$5p^6$	^1S	0	0.000	BVHU01	M00
			$5p^5(^2P^o_{1/2})6s$	$^2[1/2]^o$	1	77185.040		
60	1469.6123	2.73	$5p^6$	^1S	0	0.000	BVHU01	M00
			$5p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	1	68045.156		
1000	8231.635		$5p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	2	67067.547	HP70b	
			$5p^5(^2P^o_{3/2})6p$	$^2[3/2]$	2	79212.464		
700	8280.117		$5p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	1	68045.156	HP70b	
			$5p^5(^2P^o_{3/2})6p$	$^2[1/2]$	0	80118.962		
500	8819.411		$5p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	2	67067.547	HP70b	
			$5p^5(^2P^o_{3/2})6p$	$^2[5/2]$	3	78403.060		
300	9923.190		$5p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	1	68045.156	HP70b	
			$5p^5(^2P^o_{3/2})6p$	$^2[5/2]$	2	78119.798		
250	12623.399		$5p^5(^2P^o_{3/2})6p$	$^2[1/2]$	1	77269.144	HP70b	
			$5p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	2	85188.774		
300	14732.816		$5p^5(^2P^o_{3/2})6p$	$^2[5/2]$	3	78403.060	HP70b	
			$5p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	2	85188.774		
600	31069.23		$5p^5(^2P^o_{3/2})6p$	$^2[3/2]$	2	79212.464	HP70b	
			$5p^5(^2P^o_{3/2})5d$	$^2[5/2]^o$	3	82430.205		
500	35070.26		$5p^5(^2P^o_{3/2})6p$	$^2[5/2]^o$	2	78119.798	HP70b	
			$5p^5(^2P^o_{3/2})5d$	$^2[7/2]^o$	3	80970.439		

Energy Levels of Neutral Xenon (Xe I)

Configuration	Term	J	Level (cm^{-1})	Ref
$5p^6$	^1S	0	0.000	BVHU01
$5p^5(^2P^o_{3/2})6s$	$^2[3/2]^o$	2	67067.547	BVHU01
		1	68045.156	BVHU01
$5p^5(^2P^o_{1/2})6s$	$^2[1/2]^o$	0	76196.767	BVHU01
		1	77185.040	BVHU01
$5p^5(^2P^o_{3/2})6p$	$^2[1/2]$	1	77269.144	HP70b
		0	80118.962	HP70b
$5p^5(^2P^o_{3/2})6p$	$^2[5/2]^o$	2	78119.798	HP70b
		3	78403.060	HP70b
$5p^5(^2P^o_{3/2})6p$	$^2[3/2]$	1	78956.031	HP70b
		2	79212.464	HP70b
$5p^5(^2P^o_{3/2})5d$	$^2[1/2]^o$	0	79771.268	HP70b
		1	79986.619	HP70b

Energy Levels of Neutral Xenon (Xe I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$5p^5(^2P^o_{3/2})5d$	$^2[7/2]^o$	4	80196.629	HP70b
		3	80970.439	HP70b
$5p^5(^2P^o_{3/2})5d$	$^2[3/2]^o$	2	80322.747	HP70b
		1	83889.971	HP70b
$5p^5(^2P^o_{3/2})5d$	$^2[5/2]^o$	2	81925.515	HP70b
		3	82430.205	HP70b
$5p^5(^2P^o_{3/2})7s$	$^2[3/2]^o$	2	85188.774	HP70b
		1	85440.014	HP70b
$5p^5(^2P^o_{1/2})6p$	$^2[3/2]$	1	88379.126	HP70b
		2	89162.355	HP70b
$5p^5(^2P^o_{1/2})6p$	$^2[1/2]^o$	1	89278.706	HP70b
		0	89860.015	HP70b
$5p^5(^2P^o_{1/2})5d$	$^2[5/2]^o$	2	91152.671	HP70b
		3	91746.575	HP70b
Xe II ($^2P^o_{3/2}$)		*Limit*	**97833.787**	BVHU01,KW85

Persistent Lines of Singly-ionized Xenon (Xe II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
250	972.77		$5p^5(^2P^o_{3/2})$	$^2P^o$	3/2	0.00	B36	
			$5p^4(^3P)6s$	^2P	3/2	102799.07		
400	1041.31		$5p^5$	$^2P^o$	3/2	0.00	B36	
			$5p^4(^3P)5d$	^4D	3/2	96033.48		
300	1048.27		$5p^5$	$^2P^o$	3/2	0.00	B36	
			$5p^4(^3P)5d$	^4D	5/2	95396.74		
400	1051.92		$5p^5$	$^2P^o$	3/2	0.00	B36	
			$5p^4(^3P)6s$	^4P	3/2	95064.38		
700	1074.48		$5p^5$	$^2P^o$	3/2	0.00	B36	
			$5p^4(^3P)6s$	^4P	5/2	93068.44		
400	1100.43	0.21	$5p^5$	$^2P^o$	3/2	0.00	B36	M00
			$5s5p^6$	^2S	1/2	90873.83		
250	1183.05		$5p^5$	$^2P^o$	1/2	10537.01	B36	
			$5p^4(^3P)6s$	^4P	3/2	95064.38		
200	1244.76	0.072	$5p^5$	$^2P^o$	1/2	10537.01	B36	M00
			$5s5p^6$	^2S	1/2	90873.83		
700	4844.33	1.1	$5p^4(^3P)6s$	^4P	5/2	93068.44	HP87	FW96
			$5p^4(^3P)6p$	$^4D^o$	7/2	113705.40		
700	5292.22	0.89	$5p^4(^3P)6s$	^4P	5/2	93068.44	H39	FW96
			$5p^4(^3P)6p$	$^4P^o$	5/2	111958.89		
1000	5419.15	0.62	$5p^4(^3P)6s$	^4P	3/2	95064.38	H39	FW96
			$5p^4(^3P)6p$	$^4D^o$	5/2	113512.36		
700	5976.46	0.28	$5p^4(^3P)6s$	^4P	3/2	95064.38	H39	FW96
			$5p^4(^3P)6p$	$^4P^o$	3/2	111792.17		

Persistent Lines of Singly-ionized Xenon (Xe II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
700	6051.15	0.17	$5p^4(^3P)5d$	^4D	7/2	95437.67	H39	FW96
			$5p^4(^3P)6p$	$^4P^o$	5/2	111958.89		
500	6097.59	0.26	$5p^4(^3P)5d$	^4D	5/2	95396.74	H39	FW96
			$5p^4(^3P)6p$	$^4P^o$	3/2	111792.17		

Energy Levels of Singly-ionized Xenon (Xe II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5p^5$	$^2P^o$	3/2	0.00	HP87
		1/2	10537.01	HP87
$5s5p^6$	^2S	1/2	90873.83	HP87
$5p^4(^3P)6s$	^4P	5/2	93068.44	HP87
		3/2	95064.38	HP87
		1/2	101157.48	HP87
$5p^4(^3P)5d$	^4D	7/2	95437.67	HP87
		5/2	95396.74	HP87
		3/2	96033.48	HP87
$5p^4(^3P)6s$	^2P	3/2	102799.07	HP87
		1/2	106906.12	HP87
$5p^4(^3P)6p$	$^4P^o$	5/2	111958.89	HP87
		3/2	111792.17	HP87
		1/2	113672.89	HP87
$5p^4(^3P)6p$	$^4D^o$	7/2	113705.40	HP87
		5/2	113512.36	HP87
$5p^4(^3P)6p$	$^2D^o$	1/2	121179.80	HP87
$5p^4(^3P)6p$	$^4D^o$	3/2	121628.82	HP87
Xe III ($^3P_2$)		*Limit*	**169175**	HP87

Ytterbium (Yb)
Atomic number = 70
Atomic weight = 173.04

Isotope	Mass	Abundance	Spin	Mag moment
^{168}Yb	167.933894	0.13%	0	
^{170}Yb	169.934759	3.05%	0	
^{171}Yb	170.936323	14.3%	1/2	+0.4919
^{172}Yb	171.936378	21.9%	0	
^{173}Yb	172.938208	16.12%	5/2	−0.6776
^{174}Yb	173.938859	31.8%	0	
^{176}Yb	175.942564	12.7%	0	

Yb I Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^{14} 6s^2\ {}^1S_0$
Ionization energy: 50 443.2 cm^{-1} (6.254 16 eV)

Yb II Ground state: $(1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6) 4f^{14} 6s\ {}^2S_{1/2}$
Ionization energy: 98 207 cm^{-1} (12.176 eV)

Strong Lines of Ytterbium (Yb)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
140 P	2116.67	Yb II	M67
150 P	2126.74	Yb II	M67
20	2161.60	Yb II	M67
50 P	2185.71	Yb II	M67
40 P	2224.46	Yb II	M67
8	2320.81	Yb II	M67
9	2390.74	Yb II	M67
25 P	2464.50	Yb I	MT78
8	2512.061	Yb II	M67
15	2538.67	Yb II	M67
6	2617.01	Yb II	M67
6	2644.306	Yb II	M67
60 P	2653.75	Yb II	M67
11	2665.038	Yb II	M67
20 P	2671.958	Yb I	MT78
20	2672.656	Yb II	M67
9	2718.349	Yb II	M67
6	2732.742	Yb II	M67
13	2748.664	Yb II	M67
70 P	2750.477	Yb II	M67
9	2776.280	Yb II	M67
6	2784.656	Yb II	M67
6	2798.211	Yb II	M67
8	2821.152	Yb II	M67
6	2824.974	Yb II	M67
11	2830.989	Yb II	M67
13 h	2847.175	Yb II	M67
6	2848.445	Yb II	M67
20	2851.126	Yb II	M67
6	2859.392	Yb II	M67
25	2859.805	Yb II	M67
8	2861.212	Yb II	M67
6	2861.34	Yb II	M67
11	2867.06	Yb II	M67
11	2888.04	Yb II	M67

Strong Lines of Ytterbium (Yb)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200 P	2891.384	Yb II	M67
9	2914.210	Yb II	M67
8	2915.275	Yb II	M67
15	2919.346	Yb II	M67
8	2945.907	Yb II	M67
7	2964.755	Yb II	M67
110 P	2970.564	Yb II	M67
11	2983.990	Yb II	M67
9	2994.805	Yb II	M67
15	3005.766	Yb II	M67
6	3009.392	Yb II	M67
9	3017.560	Yb II	M67
9	3026.669	Yb II	M67
50	3031.110	Yb II	M67
6	3065.040	Yb II	M67
6	3089.102	Yb II	M67
9	3107.902	Yb II	M67
11	3117.806	Yb II	M67
13	3140.936	Yb II	M67
7	3169.056	Yb II	M67
7	3180.919	Yb II	M67
20	3192.885	Yb II	M67
13	3201.160	Yb II	M67
7	3261.508	Yb II	M67
1000 P	3289.370	Yb II	M67
7	3305.252	Yb I	MT78
8	3305.733	Yb II	M67
4	3319.412	Yb I	MT78
13	3337.171	Yb II	M67
15 d	3342.93	Yb II	M67
4	3343.071	Yb II	M67
6	3352.491	Yb II	M67
6	3362.438	Yb II	M67
13	3375.483	Yb II	M67
8	3387.505	Yb I	MT78
8	3418.390	Yb I	MT78
20	3426.044	Yb I	MT78
13	3431.107	Yb I	MT78
6	3438.848	Yb II	M67
5	3452.398	Yb I	MT78
30	3454.080	Yb II	M67
11 d	3458.286	Yb II	M67
7	3458.391	Yb I	MT78
20	3460.269	Yb I	MT78
130 P	3464.37	Yb I	MT78
30	3476.303	Yb II	M67
30	3478.835	Yb II	M67
6 h,w	3495.90	Yb II	M67
13	3520.293	Yb II	M67
6	3549.822	Yb II	M67
11	3560.327	Yb II	M67
9	3560.704	Yb II	M67
20	3585.466	Yb II	M67
7	3606.478	Yb II	M67
11	3619.803	Yb II	M67
6	3634.525	Yb I	MT78
13	3637.757	Yb II	M67
4	3648.150	Yb I	MT78
5	3655.729	Yb I	MT78

Strong Lines of Ytterbium (Yb)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
13	3669.69	Yb II	M67
8	3675.085	Yb II	M67
1000 P	3694.190	Yb II	M67
4	3700.580	Yb I	MT78
10	3734.694	Yb I	MT78
30	3770.095	Yb I	MT78
4	3774.323	Yb I	MT78
9	3839.907	Yb I	MT78
20	3872.852	Yb I	MT78
20	3900.85	Yb I	MT78
8	3911.272	Yb I	MT78
1000 P	3987.99	Yb I	MT78
50 P	3990.885	Yb I	MT78
4	4052.283	Yb I	MT78
25	4089.68	Yb I	MT78
7 h	4119.464	Yb II	M67
25	4149.066	Yb I	MT78
7	4174.56	Yb I	MT78
20	4180.809	Yb II	M67
8 d	4218.565	Yb II	M67
7	4231.972	Yb I	MT78
4	4277.738	Yb I	MT78
7	4305.966	Yb I	MT78
25	4439.19	Yb I	MT78
5 h	4482.422	Yb I	MT78
5 h	4563.95	Yb I	MT78
40 P	4576.209	Yb I	MT78
11	4582.355	Yb I	MT78
4	4589.211	Yb I	MT78
8	4590.834	Yb I	MT78
11	4726.08	Yb II	M67
9 h	4781.867	Yb I	MT78
9	4786.61	Yb II	M67
40 P	4935.500	Yb I	MT78
8	4966.902	Yb I	MT78
4	5069.144	Yb I	MT78
12	5074.34	Yb I	MT78
5	5211.604	Yb I	MT78
6	5244.11	Yb I	MT78
8 h	5277.04	Yb I	MT78
9	5335.15	Yb II	M67
8	5352.95	Yb II	M67
5 h	5539.053	Yb I	MT78
130 P	5556.466	Yb I	MT78
12	5719.99	Yb I	MT78
20	6489.06	Yb I	MT78
10	6667.82	Yb I	MT78
40 P	6799.60	Yb I	MT78
40 P	7699.49	Yb I	MT78
4 h	8922.56	Yb II	M67

Persistent Lines of Neutral Ytterbium (Yb I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
25	2464.50	1.00	$4f^{14}(^1S)6s^2$	^1S	0	0.000	MT78	M00
			$4f^{14}(^1S)6s7p$	$^1P^o$	1	40563.97		
20	2671.958	0.143	$4f^{14}(^1S)6s^2$	^1S	0	0.000	MT78	M00
			$4f^{13}(^2F^o)5d6s^2$	^{o}	1	37414.59		
130	3464.37	0.683	$4f^{14}(^1S)6s^2$	^1S	0	0.000	MT78	M00
			$4f^{13}(^2F^o_{7/2})5d_{5/2}6s^2$	$(7/2,5/2)^o$	1	28857.014		
1000	3987.99	1.92	$4f^{14}(^1S)6s^2$	^1S	0	0.000	MT78	M00
			$4f^{14}(^1S)6s6p$	$^1P^o$	1	25068.222		
50	3990.885		$4f^{14}(^1S)6s6p$	$^3P^o$	2	19710.388	MT78	
			$4f^{14}(^1S)6p^2$	^3P	2	44760.37		
40	4576.209		$4f^{14}(^1S)6s6p$	$^3P^o$	1	17992.007	MT78	
			$4f^{14}(^1S)6s6d$	^3D	2	39838.04		
40	4935.500		$4f^{14}(^1S)6s6p$	$^3P^o$	2	19710.388	MT78	
			$4f^{14}(^1S)6s6d$	^3D	3	39966.09		
130	5556.466	0.0115	$4f^{14}(^1S)6s^2$	^1S	0	0.000	MT78	M00
			$4f^{14}(^1S)6s6p$	$^3P^o$	1	17992.007		
40	6799.60		$4f^{14}(^1S)6s6p$	$^3P^o$	1	17992.007	MT78	
			$4f^{14}(^1S)6s7s$	^3S	1	32694.692		
40	7699.49		$4f^{14}(^1S)6s6p$	$^3P^o$	2	19710.388	MT78	
			$4f^{14}(^1S)6s7s$	^3S	1	32694.692		

Energy Levels of Neutral Ytterbium (Yb I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{14}(^1S)6s^2$	^1S	0	0.000	MT78
$4f^{14}(^1S)6s6p$	$^3P^o$	0	17288.439	MT78
		1	17992.007	MT78
		2	19710.388	MT78
$4f^{13}(^2F^o_{7/2})5d_{3/2}6s^2$	$(7/2,3/2)^o$	2	23188.518	MT78
		5	25859.682	MT78
		3	27445.638	MT78
		4	28184.512	MT78
$4f^{14}(^1S)5d6s$	^3D	1	24489.102	MT78
		2	24751.948	MT78
		3	25270.902	MT78
$4f^{14}(^1S)6s6p$	$^1P^o$	1	25068.222	MT78
$4f^{13}(^2F^o_{7/2})5d_{5/2}6s^2$	$(7/2,5/2)^o$	6	27314.919	MT78
		2	28195.960	MT78
		1	28857.014	MT78
		4	29774.958	MT78
		3	30207.380	MT78
		5	30524.714	MT78
$4f^{14}(^1S)5d6s$	^1D	2	27677.665	MT78

Energy Levels of Neutral Ytterbium (Yb I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{13}(^2F^o_{7/2})6s^26p_{1/2}$	(7/2,1/2)	3	32065.282	MT78
		4	32273.597	MT78
$4f^{14}(^1S)6s7s$	^3S	1	32694.692	MT78
$4f^{14}(^1S)6s7s$	^1S	0	34350.65	MT78
$4f^{13}(^2F^o_{7/2})6s^26p_{3/2}$	(7/2,3/2)	5	35178.78	MT78
		2	35196.98	MT78
		3	35807.52	MT78
		4	36060.98	MT78
$4f^{13}(^2F^o)5d6s^2$	^{o}	1	37414.59	MT78
$4f^{14}(^1S)6s7p$	$^3P^o$	0	38090.71	MT78
		1	38174.17	MT78
		2	38551.93	MT78
$4f^{13}(^2F^o)5d6s^2$	$^3D^o$	1	38422.36	MT78
$4f^{14}(^1S)6s6d$	^3D	1	39808.72	MT78
		2	39838.04	MT78
		3	39966.09	MT78
$4f^{13}(^2F^o_{7/2})5d(^2D)6s6p(^3P^o)(^4F^o_{3/2})$	(7/2,3/2)	2	39880.26	MT78
		5	42935.78	MT78
		4	44984.75	MT78
		3	45462.54	MT78
$4f^{14}(^1S)6s6d$	^1D	2	40061.51	MT78
$4f^{14}(^1S)6s7p$	$^1P^o$	1	40563.97	MT78
$4f^{14}(^1S)6s8s$	^3S	1	41615.04	MT78
$4f^{13}(^2F^o_{7/2})5d(^2D)6s6p(^3P^o)(^4F^o_{5/2})$	(7/2,5/2)	3	41827.30	MT78
$4f^{14}(^1S)6s8s$	^1S	0	41939.90	MT78
$4f^{13}(^2F^o_{7/2})5d(^2D)6s6p(^3P^o)(^4F^o_{5/2})$	(7/2,5/2)	1	42436.70	MT78
$4f^{14}(^1S)6p^2$	^3P	0	42436.91	MT78
		1	43805.42	MT78
		2	44760.37	MT78
Yb II ($^2S_{1/2}$)		*Limit*	**50443.2**	A80

Persistent Lines of Singly-ionized Ytterbium (Yb II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
140	2116.67	0.341	$4f^{14}(^1S)6s$	^2S	1/2	0.00	M67	M00
			$4f^{13}(^2F^o_{5/2})5d6s(^1D)$	$^1[1/2]^o$	1/2	47228.96		
150	2126.74	0.495	$4f^{14}(^1S)6s$	^2S	1/2	0.00	M67	M00
			$4f^{13}(^2F^o_{5/2})5d6s(^1D)$	$^1[3/2]^o$	3/2	47005.46		
50	2185.71	0.316	$4f^{14}(^1S)6s$	^2S	1/2	0.00	M67	M00
			$4f^{13}(^2F^o_{7/2})5d^2(^3F)$	^{o}	3/2	45737.29		
40	2224.46	0.479	$4f^{14}(^1S)6s$	^2S	1/2	0.00	M67	M00
			$4f^{13}(^2F^o_{5/2})5d6s(^3D)$	^{o}	3/2	44940.61		

Persistent Lines of Singly-ionized Ytterbium (Yb II)—Continued

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
60	2653.75	3.90	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	21418.75	M67	BDMQ98
			$4f^{13}(^2F^o_{7/2})6s6p(^1P^o_1)$		7/2	59090.13		
70	2750.477	3.20	$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	21418.75	M67	BDMQ98
			$4f^{13}(^2F^o_{7/2})6s6p(^1P^o_1)$	(7/2,1)	9/2	57765.32		
200	2891.384	0.342	$4f^{14}(^1S)6s$	^2S	1/2	0.00	M67	M00
			$4f^{13}(^2F^o_{7/2})5d6s(^1D)$	$^1[3/2]^o$	3/2	34575.37		
110	2970.564	0.261	$4f^{14}(^1S)6s$	^2S	1/2	0.00	M67	M00
			$4f^{13}(^2F^o_{7/2})5d6s(^3D)$	$^3[3/2]^o$	1/2	33653.86		
1000	3289.370	1.62	$4f^{14}(^1S)6s$	^2S	1/2	0.00	M67	M00
			$4f^{14}(^1S)6p$	$^2P^o$	3/2	30392.23		
1000	3694.190	1.23	$4f^{14}(^1S)6s$	^2S	1/2	0.00	M67	M00
			$4f^{14}(^1S)6p$	$^2P^o$	1/2	27061.82		

Energy Levels of Singly-ionized Ytterbium (Yb II)

Configuration	Term	J	Level (cm^{-1})	Ref
$4f^{14}(^1S)6s$	^2S	1/2	0.00	M67
$4f^{13}(^2F^o)6s^2$	$^2F^o$	7/2	21418.75	M67
		5/2	31568.08	M67
$4f^{14}(^1S)5d$	^2D	3/2	22960.80	M67
		5/2	24332.69	M67
$4f^{13}(^2F^o_{7/2})5d6s(^3D)$	$^3[3/2]^o$	5/2	26759.02	M67
		3/2	28757.98	M67
		1/2	33653.86	M67
$4f^{14}(^1S)6p$	$^2P^o$	1/2	27061.82	M67
		3/2	30392.23	M67
$4f^{13}(^2F^o_{7/2})5d6s(^1D)$	$^1[3/2]^o$	3/2	34575.37	M67
$4f^{13}(^2F^o_{5/2})5d6s(^3D)$	^{o}	3/2	44940.61	M67
$4f^{13}(^2F^o_{7/2})5d^2(^3F)$	^{o}	3/2	45737.29	M67
$4f^{13}(^2F^o_{5/2})5d6s(^1D)$	$^1[3/2]^o$	3/2	47005.46	M67
$4f^{13}(^2F^o_{5/2})5d6s(^1D)$	$^1[1/2]^o$	1/2	47228.96	M67
$4f^{13}(^2F^o_{7/2})6s6p(^1P^o_1)$	(7/2,1)	9/2	57765.32	M67
$4f^{13}(^2F^o_{7/2})6s6p(^1P^o_1)$		7/2	59090.13	M67
Yb III ($^1S_0$)		*Limit*	**98207**	SK79

Yttrium (Y)

Atomic number = 39

Atomic weight = 88.905 85

Isotope	Mass	Abundance	Spin	Mag moment
^{89}Y	88.905849	100%	1/2	−0.1373

Y I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d 5s^2$ $^2D_{3/2}$
Ionization energy: 50 145.6 cm^{-1} (6.2173 eV)

Y II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2$ $^1S_0$
Ionization energy: 98 590 cm^{-1} (12.224 eV)

Strong Lines of Yttrium (Y)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
25	2243.045	Y II	NJK91
40	2422.186	Y II	NJK91
40	2948.406	Y I	P77
40	2964.964	Y I	P77
50	2974.588	Y I	P77
80	2984.254	Y I	P77
20	3045.363	Y I	P77
300	3173.045	Y II	NJK91
200	3195.613	Y II	NJK91
150	3200.269	Y II	NJK91
150	3203.320	Y II	NJK91
300	3216.680	Y II	NJK91
500 P	3242.272	Y II	NJK91
400	3327.876	Y II	NJK91
15	3485.722	Y I	P77
130	3496.079	Y II	NJK91
300 P	3549.002	Y II	NJK91
50	3552.690	Y I	P77
15	3558.741	Y I	P77
20	3571.431	Y I	P77
25	3576.052	Y I	P77
250	3584.514	Y II	NJK91
30	3587.743	Y I	P77
300	3592.915	Y I	P77
800 P	3600.731	Y II	NJK91
500	3601.915	Y II	NJK91
600 P	3611.043	Y II	NJK91
400	3620.940	Y I	P77
150	3628.700	Y II	NJK91
600 P	3633.121	Y II	NJK91
250	3664.610	Y II	NJK91
15	3692.523	Y I	P77
1000 P	3710.287	Y II	NJK91
90	3747.551	Y II	NJK91
800 P	3774.330	Y II	NJK91
110	3776.556	Y II	NJK91
600	3788.693	Y II	NJK91
100	3818.341	Y II	NJK91
300 P	3832.889	Y II	NJK91
300	3950.349	Y II	NJK91
300 P	3982.592	Y II	NJK91

Strong Lines of Yttrium (Y)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90	4039.826	Y I	P77
250	4047.628	Y I	P77
900 P	4077.359	Y I	P77
200	4083.705	Y I	P77
1000 P	4102.364	Y I	P77
6	4106.384	Y I	P77
900 P	4128.299	Y I	P77
800 P	4142.841	Y I	P77
250	4167.513	Y I	P77
200	4174.133	Y I	P77
600 P	4177.528	Y II	NJK91
15	4217.799	Y I	P77
30	4220.629	Y I	P77
200	4235.929	Y I	P77
100	4251.201	Y I	P77
40 h	4302.290	Y I	P77
200	4309.620	Y II	NJK91
40 h	4348.783	Y I	P77
900 P	4374.933	Y II	NJK91
200	4398.008	Y II	NJK91
15	4475.720	Y I	P77
20	4476.952	Y I	P77
15	4477.442	Y I	P77
30	4487.460	Y I	P77
50	4505.948	Y I	P77
90	4527.239	Y I	P77
40	4527.783	Y I	P77
13	4596.528	Y I	P77
200	4643.698	Y I	P77
20 h	4658.319	Y I	P77
200	4674.848	Y I	P77
20	4696.800	Y I	P77
15	4728.514	Y I	P77
15	4752.790	Y I	P77
40	4760.978	Y I	P77
15	4786.875	Y I	P77
20	4799.301	Y I	P77
80	4839.866	Y I	P77
60	4845.668	Y I	P77
40	4852.682	Y I	P77
300	4854.861	Y II	NJK91
30	4859.841	Y I	P77
700 P	4883.682	Y II	NJK91
600 P	4900.118	Y II	NJK91
700 P	5087.418	Y II	NJK91
20	5135.199	Y I	P77
300	5200.409	Y II	NJK91
500 P	5205.722	Y II	NJK91
20	5240.800	Y I	P77
20	5438.226	Y I	P77
70	5466.466	Y I	P77
30	5503.464	Y I	P77
70	5527.561	Y I	P77
20	5577.416	Y I	P77
60	5581.874	Y I	P77
60	5630.138	Y I	P77
15	5706.714	Y I	P77
100	6024.271	Y I	P77
120	6191.720	Y I	P77

Strong Lines of Yttrium (Y)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
30	6222.579	Y I	P77
100	6435.022	Y I	P77
15	6687.571	Y I	P77
20	6793.704	Y I	P77
50	9476.928	Y II	NJK91
30	10329.701	Y II	NJK91
30	10605.150	Y II	NJK91
200	15619.966	Y I	P77
400	17123.808	Y I	P77
250	17366.720	Y I	P77
600 P	17422.838	Y I	P77
500	17663.292	Y I	P77
1000 P	17903.209	Y I	P77
1000 P	18049.810	Y I	P77
1000	18115.296	Y I	P77
900	18181.765	Y I	P77
800 P	21260.444	Y I	P77
700 P	22543.828	Y I	P77
500 P	23990.450	Y I	P77
400	24920.894	Y I	P77

Persistent Lines of Neutral Yttrium (Y I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
900	4077.359	1.1	$4d5s^2$	^{2}D	3/2	0.000	P77	FW96
			$4d(^3D)5s5p$	^{2}F^o	5/2	24518.751		
1000	4102.364	1.3	$4d5s^2$	^{2}D	5/2	530.351	P77	FW96
			$4d(^3D)5s5p$	^{2}F^o	7/2	24899.632		
900	4128.299	1.6	$4d5s^2$	^{2}D	5/2	530.351	P77	FW96
			$4d(^1D)5s5p$	^{2}D^o	5/2	24746.573		
800	4142.841	1.6	$4d5s^2$	^{2}D	3/2	0.000	P77	FW96
			$4d(^1D)5s5p$	^{2}D^o	3/2	24131.250		
600	17422.838		$4d^2(^3F)5s$	^{4}F	5/2	11078.614	P77	
			$4d(^3D)5s5p$	^{4}D^o	5/2	16816.641		
1000	17903.209		$4d^2(^3F)5s$	^{4}F	9/2	11532.096	P77	
			$4d(^3D)5s5p$	^{4}D^o	7/2	17116.156		
1000	18049.810		$4d^2(^3F)5s$	^{4}F	7/2	11277.928	P77	
			$4d(^3D)5s5p$	^{4}D^o	5/2	16816.641		
800	21260.444		$4d^2(^3F)5s$	^{4}F	9/2	11532.096	P77	
			$4d(^3D)5s5p$	^{4}F^o	9/2	16234.382		
700	22543.828		$4d^2(^3F)5s$	^{4}F	7/2	11277.928	P77	
			$4d(^3D)5s5p$	^{4}F^o	7/2	15712.522		
500	23990.450		$4d^2(^3F)5s$	^{4}F	5/2	11078.614	P77	
			$4d(^3D)5s5p$	^{4}F^o	5/2	15245.803		

Energy Levels of Neutral Yttrium (Y I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d5s^2$	^2D	3/2	0.000	P77
		5/2	530.351	P77
$5s^25p$	$^2P^o$	1/2	10529.169	P77
		3/2	11359.757	P77
$4d^2(^3F)5s$	^4F	3/2	10937.390	P77
		5/2	11078.614	P77
		7/2	11277.928	P77
		9/2	11532.096	P77
$4d(^3D)5s5p$	$^4F^o$	3/2	14948.994	P77
		5/2	15245.803	P77
		7/2	15712.522	P77
		9/2	16234.382	P77
$4d^2(^3P)5s$	^4P	1/2	15221.633	P77
		3/2	15328.865	P77
		5/2	15476.533	P77
$4d^2(^3F)5s$	^2F	5/2	15326.741	P77
		7/2	15864.481	P77
$4d^2(^1D)5s$	^2D	3/2	15994.045	P77
		5/2	16158.865	P77
$4d(^3D)5s5p$	$^2D^o$	5/2	16066.064	P77
		3/2	16146.138	P77
$4d(^3D)5s5p$	$^4D^o$	1/2	16435.907	P77
		3/2	16597.304	P77
		5/2	16816.641	P77
		7/2	17116.156	P77
$4d^2(^1G)5s$	^2G	9/2	18499.315	P77
		7/2	18512.402	P77
$4d(^3D)5s5p$	$^4P^o$	1/2	18976.366	P77
		3/2	19027.593	P77
		5/2	19147.983	P77
$4d(^1D)5s5p$	$^2D^o$	3/2	24131.250	P77
		5/2	24746.573	P77
$4d(^3D)5s5p$	$^2F^o$	5/2	24518.751	P77
		7/2	24899.632	P77
Y II ($^1S_0$)		*Limit*	**50145.6**	GRTE73,JS00

Persistent Lines of Singly-ionized Yttrium (Y II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
500	3242.272	2.0	$4d5s$	^3D	3	1449.752	NJK91	FW96
			$4d5p$	$^3P^o$	2	32283.420		
300	3549.002	0.397	$4d5s$	^3D	2	1045.076	NJK91	FW96
			$4d5p$	$^3D^o$	3	29213.958		
800	3600.731	1.4	$4d5s$	^3D	3	1449.752	NJK91	FW96
			$4d5p$	$^3D^o$	3	29213.958		
600	3611.043	1.04	$4d5s$	^3D	2	1045.076	NJK91	FW96
			$4d5p$	$^3D^o$	2	28730.010		
600	3633.121		$5s^2$	^1S	0	0.000	NJK91	
			$4d5p$	$^1P^o$	1	27516.699		
1000	3710.287	1.5	$4d5s$	^3D	3	1449.752	NJK91	FW96
			$4d5p$	$^3F^o$	4	28394.177		
800	3774.330	1.1	$4d5s$	^3D	2	1045.076	NJK91	FW96
			$4d5p$	$^3F^o$	3	27532.321		
300	3832.889	0.30	$4d5s$	^3D	3	1449.752	NJK91	FW96
			$4d5p$	$^3F^o$	3	27532.321		
300	3982.592	0.27	$4d5s$	^3D	2	1045.076	NJK91	FW96
			$4d5p$	$^1D^o$	2	26147.252		
600	4177.528	0.527	$4d5s$	^1D	2	3296.180	NJK91	FW96
			$4d5p$	$^3F^o$	2	27227.027		
900	4374.933	0.997	$4d5s$	^1D	2	3296.180	NJK91	FW96
			$4d5p$	$^1D^o$	2	26147.252		
700	4883.682	0.47	$4d^2$	^3F	4	8743.322	NJK91	FW96
			$4d5p$	$^3D^o$	3	29213.958		
600	4900.118	0.451	$4d^2$	^3F	3	8328.039	NJK91	FW96
			$4d5p$	$^3D^o$	2	28730.010		
700	5087.418	0.20	$4d^2$	^3F	4	8743.322	NJK91	FW96
			$4d5p$	$^3F^o$	4	28394.177		
500	5205.722	0.16	$4d^2$	^3F	3	8328.039	NJK91	FW96
			$4d5p$	$^3F^o$	3	27532.321		

Energy Levels of Singly-ionized Yttrium (Y II)

Configuration	Term	J	Level (cm^{-1})	Ref
$5s^2$	^1S	0	0.000	NJK91
$4d5s$	^3D	1	840.198	NJK91
		2	1045.076	NJK91
		3	1449.752	NJK91
$4d5s$	^1D	2	3296.180	NJK91
$4d^2$	^3F	2	8003.126	NJK91
		3	8328.039	NJK91
		4	8743.322	NJK91

Energy Levels of Singly-ionized Yttrium (Y II)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^2$	^3P	0	13883.379	NJK91
		1	14018.267	NJK91
		2	14098.076	NJK91
$4d^2$	^1D	2	14832.862	NJK91
$4d^2$	^1G	4	15682.905	NJK91
$5s5p$	$^3P^o$	0	23445.063	NJK91
		1	23776.245	NJK91
		2	24647.121	NJK91
$4d5p$	$^1D^o$	2	26147.252	NJK91
$4d5p$	$^3F^o$	2	27227.027	NJK91
		3	27532.321	NJK91
		4	28394.177	NJK91
$4d5p$	$^1P^o$	1	27516.699	NJK91
$4d5p$	$^3D^o$	1	28595.285	NJK91
		2	28730.010	NJK91
		3	29213.958	NJK91
$4d5p$	$^3P^o$	0	32048.788	NJK91
		1	32124.054	NJK91
		2	32283.420	NJK91
Y III ($^2D_{3/2}$)		*Limit*	**98590**	NJK91

Zinc (Zn)
Atomic number = 30
Atomic weight = 65.39

Isotope	Mass	Abundance	Spin	Mag moment
^{64}Zn	63.929145	48.6%	0	
^{66}Zn	65.926034	27.9%	0	
^{67}Zn	66.927129	4.1%	5/2	+0.87515
^{68}Zn	67.924846	18.8%	0	
^{70}Zn	69.925325	0.6%	0	

Zn I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2\ ^1S_0$
Ionization energy: 75 769.33 cm^{-1} (9.394 199 eV)

Zn II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s\ ^2S_{1/2}$
Ionization energy: 144 892.6 cm^{-1} (17.964 39 eV)

Strong Lines of Zinc (Zn)

Intensity	Wavelength (Å)	Spectrum	Ref
	Air		
1000 P	2025.4845	Zn II	GL00
1000 P	2062.0011	Zn II	GL00
400 P	2064.2266	Zn II	GL00
1000 P	2099.9273	Zn II	GL00
200	2102.1661	Zn II	GL00
1000 P	2138.5735	Zn I	GL00
300 P	2501.9945	Zn II	GL00
500 P	2557.9460	Zn II	GL00
10	2608.5576	Zn I	GL00
20	2770.8538	Zn I	GL00
8	2770.9740	Zn I	GL00
20 P	2800.8635	Zn I	GL00
6 P	2801.0500	Zn I	GL00
60 P	3075.8971	Zn I	GL00
100	3196.31	Zn II	CD68
50 P	3282.3256	Zn I	GL00
200 P	3302.5829	Zn I	GL00
70 P	3302.9395	Zn I	GL00
400 P	3345.0134	Zn I	GL00
80 P	3345.5694	Zn I	GL00
15 P	3345.9353	Zn I	GL00
100 P	4680.1359	Zn I	GL00
250 P	4722.1569	Zn I	GL00
400 P	4810.5321	Zn I	GL00
80 P	4911.6269	Zn II	GL00
120 P	4924.0132	Zn II	GL00
100	5894.3607	Zn II	GL00
40	6214.5778	Zn II	GL00
30 P	6362.3458	Zn I	GL00
50	7478.7691	Zn II	GL00
60	7588.4648	Zn II	GL00
40	7732.4886	Zn II	GL00

Persistent Lines of Neutral Zinc (Zn I)

Inten	Wavelength (Å)	A_{ki} (10^8 s^{-1})	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2138.5735	7.14	$4s^2$	^{1}S	0	0.000	GL00	M03
			$4s4p$	^{1}P^o	1	46745.404		
20	2800.8635		$4s4p$	^{3}P^o	2	32890.327	GL00	
			$4s5d$	^{3}D	3	68583.083		
25	2801.0500		$4s4p$	^{3}P^o	2	32890.327	GL00	
			$4s5d$	^{3}D	2	68580.705		
60	3075.8971	0.000375	$4s^2$	^{1}S	0	0.000	GL00	M03
			$4s4p$	^{3}P^o	1	32501.399		
50	3282.3256	0.90	$4s4p$	^{3}P^o	0	32311.319	GL00	FW96
			$4s4d$	^{3}D	1	62768.747		
200	3302.5829	1.2	$4s4p$	^{3}P^o	1	32501.399	GL00	FW96
			$4s4d$	^{3}D	2	62772.014		
70	3302.9395	0.67	$4s4p$	^{3}P^o	1	32501.399	GL00	FW96
			$4s4d$	^{3}D	1	62768.747		
400	3345.0134	1.7	$4s4p$	^{3}P^o	2	32890.327	GL00	FW96
			$4s4d$	^{3}D	3	62776.981		
80	3345.5694	0.40	$4s4p$	^{3}P^o	2	32890.327	GL00	FW96
			$4s4d$	^{3}D	2	62772.014		
15	3345.9353	0.045	$4s4p$	^{3}P^o	2	32890.327	GL00	FW96
			$4s4d$	^{3}D	1	62768.747		
100	4680.1359		$4s4p$	^{3}P^o	0	32311.319	GL00	
			$4s5s$	^{3}S	1	53672.240		
250	4722.1569		$4s4p$	^{3}P^o	1	32501.399	GL00	
			$4s5s$	^{3}S	1	53672.240		
400	4810.5321		$4s4p$	^{3}P^o	2	32890.327	GL00	
			$4s5s$	^{3}S	1	53672.240		
30	6362.3458	0.474	$4s4p$	^{1}P^o	1	46745.404	GL00	FW96
			$4s4d$	^{1}D	2	62458.533		

Energy Levels of Neutral Zinc (Zn I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4s^2$	^{1}S	0	0.000	GL00
$4s4p$	^{3}P^o	0	32311.319	GL00
		1	32501.399	GL00
		2	32890.327	GL00
$4s4p$	^{1}P^o	1	46745.404	GL00
$4s5s$	^{3}S	1	53672.240	GL00
$4s5s$	^{1}S	0	55789.213	GL00
$4s4d$	^{1}D	2	62458.533	GL00
$4s4d$	^{3}D	1	62768.747	GL00
		2	62772.014	GL00
		3	62776.981	GL00

Energy Levels of Neutral Zinc (Zn I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4s5d$	^3D	1	68579.141	GL00
		2	68580.705	GL00
		3	68583.083	GL00
Zn II ($^2S_{1/2}$)		*Limit*	**75769.33**	SM95

Persistent Lines of Singly-ionized Zinc (Zn II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
1000	2025.4845	4.07	$3d^{10}4s$	^2S	1/2	0.000	GL00	M03
			$3d^{10}4p$	$^2P^o$	3/2	49355.003		
1000	2062.0011	3.86	$3d^{10}4s$	^2S	1/2	0.000	GL00	M03
			$3d^{10}4p$	$^2P^o$	1/2	48481.077		
400	2064.2266	4.6	$3d^{10}4p$	$^2P^o$	1/2	48481.077	GL00	FW96
			$3d^{10}4d$	^2D	3/2	96909.893		
1000	2099.9273	5.6	$3d^{10}4p$	$^2P^o$	3/2	49355.003	GL00	FW96
			$3d^{10}4d$	^2D	5/2	96960.588		
300	2501.9945		$3d^{10}4p$	$^2P^o$	1/2	48481.077	GL00	
			$3d^{10}5s$	^2S	1/2	88437.149		
500	2557.9460		$3d^{10}4p$	$^2P^o$	3/2	49355.003	GL00	
			$3d^{10}5s$	^2S	1/2	88437.149		
80	4911.6269	1.6	$3d^{10}4d$	^2D	3/2	96909.893	GL00	FW96
			$3d^{10}4f$	$^2F^o$	5/2	117264.063		
120	4924.0132		$3d^{10}4d$	^2D	5/2	96960.588	GL00	
			$3d^{10}4f$	$^2F^o$	7/2	117263.558		

Energy Levels of Singly-ionized Zinc (Zn II)

Configuration	Term	J	Level (cm^{-1})	Ref
$3d^{10}4s$	^2S	1/2	0.000	GL00
$3d^{10}4p$	$^2P^o$	1/2	48481.077	GL00
		3/2	49355.003	GL00
$3d^94s^2$	^2D	5/2	62722.506	GL00
		3/2	65411.745	GL00
$3d^{10}5s$	^2S	1/2	88437.149	GL00
$3d^{10}4d$	^2D	3/2	96909.893	GL00
		5/2	96960.588	GL00
$3d^{10}5p$	$^2P^o$	1/2	101366.038	GL00
		3/2	101611.418	GL00
$3d^{10}4f$	$^2F^o$	7/2	117263.558	GL00
		5/2	117264.063	GL00
Zn III ($^1S_0$)		*Limit*	**144892.6**	SM95

Zirconium (Zr)
Atomic number=40
Atomic weight=91.224

Isotope	Mass	Abundance	Spin	Mag moment
^{90}Zr	89.904703	51.45%	0	
^{91}Zr	90.905644	11.22%	5/2	−1.303
^{92}Zr	91.905039	17.15%	0	
^{94}Zr	93.906314	17.38%	0	
^{96}Zr	95.908275	2.80%	0	

Zr I Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^2 5s^2\ ^3F_2$
Ionization energy: 53 506.0 cm^{-1} (6.633 90 eV)

Zr II Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^2 5s\ ^4F_{3/2}$
Ionization energy: 106 000 cm^{-1} (13.1 eV)

Strong Lines of Zirconium (Zr)

Intensity	Wavelength (Å)	Spectrum	Ref.
	Air		
300 P	2568.871	Zr II	J98
400 P	2571.457	Zr II	J98
300 P	2678.632	Zr II	J98
130	2700.129	Zr II	J98
250 P	2722.609	Zr II	J98
90	2732.721	Zr II	J98
250 P	2734.851	Zr II	J98
200	2742.553	Zr II	J98
120	2745.854	Zr II	J98
120	2752.202	Zr II	J98
90	2758.806	Zr II	J98
200	2814.902	Zr I	J98
90	2825.557	Zr II	J98
200	2837.226	Zr I	J98
120	2844.575	Zr II	J98
40	2848.186	Zr II	J98
140	2875.980	Zr I	J98
90	2960.867	Zr I	J98
250	2985.388	Zr I	J98
250	3011.743	Zr I	J98
90	3028.038	Zr II	J98
250	3029.515	Zr I	J98
120	3054.833	Zr II	J98
120	3106.576	Zr II	J98
100	3120.746	Zr I	J98
90	3129.173	Zr II	J98
90	3129.760	Zr II	J98
100	3132.060	Zr I	J98
120	3138.678	Zr II	J98
90	3164.313	Zr II	J98
150	3165.977	Zr II	J98
150	3182.860	Zr II	J98
150	3191.215	Zr I	J98
150	3212.016	Zr I	J98
130	3214.189	Zr II	J98
110	3231.692	Zr II	J98
200	3234.123	Zr I	J98

Strong Lines of Zirconium (Zr)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
130	3241.044	Zr II	J98
90	3250.393	Zr I	J98
60	3260.111	Zr I	J98
90	3272.222	Zr II	J98
200	3273.047	Zr II	J98
250 P	3279.264	Zr II	J98
90	3282.732	Zr I	J98
150	3284.712	Zr II	J98
90	3305.152	Zr II	J98
150	3306.277	Zr II	J98
130	3340.553	Zr II	J98
130	3356.087	Zr II	J98
90	3357.261	Zr II	J98
100	3387.869	Zr II	J98
130	3388.295	Zr II	J98
1000 P	3391.972	Zr II	J98
100	3393.119	Zr II	J98
100	3404.827	Zr II	J98
130	3410.243	Zr II	J98
200	3430.527	Zr II	J98
800 P	3438.231	Zr II	J98
150	3447.362	Zr I	J98
60	3455.902	Zr I	J98
70	3457.561	Zr II	J98
140	3463.013	Zr II	J98
150	3471.185	Zr I	J98
60	3478.780	Zr I	J98
200 P	3479.387	Zr II	J98
250 P	3481.155	Zr II	J98
130	3483.532	Zr II	J98
700 P	3496.206	Zr II	J98
140	3505.666	Zr II	J98
300	3509.321	Zr I	J98
600 P	3519.604	Zr I	J98
80	3525.808	Zr II	J98
130	3533.223	Zr I	J98
60	3535.159	Zr I	J98
110	3542.621	Zr II	J98
500 P	3547.683	Zr I	J98
60	3549.731	Zr I	J98
200	3550.460	Zr I	J98
300 P	3551.951	Zr II	J98
400 P	3556.594	Zr II	J98
300	3566.099	Zr I	J98
400 P	3572.468	Zr II	J98
300 P	3575.790	Zr I	J98
250 P	3576.853	Zr II	J98
250	3586.293	Zr I	J98
80	3587.974	Zr II	J98
1000 P	3601.191	Zr I	J98
120	3611.891	Zr II	J98
200	3613.097	Zr II	J98
200	3614.772	Zr II	J98
300	3623.865	Zr I	J98
90	3634.148	Zr I	J98
70	3661.202	Zr I	J98
300 P	3663.648	Zr I	J98
140	3674.715	Zr II	J98
150	3698.165	Zr II	J98

Strong Lines of Zirconium (Zr)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
130	3709.269	Zr II	J98
100	3745.947	Zr II	J98
150	3751.590	Zr II	J98
140	3764.389	Zr I	J98
140	3766.714	Zr I	J98
200	3780.534	Zr I	J98
150	3791.397	Zr I	J98
150	3822.413	Zr I	J98
600 P	3835.962	Zr I	J98
250 P	3836.761	Zr II	J98
100	3843.018	Zr II	J98
150	3847.008	Zr I	J98
150	3849.250	Zr I	J98
800 P	3863.872	Zr I	J98
200	3864.332	Zr I	J98
300	3877.595	Zr I	J98
60	3879.048	Zr I	J98
400	3885.422	Zr I	J98
800 P	3890.316	Zr I	J98
600 P	3891.380	Zr I	J98
110	3900.512	Zr I	J98
150	3921.788	Zr I	J98
300	3929.529	Zr I	J98
150	3958.220	Zr II	J98
140	3966.659	Zr I	J98
300	3968.256	Zr I	J98
200	3973.502	Zr I	J98
60	3975.294	Zr I	J98
140	3991.127	Zr II	J98
140	3998.965	Zr II	J98
60	4007.596	Zr I	J98
110	4023.977	Zr I	J98
200	4024.912	Zr I	J98
300	4027.201	Zr I	J98
70	4028.947	Zr I	J98
70	4029.675	Zr II	J98
140	4030.032	Zr I	J98
110	4035.887	Zr I	J98
70	4042.219	Zr I	J98
150	4043.570	Zr I	J98
140	4044.560	Zr I	J98
70	4045.612	Zr II	J98
110	4048.666	Zr II	J98
60	4050.476	Zr I	J98
200	4055.027	Zr I	J98
150	4055.704	Zr I	J98
90	4061.523	Zr I	J98
400	4064.151	Zr I	J98
600 P	4072.698	Zr I	J98
90	4074.925	Zr I	J98
60	4076.524	Zr I	J98
70	4078.305	Zr I	J98
600 P	4081.209	Zr I	J98
60	4108.394	Zr I	J98
200 P	4149.198	Zr II	J98
60	4152.640	Zr I	J98
70	4161.200	Zr II	J98
110	4166.366	Zr I	J98
200	4187.559	Zr I	J98

Strong Lines of Zirconium (Zr)—Continued

Intensity	Wavelength (Å)	Spectrum	Ref.
110	4194.760	Zr I	J98
150	4201.451	Zr I	J98
110	4208.980	Zr II	J98
110	4213.863	Zr I	J98
600 P	4227.750	Zr I	J98
60	4236.056	Zr I	J98
600 P	4239.309	Zr I	J98
200	4240.335	Zr I	J98
200	4241.197	Zr I	J98
300	4241.683	Zr I	J98
90	4268.015	Zr I	J98
150	4282.198	Zr I	J98
150	4294.787	Zr I	J98
90	4302.878	Zr I	J98
150	4341.127	Zr I	J98
300	4347.888	Zr I	J98
90	4360.800	Zr I	J98
150	4507.109	Zr I	J98
150	4535.742	Zr I	J98
60	4553.008	Zr I	J98
60	4555.124	Zr I	J98
140	4575.513	Zr I	J98
200	4633.982	Zr I	J98
700 P	4687.799	Zr I	J98
150	4688.450	Zr I	J98
500 P	4710.074	Zr I	J98
400	4739.475	Zr I	J98
250	4772.313	Zr I	J98
60	4784.921	Zr I	J98
70	4805.872	Zr I	J98
200	4815.630	Zr I	J98
80	4824.288	Zr I	J98
60	4851.362	Zr I	J98
70	5046.583	Zr I	J98
100	5064.904	Zr I	J98
130	5078.252	Zr I	J98
200 P	6127.457	Zr I	J98
130	6143.201	Zr I	J98
150 P	7097.727	Zr I	J98
80	7102.922	Zr I	J98
150 P	7169.092	Zr I	J98
250 P	8070.099	Zr I	J98
110	8132.984	Zr I	J98
80	8212.571	Zr I	J98

Persistent Lines of Neutral Zirconium (Zr I)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
600	3519.604		$4d^25s^2$	a ^{3}F	2	0.00	J98	
			$4d^25s(a^2F)5p$	x $^3G^o$	3	28404.26		
500	3547.683		$4d^25s^2$	a ^{3}F	3	570.41	J98	
			$4d^25s(a^2F)5p$	x $^3G^o$	4	28749.80		
300	3575.790	0.53	$4d^25s^2$	a ^{3}F	3	570.41	J98	BGHL81
			$4d^25s(a^2F)5p$	w $^3F^o$	4	28528.36		
1000	3601.191	1.33	$4d^25s^2$	a ^{3}F	4	1240.84	J98	D95
			$4d^25s(a^2F)5p$	x $^3G^o$	5	29001.65		
300	3663.648	0.57	$4d^25s^2$	a ^{3}F	4	1240.84	J98	BGHL81
			$4d^25s(a^2F)5p$	w $^3F^o$	4	28528.36		
600	3835.962		$4d^25s^2$	a ^{3}F	2	0.00	J98	
			$4d^25s(a^2D)5p$	x $^3F^o$	2	26061.70		
800	3863.872		$4d^25s^2$	a ^{3}F	3	570.41	J98	
			$4d^25s(a^2D)5p$	x $^3F^o$	3	26443.88		
800	3890.316		$4d^25s^2$	a ^{3}F	4	1240.84	J98	
			$4d^25s(a^2D)5p$	x $^3F^o$	4	26938.42		
600	3891.380	0.39	$4d^25s^2$	a ^{3}F	4	1240.84	J98	BGHL81
			$4d^25s(a^2F)5p$	z $^5G^o$	4	26931.35		
600	4072.698	1.19	$4d^3(b^4F)5s$	a ^{5}F	4	5540.54	J98	BGHL81
			$4d^3(b^4F)5p$	x $^5D^o$	3	30087.33		
600	4081.209		$4d^3(b^4F)5s$	a ^{5}F	5	5888.93	J98	
			$4d^3(b^4F)5p$	x $^5D^o$	4	30384.50		
600	4227.750		$4d^3(b^4F)5s$	a ^{5}F	5	5888.93	J98	
			$4d^3(b^4F)5p$	y $^5F^o$	5	29535.48		
600	4239.309		$4d^3(b^4F)5s$	a ^{5}F	4	5540.54	J98	
			$4d^3(b^4F)5p$	y $^5F^o$	4	29122.71		
700	4687.799	0.85	$4d^3(b^4F)5s$	a ^{5}F	5	5888.93	J98	BGHL81
			$4d^3(b^4F)5p$	y $^5G^o$	6	27214.89		
500	4710.074	0.64	$4d^3(b^4F)5s$	a ^{5}F	4	5540.54	J98	BGHL81
			$4d^3(b^4F)5p$	y $^5G^o$	5	26765.66		

Energy Levels of Neutral Zirconium (Zr I)

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^25s^2$	a ^{3}F	2	0.00	M52
		3	570.41	M52
		4	1240.84	M52
$4d^25s^2$	a ^{3}P	2	4186.11	M52
		0	4196.85	M52
		1	4376.28	M52
$4d^3(b^4F)5s$	a ^{5}F	1	4870.53	M52
		2	5023.41	M52
		3	5249.07	M52
		4	5540.54	M52
		5	5888.93	M52

Energy Levels of Neutral Zirconium (Zr I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^2 5s^2$	a ^1D	2	5101.68	M52
$4d^2 5s^2$	a ^1G	4	8057.30	M52
$4d^3(b^4P)5s$	a ^5P	1	10885.36	M52
		2	11016.65	M52
		3	11258.38	M52
$4d^3(b^4F)5s$	b ^3F	2	11640.72	M52
		3	11956.33	M52
		4	12342.37	M52
$4d^3(a^4G)5s$	a ^3G	3	12503.44	M52
		4	12760.66	M52
		5	12772.78	M52
$4d^2 5s^2$	a ^1S	0	13141.76	M52
$4d^3(b^2D)5s$	a ^3D	1	14123.01	M52
		2	14348.78	M52
		3	14697.03	M52
$4d^2 5s(a^4F)5p$	z $^5G^o$	2	14783.54	M52
		3	15201.26	M52
		4	15720.36	M52
		5	16316.96	M52
		6	16978.29	M52
$4d^2 5s(a^4F)5p$	z $^3F^o$	2	16296.51	M52
		3	16843.93	M52
		4	17556.26	M52
$4d^2 5s(a^4F)5p$	z $^5F^o$	1	16786.93	M52
		2	17059.61	M52
		3	17422.17	M52
		4	17833.73	M52
		5	18276.92	M52
$4d^2 5s(a^4F)5p$	z $^5D^o$	0	18976.36	M52
		1	19096.53	M52
		2	19323.84	M52
		3	19625.58	M52
		4	19833.78	M52
$4d^2 5s(a^4F)5p$	z $^3G^o$	3	21849.33	M52
		4	22144.08	M52
		5	22563.89	M52
$4d^2 5s(a^2D)5p$	x $^3F^o$	2	26061.70	M52
		3	26443.88	M52
		4	26938.42	M52
$4d^2 5s(a^2F)5p$	z $^5G^o$	4	26931.35	M52
$4d^3(b^4F)5p$	y $^5G^o$	5	26765.66	M52
		6	27214.89	M52
$4d^2 5s(a^2F)5p$	w $^3F^o$	2	27876.16	M52
		3	28157.42	M52
		4	28528.36	M52
$4d^2 5s(a^2F)5p$	x $^3G^o$	3	28404.26	M52
		4	28749.80	M52
		5	29001.65	M52

Energy Levels of Neutral Zirconium (Zr I)—Continued

Configuration	Term	J	Level (cm^{-1})	Ref
$4d^3(b\,^4F)5p$	y $^5F^o$	4	29122.71	M52
		5	29535.48	M52
$4d^3(b\,^4F)5p$	x $^5D^o$	3	30087.33	M52
		4	30384.50	M52
Zr II ($^4F_{3/2}$)		*Limit*	**53506.0**	HHMR86

Persistent Lines of Singly-ionized Zirconium (Zr II)

Inten	Wavelength (Å)	$A_{ki}(10^8\ s^{-1})$	Configuration	Term	J	Level (cm^{-1})	Wl Ref	A Ref
300	2568.871		$4d^2(a\,^3F)5s$	a ^4F	9/2	1322.730	J98	
			$4d5s(a\,^3D)5p$	x $^4D^o$	7/2	40238.668		
400	2571.457		$4d^2(a\,^3F)5s$	a ^4F	7/2	763.428	J98	
			$4d5s(a\,^3D)5p$	x $^4D^o$	5/2	39640.238		
300	2678.632		$4d^2(a\,^3F)5s$	a ^4F	9/2	1322.730	J98	
			$4d5s(a\,^3D)5p$	y $^4F^o$	9/2	38644.130		
250	2722.609		$4d^2(a\,^3F)5s$	a ^4F	9/2	1322.730	J98	
			$4d^2(a\,^3P)5p$	y $^4D^o$	7/2	38041.326		
250	2734.851		$4d^2(a\,^3F)5s$	a ^4F	5/2	314.673	J98	
			$4d5s(a\,^3D)5p$	y $^4F^o$	5/2	36868.921		
250	3279.264		$4d^2(a\,^3F)5s$	a ^4F	7/2	763.428	J98	
			$4d^2(a\,^3F)5p$	z $^4F^o$	7/2	31249.288		
1000	3391.972		$4d^2(a\,^3F)5s$	a ^4F	9/2	1322.730	J98	
			$4d^2(a\,^3F)5p$	z $^4G^o$	11/2	30795.649		
800	3438.231		$4d^2(a\,^3F)5s$	a ^4F	7/2	763.428	J98	
			$4d^2(a\,^3F)5p$	z $^4G^o$	9/2	29839.821		
200	3479.387	1.03	$4d^2(a\,^3F)5s$	a ^2F	5/2	5752.868	J98	BGHL81
			$4d^2(a\,^3F)5p$	z $^2G^o$	7/2	34485.338		
250	3481.155		$4d^2(a\,^3F)5s$	a ^2F	7/2	6467.509	J98	
			$4d^2(a\,^3F)5p$	z $^2G^o$	9/2	35185.385		
700	3496.206		$4d^2(a\,^3F)5s$	a ^4F	5/2	314.673	J98	
			$4d^2(a\,^3F)5p$	z $^4G^o$	7/2	28908.930		
300	3551.951	0.32	$4d^2(a\,^3F)5s$	a ^4F	7/2	763.428	J98	BGHL81
			$4d^2(a\,^3F)5p$	z $^4G^o$	7/2	28908.930		
400	3556.594		$4d^3$	b ^4F	9/2	3757.732	J98	
			$4d^2(a\,^3F)5p$	z $^4F^o$	9/2	31866.493		
400	3572.468		$4d^2(a\,^3F)5s$	a ^4F	3/2	0.000	J98	
			$4d^2(a\,^3F)5p$	z $^4G^o$	5/2	27983.864		
250	3576.853		$4d^3$	b ^4F	7/2	3299.732	J98	
			$4d^2(a\,^3F)5p$	z $^4F^o$	7/2	31249.288		
250	3836.761	0.51	$4d^2(a\,^1D)5s$	a ^2D	5/2	4505.496	J98	BGHL81
			$4d^2(a\,^3F)5p$	z $^2F^o$	7/2	30561.756		
200	4149.198	0.45	$4d^2(a\,^3F)5s$	a ^2F	7/2	6467.509	J98	BGHL81
			$4d^2(a\,^3F)5p$	z $^2F^o$	7/2	30561.756		

Energy Levels of Singly-ionized Zirconium (Zr II)

Configuration	Term	J	Level (cm^{-1})	Ref.
$4d^2(a\,^3F)5s$	a ^4F	3/2	0.000	J98
		5/2	314.673	J98
		7/2	763.428	J98
		9/2	1322.730	J98
$4d^3$	b ^4F	3/2	2572.372	J98
		5/2	2895.097	J98
		7/2	3299.732	J98
		9/2	3757.732	J98
$4d^2(a\,^1D)5s$	a ^2D	3/2	4248.165	J98
		5/2	4505.496	J98
$4d^2(a\,^3P)5s$	a ^2P	1/2	5724.150	J98
		3/2	6111.529	J98
$4d^2(a\,^3F)5s$	a ^2F	5/2	5752.868	J98
		7/2	6467.509	J98
$4d^2(a\,^3F)5p$	z $^4G^o$	5/2	27983.864	J98
		7/2	28908.930	J98
		9/2	29839.821	J98
		11/2	30795.649	J98
$4d^2(a\,^3F)5p$	z $^4F^o$	3/2	29777.624	J98
		5/2	30551.468	J98
		7/2	31249.288	J98
		9/2	31866.493	J98
$4d^2(a\,^3F)5p$	z $^2F^o$	7/2	30561.752	J98
$4d^2(a\,^3F)5p$	z $^2G^o$	7/2	34485.338	J98
		9/2	35185.385	J98
$4d^2(a\,^3P)5p$	y $^4D^o$	7/2	38041.326	J98
$4d5s(a\,^3D)5p$	y $^4F^o$	5/2	36868.921	J98
		9/2	38644.130	J98
$4d5s(a\,^3D)5p$	x $^4D^o$	5/2	39640.238	J98
		7/2	40238.668	J98
Zr III ($^3F_2$)		*Limit*	**106000**	J98

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He: These data comprise a revision of Table 11.7 of [D96].

DA78 D. S. Davis and K. L. Andrew, J. Opt. Soc. Am. **68**, 206 (1978).

V: The energy-level values in this paper are listed in tabular form in [D76]. See also [PBQS97].

DAGW97 J. Dembczynski, B. Arcimowicz, G. H. Guthöhrlein, and L. Windholz, Z. Phys. D **39**, 143 (1997).

DHL86 D. W. Duquette, E. A. Den Hartog, and J. E. Lawler, J. Quant. Spectrosc. Radiat. Transfer **35**, 281 (1986).

DHM33 T. L. de Bruin, C. J. Humphreys and W. F. Meggers, J. Res. Natl. Bur. Stand. (U.S.) **11**, 409 (1933).

DL85 D. W. Duquette and J. E. Lawler, J. Opt. Soc. Am. B **2**, 1948 (1985).

DLW02 L. Dolk, U. Litzén, and G. M. Wahlgren, Astron. Astrophys. **388**, 692 (2002).

DM98 G. W. F. Drake and W. C. Martin, Can. J. Phys. **76**, 679 (1998).

DM01 G. W. F. Drake and W. C. Martin, unpublished (2001).

Li: The data are based on accurate new energy-level calculations for ^{7}Li II. In addition to a lowering of the ionization energy of [HM59] by 1.00 cm^{-1} the results indicate that the $1s3p\ ^1P^o$, $1s4s$, $5s$, $6s\ ^1S$ and $1s4d-8d\ ^1D$ level values of [HM59] are 0.3 cm^{-1} too high with respect to their more accurately determined levels. Accurate calculated term values for $1s4p$ $^1P^o$ and $1s5p$ $^1P^o$ levels disagree with the values in [HM59], in accordance with the conclusions of Crossley [C84] and the calculations of Accad, *et al.* [APS71].

DMZ53 G. V. Deverall, K. W. Meissner, and G. J. Zissis, Phys. Rev. **91**, 297 (1953).

DR72a S. P. Davis and J. Reader, unpublished material (1972).
Pm: See [DR72b].

DR72b S. P. Davis and J. Reader, J. Opt. Soc. Am. B **62**, 1370A (1972).

E31 E. Ekefors, Z. Phys. **71**, 53 (1931).

E72 K. B. S. Eriksson, Phys. Lett. A **41**, 97 (1972).

E74 K. B. S. Eriksson, J. Opt. Soc. Am. **64**, 1272 (1974).

E83 K. B. S. Eriksson, Phys. Scr. **28**, 593 (1983).

E95 J. Emsley, *Oxford Chemistry Guides: The Elements* (Oxford Univ. Press, New York, NY, 1995).

E99 R. Engleman, unpublished wave number measurements (1999) quoted in [M03].
K: The uncertainty of the K I $4p$ $^2P^o$ levels is probably less than 0.001 cm^{-1}.

ED71 J. C. Ehrhardt and S. P. Davis, J. Opt. Soc. Am. **61**, 1342 (1971).

EJN64 K. B. Eriksson, I. Johansson, and G. Norlén, Ark. Fys. **28**, 233 (1964).

EKM00 J. O. Ekberg, R. Kling, and W. Mende, Phys. Scr. **61**, 146 (2000).
W: The eigenvector percentages in Table III of this paper indicate that no meaningful *LS*-coupling names can be assigned to some energy levels. We have used numerical designations for these levels.

EL01 R. Engleman, Jr. and U. Litzén, unpublished data (2001).
B: Engleman and Litzén improved and extended the infrared observations of B I and also made new measurements of several ultraviolet lines. The new infrared wavelengths and resulting level values supersede the data in [L70b].

ELLW98 R. Engelman, Jr., U. Litzén, H. Lundberg, and J.-F. Wyart, Phys. Scr. **57**, 345 (1998).

EOHJ70 B. Edlén, A. Ölme, G. Herzberg, and J. W. C. Johns, J. Opt. Soc. Am. **60**, 889 (1970).

ER56 B. Edlén and P. Risberg, Ark. Fys. **10**, 553 (1956).

ES36 C. B. Ellis and R. A. Sawyer, Phys. Rev. **49**, 145 (1936).

EUVH97 K. S. E. Eikema, W. Ubachs, W. Vassen, and H. Horgovorst, Phys. Rev. A **55**, 1866 (1997).

EW70 K. B. S. Eriksson and I. Wenåker, Phys. Scr. **1**, 21 (1970).

F54 G. R. Fowles, J. Opt. Soc. Am. **44**, 760 (1954).

F91 P. Forsberg, Phys. Scr. **44**, 446 (1991).

FHLP00 J. A. Fedchak, E. A. Den Hartog, J. E. Lawler, P. Palmeri, P. Quinet, and E. Biémont, Astrophys. J. **542**, 1109 (2000).

FL99 J. A. Fedchak and J. E. Lawler, Astrophys. J. **523**, 734 (1999).

FMW88 J. R. Fuhr, G. A. Martin, and W. L. Wiese, J. Phys. Chem. Ref. Data **17**, 375 (1988).

FT57 M. Fred and F. S. Tomkins, J. Opt. Soc. Am. **47**, 1076 (1957).

FTBC76 M. Fred, F. S. Tomkins, J. E. Blaise, P. Camus, and J. Vergés, Argonne Natl. Lab. Rep. No. 76-68 (1976).

FW96 J. R. Fuhr and W. L. Wiese, *NIST Atomic Transition Probability Tables*, *CRC Handbook of Chemistry & Physics*, 77th ed., D. R. Lide, ed. (CRC Press, Inc., Boca Raton, FL, 1996).

G54 W. R. S. Garton, Proc. Phys. Soc. (London) A **67**, 864 (1954); W. R. S. Garton, W. H. Parkinson, and E. M. Reeves, Can. J. Phys. **44**, 1745 (1966).
In: Garton's wavelength measurements for the four $5s^25p$ $^2P^o$–$5s5p^2$ ^2P autoionization-broadened transitions have Ritz-principle consistency of a few cm^{-1}. This multiplet was first identified in [C52].

G62 S. George, Ph. D. thesis, Univ. British Columbia (1962).

G67 A. Giachetti, J. Opt. Soc. Am. **57**, 728 (1967).

G89 A. Ginbre, Phys. Scr. **39**, 694 (1989).

G90 A. Ginbre, At. Data Nucl. Data Tables **44**, 1 (1990).

GBCZ74 A. Giacchetti, J. Blaise, C. H. Corliss, and R. Zalubas, J. Res. Natl. Bur. Stand. (U.S.) **78A**, 247 (1974).

GF02 W. L. Glab and A. M. Falleur, J. Quant. Spectrosc. Rad. Trans. **73**, 121 (2002).

GK00 U. Griesmann and R. Kling, Astrophys. J. **536**, L113 (2000).
Al: The values obtained for the Al II $3s3p$ $^1P^o$ level by these authors is 59 851.976(4) cm^{-1}. We have retained the less accurate value from [MZ79] for consistency with the other Al II levels in the table.
Si: The values of the two Si II levels corresponding to the high-accuracy wavelengths from this reference are 55 309.3404(4) and 65 500.4538(7) cm^{-1}. We have retained the less accurate level

values from [MZ83] for consistency with the other levels in the table.
GKQW91 A. Goly, J. Kusz, B. Nguyen Quang, and S. Weniger, J. Quant. Spectrosc. Radiat. Transfer **45**, 157 (1991).
GL80 Y. Guern and J. Lotrian, J. Quant. Spectrosc. Radiat. Transfer **24**, 133 (1980).
GL00 D. Gullberg and U. Litzén, Phys. Scr. **61**, 652 (2000).
GM62 P. Gunnwald and L. Minnhagen, Ark. Fys. **22**, 327 (1962).
GM65 J. D. Garcia and J. E. Mack, J. Opt. Soc. Am. **55**, 654 (1965).
GMV85 S. George, J. H. Munsee, and J. Vergés, J. Opt. Soc. Am. **2**, 1258 (1985).
Bi: The wavelengths for which this reference is cited were derived from the energy levels in the reference.
GRTE73 W. R. S. Garton, E. M. Reeves, F. S. Tomkins, and B. Ercoli, Proc. R. Soc. London, Ser. A **333**, 17 (1973).
GSZ70 A. Giacchetti, R. W. Stanley, and R. Zalubas, J. Opt. Soc. Am. **69**, 474 (1970).
GV72 D. Goorvitch and F. P. J. Valero, Astrophys. J. **171**, 643 (1972).
H39 C. J. Humphreys, J. Res. Natl. Bur. Stand. (U.S.) **22**, 19 (1939).
H53 C. J. Humphreys, J. Opt. Soc. Am. **43**, 1027 (1953).
H73 C. J. Humphreys, J. Phys. Chem. Ref. Data **2**, 519 (1973).
Xe: These are ^{136}Xe I wavelengths calculated from level differences [HP70b].
HA64 C. J. Humphreys and K. L. Andrew, J. Opt. Soc. Am. **54**, 1134 (1964).
HA85 L. E. Howard and K. L. Andrew, J. Opt. Soc. Am. B **2**, 1032 (1985).
HARV88 F. Hassini, Z. Ben Ahmed, O. Robaux, J. Vergés, and J.-F. Wyart, J. Opt. Soc. Am. B **5**, 2060 (1988).
HHMR86 P. A. Hackett, M. R. Humphries, S. A. Mitchell, and D. M. Rayner, J. Chem. Phys. **85**, 3194 (1986).
HJ69 J. E. Holmström and L. Johansson, Ark. Fys. **40**, 133 (1969).
HJLW82 S. Huldt, S. Johansson, U. Litzén, and J.-F. Wyart, Phys. Scr. **25**, 401 (1982).
HM33 C. J. Humphreys and W. F. Meggers, J. Res. Natl. Bur. Stand. (U.S.) **10**, 139 (1933).
HM59 G. Herzberg and H. R. Moore, Can. J. Phys. **37**, 1293 (1959).
Li: The data pertain to the ^{7}Li isotope. The wavelengths for some of the stronger lines and the values for the triplet levels are weighted averages of large hyperfine structures, for some of which the resolved components are given in [HM59]. The ionization energy and, consequently, all excited levels from this reference have been lowered by 1.00 cm^{-1} [DM01]. Although higher accuracy measurements of the $1s2p$ ^{3}P^o separation have been made more recently [RGKP93], we have for consistency retained the term values (positions with respect to the limit) for these levels from [HM59].
HM64 M. B. Handrup and J. E. Mack, Physica **30**, 1245 (1964).
Te: Energy level values have been reduced by 0.47 cm^{-1}, as suggested by [E74].
HP70a C. J. Humphreys and E. Paul, Jr., J. Opt. Soc. Am. **60**, 200 (1970).
Kr: These authors give four or five place Kr II wavelengths of the ^{86}Kr isotope. We have rounded the values to three decimals to be more in accordance with their probable accuracies when used as wavelengths for a natural Kr isotopic mixture.
HP70b C. J. Humphreys and E. Paul, Jr., J. Opt. Soc. Am. **60**, 1302 (1970).
Xe: We have here adjusted the ^{136}Xe I levels in this reference to a more accurate connection with the ground level and to isotopic center-of-gravity positions for natural Xe (see note with [BVHU01]). The infrared Xe I wavelengths given here with the [HP70b] reference are Ritz-principle values calculated from the isotopic center-of-gravity level values.
HP87 J. E. Hansen and W. Persson, Phys. Scr. **36**, 602 (1987).
HPCA67 C. J. Humphreys, E. Paul, Jr., R. D. Cowan, and K. L. Andrew, J. Opt. Soc. Am. **57**, 855 (1967).
HWL02 E. A. Den Hartog, M. E. Wickliffe, and J. E. Lawler, Astrophys. J. Suppl. Ser. **141**, 255 (2002).
HWL99 E. A. Den Hartog, L. M. Wiese, and J. E. Lawler, J. Opt. Soc. Am. B **16**, 2278 (1999).
ICL88 L. Iglesias, M. I. Cabeza, and B. de Luis, Pub. Inst. Opt. Madrid, No. 47 (1988).
IL85 B. Isberg and U. Litzén, Phys. Scr. **31**, 533 (1985).
Ga: See [SSM03] also.
IV64 L. Iglesias and R. Velasco, Pub. Inst. Opt. Madrid, No. 23 (1964).
J61a L. Johansson, Ark. Fys. **20**, 489 (1961).
Be: The Be II levels and ionization energy given in this reference have been decreased by 0.02 cm^{-1} [KM00] in accordance with a more accurate determination of the $1s^22p$ ^{2}P^o levels [BWWI85]. The uncertainty of the $2p$ ^{2}P^o levels is about 0.005 cm^{-1}. The

uncertainty of the other excited levels relative to the $2s$ and $2p$ levels is about 0.2 cm^{-1}, but the levels above $3s$ should, in general, be accurate within 0.10 cm^{-1} relative to the $3s$ level.

J61b I. Johansson, Ark. Fys. **20**, 135 (1961).

J66 L. Johansson, Ark. Fys. **31**, 201 (1966).

C: Johansson's values for most of the best-known C I excited-configuration levels (with respect to the $2p^2\ ^3P_0$ ground level) agree with newer redetermined values [KW66, CG98] within 0.01 cm^{-1}. The value of 90 883.84(10) cm^{-1} for the C II $2p\ ^2P^o_{3/2}$ limit, as derived by Johansson from the C I $2pnp\ ^3D_3$ series, is not changed significantly by the more recent work. His resulting value for the C II $^2P^o_{1/2}$ limit has been adjusted to the more accurate value of 63.395 cm^{-1} for the C II $2p\ ^2P^o_{3/2}$–$^2P^o_{1/2}$ splitting [CBS86]. Given the absolute uncertainty of about 0.04 cm^{-1} for the $2pnp\ ^3D$ levels and the additional uncertainty of the limit determination, Johansson's estimated uncertainty of 0.10 cm^{-1} for the ionization energy is reasonable. We used Johansson's wave numbers for the two pertinent lines near 2965 Å together with the new $2p^2\ ^3P_1$ and $^3P_2$ level values to adjust his $2s2p^3\ ^5S^o_2$ level upwards by 0.02 cm^{-1}.

J78 S. Johansson, Phys. Scr. **18**, 217 (1978).

J98 S. Johansson, unpublished (1998).

Zr: New observations of Zr I and Zr II and extensions of the analysis. No newly evaluated Zr I levels are available yet.

JC74 D. A. Jackson and M.-C. Coulombe, Proc. R. Soc. London A **338**, 277 (1974).

JC75 D. A. Jackson and M.-C. Coulombe, Proc. R. Soc. London A **343**, 453 (1975).

JJ93 A. Joueizadeh and S. Johansson, Natl. Inst. Stand. Tech. Spec. Pub. **885**, 131 (1993).

JJLL94 S. G. Johansson, A. Joueizadeh, U. Litzén, J. Larsson, A. Persson, C.-G. Wahlström, S. Svanberg, D. Leckrone, and G. M. Wahlgren, Astrophys. J. **421**, 809 (1994).

JKBL96 S. Johansson, G. Kalus, T. Brage, D. S. Leckrone, and G. M. Wahlgren, Astrophys. J. **462**, 943 (1996).

Tl: The Tl II wavelengths were obtained by averaging the isotope and hyperfine components of each transition with weighting by intensities. We evaluated the levels using the average wavelengths.

JKLC94 A. M. James, P. Kowalczyk, E. Langlois, M. D. Campbell, A. Ogawa, and B. Simard, J. Chem. Phys. **101**, 4485 (1994).

JL65 L. Johansson and U. Litzén, Ark. Fys. **29**, 175 (1965).

JL67 I. Johansson and U. Litzén, Ark. Fys. **34**, 573 (1967).

Ga: See [SSM03] also. The values of the Ga I $4s^2$ $5-7p$, $6-8s$, and $5-7d$ levels in [JL67] should be increased by 0.02 cm^{-1} for consistency with the value of the $4s^25s$ level from [ND82]. We have applied this correction to the $4s^25p$ and $6s$ levels given here.

JL80 S. Johannson and U. Litzén, Phys. Scr. **22**, 49 (1980), as compiled in [KS88].

JLKK93 S. G. Johansson, U. Litzén, J. Kasten, and M. Kock, Astrophys. J. **403**, L25 (1993).

B: The wavelengths of transitions involving the B I $2s^22p$, $2s^23s$, and $2s2p^2\ ^2D$ levels are given separately for the ^{11}B and ^{10}B isotopes in this reference. Weighted average wavelengths are given here for these lines, with the two isotopic wavelengths for each transition being weighted according to the relative abundances. Combination of the measurements of the $2s^22p\ ^2P$–$2s2p^2\ ^2D$ lines [JLKK93] with the isotopic ionization-energy shift obtained for the $2s2p^2\ ^2D$ term by Edlén *et al.* [EOHJ70] shows that the isotopically weighted average ionization energy for each of the $2s^22p\ ^2P$ ground-configuration levels probably differs by less than 0.01 cm^{-1} from the ionization energy of the corresponding level of the dominant ^{11}B isotope. The values of the two $2s^22p\ ^2P$ levels given in [JLKK93] (based on a value 0.000 cm^{-1} for the $^2P_{1/2}$ level of each isotope) are thus taken as equal to isotopically averaged values. The isotopically averaged values of the higher levels were obtained by using the averaged wavenumbers of the lines. Any additional error introduced by this procedure should be smaller than 0.01 cm^{-1}. It should be noted that the separations of the two isotopic components of the lines (which range from 0.011 to 0.025 Å) are large relative to the uncertainties of the individual measurements (less than 0.001 Å).

JM86 Y. N. Joshi and M. Mazzoni, Phys. Lett. A **118**, 237 (1986).

JPHC81 P. Juncar, J. Pinard, J. Hamond, and A. Chartier, Metrologia **17**, 77 (1981).

JRB00 T. Jaysekharan, M. A. N. Razvi, and G. L. Bhale, J. Phys. B **33**, 3123 (2000).

JS00 Z. J. Jakubeh and B. Simard, J. Phys. B **33**, 1827 (2000).

Y: We adopt a weighted average with [GRTE73].

K35 A. S. King, Astrophys. J. **82**, 140 (1935).

K40 C. C. Kiess, unpublished (1940).

K51 C. C. Kiess, J. Res. Natl. Bur. Stand. (U.S.) **47**, 385 (1951).

K53 C. C. Kiess, J. Res. Natl. Bur. Stand. (U.S.) **51**, 247 (1953).

K57 T. A. M. van Kleef, Physica **23**, 843 (1957).
Ir: We have changed the order of electron coupling for the $5d^76s6p$ configuration, as indicated in [CFSK74].

K58 C. C. Kiess, J. Res. Natl. Bur. Stand. (U.S.) **60**, 375 (1958).

K59 K. G. Kessler, J. Res. Natl. Bur. Stand. (U.S.) **63A**, 213 (1959).

K62a C. C. Kiess, J. Res. Natl. Bur. Stand. (U.S.) **66A**, 111 (1962).

K62b H. Kleiman, J. Opt. Soc. Am. **52**, 441 (1962).

K87 R. L. Kelly, J. Phys. Chem. Ref. Data **16**, Suppl. 1 (1987).

K91 V. A. Komarovskii, Opt. Spectrosc. (USSR) **71**, 559 (1991).

K93 V. Kaufman, J. Res. Natl. Inst. Stand. Tech. **98**, 717 (1993).
Kr: We give Kr I wavelengths and energy levels as obtained for the ^{84}Kr isotope because these values are close to the center-of-gravity values for a mixture of the natural isotopic abundances. The values of the ^{84}Kr I excited levels have here been increased by 0.0121 cm^{-1} [BHU02]. For the Kr I resonance lines (945–1236 Å), we list Ritz wavelengths obtained from the adjusted ^{84}Kr I levels. The ^{84}Kr I levels needed for five of these lines were not included in [K93]; we obtained values (not tabulated) for these levels by using adjusted ^{86}Kr level values and ^{84}Kr–^{86}Kr isotope shifts as estimated from related data in [K93].

KC59 C. C. Kiess and C. H. Corliss, J. Res. Natl. Bur. Stand. (U.S.) **63A**, 1 (1959).

KDEE97 S. Köhler, R. Diessenberger, K. Eberhardt, N. Erdmann, G. Herrmann, G. Huber, J. V. Kratz, M. Nunnemann, G. Passler, P. M. Rao, J. Riegel, N. Trautmann, and K. Wendt, Spectrochim. Acta B **52**, 717 (1997).

KE74 V. Kaufman and B. Edlén, J. Phys. Chem. Ref. Data **3**, 825 (1974).

KFW02 J. Z. Klose, J. R. Fuhr, and W. L. Wiese, J. Phys. Chem Ref. Data **31**, 217 (2002).

KG00 R. Kling and U. Griesmann, Astrophys. J. **531**, 1173 (2000).

KH69 V. Kaufman and C. J. Humphreys, J. Opt. Soc. Am. **59**, 1614 (1969).
Kr: These Kr I wavelengths are Ritz values from ^{86}Kr I energy levels; no comparably accurate values have been determined for either ^{84}Kr or natural Kr. We have rounded off the original four- or five-place wavelengths to three places and most of the original three-place values to two places. These ^{86}Kr I wavelengths may still differ from the natural Kr values by a few units or more in the last decimal place retained by us.

KK61 T. A. M. van Kleef and P. F. A. Klinkenberg, Physica **27**, 83 (1961).

KL99 H. Karlsson and U. Litzén, Phys. Scr. **60**, 321 (1999).

KLLT02 G. Kalus, U. Litzén, F. Launay, and W.-U. L. Tchang-Brillet, Phys. Scr. **65**, 46 (2002).

KM72 V. Kaufman and L. Minnhagen, J. Opt. Soc. Am. **62**, 92 (1972).

KM78 T. A. M. van Kleef and B. C. Metsch, Physica **95**, 251 (1978).
Ir: We have made configuration and/or term assignments, or omitted such assignments, on the basis of the calculated eigenvectors.

KM91a V. Kaufman and W. C. Martin, J. Phys. Chem. Ref. Data **20**, 83 (1991).
Mg: We have quoted Ritz-calculated wavelengths for most Mg II lines from this compilation. These values are much more accurate than the directly measured wavelengths in the region below 2000 Å.

KM91b V. Kaufman and W. C. Martin, J. Phys. Chem. Ref. Data **20**, 775 (1991).

KM93 V. Kaufman and W. C. Martin, J. Phys. Chem. Ref. Data **22**, 279 (1993).

KM97 A. E. Kramida and W. C. Martin, J. Phys. Chem. Ref. Data **26**, 1185 (1997).

KM00 A. E. Kramida and W. C. Martin, unpublished compilation (2000).

KMVC57 P. F. A. Klinkenberg, W. F. Meggers, R. Velasco, and M. A. Catalán, J. Res. Natl. Bur. Stand. (U.S.) **59**, 319 (1957).
Re: Names for even parity levels adopted here are based on eigenvector percentages from [W78]. We have assigned sequential numbers instead of term designations for those levels having no meaningful names according to the eigenvectors.

KRA66 V. Kaufman, L. J. Radziemski, and K. L. Andrew, J. Opt. Soc. Am. **56**, 911 (1966).

KS88 V. Kaufman and J. Sugar, J. Phys. Chem. Ref. Data **17**, 1679 (1988).

KT96 G. Kalus and A. Thorne, *5th International Colloquium on Atomic Spectra and Oscillator Strengths*, eds. W.-U. L. Tchang-Brillet, J. F. Wyart, and C. J. Zeippen, 1996, p. 4.

KW66 V. Kaufman and J. F. Ward, J. Opt. Soc. Am. **56**, 1591 (1966).

KW85 R. D. Knight and L. Wang, J. Opt. Soc. Am. B **2**, 1084 (1985).

Xe: These authors determined the ionization energy of the Xe I $5p^5(^2P^o_{1/2})6s$ $^2[1/2]^o_0$ level as 21 637.02(1) cm^{-1} Brandi *et al.* [BVHU01] combined this result with their accurate value for this level with respect to the ground level to obtain an improved value for the ^{136}Xe I principal ionization energy. Using the isotopic shifts [BVHU01], we have adjusted this value down to the isotopic center-of-gravity ionization energy for natural Xe.

KWL97 S. Kroger, J.-F. Wyart, and P. Luc, Phys. Scr. **55**, 579 (1997).

L49 K. Lidén, Ark. Fys. **1**, 229 (1949).

L64 D. D. Laun, J. Res. Natl. Bur. Stand. (U.S.) **68**, 207 (1964).

L70a U. Litzén, Phys. Scr. **2**, 103 (1970).

L70b U. Litzén, Phys. Scr. **1**, 251 (1970).

L99 U. Litzén, unpublished wave number determinations (1999), as quoted in [M03].

Ca: The uncertainty of the Ca II $4p$ $^2P^o$ levels is 0.002 cm^{-1}.

LA71 H. Li and K. L. Andrew, J. Opt. Soc. Am. **61**, 96 (1971).

LB82 A. Laguna and H. Beatty, Chem. Phys. Lett. **88**, 439 (1982).

F: We combined the wave numbers of the two strong F I $2p^5$ $^2P^o_{3/2}$–$^2P^o_{1/2}$ hfs transitions given in this reference with the more accurate values for the hfs splittings of the $^2P^o_{3/2}$ and $^2P^o_{1/2}$ levels in [RHB61] and [H65], respectively, to obtain a value of 404.1407(20) cm^{-1} for the separation of the hfs centers of gravity of the $^2P^o_{3/2}$ and $^2P^o_{1/2}$ levels.

LBS99 H.-P. Loock, L. M. Beaty, and B. Simard, Phys. Rev. A **59**, 873 (1999).

LBT93 U. Litzén, J. W. Brault, and A. P. Thorne, Phys. Scr. **47**, 628 (1993).

LC68 D. D. Laun and C. H. Corliss, J. Res. Natl. Bur. Stand. (U.S.) **72**, 609 (1968).

W: The numerical designations of the theoretically uninterpreted odd-parity levels are those used in [L64].

LLJ94 H. Lundberg, U. Litzén, and S. Johansson, Phys. Scr. **50**, 110 (1994).

LLTL01 U. Litzén, H. Lundberg, W.-U. L. Tchang-Brillet, F. Launay, and R. Engleman, Jr., Phys. Scr. **64**, 63 (2001).

Pd: The leading eigenvector percentages given for the $4d^85p$ levels indicate that no meaningful *LS*-coupling names exist for some levels. We have used numerical names for several such levels.

LP77 B. Lindgren and H. P. Palenius, Sol. Phys. **53**, 347 (1977).

LS31 R. J. Lang and R. A. Sawyer, Z. Phys. **71**, 453 (1931).

In: The wavelength 2079.26 Å tabulated for the important $5s5p$ $^3P^o_2$–$5s6s$ $^3S_1$ line in this paper is the vacuum wavelength, contrary to the column heading.

LZJK98 U. Litzén, T. Zethson, P. Jönsson, J. Kasten, R. Kling, and F. Launay, Phys. Rev. A **57**, 2477 (1998).

B: The authors measured two isotopic components for each B II transition involving the $2s^2$, $2s2p$, and $2p^2$ levels, the observed ^{10}B/^{11}B splittings being in the range 0.42–0.89 cm^{-1}. The wavelengths given here are isotopically weighted averages. We also give weighted averages for the corresponding energy levels. Although we have retained two decimal places for the levels, the user should keep in mind the relatively large isotopic splittings.

M35 D. C. Martin, Phys. Rev. **48**, 938 (1935).

M52 C. E. Moore, *Atomic Energy Levels*, Natl. Bur. Stand. (U.S.) Circ. 467, Vol. II (1952); reprinted as Natl. Stand. Ref. Data Ser., Natl. Bur. Stand. (U.S.) **35** (1971).

M58 C. E. Moore, *Atomic Energy Levels*, Natl. Bur. Stand. (U.S.) Circ. **467**, Vol. III (1958); reprinted as Natl. Stand. Ref. Data Ser., Natl. Bur. Stand. (U.S.) **35** (1971).

Ta: Term designations for some Ta I levels have here been changed or omitted to correspond to the eigenvectors given in [DAGW97]. Ta I and II levels with no term designation have been given sequential numbers for identification in the line list.

M59 W. C. Martin, J. Opt. Soc. Am. **49**, 1071 (1959).

M60a W. C. Martin, J. Res. Natl. Bur. Stand. (U.S.) **64A**, 19 (1960).

M60b L. Minnhagen, Ark. Fys. **18**, 97 (1960).

Ar: We have increased Minnhagen's 1960 value for the Ar II ionization energy by 0.1 cm^{-1}, in accordance with his redetermination of the connection between the excited levels and the ground level [M71]. The uncertainty of the ionization energy is probably about 1.0 cm^{-1}.

M62 L. Minnhagen, Ark. Fys. **21**, 415 (1962).

M64a R. McLaughlin, J. Opt. Soc. Am. **54**, 965 (1964).

M64b L. C. Marquet, Ph. D. thesis, Univ. California, Berkeley (1964).

Er: The most complete available list of energy-level classifications for Er I lines is given in an unpublished report by Spector and Held [SH80].

M67 W. F. Meggers, J. Res. Natl. Bur. Stand. (U.S.) **71A**, 396 (1967).

M71 L. Minnhagen, J. Opt. Soc. Am. **61**, 1257 (1971).

M73 L. Minnhagen, J. Opt. Soc. Am. **63**, 1185 (1973).

Ar: Minnhagen gave values of the Ar I excited levels with up to four decimal places to exhibit their relative accuracies; his estimated uncertainty for the connection of the excited levels to the $^1S_0$ ground level was $0.05\ cm^{-1}$. This connection has recently been determined within an estimated uncertainty of $0.003\ cm^{-1}$ [VHU99]. The resulting correction to the levels given by Minnhagen with respect to the ground level is only $+0.0053(30)\ cm^{-1}$. We have made this adjustment to the levels given here and have also made corresponding small adjustments for the tabulated Ritz wavelengths (867–1067 Å). The estimated uncertainties of most of the five-place wavelengths are 0.000 03–0.000 04 Å.

M75a C. E. Moore, Natl. Stand. Ref. Data Ser., Natl. Bur. Stand. (U.S.) **3**, Sect. 5 (1975).

M75b C. E. Moore, Natl. Stand. Ref. Data Ser., Natl. Bur. Stand. (U.S.) **3**, Sect. 7 (1975).

M75c W. C. Martin, unpublished material (1975).

M87 W. C. Martin, Phys. Rev. A **36**, 3575 (1987).

M91 D. C. Morton, Astrophys J. Suppl. Ser. **77**, 119 (1991).

M98 W. C. Martin, unpublished material (1998).

M00 D. C. Morton, Astrophys. J. Suppl. Ser. **130**, 403 (2000).

M02 W. C. Martin, ongoing compilation of data for He I (2002).

He: This work includes an updating of the energy-level data in [M87]. The uncertainty of the excited-level system and limit with respect to the ground level is about $0.002\ cm^{-1}$ [EUVH97, BBBL98]. References for most of the more recent experimental data are given in [DM98]. Some level separations are known to six or more decimal places, but have here been rounded to four places. The values for some levels are derived from recent theoretical calculations [D03]. The wavelengths are calculated from the energy levels. The estimated uncertainty of the wavelengths of the resonance lines given to five places (507–591 Å) is at most one unit in the fifth place.

M03 D. C. Morton, Astrophys. J. Suppl. Ser. **149**, 205 (2003).

MC60 W. C. Martin and C. H. Corliss, J. Res. Natl. Bur. Stand. (U.S.) **64A**, 443 (1960).

MCS58 W. F. Meggers, M. A. Catalán, and M. Sales, J. Res. Natl. Bur. Stand. (U.S.) **61**, 441 (1958).

Re: Names for even parity levels adopted here are based on eigenvector percentages from [W77].

MCS75 W. F. Meggers, C. H. Corliss, and B. F. Scribner, Natl. Bur. Stand. (U.S.), Monogr. 145 (1975).

MFT57 W. F. Meggers, M. Fred, and F. S. Tomkins, J. Res. Natl. Bur. Stand. (U.S.) **58**, 297 (1957).

Ac: The data pertain to the ^{227}Ac isotope. The designations for several of the odd-parity levels of Ac II are taken from [BW92b].

MG93 C. E. Moore, *Tables of Spectra of Hydrogen, Carbon, Nitrogen, and Oxygen*, J. W. Gallagher, ed. (CRC Press, Inc., Boca Raton, FL, 1993).

C: The C II $2p\ ^2P^o_{3/2}$–$^2P_{1/2}$ separation of $63.42\ cm^{-1}$ from this reference is $0.025\ cm^{-1}$ larger than a more recent high-accuracy value [CBS86]. We have retained the older value for consistency with the other C II levels tabulated here, which have not been re-evaluated.

MGGB89 C. W. Matthews, M. L. Ginter, D. S. Ginter, and C. M. Brown, J. Opt. Soc. Am. B **6**, 1627 (1989).

MH42 W. F. Meggers and C. J. Humphreys, J. Res. Natl. Bur. Stand. (U.S.) **28**, 463 (1942).

MH84 R. G. Montague and M. F. A. Harrison, J. Phys. B **17**, 2707 (1984).

MHRS74 W. C. Martin, L. Hagan, J. Reader, and J. Sugar, J. Phys. Chem. Ref. Data **3**, 771 (1974).

MK00a P. Mohr and S. Kotochigova, unpublished calculations (2000).

H: The wavelengths for the Balmer-alpha and Balmer-beta transitions at 6563 and 4861 Å include only the stronger components of more extensive fine structures.

MK00b P. Mohr and S. Kotochigova, unpublished calculations (2000).

He: Several weaker fine-structure components for the He II multiplet at 4685 Å have been omitted here.

MKM93 W. C. Martin, V. Kaufman, and A. Musgrove, J. Phys. Chem. Ref. Data **22**, 1179 (1993).

MKMD94 W. C. Martin, V. Kaufman, A. Musgrove, and G. R. Dalton, unpublished compilation of energy-level and wavelength data for Si I (1994).

Si: The energy-level data supersede those in [MZ83].

MKSM92 W. C. Martin, V. Kaufman, J. Sugar, and A. Musgrove, unpublished preliminary compilation of the wavelength and energy-level data for the spectra of chlorine (1992–1997).

Cl: Many of the energy-level data are available in the NIST Atomic Spectra Database.

MM52 W. F. Meggers and R. J. Murphy, J. Res. Natl. Bur. Stand. (U.S.) **48**, 334 (1952).

MM76 W. F. Meggers and C. E. Moore, Natl. Bur. Stand. (U.S.), Monogr. 153 (1976).

MMHS95 A. Marijnissen, J. J. ter Meulen, P. A. Hackett, and B. Simard, Phys. Rev. A **52**, 2606 (1995).

MMMS89 H. Maeda, Y. Mizugai, Y. Matsumoto, A. Suzuki, and M. Takami, J. Phys. B **22**, L511 (1989).

MOW98 M. Miyabe, M. Oba, and I. Wakaida, J. Phys. B **31**, 4559 (1998).

MS96 W. C. Martin and J. Sugar, Phys. Rev. A **53**, 1911 (1996).

MSB51 W. F. Meggers, B. F. Scribner, and W. R. Bozman, J. Res. Natl. Bur. Stand. (U.S.) **46**, 85 (1951).

MSP69 L. Minnhagen, H. Strihed, and B. Petersson, Ark. Fys. **39**, 471 (1969).

MT61 W. C. Martin and J. L. Tech, J. Opt. Soc. Am. **51**, 591 (1961).

MT78 W. F. Meggers and J. L. Tech, J. Res. Natl. Bur. Stand. (U.S.) **83**, 13 (1978).

Yb: Wyart and Camus [WC79] extended the energy-level analysis of Yb I. The names of the odd-parity levels having $J=1$ at 37 414.59 and 38 422.36 cm^{-1} are from their paper.

MT84 W. C. Martin and J. L. Tech, unpublished preliminary extension and revision of Br II analysis (1984).

Br: See [MT61].

MV74 C. Morillon and J. Vergés, Phys. Scr. **10**, 227 (1974).

Se: All $4p^3nl$ levels from this reference have been increased by 0.23 cm^{-1}, in accordance with [LP77].

MV75 C. Morillon and J. Vergés, Phys. Scr. **12**, 129 (1975).

Te: Wavelengths for Te I shorter than 9800 Å are calculated from energy levels given in this reference.

MZ79 W. C. Martin and R. Zalubas, J. Phys. Chem. Ref. Data **8**, 817 (1979), as modified by [KM91b].

MZ80 W. C. Martin and R. Zalubas, J. Phys. Chem. Ref. Data **9**, 1 (1980).

MZ81 W. C. Martin and R. Zalubas, J. Phys. Chem. Ref. Data **10**, 153 (1981).

Na: See [JPHC81] and [BBLB98] for more recent, higher-accuracy data for Na I.

MZ83 W. C. Martin and R. Zalubas, J. Phys. Chem. Ref. Data **12**, 323 (1983).

MZH78 W. C. Martin, R. Zalubas, and L. Hagan, *Atomic Energy Levels—The Rare Earth Elements*, Natl. Stand. Ref. Data Ser., Natl. Bur. Stand. (U.S.) **60** (1978).

Eu, Ho, Nd, Sm: Wavelengths for which this reference is given are calculated from the energy levels.

MZM85 W. C. Martin, R. Zalubas, and A. Musgrove, J. Phys. Chem. Ref. Data **14**, 751 (1985).

MZM90 W. C. Martin, R. Zalubas, and A. Musgrove, J. Phys. Chem. Ref. Data **19**, 821 (1990).

N73 G. Norlén, Phys. Scr. **8**, 249 (1973).

ND81 J. H. M. Neijzen and A. Donszelmann, Physica **106C**, 271 (1981).

ND82 J. H. M. Neijzen and A. Donszelmann, Physica **114C**, 241 (1982).

Ga: The stated uncertainties of the Ga I $5s$ ^2S level and the ionization energy are 0.007 and 0.010 cm^{-1}, respectively.

NG00 G. Nave and U. Griesmann, Phys. Scr. **62**, 463 (2000).

Dy: Only newly classified lines and newly found energy levels for Dy I and Dy II are listed in this paper. Wavelengths and levels tablulated here were taken from complete line and level tables provided by the authors.

NIJL02 H. Nilsson, S. Ivarsson, S. Johansson, and H. Lundberg, Astron. Astrophys. **381**, 1090 (2002).

NJK91 A. E. Nilsson, S. Johansson, and R. L. Kurucz, Phys. Scr. **44**, 226 (1991).

NJLT94 G. Nave, S. Johansson, R. C. M. Learner, A. P. Thorne, and J. W. Brault, Astrophys. J. Suppl. Ser. **94**, 221 (1994).

NLTH91 G. Nave, R. C. M. Learner, A. P. Thorne, and C. J. Harris, J. Opt. Soc. Am. B **8**, 2028 (1991).

NOL73 G. H. Newsom, S. O'Connor, and R. C. M. Learner, J. Phys. B **6**, 2162 (1973).

NRCA00 S. G. Nakhate, M. A. N. Razvi, J. P. Connerade, and S. A. Ahmad, J. Phys. B **33**, 5191 (2000).

NZLJ02 H. Nilsson, Z. G. Zhang, H. Lundberg, S. Johansson, and B. Nordström, Astron. Astrophys. **382**, 368 (2002).

O70 A. Ölme, Phys. Scr. **1**, 256 (1970).

OHRW95 R. Otto, H. Hühnermann, J. Reader, and J.-F. Wyart, J. Phys. B **28**, 3615 (1995).

Pm: Tables 1 and 4 of this reference

comprise the most extensive published data on energy-level classifications for Pm II lines. The wavelengths in Table 1 were apparently derived from the levels by using an inaccurate formula for the dispersion of air; the resulting values are longer than the more accurate values in [RCWM80] by 0.02–0.05 Å.

OL92 T. R. O'Brian and J. E. Lawler, Astron. Astrophys. **255**, 420 (1992).

OWLW91 T. R. O'Brian, M. E. Wickliffe, J. E. Lawler, W. Whaling, and J. W. Brault, J. Opt. Soc. Am. B **8**, 1185 (1991).

P38 F. Paschen, Ann. Physik (5) **32**, 148 (1938).

In: We have adjusted the values of the $5s5p^2\ ^4$P levels to the more accurate $5s^25p\ ^2$P^o ground term fine-structure splitting given by the measurements in [DMZ53].

P69 H. P. Palenius, Ark. Fys. **39**, 15 (1969).

F: Palenius's estimate of the wavelength uncertainty near 600 Å implies an uncertainty of $1-2\ \mathrm{cm}^{-1}$ in the excited-configuration level values and the ionization limit with respect to the $2p^4\ ^3$P ground-term levels. His value for the $2p^4\ ^3\mathrm{P}_1-^3\mathrm{P}_0$ fine structure interval differs from the more accurate measurement in [BZE98] by only $0.36\ \mathrm{cm}^{-1}$. We have adjusted the values for these two levels to display the more accurate interval, assuming Palenius's value for the $2p^4\ ^3\mathrm{P}_2-^3\mathrm{P}_1$ interval as somewhat more accurate than his $^3\mathrm{P}_1-^3\mathrm{P}_0$ interval. We have not correspondingly reevaluated the upper levels or Palenius's Ritz-principle wavelengths for the resonance lines (wavelength less than 608 Å) because the resulting wavelength changes for any of these lines would be less than 0.001 Å, which is insignificant relative to the uncertainties.

P71 W. Persson, Phys. Scr. **3**, 133 (1971).

P77 B. A. Palmer, Ph. D. thesis, Purdue Univ., 1977.

PBFS89 M. D. Plimmer, P. E. G. Baird, C. J. Foot, D. N. Stacey, J. B. Swan, and G. K. Woodgate, J. Phys. B **22**, L241 (1989).

PBQS97 P. Palmeri, E. Biémont, P. Quinet, G. Szawiola, and R. L. Kurucz, Phys. Scr. **55**, 586 (1997).

V: These authors have recently extended the energy-level analysis of V I, including hyperfine structures.

PBT55 E. K. Plyer, L. R. Blaine, and E. Tidwell, J. Res. Natl. Bur. Stand. (U.S.) **55**, 279 (1955).

PC38 F. Paschen and J. S. Campbell, Ann. Phys. (5) **31**, 29 (1938).

In: Wavelengths of resolved hyperfine components are tabulated for many of the In II lines in this paper, together with the corresponding hfs center-of-gravity wave number for each line. The wavelengths for such lines quoted here were derived by converting these center-of-gravity wave numbers back to air wavelengths using, in effect, the same (now superseded) air-dispersion formula as Paschen and Campbell.

PE83 B. A. Palmer and R. Engleman, Jr., Los Alamos Natl. Lab. Report LA-9615 (1983).

Th: The accuracy of these data is comfirmed by their agreement with optogalvanic measurements [SW84] to ± 0.0002 Å in the wavelength range 5750–6900 Å.

PG90 R. H. Page and C. S. Gudeman, J. Opt. Soc. Am. B **7**, 1761 (1990).

PKE80 B. A. Palmer, R. A. Keller, and R. Engleman, Jr., Los Alamos Natl. Lab. Report LA-8251-MS (1980).

PRUJ98 J. C. Pickering, A. J. J. Raassen, P. H. M. Uylings, and S. Johansson, Astrophys. J. Suppl. Ser. **117**, 261 (1998).

PT96 J. C. Pickering and A. P. Thorne, Astrophys. J. Suppl. Ser. **107**, 761 (1996).

PTW98 J. C. Pickering, A. P. Thorne, and J. K. Webb, Mon. Not. R. Astron Soc. **300**, 131 (1998).

Mg: High-accuracy measurements of Mg I and Mg II resonant lines [PTW98], quoted here, give improved values of $35\,051.277(1)\ \mathrm{cm}^{-1}$ for the Mg I $3s3p\ ^1$P^o level and 35 669.298(2) and $35\,760.848(2)\ \mathrm{cm}^{-1}$ for the Mg II $3p\ ^2$P^o levels. We have retained the less accurate values from [MZ80] for these levels for consistency with the values of other levels in the tables.

PVHA85 B. H. Post, W. Vassen, W. Hogervorst, M. Aymar, and O. Robaux, J. Phys. B **18**, 187 (1985).

Ba: The value for the Ba I ionization energy quoted here is $0.01\ \mathrm{cm}^{-1}$ higher than the value given in this reference, as suggested in [KL99] on the basis of an improved value for the $6s5d\ ^3\mathrm{D}_1$ level.

PW99 P. Palmeri and J.-F. Wyart, J. Quant. Spectrosc. Radiat. Transfer **61**, 603 (1999).

Tc: This paper reports an extension and revision of the energy-level analysis and a calculation of A values for Tc I based on a theoretical interpretation.

PZ01 J. C. Pickering and V. Zilio, Eur. Phys. J. D **13**, 181 (2001).

Q96 P. Quinet, Phys. Scr. **54**, 483 (1996).

QPBM99 P. Quinet, P. Palmeri, E. Biémont, M. M. McCurdy, G. Reiger, E. H. Pinnington, M. E. Wickliffe, and J. E. Lawler, Mon. Not. R. Astron. Soc. **307**, 934 (1999).

R30 E. Rasmussen, Z. Phys. **62**, 494 (1930).

R33 E. Rasmussen, Z. Phys. **80**, 726 (1933).

R34a E. Rasmussen, Z. Phys. **86**, 24 (1934).

R34b E. Rasmussen, Z. Phys. **87**, 607 (1934).

R37 H. A. Robinson, Phys. Rev. **51**, 14 (1937).

Li: The tabulated wavelengths for the first three resonance lines of Li II (199, 178, and 171 Å) were quoted by Robinson from measurements by B. Edlén.

R56 P. Risberg, Ark. Fys. **10**, 583 (1956).

Na: See [JPHC81] and [BBLB98] for more recent, higher-accuracy data for Na I.

R58 Y. B. Rao, Indian J. Phys. **32**, 497 (1958).

R68 G. Risberg, Ark. Fys. **37**, 231 (1968).

R69 C. B. Ross, Jr., Ph. D. dissertation, Purdue Univ., 1969.

Cu: The Cu II data are also given by C. B. Ross, Los Alamos Report LA-4498 (1970).

R75 J. Reader, J. Opt. Soc. Am. **65**, 286 (1975).

R98 A. N. Ryabtsev, private communication (1998).

B: Ryabtsev has reevaluated the B II levels using all available data. Since no transition between singlet and triplet levels has been observed, he followed Ölme [O70] in fixing the triplet system relative to the singlets by assuming that the $2s6g$ ^{1}G and ^{3}G levels have the same value relative to the ground level. The new level values then required a lowering of the basic $2s2p$ ^{3}P^o and $2p^2$ ^{3}P levels by $0.5\ \mathrm{cm}^{-1}$ from their previous values. We have lowered Ölme's value for the B II ionization energy by $0.4\ \mathrm{cm}^{-1}$ based on Ryabtsev's new values for the $2s5g$ and $2s6g$ levels used by Ölme. The uncertainties of the singlet–triplet connection and of the ionization energy are both probably of the order of $1.0\ \mathrm{cm}^{-1}$.

R02 A. N. Ryabtsev, private communication (2002).

B: Ryabtsev obtained a value of $66\,928.04(3)\ \mathrm{cm}^{-1}$ for the ^{11}B I ionization energy by adjusting the experimental value of Glab and Falleur [GF02] to a more accurate value for the ^{11}B I $2s^23s$ level [JLKK93]. We quote this adjusted ^{11}B value as the most accurate estimate of the isotopically averaged B I ionization energy (see our note appended to [JLKK93]). With an appropriate adjustment, the value obtained by Edlén *et al.* [EOHJ70] for the center-of-gravity ionization energy was $66\,928.15(10)\ \mathrm{cm}^{-1}$.

RA65 L. J. Radziemski, Jr. and K. L. Andrew, J. Opt. Soc. Am. **55**, 474 (1965).

RAKL67 L. J. Radziemski, K. L. Andrew, V. Kaufman, and U. Litzén, J. Opt. Soc. Am. **57**, 336 (1967).

RAVS90 P. M. Rao, S. A. Ahmad, A. Venugopalan, and G. D. Saksena, Z. Phys. D **15**, 211 (1990).

Sm: Configuration assignments for four odd-parity Sm II levels have been taken from this reference.

RB78 J. R. Rubbmark and S. A. Borgström, Phys. Scr. **18**, 196 (1978).

RCL00 A. N. Ryabtsev, S. S. Churilov, and U. Litzén, Phys. Scr. **62**, 368 (2000).

RCWM80 J. Reader, C. H. Corliss, W. L. Wiese, and G. A. Martin, Natl. Stand. Ref. Data Ser., Natl. Bur. Stand. (U.S.) **68** (1980).

Pm: The Pm II wavelengths in this reference were taken from [MSB51] and [DR72a]. The energy-level classifications for the Pm II persistent lines given here are from [DR72a] and [OHRW95].

RD67 J. Reader and S. P. Davis, J. Res. Natl. Bur. Stand. (U.S.) **71A**, 587 (1967) and unpublished material.

RE75 J. Reader and G. L. Epstein, J. Opt. Soc. Am. **65**, 638 (1975).

RE80 J. Reader and G. L. Epstein, Natl. Bur. Stand (U.S.), unpublished (1980).

REB95 L. J. Radziemski, R. Engleman, Jr., and J. W. Brault, Phys. Rev. A **52**, 4462 (1995).

RG34 J. E. Ruedy and R. C. Gibbs, Phys. Rev. **46**, 880 (1934).

RGKP93 H. Rong, S. Grafström, J. Kowalski, G. zu Pulitz, W. Jastrzebski, and R. Neumann, Z. Phys. D **25**, 337 (1993), and references therein.

RHB61 H. E. Radford, V. W. Hughes, and V. Beltran-Lopez, Phys. Rev. **123**, 153 (1961).

RK69 L. J. Radziemski, Jr. and V. Kaufman, J. Opt. Soc. Am. **59**, 424 (1969).

Cl: See [MKSM92] for more complete energy-level data.

RK74 L. J. Radziemski, Jr. and V. Kaufman, J. Opt. Soc. Am. **64**, 366 (1974).

Cl: See [MKSM92] for more complete energy-level data.

RMBH87 D. M. Rayner, S. A. Mitchell, O. L. Bourne, and P. A. Hackett, J. Opt. Soc. Am. B **4**, 900 (1987).

RMW44 H. N. Russell, C. E. Moore, and D. W. Weeks, Trans. Am. Phil. Soc. **34** (Part 2), 111 (1944).

RR44 R. Ramanadham and K. R. Rao, Indian J. Phys. **18**, 317 (1944).

RT76 R. A. Roig and G. Tondello, J. Phys. B **9**, 2373 (1976).

B: The quantity "x" represents an uncertain correction for the B I $2s2p^2$ ^{4}P term. The estimated value of "x" is 0.0 ± 15 cm^{-1}.

RW97 M. Rosberg and J.-F. Wyart, Phys. Scr. **55**, 690 (1997).

Au: The uncertainty of the $5d^{10}$ ^{1}S ground level is 0.06 cm^{-1} with respect to the best determined excited levels. The estimated relative uncertainties of the excited Au II levels given here are about 0.005 cm^{-1} except for the $5d^9 6d$ level at 116 050.55 cm^{-1}, which has an uncertainty of about 0.2 cm^{-1}. The intensities of the lines above 2000 Å are based on the "peak value" intensities from this reference, except that we have increased the intensities (to somewhat arbitrary values) for three transitions to metastable lower $5d^9 6s$ levels that were clearly affected by self-absorption. The intensities of most of the lines below 2000 Å are also based roughly on values estimated by Rosberg and Wyart, but we have expanded the scale. We have omitted term names for the two Au II $5d^8 6s^2$ levels designated as ^{3}P$_2$ and ^{3}F$_2$ because the eigenvectors indicate that no meaningful single-term names exist for them.

RWS76 C. B. Ross, D. R. Wood, and P. S. Scholl, J. Opt. Soc. Am. **66**, 36 (1976).

S38a F. J. Sullivan, Univ. Pitts. Bull. **35**, 1 (1938).

S38b A. G. Shenstone, Phil. Trans. R. Soc. (London) **237A**, 57 (1938).

S40 A. G. Shenstone, Phys. Rev. **57**, 894 (1940).

S48 A. G. Shenstone, Phil. Trans. R. Soc. (London) **241A**, 297 (1948).

S58 F. J. Sancho, Anales Real. Soc. Esp. Fis. y Quim. **54A**, 41 (1958).

Rh: We have interchanged Sancho's designations for thee Rh II $4d^8$ ^{1}D$_2$ and ^{3}P$_2$ levels, as indicated by the calculations of Shadmi [S61a].

S61a Y. Shadmi, Bull. Res. Council Israel **9F**, 141 (1961).

S61b A. G. Shenstone, Proc. R. Soc. London, Ser. A **261**, 153 (1961).

S63a A. G. Shenstone, Proc. R. Soc. London, Ser. A **276**, 293 (1963).

S70 A. G. Shenstone, J. Res. Natl. Bur. Stand. (U.S.) **74A**, 801 (1970).

S74 J. Sugar, J. Chem. Phys. **60**, 4103 (1974).

S75 P. S. Scholl, unpublished material (1975); data taken from [RCWM80].

S80 N. Svendenius, Phys. Scr. **22**, 240 (1980).

S81 C. J. Sansonetti, dissertation, Purdue University, 1981.

S95 J. Spyromilio, Mon. Not. R. Astron. Soc. **277**, L59 (1995).

N: The N II ^{3}P$_2$–^{3}P$_1$ ground-term interval derived from the wavelength measurements for the two ^{3}P–^{1}D$_2$ transitions in this reference is 82.033(2) cm^{-1}, not 82.059 cm^{-1} as given by the author. The corrected value is in excellent agreement with the more accurate value of 82.036 09 cm^{-1} [BVEC94].

SAV81 C. J. Sansonetti, K. L. Andrew, and J. Vergés, J. Opt. Soc. Am. **71**, 423 (1981).

SC85 J. Sugar and C. Corliss, J. Phys. Chem. Ref. Data **14**, Suppl. 2 (1985).

K: We have increased the $3d$ ^{2}D$^o_{5/2}$ and ^{2}D$^o_{3/2}$ levels by 0.020 and 0.016 cm^{-1}, respectively, in accordance with the new values for the $4p$ ^{2}P^o levels [E99].

Ca: We have increased the values of the two-place Ca II excited levels, as well as the ionization energy, by 0.01 cm^{-1} in accordance with the new values of the $4p$ ^{2}P^o levels [L99].

SH80 N. Spector and S. Held, Israel Atomic Energy Comm. Report IA-1354-T (1980).

SK79 J. Sugar and V. Kaufman, J. Opt. Soc. Am. **69**, 141 (1979).

SKJ94 B. Simard, P. Kowalczyk, and A. M. James, Phys. Rev. A **50**, 846 (1994).

SKRR03 C. J. Sansonetti, F. Kerber, J. Reader, and M. R. Rosa, to be published (2003).

Cr: The wavelengths from this reference have estimated uncertainties of 0.002 Å.

SM58 A. G. Shenstone and W. F. Meggers, J. Res. Natl. Bur. Stand. (U.S.) **61**, 373 (1958).

SM88 J. Sugar and A. Musgrove, J. Phys. Chem. Ref. Data **17**, 155 (1988).

SM90 J. Sugar and A. Musgrove, J. Phys. Chem. Ref. Data **19**, 527 (1990).

SM91 J. Sugar and A. Musgrove, J. Phys. Chem. Ref. Data **20**, 861 (1991).

Kr: This compilation gives three-place values for the Kr II $4p^4$ (^{3}P)$5s$ and $5p$ levels as determined for ^{86}Kr [HP70a]. These values have been rounded to two places here.

SM93a E. B. Saloman and W. C. Martin, unpublished material (1993).

SM93b J. Sugar and A. Musgrove, J. Phys. Chem Ref. Data **22**, 1213 (1993).

SM95 J. Sugar and A. Musgrove, J. Phys. Chem. Ref. Data **24**, 1803 (1995).

SM02 J. E. Sansonetti and W. C. Martin (this work).

In: Paschen and Campbell observed the

spectrum from 2078 to 9246 Å, but adopted a value of 43 349 cm^{-1} for the $5s^2$ $^1S_0$–$5s5p$ $^3P^o_1$ separation, as determined earlier by Lang and Sawyer [LS31]. The value for the $5s^2$ $^1S_0$–$5s5p$ $^3P^o_1$ wave number obtained from Bhatia's more recent measurement [B69] of the corresponding line is 43 351.00 cm^{-1}, in good agreement with the value 43 350.85 cm^{-1} obtained for the wave number of this line by Paschen and Campbell. We have thus adopted a value of 43 350.9 cm^{-1} for the $5s5p$ $^3P^o_1$ level and used this value together with measurements of $5s5p$ $^3P^o$–$5s6s$ ^3S, $5s5d$ ^3D, $5p^2$ ^3P, and $5p^2$ ^1D wavelengths (1607–1977 Å) from Bhatia to redetermine the $5s5p$ $^3P^o_0$, $^3P^o_2$, and $5s6s$ $^3S_1$ levels. The Ritz-principle consistency of six determinations of $5s5p$ $^3P^o$ level separations from Bhatia's measurements indicates a wave number uncertainty of the order of 0.3 cm^{-1}, corresponding to a wavelength error of order 0.010 Å at 1800 Å. Our new position for the $5s6s$ $^3S_1$ level is 4.37 cm^{-1} above the value in *Atomic Energy Levels* [M58], which was taken from [PC38]. Since Paschen and Campbell evaluated the $5s5p$ $^1P^o_1$ level and all levels above the $5s6s$ $^3S_1$ level with respect to the $5s6s$ $^3S_1$ level, all levels given to two decimal places by Moore [M58] should be increased by 4.37 cm^{-1}. The ionization energy is also increased by 4 cm^{-1}. The corrected levels can be used to obtain Ritz vacuum UV wavelengths for In II having much greater accuracy than the measured values of Lang and Sawyer and, for wavelengths below about 1600 Å, greater accuracy than those given by Bhatia. Thus, for example, the new Ritz wavelength of 734.773 Å for the $5s^2$ $^1S_0$–$5s8p$ $^1P^o_1$ line should be accurate to about 0.002 Å, whereas the values from Bhatia [B69] and Lang and Sawyer [LS31] are longer than this Ritz value by 0.005 and 0.17 Å, respectively.

Sb: Wavelengths are calculated from energy levels in [HARV88]. The relative intensities are from [MH42], except that we have increased the intensities for the three lines below 2000 Å to be more in accord with the scale used above 2000 Å. Although we have given the Sb I levels with *LS*-coupling designations as assigned by Hassini *et al.* [HARV88], their calculations show that several of the even-parity levels tabulated here have no meaningful term names; the average purity in the three (^{3}P)$5d$ "^{4}P" levels, for example, is 32%.

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4. Finding List

Finding List

Intensity	Wavelength (Å)	Spectrum	Ref
	Vacuum		
30	171.575	Li II	R37
300 P	178.014	Li II	R37
1000 P	199.280	Li II	R37
15 c	231.4541	He II	GM65
20 c	232.5842	He II	GM65
30 c	234.3472	He II	GM65
50 c	237.3307	He II	GM65
100 c	243.0266	He II	GM65
300 P	256.3166	He II	MK00b
150 P	256.3177	He II	MK00b
90 P	300.15	Na II	W71
90	300.20	Na II	W71
50	301.32	Na II	W71
60	301.44	Na II	W71
30	302.45	Na II	W71
1000 P	303.7804	He II	MK00b
500 P	303.7858	He II	MK00b
10	320.293	He I	TW71
90 P	352.9549	Ne II	P71
60 P	354.9620	Ne II	P71
90	361.4321	Ne II	P71
60	362.4544	Ne II	P71
150 P	372.08	Na II	W71
200	376.38	Na II	W71
150	405.8538	Ne II	P71
120	407.1377	Ne II	P71
400 P	429.918	O II	MKM93
700 P	430.041	O II	MKM93
1000 P	430.177	O II	MKM93
800	441.81	K II	E31
200 P	445.0393	Ne II	P71
300 P	446.2552	Ne II	P71
250 P	446.5902	Ne II	P71
200	447.8146	Ne II	P71
150	454.6540	Ne II	P71
200	455.2730	Ne II	P71
10	456.2728	Ne II	P71
120	456.3485	Ne II	P71
90	456.8962	Ne II	P71
1000 P	460.7284	Ne II	P71
500 P	462.3908	Ne II	P71
150	465.08	K II	E31
	469.50	K II	E31
300	476.03	K II	E31
900 P	484.602	F II	P69
10	487.2272	Ar II	M71
15	490.6495	Ar II	M71
10	490.7013	Ar II	M71
1000	495.14	K II	E31
2	505.50035	He I	M02
3	505.68433	He I	M02
4	505.91252	He I	M02
5	506.20034	He I	M02
7	506.57057	He I	M02

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
10	507.05802	He I	M02
15	507.71809	He I	M02
20	508.64338	He I	M02
25	509.99829	He I	M02
35	512.09856	He I	M02
2	513.266	Rb II	R75
50	515.61684	He I	M02
10	519.3270	Ar II	M71
100 P	522.21309	He I	M02
3	530.173	Rb II	R75
400 P	537.02992	He I	M02
800 P	537.8319	O II	MKM93
1000 P	538.2636	O II	MKM93
600 P	538.318	O II	MKM93
800 P	539.0855	O II	MKM93
700 P	539.5489	O II	MKM93
500 P	539.8544	O II	MKM93
10	542.9124	Ar II	M71
70	543.2033	Ar II	M71
25	547.4606	Ar II	M71
25	556.8170	Ar II	M71
25	573.3619	Ar II	M71
10	576.7364	Ar II	M71
25	580.2632	Ar II	M71
10	583.4371	Ar II	M71
1000 P	584.33436	He I	M02
30	587.1792	Ne I	SS04
30	587.2127	Ne I	SS04
30 P	589.419	Rb II	R75
30	589.9114	Ne I	SS04
50	591.41207	He I	M02
70	591.8306	Ne I	SS04
100	595.9200	Ne I	SS04
25	597.7001	Ar II	M71
70	598.7056	Ne I	SS04
30	598.8897	Ne I	SS04
70	600.0365	Ne I	SS04
1000 P	600.77	K II	E31
130	602.7263	Ne I	SS04
10	602.8584	Ar II	M71
900 P	605.669	F II	P69
800 P	606.288	F II	P69
1000 P	606.804	F II	P69
700 P	606.923	F II	P69
800 P	607.472	F II	P69
800 P	607.93	K II	E31
900 P	608.062	F II	P69
10	612.3716	Ar II	M71
1000 P	612.62	K II	E31
170 P	615.6283	Ne I	SS04
170 P	618.6716	Ne I	SS04
130 P	619.1023	Ne I	SS04
200 P	626.8232	Ne I	SS04
200 P	629.7388	Ne I	SS04
20	639.36	Cs II	RE75
15	643.878	Rb II	R75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200 P	644.635	N II	E83
600 P	644.837	N II	E83
1000 P	645.179	N II	E83
150 P	661.8690	Ar II	M71
10	664.5623	Ar II	M71
70	666.0109	Ar II	M71
300 P	670.9455	Ar II	M71
1000 P	671.8513	Ar II	M71
25	676.2425	Ar II	M71
10	677.9518	Ar II	M71
10	679.2184	Ar II	M71
70	679.4006	Ar II	M71
600 P	687.0526	C II	KE74
1000 P	687.346	C II	KE74
80	692.70	N I	M75a
180	693.947	B II	O70
500 r	696.30	Tl II	ES36
30 P	697.049	Rb II	R75
70 P	711.187	Rb II	R75
70	718.0899	Ar II	M71
150	718.14	Cs II	RE75
800 P	718.5036	O II	MKM93
500 P	718.5663	O II	MKM93
1000 P	723.3606	Ar II	M71
150	725.5485	Ar II	M71
20	729.40	Kr II	MSP69
25	730.9297	Ar II	M71
1000 P	735.8962	Ne I	SS04
70	740.2692	Ar II	M71
120	740.41	Xe II	B36
110 P	741.456	Rb II	R75
400 P	743.7195	Ne I	SS04
70	744.9248	Ar II	M71
25	745.3223	Ar II	M71
70	761.18	Kr II	MSP69
30	763.98	Kr II	MSP69
20	766.20	Kr II	MSP69
70	771.03	Kr II	MSP69
20	773.69	Kr II	MSP69
200 P	775.967	N II	E83
70	782.10	Kr II	MSP69
30	783.72	Kr II	MSP69
600	787.580	Cl II	RK74
600	788.740	Cl II	RK74
600	793.342	Cl II	RK74
250	796.664	O II	MKM93
250	796.682	O II	MKM93
40	802.28	Te II	HM64
20	802.85896	Ar I	M73
120	803.07	Xe II	B36
100	806.4710	Ar I	M73
60	806.86887	Ar I	M73
30	807.21842	Ar I	M73
40	807.6529	Ar I	M73
150 P	808.76	Cs II	RE75
50	809.92660	Ar I	M73
150 P	813.84	Cs II	RE75
120	816.23193	Ar I	M73
70	816.46391	Ar I	M73
300 r	817.18	Tl II	ES36

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
20	818.15	Kr II	MSP69
80	820.12352	Ar I	M73
120	825.34592	Ar I	M73
120	826.36484	Ar I	M73
140	829.529	Ga II	IL85
20	830.38	Kr II	MSP69
800	832.62	Se II	G62
250 P	832.7587	O II	MKM93
400 P	833.3302	O II	MKM93
150	834.3918	Ar I	M73
500 P	834.4655	O II	MKM93
100	835.00210	Ar I	M73
700 P	839.297	Cl II	RK74
900 P	839.599	Cl II	RK74
800 P	841.414	Cl II	RK74
100	842.80506	Ar I	M73
30 P	844.06	Kr II	MSP69
600 P	851.691	Cl II	RK74
20	864.82	Kr II	MSP69
180 P	866.79997	Ar I	M73
20	868.87	Kr II	MSP69
150 P	869.75411	Ar I	M73
180 P	876.05767	Ar I	M73
100	879.84	I II	MC60
180 P	879.94656	Ar I	M73
200	880.80	Xe II	B36
500	882.543	B II	O70
500	882.681	B II	O70
70	884.14	Kr II	MSP69
120	885.54	Xe II	B36
300 P	886.30	Kr II	MSP69
400	886.943	Cu II	R69
1000 P	889.25	Br II	MT84
400	890.567	Cu II	R69
130	891.01	Kr II	MSP69
70	892.001	Si II	RA65
20	893.0847	Hg II	SR01
500	893.678	Cu II	R69
150 P	894.31013	Ar I	M73
500	896.65	Br II	MT84
400	896.759	Cu II	R69
400	901.073	Cu II	R69
400 P	901.27	Cs II	RE75
150	903.6235	C II	KE74
300	903.9616	C II	KE74
750 P	904.1416	C II	KE74
150	904.4801	C II	KE74
500	906.01	Br II	MT84
400	906.885	S II	KM93
300	910.484	S II	KM93
70	911.39	Kr II	MSP69
800	912.69	Se II	G62
250	912.735	S II	KM93
500	914.213	Cu II	R69
50 P	915.613	N II	E83
12	915.819	Hg II	SR01
50 P	915.963	N II	E83
60 P,d	916.019	N II	E83
200 P,d	916.708	N II	E83
700 P	917.43	Kr II	MSP69

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
300 P	919.7810	Ar II	M71
400	922.019	Cu II	R69
200	925.87	Xe II	B36
15	926.2256	H I	MK00a
400 P	926.66	Cs II	RE75
20	930.7482	H I	MK00a
300 P	932.0537	Ar II	M71
400	932.939	Cu II	R69
400	935.058	Cu II	R69
400	935.086	Cu II	R69
80	935.40	Xe II	B36
400	935.898	Cu II	R69
250	937.421	S II	KM93
300	937.684	S II	KM93
30	937.8034	H I	MK00a
20	942.630	Hg II	SR01
400	943.335	Cu II	R69
10	944.73	Li II	SO82
100	945.4414	Kr I	K93
400	945.525	Cu II	R69
80	946.5443	Kr I	K93
50 P	949.7430	H I	MK00a
30	951.056	Kr I	K93
500 P	951.870	F I	L49
80	953.4041	Kr I	K93
1000 P	954.826	F I	L49
800 P	955.546	F I	L49
500 P	958.525	F I	L49
5 c	958.70	He II	GM65
25	962.711	Hg II	SR01
80	963.3745	Kr I	K93
700 P	964.97	Kr II	MSP69
25	969.142	Hg II	SR01
6 c	972.11	He II	GM65
100 P	972.5367	H I	MK00a
250 P	972.77	Xe II	B36
400	973.895	F I	L49
100	976.217	F I	L49
250	976.68	Xe II	B36
100	977.743	F I	L49
500	984.99	Br II	MT84
50	988.773	O I	M75b
8 c	992.36	He II	GM65
70	992.684	Si II	RA65
60	993.8825	Ne II	P71
150	1001.0606	Kr I	K93
150	1003.5504	Kr I	K93
500	1012.13	Br II	MT84
800 P	1013.40	Se II	G62
800	1013.99	Se II	G62
250	1014.449	S II	KM93
1000 P	1015.53	Br II	MT84
10	1017.88	Li II	SO82
200	1018.58	I II	MC60
15 c	1025.27	He II	GM65
300 P	1025.7222	H I	MK00a
80	1025.762	O I	M75b
14 P	1025.9681	Mg II	KM91a
12 P	1026.1134	Mg II	KM91a
150	1030.0232	Kr I	K93

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
150	1032.44	Xe II	B36
1000 P	1033.56	Se II	G62
500 P	1034.66	I II	MC60
250 P	1036.3367	C II	KE74
400	1036.470	Cu II	R69
500	1036.98	Br II	MT84
500 P	1037.0182	C II	KE74
250	1037.68	Xe II	B36
50	1039.230	O I	M75b
400	1039.348	Cu II	R69
400	1039.582	Cu II	R69
20	1039.6315	Hg II	SR01
400 P	1041.31	Xe II	B36
500	1044.519	Cu II	R69
500	1044.744	Cu II	R69
1000 P	1048.21987	Ar I	VHU99
300 P	1048.27	Xe II	B36
1000 P	1048.94	Br II	MT84
1000 P	1049.65	Se II	G62
400 P	1051.92	Xe II	B36
400	1054.690	Cu II	R69
400	1056.955	Cu II	R69
800	1057.41	Se II	G62
400	1059.096	Cu II	R69
40	1059.51	Te II	HM64
200	1060.619	Pb II	WRSH74
400	1060.634	Cu II	R69
20	1062.7802	Hg II	SR01
400	1063.005	Cu II	R69
700 P	1063.831	Cl II	RK74
400	1064.71	Br II	MT84
100	1066.34	I II	MC60
500 P	1066.65980	Ar I	M73
300 P	1067.945	Cl II	RK74
70	1068.6488	Ne II	P71
1000 P	1071.036	Cl II	RK74
700 P	1071.767	Cl II	RK74
500	1071.84	Br II	MT84
700 P	1074.48	Xe II	B36
150	1075.21	I II	MC60
600 P	1075.230	Cl II	RK74
40 P	1077.66	Te II	HM64
600 P	1079.080	Cl II	RK74
500	1081.875	B II	O70
500	1082.073	B II	O70
200	1083.86	Xe II	B36
25 P	1083.994	N II	E83
60 P,d	1084.580	N II	E83
30 c	1084.94	He II	GM65
300	1085.51	Ge II	S63a
15 P	1085.550	N II	E83
100 P	1085.710	N II	E83
400 P	1100.43	Xe II	B36
250	1105.00	I II	MC60
500 P	1106.74	Ge II	S63a
1000 P	1106.9931	Ag II	KLLT01
120	1111.16	I II	MC60
600 P	1112.4006	Ag II	KLLT01
200	1113.708	Ga II	IL85
200	1119.133	Ga II	IL85

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500 P	1120.46	Ge II	S63a
200	1121.325	Pb II	WRSH74
200	1125.25	I II	MC60
300	1130.760	Ga II	IL85
100	1131.50	I II	MC60
90	1131.7224	Ne II	P71
100	1131.8490	Ne II	P71
30	1131.88	Li II	SO82
90	1134.165	N I	M75a
90	1134.415	N I	M75a
500 P	1139.80	I II	MC60
800	1141.97	Se II	G62
200	1143.039	Be II	J61a
200	1158.47	Xe II	B36
500 P	1160.56	I II	MC60
600 P	1162.1700	Pd II	LLTL01
500 r	1162.55	Tl II	ES36
30	1164.4184	Pt II	SRSA92
300 P	1164.8671	Kr I	K93
1000 P	1166.48	I II	MC60
10	1166.63	Li II	SO82
30	1166.8635	Pt II	SRSA92
80	1169.63	Xe II	B36
90	1169.7477	Pt II	SRSA92
50 P	1174.34	Te II	HM64
60 P	1175.79	Te II	HM64
250	1175.84	I II	MC60
500 P	1178.65	I II	MC60
80	1178.9614	Pt II	SRSA92
150	1179.293	Cl I	RK69
500	1181.19	Ge II	S63a
500	1181.65	Ge II	S63a
30	1182.3552	Pt II	SRSA92
250 P	1183.05	Xe II	B36
700 P	1183.4003	Pd II	LLTL01
60	1186.2203	Pt II	SRSA92
800 P	1187.34	I II	MC60
200 P	1188.73	Ge II	S63a
300 P	1190.4160	Si II	KE74
500 P	1190.85	I II	MC60
300	1191.26	Ge II	S63a
25 P	1192.0376	Xe I	BVHU01
1000 P	1192.24	Se II	G62
300*	1193.0088	C I	J66
300*	1193.0308	C I	J66
400	1193.2402	C I	KE74
100	1193.2644	C I	KE74
700 P	1193.2898	Si II	KE74
60	1193.4484	Pt II	SRSA92
800 P	1194.5004	Si II	KE74
700 P	1195.8092	Ag II	KLLT01
1000 P	1196.4051	Pd II	LLTL01
400	1197.188	Be II	J61a
50	1198.092	Li II	HM59
70	1198.7745	Pt II	SRSA92
250	1198.88	I II	MC60
1000 P	1199.550	N I	M75a
400	1200.22	I II	MC60
700 P	1200.223	N I	M75a
300 P	1200.710	N I	M75a

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
800 P	1203.9645	Pd II	LLTL01
40	1208.54	Te II	HM64
800	1211.17	As II	LA71
600	1214.5242	Pd II	LLTL01
35	1215.09	He II	GM65
50 c	1215.17	He II	GM65
1000 P	1215.66824	H I	MK00a
500 P	1215.67364	H I	MK00a
800	1218.10	As II	LA71
700 P	1218.6219	Pd II	LLTL01
110	1219.4931	Pt II	SRSA92
90	1220.165	Cr II	SKRR03
1000 P	1220.89	I II	MC60
40	1220.98	Te II	HM64
600	1223.721	Sn II	B64
600 P	1224.592	Au II	RW97
600	1225.2684	Pd II	LLTL01
70	1228.746	Si II	S61b
40	1229.0134	Pt II	SRSA92
100	1229.388	Si II	S61b
90	1229.8367	Ne II	P71
600	1229.901	Au II	RW97
500	1230.160	B II	O70
100	1232.43	Br I	T63
40	1232.8739	Pt II	SRSA92
1000 P	1234.06	I II	MC60
600	1235.1957	Pd II	LLTL01
1000 P	1235.8378	Kr I	K93
500 P	1237.059	Ge II	KE74
700 P	1237.0677	Pd II	LLTL01
20	1237.29	Li II	SO82
90	1238.8499	Pt II	SRSA92
25 P	1239.9253	Mg II	KM91a
20 P	1240.3946	Mg II	KM91a
400 P	1241.045	Bi II	WBBF01
800	1241.31	As II	LA71
500	1242.926	Sn II	B64
1000 P	1243.08	As II	LA71
250 P	1243.179	N I	M75a
200 P	1244.76	Xe II	B36
900	1245.67	As II	LA71
150	1247.554	Cr II	SKRR03
100	1248.426	Si II	S61b
200	1248.6069	Pt II	SRSA92
25 P	1250.2091	Xe I	BVHU01
70	1250.433	Si II	S61b
400 P	1250.578	S II	KM93
130	1251.164	Si II	S61b
10	1253.32	Li II	SO82
40	1253.62	Te II	HM64
900 P	1253.805	S II	KM93
800	1258.58	As II	LA71
40	1259.51	I I	KC59
1000 P	1259.518	S II	KM93
500 P	1260.4223	Si II	KE74
200	1261.5520	C I	KE74
500 P	1261.905	Ge II	KE74
1000 P	1263.77	As II	LA71
40	1264.5677	Pt II	SRSA92
1000 P	1264.7379	Si II	KE74

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
800	1266.34	As II	LA71
800	1267.59	As II	LA71
40	1270.52	Te II	HM64
40	1271.7939	Pt II	SRSA92
800 P	1274.938	Sb II	AJK89
400 P	1277.2452	C I	KE74
800 P	1277.2824	C I	KE74
200 P	1277.5131	C I	KE74
1000 P	1277.5497	C I	KE74
800 P	1280.3330	C I	KE74
700	1280.99	As II	LA71
30	1283.6978	Pt II	SRSA92
300 P	1283.715	Bi II	WBBF01
700	1287.54	As II	LA71
40	1289.40	I I	KC59
70	1289.9515	Pt II	SRSA92
30	1290.0131	Pt II	SRSA92
30	1290.0131	Pt II	SRSA92
1000	1290.880	Sn II	B64
30	1292.7998	Pt II	SRSA92
100 P	1295.5878	Xe I	BVHU01
130	1300.34	I I	KC59
1000 P	1302.168	O I	M75b
50	1302.4578	Pt II	SRSA92
40	1302.98	I I	KC59
40	1303.1187	Pt II	SRSA92
700 P	1304.858	O I	M75b
700	1305.70	As II	LA71
300 P	1306.029	O I	M75b
500 r	1307.50	Tl II	ES36
100	1309.2766	Si II	KE74
200 P	1310.700	P II	SMZ83
40	1313.95	I I	KC59
1000	1316.576	Sn II	B64
40	1317.54	I I	KC59
800 P	1320.0229	Pd II	LLTL01
800 P,r	1321.644	Tl II	JKBL96
50 P	1324.92	Te II	HM64
800 P	1327.378	Sb II	AJK89
40	1327.4314	Pt II	SRSA92
9 h	1328.374	Au I	BG78
200	1329.5775	C I	KE74
100	1329.6005	C I	KE74
800	1333.15	As II	LA71
80 P	1334.5323	C II	KE74
150 P	1335.7077	C II	KE74
300 P	1335.726	Cl I	RK69
1000 P	1336.52	I II	MC60
1000 P	1341.55	As II	LA71
1000 P	1347.240	Cl I	RK69
40	1348.8300	Pt II	SRSA92
70	1350.057	Si II	S61b
500 P	1351.657	Cl I	RK69
30	1352.9768	Pt II	SRSA92
800	1354.955	Sb II	AJK89
70	1355.10	I I	KC59
400	1355.616	Au II	RW97
800	1355.93	As II	LA71
40	1357.97	I I	KC59
600	1358.009	Sb II	AJK89

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200 P	1358.773	Cu II	R69
70	1360.97	I I	KC59
40	1361.11	I I	KC59
400 P	1362.326	Au II	RW97
1000 P	1362.463	B II	LZJK98
40	1363.24	Te II	HM64
30	1363.3059	Pt II	SRSA92
500 P	1363.447	Cl I	RK69
700 P	1363.6892	Pd II	LLTL01
30	1364.1171	Pt II	SRSA92
600	1365.5430	Pd II	LLTL01
15	1367.257	Mg II	KM91a
800 P	1367.7039	Pd II	LLTL01
15	1367.708	Mg II	KM91a
150 P	1367.951	Cu II	R69
20	1369.423	Mg II	KM91a
1000 P	1369.77	As II	LA71
120	1373.116	Cl I	RK69
30	1373.1724	Pt II	SRSA92
800	1373.65	As II	LA71
50	1374.69	Na II	W71
50	1374.80	Te II	HM64
900 P	1374.8481	Pd II	LLTL01
1000 P	1375.07	As II	LA71
800	1375.78	As II	LA71
120	1378.9572	Pt II	SRSA92
500 P	1379.528	Cl I	RK69
100	1382.0460	Pt II	SRSA92
50	1383.23	I I	KC59
150	1384.60	Br I	T63
800 P	1384.656	Sb II	AJK89
1000 P	1387.565	Sb II	AJK89
200	1388.435	S I	KM93
500 P	1389.693	Cl I	RK69
500 P	1389.957	Cl I	RK69
40	1390.75	I I	KC59
120	1392.588	S I	KM93
800	1394.64	As II	LA71
250	1396.112	S I	KM93
500 P	1396.527	Cl I	RK69
800	1400.31	As II	LA71
1000 P	1400.440	Sn II	B64
150	1401.514	S I	KM93
200	1403.9006	Pt II	SRSA92
50	1404.68	Na II	W71
600	1407.784	Sb II	AJK89
9	1408.451	Au I	BG78
90	1411.94	N I	M75a
1000 P	1414.401	Ga II	IL85
90	1418.3779	Ne II	P71
60	1420.900	Li II	DM01
1000 P	1425.030	S I	KM93
110	1425.49	I I	KC59
1000 P	1426.208	Cr II	SKRR03
90	1428.5822	Ne II	P71
80	1429.5248	Pt II	SRSA92
800 P	1431.323	Cr II	SKRR03
600 P	1431.865	Cr II	SKRR03
600 P	1432.056	Cr II	SKRR03
500 P	1433.004	Cr II	SKRR03

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
600 P	1433.280	S I	KM93
200 P	1433.310	S I	KM93
1000 P	1433.906	Pb II	KT96
600 P	1434.808	Cr II	SKRR03
400 P	1435.207	Cr II	SKRR03
350 P	1435.582	Cr II	SKRR03
90	1436.0813	Ne II	P71
800 P	1436.447	Sb II	AJK89
400 P	1436.810	Bi II	WBBF01
250	1436.968	S I	KM93
70	1446.26	I I	KC59
40	1447.8030	Pt II	SRSA92
300	1448.428	Cr II	SKRR03
P	1451.56	Rn I	R30
70	1453.18	I I	KC59
30	1454.2866	Pt II	SRSA92
30	1454.2866	Pt II	SRSA92
500	1455.091	Bi II	WBBF01
70	1457.39	I I	KC59
70	1457.47	I I	KC59
130 P	1457.98	I I	KC59
50	1459.15	I I	KC59
40	1461.0786	Pt II	SRSA92
40	1462.6591	Pt II	SRSA92
60 P	1469.6123	Xe I	BVHU01
1000 P	1473.995	S I	KM93
1000 P	1474.997	Sn II	B64
60	1475.6306	Pt II	SRSA92
20	1476.000	Mg II	KM91a
25	1478.004	Mg II	KM91a
20	1480.880	Mg II	KM91a
9	1481.764	Au I	BG78
150	1482.8256	Pt II	SRSA92
30	1482.890	Mg II	KM91a
700	1483.039	S I	KM93
500	1486.547	Au II	RW97
400	1486.954	Bi II	WBBF01
700 P	1488.45	Br I	T63
500	1488.637	Cu II	R69
25	1491.9735	Pt II	SRSA92
250 P	1492.625	N I	M75a
120	1492.820	N I	M75a
70	1492.89	I I	KC59
15	1492.931	Li II	HM59
30	1492.973	Li II	HM59
6	1493.036	Li II	HM59
150	1494.675	N I	M75a
200	1494.7256	Pt II	SRSA92
100	1498.1132	Pt II	SRSA92
800	1498.549	Sb II	AJK89
200	1499.3707	Pt II	SRSA92
140	1505.2462	Pt II	SRSA92
110	1506.2923	Pt II	SRSA92
40	1506.41	Na II	W71
70	1507.04	I I	KC59
30	1507.6288	Pt II	SRSA92
600	1509.2920	Pt II	SRSA92
600 P	1512.269	Be II	J61a
1000 P	1512.298	Pb II	KT96
800 P,c	1512.412	Be II	J61a

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
800	1513.255	Sb II	AJK89
200	1514.26	Cd II	SP49
70	1514.68	I I	KC59
9 r	1515.63	Ag I	S40
200 P	1518.05	I I	KC59
400	1519.837	Cu II	R69
400	1520.549	Bi II	WBBF01
30	1520.7414	Pt II	SRSA92
800	1524.367	Sb II	AJK89
150	1524.5715	Pt II	SRSA92
900	1524.7295	Pt II	SRSA92
900	1524.7295	Pt II	SRSA92
150	1526.70698	Si II	GK00
80	1528.2831	Pt II	SRSA92
60	1530.1969	Pt II	SRSA92
400	1531.74	Br I	T63
80 P	1532.530	P II	SMZ83
400	1533.139	Bi II	WBBF01
300 P	1533.4318	Si II	KE74
100	1534.9063	Pt II	SRSA92
800 P	1535.309	Ga II	IL85
130 P	1535.917	P II	SMZ83
80 P	1536.410	P II	SMZ83
300	1536.745	Bi II	WBBF01
400	1538.037	Bi II	WBBF01
800 P	1539.830	Al II	KM91b
50	1540.5040	Pt II	SRSA92
300 P	1540.65	Br I	T63
500	1541.703	Cu II	R69
60 l	1541.8337	Pt II	SRSA92
130 P	1542.297	P II	SMZ83
30	1542.7098	Pt II	SRSA92
40	1546.8248	Pt II	SRSA92
110	1552.3268	Pt II	SRSA92
200	1554.9285	Pt II	SRSA92
30	1558.3479	Pt II	SRSA92
40	1559.3893	Pt II	SRSA92
200	1560.309	C I	KE74
500 P	1560.682	C I	KE74
200 P	1560.709	C I	KE74
600 P	1561.438	C I	KE74
40	1561.5450	Pt II	SRSA92
40	1561.5450	Pt II	SRSA92
500 r	1561.58	Tl II	ES36
800	1565.501	Sb II	AJK89
30	1568.9021	Pt II	SRSA92
200	1571.58	Cd II	SP49
30	1573.1802	Pt II	SRSA92
400	1573.69	Bi II	WBBF01
40	1573.8180	Pt II	SRSA92
200	1574.3059	Pt II	SRSA92
400 P	1574.84	Br I	T63
900 P	1576.099	Sb II	AJK89
250	1576.39	Br I	T63
500 P	1576.855	Ge II	KE74
80	1579.4357	Pt II	SRSA92
800	1581.353	Sb II	AJK89
90	1581.3980	Pt II	SRSA92
300	1582.31	Br I	T63
20 P	1586.340	In II	SM02

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
20	1587.158	Au I	BG78
40	1587.7205	Pt II	SRSA92
40	1589.3735	Pt II	SRSA92
600 P	1591.76	Bi II	WBBF01
400	1593.556	Cu II	R69
70	1593.58	I I	KC59
40	1594.0344	Pt II	SRSA92
40	1594.2611	Pt II	SRSA92
70	1594.5655	Si I	RAKL67
70	1594.9493	Si I	RAKL67
9	1604.0102	Pt I	SRSA92
11	1604.12	Rb II	R75
1000 P	1604.45	Rh II	S58
1000 P	1606.952	Sb II	AJK89
50	1608.41	Te II	HM64
400	1609.69	Bi II	WBBF01
400	1611.358	Bi II	WBBF01
50	1613.15	Te II	HM64
70	1617.60	I I	KC59
400	1621.426	Cu II	R69
80 l	1621.6590	Pt II	SRSA92
90	1622.8806	Si I	RAKL67
700 P	1623.597	B II	LZJK98
500 P	1623.790	B II	LZJK98
1000 P	1624.023	B II	LZJK98
300	1624.175	B II	LZJK98
9	1624.335	Au I	BG78
700 P	1624.376	B II	LZJK98
400 P	1624.47	Rh II	S58
1000 P	1628.94	Rh II	S58
100	1629.441	Si I	KRA66
100	1629.9477	Si I	RAKL67
80	1631.0903	Pt II	SRSA92
1000 P	1633.40	Br I	T63
120	1634.2337	Pt II	SRSA92
400 P	1634.72	Rh II	S58
25	1636.1647	Pt I	SRSA92
400 P	1637.88	Rh II	S58
120 P	1640.3321	He II	MK00b
50 P	1640.3447	He II	MK00b
7 P	1640.3750	He II	MK00b
25 P	1640.3914	He II	MK00b
180 P	1640.4742	He II	MK00b
25 P	1640.4897	He II	MK00b
15 P	1640.5326	He II	MK00b
8	1644.4634	Pt I	SRSA92
300	1644.4958	Ag II	KLLT01
14 P	1646.674	Au I	BG78
250	1649.858	Ca II	ER56
1000 P	1649.9373	Hg II	SR01
5	1651.52	Ag I	S40
140	1651.991	Ca II	ER56
15	1653.077	Li II	HM59
30	1653.132	Li II	HM59
6	1653.213	Li II	HM59
500 P	1656.267	C I	KE74
400 P	1656.928	C I	KE74
1000 P	1657.008	C I	KE74
400 P	1657.379	C I	KE74
400 P	1657.907	C I	KE74

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500 P	1658.121	C I	KE74
50	1659.4860	Pt II	SRSA92
100 P	1661.478	Be I	KM97
400	1665.3513	Ag II	KLLT01
9	1665.755	Au I	BG78
900 P	1666.688	S I	KM93
300	1666.850	B I	BTG74
500	1667.272	B I	BTG74
200	1669.2312	Pt II	SRSA92
170	1669.876	Cr II	SKRR03
1000 P	1670.7886	Al II	GK00
500	1671.553	Pb II	KT96
150	1672.738	Cr II	SKRR03
800 P	1674.591	P I	S80
200	1675.2052	Si I	RAKL67
200	1676.152	Cr II	SKRR03
20	1677.8443	Pt I	SRSA92
1000 P	1679.695	P I	S80
40	1681.661	Li II	HM59
120	1681.6840	Ne II	P71
500	1682.127	Pb II	KT96
300	1682.8353	Ag II	KLLT01
2	1683.412	Mg I	KM91a
50	1684.5867	Pt II	SRSA92
50	1684.5867	Pt II	SRSA92
800 P	1687.530	S I	KM93
200	1688.3553	Ne II	P71
7	1690.7825	Pt I	SRSA92
200	1696.2065	Si I	RAKL67
250	1697.9409	Si I	RAKL67
30	1698.4958	Pt II	SRSA92
20 P	1699.339	Au I	BG78
200 P	1702.07	I I	KC59
2	1707.061	Mg I	KM91a
80	1707.0710	Pt II	SRSA92
14 P,w	1711.1	In I	G54
40	1713.8364	Pt II	SRSA92
7	1714.4801	Pt I	SRSA92
80 r	1716.784	Ge I	KE74
800 P	1719.440	Al II	KM91b
500	1721.244	Al II	KM91b
900 P	1721.271	Al II	KM91b
150	1723.1314	Pt II	SRSA92
300	1723.6119	Ag II	KLLT01
500	1724.952	Al II	KM91b
900 P	1724.984	Al II	KM91b
600 P	1726.802	Pb II	KT96
50	1727.6799	Pt II	SRSA92
40	1734.852	Mg II	KM91a
90	1735.8642	Pt II	SRSA92
14	1737.1732	Pt I	SRSA92
50	1737.628	Mg II	KM91a
600	1740.475	Au II	RW97
150 P	1741.547	Ni II	S70
200 P	1742.729	N I	M75a
10	1744.4305	Pt I	SRSA92
150	1745.252	N I	M75a
3	1747.794	Mg I	KM91a
80	1750.043	Ge I	KE74
40	1750.663	Mg II	KM91a

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500 P	1751.827	C I	KE74
180	1752.585	Cr II	SKRR03
50	1753.474	Mg II	KM91a
120	1753.8286	Pt II	SRSA92
120	1753.8286	Pt II	SRSA92
50	1755.332	Li II	HM59
14 P,w	1757.3	In I	G54
60	1760.50	Rb II	R75
180	1760.747	Cr II	SKRR03
30	1762.899	Al I	KM91b
500	1763.869	Al II	KM91b
700 P	1763.952	Al II	KM91b
14	1764.5948	Pt I	SRSA92
50	1765.636	Al I	KM91b
300	1765.815	Al II	KM91b
25	1766.0328	Pt II	SRSA92
50	1766.385	Al I	KM91b
120	1767.1612	Pt II	SRSA92
150	1767.457	Cr II	SKRR03
400	1767.731	Al II	KM91b
50	1769.140	Al I	KM91b
300	1770.9223	Si I	RAKL67
80	1774.176	Ge I	KE74
1000 P	1774.951	P I	S80
200	1775.0160	Pt II	SRSA92
40	1776.5571	Pt I	SRSA92
50	1776.57	Na II	W71
800 P	1777.05	Bi II	WBBF01
600 P	1777.0866	Pt II	SRSA92
20	1777.2783	Pt I	SRSA92
250	1781.8617	Pt II	SRSA92
150 P	1782.76	I I	KC59
800 P	1782.838	P I	S80
600	1783.200	Au II	RW97
80	1785.046	Ge I	KE74
30	1785.8803	Pt II	SRSA92
P	1786.07	Rn I	R30
25	1786.6480	Pt I	SRSA92
40	1787.19	Na II	W71
600	1787.406	Bi II	WBBF01
700 P	1787.656	P I	S80
700 P	1791.842	Bi II	WBBF01
300 P,r	1792.827	Tl II	JKBL96
300	1795.28	Se I	RG34
400	1796.669	Pb II	KT96
40	1798.41	Na II	W71
70	1799.09	I I	KC59
20	1802.9398	Pt I	SRSA92
50	1807.09	Na II	W71
1000 P	1807.311	S I	KM93
30	1808.01288	Si II	GK00
300	1811.201	Sn II	B64
20	1812.8819	Pt I	SRSA92
800 P	1813.878	Ga II	IL85
250	1814.0794	Si I	RAKL67
400 P,r	1814.776	Tl II	JKBL96
700	1814.964	Sb II	AJK89
40	1816.9290	Si II	KE74
300	1817.843	B I	BTG74
15	1817.8736	Pt I	SRSA92
500	1818.348	B I	BTG74
900 P	1820.343	S I	KM93
1000 P	1822.052	Pb II	KT96
500 P	1822.155	Te I	MV75
700 P	1823.728	Bi II	WBBF01
8	1825.3262	Pt I	SRSA92
800 P	1825.894	B I	EL01
13	1826.1377	Pt I	SRSA92
800 P	1826.245	S I	KM93
1000 P	1826.400	B I	EL01
5	1827.934	Mg I	KM91a
600	1828.588	Al II	KM91b
1000 P	1830.38	I I	KC59
25	1833.3875	Pt II	SRSA92
40	1835.0745	Pt II	SRSA92
40	1835.22	Na II	W71
80	1836.5075	Pt II	SRSA92
200	1836.5102	Si I	RAKL67
30	1838.8246	Pt II	SRSA92
80	1839.5258	Pt II	SRSA92
250	1840.061	Ca II	ER56
1	1840.50	Cs II	S81
80 h	1841.328	Ge I	KE74
400	1841.4490	Si I	RAKL67
80 h	1842.410	Ge I	KE74
500 P	1842.820	B II	LZJK98
200	1843.7700	Si I	RAKL67
200 P	1844.45	I I	KC59
900 P	1845.199	Ga II	IL85
200	1845.5203	Si I	RAKL67
25	1845.7517	Pt I	SRSA92
200	1846.1118	Si I	RAKL67
300	1847.4737	Si I	RAKL67
200	1848.1504	Si I	RAKL67
250	1848.7480	Si I	RAKL67
1000 P	1849.499	Hg I	WA63
13	1849.6831	Pt I	SRSA92
400 P	1850.6719	Si I	RAKL67
250	1852.4717	Si I	RAKL67
80	1853.134	Ge I	KE74
40	1853.17	Na II	W71
9	1853.4523	Pt I	SRSA92
40	1853.4523	Pt II	SRSA92
300	1855.20	Se I	RG34
500 P	1857.296	Te I	MV75
700 P	1858.026	Al II	KM91b
600	1858.886	P I	S80
1	1859.16	Cs II	S81
400	1859.393	P I	S80
200 r	1860.086	Ge I	KE74
140	1860.330	Sn I	B64
1000 P	1862.311	Al II	KM91b
80	1867.1302	Pt II	SRSA92
90	1870.4100	Pt II	SRSA92
30	1871.1038	Pt II	SRSA92
400 P,r	1871.154	Sb I	SM02
120 r	1874.256	Ge I	KE74
200	1874.8423	Si I	RAKL67
600 P	1875.564	Ru II	CHR88a
70	1879.1031	Pt II	SRSA92

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
9	1879.829	Au I	BG78
700	1881.121	Tl II	JKBL96
90	1881.91	Na II	W71
200	1882.568	Sb I	SM02
600 P	1883.0587	Pt II	SRSA92
1	1883.93	Cs II	S81
30	1885.8171	Pt II	SRSA92
600 P	1888.043	Ru II	JJLL94
100	1888.1064	Ne II	P71
140	1889.5226	Pt II	SRSA92
100	1889.7120	Ne II	P71
700 P,r	1890.43	As I	HA85
30	1895.0088	Pt II	SRSA92
30	1897.5769	Pt II	SRSA92
40	1898.1722	Pt II	SRSA92
400	1898.55	Se I	RG34
30	1899.0445	Pt II	SRSA92
300 P	1899.881	Sn II	B64
200	1900.286	S I	KM93
400 P	1901.3377	Si I	RAKL67
1000 P	1902.341	Bi II	WBBF01
15	1903.2186	Pt I	SRSA92
600 P	1903.221	Ru II	JJLL94
200 r	1904.702	Ge I	KE74
200	1907.4940	Ne II	P71
800 P,r	1908.617	Tl II	JKBL96
400 P	1911.7092	Pt II	SRSA92
400	1913.79	Se I	RG34
100	1914.698	S I	KM93
8	1915.10	Mn II	IV64
500 P	1916.0818	Ne II	P71
250 P	1916.816	Ru II	JJLL94
120 r	1917.592	Ge I	KE74
300	1919.19	Se I	RG34
7	1921.250	Mn II	IV64
300	1922.23	Cd II	SP49
40	1928.4320	Pt II	SRSA92
250 P	1929.2449	Pt II	SRSA92
40	1929.6829	Pt II	SRSA92
200 r	1929.826	Ge I	KE74
300 P	1930.0345	Ne II	P71
1000 P	1930.906	C I	KE74
50	1934.3690	Pt I	SRSA92
1	1935.19	Cs II	S81
6 P	1936.217	In II	B69
100	1937.4245	Pt I	SRSA92
400 P,r	1937.59	As I	HA85
500 P	1938.008	Ge II	KE74
200	1938.8269	Ne II	P71
500 P	1938.891	Ge II	KE74
250 P	1939.043	Ru II	JJLL94
250 P	1939.505	Ru II	JJLL94
130 l	1939.8110	Pt II	SRSA92
20	1940.0319	Pt I	SRSA92
1000 P	1942.273	Hg II	SR01
150	1944.4617	Pt II	SRSA92
80	1944.731	Ge I	KE74
100 c	1945.4521	Ne II	P71
40	1949.9102	Pt II	SRSA92
300 r	1950.393	Sb I	SM02

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1000 P	1951.051	W II	EKM00
300 P	1954.706	Bi I	WBBF01
30	1954.7436	Pt II	SRSA92
80	1955.115	Ge I	KE74
250 P	1960.049	Bi I	WBBF01
600 P	1960.894	Se I	LP77
200	1962.013	Ge I	KE74
900 P	1962.140	W II	EKM00
11	1963.1429	Pt I	SRSA92
50 c	1964.59	Be I	KM97
6 P	1966.711	In II	B69
13	1969.6807	Pt I	SRSA92
140	1970.769	Co I	PT96
80	1970.880	Ge I	KE74
30	1971.5374	Pt I	SRSA92
200 P,r	1972.62	As I	HA85
800 P,c	1973.1340	Re II	WJLG97
15	1973.794	Hg II	SR01
11 P	1977.359	In II	B69
600	1977.524	W II	EKM00
400 P	1977.5978	Si I	RAKL67
50	1978.8444	Pt II	SRSA92
400 P	1979.2056	Si I	RAKL67
25	1979.7647	Pt I	SRSA92
300 P	1979.956	Cu II	R69
300 P	1980.6185	Si I	RAKL67
600	1982.907	W II	EKM00
300 P	1983.2330	Si I	RAKL67
40	1983.7486	Pt II	SRSA92
500 P	1986.3640	Si I	RAKL67
9	1987.7868	Pt I	SRSA92
10	1987.841	Hg II	SR01
120 h	1987.849	Ge I	KE74
120 P	1988.267	Ge I	KE74
1000 P	1988.9937	Si I	RAKL67
15	1989.1056	Pt I	SRSA92
900 P	1989.394	W II	EKM00
700	1990.531	Al II	KM91b
80	1990.5751	Pt II	SRSA92
500	1990.863	W II	EKM00
8	1991.5830	Pt I	SRSA92
300	1994.3173	Ag II	KLLT01
500 P	1994.839	Te I	MV75
150 P	1995.111	Se I	LP77
200	1995.43	Cd II	SP49
11	1995.8991	Pt I	SRSA92
400 P	1996.056	Mn I	CMG64
60 c	1998.01	Be I	KM97
200 r	1998.887	Ge I	KE74
500 P	1999.511	Mn I	CMG64
	Air		
150 P	1999.698	Cu II	R69
150	2000.792	Au II	RW97
300	2001.45	Os I	MCS75
400 P	2001.712	W II	EKM00
1000 P	2002.028	Te I	MV75
200 P,r	2003.35	As I	HA85
500 P	2003.53	Re I	MCS75
400	2003.73	Os I	MCS75
700 P	2003.849	Mn I	CMG64

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
300	2004.81	Os I	MCS75
80	2007.009	Ne II	P71
5 r	2007.56	Tl I	C52
140	2007.7572	Pt II	SRSA92
800 P	2008.095	W II	EKM00
300 P	2009.982	W II	EKM00
600	2010.15	Os I	MCS75
250	2010.236	W II	EKM00
600	2010.65	Ir I	MCS75
80	2011.29	Ge I	AM59
1000 P	2012.00	Au I	MCS75
700 P	2012.78	Hf II	MCS75
250	2014.238	W II	EKM00
200	2014.9330	Pt II	SRSA92
500 P	2015.109	Mo II	SPNL01
300 P	2017.87	Re I	MCS75
1000 P	2018.14	Os I	MCS75
700 P	2019.068	Ge I	AM59
1000	2020.26	Os	MCS75
1000 P	2020.314	Mo II	SPNL01
9	2020.5434	Pt I	SRSA92
250 P	2021.149	Bi I	WBBF01
250 P	2021.38	Au I	MCS75
200 P	2022.016	Pb I	WA68
500	2022.35	Ir I	MCS75
500	2022.76	Os I	MCS75
1000 P	2025.4845	Zn II	GL00
80	2025.560	Ne II	P71
2 P	2025.824	Mg I	KM91a
500 P	2026.088	W II	EKM00
20	2026.860	Hg II	SR01
1000 P	2028.18	Hf II	MCS75
500	2028.23	Os I	MCS75
1000 P	2029.3423	Nb II	RCL00
900 P	2029.995	W II	EKM00
20	2030.6456	Pt I	SRSA92
30	2032.4256	Pt I	SRSA92
200	2032.432	P I	S80
900 P	2033.0102	Nb II	RCL00
300	2033.477	P I	S80
900 P	2033.57	Ir I	MCS75
600 P	2034.44	Os I	MCS75
150	2035.043	W II	EKM00
7	2035.7985	Pt I	SRSA92
200 P	2035.854	Cu II	R69
250 P	2036.4666	Pt II	SRSA92
150 P	2037.127	Cu II	R69
500 P	2038.452	Mo II	SPNL01
30 r	2039.792	Sb I	SM02
600 P	2039.842	Se I	LP77
150	2041.5751	Pt II	SRSA92
900 P,r	2041.712	Ge I	AM59
600 P,r	2043.770	Ge I	AM59
250 P	2043.802	Cu II	R69
150	2044.587	Au II	RW97
900 P	2045.36	Os I	MCS75
400 P	2045.973	Mo II	SPNL01
500 P	2049.08	Re I	MCS75
30	2049.1689	Pt II	SRSA92
60	2049.3915	Pt I	SRSA92
60 P,r	2049.577	Sb I	SM02
300	2049.636	W II	EKM00
400	2052.22	Ir I	MCS75
400 P	2052.828	Hg II	SR01
200 P	2053.284	Pb I	WA68
150	2054.461	Ge I	AM59
100	2054.734	Sb II	AJK89
1000 P	2055.59	Cr II	K51
50	2056.012	Be I	KM97
100	2057.0265	Pt II	SRSA92
80 h	2057.238	Ge I	AM59
600 P	2058.1323	Si I	KRA66
300*	2058.69	Os I	MCS75
300*	2058.78	Os I	MCS75
300	2060.64	Ir I	MCS75
9	2060.7621	Pt I	SRSA92
20	2061.162	Ag I	PZ01
700 P	2061.54	Cr II	K51
25 P	2061.63	I I	KC59
300 P	2061.634	Bi I	WBBF01
400	2061.69	Os I	MCS75
1000 P	2062.0011	Zn II	GL00
400 P	2062.779	Se I	LP77
15	2062.7943	Pt I	SRSA92
400 P	2064.2266	Zn II	GL00
300 r	2065.215	Ge I	AM59
500 P	2065.46	Cr II	K51
140	2065.573	W II	EKM00
200	2066.364	B I	GV72,GM62
200	2066.646	B I	GV72,GM62
250	2067.186	B I	GV72,GM62
1000 P	2067.21	Os II	MCS75
20	2067.5105	Pt I	SRSA92
400 P,r	2068.344	Sb I	SM02
1000 P,r	2068.656	Ge I	AM59
20	2068.92	Rb II	R75
400 h	2068.937	Bi II	WBBF01
9	2069.844	Ag I	PZ01
500 P	2070.67	Os II	MCS75
8	2070.9443	Pt I	SRSA92
8	2070.9443	Pt I	SRSA92
200	2071.208	W II	EKM00
11	2071.50	Rb II	R75
20	2072.016	Si II	S61b
30	2072.701	Si II	S61b
80 P	2074.70	Re I	MCS75
600 P	2074.784	Se I	LP77
80	2075.4004	Pt II	SRSA92
140	2075.590	W II	EKM00
110	2075.95	Rb II	R75
200	2076.43	Ru I	K59
250	2076.95	Os I	MCS75
250	2078.09	Os	MCS75
14 P	2078.608	In II	SM02
600 P	2079.118	W II	EKM00
600 P	2079.120	W II	EKM00
500 P	2079.97	Os I	MCS75
250 P	2081.172	Te I	MV75
120 P	2081.681	Mo II	SPNL01
400 P	2082.077	Au II	RW97

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
100	2082.54	Os I	MCS75
200	2083.22	Ir I	MCS75
250	2083.78	Ru I	K59
50	2084.5960	Pt I	SRSA92
150	2085.466	Ne II	P71
200 P	2085.59	Re I	MCS75
200	2085.74	Ir I	MCS75
150	2086.021	Ge I	AM59
200	2088.204	W II	EKM00
1000 P	2088.82	Ir I	MCS75
400 P	2088.889	B I	JLKK93
100	2089.03	Os I	MCS75
140	2089.156	W II	EKM00
100	2089.21	Os I	MCS75
60 P	2089.52	Mo II	MCS75
500 P	2089.570	B I	JLKK93
200	2090.22	Ru I	K59
11	2090.29	Rb II	R75
200	2090.48	W I	MCS75
1000 P	2090.771	Ga II	IL85
200 P	2091.590	Sn I	B64
60	2092.159	Mn I	CMG64
60 P	2092.50	Mo II	MCS75
800	2092.63	Ir I	MCS75
100 P	2093.11	Mo II	MCS75
800 P,r	2094.258	Ge I	AM59
700	2094.264	Al II	KM91b
400 P	2094.751	W II	EKM00
200	2096.106	Ne II	P71
140	2096.18	Hf II	MCS75
120	2096.248	Ne II	P71
200 P	2097.12	Re I	MCS75
200	2097.4478	Pt II	SRSA92
200	2097.60	Os I	MCS75
20 r	2098.424	Sb I	SM02
150	2098.602	W II	EKM00
1000 P	2099.9273	Zn II	GL00
200	2100.63	Os I	MCS75
140	2100.675	W II	EKM00
70 P	2100.84	Mo II	MCS75
150	2101.54	W I	MCS75
50	2101.5979	Pt II	SRSA92
10	2101.6839	Pt I	SRSA92
10	2101.6839	Pt I	SRSA92
200	2102.1661	Zn II	GL00
70	2103.3449	Pt I	SRSA92
30	2103.7804	Pt II	SRSA92
30	2103.7804	Pt II	SRSA92
40	2104.29	Mo II	MCS75
90	2105.824	Ge I	AM59
90	2106.187	W II	EKM00
40	2108.02	Mo II	MCS75
50	2109.22	Re I	MCS75
600 P	2109.4384	Nb II	RCL00
60	2109.585	Mn I	CMG64
8	2109.6631	Pt I	SRSA92
200 P	2110.217	Bi I	WBBF01
80	2110.323	W II	EKM00
500 P	2110.685	Au II	RW97
150	2112.68	Ir I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
300 P,r	2113.8250	Ag II	KLLT01
60	2115.5823	Pt II	SRSA92
140 P	2116.67	Yb II	M67
70	2117.66	Os I	MCS75
150	2117.96	Os I	MCS75
130	2118.874	W II	EKM00
250	2119.79	Os	MCS75
150	2121.576	W II	EKM00
70	2123.84	Os I	MCS75
500	2125.2164	Nb II	RCL00
11	2125.25	Rb II	R75
300	2126.5498	Nb II	RCL00
150 P	2126.74	Yb II	M67
800 P	2126.81	Ir II	KM78
80	2127.4231	Pt II	SRSA92
250	2127.94	Ir I	MCS75
25	2128.5878	Pt I	SRSA92
90	2128.6340	Pt I	SRSA92
60	2130.7079	Pt II	SRSA92
500	2131.1832	Nb II	RCL00
120	2133.600	Bi I	WBBF01
7	2135.1631	Pt I	SRSA92
200 P	2135.465	P I	S80
600 P	2135.981	Cu II	R69
400 P	2136.182	P I	S80
200	2137.11	Os I	MCS75
1000 P	2138.5735	Zn I	GL00
600 P	2139.04	Re II	MCS75
40 P,r	2139.698	Sb I	SM02
500	2140.13	Ta II	MCS75
250 P	2142.74	Re II	MCS75
700 P	2142.822	Te I	MV75
300	2143.83	Rb II	R75
130 u	2144.2123	Pt I	SRSA92
900 P	2144.2458	Pt II	SRSA92
1000 P,r	2144.408	Cd II	SP49
40 P,r	2144.841	Sb I	SM02
600 P	2146.87	Ta II	MCS75
120 P	2147.260	Te I	MV75
200	2148.22	Ir I	MCS75
400 P	2149.145	P I	S80
80	2149.97	Os	MCS75
150	2150.54	Ir I	MCS75
300	2150.62	Ta II	MCS75
80 P	2150.844	Sn II	B64
600 P	2152.68	Ir II	KM78
30 P	2152.84	Sr II	MCS75
150 P	2152.940	P I	S80
50	2153.558	W II	EKM00
300 P	2154.080	P I	S80
90	2154.59	Os I	MCS75
150	2155.81	Ir I	MCS75
70	2156.67	Re I	MCS75
50	2157.796	W II	EKM00
40	2157.84	Os I	MCS75
500 P	2158.05	Ir I	MCS75
40	2158.53	Os I	MCS75
14	2159.864	Te I	MV75
80	2161.00	Os	MCS75
20	2161.60	Yb II	M67

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
800 P	2162.25	At I	M64a
120	2162.88	Ir I	MCS75
600 P	2164.188	Se I	LP77
250	2165.01	Ta II	MCS75
130 P	2165.09	Cu I	S48
20	2165.2108	Pt I	SRSA92
150 P	2165.553	Ni II	S70
30 P	2165.96	Sr II	MCS75
90	2166.316	W II	EKM00
110	2166.90	Os I	MCS75
40	2167.75	Os I	MCS75
90 P	2167.94	Re I	MCS75
300	2169.096	Ni II	S70
1000 P	2169.42	Ir II	MCS75
150 P,r	2170.005	Pb I	WA68
100	2170.855	Sb II	AJK89
70	2171.65	Os I	MCS75
300 P	2174.666	Ni II	S70
200	2174.6853	Pt I	SRSA92
50 P,c	2174.986	Be I	KM97
60 P	2175.103	Be I	KM97
250	2175.147	Ni II	S70
250	2175.24	Ir I	MCS75
600 P,r	2175.818	Sb I	SM02
60	2176.21	Re I	MCS75
300	2178.03	Ta II	MCS75
30	2178.0808	Fe I	NJLT94
150	2178.17	Ir I	MCS75
150 P	2178.94	Cu I	S48
100 P,r	2179.190	Sb I	SM02
500	2179.410	Cu II	R69
130	2180.473	Ni II	S70
11	2180.5042	Pt I	SRSA92
150 P	2181.72	Cu I	S48
500	2182.71	Ta II	MCS75
60	2182.90	W I	MCS75
130	2184.605	Ni II	S70
30	2184.68	Os I	MCS75
400 P	2185.504	Ni II	S70
50 P	2185.71	Yb II	M67
600 P	2186.930	Bi II	DLW02
300	2187.43	Ir II	MCS75
500	2189.630	Cu II	R69
200	2190.00	K II	D26
100	2190.3216	Pt II	SRSA92
200	2190.38	Ir II	MCS75
500 P	2192.090	Ni II	S70
600 P	2192.268	Cu II	R69
200	2193.20	Ta II	MCS75
200	2193.605	Co II	PRUJ98
500	2193.88	Ta II	MCS75
110 P	2194.39	Os II	MCS75
30	2194.528	W II	EKM00
1000	2194.557	Cd II	SP49
90 P,h	2195.54	Lu II	MCS75
600 P	2196.03	Ta II	MCS75
	2197.787	Ca II	ER56
130 P,r	2198.714	Ge I	AM59
200 P	2199.346	Sn I	B64
150	2199.58	Cu I	S48

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
600 P	2199.67	Ta II	MCS75
100	2201.409	Ni II	S70
30	2202.2230	Pt I	SRSA92
40	2202.4664	Pt II	SRSA92
500 P	2203.534	Pb II	WRSH74
80 P	2204.483	W II	EKM00
500 P	2204.96	Ir II	KM78
800 P	2205.548	Ni II	S70
700 P	2206.715	Ni II	S70
200	2207.14	Ta II	MCS75
400 P	2207.978	Si I	RA65
150	2208.09	Ir II	MCS75
120 P,r	2208.430	Sb I	SM02
	2208.611	Ca II	ER56
11	2208.806	Mn I	CMG64
40	2209.5043	Pt II	SRSA92
300 P	2209.660	Sn I	B64
600* P,d	2210.03	Ta II	MCS75
600* P	2210.19	Ta II	MCS75
500	2210.268	Cu II	R69
5 r	2210.71	Tl I	C52
60	2210.82	Hf II	MCS75
500 P	2210.894	Si I	RA65
300 P	2211.744	Si I	RA65
20	2213.855	Mn I	CMG64
400 h	2214.031	Bi II	DLW02
1000 P,c	2214.2749	Re II	WJLG97
40	2214.58	Re I	MCS75
150	2214.58	Cu I	S48
15	2215.630	Te I	MV75
1000 P	2216.482	Ni II	S70
500 P	2216.669	Si I	RA65
110	2217.08	Rb II	R75
400 P	2218.057	Si I	RA65
500 P	2218.108	Cu II	R69
80	2220.37	Ir I	MCS75
130	2220.402	Ni II	S70
30	2221.837	Mn I	CMG64
13	2222.6134	Pt I	SRSA92
150	2222.957	Ni II	S70
40 P	2224.46	Yb II	M67
20	2224.711	Hg II	SR01
120	2225.0094	Pt II	SRSA92
200 P	2225.70	Cu I	S48
30	2226.42	Re I	MCS75
150	2227.78	Cu I	S48
120 P	2228.203	Bi I	WBBF01
200	2228.915	Au II	RW97
250 P	2230.08	Cu I	S48
600 P	2230.602	Bi I	WBBF01
400 P	2231.5907	Pd II	LLJ94
40	2232.9725	Pt II	SRSA92
40	2234.61	Os I	MCS75
12	2234.9262	Pt I	SRSA92
15	2235.44	Re I	MCS75
600 P	2239.48	Ta II	MCS75
600 P	2240.8965	Pt II	SRSA92
40	2241.2288	Pt II	SRSA92
600	2242.618	Cu II	R69
400 P	2242.69	Ir II	KM78

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
25	2243.045	Y II	NJK91
300	2243.4485	Ag II	KLLT01
1000 P	2244.01	At I	M64a
250 P	2244.26	Cu I	S48
14	2244.9773	Pt I	SRSA92
400 P	2245.5244	Pt II	SRSA92
300 P	2246.057	Sn I	B64
700 P,r	2246.4120	Ag II	KLLT01
300 P	2246.5216	Pt II	SRSA92
700 P	2247.002	Cu II	R69
40	2247.4822	Pt II	SRSA92
400	2248.562	Au II	RW97
300 P,r	2248.7490	Ag II	KLLT01
30 P	2248.758	W II	EKM00
15	2249.3075	Pt I	SRSA92
60	2249.3075	Pt II	SRSA92
200	2249.79	Ta II	MCS75
50	2249.80	W I	MCS75
11	2249.8994	Pt I	SRSA92
500	2250.76	Ta II	MCS75
50	2251.5105	Pt II	SRSA92
30	2251.8084	Pt II	SRSA92
40	2252.15	Os I	MCS75
10	2252.786	Hg II	SR01
120	2253.38	Ir I	MCS75
40	2254.01	Hf II	MCS75
120	2255.10	Ir I	MCS75
5	2255.507	Te I	MV75
60	2255.53	Ru I	K59
8	2255.73	Re I	MCS75
80	2255.81	Ir I	MCS75
250 P	2255.85	Os II	MCS75
15	2256.19	Re I	MCS75
200	2256.745	Co II	PRUJ98
90	2256.76	La II	MCS75
200	2258.71	Ta II	MCS75
80	2258.86	Ir I	MCS75
20 P	2259.034	Te I	MV75
30	2259.5103	Fe I	NJLT94
60	2260.294	Hg II	SR01
400	2261.42	Ta II	MCS75
400 P	2262.223	Hg II	SR01
400	2262.30	Ta II	MCS75
120 r	2262.483	Sb I	SM02
600 P	2262.7185	Pt II	SRSA92
200	2263.08	Cu I	S48
700 P	2263.627	Au II	RW97
10	2263.634	Hg II	SR01
50	2263.8611	Pt II	SRSA92
40	2264.39	Re I	MCS75
150	2264.461	Ni II	S70
50	2264.60	Os I	MCS75
50	2264.61	Ir I	MCS75
1000 P	2265.018	Cd II	SP49
5	2265.536	Te I	MV75
80 P	2266.016	Sn II	B64
60	2266.33	Ir I	MCS75
15	2267.65	Cs II	S81
15	2268.8384	Pt I	SRSA92
60	2268.90	Ir I	MCS75
300 P	2268.930	Sn I	B64
40 P	2269.096	Al I	KM91b
20	2269.69	Mo II	MCS75
30	2270.17	Os I	MCS75
300 P	2270.214	Ni II	S70
40	2271.6194	Pt II	SRSA92
300	2271.85	Ta II	MCS75
70	2272.091	Ru I	K59
400	2272.59	Ta II	MCS75
8	2273.84	Cs II	S81
50	2274.3816	Pt I	SRSA92
40	2274.62	Re I	MCS75
12	2274.8409	Pt I	SRSA92
900 P,c	2275.2532	Re II	WJLG97
120	2275.462	Ca I	R68
70	2277.16	Hf II	MCS75
130	2277.282	Ni II	S70
60	2277.58	W I	MCS75
130	2278.770	Ni II	S70
70	2279.582	Ru I	K59
80	2279.85	Ta I	MCS75
25	2279.967	Ti I	F91
300 P	2279.9812	Ag II	KLLT01
150 P	2281.02	Ir II	MCS75
70	2281.1942	Pt II	SRSA92
30	2281.62	Re I	MCS75
200 P	2282.26	Os II	MCS75
200	2283.522	Co II	PRUJ98
30	2283.67	Os I	MCS75
300	2285.25	Ta II	MCS75
1000 P	2286.159	Co II	PRUJ98
40	2286.4390	Pt II	SRSA92
250	2286.59	Ta II	MCS75
300	2286.681	Sn I	B64
60	2287.3643	Pt II	SRSA92
50	2287.51	Re I	MCS75
800 P,r	2288.022	Cd I	BA56
50 P,r	2288.12	As I	HA85
400 P	2288.2050	Pt II	SRSA92
400	2289.16	Ta II	MCS75
15	2289.2765	Pt I	SRSA92
200	2289.987	Ni I	LBT93
60	2291.71	Rb II	R75
200	2291.991	Co II	PRUJ98
60	2292.3987	Pt I	SRSA92
30	2292.5249	Fe I	NJLT94
300	2293.390	Co II	PRUJ98
250	2293.84	Cu I	S48
60 d	2294.49	W I	MCS75
50	2294.49	Re I	MCS75
110	2295.6800	Nb II	RCL00
700 P	2296.5164	Pd II	LLJ94
50	2298.05	Ir I	MCS75
1000 P	2298.058	Tl II	JKBL96
60	2298.09	Re II	MCS75
60	2298.1689	Fe I	NJLT94
7	2299.77	Re I	MCS75
30	2300.1418	Fe I	NJLT94
50	2300.50	Ir I	MCS75
80	2300.781	Ni I	LBT93

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
300	2301.403	Co II	PRUJ98
30	2302.3068	Pt II	SRSA92
11	2302.99	Re I	MCS75
150	2302.996	Ni II	S70
150	2304.22	Ir I	MCS75
20 P	2304.247	Ba II	KL99
250	2304.684	Au II	RW97
25	2305.674	Ti I	F91
6 P,c	2306.046	In II	PC38,B69
120 r	2306.507	Sb I	SM02
12	2306.54	Re I	MCS75
1	2306.86	In I	P38
800 P	2307.860	Co II	PRUJ98
25	2308.0437	Pt I	SRSA92
25	2308.31	Os I	MCS75
50	2308.93	Ir I	MCS75
120	2309.010	Co I	PT96
250 P	2310.961	Ni I	LBT93
500 P	2310.9626	Pt II	SRSA92
1000 P,r	2311.463	Sb I	SM02
500 P	2311.604	Co II	PRUJ98
200	2312.344	Ni I	LBT93
1000 P	2312.766	Cd II	SP49
50	2313.17	W I	MCS75
150	2313.656	Ni I	LBT93
25	2313.75	Os II	MCS75
150	2313.983	Ni I	LBT93
500 P	2314.056	Co II	PRUJ98
300	2314.975	Co II	PRUJ98
9	2315.5024	Pt I	SRSA92
150	2315.65	Na II	W71
7	2315.98	Tl I	MCS75
150 P	2316.039	Ni II	S70
200	2317.0342	Ag II	KLLT01
200	2317.070	Co II	PRUJ98
150	2317.165	Ni I	LBT93
400	2317.230	Sn I	B64
500 h	2317.30	Br II	R58
40	2317.784	Ru I	K59
40	2318.2969	Pt I	SRSA92
30	2319.8869	Pt II	SRSA92
300 P	2320.034	Ni I	LBT93
400 P,r	2320.2451	Ag II	KLLT01
8	2320.81	Yb II	M67
200	2321.074	Cd II	SP49
250	2321.383	Ni I	LBT93
50	2321.63	W I	MCS75
70	2322.47	Hf II	MCS75
15	2322.49	Re I	MCS75
40	2322.58	Rh I	MCS75
110	2323.145	Co I	PT96
40	2323.25	Hf II	MCS75
300	2324.321	Co II	PRUJ98
300 P,r	2324.6670	Ag II	KLLT01
40	2324.89	Hf II	MCS75
150	2325.802	Ni I	LBT93
200	2326.100	Co II	PRUJ98
30	2326.3386	Pt II	SRSA92
500	2326.473	Co II	PRUJ98
60	2327.3958	Fe II	NLTH91

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
10	2329.836	Li II	HM59
110	2329.970	Ni I	LBT93
60	2331.3084	Fe II	NLTH91
500 P,r	2331.3665	Ag II	KLLT01
300	2331.98	Ta II	MCS75
250	2332.19	Ta II	MCS75
14	2332.46	Cs II	S81
200	2332.7990	Fe II	NLTH91
30	2333.30	Ir I	MCS75
20	2333.39	Rb II	R75
40	2333.84	Ir I	MCS75
30	2334.50	Ir I	MCS75
800 P	2334.77	Rh II	S58
400	2334.812	Sn I	B64
30 P	2335.267	Ba II	KL99
90 P	2336.80	Os II	MCS75
60	2337.488	Ni I	LBT93
120	2338.0065	Fe II	NLTH91
30	2339.0741	Pt II	SRSA92
14	2340.1805	Pt I	SRSA92
90	2343.18	Ir I	MCS75
400 P	2343.4951	Fe II	NLTH91
40	2343.61	Ir I	MCS75
50	2343.9610	Fe II	NLTH91
90	2344.2816	Fe II	NLTH91
15	2344.78	Re I	MCS75
150 P	2345.543	Ni I	LBT93
200 P	2347.399	Co II	PRUJ98
40	2347.44	Hf II	MCS75
50	2347.514	Ni I	LBT93
120	2348.1159	Fe II	NLTH91
150	2348.3025	Fe II	NLTH91
1000 P	2348.610	Be I	KM97
100 P,r	2349.84	As I	HA85
30	2350.23	Os II	MCS75
60	2350.703	Be I	KM97
300 P	2350.829	Be I	KM97
60	2351.22	Hf II	MCS75
400 P	2351.3469	Pd II	LLJ94
12	2352.07	Re I	MCS75
15	2352.65	Au I	MCS75
90	2353.368	Co I	PT96
200 P	2353.422	Co II	PRUJ98
700 P	2354.850	Sn I	B64
30	2355.00	Ir I	MCS75
15	2355.28	Os II	MCS75
40	2357.1047	Pt I	SRSA92
100	2357.30	Ta I	MCS75
200 P	2357.916	Ru II	JJLL94
120	2359.1322	Fe II	NLTH91
90	2359.9997	Fe II	NLTH91
70	2360.2945	Fe II	NLTH91
70	2360.44	W I	MCS75
800	2360.5341	Pd II	LLJ94
100	2361.09	Ta I	MCS75
30	2361.92	Rh I	MCS75
30	2362.77	Os I	MCS75
150	2363.04	Ir I	MCS75
100	2363.07	W I	MCS75
500 P	2363.800	Co II	PRUJ98

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	2363.8612	Fe II	NLTH91
250	2364.24	Ta II	MCS75
120	2364.8281	Fe II	NLTH91
50	2365.7654	Fe II	NLTH91
20	2365.90	Re I	MCS75
30	2366.3729	Pt II	SRSA92
50 P	2367.052	Al I	KM91b
60 P	2367.35	Os II	MCS75
10	2367.68	Re I	MCS75
300 P	2367.9664	Pd II	LLJ94
60 P	2368.04	Ir II	KM78
80 P	2368.226	Sn II	B64
14	2368.2781	Pt I	SRSA92
600 P	2368.384	Bi II	DLW02
50	2368.5964	Fe II	NLTH91
9	2369.27	Re I	MCS75
50	2369.9534	Fe II	NLTH91
40	2370.76	Re II	MCS75
70 P,r	2370.77	As I	HA85
120	2371.58	Ta I	MCS75
200 P	2372.77	Ir I	MCS75
100	2373.06	Te II	HM64
90 P	2373.124	Al I	KM91b
40	2373.6245	Fe I	NJLT94
150 h	2373.631	Sb I	SM02
60	2373.7357	Fe II	NLTH91
60	2374.47	W I	MCS75
12	2375.06	Os II	MCS75
50	2375.09	Ir II	MCS75
40	2375.1940	Fe II	NLTH91
150	2375.418	Ni II	S70
70	2376.4294	Fe II	NLTH91
90	2377.03	Os I	MCS75
60	2377.2773	Pt II	SRSA92
400 P	2378.626	Co II	PRUJ98
50	2379.2765	Fe II	NLTH91
30	2379.39	Os I	MCS75
40 P,h	2379.69	Tl I	MCS75
70	2380.7616	Fe II	NLTH91
10	2381.538	Li II	HM59
30	2381.62	Ir I	MCS75
200	2381.765	Co II	PRUJ98
1000 P	2382.0376	Fe II	NLTH91
30	2382.89	Rh I	MCS75
20	2383.199	Li II	HM59
40	2383.2452	Fe II	NLTH91
50 P	2383.277	Te I	MV75
6	2383.303	Cr I	K53
25	2383.40	Rh I	MCS75
300 P	2383.459	Co II	PRUJ98
120 h	2383.616	Sb I	SM02
8	2383.6432	Pt I	SRSA92
80	2384.82	W I	MCS75
20	2385.34	Rb II	R75
7 c	2385.40	He II	GM65
60 P	2385.792	Te I	MV75
200 P	2386.370	Co II	PRUJ98
500	2386.70	Br II	R58
7	2386.8089	Pt I	SRSA92
80	2386.89	Ir I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
600 P	2387.06	Ta II	MCS75
60	2387.29	Os I	MCS75
11	2387.75	Au I	MCS75
200	2388.6289	Fe II	NLTH91
500 P	2388.917	Co II	PRUJ98
400	2388.96	Br II	R58
25	2389.5358	Pt I	SRSA92
2	2389.54	In I	P38
500	2389.69	Br II	R58
150	2390.62	Ir I	MCS75
9	2390.74	Yb II	M67
150	2391.18	Ir I	MCS75
250	2392.63	Cu I	S48
10	2392.86	Cs II	S81
50	2393.36	Hf II	MCS75
50 P,r	2393.792	Pb I	WA68
80	2393.83	Hf II	MCS75
150	2394.519	Ni II	S70
200 P	2395.048	B II	O70
700 P	2395.6254	Fe II	NLTH91
40	2395.88	Os I	MCS75
50	2397.107	W II	EKM00
200	2397.386	Co II	PRUJ98
70	2397.73	W I	MCS75
70	2397.98	W I	MCS75
200	2399.2413	Fe II	NLTH91
1000 P	2400.63	Ta II	MCS75
30	2401.13	Os I	MCS75
20 r	2401.940	Pb I	WA68
15	2402.331	Li II	HM59
1000 P	2402.72	Ru II	MCS75
11	2403.0918	Pt I	SRSA92
200	2404.172	Co II	PRUJ98
500 P	2404.8858	Fe II	NLTH91
25	2405.06	Re I	MCS75
12	2405.08	Os II	MCS75
60	2405.42	Hf II	MCS75
200 d	2405.58	W I	MCS75
13	2405.60	Re I	MCS75
40	2405.7269	Pt II	SRSA92
150	2406.66	Cu I	S48
150	2406.6612	Fe II	NLTH91
50	2406.9761	Fe II	NLTH91
250 P	2407.256	Co I	PT96
7	2408.60	Cr I	K53
40	2410.14	Hf II	MCS75
200	2410.5192	Fe II	NLTH91
10	2410.842	Li II	HM59
120	2411.0677	Fe II	NLTH91
250 P	2411.624	Co I	PT96
4 r	2411.734	Pb I	WA68
1000 P,r	2413.1883	Ag II	KLLT01
30	2413.31	Ir I	MCS75
90	2413.3104	Fe II	NLTH91
700 P	2413.535	Se I	LP77
250	2414.464	Co I	PT96
250	2415.290	Co I	PT96
70	2415.68	W I	MCS75
300 P	2415.84	Rh II	S58
300	2416.134	Ni II	S70

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
300	2417.659	Co II	PRUJ98
40	2417.69	Hf II	MCS75
50	2417.8707	Fe II	NLTH91
10	2418.0583	Pt I	SRSA92
40	2418.11	Ir I	MCS75
20	2419.81	Re I	MCS75
12	2420.02	Os II	MCS75
2	2420.456	Ar II	N73
40	2420.8161	Pt II	SRSA92
150	2420.99	Na II	W71
600 P	2421.694	Sn I	B64
40	2422.186	Y II	NJK91
40	2422.6882	Fe II	NLTH91
25	2423.07	Os II	MCS75
90	2424.1456	Fe II	NLTH91
100	2424.21	W I	MCS75
150	2424.73	Na II	W71
150	2424.8672	Pt II	SRSA92
200 P	2424.935	Co I	PT96
50	2424.97	Os I	MCS75
30	2426.53	Ir II	MCS75
30	2427.61	Ir I	MCS75
140	2427.64	Ta I	MCS75
250 P	2427.95	Au I	MCS75
70	2428.3638	Fe II	NLTH91
50	2428.58	Re I	MCS75
700 P	2429.495	Sn I	B64
25	2429.52	Rh I	MCS75
10	2429.814	Li II	HM59
70	2430.0783	Fe II	NLTH91
70	2431.08	W I	MCS75
30	2431.24	Ir I	MCS75
9	2431.54	Re I	MCS75
80	2431.94	Ir I	MCS75
8	2432.18	Re I	MCS75
150	2432.213	Co I	PT96
50	2432.2612	Fe II	NLTH91
200	2432.70	Ta II	MCS75
40	2432.8732	Fe II	NLTH91
25	2433.3064	Pt II	SRSA92
70	2433.98	W I	MCS75
40	2434.4610	Pt II	SRSA92
300	2435.154	Si I	RA65
200	2435.96	W I	MCS75
140	2436.662	Co I	PT96
25	2436.6887	Pt I	SRSA92
1000 P,r	2437.7832	Ag II	KLLT01
250	2438.69	Te II	HM64
110	2439.040	Co I	PT96
90	2439.3014	Fe II	NLTH91
110	2440.0608	Pt I	SRSA92
40	2440.34	Rh I	MCS75
100 P	2441.64	Cu I	S48
200	2442.617	Co II	PRUJ98
40	2443.7100	Fe II	NLTH91
70	2444.06	W I	MCS75
60	2444.5154	Fe II	NLTH91
150 r	2445.502	Sb I	SM02
250	2445.538	O II	MKM93
60	2445.5732	Fe II	NLTH91
200	2446.017	Co II	PRUJ98
500 P	2446.1888	Pd II	LLJ94
11	2446.98	Re I	MCS75
50	2447.25	Hf II	MCS75
200	2447.711	Co II	PRUJ98
300 P	2447.9058	Pd I	ELLW98
25	2448.908	Sn II	B64
11	2449.71	Re I	MCS75
200	2450.002	Co II	PRUJ98
600 P,w	2450.08	Po I	C66a
150	2450.08	Ga I	MM52
80	2450.4390	Pt II	SRSA92
30	2450.74	Os I	MCS75
7 c	2450.9670	Pt I	SRSA92
50	2451.476	W II	EKM00
100	2452.00	W I	MCS75
50	2452.81	Ir I	MCS75
50	2454.72	W I	MCS75
14	2454.91	Os II	MCS75
70	2454.98	W I	MCS75
90	2455.51	W I	MCS75
250	2455.531	Ru II	JJ93
80	2455.61	Ir I	MCS75
30	2455.83	Re II	MCS75
200 P	2456.438	Ru II	JJLL94
400 P,r	2456.53	As I	HA85
90	2456.53	W I	MCS75
500 P	2456.57	Ru II	MCS75
150	2457.5891	Fe I	NJLT94
90	2458.7838	Fe II	NLTH91
130	2459.30	W I	MCS75
3	2460.08	In I	P38
40	2460.4404	Fe II	NLTH91
50	2460.49	Hf II	MCS75
400 P	2461.03	Rh II	S58
7	2461.20	Re I	MCS75
50	2461.2835	Fe II	NLTH91
60	2461.42	Os I	MCS75
130 c	2461.84	Re II	MCS75
60	2461.8610	Fe II	NLTH91
150	2462.6472	Fe I	NJLT94
1000 P	2462.764	Cm II	WHGC76
60	2462.79	W I	MCS75
50	2464.19	Hf II	MCS75
200	2464.199	Co II	PRUJ98
25 P	2464.50	Yb I	MT78
30 h	2464.77	Kr II	RCWM80
80	2465.1492	Fe I	NJLT94
40	2466.6713	Fe II	NLTH91
40	2466.8194	Fe II	NLTH91
150	2466.85	W I	MCS75
50	2467.30	Ir I	MCS75
50	2467.4003	Pt I	SRSA92
10	2467.4824	Pt I	SRSA92
30	2467.57	Re II	MCS75
2 h	2468.02	In I	P38
60	2468.8799	Fe I	NJLT94
14	2468.90	Os II	MCS75
250	2469.2517	Pd II	LLJ94
40	2469.5147	Fe II	NLTH91

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	2470.6694	Fe II	NLTH91
600	2472.20	Rb II	R75
80	2472.3320	Fe I	NJLT94
60	2472.51	W I	MCS75
100	2472.8713	Fe I	NJLT94
140	2474.15	W I	MCS75
250	2474.62	Ta I	MCS75
60	2474.8145	Fe I	NJLT94
200 P	2475.12	Ir I	MCS75
250 P	2476.4127	Pd I	ELLW98
30	2476.84	Os I	MCS75
200	2477.1279	Ag II	KLLT01
150	2478.316	Sb I	SM02
400 P	2478.561	C I	J66
40	2478.5722	Fe II	NLTH91
400 P	2478.93	Ru II	MCS75
40	2478.9449	Pt II	SRSA92
120	2479.7764	Fe I	NJLT94
100	2480.13	W I	MCS75
90	2480.13	Tm II	MCS75
60	2480.1577	Fe II	NLTH91
50	2480.96	W I	MCS75
120	2481.18	Ir I	MCS75
150	2481.44	W I	MCS75
60 d	2482.10	W I	MCS75
50	2482.1172	Fe II	NLTH91
60	2482.6577	Fe II	NLTH91
1000 P	2483.2708	Fe I	NJLT94
200	2483.410	Sn I	B64
30	2483.5334	Fe I	NJLT94
20	2483.92	Re I	MCS75
300	2483.94	Po I	C66a
100	2484.1875	Fe I	NJLT94
40	2484.2446	Fe II	NLTH91
70	2484.74	W I	MCS75
200	2484.95	Ta I	MCS75
7	2485.81	Re I	MCS75
70 P	2486.24	Os II	MCS75
80	2486.3728	Fe I	NJLT94
200	2486.441	Co II	PRUJ98
400 P	2486.5260	Pd II	LLJ94
60	2486.967	Sn II	B64
40	2486.9827	Pt II	SRSA92
200 P	2487.1685	Pt I	SRSA92
200 P	2487.1685	Pt I	SRSA92
20	2487.33	Re I	MCS75
50	2487.50	W I	MCS75
600 P	2488.1426	Fe I	NJLT94
250	2488.70	Ta II	MCS75
40	2488.8753	Pt II	SRSA92
700 P	2488.9146	Pd II	LLJ94
25	2489.231	W II	EKM00
50	2489.4833	Fe II	NLTH91
100	2489.7524	Fe I	NJLT94
25	2490.1265	Pt I	SRSA92
200	2490.46	Ta I	MCS75
300	2490.53	Po I	C66a
500 P	2490.6443	Fe I	NJLT94
400 P	2490.79	Rh II	S58
40	2490.8584	Fe II	NLTH91

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	2491.1550	Fe I	NJLT94
60	2491.3965	Fe II	NLTH91
200 P	2492.15	Cu I	S48
20	2492.48	Kr II	DHM33
300 h	2492.85	Pa II	BW92b
40	2493.08	Ir I	MCS75
600	2493.15	Na II	W71
60	2493.1846	Fe II	NLTH91
300 P	2493.2637	Fe II	NLTH91
100 P	2494.728	Be I	KM97
70	2495.26	W I	MCS75
140	2495.724	Sn I	B64
20	2495.8126	Pt I	SRSA92
8	2496.30	Cr I	K53
20	2496.38	Rb II	R75
60	2496.5337	Fe I	NJLT94
500 P	2496.769	B I	JLKK93
200	2496.77	Tc II	BMC67
800 P	2497.722	B I	JLKK93
90	2498.41	Os I	MCS75
200	2498.42	Ru II	MCS75
60	2498.4996	Pt I	SRSA92
200	2498.57	Ru II	MCS75
40	2498.6806	Pt II	SRSA92
400 P	2498.7769	Pd II	LLJ94
200	2498.821	Co II	PRUJ98
200	2500.19	Ga I	MM52
500	2500.54	Ge II	S63a
100	2501.1318	Fe I	NJLT94
300 P	2501.9945	Zn II	GL00
90 P	2502.35	Re II	MCS75
40	2502.3930	Fe II	NLTH91
250 P	2502.98	Ir I	MCS75
40	2503.8745	Fe II	NLTH91
10	2504.31	Cr I	K53
250	2504.45	Ta I	MCS75
40	2504.60	Re II	MCS75
80	2504.70	W I	MCS75
300	2505.7293	Pd II	LLJ94
50	2506.0935	Fe II	NLTH91
500	2506.464	Co II	PRUJ98
400 P	2506.897	Si I	RA65
15	2506.940	Li II	HM59
300 P	2507.01	Ru II	MCS75
250	2507.45	Ta I	MCS75
20	2507.782	V I	DA78
50	2507.9004	Fe I	NJLT94
7	2508.4973	Pt I	SRSA92
30	2508.785	Li II	HM59
30 c	2508.99	Re I	MCS75
150	2509.08	Tm II	MCS75
40	2509.70	Rh I	MCS75
100	2510.8350	Fe I	NJLT94
200	2511.160	Co II	PRUJ98
9 c	2511.20	He II	GM65
70	2511.7603	Fe II	NLTH91
8	2512.061	Yb II	M67
40	2512.3650	Fe I	NJLT94
30	2512.58	Ir II	MCS75
90	2512.65	Ta I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
70	2512.69	Hf II	MCS75
25	2512.87	Os I	MCS75
70	2513.03	Hf II	MCS75
80	2513.25	Os I	MCS75
70	2513.8885	Pt II	SRSA92
400 P	2514.316	Si I	RA65
25	2515.04	Os I	MCS75
300	2515.46	Na II	W71
40	2515.5770	Pt I	SRSA92
20	2515.75	Rh I	MCS75
500 P	2516.112	Si I	RA65
3	2516.789	Ar II	N73
100 P	2516.88	Hf II	MCS75
30	2517.6611	Fe I	NJLT94
80	2518.1018	Fe I	NJLT94
25	2518.44	Os I	MCS75
40	2519.0472	Fe II	NLTH91
400 P	2519.202	Si I	RA65
20	2519.51	Cr I	K53
20	2519.622	V I	DA78
500	2519.823	Co II	PRUJ98
10	2520.01	Re I	MCS75
500 P	2520.52	Rh II	S58
90	2521.32	W I	MCS75
200 P	2521.365	Co I	PT96
6	2521.37	In I	P38
10	2521.50	Re I	MCS75
400	2521.70	Br II	R58
400 P	2522.8494	Fe I	NJLT94
90	2523.41	W I	MCS75
400 P	2524.108	Si I	RA65
11	2524.24	Rb II	R75
50	2524.2925	Fe I	NJLT94
9	2524.3065	Pt I	SRSA92
200	2524.634	Co II	PRUJ98
300	2524.974	Co II	PRUJ98
120	2525.3879	Fe II	NLTH91
30	2525.586	Ti II	HJLW82
30	2526.221	V I	DA78
200	2526.2939	Fe II	NLTH91
500 d	2526.35	Ta I	MCS75
200	2527.4351	Fe I	NJLT94
50	2527.76	W I	MCS75
400 P	2528.509	Si I	RA65
800 P,r	2528.509	Sb I	SM02
500	2528.616	Co II	PRUJ98
80	2528.7336	Pt II	SRSA92
140	2528.970	Co I	PT96
80	2529.1350	Fe I	NJLT94
25	2529.871	Ti I	F91
200	2530.080	Co II	PRUJ98
20	2530.183	V I	DA78
5	2530.738	Te I	MV75
700 P	2530.740	Tl II	JKBL96
40	2531.19	Hf II	MCS75
300	2531.54	Na II	W71
250	2532.12	Ta II	MCS75
60	2533.13	Ir I	MCS75
400	2533.518	Au II	RW97
70	2533.6274	Fe II	NLTH91

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90	2533.64	W I	MCS75
200	2533.801	Co II	PRUJ98
400 P	2533.987	P I	M59
7	2534.221	Mn II	IV64
60	2534.4186	Fe II	NLTH91
60	2534.46	Ir I	MCS75
3	2534.709	Ar II	N73
70	2535.4856	Fe II	NLTH91
500 P	2535.606	P I	M59
40	2535.6069	Fe I	NJLT94
8	2535.658	Mn II	IV64
140	2535.966	Co I	PT96
1000 P,c	2536.517	Hg I	BAL50
40	2536.6726	Fe II	NLTH91
120	2536.80	Fe II	C74
30	2537.22	Ir I	MCS75
8	2537.919	Mn II	IV64
100 P	2538.00	Os II	MCS75
30	2538.46	Mo II	MCS75
15	2538.67	Yb II	M67
60	2538.7987	Fe II	NLTH91
60	2538.9094	Fe II	NLTH91
90	2538.99	Fe II	C74
30	2539.2067	Pt I	SRSA92
20	2539.487	Li II	HM59
10	2540.51	Re I	MCS75
120	2540.66	Fe II	C74
60	2540.9722	Fe I	NJLT94
50	2541.1010	Fe II	NLTH91
40	2541.8358	Fe II	NLTH91
25	2541.908	Ti I	F91
300	2541.953	Co II	PRUJ98
30	2542.02	Ir I	MCS75
30	2542.1013	Fe I	NJLT94
30	2542.51	Os I	MCS75
25	2542.67	Mo II	MCS75
1000 P	2543.23	Tc II	BMC67
40	2543.3781	Fe II	NLTH91
500 P	2543.97	Ir I	MCS75
13 d	2544.74	Re I	MCS75
120	2544.806	Nb II	RCL00
70	2545.34	W I	MCS75
40	2545.70	Rh I	MCS75
80	2545.9785	Fe I	NJLT94
50	2546.03	Ir I	MCS75
300	2546.549	Sn I	B64
50	2546.6701	Fe II	NLTH91
200	2546.739	Co II	PRUJ98
90	2546.80	Ta I	MCS75
140	2547.14	W I	MCS75
300	2547.98	Se I	RG34
11	2548.225	Mo I	WB88
60	2548.7442	Fe II	NLTH91
8	2548.750	Mn II	IV64
50	2549.0833	Fe II	NLTH91
50	2549.3947	Fe II	NLTH91
40	2549.4616	Fe II	NLTH91
8	2549.548	Cr I	K53
50	2549.56	Ru I	K59
60	2549.6133	Fe I	NJLT94

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	2550.02	K II	D26
40	2550.0274	Fe II	NLTH91
90	2550.38	W I	MCS75
30	2550.6832	Fe II	NLTH91
200 d	2551.07	Ta I	MCS75
300 P	2551.35	W I	MCS75
40	2551.40	Hf II	MCS75
10	2551.70	Li II	SO82
300	2551.8452	Pd II	LLJ94
100	2552.350	Sc II	JL80
100	2552.658	Au II	RW97
40	2552.764	Tm I	SMC73
400 P	2553.253	P I	M59
50	2553.82	W I	MCS75
9 P,d	2554.434	In II	PC38
200	2554.62	Ta II	MCS75
60	2554.63	Re II	MCS75
25 P	2554.853	W II	EKM00
300	2554.904	P I	M59
90	2555.05	Ta I	MCS75
40 P	2555.095	W II	EKM00
60	2555.36	Rh I	MCS75
20	2556.51	Re I	MCS75
500 P	2557.9460	Zn II	GL00
600 P,w	2558.01	Po I	C66a
8	2558.605	Mn II	IV64
300	2559.405	Co II	PRUJ98
500 P	2559.43	Ta I	MCS75
200	2560.031	Co II	PRUJ98
60 P	2560.150	In I	P38
80	2560.232	Sc II	JL80
6	2560.695	Cr I	K53
60	2561.65	Tm II	MCS75
80	2561.97	W I	MCS75
5	2562.087	Ar II	N73
200	2562.10	Ta I	MCS75
80	2562.123	Ne II	P71
250	2562.5356	Fe II	NLTH91
25	2563.16	Os II	MCS75
120	2563.4755	Fe II	NLTH91
12	2563.642	Mn II	IV64
500	2564.034	Co II	PRUJ98
50	2564.18	Ir I	MCS75
150	2565.5045	Pd II	LLJ94
120	2565.593	Th II	GSZ70
20	2566.49	Os I	MCS75
40	2566.9126	Fe II	NLTH91
90 w	2567.121	Ne II	P71
100	2567.82	Te II	HM64
25	2567.984	Al I	KM91b
90 P	2568.64	Re II	MCS75
300 P	2568.871	Zr II	J98
30	2571.444	W II	EKM00
400 P	2571.457	Zr II	J98
400	2571.594	Sn I	B64
100	2571.67	Hf II	MCS75
8	2571.74	Cr I	K53
60	2571.81	Re II	MCS75
11	2572.345	Mo I	WB88
20	2572.755	Mn I	CMG64
500 P	2572.930	Cd II	SP49
150	2573.54	Ta I	MCS75
150	2573.79	Ta I	MCS75
40	2573.90	Hf II	MCS75
20	2574.018	V I	DA78
90	2574.3662	Fe II	NLTH91
50	2574.96	Te II	HM64
50 P	2575.094	Al I	KM91b
20	2575.509	Mn I	CMG64
1000 P	2576.103	Mn II	KG00
30	2576.6902	Fe I	NJLT94
40	2576.82	Hf II	MCS75
4	2577.14	Eu II	MCS75
40	2577.26	Ir I	MCS75
250	2577.37	Ta II	MCS75
130	2577.78	Ta I	MCS75
40	2577.9219	Fe II	NLTH91
40	2578.14	Hf II	MCS75
20	2578.32	Os II	MCS75
90	2578.79	Lu II	MCS75
80	2579.31	Pr I	MCS75
15	2580.03	Os II	MCS75
40 P	2580.14	Tl I	MCS75
800	2580.326	Co II	PRUJ98
100	2580.49	W I	MCS75
140	2580.8102	Pt II	SRSA92
25	2581.96	Os I	MCS75
300	2582.240	Co II	PRUJ98
40	2582.54	Hf II	MCS75
60	2582.5832	Fe II	NLTH91
100	2582.79	I II	MC60
120	2583.987	Nb II	RCL00
20	2584.302	Mn I	CMG64
150	2584.5359	Fe I	NJLT94
300 P	2585.8758	Fe II	NLTH91
300	2586.31	Na II	W71
7	2586.79	Re I	MCS75
500	2587.220	Co II	PRUJ98
500	2587.524	Co II	PRUJ98
200	2588.904	Co II	PRUJ98
25	2589.160	W II	EKM00
30	2590.76	Os I	MCS75
120	2590.943	Nb II	RCL00
50	2591.12	Te II	HM64
60	2591.5428	Fe II	NLTH91
20	2591.84	Cr I	K53
40	2592.06	Ir I	MCS75
15	2592.20	Nb I	MCS75
200 P	2592.534	Ge I	AM59
50	2592.85	Te II	HM64
9	2592.944	Mn I	CMG64
150	2593.08	Ta I	MCS75
25	2593.640	Ti I	F91
20	2593.710	Mo II	SPNL01
500 P	2593.720	Mn II	KG00
140	2594.421	Sn I	B64
300	2594.96	Na II	W71
200	2595.26	Ta I	MCS75
9	2595.763	Mn I	CMG64
20	2596.00	Os II	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
15	2596.489	Tm I	SMC73
600 P,r	2598.048	Sb I	SM02
200 r	2598.084	Sb I	SM02
400 P	2598.3692	Fe II	NLTH91
8	2598.905	Mn II	IV64
40	2599.04	Ir I	MCS75
300	2599.16	Pa II	BW92b
700 P	2599.3956	Fe II	NLTH91
30	2599.5669	Fe I	NJLT94
30	2599.904	Ti I	F91
11	2601.76	In I	P38
20	2602.800	Mo II	SPNL01
9	2603.1374	Pt I	SRSA92
250	2603.49	Ta II	MCS75
15	2605.081	Li II	HM59
40	2605.133	Ti I	F91
400 P	2605.680	Mn II	KG00
50	2605.72	Te II	HM64
50	2606.37	Hf II	MCS75
80	2606.39	W I	MCS75
200	2606.5162	Fe II	NLTH91
80	2606.8264	Fe I	NJLT94
50	2607.03	Hf II	MCS75
90	2607.06	Tm II	MCS75
300 P	2607.0871	Fe II	NLTH91
40	2608.25	Ir I	MCS75
110 P	2608.50	Re II	MCS75
10	2608.5576	Zn I	GL00
500 P	2608.63	Ta I	MCS75
30	2609.062	Ru I	K59
1000 P,c	2609.99	Tc II	BMC67
15	2610.200	Mn II	IV64
70	2611.285	Ti I	F91
110	2611.30	Ir I	MCS75
120 d	2611.34	Ta I	MCS75
11 d	2611.54	Re I	MCS75
500	2611.81	Na II	W71
400 P	2611.8736	Fe II	NLTH91
80	2612.06	Ru I	K59
120 r	2612.304	Sb I	SM02
60	2613.06	Os I	MCS75
110	2613.08	W I	MCS75
10	2613.084	Mo I	WB88
100	2613.40	Lu II	MCS75
15 r	2613.655	Pb I	WA68
60	2613.82	W I	MCS75
200	2613.8243	Fe II	NLTH91
200 P,r	2614.175	Pb I	WA68
150	2614.23	Tc I	BMC67
1000 P	2615.42	Lu II	MCS75
130	2615.46	Ta I	MCS75
120	2615.66	Ta I	MCS75
100	2615.87	Tc I	BMC67
400	2616.393	Au II	RW97
14	2616.786	Mo I	WB88
6	2617.01	Yb II	M67
1000	2617.169	Cm II	WHGC76
200	2617.6174	Fe II	NLTH91
40	2618.145	Mn II	IV64
250	2618.37	Cu I	S48
100	2619.26	Lu II	MCS75
40	2619.933	Ti I	F91
30	2619.94	Os I	MCS75
50	2620.25	W I	MCS75
60	2620.41	Fe II	D38
20	2621.82	Os I	MCS75
50	2622.21	W I	MCS75
50	2622.74	Hf II	MCS75
80	2623.107	Ne II	P71
40	2623.5339	Fe I	NJLT94
25	2623.688	Dy I	NG00
80	2624.33	Tm II	MCS75
50	2624.86	Te II	HM64
50	2625.22	W I	MCS75
15	2625.606	Mn II	IV64
120	2625.6671	Fe II	NLTH91
25	2625.88	Rh I	MCS75
80	2627.904	Bi I	WBBF01
200 P	2628.0269	Pt I	SRSA92
90	2628.2931	Fe II	NLTH91
15	2629.850	Mo I	WB88
80	2629.885	Ne II	P71
150	2631.0471	Fe II	NLTH91
200	2631.282	Si I	RA65
150	2631.3232	Fe II	NLTH91
15	2632.354	Mn II	IV64
50	2632.48	W I	MCS75
50	2632.70	W I	MCS75
90	2633.13	W I	MCS75
40	2634.17	Ir I	MCS75
20	2634.803	Dy II	NG00
200	2634.91	Tc II	BMC67
120	2635.529	U II	BW92b
500 P	2635.58	Ta II	MCS75
30	2635.8088	Fe I	NJLT94
50	2635.83	Re II	MCS75
90 w	2636.069	Ne II	P71
1000 P	2636.281	Cm II	WHGC76
10	2636.64	Re I	MCS75
200	2636.67	Ta I	MCS75
25	2636.670	Mo II	SPNL01
300	2636.90	Ta I	MCS75
130 P	2637.13	Os I	MCS75
11	2638.173	Mn II	IV64
80	2638.289	Ne II	P71
50 d	2638.62	W I	MCS75
130	2638.71	Hf II	MCS75
50	2638.761	Mo II	SPNL01
15	2638.77	Eu II	MCS75
15	2639.3454	Pt I	SRSA92
15	2639.3454	Pt I	SRSA92
200 P	2639.71	Ir I	MCS75
7	2639.849	Mn II	IV64
14	2640.984	Mo I	WB88
80	2641.087	Ti I	F91
6	2641.27	Eu II	MCS75
130 P	2641.41	Hf II	MCS75
25	2641.480	Au I	ED71
40	2642.946	Ru I	K59
80	2644.097	Ne II	P71

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
70	2644.11	Os I	MCS75
100	2644.253	Ti I	F91
6	2644.306	Yb II	M67
40	2644.348	Mo II	SPNL01
80	2646.18	W I	MCS75
200	2646.22	Ta I	MCS75
100	2646.254	Nb II	RCL00
250	2646.37	Ta I	MCS75
30	2646.486	Mo II	SPNL01
120	2646.625	Ti I	F91
50	2646.73	W I	MCS75
90	2646.8804	Pt I	SRSA92
1000 P,c	2647.01	Tc II	BMC67
80	2647.29	Hf II	MCS75
900 P	2647.47	Ta I	MCS75
20	2647.50	Nb I	MCS75
20	2649.458	Mo I	WB88
500	2649.66	Te II	HM64
100 P	2650.454	Be I	KM97
60 P	2650.550	Be I	KM97
200* P	2650.613	Be I	KM97
200* P	2650.619	Be I	KM97
60 P	2650.694	Be I	KM97
100 P	2650.760	Be I	KM97
300 P	2650.8524	Pt I	SRSA92
1000	2651.171	Cm II	WHGC76
500 P	2651.172	Ge I	AM59
110	2651.22	Ta II	MCS75
200 P	2651.568	Ge I	AM59
12	2651.90	Re I	MCS75
25	2652.039	Hg I	BAL50
100	2652.35	Tc II	BMC67
40	2652.66	Rh I	MCS75
1000 P	2653.27	Ta I	MCS75
40	2653.347	Mo II	SPNL01
13	2653.57	Cr II	K51
40	2653.679	Hg I	BAL50
60 P	2653.75	Yb II	M67
1000	2653.804	Cm II	WHGC76
7	2654.12	Re I	MCS75
20	2654.45	Nb I	MCS75
20	2655.021	Mo I	WB88
200	2656.54	W I	MCS75
700 P	2656.61	Ta I	MCS75
20	2657.293	Li II	HM59
30	2657.303	Li II	HM59
50	2657.38	W I	MCS75
150	2657.80	Lu II	MCS75
25 d	2658.032	W II	EKM00
10	2658.111	Mo I	WB88
13	2658.59	Cr II	K51
70	2658.60	Os I	MCS75
100	2658.7201	Pd II	LLJ94
500 P	2659.4503	Pt I	SRSA92
40	2659.617	Ru I	K59
20	2659.83	Os I	MCS75
50	2660.576	Mo II	SPNL01
500	2661.00	Na II	W71
140 P	2661.244	Sn I	B64
600 P	2661.34	Ta I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400 P	2661.61	Ru II	MCS75
110	2661.98	Ir I	MCS75
90	2662.84	W I	MCS75
90	2663.154	Pb I	WA68
300 h	2663.33	Po	CHPT55
15	2663.42	Cr II	K51
40	2664.6638	Fe II	NLTH91
150 P	2664.79	Ir I	MCS75
11	2665.038	Yb II	M67
25	2666.02	Cr II	K51
200	2666.740	Co II	PRUJ98
30	2666.8125	Fe I	NJLT94
11	2668.34	Eu II	MCS75
250	2668.62	Ta I	MCS75
15	2668.71	Cr II	K51
30	2669.91	Ir I	MCS75
40	2670.260	Er II	M64b
120 r	2670.630	Sb I	SM02
90	2671.47	W I	MCS75
20	2671.80	Cr II	K51
600	2671.83	Na II	W71
30	2671.84	Ir I	MCS75
20 P	2671.958	Yb I	MT78
9	2672.581	Mn II	IV64
20	2672.656	Yb II	M67
15	2672.83	Cr II	K51
50	2672.843	Mo II	SPNL01
20	2673.27	Mo II	MCS75
15	2674.34	Re I	MCS75
20	2674.460	Li II	HM59
9	2674.5700	Pt I	SRSA92
20	2674.57	Os I	MCS75
300	2675.90	Ta II	MCS75
300 P	2675.954	Au I	ED71
4	2677.13	Te I	MCS75
50	2677.1477	Pt I	SRSA92
90 P	2677.19	Cr II	K51
80	2677.28	W I	MCS75
500	2678.09	Na II	W71
4	2678.29	Eu II	MCS75
300 P	2678.632	Zr II	J98
900 P	2678.76	Ru II	MCS75
15	2678.79	Cr II	K51
50	2678.88	W I	MCS75
60	2679.0242	Fe I	NJLT94
30	2679.854	Mo I	WB88
2	2680.34	Na I	R56
1	2680.43	Na I	R56
250 P	2681.42	W I	MCS75
50	2683.234	Mo II	SPNL01
11	2684.10	Rb II	R75
70	2684.140	Mo II	SPNL01
250	2684.28	Ta I	MCS75
90	2684.288	Th II	GSZ70
300	2684.7536	Fe II	NLTH91
80 h	2685.08	Lu I	MCS75
600 P	2685.17	Ta II	MCS75
4	2685.66	Eu II	MCS75
12	2687.09	Cr II	K51
300 P	2687.954	V II	ICL88

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	2687.992	Mo II	SPNL01
9	2688.247	Mn II	IV64
40	2689.2122	Fe I	NJLT94
500	2689.300	Cu II	R69
70	2689.82	Os I	MCS75
15	2691.03	Cr II	K51
130	2691.31	Ta I	MCS75
200 P	2691.341	Ge I	AM59
9	2692.03	Eu II	MCS75
400	2692.06	Ru II	MCS75
100	2692.40	Ta I	MCS75
110	2692.415	Th II	Z79
40	2692.6019	Fe II	NLTH91
200 P	2694.23	Ir I	MCS75
200	2694.52	Ta II	MCS75
80	2695.67	W I	MCS75
90	2696.81	Ta I	MCS75
300 P	2697.060	Nb II	RCL00
13	2697.710	W II	EKM00
400 P	2698.30	Ta I	MCS75
9	2698.40	Cr II	K51
20	2698.4248	Pt I	SRSA92
9	2698.68	Cr II	K51
100 c	2698.860	Nb II	RCL00
300	2699.22	Pa II	BW92b
80	2699.59	W I	MCS75
20	2699.59	Os I	MCS75
50	2700.01	W I	MCS75
130	2700.129	Zr II	J98
300	2700.491	Ga II	IL85
200 P	2700.937	V II	ICL88
500	2700.962	Cu II	R69
7	2701.024	Mn II	IV64
12	2701.14	Eu II	MCS75
40	2701.416	Mo II	SPNL01
13	2701.698	Mn II	IV64
250 P	2701.71	Lu II	MCS75
13	2701.90	Eu II	MCS75
100	2702.194	Nb II	RCL00
200 P	2702.3995	Pt I	SRSA92
400	2703.184	Cu II	R69
40	2703.73	Rh I	MCS75
8	2703.98	Mn II	IV64
40	2703.9891	Fe II	NLTH91
4	2705.28	Eu II	MCS75
300	2705.61	Hf I	MCS75
11	2705.732	Mn II	IV64
150 P	2705.8951	Pt I	SRSA92
140	2706.174	V II	ICL88
500 P	2706.505	Sn I	B64
50	2706.58	W I	MCS75
40	2706.5820	Fe I	NJLT94
200	2706.606	Co II	PRUJ98
200	2706.69	Ta I	MCS75
20	2706.70	Os I	MCS75
15	2706.738	Sc I	AV77
200	2707.343	Co II	PRUJ98
7	2707.544	Mn II	IV64
70	2707.90	Tc II	BMC67
9	2708.452	Mn II	IV64
50	2708.59	W I	MCS75
1000 P,s	2708.66	Es II	WLGC74
100	2708.78	Tc I	BMC67
50 d	2708.80	W I	MCS75
100	2708.96	Ra II	R34a
20	2709.23	Tl I	MCS75
300 P	2709.624	Ge I	AM59
15	2709.981	Eu I	ST76
500	2710.13	Ta I	MCS75
90 P	2710.265	In I	P38
7	2710.336	Mn II	IV64
25	2711.341	Sc I	AV77
9	2711.568	Mn II	IV64
11	2711.76	Rb II	R75
200	2711.8732	Ag II	KLLT01
25 h	2712.40	Kr II	DHM33
250 P	2712.41	Ru II	MCS75
500	2713.508	Cu II	R69
15	2713.94	In I	P38
50	2714.4129	Fe II	NLTH91
100 P	2714.64	Os I	MCS75
1000 P	2714.67	Ta I	MCS75
400 P	2715.27	Rh II	S58
20	2715.36	Os I	MCS75
25	2715.47	Re I	MCS75
50	2715.50	W I	MCS75
150	2715.664	V II	ICL88
140 P	2716.622	Nb II	RCL00
12	2716.98	Eu II	MCS75
90	2717.18	Ta I	MCS75
20	2717.35	Mo II	MCS75
9	2718.349	Yb II	M67
20	2718.54	Rh I	MCS75
110	2718.59	Hf I	MCS75
400	2718.778	Cu II	R69
250	2718.91	W I	MCS75
400 P	2719.0273	Fe I	NJLT94
130	2719.0333	Pt I	SRSA92
60	2719.51	Ru I	K59
300 P	2719.5239	Pt II	SRSA92
40	2720.04	Os I	MCS75
200	2720.76	Ta I	MCS75
150	2720.9023	Fe I	NJLT94
60	2721.19	Tm II	MCS75
140 P	2721.645	Ca I	R68
5	2721.77	Ag I	S40
30	2721.86	Os I	MCS75
140 P	2721.981	Nb II	RCL00
250 P	2722.609	Zr II	J98
9	2722.74	Cr II	K51
1	2723.19	He I	M60a
40	2723.5774	Fe I	NJLT94
300 P	2724.35	W I	MCS75
100 s	2724.57	Es II	WLGC74
50	2725.03	W I	MCS75
1000	2725.682	Cm II	WHGC76
20	2726.496	Cr I	K53
100	2726.69	Tc I	BMC67
200	2727.44	Ta II	MCS75
50	2727.5392	Fe II	NLTH91

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
150	2727.78	Ta I	MCS75
70 P	2727.78	Eu II	MCS75
20	2728.288	Li II	HM59
7	2728.315	Li II	HM59
50	2728.90	Fe II	C74
15	2728.94	Rh I	MCS75
60 h	2728.95	Lu I	MCS75
6	2729.44	Eu II	MCS75
400	2729.78	Ge II	S63a
13	2729.9123	Pt I	SRSA92
50*	2730.473	Li II	HM59
50*	2730.551	Li II	HM59
20	2730.61	Os I	MCS75
30	2731.56	Re II	MCS75
14	2731.895	Cr I	K53
90	2732.721	Zr II	J98
6	2732.742	Yb II	M67
20	2732.80	Os I	MCS75
25	2732.880	Mo II	SPNL01
100 P	2733.04	Re II	MCS75
250	2733.289	O II	MKM93
12 c	2733.30	He II	GM65
100	2733.5806	Fe I	NJLT94
300 P	2733.9567	Pt I	SRSA92
400 P	2734.35	Ru II	MCS75
250 P	2734.851	Zr II	J98
50	2735.4753	Fe I	NJLT94
150	2735.727	Ru I	K59
8	2736.463	Cr I	K53
2	2736.542	Mg I	KM91a
1000	2736.892	Cm II	WHGC76
50	2737.3091	Fe I	NJLT94
80	2738.76	Hf II	MCS75
1000	2739.31	Cf II	RCWM80
400 P	2739.5474	Fe II	NLTH91
80	2742.4053	Fe I	NJLT94
200	2742.553	Zr II	J98
120	2743.1969	Fe II	NLTH91
300 P	2743.2944	Pt II	SRSA92
13	2743.63	Cr II	K51
120	2745.854	Zr II	J98
20	2746.30	Mo II	MCS75
200	2746.4838	Fe II	NLTH91
200	2746.68	Ta I	MCS75
120	2747.156	Th II	Z79
1000 s	2748.019	Bk II	WC78
1000	2748.039	Cm II	WHGC76
100 P	2748.253	Au I	ED71
1000 P	2748.549	Cd II	SP49
13	2748.664	Yb II	M67
500	2748.78	Ta I	MCS75
80	2748.84	W I	MCS75
15	2748.98	Cr II	K51
400 P	2749.3216	Fe II	NLTH91
60	2749.4860	Fe II	NLTH91
300	2749.83	Ta I	MCS75
120	2750.1406	Fe I	NJLT94
70 P	2750.477	Yb II	M67
20	2750.72	Cr II	K51
11	2751.468	Mo I	WB88

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	2751.81	Hf II	MCS75
15	2751.85	Cr II	K51
100	2752.166	Th II	GSZ70
120	2752.202	Zr II	J98
50	2753.2877	Fe II	NLTH91
8	2753.8531	Pt I	SRSA92
40 P	2753.878	In I	P38
200 P	2754.17	Lu II	MCS75
250 P	2754.588	Ge I	AM59
30	2754.9122	Pt I	SRSA92
60	2755.630	Er II	M64b
500 P	2755.7365	Fe II	NLTH91
40 s	2756.550	Am II	FT57
8	2757.086	Cr I	K53
20	2757.72	Cr II	K51
400 P	2758.31	Ta I	MCS75
20	2758.61	Nb I	MCS75
90	2758.806	Zr II	J98
1000 P,s	2759.10	Cf II	RCWM80
25	2761.42	Os I	MCS75
200	2761.63	Hf I	MCS75
200	2761.68	Ta II	MCS75
100	2761.81	Fe II	C74
250	2761.92	Po I	C66a
50	2762.34	W I	MCS75
40 P	2762.58	Cr II	K51
80	2762.921	Ne II	P71
400 P	2763.0899	Pd I	ELLW98
15	2763.62	Mo II	MCS75
2	2763.80	He I	M60a
25 P	2764.261	W II	EKM00
100 h	2765.74	Lu I	MCS75
100 l	2765.76	Es II	WLGC74
250	2766.37	Cu I	S48
40 P	2766.55	Cr II	K51
40	2766.989	Li II	HM59
200 P,d	2767.87	Tl I	MCS75
500	2769.669	Cu II	R69
50	2769.74	W I	MCS75
20	2769.76	Mo II	MCS75
7	2769.8332	Pt I	SRSA92
12	2769.902	Cr I	K53
150 r	2769.931	Sb I	SM02
50	2770.016	Er II	M64b
30	2770.71	Os I	MCS75
20	2770.8538	Zn I	GL00
90	2770.88	W I	MCS75
8	2770.9740	Zn I	GL00
100	2771.6594	Pt I	SRSA92
30	2772.0740	Fe I	NJLT94
20	2773.20	Nb I	MCS75
120 P	2773.36	Hf II	MCS75
90	2774.00	W I	MCS75
90	2774.48	W I	MCS75
1000 P	2774.52	Cf II	RCWM80
2	2775.37	In I	P38
130 P	2775.402	Mo II	SPNL01
300	2775.88	Ta I	MCS75
9	2776.280	Yb II	M67
40	2776.6595	Pd II	LLJ94

Finding List—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
6		2776.690	Mg I	KM91a
60		2778.2202	Fe I	NJLT94
5		2778.270	Mg I	KM91a
200		2779.37	Hf I	MCS75
15*	P	2779.820	Mg I	KM91a
15*	P	2779.834	Mg I	KM91a
300		2779.977	Ga II	IL85
70		2780.037	Mo II	SPNL01
900	P,r	2780.22	As I	HA85
50		2780.476	Bi I	WBBF01
30		2780.695	Cr I	K53
9		2780.822	Au I	ED71
30		2781.29	Ir I	MCS75
5		2781.416	Mg I	KM91a
8		2781.89	Eu II	MCS75
100		2782.05	Tc I	BMC67
25		2782.55	Os I	MCS75
6		2782.972	Mg I	KM91a
10		2783.57	Re I	MCS75
6		2784.656	Yb II	M67
1000		2784.826	Cm II	WHGC76
30		2784.99	Mo II	MCS75
20		2786.31	Os I	MCS75
300	P,l	2787.10	Es II	WLGC74
150		2787.69	Ta I	MCS75
300	P	2788.1047	Fe I	NJLT94
20		2790.313	Li II	HM59
13	P	2790.776	Mg II	KM91a
90		2792.019	Ne II	P71
90		2792.70	W I	MCS75
150		2793.934	U II	BW92b
80		2794.221	Ne II	P71
80		2794.60	Tm II	MCS75
250	P	2794.817	Mn I	CMG64
1000	P	2795.5301	Mg II	PTW98
130		2795.78	Tc II	BMC67
100	l	2796.11	Es II	WLGC74
250		2796.34	Ta I	MCS75
150		2796.63	Lu II	MCS75
20		2796.73	Os I	MCS75
110		2796.93	Gd II	MCS75
80		2797.27	Tm II	MCS75
30		2797.35	Ir I	MCS75
90		2797.70	Ir I	MCS75
300		2797.76	Ta II	MCS75
15		2797.998	Mg II	KM91a
6		2798.211	Yb II	M67
200	P	2798.270	Mn I	CMG64
50		2799.93	W I	MCS75
20	P	2800.8635	Zn I	GL00
6	P	2801.0500	Zn I	GL00
140	P	2801.084	Mn I	CMG64
300	P,r	2801.995	Pb I	WA68
600	P	2802.036	Au II	RW97
150		2802.07	Ta I	MCS75
30		2802.494	Ti I	F91
200		2802.560	U II	BW92b
600	P	2802.7056	Mg II	PTW98
100		2802.81	Tc I	BMC67
30		2802.84	Eu II	MCS75
20		2803.2357	Pt I	SRSA92
40		2804.5203	Fe I	NJLT94
150		2806.30	Ta I	MCS75
200		2806.58	Ta I	MCS75
100	P	2806.91	Os I	MCS75
150		2806.9841	Fe I	NJLT94
130		2807.119	U II	BW92b
30		2807.753	Mo II	SPNL01
100		2809.485	Ne II	P71
500		2809.52	Na II	W71
90		2809.72	Gd II	MCS75
150		2810.551	Ru I	K59
300		2811.61	Tc II	BMC67
1000		2811.618	Cm II	WHGC76
4		2811.75	Eu II	MCS75
40	s	2812.920	Am II	FT57
250		2813.2864	Fe I	NJLT94
150	P	2813.76	Ra II	R34a
60	P	2813.94	Eu II	MCS75
25		2814.20	Os I	MCS75
200		2814.902	Zr I	J98
300*	l	2815.15	Es I	WLGC74
300*	P,l	2815.15	Es II	WLGC74
200	l	2815.282	Am II	FT57
130	P	2816.158	Mo II	SPNL01
9		2816.18	Eu II	MCS75
600	P	2816.185	Al II	KM91b
200		2816.9021	Pt II	SRSA92
15		2817.44	Mo II	MCS75
100		2817.68	Hf I	MCS75
130		2817.958	U II	BW92b
90		2818.06	W I	MCS75
10		2818.2	He I	BDD72
30		2818.2450	Pt I	SRSA92
200		2819.793	Au II	RW97
15		2819.95	Re I	MCS75
140	P	2820.22	Hf II	MCS75
30		2820.78	Eu II	MCS75
200		2821.121	U II	BW92b
8		2821.152	Yb II	M67
70		2821.35	Tc II	BMC67
9		2822.38	Cr II	K51
1000	P	2822.546	Au II	RW97
60		2822.68	Hf II	MCS75
300		2822.792	Pa II	G67
40		2823.0513	Pt II	SRSA92
40		2823.18	Ir I	MCS75
120	r	2823.189	Pb I	WA68
30		2823.2756	Fe I	NJLT94
1000	P	2824.204	Cm II	WHGC76
9	h	2824.39	Ag I	S40
70		2824.45	Ir I	MCS75
6		2824.974	Yb II	M67
400	h	2825.437	Au II	RW97
60		2825.5557	Fe I	NJLT94
90		2825.557	Zr II	J98
14		2826.16	Tl I	MCS75
20		2826.68	Rh I	MCS75
1000	s	2827.567	Bk II	WC78
70		2827.92	Tm II	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
7 c,w	2828.72	Eu II	MCS75
140	2828.935	U II	BW92b
4	2829.08	He I	M60a
40	2829.149	Ru I	K59
300 P,c	2830.2919	Pt I	SRSA92
9	2830.46	Cr II	K51
11	2830.989	Yb II	M67
200 P	2831.38	W I	MCS75
1000 P	2831.843	Ge II	S63a
200	2832.061	U II	BW92b
300 l	2832.14	Pa II	BW92b
1000 P,s	2832.258	Am II	FT57
200	2832.3154	Th II	PE83
150	2832.4355	Fe I	NJLT94
30	2833.00	Kr II	DHM33
300 P,r	2833.053	Pb I	WA68
1000 P	2833.580	Cm II	WHGC76
90	2833.63	W I	MCS75
15	2834.7107	Pt I	SRSA92
130 P	2835.63	Cr II	K51
50	2836.40	Ir I	MCS75
500 P	2836.710	C II	MG93
100	2836.900	Cd I	BA56
10 c	2836.92	In I	P38
200	2837.226	Zr I	J98
300 P	2837.2954	Th II	PE83
400 P	2837.603	C II	MG93
120	2837.848	Au II	RW97
20	2838.1194	Fe I	NJLT94
200 P	2838.63	Os I	MCS75
60	2839.16	Ir I	MCS75
400	2839.56	Na II	W71
1000 P	2839.976	Sn I	B64
50	2840.22	Ir I	MCS75
50	2841.57	W I	MCS75
25	2841.60	Os I	MCS75
600	2841.72	Na II	W71
30	2842.4101	Pt II	SRSA92
80	2842.8127	Th II	PE83
100	2842.82	Ta I	MCS75
90 P	2843.24	Cr II	K51
100	2843.9763	Fe I	NJLT94
250	2844.25	Ta I	MCS75
80	2844.40	Os I	MCS75
120	2844.575	Zr II	J98
110 c	2845.35	Ta I	MCS75
1000 P	2845.527	Ge II	S63a
200	2845.83	Hf I	MCS75
2	2846.716	Mg I	KM91a
400	2846.920	Au II	RW97
100 h	2847.16	Ac II	MFT57
13 h	2847.175	Yb II	M67
150	2847.51	Lu II	MCS75
400 P	2847.675	Hg II	SR01
90	2848.02	W I	MCS75
150	2848.0839	Th I	PE83
40	2848.186	Zr II	J98
130 P	2848.233	Mo II	SPNL01
2	2848.342	Mg I	KM91a
6	2848.445	Yb II	M67
200	2848.52	Ta I	MCS75
200 P	2849.72	Ir I	MCS75
60 P	2849.83	Cr II	K51
600 P	2850.49	Ta I	MCS75
50	2850.76	Os I	MCS75
120	2850.96	Hf I	MCS75
700 P	2850.98	Ta I	MCS75
20	2851.126	Yb II	M67
3	2851.660	Mg I	KM91a
80	2851.7969	Fe I	NJLT94
1000 l	2852.03	Cf II	RCWM80
1000 P	2852.1251	Mg I	PTW98
5 P	2852.81	Na I	R56
2 P	2853.01	Na I	R56
30	2853.23	Mo II	MCS75
60	2854.075	Ru I	K59
20	2854.166	Tm I	SMC73
40 P	2854.5776	Pd II	LLJ94
1000 s	2855.24	Cf II	RCWM80
50 P	2855.67	Cr II	K51
80	2856.03	W I	MCS75
2 c	2858.14	In I	P38
500	2858.29	Te II	HM64
30	2858.91	Cr II	K51
200 c	2859.11	Tc I	BMC67
6	2859.392	Yb II	M67
400	2859.49	Na II	W71
4	2859.67	Eu II	MCS75
25	2859.805	Yb II	M67
1000 P,r	2860.44	As I	HA85
25	2860.92	Cr II	K51
50	2860.96	Os I	MCS75
90	2861.01	Hf II	MCS75
8	2861.212	Yb II	M67
6	2861.34	Yb II	M67
40	2861.408	Ru I	K59
90	2861.70	Hf II	MCS75
140	2861.98	Ta I	MCS75
40 P	2862.57	Cr II	K51
5	2862.57	Eu II	MCS75
30	2862.94	Rh I	MCS75
700 P	2863.315	Sn I	B64
30	2863.81	Mo II	MCS75
20	2864.361	V I	DA78
70	2864.73	Xe II	H39
40 P	2865.10	Cr II	K51
200	2865.681	U II	BW92b
80	2866.06	W I	MCS75
1000 P	2866.37	Hf I	MCS75
50	2866.653	Ru I	K59
15	2866.69	Mo II	MCS75
30	2866.72	Cr II	K51
11	2867.06	Yb II	M67
25	2867.65	Cr II	K51
20	2868.095	V I	DA78
150	2868.515	Nb II	RCL00
120	2868.65	Ta I	MCS75
200	2869.23	Tm II	MCS75
300	2870.005	Pa II	G67
130	2870.4066	Th II	PE83

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
11	2870.43	Cr II	K51
400	2871.28	Na II	W71
300 h	2871.413	Pa II	G67
200	2871.42	Ta I	MCS75
130 P	2871.512	Mo II	SPNL01
1000 l	2872.114	Bk II	WC78
120 r	2873.311	Pb I	WA68
100	2873.36	Ta I	MCS75
100	2873.56	Ta I	MCS75
400 P	2874.235	Ga I	JL67
110	2874.9196	Pt II	SRSA92
150	2874.984	Ru I	K59
250 P	2875.390	Nb II	RCL00
1000 P	2875.6314	Pt II	SRSA92
15	2875.97	Cr II	K51
140	2875.980	Zr I	J98
12	2876.24	Cr II	K51
150	2877.038	Nb II	RCL00
400	2877.100	Cu II	R69
40	2877.2783	Pt II	SRSA92
400 P,r	2877.913	Sb I	SM02
9	2877.97	Cr II	K51
1000 P,s	2878.572	Bk II	WC78
15	2879.05	Mo II	MCS75
70	2879.11	W I	MCS75
70	2879.40	W I	MCS75
7	2879.482	Mn II	IV64
150	2880.02	Ta I	MCS75
100 r	2880.767	Cd I	BA56
30	2880.98	Ho II	MCS75
500	2881.15	Na II	W71
1000 P	2881.5771	Si I	BE93
130	2881.60	Pr I	MCS75
50	2882.64	Ir I	MCS75
150 P	2883.174	Nb II	RCL00
25	2883.446	Au I	ED71
80	2884.2897	Th II	PE83
1000 l	2884.772	Bk II	WC78
90	2885.0491	Th II	PE83
80 h	2885.14	Lu I	MCS75
500	2886.26	Na II	W71
70	2886.528	Ru I	K59
8	2886.995	Cr I	K53
50	2887.68	Re I	MCS75
100	2887.73	Tc I	BMC67
90	2887.8176	Th II	PE83
11	2888.04	Yb II	M67
200 l	2888.505	Am II	FT57
40	2889.294	Cr I	K53
13	2889.600	Mn II	IV64
400	2889.62	Hf I	MCS75
250	2889.624	U II	BW92b
1000 s	2889.803	Bk II	WC78
7 P,d	2890.179	In II	PC38
70	2890.94	Tm II	MCS75
100	2890.994	Mo II	SPNL01
300 h	2891.139	Pa II	G67
200 P	2891.384	Yb II	M67
8	2891.612	Ar II	N73
250	2891.644	V II	ICL88
300	2891.84	Ta I	MCS75
25	2891.961	Au I	ED71
140	2892.433	V II	ICL88
20	2892.502	Eu I	ST76
250	2892.652	V II	ICL88
13	2893.013	Eu I	ST76
400 P	2893.247	Au II	RW97
20	2893.254	Cr I	K53
400 P	2893.307	V II	ICL88
1000 s	2893.660	Bk II	WC78
30	2893.838	Eu I	ST76
130 P	2893.8630	Pt I	SRSA92
10	2894.168	Cr I	K53
70	2894.451	Mo II	SPNL01
400 P	2894.84	Lu II	MCS75
50 h	2895.22	Xe II	H39
800	2895.41	Te II	HM64
50	2896.01	W I	MCS75
100	2896.34	Tc I	BMC67
150 P	2896.44	W I	MCS75
10	2896.756	Cr I	K53
40	2897.15	Ir I	MCS75
140	2897.806	Nb II	RCL00
60	2897.8715	Pt I	SRSA92
500 P	2897.965	Bi I	WBBF01
800 P	2898.26	Hf I	MCS75
100	2899.04	Ta I	MCS75
40	2899.3861	Pt II	SRSA92
40 l	2899.562	Am II	FT57
1000	2899.904	Cm II	WHGC76
7	2900.154	Mn II	IV64
250 P	2900.30	Lu II	MCS75
500	2901.14	Na II	W71
200	2902.05	Ta I	MCS75
15 c	2902.48	Re I	MCS75
20	2903.07	Mo II	MCS75
50	2904.283	Si II	S61b
500 P	2904.41	Hf I	MCS75
90	2904.469	Er II	M64b
400	2904.72	Na II	W71
400	2904.75	Hf I	MCS75
600	2904.92	Na II	W71
9	2905.477	Cr I	K53
80	2905.692	Si II	S61b
8	2905.8974	Pt I	SRSA92
250	2906.454	V II	ICL88
80	2906.592	Ne II	P71
50 P	2906.68	Eu II	MCS75
150	2906.794	U II	BW92b
80	2906.816	Ne II	P71
300 h	2906.93	Pa II	BW92b
300	2907.03	Es	WLGC74
20	2907.042	Au II	RW97
15	2907.21	Rh I	MCS75
130	2907.462	V II	ICL88
140	2908.240	Nb II	RCL00
150	2908.272	U II	BW92b
600 P	2908.810	V II	ICL88
30	2908.883	Ru I	K59
15	2908.993	Eu I	ST76

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
13	2909.049	Cr I	K53
300 P	2909.06	Os I	MCS75
40	2909.117	Mo II	SPNL01
40 c	2909.41	Ho II	MCS75
10	2909.82	Re I	MCS75
200	2910.016	V II	ICL88
90	2910.061	Ne II	P71
300 P	2910.15	Rh II	S58
140	2910.359	Er II	M64b
140	2910.385	V II	ICL88
90	2910.408	Ne II	P71
200	2910.587	Nb II	RCL00
1000 l	2910.645	Bk II	WC78
13	2910.892	Cr I	K53
150	2911.058	V II	ICL88
40 l	2911.130	Am II	FT57
80	2911.138	Ne II	P71
12	2911.148	Cr I	K53
500 P	2911.39	Lu II	MCS75
140 c	2911.743	Nb II	RCL00
80	2911.917	Mo II	SPNL01
60	2912.083	Ti I	F91
15	2912.2515	Pt I	SRSA92
70	2912.33	Os I	MCS75
1000 P	2912.965	Cm II	WHGC76
100	2913.15	Tc I	BMC67
40	2913.517	Au II	RW97
15	2913.5386	Pt I	SRSA92
140	2913.559	Sn I	B64
9	2914.210	Yb II	M67
200	2914.672	Cd II	SP49
30	2914.926	V I	DA78
80	2915.122	Ne II	P71
8	2915.275	Yb II	M67
120	2915.49	Ta I	MCS75
30	2916.250	Hg II	SR01
100	2916.251	Ru I	K59
900 P	2916.48	Hf I	MCS75
20	2917.26	Os I	MCS75
600	2917.52	Na II	W71
700	2918.076	B II	O70
400 P	2918.235	Au II	RW97
140 P	2918.32	Tl I	MCS75
250	2918.58	Hf I	MCS75
600	2919.05	Na II	W71
15	2919.346	Yb II	M67
40	2919.59	Hf II	MCS75
70	2919.79	Os I	MCS75
700	2919.85	Na II	W71
200 s	2920.593	Am II	FT57
700	2920.95	Na II	W71
7	2921.3792	Pt I	SRSA92
20	2921.52	Tl I	MCS75
100	2923.392	Mo II	SPNL01
600	2923.49	Na II	W71
60	2923.619	V I	DA78
600 P	2924.017	V II	ICL88
20	2924.02	Rh I	MCS75
400 P	2924.630	V II	ICL88
250 P	2924.79	Ir I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
14	2925.04	Eu II	MCS75
150	2925.19	Ta I	MCS75
80	2925.618	Ne II	P71
1000 s	2926.489	Bk II	WC78
80	2926.74	Tm II	MCS75
15 c	2927.42	Re I	MCS75
40 l	2927.534	Am II	FT57
300 P	2927.814	Nb II	RCL00
1000 s	2927.907	Bk II	WC78
100	2928.20	Tc I	BMC67
40	2928.327	Ti I	F91
1000 P	2928.922	Cm II	WHGC76
200	2929.271	Cd II	SP49
60	2929.63	Hf II	MCS75
400 P	2929.7894	Pt I	SRSA92
200	2929.90	Hf I	MCS75
80	2930.502	Mo II	SPNL01
200	2930.805	V II	ICL88
15	2931.08	Cs II	S81
20	2931.28	Os I	MCS75
120	2931.414	U II	BW92b
80 w	2932.103	Ne II	P71
60 P	2932.630	In I	P38
120	2932.70	Ta I	MCS75
90 P	2933.054	Mn II	KG00
500	2933.298	Pu II	BFG84
700 P	2933.55	Ta I	MCS75
700 P	2933.602	Pu II	BFG84
60	2934.0209	Ag II	KLLT01
60	2934.298	Mo II	SPNL01
70	2934.64	Ir I	MCS75
80	2935.00	W I	MCS75
70	2935.99	Tm II	MCS75
150	2936.0846	Th I	PE83
50	2936.68	Ir I	MCS75
120	2936.9033	Fe I	NJLT94
40 l	2936.992	Am II	FT57
500	2937.74	Na II	W71
80	2937.80	Hf II	MCS75
400 P	2938.297	Bi I	WBBF01
2	2938.473	Mg I	KM91a
120 P	2939.308	Mn II	KG00
200	2940.06	Ta I	MCS75
500	2940.22	Ta I	MCS75
9 h	2940.331	Mn I	CMG64
80	2940.653	Ne II	P71
900 P	2940.77	Hf I	MCS75
6 P	2941.050	In II	PC38
250	2941.372	V II	ICL88
120	2941.499	V II	ICL88
250	2941.543	Nb II	RCL00
1000 l	2941.713	Bk II	WC78
250	2941.916	U II	BW92b
90	2942.14	Ta I	MCS75
20	2942.319	V I	DA78
20	2942.388	V I	DA78
80	2942.8600	Th II	PE83
70	2942.893	Ar II	N73
8	2943.14	Re I	MCS75
150	2943.15	Ir I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
20	2943.189	V I	DA78
600 P	2943.636	Ga I	JL67
150	2943.7288	Th I	PE83
150	2943.896	U II	BW92b
60	2943.912	Ni I	LBT93
200 P	2944.173	Ga I	JL67
300 P	2944.40	W I	MCS75
300	2944.569	V II	ICL88
10	2945.11	He I	M60a
250	2945.67	Ru II	MCS75
8	2945.907	Yb II	M67
90	2946.044	Ne II	P71
300 P	2946.99	W I	MCS75
25	2947.074	Hg II	SR01
60	2947.39	W I	MCS75
500	2947.50	Na II	W71
100	2947.8760	Fe I	NJLT94
40 h	2948.23	Os I	MCS75
150	2948.242	Ti I	F91
40	2948.406	Y I	P77
150 P	2949.205	Mn II	KG00
30	2949.492	Ru I	K59
50	2949.53	Os I	MCS75
20	2949.629	V I	DA78
100 l	2950.393	Am II	FT57
500	2950.68	Hf I	MCS75
300 P	2950.882	Nb II	RCL00
70	2951.22	Ir I	MCS75
700	2951.24	Na II	W71
1000 P,l	2951.761	Bk II	WC78
700 P	2951.820	Pu II	BFG84
200	2951.92	Ta I	MCS75
150	2952.068	V II	ICL88
13	2952.268	W II	EKM00
600	2952.40	Na II	W71
3 c,w	2952.68	Eu II	MCS75
130	2953.56	Ta I	MCS75
60	2953.9399	Fe I	NJLT94
500	2954.20	Hf I	MCS75
200	2954.222	Au II	RW97
150	2955.725	Ne II	P71
20	2956.057	Mo II	SPNL01
120	2956.060	U II	BW92b
200	2956.123	Ti I	F91
1 c	2957.01	In I	P38
250	2958.02	Hf I	MCS75
250	2958.92	Po I	C66a
4	2960.21	Eu II	MCS75
7	2960.7494	Pt I	SRSA92
90	2960.867	Zr I	J98
250	2961.16	Cu I	S48
20	2962.15	Os I	MCS75
30	2962.781	V I	DA78
150	2963.236	Ne II	P71
600 P	2963.32	Ta I	MCS75
250 P	2963.32	Lu II	MCS75
20	2963.797	Mo II	SPNL01
50	2964.52	W I	MCS75
140	2964.520	Er II	M64b
700 P	2964.644	Pu II	BFG84
7	2964.755	Yb II	M67
600	2964.88	Hf I	MCS75
40	2964.964	Y I	P77
13	2965.11	Re I	MCS75
300	2965.13	Ta II	MCS75
50	2965.166	Ru I	K59
300	2965.54	Ta I	MCS75
200	2965.55	Ru II	MCS75
25	2965.76	Re I	MCS75
15	2965.879	Sc I	AV77
200 l	2966.712	Am II	FT57
700	2966.843	Pu II	BFG84
150	2966.8982	Fe I	NJLT94
300	2966.93	Hf I	MCS75
150	2967.184	Ne II	P71
25	2967.225	Ti I	F91
250 P	2967.280	Hg I	BAL50
400	2967.29	Te II	HM64
25	2967.64	Cr I	K53
120	2967.936	U II	BW92b
150	2968.374	V II	ICL88
25	2968.66	Rh I	MCS75
80	2968.81	Hf II	MCS75
700 P	2969.035	Pu II	BFG84
1000 l	2969.125	Bk II	WC78
200 l	2969.292	Am II	FT57
130	2969.47	Ta I	MCS75
130	2969.82	Lu II	MCS75
80	2970.0994	Fe I	NJLT94
110 P	2970.564	Yb II	M67
25	2970.97	Os I	MCS75
120	2971.066	U II	BW92b
25	2971.102	Cr I	K53
11	2971.90	Cr II	K51
500 h	2972.26	Br II	R58
90	2972.29	O I	HHMR86
700 P	2972.500	Pu II	BFG84
120	2972.571	Nb II	RCL00
20	2972.611	Mo II	SPNL01
100	2972.997	Ne II	P71
25	2973.00	Ho II	MCS75
120	2973.1323	Fe I	NJLT94
50	2973.218	Tm I	SMC73
50	2973.2354	Fe I	NJLT94
50	2974.010	Sc I	AV77
100	2974.094	Nb II	RCL00
50	2974.588	Y I	P77
30	2974.7189	Ne I	SS04
25	2975.478	Cr I	K53
150	2975.56	Ta I	MCS75
100	2975.88	Hf II	MCS75
200 P	2976.584	Ru II	JJLL94
50	2976.923	Ru I	K59
60	2977.11	W I	MCS75
600	2977.13	Na II	W71
20	2977.540	V I	DA78
15	2977.68	Rh I	MCS75
30	2979.050	Ar II	N73
130	2979.32	Xe II	H39
100	2979.461	Ne II	P71

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
25 c	2979.63	Ho II	MCS75
600	2979.66	Na II	W71
80 d	2979.71	W I	MCS75
10	2979.73	Cr II	K51
700	2980.227	Pu II	BFG84
500 r	2980.620	Cd I	BA56
600	2980.63	Na II	W71
60	2980.755	Sc I	AV77
20	2980.784	Cr I	K53
500	2980.81	Hf I	MCS75
100 r	2981.362	Cd I	BA56
60	2981.4451	Fe I	NJLT94
60	2981.48	Tm II	MCS75
70	2981.646	Ni I	LBT93
30	2982.6696	Ne I	SS04
20	2982.90	Os I	MCS75
100	2983.5696	Fe I	NJLT94
11	2983.990	Yb II	M67
700	2984.19	Na II	W71
80	2984.254	Y I	P77
250	2985.388	Zr I	J98
25	2985.849	Cr I	K53
80	2986.01	Cr I	K53
50	2986.20	Rh I	MCS75
100	2986.466	Cr I	K53
200 s	2987.238	Am II	FT57
25	2987.64	Ho II	MCS75
150	2987.645	Si I	RA65
1000 l	2987.755	Bk II	WC78
90	2988.2318	Th II	PE83
30	2988.638	Cr I	K53
130	2988.945	Ru I	K59
15	2988.965	Sc I	AV77
300 P	2989.019	Bi I	GMV85
250	2989.27	Lu I	MCS75
200 h	2990.268	Au II	RW97
100	2990.278	Nb II	RCL00
70	2990.54	Tm II	MCS75
5	2991.33	Eu II	MCS75
60	2991.4665	Pt II	SRSA92
25	2991.877	Cr I	K53
	2992.12	K I	R56
	2992.22	K I	R56
30	2992.36	Re I	MCS75
60	2992.592	Ni I	LBT93
400 h	2992.618	C II	MG93
80 P	2993.336	Bi I	GMV85
100 l	2993.508	Am II	FT57
50	2993.61	W I	MCS75
700	2994.046	Pu II	BFG84
12	2994.06	Cr I	K53
130	2994.17	Ac II	MFT57
100	2994.4268	Fe I	NJLT94
120	2994.453	Ni I	LBT93
140	2994.728	Nb II	RCL00
400 P	2994.800	Au II	RW97
9	2994.805	Yb II	M67
40	2994.967	Ru I	K59
15	2995.094	Cr I	K53
1000	2996.180	Cm II	WHGC76

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
700	2996.406	Pu II	BFG84
40	2996.571	Cr I	K53
600 P,c	2997.9622	Pt I	SRSA92
10	2998.783	Cr I	K53
140	2999.04	Gd II	MCS75
1000	2999.385	Cm I	WHGC76
50	2999.5117	Fe I	NJLT94
100 P	2999.60	Re I	MCS75
700	3000.572	Pu II	BW92b
60	3000.88	Cr I	K53
80	3000.9478	Fe I	NJLT94
150	3001.668	Ne II	P71
40	3002.2641	Pt I	SRSA92
110	3002.407	Er II	M64b
500 P	3002.485	Ni I	LBT93
1000 P,w	3003.21	Po I	C66a
250	3003.621	Ni I	LBT93
40	3003.63	Ir I	MCS75
300	3004.15	Na II	W71
200 s	3004.250	Am II	FT57
40	3005.06	Cr I	K53
400	3005.56	Hf I	MCS75
15	3005.766	Yb II	M67
40	3006.588	Ru I	K59
400	3007.44	Na II	W71
50	3008.1382	Fe I	NJLT94
500 P	3009.133	Sn I	B64
400	3009.14	Na II	W71
6	3009.392	Yb II	M67
250	3010.13	Gd II	MCS75
300 l	3011.10	Pa II	BW92b
250	3011.743	Zr I	J98
500 P	3012.001	Ni I	LBT93
800 P	3012.54	Ta II	MCS75
130	3012.90	Hf II	MCS75
40	3013.7	He I	BDD72
40	3013.72	Cr I	K53
40	3014.756	Cr I	K53
1000 b	3014.867	Cm II	WHGC76
70	3014.932	Cr I	K53
40	3015.197	Cr I	K53
150	3015.30	Tm II	MCS75
90	3015.367	Sc I	AV77
300	3015.40	Na II	W71
9	3016.02	Re I	MCS75
100 c	3016.387	Pb II	WRSH74
60	3016.47	W I	MCS75
250	3016.78	Hf I	MCS75
130	3016.94	Hf II	MCS75
20	3017.25	Os I	MCS75
120	3017.311	Ne II	P71
30 h	3017.43	Xe II	H39
90	3017.44	W I	MCS75
9	3017.560	Yb II	M67
140	3017.591	Cr I	K53
150 P	3018.04	Os I	MCS75
400	3018.31	Hf I	MCS75
20	3018.492	Cr I	K53
12	3018.827	Cr I	K53
40	3019.143	Ni I	LBT93

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
120	3019.349	Sc I	AV77
40	3020.01	Fe II	C74
50	3020.4907	Fe I	NJLT94
500	3020.53	Hf I	MCS75
150 P	3020.54	Lu II	MCS75
150	3020.6389	Fe I	NJLT94
20	3020.671	Cr I	K53
60	3021.0728	Fe I	NJLT94
70	3021.498	Hg I	BAL50
140	3021.576	Cr I	K53
130	3022.210	U II	BW92b
50	3024.0327	Fe I	NJLT94
60	3024.359	Cr I	K53
300 P	3024.621	Bi I	GMV85
50	3025.8423	Fe I	NJLT94
9	3026.669	Yb II	M67
300 P	3027.016	Ne II	P71
110 d	3027.48	Ta I	MCS75
200	3027.60	Gd II	MCS75
100 s	3027.990	Am II	FT57
90	3028.038	Zr II	J98
110	3028.440	Nb II	RCL00
300 P	3028.864	Ne II	P71
20*	3029.121	Li II	HM59
20*	3029.136	Li II	HM59
8	3029.165	Cr I	K53
30 P	3029.204	Au I	ED71
250	3029.515	Zr I	J98
200 r	3029.809	Sb I	SM02
700	3029.924	Pu II	BFG84
40	3030.25	Cr I	K53
7	3030.45	Re I	MCS75
40	3030.70	Os I	MCS75
15	3030.759	Sc I	AV77
100	3030.787	Ne II	P71
50	3031.110	Yb II	M67
50	3031.16	Hf II	MCS75
7	3031.346	Cr I	K53
130	3031.987	U II	BW92b
140	3032.778	Sn I	B64
250	3032.84	Gd II	MCS75
15	3033.508	Ar II	N73
300 s	3033.59	Pa II	BW92b
200	3034.05	Gd II	MCS75
90	3034.0654	Th II	PE83
600 P	3034.115	Sn I	B64
20	3034.191	Cr I	K53
120	3034.461	Ne II	P71
	3034.76	K I	R56
	3034.92	K I	R56
100	3035.923	Ne II	P71
250	3036.10	Cu I	S48
20	3036.4425	Pt I	SRSA92
30	3037.049	Cr I	K53
80	3037.3887	Fe I	NJLT94
100	3037.720	Ne II	P71
200	3037.932	Ni I	LBT93
30	3038.288	Dy II	NG00
100 l	3038.363	Am II	FT57
300 P	3039.067	Ge I	AM59

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400 P	3039.356	In I	P38
100	3039.586	Ne II	P71
30	3040.837	Cr I	K53
100	3040.90	Os I	MCS75
10	3041.699	Mo I	WB88
50 d	3041.73	W I	MCS75
800 P,c	3042.6318	Pt I	SRSA92
15	3042.74	Os II	MCS75
20	3043.119	V I	DA78
300	3043.30	Ac II	MFT57
20	3043.548	V I	DA78
150	3044.005	Co I	PT96
100	3044.088	Ne II	P71
12	3044.566	Mn I	CMG64
1000 P	3044.848	Cm II	WHGC76
20	3044.933	V I	DA78
20	3045.363	Y I	P77
100	3045.556	Ne II	P71
50	3046.44	W I	MCS75
400	3047.00	Te II	HM64
120	3047.556	Ne II	P71
80	3047.6045	Fe I	NJLT94
100	3049.0924	Th II	PE83
30 c	3049.38	Ho II	MCS75
200	3049.56	Ta I	MCS75
90	3049.69	W I	MCS75
40	3050.073	Al I	KM91b
120	3050.197	U II	BW92b
300	3050.76	Hf I	MCS75
400 P	3050.816	Ni I	LBT93
11	3051.36	Rb II	R75
15 h	3053.184	Si II	S61b
40	3053.653	V I	DA78
500	3053.67	Na II	W71
40 s	3053.688	Am II	FT57
40	3053.87	Cr I	K53
25 c	3054.00	Ho II	MCS75
200	3054.312	Ni I	LBT93
100	3054.345	Ne II	P71
9	3054.362	Mn I	CMG64
100	3054.677	Ne II	P71
120	3054.833	Zr II	J98
5 c,w	3054.94	Eu II	MCS75
600	3056.16	Na II	W71
100	3056.334	V I	DA78
120	3056.72	Lu II	MCS75
500	3057.02	Hf I	MCS75
50	3057.144	Al I	KM91b
30	3057.3907	Ne I	SS04
60	3057.4458	Fe I	NJLT94
30 c	3057.45	Ho II	MCS75
250	3057.639	Ni I	LBT93
130	3057.939	U II	BW92b
300 P	3058.66	Os I	MCS75
11	3058.975	Eu I	ST76
100	3059.0857	Fe I	NJLT94
100	3059.106	Ne II	P71
400	3060.25	Na II	W71
120	3060.456	V I	DA78
400	3061.35	Na II	W71

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
20	3062.19	Os I	MCS75
100	3062.491	Ne II	P71
130	3062.537	U II	BW92b
200	3063.008	Ce II	C73
100	3063.301	Ne II	P71
250	3063.41	Cu I	S48
30	3064.274	Mo I	WB88
60	3064.618	Ni I	LBT93
1000 P,c	3064.7110	Pt I	SRSA92
40	3064.834	Ru I	K59
6	3065.040	Yb II	M67
20	3065.04	Mo II	MCS75
100 l	3065.40	Es	WLGC74
25	3065.424	Au I	ED71
110 d	3066.229	Ti II	HJLW82
200	3066.374	V I	DA78
250	3067.021	Ge I	AM59
30	3067.40	Re I	MCS75
400	3067.41	Hf I	MCS75
1000 P,c	3067.700	Bi I	WBBF01
110	3067.7294	Th II	PE83
110	3068.64	Gd II	MCS75
90	3068.89	Ir I	MCS75
200	3069.24	Ta I	MCS75
130	3069.36	Ac II	MFT57
6	3069.94	Re I	MCS75
100	3070.887	Ne II	P71
300 l	3071.24	Pa II	BW92b
100	3071.529	Ne II	P71
30 P	3071.584	Ba I	KL99
20	3071.9336	Pt I	SRSA92
90	3072.1150	Th II	PE83
50	3072.117	Ti II	HJLW82
300	3072.41	Pm II	RCWM80
50	3072.53	Er II	M64b
120	3072.783	U II	BW92b
1000 P	3072.88	Hf I	MCS75
90	3072.986	Ti II	HJLW82
70	3073.08	Tm II	MCS75
60	3073.344	Er II	M64b
30	3074.369	Mo I	WB88
110	3074.79	Hf I	MCS75
130	3075.231	Ti II	HJLW82
100	3075.731	Ne II	P71
60 P	3075.8971	Zn I	GL00
120	3076.865	Nb II	RCL00
70	3076.92	Gd II	MCS75
140	3077.24	Ta I	MCS75
4	3077.36	Eu II	MCS75
400 P	3077.60	Lu II	MCS75
40	3077.72	Os I	MCS75
200 P	3078.651	Ti II	HJLW82
250	3078.75	I II	MC60
150	3078.8280	Th II	PE83
120	3078.905	Tb II	B01
110	3080.2170	Th II	PE83
50	3080.752	Ni I	LBT93
200	3080.84	Hf I	MCS75
40	3081.121	Tm I	SMC73
700 P,h	3081.47	Lu I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
250	3081.99	Gd II	MCS75
70	3082.083	Er II	M64b
500 P	3082.153	Al I	KM91b
30 c	3082.34	Ho II	MCS75
10	3082.43	Re I	MCS75
20	3083.96	Rh I	MCS75
60	3084.020	Er II	M64b
60	3084.36	Ho II	MCS75
30	3085.616	Mo I	WB88
25 c	3086.54	Ho II	MCS75
20	3087.62	Mo II	MCS75
300 P	3088.042	Ti II	HJLW82
120	3088.166	Ne II	P71
6	3089.102	Yb II	M67
3	3091.065	Mg I	KM91a
700 P	3091.570	Tl II	JKBL96
100	3092.092	Ne II	P71
800 P	3092.710	Al I	KM91b
600 P	3092.73	Na II	W71
200 P	3092.839	Al I	KM91b
120	3092.901	Ne II	P71
4	3092.984	Mg I	KM91a
120	3093.005	U II	BW92b
1000 P	3093.102	V II	ICL88
300 l	3093.23	Pa II	BW92b
15	3093.402	Ar II	N73
100	3094.006	Ne II	P71
500 P	3094.176	Nb II	RCL00
400	3094.45	Na II	W71
20	3094.663	Mo I	WB88
100	3095.103	Ne II	P71
400	3095.55	Na II	W71
30	3096.565	Ru I	K59
110	3096.8104	Pt II	SRSA92
2	3096.890	Mg I	KM91a
100	3097.131	Ne II	P71
80	3098.60	Tm II	MCS75
100	3099.10	Tc I	BMC67
80	3099.284	Ru I	K59
25	3100.0252	Pt I	SRSA92
30	3100.29	Ir I	MCS75
30	3100.45	Ir I	MCS75
400	3100.50	Gd II	MCS75
13	3100.67	Re I	MCS75
70	3100.836	Ru I	K59
20	3101.344	Mo I	WB88
40	3101.40	Hf II	MCS75
300 P	3101.557	Ni I	LBT93
150	3101.79	K I	R56
150	3101.878	Ni I	LBT93
120	3102.04	K I	R56
800 P	3102.292	V II	ICL88
120	3102.422	U II	BW92b
70	3102.55	Gd II	MCS75
200	3103.25	Ta I	MCS75
200	3105.00	K II	D26
30	3106.162	Eu I	ST76
120	3106.576	Zr II	J98
9	3107.902	Yb II	M67
120	3108.2968	Th II	PE83

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	3108.60	Cu I	S48
13	3108.81	Re I	MCS75
80	3109.12	Hf II	MCS75
20	3109.38	Os I	MCS75
1000 P	3109.690	Cm I	WHGC76
700 P	3110.709	V II	ICL88
90 P	3111.427	Eu I	ST76
200	3111.618	U II	BW92b
50	3112.119	Mo I	WB88
130	3112.83	Ac II	MFT57
100	3114.0380	Pd I	ELLW98
150	3116.2630	Th I	PE83
1000 P	3116.411	Cm I	WHGC76
11	3117.806	Yb II	M67
100	3117.980	Ne II	P71
120	3118.160	Ne II	P71
500 P	3118.376	V II	ICL88
400 P	3118.43	Lu I	MCS75
50	3118.50	Ho II	MCS75
13	3118.64	Cr II	K51
120	3119.5262	Th II	PE83
90	3119.723	Ti I	F91
25	3120.36	Cr II	K51
400 s	3120.486	Am II	FT57
100	3120.746	Zr I	J98
100	3121.87	Xe II	H39
20	3122.00	Mo II	MCS75
70	3122.64	Tc I	BMC67
70	3122.722	Er II	M64b
150 P	3122.784	Au I	ED71
120	3122.9634	Th II	PE83
25	3123.073	Ti I	F91
25	3123.70	Rh I	MCS75
90	3124.3874	Th II	PE83
900	3124.42	Na II	W71
25	3124.94	Cr II	K51
140	3124.952	U II	BW92b
150	3124.97	Ta I	MCS75
400 P	3125.282	V II	ICL88
110	3125.5071	Th II	PE83
90	3125.668	Hg I	BAL50
300 l	3126.23	Pa II	BW92b
8	3128.94	Re I	MCS75
90	3129.173	Zr II	J98
90	3129.760	Zr II	J98
140	3130.272	V II	ICL88
1000 P	3130.4219	Be II	BWWI85
150	3130.58	Ta I	MCS75
500 P	3130.782	Nb II	RCL00
600 P	3131.0667	Be II	BWWI85
150	3131.23	Tc I	BMC67
800 P	3131.26	Tm II	MCS75
80	3131.548	Hg I	BAL50
300	3131.81	Hf I	MCS75
80	3131.839	Hg I	BAL50
30	3132.05	Cr II	K51
100	3132.060	Zr I	J98
500 P	3132.594	Mo I	WB88
100	3132.64	Ta I	MCS75
100	3133.167	Cd I	BA56
200	3133.32	Ir I	MCS75
110	3133.339	V II	ICL88
250	3133.89	Tm II	MCS75
400 P	3134.104	Ni I	LBT93
400 P	3134.720	O II	MKM93
100 P	3134.72	Hf II	MCS75
1000	3135.099	Cm I	WHGC76
300	3135.25	Es I	WLGC74
40	3135.384	Dy II	NG00
1000	3135.48	Na II	W71
150	3136.2161	Th I	PE83
1000	3137.160	Cm I	WHGC76
900	3137.86	Na II	W71
250	3138.335	O II	MKM93
120	3138.678	Zr II	J98
100	3139.3066	Th II	PE83
90	3139.3870	Pt I	SRSA92
13	3140.936	Yb II	M67
300	3141.332	Ne II	P71
100	3142.8356	Th II	PE83
100	3143.721	Ne II	P71
110	3145.00	Gd II	MCS75
120	3145.403	Nb II	RCL00
500	3145.71	Na II	W71
70	3146.0434	Th II	PE83
300 l	3146.28	Pa II	BW92b
1000	3147.325	Cm I	WHGC76
100	3148.681	Ne II	P71
60 c	3148.90	Rb II	R75
140	3149.240	U II	BW92b
1000	3149.28	Na II	W71
200	3151.04	Tm II	MCS75
8	3151.64	Re I	MCS75
15	3152.82	Mo II	MCS75
300 s	3153.09	Ac II	MFT57
100 l	3154.27	Es II	WLGC74
70	3154.3009	Th II	PE83
300 s	3154.41	Ac II	MFT57
20*	3155.308	Li II	HM59
20*	3155.330	Li II	HM59
110	3156.25	Os I	MCS75
50	3156.521	Dy II	NG00
110	3156.53	Gd II	MCS75
40	3156.5625	Pt I	SRSA92
200	3156.63	Hf I	MCS75
150	3157.34	Tm II	MCS75
200 P	3158.167	Mo I	WB88
1000	3158.599	Cm I	WHGC76
700 P	3158.869	Ca II	ER56
700	3159.201	Pu II	BFG84
120	3159.82	Hf I	MCS75
13	3161.00	Rb II	R75
40	3161.231	Ti II	HJLW82
110	3161.37	Gd II	MCS75
60	3161.798	Ti II	HJLW82
40 s	3161.826	Am II	FT57
80	3162.586	Ti II	HJLW82
80	3162.61	Hf II	MCS75
30	3162.833	Dy II	NG00
400 P	3163.401	Nb II	RCL00

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1000	3163.74	Na II	W71
90	3164.313	Zr II	J98
100	3164.429	Ne II	P71
150 s	3164.81	Ac II	MFT57
100	3165.648	Ne II	P71
150	3165.977	Zr II	J98
40 c	3166.62	Ho II	MCS75
90	3167.2244	Pt II	SRSA92
13	3168.37	Re I	MCS75
200	3168.39	Hf I	MCS75
130	3168.550	Ti II	HJLW82
7	3169.056	Yb II	M67
1000	3169.983	Cm II	WHGC76
50	3169.992	Dy II	NG00
120	3170.29	Ta I	MCS75
300 P	3170.344	Mo I	WB88
300 l	3170.89	Pa II	BW92b
300	3171.36	Lu I	MCS75
300 l	3171.54	Pa II	BW92b
25 d,l	3171.72	Ho II	MCS75
40	3172.654	Tm I	SMC73
250	3172.83	Tm II	MCS75
400	3172.94	Hf I	MCS75
300	3173.045	Y II	NJK91
300 P	3173.30	Tc I	BMC67
100	3173.59	Ta I	MCS75
50	3173.78	Ho II	MCS75
25	3173.93	Os II	MCS75
700	3174.488	Pu II	BFG84
25	3174.84	Ho II	MCS75
400 P	3175.035	Sn I	B64
4	3175.147	Te I	MV75
700	3175.152	Pu II	BFG84
100	3175.7257	Th II	PE83
50	3176.86	Hf II	MCS75
1000	3177.554	Cm I	WHGC76
1000 l	3178.466	Bk II	WC78
600	3179.06	Na II	W71
1000	3179.098	Cm I	WHGC76
800 P	3179.332	Ca II	ER56
250 P	3180.1937	Th II	PE83
120	3180.285	Nb II	RCL00
13	3180.70	Cr II	K51
7	3180.919	Yb II	M67
250	3180.95	Ta I	MCS75
700	3181.275	Ca II	ER56
50 c	3181.50	Ho II	MCS75
80	3181.919	Er II	M64b
200 P	3182.37	Tc I	BMC67
150	3182.860	Zr II	J98
11	3182.87	Re I	MCS75
13	3183.033	Mo I	WB88
200 P	3183.11	Tc I	BMC67
250 P	3183.412	V I	D76
25	3183.84	Ho II	MCS75
400 P	3183.992	V I	D76
90	3184.55	Ta I	MCS75
20	3184.76	Re I	MCS75
70	3184.9492	Th II	PE83
13	3185.104	Mo I	WB88
300 P	3185.385	V I	DA78
500	3185.51	Tl II	ES36
20	3185.57	Re I	MCS75
1000	3186.412	Cm I	WHGC76
300	3186.451	Ti I	F91
500	3186.56	Tl II	ES36
110	3187.717	V II	ICL88
500	3187.74	Tl II	ES36
20	3187.74	He I	M60a
1000	3188.109	Cm I	WHGC76
200	3188.2329	Th II	PE83
140	3188.522	V II	ICL88
100	3188.743	Ne II	P71
15	3188.97	Si II	S61b
900	3189.79	Na II	W71
200 P	3190.686	V II	ICL88
80	3190.914	Ti II	HJLW82
50	3191.19	Rh I	MCS75
150	3191.215	Zr I	J98
400	3191.993	Ti I	F91
90	3192.5856	Th I	PE83
20	3192.885	Yb II	M67
15	3193.09	Si II	S61b
50	3193.2258	Fe I	NJLT94
80	3193.2998	Fe I	NJLT94
40	3193.53	Hf II	MCS75
250 P	3193.979	Mo I	WB88
150	3194.10	Cu I	S48
80	3194.19	Hf II	MCS75
120	3194.579	Ne II	P71
9	3194.720	Au I	ED71
200	3194.821	Ce II	C73
300 P	3194.975	Nb II	RCL00
500 P,c	3195.20	Tc II	BMC67
200	3195.613	Y II	NJK91
90	3195.6891	Th I	PE83
10	3195.960	Mo I	WB88
100	3196.31	Zn II	CD68
20	3196.330	Li II	HM59
10	3196.356	Li II	HM59
12	3197.08	Cr II	K51
20	3197.13	Rh I	MCS75
25 c	3197.83	Ho II	MCS75
40	3198.012	V I	DA78
700 P	3198.467	Pu II	BFG84
500 P	3198.586	Ne II	P71
70*	3199.332	Li II	HM59
70*	3199.434	Li II	HM59
120	3199.5087	Pt II	SRSA92
7	3199.514	Si II	S61b
500	3199.915	Ti I	F91
150	3200.269	Y II	NJK91
40	3200.7097	Pt I	SRSA92
13	3201.160	Yb II	M67
300	3201.712	Ce II	C73
25	3201.76	Ho II	MCS75
60	3202.389	V I	DA78
60	3202.559	Ti II	HJLW82
15 c	3203.10	He II	GM65
150	3203.320	Y II	NJK91

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
30	3203.825	Ti I	F91
20 h	3203.872	Si II	S61b
80	3204.0364	Pt I	SRSA92
20 c	3204.25	Re I	MCS75
11	3205.217	Mo I	WB88
40	3205.577	V I	DA78
30	3205.887	Mo I	WB88
140	3206.11	Hf I	MCS75
1000	3207.121	Cm II	WHGC76
60	3207.25	W I	MCS75
40	3207.408	V I	DA78
1000	3207.708	Cm I	WHGC76
12	3208.169	Hg II	SR01
100 P	3208.838	Mo I	WB88
60	3208.965	Ne II	P71
9	3209.19	Cr II	K51
120	3209.356	Ne II	P71
1000	3209.892	Cm II	WHGC76
1000	3209.943	Cm I	WHGC76
30 h	3210.020	Si II	RA65
1000	3210.050	Cm II	WHGC76
40	3210.566	Eu I	ST76
150	3212.016	Zr I	J98
700 P	3212.02	Tc II	BMC67
40	3212.12	Ir I	MCS75
900	3212.19	Na II	W71
30	3212.432	V I	DA78
90 P	3212.804	Eu I	ST76
20	3213.31	Os II	MCS75
120	3213.735	Ne II	P71
40	3213.745	Eu I	ST76
130	3214.189	Zr II	J98
30	3214.237	Ti I	F91
150	3214.329	Ne II	P71
90	3214.3801	Th I	PE83
20	3215.072	Mo I	WB88
120 P	3215.56	W I	MCS75
120	3215.593	Nb II	RCL00
40	3216.627	Dy II	NG00
300	3216.680	Y II	NJK91
90	3217.073	Ti II	HJLW82
300	3217.16	K I	R56
250	3217.62	K I	R56
150	3218.193	Ne II	P71
200	3218.925	Tb II	B01
200	3218.944	Ce II	C73
200	3219.982	Tb II	B01
2	3220.528	Pb I	WA68
80	3220.729	Er II	M64b
1000	3220.759	Cm II	WHGC76
300 P	3220.78	Ir I	MCS75
700 P	3220.942	Pu II	BFG84
250	3221.171	Ce II	C73
130	3221.2912	Th II	PE83
12	3221.734	Mo I	WB88
30	3222.0591	Fe I	NJLT94
110	3222.839	Ti II	HJLW82
60	3223.306	Er II	M64b
80*	3223.74	Gd II	MCS75
1000 P	3224.226	Cm I	WHGC76

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
120	3224.818	Ne II	P71
700 P	3224.873	Pu II	BFG84
1000 P	3225.108	Cm I	WHGC76
250 P	3225.467	Nb II	RCL00
60	3225.7871	Fe I	NJLT94
1000	3226.412	Cm II	WHGC76
200	3227.114	Ce II	C73
1	3227.98	Rb I	RE80
40	3228.092	Mn I	CMG64
30	3228.212	Mo I	WB88
40	3228.618	Ti II	HJLW82
130	3229.0096	Th II	PE83
60	3229.194	Ti II	HJLW82
40	3229.430	Ti II	HJLW82
150	3229.499	U II	BW92b
120	3229.573	Ne II	P71
60 P	3229.75	Tl I	MCS75
20	3229.795	Mo I	WB88
200	3230.070	Ne II	P71
1000	3230.278	Cm I	WHGC76
12	3230.2837	Pt I	SRSA92
1000	3230.349	Cm II	WHGC76
120	3230.419	Ne II	P71
200 P	3230.582	Er II	M64b
130 s	3230.59	Ac II	MFT57
25	3230.632	Au I	ED71
11	3230.716	Mn I	CMG64
110	3231.692	Zr II	J98
120	3232.022	Ne II	P71
70	3232.06	Os I	MCS75
140	3232.156	U II	BW92b
500 d	3232.224	Pu I	BFG84
150	3232.372	Ne II	P71
250 P,r	3232.495	Sb I	SM02
2*	3232.633	Li I	REB95
2*	3232.643	Li I	REB95
130	3232.933	Ni I	LBT93
40	3233.142	Mo I	WB88
7	3233.4167	Pt I	SRSA92
200	3234.123	Zr I	J98
200	3234.161	Ce II	C73
600 P	3234.513	Ti II	HJLW82
110	3235.8400	Th II	PE83
7	3235.94	Re I	MCS75
30	3236.2224	Fe I	NJLT94
120	3236.410	Nb II	RCL00
400 P	3236.581	Ti II	HJLW82
1000	3236.737	Cm I	WHGC76
30	3236.778	Mn I	CMG64
130	3236.81	Tm II	MCS75
700 P	3237.02	Tc II	BMC67
30	3237.060	Mo I	WB88
140	3238.1157	Th II	PE83
1000	3238.548	Cm II	WHGC76
300 P	3239.038	Ti II	HJLW82
2	3240.186	Pb I	WA68
200	3240.23	Tm II	MCS75
300 l	3240.58	Pa II	BW92b
130	3241.044	Zr II	J98
250	3241.54	Tm II	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	3241.994	Ti II	HJLW82
500 P	3242.272	Y II	NJK91
1000 P	3242.657	Cm II	WHGC76
500 P	3242.6983	Pd I	ELLW98
70	3243.054	Ni I	LBT93
150 h	3243.16	Cu I	S48
100	3243.396	Ne II	P71
7	3243.689	Ar II	N73
12	3243.777	Mn I	CMG64
100	3244.095	Ne II	P71
500	3244.162	Pu I	BFG84
200	3244.4488	Th I	PE83
60	3245.13	La II	MCS75
700 P	3245.206	Pu II	BFG84
1000	3246.247	Cm I	WHGC76
30	3246.963	Tm I	SMC73
1000 P,s	3247.262	Bk II	WC78
1000 P	3247.54	Cu I	S48
150	3247.66	Hf I	MCS75
100	3248.345	Ne II	P71
25	3248.512	Mn I	CMG64
100	3248.605	Ti II	HJLW82
100	3249.53	Hf I	MCS75
50	3249.868	Li II	HM59
100	3250.355	Ne II	P71
90	3250.393	Zr I	J98
50	3251.268	Dy II	NG00
110	3251.6361	Pd I	ELLW98
80	3251.909	Ti II	HJLW82
70	3251.9159	Th II	PE83
30	3251.9787	Pt I	SRSA92
500	3252.070	Pu I	BFG84
1000	3252.191	Bk I	WC78
150	3252.524	Cd I	BA56
1000 b	3252.675	Cm I	WHGC76
100	3252.916	Ti II	HJLW82
11	3252.949	Mn I	CMG64
100 P	3253.70	Hf II	MCS75
100	3254.066	Nb II	RCL00
100	3254.251	Ti II	HJLW82
250 P	3254.31	Lu II	MCS75
200	3254.377	Sm II	K35
70	3255.676	Sc I	AV77
50	3255.9088	Pt I	SRSA92
700 P	3256.089	In I	P38
11	3256.137	Mn I	CMG64
30	3256.208	Mo I	WB88
200	3256.2738	Th II	PE83
300	3257.3667	Th I	PE83
6	3257.826	Cr I	K53
800	3257.96	Na II	W71
200	3258.05	Tm II	MCS75
150 P	3258.565	In I	P38
150	3258.7765	Pd I	ELLW98
11	3258.85	Re I	MCS75
50	3259.050	Er II	M64b
11	3259.55	Re I	MCS75
60	3260.111	Zr I	J98
700 d	3260.539	Pu II	BFG84
300	3260.91	Ac II	MFT57
150	3261.055	Cd I	BA56
7	3261.508	Yb II	M67
100	3261.585	Ti II	HJLW82
110 P	3262.29	Os I	MCS75
400 P	3262.331	Sn I	B64
1	3262.355	Pb I	WA68
10	3262.626	Mo I	WB88
200	3262.6684	Th II	PE83
60	3263.14	Rh I	MCS75
1000 s	3263.473	Bk II	WC78
15	3264.401	Mo I	WB88
250 P	3264.782	Er II	M64b
500	3265.177	Pu I	BFG84
60	3265.67	La II	MCS75
1000	3265.806	Cm I	WHGC76
200	3266.64	Tm II	MCS75
110	3266.73	Gd I	MCS75
130	3267.40	Tm II	MCS75
300 P,r	3267.491	Sb I	SM02
300	3267.702	V II	ICL88
110 P	3267.94	Os I	MCS75
10	3268.4170	Pt I	SRSA92
90	3268.99	Tm II	MCS75
20	3269.21	Os I	MCS75
40 P	3269.489	Ge I	AM59
200 P	3269.897	Sc I	AV77
30	3270.899	Mo I	WB88
20	3270.99	Rb II	R75
250	3271.124	V II	ICL88
60	3271.61	Rh I	MCS75
200	3272.0268	Th I	PE83
90	3272.222	Zr II	J98
300	3272.253	Ce II	C73
200	3273.047	Zr II	J98
700 P	3273.111	Pu II	BFG84
250 P	3273.628	Sc I	AV77
1000 P	3273.96	Cu I	S48
500	3274.22	Na II	W71
300	3274.46	Pa II	BW92b
700 P	3275.125	Pu II	BFG84
20	3275.20	Os I	MCS75
500	3275.236	Pu I	BFG84
200 P	3276.130	V II	ICL88
120	3276.81	Tm II	MCS75
4	3277.78	Eu II	MCS75
25 c	3278.15	Ho II	MCS75
500 P	3278.97	Lu I	MCS75
250 P	3279.264	Zr II	J98
700 P	3279.326	Pu II	BFG84
70	3279.326	Er II	M64b
40	3280.091	Dy II	NG00
70	3280.218	Er II	M64b
1000	3280.450	Cm I	WHGC76
250	3280.55	Rh I	MCS75
1000 P,r	3280.680	Ag I	PZ01
1000 P	3281.74	Lu I	MCS75
11	3281.9670	Pt I	SRSA92
60 c	3281.97	Ho II	MCS75
100 s	3282.320	Am II	FT57
50 P	3282.3256	Zn I	GL00

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90	3282.732	Zr I	J98
50 P	3283.140	Sn II	B64
130	3283.40	Tm II	MCS75
250	3283.57	Rh I	MCS75
150	3284.712	Zr II	J98
200	3285.030	Tb II	B01
11	3285.355	Mo I	WB88
1000 P	3285.60	Na II	W71
130	3285.61	Tm II	MCS75
200	3285.7525	Th I	PE83
40 l	3286.666	Am II	FT57
300	3287.472	O II	MKM93
40	3287.657	Ti II	HJLW82
150	3287.7893	Th II	PE83
25	3288.46	Ho II	MCS75
1000 P,l	3288.750	Bk I	WC78
40	3289.011	Mo I	WB88
30	3289.14	Rh I	MCS75
1000 P	3289.347	Bk I	WC78
1000 P	3289.370	Yb II	M67
700 P	3289.977	Pu II	BFG84
25	3290.2196	Pt I	SRSA92
40	3290.26	Os I	MCS75
700 P	3290.345	Pu II	BFG84
150 h	3290.54	Cu I	S48
30	3290.820	Mo I	WB88
250	3291.00	Tm II	MCS75
500	3291.01	Tl II	ES36
150	3291.332	U II	BW92b
90	3291.48	Gd I	MCS75
200	3291.7394	Th II	PE83
40	3292.076	Ti I	F91
150	3292.5209	Th II	PE83
500	3292.560	Pu I	BFG84
250	3293.065	Tb II	B01
8	3293.640	Ar II	N73
90	3294.08	Gd I	MCS75
40	3294.109	Ru I	K59
20	3294.28	Rh I	MCS75
20	3296.01	Nb I	MCS75
1000	3296.708	Cm II	WHGC76
80	3297.600	Ni II	S70
150	3297.726	Ne II	P71
1000 P	3298.14	Cf I	RCWM80
30	3300.46	Rh I	MCS75
80	3300.82	W I	MCS75
900	3301.35	Na II	W71
250 P	3301.56	Os I	MCS75
30	3301.593	Ru I	K59
400	3301.6511	Th I	PE83
500	3301.754	Pu I	BFG84
250 P	3301.8596	Pt I	SRSA92
150	3302.1262	Pd I	ELLW98
15 P	3302.37	Na I	R56
200	3302.46	Tm II	MCS75
200 P	3302.5829	Zn I	GL00
70 P	3302.9395	Zn I	GL00
8 P	3302.98	Na I	R56
90	3303.11	La II	MCS75
50	3303.21	Re II	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
800 P	3304.2383	Th I	PE83
1000 P	3304.849	Cm I	WHGC76
800	3304.96	Na II	W71
90	3305.152	Zr II	J98
7	3305.252	Yb I	MT78
11	3305.563	Mo I	WB88
8	3305.733	Yb II	M67
200	3305.8912	U II	SPMR72
150	3306.277	Zr II	J98
40	3306.284	Li II	HM59
400	3306.388	Sm II	K35
200	3307.017	Sm II	K35
11	3307.125	Mo I	WB88
7	3307.228	Ar II	N73
250 h	3307.95	Cu I	S48
25	3308.305	Au I	ED71
50	3308.883	Dy II	NG00
200	3309.3654	Th I	PE83
30	3309.497	Ti I	F91
25	3309.638	Au I	ED71
150	3309.740	Ne II	P71
130	3309.80	Tm II	MCS75
150	3310.27	Hf I	MCS75
200	3310.661	Sm II	K35
20	3310.91	Os I	MCS75
400 P	3311.16	Ta I	MCS75
50	3311.38	W I	MCS75
800 P	3312.11	Lu I	MCS75
200 P	3312.424	Er II	M64b
25	3312.60	Nb I	MCS75
700 P	3312.647	Pu II	BFG84
300	3312.86	Hf I	MCS75
110	3314.421	Ti I	F91
150 P	3315.0419	Pt I	SRSA92
80	3315.663	Ni I	LBT93
40	3316.316	Dy II	NG00
50	3316.390	Er II	M64b
1000	3317.143	Cm I	WHGC76
30	3318.021	Ti II	HJLW82
600	3318.04	Na II	W71
250	3318.84	Ta I	MCS75
4	3319.412	Yb I	MT78
300	3319.722	Ne II	P71
50	3319.878	Dy II	NG00
40	3320.259	Ni I	LBT93
500	3320.607	Pu I	BFG84
500	3320.834	Pu I	BFG84
300	3321.179	Sm II	K35
100 P	3321.340	Be I	KM97
120	3321.4508	Th II	PE83
15	3321.49	Rb II	R75
50	3321.697	Ti II	HJLW82
40	3322.309	Ni I	LBT93
11	3322.48	Re I	MCS75
250	3322.939	Ti II	HJLW82
400 P	3323.09	Rh I	MCS75
70	3323.195	Er II	M64b
1000 P	3323.745	Ne II	P71
20	3323.949	Mo I	WB88
700 P	3324.413	Tb II	B01

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90	3324.7527	Th II	PE83
200	3325.1207	Th II	PE83
12	3325.674	Mo I	WB88
50	3326.20	W I	MCS75
30	3326.765	Ti II	HJLW82
150	3327.153	Ne II	P71
12	3327.304	Mo I	WB88
500	3327.69	Na II	W71
400	3327.876	Y II	NJK91
250	3328.60	Po I	C66a
100	3329.158	Ne II	P71
200	3329.458	Ti II	HJLW82
3	3329.919	Mg I	KM91a
400	3330.4770	Th I	PE83
15	3330.775	Mn II	IV64
140 d	3330.99	Ta II	MCS75
150	3331.38	Gd II	MCS75
50	3331.69	W I	MCS75
300	3331.875	Ni II	S70
50	3332.112	Ti II	HJLW82
90	3332.13	Gd II	MCS75
300 l	3332.69	Pa II	BW92b
70	3332.702	Er II	M64b
400	3332.73	Hf I	MCS75
20	3333.139	Si II	S61b
90 P	3334.313	Eu I	ST76
150	3334.6041	Th II	PE83
200	3334.836	Ne II	P71
150	3335.182	Ti II	HJLW82
1000	3335.261	Bk I	WC78
30	3336.15	Os I	MCS75
130	3336.18	Gd II	MCS75
8	3336.394	Mn II	IV64
13	3337.171	Yb II	M67
40 c	3337.23	Ho II	MCS75
150	3337.49	La II	MCS75
700 P	3337.708	Pu II	BFG84
150	3337.84	Cu I	S48
150	3337.8703	Th II	PE83
40	3338.18	Re I	MCS75
40	3338.54	Rh I	MCS75
25 c	3338.86	Ho II	MCS75
500	3338.942	Pu I	BFG84
80	3339.555	Ru I	K59
7	3339.81	Cr II	K51
30	3339.819	Si II	S61b
90	3340.341	Ti II	HJLW82
13	3340.55	Rb II	R75
130	3340.553	Zr II	J98
200	3340.579	Sm II	K35
40	3340.993	Dy II	NG00
700	3341.874	Ti I	F91
80 P	3341.97	Nb I	MCS75
30	3342.24	Re I	MCS75
15 d	3342.93	Yb II	M67
4	3343.071	Yb II	M67
60 c	3343.58	Ho II	MCS75
80 P	3343.71	Nb I	MCS75
10 l	3343.867	Am I	FT57
9	3343.8961	Pt I	SRSA92

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
15	3344.32	Re I	MCS75
150	3344.395	Ne II	P71
100	3344.56	La II	MCS75
40	3344.730	Mo I	WB88
400 P	3345.0134	Zn I	GL00
25	3345.2555	Pt II	SRSA92
300	3345.453	Ne II	P71
80 P	3345.5694	Zn I	GL00
150	3345.829	Ne II	P71
15 P	3345.9353	Zn I	GL00
70	3345.98	Gd II	MCS75
120	3346.036	Er II	M64b
300 s	3346.661	Pa II	G67
30	3346.745	Ti II	HJLW82
11	3347.004	Mo I	WB88
1	3348.72	Rb I	RE80
500 P	3348.7684	Th I	PE83
400 P	3349.029	Ti II	HJLW82
110 P	3349.06	Nb I	MCS75
1000 P	3349.405	Ti II	HJLW82
25	3349.52	Nb I	MCS75
25	3349.987	Tm I	SMC73
700 P	3350.330	Pu II	BFG84
10	3350.397	Eu I	ST76
600 P	3350.47	Gd II	MCS75
1	3350.82	Rb I	RE80
8	3350.924	Ar II	N73
250 P	3351.2286	Th II	PE83
60 P	3351.952	Sn II	B64
40	3352.06	Hf II	MCS75
6	3352.491	Yb II	M67
1000 P	3352.71	Cf I	RCWM80
400 P	3353.724	Sc II	JL80
70	3354.1796	Th II	PE83
1	3354.55	He I	M60a
500	3354.633	Ti I	F91
20	3354.74	Nb I	MCS75
200	3355.016	Ne II	P71
40	3355.2278	Fe I	NJLT94
130	3356.087	Zr II	J98
90	3357.261	Zr II	J98
120	3357.820	Ne II	P71
120	3357.8437	U I	SPMR72
60	3358.118	Mo I	WB88
40	3358.271	Ti I	F91
110 P	3358.42	Nb I	MCS75
9	3358.49	Cr II	K51
150	3358.6020	Th II	PE83
500 P	3358.62	Gd II	MCS75
100	3358.676	Ni II	S70
100	3358.91	Hf I	MCS75
1000 P	3359.56	Lu I	MCS75
70	3359.668	Sc II	JL80
200	3360.597	Ne II	P71
90	3360.71	Gd II	MCS75
30	3360.80	Rh I	MCS75
40	3360.989	Ti I	F91
600 P	3361.227	Ti II	HJLW82
60	3361.257	Sc II	JL80
40	3361.266	Ti I	F91

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	3361.554	Ni I	LBT93
60	3361.926	Sc II	JL80
120	3362.161	Ne II	P71
600 P	3362.23	Gd II	MCS75
6	3362.438	Yb II	M67
100 s	3362.546	Am II	FT57
400 P	3362.61	Tm II	MCS75
100	3362.707	Ne II	P71
30	3363.778	Mo I	WB88
130	3364.078	Er II	M64b
40	3365.765	Ni I	LBT93
300	3365.863	Sm II	K35
40	3366.166	Ni I	LBT93
70 h	3366.72	Xe II	H39
20	3366.96	Nb I	MCS75
120	3367.218	Ne II	P71
1000 l	3367.79	Cf II	RCWM80
90	3367.8189	Th II	PE83
130 d	3368.022	Er II	M64b
25	3368.04	Cr II	K51
40	3368.38	Rh I	MCS75
30	3368.455	Ru I	K59
30	3368.48	Ir I	MCS75
140	3368.936	Sc II	JL80
500	3369.15	Tl II	ES36
400	3369.566	Ni I	LBT93
50	3369.8076	Ne I	SS04
70	3369.9072	Ne I	SS04
140	3370.434	Ti I	F91
30	3370.59	Os I	MCS75
600	3371.452	Ti I	F91
250	3371.54	Ta I	MCS75
100	3371.799	Ne II	P71
50	3371.987	Ni I	LBT93
250 P	3372.150	Sc II	JL80
120	3372.25	Rh I	MCS75
700 P	3372.71	Er II	M64b
500 P	3372.798	Ti II	HJLW82
200	3372.9943	Pd I	ELLW98
50	3373.75	W I	MCS75
90	3374.173	Er II	M64b
1000	3374.696	Cm I	WHGC76
600	3374.915	Ga II	IL85
20	3374.92	Nb I	MCS75
400	3374.9749	Th I	PE83
13	3375.483	Yb II	M67
500	3375.948	Ga II	IL85
8	3376.436	Ar II	N73
800 P	3376.50	Lu I	MCS75
150	3377.486	Ti I	F91
400	3377.575	Ti I	F91
500 P	3378.216	Ne II	P71
90	3378.5734	Th II	PE83
50	3379.06	Re II	MCS75
40	3379.211	Ti I	F91
30	3379.965	Mo I	WB88
120	3380.277	Ti II	HJLW82
15	3380.41	Nb I	MCS75
400	3380.570	Ni I	LBT93
14 P	3380.71	Sr II	MCS75
200	3380.8595	Th I	PE83
150	3380.91	La II	MCS75
300	3382.399	Sm II	K35
11	3382.482	Mo I	WB88
500 P,r	3382.887	Ag I	PZ01
130 s	3383.53	Ac II	MFT57
500 P	3383.769	Ti II	HJLW82
70	3384.609	Mo I	WB88
250 P	3385.014	Dy II	NG00
140	3385.05	Ta I	MCS75
150	3385.083	Er II	M64b
120	3385.50	Lu I	MCS75
70	3385.5316	Th II	PE83
20	3385.660	Ti I	F91
200	3385.941	Ti I	F91
70	3386.5006	Th II	PE83
1000 s	3387.446	Bk II	WC78
8	3387.505	Yb I	MT78
120	3387.840	Ti II	HJLW82
20	3387.84	Os I	MCS75
100	3387.869	Zr II	J98
200	3387.9205	Th I	PE83
130	3388.295	Zr II	J98
150	3388.417	Ne II	P71
8	3388.531	Ar II	N73
30	3388.850	Dy II	NG00
120	3388.945	Ne II	P71
90	3389.83	Hf II	MCS75
250	3390.209	O II	MKM93
250	3390.3775	U I	SPMR72
150	3391.043	Ni I	LBT93
700 P	3391.405	Pu II	BFG84
1000 P	3391.972	Zr II	J98
200 P	3391.998	Er II	M64b
300 P	3392.0349	Th II	PE83
1000	3392.22	Cf I	RCWM80
20	3392.34	Nb I	MCS75
130	3392.53	Gd II	MCS75
30	3392.533	Ru I	K59
300	3392.798	Ne II	P71
100	3392.81	Hf I	MCS75
400	3392.986	Ni I	LBT93
13	3393.03	Rb II	R75
100	3393.119	Zr II	J98
150	3393.567	Dy II	NG00
300 l	3394.49	Pa II	BW92b
90	3394.578	Ti II	HJLW82
20 l	3395.010	Am I	FT57
100	3395.373	Co I	PT96
60	3396.156	Dy II	NG00
5	3396.58	Eu II	MCS75
300	3396.7278	Th I	PE83
600 P	3396.82	Rh I	MCS75
200	3396.82	Lu I	MCS75
250 P	3397.07	Lu II	MCS75
70 c	3397.198	Bi I	GMV85
100	3397.26	Hf I	MCS75
200	3397.50	Tm II	MCS75
100	3397.60	Hf I	MCS75
400	3398.5448	Th I	PE83

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500 P,c	3398.95	Ho II	MZH78
70 P	3399.30	Re I	MCS75
90	3399.70	Rh I	MCS75
250 P	3399.80	Hf II	MCS75
700 d	3401.09	Pu II	BFG84
20	3401.86	Os I	MCS75
9	3403.30	Cr II	K51
400 P	3403.652	Cd I	BA56
20	3404.335	Mo I	WB88
1000 P	3404.5764	Pd I	ELLW98
12	3404.72	Re I	MCS75
100	3404.822	Ne II	P71
100	3404.827	Zr II	J98
500 P	3405.118	Co I	PT96
300	3405.5584	Th I	PE83
12	3405.89	Re I	MCS75
40	3405.94	Mo I	MCS75
15	3406.55	Rh I	MCS75
800	3406.79	Te II	HM64
150	3406.94	Ta I	MCS75
120	3406.947	Ne II	P71
50	3407.4597	Fe I	NJLT94
130*	3407.56	Gd II	MCS75
130*	3407.61	Gd II	MCS75
250 P	3407.792	Dy II	NG00
900 P,c	3408.1308	Pt I	SRSA92
1000	3408.281	Bk I	WC78
15	3408.38	Nb I	MCS75
200	3408.676	Sm II	K35
20	3408.76	Cr II	K51
200	3409.176	Co I	PT96
80	3410.048	Tm I	SMC73
130	3410.243	Zr II	J98
50 c	3410.26	Ho II	MCS75
25 c	3410.65	Ho II	MCS75
1000 P,l	3412.131	Bk II	WC78
90	3412.27	Rh I	MCS75
300	3412.337	Co I	PT96
30	3412.590	Tm I	SMC73
100	3412.633	Co I	PT96
400	3413.0130	Th I	PE83
100	3413.148	Ne II	P71
1000	3413.17	Es	WLGC74
40	3413.476	Ni I	LBT93
60	3413.783	Dy II	NG00
130	3413.84	Ac II	MFT57
40	3413.936	Ni I	LBT93
1000 P	3414.764	Ni I	LBT93
90 c	3414.90	Ho II	MCS75
300 P	3416.44	Ho II	MZH78
30	3416.588	Tm I	SMC73
120	3416.914	Ne II	P71
150	3416.95	Gd II	MCS75
130	3417.157	Co I	PT96
300	3417.332	Ru I	K59
100	3417.34	Hf I	MCS75
120	3417.688	Ne II	P71
200	3417.77	Ac II	MFT57
30	3417.8034	Pt II	SRSA92
50	3417.9031	Ne I	SS04

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
5	3418.0055	Ne I	SS04
8	3418.390	Yb I	MT78
150	3418.73	Gd II	MCS75
200	3419.18	Hf I	MCS75
15	3419.41	Re I	MCS75
40	3419.631	Dy II	NG00
40 s	3419.662	Am II	FT57
11	3421.19	Cr II	K51
700 P	3421.2100	Th I	PE83
40	3421.22	Rh I	MCS75
500 P	3421.2214	Pd I	ELLW98
80	3421.63	Ho II	MCS75
800 P	3422.47	Gd II	MCS75
14	3422.73	Cr II	K51
200	3423.708	Ni I	LBT93
250*	3423.90	Gd I	MCS75
250*	3423.92	Gd II	MCS75
500	3423.9897	Th I	PE83
120	3424.5566	U II	SPMR72
90	3424.59	Gd II	MCS75
150 P	3424.62	Re I	MCS75
700 P	3425.08	Tm II	MCS75
120 c	3425.34	Ho II	MCS75
110	3425.63	Tm II	MCS75
20	3426.044	Yb I	MT78
7	3426.19	Re I	MCS75
1	3426.86	Na I	R56
1000 P	3426.951	Bk I	WC78
50	3427.1194	Fe I	NJLT94
500	3427.40	Pm II	RCWM80
25	3427.9268	Pt I	SRSA92
120 c	3428.13	Ho II	MCS75
400	3428.319	Ru I	K59
40	3428.388	Er II	M64b
1000 P,s	3428.48	Es I	WLGC74
120	3428.687	Ne II	P71
40 c	3429.18	Ho II	MCS75
30	3429.332	Tm I	SMC73
90	3429.96	Tm II	MCS75
200	3430.527	Zr II	J98
400 c	3430.605	Bi II	DLW02
40	3430.764	Ru I	K59
13	3431.107	Yb I	MT78
12	3431.351	Sc I	AV77
120	3431.582	Co I	PT96
80	3432.99	Gd II	MCS75
200	3433.040	Co I	PT96
500	3433.4278	Pd I	ELLW98
300	3433.556	Ni I	LBT93
14	3433.589	Cr I	K53
250 P	3433.9988	Th II	PE83
11	3434.18	Rb II	R75
90	3434.367	Dy II	NG00
13	3434.788	Mo I	WB88
900 P	3434.89	Rh I	MCS75
11	3435.448	Mo I	WB88
200	3435.4913	U I	SPMR72
25	3435.541	Sc I	AV77
200	3435.9771	Th II	PE83
8	3436.190	Cr I	K53

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
600 P	3436.737	Ru I	K59
40	3437.02	Ir I	MCS75
20	3437.213	Mo I	WB88
120	3437.278	Ni I	LBT93
800 P	3438.231	Zr II	J98
6	3438.848	Yb II	M67
80	3438.9503	Th II	PE83
200	3439.21	Gd II	MCS75
90	3439.78	Gd II	MCS75
300	3439.99	Gd II	MCS75
250	3440.05	K II	D26
150	3440.53	Rh I	MCS75
400 P	3440.6060	Fe I	NJLT94
250	3440.9888	Fe I	NJLT94
70	3441.128	Er II	M64b
250	3441.3896	Pd I	ELLW98
60	3441.446	Dy II	NG00
7	3441.449	Cr I	K53
600 P	3441.50	Tm II	MCS75
60 P	3441.985	Mn II	KG00
200	3442.5790	Th I	PE83
1000 P	3442.664	Bk I	WC78
30	3442.684	Er I	M64b
400 P	3443.645	Co I	PT96
100	3443.8765	Fe I	NJLT94
70	3444.322	Ti II	HJLW82
300 s	3445.25	Es	WLGC74
150	3445.572	Dy II	NG00
8	3445.604	Cr I	K53
20	3446.186	Am I	FT57
600 P	3446.259	Ni I	LBT93
400	3446.37	K I	R56
40	3446.992	Dy II	NG00
110 P	3447.124	Mo I	WB88
150	3447.362	Zr I	J98
400	3447.38	K I	R56
8	3447.426	Cr I	K53
2	3447.59	He I	M60a
20	3447.7024	Ne I	SS04
20	3449.074	Mo I	WB88
200	3449.170	Co I	PT96
40	3449.35	Ho I	MCS75
100	3449.440	Co I	PT96
400	3449.80	Pm II	RCWM80
150	3450.38	Gd II	MCS75
130	3451.23	Gd II	MCS75
500 P	3451.303	B II	LZJK98
200	3451.7023	Th I	PE83
10	3451.75	Mo I	MCS75
300 P,c	3451.88	Re I	MCS75
200 l	3452.098	Am II	FT57
300	3452.36	Es	WLGC74
5	3452.398	Yb I	MT78
300 l	3452.82	Pa II	BW92b
150	3452.889	Ni I	LBT93
1000 P	3452.922	Cm I	WHGC76
200 P	3453.11	Ho II	MZH78
10	3453.328	Cr I	K53
1000 P	3453.510	Co I	PT96
600 P	3453.66	Tm II	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1000 l	3453.897	Bk I	WC78
30	3454.080	Yb II	M67
10	3454.1944	Ne I	SS04
120	3454.315	Dy II	NG00
100	3454.90	Gd II	MCS75
40	3455.22	Rh I	MCS75
6	3455.607	Cr I	K53
50 c	3455.70	Ho II	MCS75
60	3455.902	Zr I	J98
1000 P,c	3456.02	Ho II	MZH78
30	3456.386	Mo I	WB88
60	3456.557	Dy II	NG00
100	3456.610	Ne II	P71
20	3457.07	Rh I	MCS75
12	3457.442	Sc I	AV77
70	3457.561	Zr II	J98
25	3457.93	Rh I	MCS75
11 d	3458.286	Yb II	M67
1000 P	3458.338	Cm I	WHGC76
7	3458.391	Yb I	MT78
600 P	3458.460	Ni I	LBT93
100	3459.321	Ne II	P71
110	3459.9191	U I	SPMR72
20	3460.269	Yb I	MT78
30	3460.314	Mn II	KG00
1000 P,c	3460.46	Re I	MCS75
10	3460.5237	Ne I	SS04
300 P	3460.7381	Pd I	ELLW98
20	3460.778	Mo I	WB88
200 P	3460.966	Dy II	NG00
1000 s	3461.244	Bk II	WC78
30 h	3461.26	Xe II	H39
15	3461.50	Rb II	R75
50	3461.507	Ti II	HJLW82
600 P	3461.652	Ni I	LBT93
100	3461.97	Ho II	MCS75
600	3462.04	Rh I	MCS75
1000 P	3462.20	Tm II	MCS75
100	3462.2200	U I	SPMR72
250	3462.805	Co I	PT96
80	3462.8505	Th II	PE83
140	3463.013	Zr II	J98
140	3463.5479	U I	SPMR72
300	3463.98	Gd II	MCS75
1000 s	3464.133	Bk II	WC78
10	3464.3382	Ne I	SS04
130 P	3464.37	Yb I	MT78
20 P	3464.46	Sr II	MCS75
700 P,c	3464.73	Re I	MCS75
250	3465.793	Co I	PT96
120	3465.8606	Fe I	NJLT94
500 P	3466.200	Cd I	BA56
500 P,c	3466.28	Tc I	BMC67
200	3466.3010	U I	SPMR72
20	3466.5781	Ne I	SS04
11	3466.824	Mo I	WB88
200	3467.27	Gd II	MCS75
20	3467.513	Tm I	SMC73
400 P	3467.655	Cd I	BA56
7	3467.96	Re I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90	3468.2198	Th II	PE83
30	3468.429	Dy II	NG00
200	3468.99	Gd II	MCS75
11	3469.219	Mo I	WB88
40	3469.509	Er I	M64b
20	3469.62	Rh I	MCS75
300 P	3469.9208	Th II	PE83
500	3470.347	Ga II	IL85
500	3470.66	Rh I	MCS75
250	3470.676	O II	MKM93
150	3471.185	Zr I	J98
300	3471.2186	Th I	PE83
90	3471.709	Er II	M64b
1000 s	3472.016	Bk II	WC78
300	3472.40	Hf I	MCS75
250 P	3472.48	Lu II	MCS75
200	3472.545	Ni I	LBT93
50	3472.5706	Ne I	SS04
150	3473.22	Gd II	MCS75
100	3473.4269	U I	SPMR72
50 c	3473.91	Ho II	MCS75
400 P	3473.974	Co I	PT96
30 h	3474.038	Mn II	KG00
400 P	3474.042	Co I	PT96
300 P,c	3474.25	Ho II	MZH78
500	3474.78	Rh I	MCS75
200	3475.4502	Fe I	NJLT94
100	3475.59	Tc I	BMC67
30	3476.303	Yb II	M67
30	3476.692	Tm I	SMC73
50	3476.7019	Fe I	NJLT94
25	3476.747	Ar II	N73
60	3477.067	Dy II	NG00
50	3477.187	Ti II	HJLW82
1000 s	3477.620	Bk II	WC78
7	3478.232	Ar II	N73
20	3478.69	Nb I	MCS75
60	3478.780	Zr I	J98
30	3478.835	Yb II	M67
200	3478.91	Rh I	MCS75
60	3479.28	Hf II	MCS75
200 P	3479.387	Zr II	J98
60	3479.413	Er II	M64b
150	3479.519	Ne II	P71
120	3480.0525	Th I	PE83
110	3480.3634	U I	SPMR72
7	3480.38	Re I	MCS75
200	3480.52	Ta I	MCS75
30	3480.525	Ti I	F91
200	3480.718	Ne II	P71
30	3480.975	Tm I	SMC73
1000	3481.07	Cf I	RCWM80
400 P	3481.1516	Pd I	ELLW98
250 P	3481.155	Zr II	J98
300 s	3481.16	Ac II	MFT57
250	3481.28	Gd II	MCS75
200	3481.80	Gd II	MCS75
300 P	3481.93	Np I	FTBC76
200	3481.933	Ne II	P71
140	3482.4900	U II	SPMR72
25	3482.904	Mn II	KG00
1000 P,l	3483.308	Am II	FT57
12	3483.4231	Pt I	SRSA92
130	3483.532	Zr II	J98
70	3483.777	Ni I	LBT93
300 s	3484.59	Es I	WLGC74
400 P	3484.80	Ho II	MZH78
250 h	3484.88	Nd I	MCS75
200	3485.046	Ce II	C73
60	3485.2641	Pt I	SRSA92
15	3485.722	Y I	P77
90	3485.854	Er II	M64b
100 c	3486.23	Tc I	BMC67
300	3486.5512	Th I	PE83
40	3487.379	Tm I	SMC73
15	3488.675	Mn II	KG00
150	3489.1841	Th I	PE83
500 P	3489.3672	U I	SPMR72
250	3489.400	Co I	PT96
130	3489.53	Ac II	MFT57
30	3489.58	Ho II	MCS75
80	3489.7700	Pd I	ELLW98
250	3490.5740	Fe I	NJLT94
40	3491.072	Ti II	HJLW82
15	3491.244	Ar II	N73
30	3491.536	Ar II	N73
110	3491.95	Gd II	MCS75
700 P	3492.956	Ni I	LBT93
40 c	3493.09	Ho II	MCS75
110	3493.9963	U I	SPMR72
200	3494.40	Gd II	MCS75
200 P	3494.489	Dy II	NG00
150 c	3494.76	Ho II	MCS75
50	3495.24	W I	MCS75
110	3495.682	Co I	PT96
12	3495.833	Mn II	KG00
6 h,w	3495.90	Yb II	M67
130	3496.079	Y II	NJK91
700 P	3496.206	Zr II	J98
120	3496.8107	Th I	PE83
110	3497.16	Hf I	MCS75
400	3497.49	Hf I	MCS75
8	3497.525	Mn II	KG00
50	3497.8406	Fe I	NJLT94
150	3497.85	Ta I	MCS75
10	3498.0636	Ne I	SS04
1000 P,s	3498.11	Es I	WLGC74
200	3498.6210	Th I	PE83
30	3498.63	Nb I	MCS75
40	3498.707	Dy II	NG00
130	3498.73	Rh I	MCS75
50 c	3498.88	Ho II	MCS75
800 P	3498.944	Ru I	K59
600 P	3499.104	Er II	M64b
300	3499.21	Ge II	S63a
30	3499.948	Tm I	SMC73
200	3500.0760	U I	SPMR72
100	3500.70	Tc I	BMC67
80	3500.851	Ni I	LBT93
80 P	3501.108	Ba I	KL99

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
20	3501.2159	Ne I	SS04
200	3501.388	F II	P69
200	3501.451	F II	P69
300 P,h	3501.50	Np I	FTBC76
200	3501.569	F II	P69
500 P	3502.280	Co I	PT96
600 P	3502.52	Rh I	MCS75
80 c	3502.70	Tc I	BMC67
40	3502.780	Er I	M64b
200	3502.840	F II	P69
200	3502.964	F II	P69
10	3503.06	Re I	MCS75
200	3503.106	F II	P69
120	3503.7859	Th I	PE83
90	3503.87	Ta I	MCS75
100	3504.0089	U I	SPMR72
30	3504.411	Mo I	WB88
40	3504.528	Dy II	NG00
20	3504.66	Os I	MCS75
70	3504.900	Ti II	HJLW82
300	3504.97	Pa I	BW92b
140	3505.23	Hf II	MCS75
150	3505.369	F II	P69
40	3505.452	Dy II	NG00
150	3505.51	Gd II	MCS75
200	3505.515	F II	P69
200	3505.628	F II	P69
140	3505.666	Zr II	J98
300	3506.312	Co I	PT96
1	3506.74	Xe I	HM33
60	3506.812	Dy II	NG00
25 c	3506.95	Ho II	MCS75
300 P	3507.32	Rh I	MCS75
250	3507.3442	U I	SPMR72
500 P,c	3507.39	Lu II	MCS75
30	3507.96	Nb I	MCS75
20	3508.114	Mo I	WB88
200	3508.42	Lu I	MCS75
60	3508.8500	Pt II	SRSA92
1000 P	3509.146	Tb II	B01
300	3509.321	Zr I	J98
25	3509.778	Ar II	N73
140	3509.841	Co I	PT96
500 P	3510.127	Am I	FT57
1000	3510.279	Cm I	WHGC76
300	3510.335	Ni I	LBT93
90	3510.73	Ho I	MCS75
50	3510.862	Ti II	HJLW82
60 c	3510.864	Bi I	GMV85
200	3511.04	Ta I	MCS75
200	3511.1574	Th I	PE83
90	3512.22	Gd II	MCS75
130	3512.50	Gd II	MCS75
250	3512.640	Co I	PT96
1000 l	3513.47	Cf II	RCWM80
200	3513.481	Co I	PT96
200 P	3513.64	Ir I	MCS75
150	3513.65	Gd I	MCS75
100	3513.6742	U I	SPMR72
1000 P,l	3514.33	Es I	WLGC74
25	3514.388	Ar II	N73
60	3514.491	Ru I	K59
500 P	3514.6107	U I	SPMR72
10	3514.7134	Pt I	SRSA92
40	3514.889	Er II	M64b
800 P	3515.052	Ni I	LBT93
20	3515.1902	Ne I	SS04
250 P,c	3515.56	Ho II	MZH78
500 P	3516.9438	Pd I	ELLW98
150	3517.296	V II	ICL88
25	3517.598	Tm I	SMC73
250	3518.347	Co I	PT96
250	3518.4040	Th I	PE83
1000 P	3519.24	Tl I	MCS75
600 P	3519.604	Zr I	J98
80	3519.765	Ni I	LBT93
25 c	3519.94	Ho II	MCS75
13	3520.293	Yb II	M67
100 P	3520.4711	Ne I	SS04
120	3521.0595	Th I	PE83
8 c,w	3521.09	Eu II	MCS75
250 P	3521.11	Te II	HM64
30	3521.2612	Fe I	NJLT94
1000 P,s	3521.38	Es I	WLGC74
30	3521.39	Rb II	R75
15	3521.413	Mo I	WB88
130	3521.566	Co I	PT96
1000	3522.355	Cm I	WHGC76
400	3523.02	Hf I	MCS75
200	3523.433	Co I	PT96
1000 P,s	3523.49	Es I	WLGC74
250	3523.679	Tb II	B01
200	3523.979	Dy II	NG00
110	3524.20	Gd II	MCS75
1000 P	3524.536	Ni I	LBT93
60	3524.912	Er II	M64b
1000	3524.938	Cm I	WHGC76
80	3525.808	Zr II	J98
80	3525.83	Tc I	BMC67
40	3526.0408	Fe I	NJLT94
120	3526.6342	Th I	PE83
300 P	3526.850	Co I	PT96
900 P	3528.02	Rh I	MCS75
9	3528.5348	Pt I	SRSA92
40	3528.60	Os I	MCS75
1000	3528.721	Bk I	WC78
130	3529.033	Co I	PT96
250 P	3529.43	Tl I	MCS75
20	3529.733	V I	DA78
300 P	3529.808	Co I	PT96
200	3530.38	Cu I	S48
300 s	3530.65	Pa II	BW92b
250	3530.75	K II	D26
100 l	3530.948	Am I	FT57
1000 l	3531.397	Bk I	WC78
250	3531.4505	Th I	PE83
1000	3531.49	Cf I	RCWM80
30 l	3531.55	Rb II	R75
1000 P	3531.703	Dy II	NG00
13	3531.836	Mn I	CMG64

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	3532.110	Mn I	CMG64
10	3532.594	Hg II	SR01
800	3533.05	Na II	W71
130	3533.223	Zr I	J98
130	3533.5659	U II	SPMR72
50	3533.676	V I	DA78
100	3534.3346	U I	SPMR72
200	3534.958	Dy II	NG00
60	3535.159	Zr I	J98
120 P	3535.30	Nb I	MCS75
200	3535.52	Tm II	MCS75
120	3535.54	Hf II	MCS75
100	3535.713	Sc II	JL80
1000 l	3535.731	Bk I	WC78
1000 s	3536.01	Es	WLGC74
250 P	3536.018	Dy II	NG00
90	3536.58	Tm II	MCS75
300	3536.62	Hf I	MCS75
20	3537.28	Mo I	MCS75
80	3537.48	Nb I	MCS75
40	3537.910	Tm I	SMC73
90 d	3538.14	Rh I	MCS75
200	3538.516	Dy II	NG00
80	3538.68	Tc I	BMC67
200	3539.076	Ce II	C73
70	3539.368	Ru I	K59
150	3539.5872	Th II	PE83
30	3539.590	Er I	M64b
200	3540.270	Tb II	B01
40	3540.76	Ho II	MCS75
1000	3540.98	Cf I	RCWM80
30	3541.0833	Fe I	NJLT94
11	3541.15	Rb II	R75
200 c	3541.77	Tc I	BMC67
30	3541.91	Rh I	MCS75
1000	3542.059	Cm I	WHGC76
11	3542.166	Mo I	WB88
1000 P,s	3542.187	Bk II	WC78
80	3542.327	Dy II	NG00
100	3542.5704	U I	SPMR72
110	3542.621	Zr II	J98
120	3542.847	Ne II	P71
130	3543.95	Rh I	MCS75
300	3544.0179	Th I	PE83
30	3544.02	Nb I	MCS75
150	3545.195	V II	ICL88
80	3545.22	W I	MCS75
25	3545.596	Ar II	N73
500 P	3545.80	Gd II	MCS75
25	3545.845	Ar II	N73
100	3546.05	Ho II	MCS75
60	3546.832	Dy II	NG00
1000	3547.018	Cm I	WHGC76
25	3547.028	Ti I	F91
500 P	3547.683	Zr I	J98
1000 P,s	3547.75	Es II	WLGC74
50	3547.794	Mn I	CMG64
1000	3547.922	Cm I	WHGC76
40	3548.022	Mn I	CMG64
40	3548.182	Ni I	LBT93
14	3548.182	Mn I	CMG64
40	3548.5211	Pt II	SRSA92
300 P	3549.002	Y II	NJK91
100	3549.2018	U I	SPMR72
400	3549.36	Gd II	MCS75
200	3549.54	Rh I	MCS75
300	3549.5959	Th I	PE83
600 c	3549.72	Tc I	BMC67
60	3549.731	Zr I	J98
6	3549.822	Yb II	M67
70	3549.844	Er II	M64b
1	3549.86	Xe I	HM33
200	3550.217	Dy II	NG00
20	3550.45	Nb I	MCS75
200	3550.460	Zr I	J98
400 c	3550.64	Tc I	BMC67
250	3550.8223	U II	SPMR72
250	3551.4019	Th I	PE83
100	3551.615	Dy II	NG00
300 P	3551.951	Zr II	J98
50	3552.690	Y I	P77
60	3552.70	Hf II	MCS75
500 P	3553.0803	Pd I	ELLW98
1000	3553.596	Bk I	WC78
1	3554.04	Xe I	HM33
250 P	3554.43	Lu II	MCS75
60	3554.66	Nb I	MCS75
40	3554.9246	Fe I	NJLT94
130 s	3554.99	Ac II	MFT57
300	3555.0135	Th I	PE83
200	3555.3188	U I	SPMR72
1000 P,l	3555.34	Es I	WLGC74
20	3555.818	Tm I	SMC73
1000	3556.515	Bk I	WC78
400 P	3556.594	Zr II	J98
300 s	3556.65	Es	WLGC74
70 c	3556.78	Ho II	MCS75
150	3556.800	V II	ICL88
150	3557.05	Gd II	MCS75
25	3557.365	Au I	ED71
120	3557.805	Ne II	P71
110	3558.016	Er I	M64b
20	3558.095	Mo I	WB88
40	3558.5151	Fe I	NJLT94
250	3558.534	Sc II	JL80
40	3558.713	Er I	M64b
15	3558.741	Y I	P77
130	3559.4500	Th II	PE83
30	3559.508	Ar II	N73
30	3559.79	Os I	MCS75
90	3559.896	Er II	M64b
25	3560.15	Ho II	MCS75
80	3560.32	Tc I	BMC67
11	3560.327	Yb II	M67
9	3560.704	Yb II	M67
300	3560.798	Ce II	C73
40	3560.86	Os I	MCS75
30	3560.916	Tm I	SMC73
300 s	3560.92	Es	WLGC74
30	3561.030	Ar II	N73

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
100	3561.198	Ne II	P71
100	3561.4110	U I	SPMR72
1000	3561.437	Cm I	WHGC76
150	3561.66	Hf II	MCS75
600 P	3561.708	Tb II	B01
400 P	3561.8038	U I	SPMR72
40 s	3562.680	Am II	FT57
14	3563.136	Mo I	WB88
100	3563.146	Dy II	NG00
200	3563.3756	Th I	PE83
40	3563.50	Nb I	MCS75
40	3563.62	Nb I	MCS75
120	3563.6559	U I	SPMR72
40	3563.876	Tm I	SMC73
25	3564.13	Rh I	MCS75
20	3565.172	Er I	M64b
100	3565.3789	Fe I	NJLT94
700 P,s	3565.59	Ac II	MFT57
10	3566.052	Mo I	WB88
300	3566.099	Zr I	J98
600 P	3566.372	Ni I	LBT93
150	3566.47	Tm II	MCS75
700 P	3566.5909	U I	SPMR72
1000 l	3567.254	Bk II	WC78
40	3567.356	Tm I	SMC73
120	3567.36	Hf I	MCS75
200	3567.702	Sc II	JL80
600 P	3567.84	Lu I	MCS75
1000 P	3568.271	Sm II	K35
250	3568.502	Ne II	P71
700 P	3568.513	Tb II	B01
80	3568.85	Tc I	BMC67
300	3568.970	Tb II	B01
130	3569.04	Hf II	MCS75
150	3569.0781	U I	SPMR72
500 P	3569.163	Am I	FT57
400 P	3569.376	Co I	PT96
80	3569.494	Mn I	CMG64
25	3569.804	Mn I	CMG64
120	3569.8204	Th I	PE83
120	3570.0977	Fe I	NJLT94
130	3570.18	Rh I	MCS75
80	3570.2542	Fe I	NJLT94
300	3570.56	Pa I	BW92b
60	3570.606	Ru I	K59
70	3570.753	Er I	M64b
200	3571.1489	Pd I	ELLW98
20	3571.431	Y I	P77
300	3571.82	Pa I	BW92b
120	3571.864	Ni I	LBT93
80	3571.93	Gd II	MCS75
400 P	3572.468	Zr II	J98
500 P	3572.530	Sc II	JL80
30	3572.729	Pb I	WA68
1000 P	3572.949	Cm II	WHGC76
25 c	3573.24	Ho II	MCS75
6	3573.636	Cr I	K53
70	3573.72	Ir I	MCS75
40	3573.830	Dy II	NG00
11	3573.878	Mo I	WB88
60	3574.152	Dy II	NG00
100	3574.181	Ne II	P71
300 P	3574.43	La I	MCS75
200	3574.612	Ne II	P71
100	3574.7602	U I	SPMR72
15	3574.796	Cr I	K53
40 c	3574.80	Ho II	MCS75
120	3575.360	Co I	PT96
100 s	3575.68	Es	WLGC74
300 P	3575.790	Zr I	J98
90 P	3575.85	Nb I	MCS75
25	3576.052	Y I	P77
200	3576.242	Dy II	NG00
400 P	3576.340	Sc II	JL80
300	3576.5574	Th I	PE83
25	3576.616	Ar II	N73
250 P	3576.853	Zr II	J98
80	3576.865	Dy II	NG00
300	3577.450	Ce II	C73
50	3577.870	Mn I	CMG64
110	3577.9162	U I	SPMR72
40	3577.983	Dy II	NG00
20	3578.244	Er I	M64b
1000 P	3578.682	Cr I	K53
130	3578.7211	U II	SPMR72
90	3579.12	Ho I	MCS75
200	3579.227	Tb II	B01
100	3580.06	Tc I	BMC67
140 P,c	3580.15	Re II	MCS75
300 P	3580.27	Nb I	MCS75
90	3580.519	Er II	M64b
25	3580.75	Ho II	MCS75
300 P	3580.928	Sc II	JL80
12	3580.97	Re I	MCS75
600 P	3581.1931	Fe I	NJLT94
60	3581.26	Tc I	BMC67
8	3581.608	Ar II	N73
25	3581.83	Ho II	MCS75
50	3581.885	Mo I	WB88
110	3581.91	Gd II	MCS75
80	3582.08	Tc I	BMC67
15	3582.355	Ar II	N73
200	3582.63	Tc I	BMC67
100 s	3582.95	Es II	WLGC74
15	3583.02	Re I	MCS75
500	3583.10	Rh I	MCS75
150	3583.1022	Th I	PE83
250	3584.514	Y II	NJK91
1000 P	3584.8774	U I	SPMR72
600 P	3584.96	Gd II	MCS75
30	3584.97	Nb I	MCS75
150	3585.058	Dy II	NG00
30	3585.3188	Fe I	NJLT94
20	3585.466	Yb II	M67
60	3585.778	Dy II	NG00
30	3586.067	Tm I	SMC73
250	3586.293	Zr I	J98
25	3586.540	Mn I	CMG64
400	3586.557	Al II	KM91b
25	3586.601	Er I	M64b

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
25	3586.731	Au I	ED71
40	3586.9849	Fe I	NJLT94
1	3587.05	Rb I	RE80
300	3587.187	Co I	PT96
40	3587.204	Ru I	K59
1	3587.27	He I	M60a
30	3587.743	Y I	P77
400	3587.94	Tc I	BMC67
80	3587.974	Zr II	J98
25	3588.441	Ar II	N73
50	3589.11	Nb I	MCS75
600 P	3589.220	Ru I	K59
30	3589.36	Nb I	MCS75
140	3589.633	Sc II	JL80
300	3589.7495	Th I	PE83
150	3589.763	V II	ICL88
300	3590.28	Es	WLGC74
1000	3590.320	Bk I	WC78
140	3590.474	Sc II	JL80
40	3590.764	Er I	M64b
50	3591.416	Dy II	NG00
120	3591.7443	U I	SPMR72
130	3592.021	V II	ICL88
40 c	3592.23	Ho II	MCS75
50	3592.530	V I	DA78
1000 P	3592.603	Sm II	K35
130	3592.71	Gd II	MCS75
500	3592.7794	Th I	PE83
300	3592.915	Y I	P77
600 P	3593.029	Ru I	K59
800 P	3593.481	Cr I	K53
50	3593.5257	Ne I	SS04
30	3593.6389	Ne I	SS04
30	3593.97	Nb I	MCS75
80	3595.037	Dy II	NG00
11	3595.110	Mn I	CMG64
100	3595.47	Es	WLGC74
100 c	3595.66	Tc I	BMC67
30	3595.835	Er I	M64b
1000	3595.880	Bk I	WC78
50 c	3596.097	Bi I	GMV85
600 P	3596.185	Ru I	K59
500	3596.19	Rh I	MCS75
600	3597.15	Rh I	MCS75
150	3597.703	Ni I	LBT93
20	3598.11	Os I	MCS75
500	3598.1199	Th I	PE83
25	3598.713	Ti I	F91
1000 P	3598.77	Cf I	RCWM80
70 c,w	3598.77	Ho II	MCS75
40	3599.48	Ho I	MCS75
60	3599.501	Er II	M64b
120	3599.769	Ru I	K59
90	3599.826	Er II	M64b
250	3599.87	Hf I	MCS75
10	3600.1685	Ne I	SS04
25	3600.374	Dy II	NG00
300	3600.410	Tb II	B01
60	3600.60	Rb II	R75
1000	3600.615	Cm I	WHGC76
110	3600.64	Rb II	R75
800 P	3600.731	Y II	NJK91
30 c	3600.95	Ho II	MCS75
90	3601.0344	Th II	PE83
1000	3601.115	Bk I	WC78
1000 P	3601.191	Zr I	J98
200	3601.393	F II	P69
20	3601.655	Cr I	K53
500	3601.915	Y II	NJK91
1000 P,s	3602.43	Es II	WLGC74
30	3602.56	Nb I	MCS75
200	3602.838	F II	P69
9	3602.938	Mo I	WB88
1000 s	3603.201	Bk II	WC78
50	3603.410	Am I	FT57
400	3604.285	Sm II	K35
12	3604.48	Os II	MCS75
1000	3604.781	Bk I	WC78
250	3604.87	Gd I	MCS75
50	3604.898	Er II	M64b
140	3605.2742	U I	SPMR72
1000	3605.32	Cf I	RCWM80
600 P	3605.320	Cr I	K53
10	3605.762	Hg II	SR01
30	3605.86	Rh I	MCS75
80	3606.121	Dy II	NG00
7	3606.478	Yb II	M67
50	3606.6794	Fe I	NJLT94
100 s	3606.75	Es II	WLGC74
100 c	3607.32	Tc I	BMC67
300	3607.41	Ta I	MCS75
30	3607.424	Er I	M64b
15	3607.530	Mn I	CMG64
30 h	3607.88	Kr II	DHM33
200 c	3608.27	Tc I	BMC67
300	3608.3779	Th I	PE83
15	3608.485	Mn I	CMG64
90	3608.75	Gd II	MCS75
250	3608.77	Tm II	MCS75
150	3608.8594	Fe I	NJLT94
250 P	3609.4452	Th II	PE83
800 P	3609.491	Sm II	K35
800 P	3609.5547	Pd I	ELLW98
1000 P	3609.614	Bk I	WC78
80	3610.153	Ti I	F91
13	3610.298	Mn I	CMG64
2	3610.32	Xe I	HM33
150	3610.462	Ni I	LBT93
500 P	3610.508	Cd I	BA56
90	3610.76	Gd II	MCS75
600 P	3611.043	Y II	NJK91
9	3611.568	Au I	ED71
500	3611.78	Te II	HM64
120	3611.891	Zr II	J98
1000	3612.11	Cf I	RCWM80
300	3612.4275	Th I	PE83
300	3612.47	Rh I	MCS75
60	3612.740	Ni I	LBT93
400 P	3612.873	Cd I	BA56
1	3613.06	Xe I	HM33

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	3613.097	Zr II	J98
20	3613.31	Ho II	MCS75
3	3613.64	He I	M60a
1000 P	3613.831	Sc II	JL80
200	3614.772	Zr II	J98
25	3614.78	Rh I	MCS75
110	3615.1327	Th II	PE83
100	3616.3305	U I	SPMR72
300 P	3616.565	Er II	M64b
1000	3616.620	Bk I	WC78
400	3616.89	Hf I	MCS75
90	3617.1173	Th II	PE83
1000	3617.49	Cf I	RCWM80
200 P	3617.52	W I	MCS75
50	3617.850	Er II	M64b
300	3618.07	Pa I	BW92b
50	3618.43	Ho I	MCS75
200	3618.49	K II	D26
150	3618.7678	Fe I	NJLT94
50	3618.916	Er II	M64b
11	3619.272	Mn I	CMG64
800 P	3619.391	Ni I	LBT93
11	3619.803	Yb II	M67
100	3620.0838	U I	SPMR72
20	3620.46	Rh I	MCS75
400	3620.940	Y I	P77
400	3621.229	Sm II	K35
1000 s	3621.805	Bk II	WC78
8	3622.138	Ar II	N73
100	3622.6987	U I	SPMR72
300	3623.865	Zr I	J98
50	3624.462	Mo I	WB88
90	3625.6280	Th II	PE83
11	3626.180	Mo I	WB88
200	3626.59	Rh I	MCS75
400	3626.62	Ta I	MCS75
25 c	3626.69	Ho II	MCS75
30	3626.740	Ru I	K59
1000 P,s	3626.76	Cf II	RCWM80
200	3627.014	Sm II	K35
30	3627.25	Ho II	MCS75
100 c	3627.36	Tc I	BMC67
1000	3627.607	Bk I	WC78
50	3628.037	Er I	M64b
60	3628.1107	Pt I	SRSA92
40	3628.67	Ir I	MCS75
150	3628.700	Y II	NJK91
13	3628.8660	Pt I	SRSA92
20	3629.368	Er I	M64b
50	3629.419	Dy II	NG00
200 P	3630.239	Dy II	NG00
700 P	3630.742	Sc II	JL80
40	3630.87	Hf II	MCS75
300 l	3631.09	Es	WLGC74
200	3631.126	Sm II	K35
700	3631.27	Na II	W71
9 h	3631.311	Au I	ED71
120	3631.4631	Fe I	NJLT94
25 c	3631.76	Ho II	MCS75
70	3631.889	Kr II	HP70a
700	3632.210	Pu II	BFG84
500	3632.210	Pu I	BFG84
250	3632.8303	Th I	PE83
6	3632.832	Cr I	K53
1000 s	3632.87	Es	WLGC74
1	3633.06	Xe I	HM33
600 P	3633.121	Y II	NJK91
90	3633.536	Er II	M64b
10	3633.6640	Ne I	SS04
90	3634.148	Zr I	J98
300	3634.20	Pm II	RCWM80
2	3634.23	He I	M60a
800 P	3634.290	Sm II	K35
6	3634.525	Yb I	MT78
40	3634.674	Er I	M64b
800 P	3634.6884	Pd I	ELLW98
300	3634.931	Ru I	K59
300 c	3635.15	Tc I	BMC67
30	3635.43	Mo I	MCS75
600 P	3635.462	Ti I	F91
500	3635.9433	Th I	PE83
1000 P,c	3636.07	Tc I	BMC67
90	3636.25	Lu I	MCS75
1000 P	3636.52	Pa I	BW92b
20	3636.588	Cr I	K53
1000 l	3637.054	Bk I	WC78
13	3637.757	Yb II	M67
15	3637.84	Re I	MCS75
25	3637.905	Au I	ED71
250	3638.1986	U I	SPMR72
100	3638.22	Tc I	BMC67
25 c	3638.30	Ho II	MCS75
40	3638.408	Tm I	SMC73
120	3638.6444	Th I	PE83
110	3638.676	Er I	M64b
25	3638.7879	Pt I	SRSA92
25	3638.7879	Pt I	SRSA92
90	3639.38	Tc I	BMC67
30	3639.51	Rh I	MCS75
150 P,r	3639.568	Pb I	WA68
30	3639.80	Cr I	K53
7	3639.833	Ar II	N73
1000	3639.944	Cm I	WHGC76
50	3640.249	Dy II	NG00
1000	3640.255	Bk I	WC78
1000 s	3640.928	Bk II	WC78
15	3641.408	W II	EKM00
250 d	3641.53	La I	MCS75
11	3641.84	Cr I	K53
200	3642.06	Ta I	MCS75
400	3642.2490	Th I	PE83
800 P	3642.674	Ti I	F91
500 P	3642.782	Sc II	JL80
40	3643.1667	Pt I	SRSA92
30	3643.6290	Pt II	SRSA92
110	3643.65	Tm II	MCS75
150	3643.927	Ne II	P71
130	3644.2422	U I	SPMR72
90	3644.36	Hf II	MCS75
9 h	3645.016	Au I	ED71

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
250	3645.308	Sc II	JL80
500 P	3645.396	Dy II	NG00
110	3645.42	La II	MCS75
100	3645.62	Gd II	MCS75
80	3645.936	Er II	M64b
700 P	3646.19	Gd II	MCS75
25	3646.196	Ti I	F91
300 P	3647.77	Lu I	MCS75
150	3647.8428	Fe I	NJLT94
100 c	3648.04	Tc I	BMC67
4	3648.150	Yb I	MT78
50	3648.786	Dy II	NG00
120	3648.84	K I	R56
150	3648.98	K I	R56
11	3648.993	Cr I	K53
150	3649.10	Hf I	MCS75
500 P	3649.55	Ra II	R34a
300	3649.7349	Th I	PE83
25	3649.85	Nb I	MCS75
600 P	3650.153	Hg I	BAL50
50	3650.408	Er II	M64b
400 P	3650.421	Tb II	B01
9	3650.739	Au I	ED71
120	3651.182	Nb II	RCL00
60	3651.47	Tc I	BMC67
200	3651.5366	U I	SPMR72
200	3651.798	Sc II	JL80
100 l	3651.94	Es	WLGC74
8	3651.97	Re I	MCS75
150	3652.0641	U I	SPMR72
70	3652.54	Gd II	MCS75
50	3652.874	Er II	M64b
900 P	3653.495	Ti I	F91
200	3653.664	Ce II	C73
8	3653.916	Cr I	K53
80	3653.928	Kr II	HP70a
40	3654.590	Ti I	F91
400	3654.62	Gd II	MCS75
70	3654.836	Hg I	BAL50
40	3654.87	Rh I	MCS75
5	3655.729	Yb I	MT78
500 P	3655.843	Ce II	C73
400	3656.15	Gd II	MCS75
11	3656.26	Cr I	K53
14	3657.357	Mo I	WB88
900 P	3657.99	Rh I	MCS75
80	3658.095	Ti I	F91
100 c	3658.59	Tc I	BMC67
400 P	3658.891	Tb II	B01
300 P	3659.1548	U I	SPMR72
300	3659.39	Pm II	RCWM80
1000	3659.46	Cf I	RCWM80
150	3659.6294	Th I	PE83
40	3660.37	Nb I	MCS75
50	3660.629	Ti I	F91
250	3660.639	Ce II	C73
70	3661.202	Zr I	J98
600	3661.364	Ru I	K59
500	3661.365	Sm II	K35
30	3661.86	Rh I	MCS75
150	3662.26	Gd II	MCS75
200 c	3662.29	Ho I	MCS75
1000	3662.70	Cf I	RCWM80
11 c	3662.74	Rb II	R75
50	3662.99	Ho I	MCS75
400	3663.2025	Th I	PE83
6	3663.206	Cr I	K53
50	3663.279	Hg I	BAL50
80	3663.378	Ru I	K59
20	3663.604	V I	DA78
300 P	3663.648	Zr I	J98
200	3664.073	Ne II	P71
1000	3664.340	Cm I	WHGC76
25	3664.445	Er I	M64b
300	3664.60	Gd II	MCS75
250	3664.610	Y II	NJK91
30	3664.614	Dy II	NG00
60	3664.70	Nb I	MCS75
20	3664.811	Mo I	WB88
50	3665.1680	Pt II	SRSA92
100	3665.18	Nd II	MCS75
13	3665.324	Kr I	KH69
140	3666.22	Rh I	MCS75
80	3666.65	Ho I	MCS75
25	3666.838	Dy I	NG00
20	3666.91	Rh I	MCS75
20	3667.741	V I	DA78
150	3667.97	Ho I	MCS75
250	3667.976	Ce II	C73
120	3668.09	Tm II	MCS75
250	3668.1398	Th I	PE83
70	3668.83	Pr II	MCS75
50	3668.963	Ti I	F91
50	3669.01	Kr II	DHM33
50	3669.52	Ho I	MCS75
60	3669.546	Ru I	K59
13	3669.69	Yb II	M67
1	3669.91	Xe I	HM33
500	3669.9684	Th I	PE83
1000 P,l	3670.01	Es II	WLGC74
600 P	3670.0701	U II	SPMR72
500	3670.840	Sm II	K35
250	3671.20	Gd II	MCS75
10	3671.491	Pb I	WA68
80	3671.671	Ti I	F91
15	3671.9990	Pt I	SRSA92
40	3672.296	Dy II	NG00
100	3672.36	Nd II	MCS75
20	3672.807	Mo I	WB88
500 P	3673.121	Am I	FT57
25	3673.406	V I	DA78
110	3673.54	Nd II	MCS75
12	3674.0449	Pt I	SRSA92
200	3674.05	Gd I	MCS75
60	3674.086	Dy II	NG00
140	3674.715	Zr II	J98
30 c	3674.77	Ho II	MCS75
15	3674.78	Nb I	MCS75
8	3675.085	Yb II	M67
150	3675.5675	Th II	PE83

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1000 l	3675.585	Bk I	WC78
25	3675.699	V I	DA78
200	3675.74	Hf I	MCS75
700 P	3676.363	Tb II	B01
100	3676.586	Dy II	NG00
40	3678.504	Dy I	NG00
100	3679.15	Tc I	BMC67
80	3679.19	Ho I	MCS75
70	3679.21	Gd I	MCS75
15 d	3679.58	Kr I	KH69
80	3679.70	Ho I	MCS75
150	3679.9133	Fe I	NJLT94
25	3680.119	V I	DA78
40	3680.590	Mo I	WB88
60	3681.04	Rh I	MCS75
1000 s	3681.221	Bk II	WC78
200	3681.54	K II	D26
80	3682.08	W I	MCS75
1000 P	3682.24	Hf I	MCS75
10	3682.2421	Ne I	SS04
250	3682.4863	Th I	PE83
80	3682.65	Ho I	MCS75
50	3682.701	Er II	M64b
10	3682.9727	Pt I	SRSA92
50	3683.118	V I	DA78
50	3683.30	W I	MCS75
400 P,r	3683.462	Pb I	WA68
25	3684.012	Er I	M64b
400 P	3684.13	Gd I	MCS75
30	3684.320	Li II	HM59
1000 l	3684.427	Bk I	WC78
500	3684.74	Tc I	BMC67
50	3684.850	Dy I	NG00
25	3685.16	Ho II	MCS75
250 P	3685.205	Ti II	HJLW82
10	3685.7352	Ne I	SS04
80	3685.777	Dy I	NG00
200	3685.80	Nd II	MCS75
4	3685.90	Xe I	HM33
25	3686.182	Kr II	HP70a
80	3686.33	Gd II	MCS75
700	3686.555	Cu II	R69
1000 l	3686.737	Bk I	WC78
6	3686.82	Cr I	K53
6	3687.25	Cr I	K53
20	3687.4152	Pt I	SRSA92
50	3687.4568	Fe I	NJLT94
40	3687.498	V I	DA78
400	3687.74	Gd II	MCS75
70	3688.06	W I	MCS75
110	3688.069	V I	DA78
110 P	3688.42	Eu II	MCS75
15 c	3689.50	Re I	MCS75
400	3689.79	Pm II	RCWM80
80	3689.914	Ti I	F91
80	3690.282	V I	DA78
200	3690.3368	Pd I	ELLW98
150	3690.6238	Th I	PE83
70	3690.65	Ho I	MCS75
200	3690.70	Rh I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
25 c	3691.48	Re I	MCS75
40	3691.95	Ho I	MCS75
120	3692.222	V I	DA78
1000 P	3692.36	Rh I	MCS75
300	3692.50	Pm II	RCWM80
15	3692.523	Y I	P77
300	3692.5664	Th I	PE83
700 P	3692.650	Er II	M64b
4	3693.49	Xe I	HM33
10	3693.671	Mn I	CMG64
250 P	3693.989	Sm II	K35
1000 P	3694.190	Yb II	M67
200	3694.213	Ne II	P71
200 P	3694.811	Dy II	NG00
50	3694.939	Mo I	WB88
40	3695.342	V I	DA78
1000	3695.368	Bk I	WC78
100	3695.52	Rh I	MCS75
80	3695.864	V I	DA78
200 s	3696.420	Am II	FT57
130	3696.51	Hf I	MCS75
300	3697.50	Pm II	RCWM80
25	3697.679	Er I	M64b
250	3697.73	Gd II	MCS75
90	3697.85	Nb I	MCS75
300	3698.1061	Th I	PE83
150	3698.165	Zr II	J98
40	3698.206	Dy II	NG00
30	3698.26	Rh I	MCS75
40	3698.60	Rh I	MCS75
1000 s	3699.49	Cf II	RCWM80
30 c	3699.58	Rb II	R75
150	3699.73	Gd II	MCS75
14	3699.9126	Pt I	SRSA92
50	3700.04	Ho I	MCS75
500 P	3700.26	Tm II	MCS75
4	3700.580	Yb I	MT78
50	3700.719	Er II	M64b
800 P	3700.91	Rh I	MCS75
40	3701.15	Hf II	MCS75
4	3701.2244	Ne I	SS04
400 P	3701.36	Tm II	MCS75
200	3701.5161	U II	SPMR72
30 c	3702.35	Ho II	MCS75
400	3702.63	Pm II	RCWM80
300	3702.74	Pa I	BW92b
800 P	3702.856	Tb II	B01
9	3703.24	Re I	MCS75
1000	3703.279	Bk I	WC78
300 P	3703.574	V I	DA78
70	3703.83	Tc I	BMC67
400 P	3703.930	Tb II	B01
1000 s	3704.015	Bk I	WC78
200	3704.526	F II	P69
150	3704.703	V I	DA78
3	3705.00	He I	M60a
50	3705.038	V I	DA78
120	3705.5659	Fe I	NJLT94
700 P	3706.026	Ca II	ER56
15	3706.5217	Pt I	SRSA92

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
600 P	3706.7672	Th I	PE83
50	3707.637	Er II	M64b
30	3707.9199	Fe I	NJLT94
90	3707.92	W I	MCS75
40	3708.4731	Pt II	SRSA92
200	3708.654	Sm II	K35
60	3709.2463	Fe I	NJLT94
130	3709.269	Zr II	J98
300	3709.285	Ce II	C73
1000	3709.426	Cm I	WHGC76
9	3709.622	Au I	ED71
150	3709.622	Ne II	P71
40	3709.76	Ho I	MCS75
300	3709.926	Ce II	C73
40	3709.957	Ti I	F91
1000 P	3710.287	Y II	NJK91
500	3711.07	Na II	W71
1000 s	3711.135	Bk II	WC78
70	3711.3041	Th II	PE83
20	3711.34	Nb I	MCS75
800	3711.72	Pm II	RCWM80
200 d	3711.768	Tb II	B01
80	3712.26	Tc I	BMC67
50	3712.391	Er II	M64b
300	3712.70	Gd II	MCS75
50	3712.88	Ho I	MCS75
1000	3712.929	Bk I	WC78
200	3713.01	Nb I	MCS75
100	3713.02	Rh I	MCS75
250	3713.079	Ne II	P71
110	3713.5546	U I	SPMR72
400 P	3713.57	Gd I	MCS75
50	3713.982	Pb II	WRSH74
60	3714.05	Pr II	MCS75
120 d	3714.73	Nd II	MCS75
20 w	3716.14	In II	PC38
150	3716.36	Gd II	MCS75
400	3716.364	Ce II	C73
30	3716.99	Nb I	MCS75
40	3716.998	Ru I	K59
60	3717.391	Ti I	F91
400 P	3717.48	Gd I	MCS75
500	3717.80	Hf I	MCS75
800 P	3717.914	Tm I	SMC73
100 h	3718.02	Kr II	DHM33
12	3718.206	Ar II	N73
70	3718.595	Kr II	HP70a
800 P	3718.86	Tc I	BMC67
200	3718.877	Sm II	K35
80	3719.28	Hf II	MCS75
25	3719.351	Er I	M64b
1000 P	3719.4347	Th I	PE83
200*	3719.45	Gd II	MCS75
200*	3719.53	Gd II	MCS75
600 P	3719.9348	Fe I	NJLT94
800	3720.243	Pu I	BFG84
1000	3720.243	Pu II	BFG84
100 l	3720.56	Es II	WLGC74
50	3720.72	Ho I	MCS75
50	3721.350	Kr II	HP70a

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	3721.8254	Th II	PE83
200	3721.847	Sm II	K35
1000 P,l	3722.11	Cf II	RCWM80
150	3722.5630	Fe I	NJLT94
40	3722.570	Ti I	F91
140	3723.50	Nd II	MCS75
120	3723.67	Tc I	BMC67
150	3724.40	Tc I	BMC67
70	3724.445	Dy II	NG00
80	3724.569	Ti I	F91
300 P,c,w	3724.94	Eu II	MCS75
100	3725.06	Tm II	MCS75
1000	3725.385	Bk I	WC78
70 P	3725.76	Re I	MCS75
150	3726.01	Pm I	RD67
50	3726.096	Ru I	K59
150	3726.24	Nb I	MCS75
400	3726.35	Tc I	BMC67
800 P	3726.926	Ru I	K59
250	3727.107	Ne II	P71
250	3727.320	O II	MKM93
50	3727.6189	Fe I	NJLT94
15	3727.679	Mo I	WB88
200	3727.9027	Th I	PE83
20	3727.996	Dy I	NG00
1000 P	3728.026	Ru I	K59
130	3728.13	Nd II	MCS75
250	3728.414	Ce II	C73
400	3728.469	Sm II	K35
1000 P,l	3728.55	Es II	WLGC74
1000	3729.004	Cm I	WHGC76
25	3729.309	Ar II	N73
120	3729.524	Er II	M64b
400	3729.806	Ti I	F91
600 P	3730.432	Ru I	K59
6	3730.805	Cr I	K53
150	3730.84	Gd II	MCS75
500	3731.258	Sm II	K35
30 P	3731.36	Ir II	MCS75
120	3731.40	Ho I	MCS75
8	3732.03	Cr I	K53
40	3732.09	Ho I	MCS75
1000	3732.351	Cm I	WHGC76
11	3732.709	Mo I	WB88
1	3732.86	He I	M60a
120	3733.3176	Fe I	NJLT94
200	3733.79	Hf I	MCS75
250	3734.12	Tm II	MCS75
10	3734.694	Yb I	MT78
700 P	3734.8638	Fe I	NJLT94
300	3735.024	Ga II	IL85
70	3735.28	Rh I	MCS75
15	3735.31	Re I	MCS75
200 d	3735.54	Nd II	MCS75
400	3735.980	Sm II	K35
90	3736.35	Ho I	MCS75
800 P	3736.901	Ca II	ER56
600 P	3737.1316	Fe I	NJLT94
200	3737.141	Sm II	K35
40	3737.27	Rh I	MCS75

Finding List—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
15		3737.889	Ar II	N73
120		3738.0405	U II	SPMR72
200		3738.06	Nd II	MCS75
50		3738.162	Er II	M64b
15		3738.42	Nb I	MCS75
700*	P	3739.117	Sm II	K35
80		3739.18	Pr II	MCS75
700*	P	3739.197	Sm II	K35
60		3739.340	Dy I	NG00
1000		3739.35	Cf I	RCWM80
40		3739.470	Ru I	K59
100		3739.76	Gd I	MCS75
150	P	3739.80	Nb I	MCS75
1000		3739.916	Bk I	WC78
80	P	3739.935	Pb I	WA68
15		3740.10	Re I	MCS75
200		3740.714	Nb II	RCL00
400		3741.060	Ti I	F91
300	P	3741.1830	Th II	PE83
200		3741.288	Sm II	K35
6		3741.31	Eu II	MCS75
70		3741.638	Kr II	HP70a
30		3741.644	Ti II	HJLW82
15		3741.78	Nb I	MCS75
300		3742.287	Ru I	K59
110		3742.39	Nb I	MCS75
300		3742.52	Pm II	RCWM80
80		3742.640	Er II	M64b
80		3742.798	Ru I	K59
1000		3743.047	Bk I	WC78
40		3743.3621	Fe I	NJLT94
500	P	3743.47	Gd II	MCS75
25		3743.57	Cr I	K53
300		3743.868	Sm II	K35
30		3743.887	Cr I	K53
500	P	3744.064	Tm I	SMC73
40		3744.17	Rh I	MCS75
40		3744.396	Ru I	K59
50		3744.80	Kr II	DHM33
130		3744.83	Gd I	MCS75
1000		3745.403	Bk I	WC78
600*	P	3745.465	Sm I	K35
600	P	3745.5613	Fe I	NJLT94
250		3745.592	Ru I	K59
600*	P	3745.605	Sm II	K35
500		3745.86	Pm II	RCWM80
120		3745.8994	Fe I	NJLT94
100		3745.947	Zr II	J98
100		3746.15	Tc I	BMC67
140		3746.4190	U II	SPMR72
200		3746.80	Hf I	MCS75
500		3746.84	Tc I	BMC67
300		3747.09	Pm II	RCWM80
30		3747.20	Ir I	MCS75
60		3747.430	Er I	M64b
70		3747.5390	Th II	PE83
90		3747.551	Y II	NJK91
50		3747.813	Dy II	NG00
1000		3747.863	Cm I	WHGC76
200	P,c,w	3748.17	Ho II	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
130	3748.22	Rh I	MCS75
300 P	3748.2622	Fe I	NJLT94
200	3748.6758	U II	SPMR72
15	3749.00	Cr I	K53
400 P	3749.4854	Fe I	NJLT94
300	3749.486	O II	MKM93
1000	3750.075	Bk I	WC78
500	3750.09	Pm II	RCWM80
200	3751.1746	U I	SPMR72
150	3751.590	Zr II	J98
150	3751.806	Tm I	SMC73
1000	3751.905	Bk I	WC78
100	3752.13	Tc I	BMC67
110	3752.49	Nd II	MCS75
130	3752.52	Os I	MCS75
150	3752.5689	Th II	PE83
300	3752.67	Pa I	BW92b
700 P	3752.858	Ti I	F91
60	3753.504	Dy II	NG00
70	3753.546	Ru I	K59
500 P	3753.628	Pu I	BFG84
80	3753.633	Ti I	F91
70	3753.65	Rn I	R33
60	3753.747	Dy II	NG00
25	3754.12	Rh I	MCS75
25	3754.245	Kr II	HP70a
40	3754.27	Rh I	MCS75
400	3754.37	Tc I	BMC67
200	3755.251	Tb II	B01
200	3755.276	Sm II	K35
50	3755.58	Rh I	MCS75
80	3755.937	Ru I	K59
500 P	3755.940	Pu I	BFG84
40	3756.050	Er I	M64b
500	3756.411	Sm I	K35
150 s	3756.67	Ac II	MFT57
80	3757.049	Dy I	NG00
200 P	3757.367	Dy II	NG00
300	3757.529	Sm II	K35
12	3757.659	Cr I	K53
250	3757.6941	Th I	PE83
90	3757.82	Nd II	MCS75
1000	3757.851	Bk I	WC78
60	3757.92	W I	MCS75
200	3757.94	Gd I	MCS75
300 P	3758.2329	Fe I	NJLT94
150	3758.31	Gd II	MCS75
500 P	3758.338	Pu I	BFG84
150	3758.3480	U I	SPMR72
100	3758.54	Tc I	BMC67
150	3758.95	Nd II	MCS75
90	3759.00	Gd II	MCS75
250 P	3759.08	La II	MCS75
300 P	3759.300	Ti II	HJLW82
110	3759.838	Ru I	K59
30	3760.019	Ru I	K59
40	3760.0498	Fe I	NJLT94
80	3760.13	W I	MCS75
110	3760.40	Rh I	MCS75
500	3760.694	Sm II	K35

Finding List—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
70		3760.71	Gd II	MCS75
4		3761.12	Eu II	MCS75
30		3761.1616	Pt II	SRSA92
250	P	3761.326	Ti II	HJLW82
700	P	3761.33	Tm II	MCS75
50		3761.511	Ru I	K59
200		3761.81	Tc I	BMC67
130		3761.87	Pr II	MCS75
500	P	3761.91	Tm II	MCS75
200		3762.20	Gd I	MCS75
1000		3763.045	Cm I	WHGC76
100		3763.2643	U I	SPMR72
150		3763.47	Nd II	MCS75
30		3763.49	Nb I	MCS75
150		3763.7891	Fe I	NJLT94
200		3764.115	Ce II	C73
250		3764.370	Sm II	K35
140		3764.389	Zr I	J98
250		3765.08	Rh I	MCS75
20		3765.08	Nb I	MCS75
300	P	3765.136	Tb II	B01
200		3765.2401	Th I	PE83
50		3765.270	Ar II	N73
40		3765.5388	Fe I	NJLT94
15		3766.119	Ar II	N73
800	P	3766.259	Ne II	P71
140		3766.714	Zr I	J98
130		3766.8864	U I	SPMR72
100		3767.04	Gd II	MCS75
60		3767.1919	Fe I	NJLT94
50		3767.353	Ru I	K59
40		3767.625	Dy I	NG00
13		3768.237	Cr I	K53
1000	P	3768.39	Gd II	MCS75
120		3768.45	W I	MCS75
500		3768.77	Tc I	BMC67
40		3769.09	Ho I	MCS75
70		3769.45	Gd II	MCS75
90		3769.65	Nd II	MCS75
50		3769.97	Rh I	MCS75
300		3770.0560	Th I	PE83
30		3770.095	Yb I	MT78
1		3770.369	Ar I	N73
12		3770.445	Mo I	WB88
7		3770.520	Ar II	N73
150		3770.69	Gd II	MCS75
300		3771.03	Tc I	BMC67
1000	s	3771.060	Bk II	WC78
20		3771.106	Dy I	NG00
80		3771.651	Ti I	F91
30		3771.85	Nb I	MCS75
40		3773.051	Dy I	NG00
250*	d	3773.331	Sm I	K35
250*	d	3773.422	Sm II	K35
150		3773.4339	U I	SPMR72
4		3774.323	Yb I	MT78
800	P	3774.330	Y II	NJK91
500	P	3774.384	Pu I	BFG84
25		3774.714	Dy I	NG00
250		3775.50	Nd II	MCS75

Finding List—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
70		3775.571	Ni I	LBT93
600	P,c,w	3775.72	Tl I	MCS75
1000		3775.751	Cm I	WHGC76
140		3776.2711	Th I	PE83
400	P	3776.489	Tb II	B01
110		3776.556	Y II	NJK91
1000	P	3777.133	Ne II	P71
1000	P,l	3777.504	Am II	FT57
140		3777.588	Ru I	K59
600		3777.64	Hf I	MCS75
150		3778.046	Kr II	HP70a
40		3778.13	Rh I	MCS75
250		3778.135	Sm II	K35
20		3778.675	V I	DA78
200		3779.37	Tc I	BMC67
130		3779.47	Nd II	MCS75
110		3780.40	Nd II	MCS75
200		3780.534	Zr I	J98
300	c	3780.68	Tc I	BMC67
120		3780.77	W I	MCS75
8		3780.840	Ar II	N73
50		3781.01	Nb I	MCS75
40		3781.171	Ru I	K59
90		3781.32	Nd II	MCS75
25		3781.467	Dy I	NG00
12		3781.592	Mo I	WB88
200		3781.616	Ce II	C73
70	P	3782.20	Os I	MCS75
110		3782.34	Gd II	MCS75
50		3782.749	Ru I	K59
400	P	3782.8407	U II	SPMR72
600	P	3783.05	Gd I	MCS75
150		3783.095	Kr II	HP70a
90		3783.530	Ni I	LBT93
400	P	3784.25	Nd II	MCS75
11	w	3785.44	Cs II	S81
600		3785.46	Hf I	MCS75
80		3785.6002	Th II	PE83
1000		3785.61	Cf I	RCWM80
110		3786.042	Ti I	F91
400		3786.065	Ru I	K59
150		3786.176	Dy II	NG00
250		3786.628	Ce II	C73
150		3786.836	Er II	M64b
110		3787.06	Nb I	MCS75
13		3787.52	Re I	MCS75
130		3787.56	Gd II	MCS75
50		3787.858	Er II	M64b
400		3788.125	Sm II	K35
1000		3788.205	Bk I	WC78
70		3788.438	Dy II	NG00
110		3788.47	Rh I	MCS75
600		3788.693	Y II	NJK91
1000	l	3789.04	Cf II	RCWM80
150		3789.1679	Th I	PE83
20		3790.14	Os I	MCS75
80		3790.15	Nb I	MCS75
10		3790.214	Mn I	CMG64
40		3790.325	V I	DA78
500		3790.521	Ru I	K59

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400 P	3790.83	La II	MCS75
90	3791.17	Gd II	MCS75
200	3791.21	Nb I	MCS75
6	3791.384	Cr I	K53
150	3791.397	Zr I	J98
1000	3791.419	Bk I	WC78
50	3791.829	Er II	M64b
30	3791.870	Dy II	NG00
6	3792.142	Cr I	K53
140	3792.18	Rh I	MCS75
500	3792.220	Pu I	BFG84
700 P	3792.564	Bi II	DLW02
40	3792.794	Er I	M64b
1000 l	3792.99	Es	WLGC74
120	3793.1002	U II	SPMR72
400	3793.22	Rh I	MCS75
120	3793.2638	U I	SPMR72
80	3793.37	Hf II	MCS75
6	3793.872	Cr I	K53
400	3793.971	Sm II	K35
400 P	3794.78	La II	MCS75
90	3794.962	V I	DA78
40	3795.0022	Fe I	NJLT94
140	3795.3858	Th I	PE83
400	3795.66	Pm II	RCWM80
800 P	3795.75	Tm II	MCS75
9	3796.007	Au I	ED71
1000	3796.206	Bk I	WC78
600 P	3796.37	Gd II	MCS75
600 P,c	3796.75	Ho II	MZH78
40	3796.81	Rb II	R75
50	3797.058	Er II	M64b
7	3797.138	Cr I	K53
10	3797.714	Cr I	K53
400	3797.730	Sm II	K35
100	3797.77	Tc I	BMC67
70	3798.054	Ru I	K59
150	3798.12	Nb I	MCS75
1000 P	3798.252	Mo I	WB88
80	3798.541	Tm I	SMC73
1000	3798.629	Bk I	WC78
700 P	3798.899	Ru I	K59
13 c	3799.21	In II	PC38
500	3799.31	Rh I	MCS75
700 P	3799.353	Ru I	K59
500	3799.368	Pu I	BFG84
40	3799.5476	Fe I	NJLT94
70	3799.82	Ac II	MFT57
50	3799.907	V I	DA78
200	3800.12	Ir I	MCS75
130	3800.30	Pr II	MCS75
400 d	3800.38	Hf I	MCS75
200	3800.887	Sm II	K35
200 P	3801.011	Sn I	B64
13 d	3801.0723	Pt I	SRSA92
80	3801.29	Gd II	MCS75
15	3801.30	Nb I	MCS75
1000 P,l	3801.49	Es I	WLGC74
700 P	3801.520	Ce II	C73
10	3801.840	Mo I	WB88
30	3801.90	Rb II	R75
1000 s	3802.345	Bk I	WC78
1000	3802.470	Bk I	WC78
150	3802.92	Nb I	MCS75
1000 P	3803.0750	Th I	PE83
250	3803.086	Ce II	C73
8	3803.172	Ar II	N73
200	3803.47	Nd II	MCS75
50	3803.475	V I	DA78
40	3803.88	Nb I	MCS75
30	3804.74	Nb I	MCS75
25	3804.801	Cr I	K53
60	3804.84	Pr II	MCS75
25	3805.12	Cs II	S81
500 P	3805.36	Nd II	MCS75
80	3805.92	Rh I	MCS75
500	3805.923	Pu I	BFG84
25	3806.269	Dy II	NG00
120 P	3806.715	Mn I	CMG64
140	3806.76	Rh I	MCS75
90	3807.144	Ni I	LBT93
25	3807.502	V I	DA78
60	3807.719	Tm I	SMC73
300	3808.110	Ce II	C73
40	3808.517	V I	DA78
100	3808.77	Nd II	MCS75
120	3808.9207	U I	SPMR72
15	3809.456	Ar II	N73
25	3809.593	Mn I	CMG64
20	3809.596	V I	DA78
110	3810.330	Er I	M64b
40	3810.49	Nb I	MCS75
110	3810.49	Nd II	MCS75
600 P,c	3810.74	Ho II	MZH78
20	3810.941	Ag I	PZ01
30	3811.03	Nb I	MCS75
11	3811.33	Eu I	MCS75
500	3811.396	Pu I	BFG84
150	3811.78	Hf I	MCS75
80	3811.84	Pr II	MCS75
60	3811.86	Ho I	MCS75
600 P	3811.9911	U I	SPMR72
30	3812.272	Dy I	NG00
50	3812.739	Ru I	K59
60	3812.9646	Fe I	NJLT94
80	3813.0676	Th II	PE83
60 c	3813.25	Ho II	MCS75
15	3813.454	Be I	KM97
80	3813.485	V I	DA78
400	3813.97	Gd II	MCS75
1000 P	3814.42	Ra II	R34a
130	3814.73	Nd II	MCS75
50	3815.01	Rh I	MCS75
9	3815.438	Cr I	K53
30	3815.51	Nb I	MCS75
150	3815.8403	Fe I	NJLT94
250 h	3816.02	Pr II	MCS75
1000 P	3816.304	Cm I	WHGC76
80	3816.47	Rh I	MCS75
200	3816.56	K II	D26

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90	3816.64	Gd II	MCS75
60	3816.762	Dy II	NG00
70	3817.293	Ru I	K59
60	3817.39	Tm II	MCS75
150	3817.48	W I	MCS75
250	3817.50	K II	D26
140	3818.19	Rh I	MCS75
110	3818.240	V I	DA78
130	3818.28	Pr II	MCS75
100	3818.341	Y II	NJK91
100	3818.427	Ne II	P71
250	3818.6874	Pt I	SRSA92
70	3819.039	Ru I	K59
9	3819.57	Cr I	K53
10	3819.607	He I	M60a
600 P,c,w	3819.67	Eu II	MCS75
1	3819.76	He I	M60a
20	3819.960	V I	DA78
500 P	3820.4253	Fe I	NJLT94
300	3820.53	Pm II	RCWM80
600	3820.73	Hf I	MCS75
20	3821.483	V I	DA78
60	3821.80	Pr II	MCS75
50	3822.002	V I	DA78
60	3822.091	Ru I	K59
400	3822.26	Rh I	MCS75
150	3822.413	Zr I	J98
40	3822.886	V I	DA78
1000 s	3823.098	Bk II	WC78
25	3823.209	V I	DA78
80	3823.508	Mn I	CMG64
14	3823.891	Mn I	CMG64
1000 s	3824.083	Bk II	WC78
250	3824.4436	Fe I	NJLT94
40	3824.88	Nb I	MCS75
50	3824.938	Ru I	K59
130	3825.1331	Th I	PE83
1000	3825.138	Cm I	WHGC76
1000	3825.190	Bk I	WC78
30	3825.682	Dy II	NG00
1000 s	3825.844	Bk II	WC78
150	3825.8811	Fe I	NJLT94
400	3826.202	Sm II	K35
30	3826.386	Tm I	SMC73
200	3826.42	Nd II	MCS75
6	3826.427	Cr I	K53
150	3826.5084	U II	SPMR72
11	3826.66	Rb II	R75
20	3826.694	Mo I	WB88
120	3827.8225	Fe I	NJLT94
800 P	3828.3846	Th I	PE83
250	3828.48	Rh I	MCS75
140	3828.555	V I	DA78
100	3828.85	Nd II	MCS75
30	3828.876	Mo I	WB88
40	3829.27	Ho I	MCS75
25 P	3829.355	Mg I	KM91a
120	3829.749	Ne II	P71
130	3830.02	Hf I	MCS75
500 P	3830.261	Tb I	B01
90	3830.47	Nd II	MCS75
300 P	3830.482	Er II	M64b
200	3830.72	Pr II	MCS75
400 P	3831.4593	U II	SPMR72
250	3831.501	Sm II	K35
1000 l	3831.565	Bk II	WC78
70	3831.795	Ru I	K59
50 P	3832.300	Mg I	KM91a
60	3832.82	Tc I	BMC67
300 P	3832.889	Y II	NJK91
1000	3833.315	Cm I	WHGC76
25	3833.348	Cl II	RK74
1000 s	3833.480	Bk I	WC78
90	3833.74	Ta II	MCS75
60	3833.747	Mo I	WB88
20	3833.865	Mn I	CMG64
200	3833.89	Rh I	MCS75
25	3834.216	V I	DA78
100	3834.2224	Fe I	NJLT94
50	3834.368	Mn I	CMG64
400	3834.476	Sm I	K35
14 c	3834.65	In II	PC38
130	3835.06	W I	MCS75
20	3835.18	Nb I	MCS75
25 c	3835.35	Ho II	MCS75
5	3835.384	H I	RCWM80
500	3835.520	Pu I	BFG84
600 P	3835.962	Zr I	J98
1000 s	3835.967	Bk II	WC78
100	3836.504	Dy II	NG00
140	3836.54	Nd II	MCS75
120	3836.5851	Th I	PE83
250 P	3836.761	Zr II	J98
110	3836.91	Gd II	MCS75
80 c,w	3837.51	Ho II	MCS75
150	3837.56	Tc I	BMC67
1000	3837.593	Cm I	WHGC76
150	3838.20	Tm II	MCS75
80 P	3838.292	Mg I	KM91a
300	3838.535	Ce II	C73
300	3838.98	Nd II	MCS75
400 P	3839.6255	U I	SPMR72
110	3839.64	Gd II	MCS75
80	3839.699	Ru I	K59
200	3839.7475	Th II	PE83
13	3839.779	Mn I	CMG64
9	3839.907	Yb I	MT78
50	3840.429	V I	DA78
50	3840.4375	Fe I	NJLT94
9 h	3840.750	Ag I	PZ01
200	3840.750	V I	DA78
30	3840.869	Tm I	SMC73
25	3840.890	Dy I	NG00
90	3840.99	Pr II	MCS75
80	3841.0481	Fe I	NJLT94
25	3841.074	Mn I	CMG64
400 P	3841.18	Lu I	MCS75
20	3841.28	Cr I	K53
60	3841.307	Dy II	NG00
80	3841.31	Tc I	BMC67

Finding List—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
70		3841.9601	Th II	PE83
1000		3842.000	Cm I	WHGC76
25	c	3842.05	Ho II	MCS75
11	c	3842.18	In II	PC38
1000		3842.185	Bk I	WC78
140		3842.20	Gd II	MCS75
150	d	3842.471	Tb II	B01
300		3842.98	Pm II	RCWM80
100		3843.018	Zr II	J98
300		3843.28	Gd I	MCS75
400		3843.500	Sm II	K35
70		3843.86	Ho II	MCS75
13		3843.988	Mn I	CMG64
20		3844.361	Dy I	NG00
30		3844.434	V I	DA78
150		3844.58	Gd II	MCS75
15		3845.367	Cl II	RK74
300		3845.469	Co I	PT96
20		3845.651	Cl II	RK74
80		3845.97	Tc I	BMC67
80		3846.22	W I	MCS75
110		3846.59	Pr II	MCS75
1000	l	3846.618	Bk I	WC78
40		3846.672	Ru I	K59
30	c	3846.73	Ho II	MCS75
150		3846.8876	Th I	PE83
150		3847.008	Zr I	J98
25		3847.019	Dy I	NG00
250	P	3847.086	F II	P69
13		3847.246	Mo I	WB88
25		3847.326	V I	DA78
1000		3847.626	Bk I	WC78
1000	P	3848.02	Tm II	MCS75
300*	d	3848.24	Nd II	MCS75
300*	d	3848.31	Nd II	MCS75
300		3848.52	Nd II	MCS75
250		3848.595	Ce II	C73
600	P	3848.740	Tb II	B01
10		3848.983	Cr I	K53
200		3849.02	La II	MCS75
400		3849.18	Hf I	MCS75
150		3849.250	Zr I	J98
7		3849.35	Cr I	K53
30		3849.88	Ho I	MCS75
40		3849.914	Er I	M64b
1000		3849.924	Cm I	WHGC76
250	P	3849.985	F II	P69
14		3850.029	Cr I	K53
70		3850.441	Ru I	K59
25		3850.581	Ar II	N73
400		3850.69	Gd II	MCS75
250		3850.79	Pr II	MCS75
600	P	3850.97	Gd II	MCS75
60	P	3850.991	Cl II	RK74
500	P	3851.007	Pu I	BFG84
40	P	3851.373	Cl II	RK74
140	c	3851.55	Pr II	MCS75
400*	P,d	3851.66	Nd II	MCS75
250	P	3851.668	F II	P69
400*	P,d	3851.74	Nd II	MCS75
400		3851.849	Pu I	BFG84
140		3852.1353	Th I	PE83
7		3852.221	Cr I	K53
500	P	3852.45	Gd II	MCS75
200		3852.80	Pr II	MCS75
50		3853.026	Dy II	NG00
250		3853.148	Ce II	C73
300		3853.295	Sm I	K35
110	c	3854.07	Ho II	MCS75
1000		3854.106	Cm I	WHGC76
300		3854.187	Ce II	C73
600		3854.209	Sm II	K35
200		3854.2202	U I	PKE80
10		3854.229	Cr I	K53
300		3854.320	Ce II	C73
90		3854.5108	Th II	PE83
300		3854.556	Sm I	K35
500	P	3854.6448	U II	PKE80
1000		3855.030	Bk I	WC78
200		3855.301	Ce II	C73
100		3855.363	V I	DA78
7		3855.58	Cr I	K53
250	P	3855.845	V I	DA78
50		3855.898	Er I	M64b
200		3855.901	Sm II	K35
100	P,h	3856.017	Si II	S61b
250		3856.3716	Fe I	NJLT94
40		3856.458	Ru I	K59
600		3856.52	Rh I	MCS75
25	c,w	3856.94	Ho II	MCS75
120		3857.551	Ru I	K59
13		3857.63	Cr I	K53
40		3857.72	Ho II	MCS75
150		3858.297	Ni I	LBT93
250		3858.31	Hf I	MCS75
50		3858.392	Er II	M64b
25		3858.402	Dy I	NG00
250		3858.737	Sm I	K35
20		3858.95	Nb I	MCS75
1000	P	3859.5716	U II	PKE80
1000	l	3859.888	Bk II	WC78
500	P	3859.9114	Fe I	NJLT94
140	P	3860.83	Cl II	RK74
100		3860.91	Hf I	MCS75
25		3860.985	Cl II	RK74
150	c	3861.68	Ho II	MCS75
40	h	3862.595	Si II	S61b
60		3862.62	Ho I	MCS75
60		3862.690	Ru I	K59
500	P	3862.851	Er I	M64b
700	P,s	3863.12	Ac II	MFT57
700*	P,d	3863.33	Nd II	MCS75
20		3863.38	Nb I	MCS75
700*	P,d	3863.40	Nd II	MCS75
110		3863.4059	Th II	PE83
800	P	3863.872	Zr I	J98
300		3864.025	Bi II	DLW02
1000	P	3864.104	Mo I	WB88
200		3864.332	Zr I	J98
110		3864.856	V I	DA78

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90 c	3865.45	Pr II	MCS75
15	3865.57	Eu I	MCS75
400 P	3865.9176	U II	PKE80
30	3866.439	Ti I	F91
300	3866.99	Gd I	MCS75
20	3867.601	V I	DA78
120	3867.844	Ru I	K59
15	3867.92	Nb I	MCS75
200	3867.99	W I	MCS75
100	3868.24	Tc I	BMC67
15	3868.4209	Pt I	SRSA92
12	3868.528	Ar II	N73
100	3868.803	Dy I	NG00
150	3869.07	Nd II	MCS75
20	3869.082	Mo I	WB88
150	3869.6633	Th I	PE83
40	3869.861	Dy II	NG00
50	3870.01	Rh I	MCS75
500 P	3871.0353	U I	PKE80
400 P	3871.64	La II	MCS75
200	3871.778	Sm II	K35
300 P	3872.103	Dy II	NG00
20	3872.852	Yb I	MT78
250	3873.114	Co I	PT96
300	3873.35	Pa I	BW92b
130	3873.955	Co I	PT96
50	3873.986	Dy II	NG00
130	3874.0387	U II	PKE80
600 P,w	3874.172	Tb II	B01
40	3874.68	Ho II	MCS75
120	3875.071	V I	DA78
30	3875.257	Ti I	F91
400	3875.3731	Th I	PE83
50 h	3875.44	Kr II	DHM33
15	3875.7150	Pt I	SRSA92
40	3875.898	V I	DA78
50	3876.082	V I	DA78
30 c	3876.15	Cs I	S81
90	3876.19	Pr II	MCS75
25	3876.77	Os I	MCS75
200	3876.971	Ce II	C73
300 c	3877.18	Pr II	MCS75
40	3877.34	Rh I	MCS75
30	3877.56	Nb I	MCS75
300	3877.595	Zr I	J98
800	3877.62	Pm II	RCWM80
1000 l	3877.937	Bk II	WC78
130	3878.0847	U II	PKE80
300	3878.358	Ce II	C73
500 P	3878.540	Pu I	BFG84
150	3878.5732	Fe I	NJLT94
200	3878.58	Nd II	MCS75
50	3878.82	Nb I	MCS75
60	3879.048	Zr I	J98
200	3879.55	Nd II	MCS75
250	3879.6441	Th I	PE83
1000	3880.106	Bk I	WC78
140	3880.38	Nd II	MCS75
130	3880.47	Pr II	MCS75
140	3880.611	Er II	M64b
60 c	3880.72	Tc I	BMC67
200	3880.766	Sm II	K35
200	3880.78	Nd II	MCS75
40	3880.82	Hf II	MCS75
80	3881.41	W I	MCS75
200	3881.4546	U II	PKE80
30	3881.61	Ho II	MCS75
400	3882.447	Ce II	C73
1000 l	3882.602	Bk I	WC78
110	3882.886	Er II	M64b
60	3882.891	Ti I	F91
700 P	3883.132	Tm I	SMC73
40	3883.14	Nb I	MCS75
30	3883.289	Cr I	K53
200	3883.44	Tm II	MCS75
14	3884.75	Eu I	MCS75
80 c	3885.19	Pr II	MCS75
30	3885.24	Cr I	K53
900 P	3885.286	Sm II	K35
400	3885.422	Zr I	J98
70	3885.44	Nb I	MCS75
400 P	3885.56	Ac I	MFT57
40	3885.68	Nb I	MCS75
300 P	3886.2822	Fe I	NJLT94
200	3886.37	La II	MCS75
20	3886.80	Cr I	K53
20	3886.822	Mo I	WB88
150	3886.9159	Th I	PE83
500 P	3887.348	Tm I	SMC73
100	3887.87	Nd II	MCS75
30	3888.5134	Fe I	NJLT94
60 P	3888.6046	He I	M02
10 c	3888.61	Cs I	S81
200 P	3888.6456	He I	M02
300 P	3888.6489	He I	M02
200 P,c	3888.96	Ho II	MZH78
6	3889.049	H I	RCWM80
80 c	3889.34	Pr II	MCS75
250	3889.93	Nd II	MCS75
300	3889.984	Ce II	C73
60	3890.179	V I	DA78
800 P	3890.316	Zr I	J98
400 P	3890.3615	U II	PKE80
60	3890.42	Ho I	MCS75
250	3890.58	Nd II	MCS75
250	3890.94	Nd II	MCS75
800 P,c	3890.94	Ho II	MZH78
40	3891.30	Nb I	MCS75
600 P	3891.380	Zr I	J98
110	3891.51	Nd II	MCS75
20 P	3891.779	Ba II	KL99
1000 P	3892.15	Pm II	RCWM80
60	3892.230	Ru I	K59
130	3892.6810	U II	PKE80
300 P	3892.684	Er I	M64b
40	3892.858	V I	DA78
1000 s	3893.23	Cf II	RCWM80
13	3894.039	Cr I	K53
400	3894.078	Co I	PT96
150	3894.1206	U I	PKE80

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90	3894.1988	Pd I	ELLW98
1000 P,l	3894.547	Bk II	WC78
150	3894.63	Nd II	MCS75
150	3894.70	Gd II	MCS75
200	3895.113	Ce II	C73
600 P	3895.4192	Th I	PE83
80	3895.6565	Fe I	NJLT94
400	3895.888	Pu I	BFG84
500 P	3896.234	Er II	M64b
40	3896.617	Tm I	SMC73
30	3896.76	Ho II	MCS75
400	3896.977	Sm II	K35
30	3896.99	Cs II	S81
40	3897.865	Au I	ED71
250	3897.92	K II	D26
250 P	3898.528	Dy II	NG00
15 s	3898.7316	Pt I	SRSA92
200	3898.825	F II	P69
400 P	3899.197	Tb II	B01
120	3899.7075	Fe I	NJLT94
130	3899.7775	U II	PKE80
400	3899.78	Pm II	RCWM80
60	3899.83	Tc I	BMC67
300	3899.94	Hf I	MCS75
400 P	3900.21	Nd II	MCS75
1000	3900.253	Cm I	WHGC76
110	3900.512	Zr I	J98
40	3900.559	Ti II	HJLW82
400	3900.675	Al II	KM91b
30 s	3900.7228	Pt I	SRSA92
80	3900.79	Tm II	MCS75
20	3900.85	Yb I	MT78
25	3900.959	Ti I	F91
500 P	3901.325	Tb I	B01
13	3901.770	Mo I	WB88
250	3901.84	Nd II	MCS75
200	3901.933	F II	P69
200 P	3902.256	V I	DA78
90	3902.40	Gd II	MCS75
70	3902.756	Er II	M64b
20	3902.911	Cr I	K53
40	3902.9458	Fe I	NJLT94
700 P	3902.953	Mo I	WB88
200	3903.1024	Th I	PE83
300	3903.417	Sm II	K35
1000 P	3904.064	Cm II	WHGC76
12	3904.3823	Pt I	SRSA92
40	3904.44	Ho I	MCS75
300	3904.784	Ti I	F91
90	3905.404	Er I	M64b
200	3905.523	Si I	RA65
90	3905.65	Gd I	MCS75
80 c,w	3905.68	Ho II	MCS75
300	3905.89	Nd II	MCS75
1000 P,s	3906.094	Bk II	WC78
50	3906.177	Kr II	HP70a
1000 P	3906.311	Er II	M64b
120	3906.4530	U I	PKE80
500 P,c,w	3907.10	Eu II	MCS75
200	3907.286	Ce II	C73
900 P	3907.484	Sc I	AV77
90	3907.84	Nd II	MCS75
30 l	3907.91	Xe II	H39
150 c	3908.05	Pr II	MCS75
1000 P	3908.238	Cm II	WHGC76
50	3908.762	Cr I	K53
70	3909.085	Ru I	K59
25	3909.383	Au I	ED71
60	3909.888	V I	DA78
1000 P	3910.26	Pm II	RCWM80
13	3910.8955	Pt I	SRSA92
400 P	3911.16	Nd II	MCS75
8	3911.272	Yb I	MT78
40	3911.80	Ho I	MCS75
1000 P	3911.812	Sc I	AV77
140	3911.9091	Th I	PE83
400 P	3911.957	O II	MKM93
150	3912.23	Nd II	MCS75
300	3912.426	Ce II	C73
120	3912.90	Pr II	MCS75
40	3913.477	Ti II	HJLW82
60	3913.55	Pr II	MCS75
60	3914.334	Ti I	F91
500	3914.38	Br II	RR44
40	3914.70	Nb I	MCS75
110	3915.95	Nd II	MCS75
140	3916.05	La II	MCS75
10	3916.25	Cr I	K53
1000 l	3916.365	Bk II	WC78
400 P	3916.477	Tm I	SMC73
250 P	3916.51	Gd II	MCS75
30	3917.286	Dy I	NG00
20	3917.29	Eu I	MCS75
70	3918.09	Hf II	MCS75
200	3918.269	Ce II	C73
250 c	3918.85	Pr II	MCS75
300 P	3918.978	C II	MG93
200	3919.0234	Th I	PE83
1000 P	3919.10	Pm II	RCWM80
90	3919.165	Cr I	K53
40	3919.45	Ho I	MCS75
80	3919.63	Pr II	MCS75
70	3920.081	Kr II	HP70a
30	3920.20	Nb I	MCS75
60	3920.2581	Fe I	NJLT94
400 P	3920.693	C II	MG93
200	3920.96	Nd II	MCS75
30	3921.031	Cr I	K53
1000	3921.415	Bk I	WC78
40	3921.422	Ti I	F91
120	3921.54	La II	MCS75
150	3921.788	Zr I	J98
25	3922.19	Rh I	MCS75
600 P	3922.397	Sm II	K35
20	3922.431	V I	DA78
120	3922.9119	Fe I	NJLT94
60 c	3922.9559	Pt I	SRSA92
140	3923.486	Ru I	K59
140	3924.526	Ti I	F91
20	3924.651	V I	DA78

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
250	3925.0934	Th I	PE83
15	3925.3359	Pt I	SRSA92
200	3925.47	Pr II	MCS75
12	3925.719	Ar II	N73
300	3925.930	Ru I	K59
100	3926.2078	U I	PKE80
1000 P,l	3926.248	Am II	FT57
30 l	3926.44	Rb II	R75
100	3926.7153	U I	PKE80
90	3927.10	Nd II	MCS75
90	3927.46	Pr II	MCS75
200	3927.56	La I	MCS75
25	3927.860	Dy I	NG00
120	3927.9199	Fe I	NJLT94
1000 l	3928.045	Bk II	WC78
500	3928.279	Sm II	K35
15	3928.623	Ar II	N73
30	3928.647	Cr I	K53
250	3929.22	La II	MCS75
70	3929.29	Pr II	MCS75
300	3929.529	Zr I	J98
60	3929.58	Tm II	MCS75
140	3929.6693	Th II	PE83
10	3929.85	Re I	MCS75
110	3929.874	Ti I	F91
20	3930.022	V I	DA78
30	3930.147	Dy I	NG00
200	3930.2966	Fe I	NJLT94
500 P,c,w	3930.48	Eu II	MCS75
300	3930.77	Es I	WLGC74
200	3931.082	Ce II	C73
150	3931.38	Hf I	MCS75
90	3931.526	Dy II	NG00
50	3931.787	Ru I	K59
300	3931.83	Pa I	BW92b
400 P	3932.0221	U II	PKE80
70	3932.254	Er II	M64b
8	3932.547	Ar II	N73
300	3932.9113	Th I	PE83
200 P	3933.375	Sc I	AV77
1000 P	3933.6614	Ca II	L99
20	3934.010	V I	DA78
200	3934.23	Rh I	MCS75
250*	3934.79	Gd I	MCS75
110	3934.82	Nd II	MCS75
250*	3934.82	Gd II	MCS75
70	3935.82	Pr II	MCS75
800 P	3936.48	Pm II	RCWM80
1000 P	3936.666	Cm I	WHGC76
25	3936.701	Dy I	NG00
250 P	3937.014	Er I	M64b
40	3937.44	Nb I	MCS75
200 P	3938.626	Er II	M64b
25	3938.85	Ho I	MCS75
90	3938.86	Nd II	MCS75
200	3940.326	Ce II	C73
300 P	3940.51	Rb II	R75
20	3941.499	Cr I	K53
400 P	3941.51	Nd II	MCS75
90	3941.80	Gd I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
300	3941.874	Sm II	K35
1000	3942.025	Cm I	WHGC76
600 P	3942.157	Ce II	C73
120	3942.63	Gd I	MCS75
60	3942.72	Rh I	MCS75
800 P	3942.746	Ce II	C73
30	3943.67	Nb I	MCS75
400 P	3943.8161	U I	PKE80
200	3943.881	Ce II	C73
500 P	3944.006	Al I	KM91b
1000	3944.146	Cm I	WHGC76
300	3944.21	Pm II	RCWM80
250 P	3944.420	Er I	M64b
500 P	3944.679	Dy II	NG00
300	3945.54	Gd I	MCS75
70	3945.586	Ru I	K59
25	3946.097	Ar II	N73
400 c	3946.57	Tc I	BMC67
200	3947.09	Tc I	BMC67
60	3947.29	O I	M75b
50	3947.48	O I	M75b
50	3947.59	O I	M75b
140 c	3947.63	Pr II	MCS75
140	3947.769	Ti I	F91
40	3948.062	Er I	M64b
200	3948.113	Sm II	K35
9	3948.3881	Pt I	SRSA92
600 P	3948.670	Ti I	F91
1000	3948.683	Cm I	WHGC76
1	3948.979	Ar I	N73
1000 P	3949.10	La II	MCS75
150	3949.270	Tm I	SMC73
150 c	3949.43	Pr II	MCS75
40	3950.230	Ru I	K59
300	3950.349	Y II	NJK91
25	3950.56	Ho I	MCS75
400 P	3951.16	Nd II	MCS75
200	3951.83	Hf I	MCS75
300	3951.887	Sm I	K35
150	3952.20	Nd II	MCS75
900 P	3952.545	Ce II	C73
200 l	3952.576	Am II	FT57
300 s	3952.62	Pa II	BW92b
1000	3953.362	Cm I	WHGC76
120	3953.37	Gd I	MCS75
150 c	3953.51	Pr II	MCS75
70	3955.73	Ho I	MCS75
20	3955.85	N II	M75a
300	3956.275	Ce II	C73
600 P	3956.334	Ti I	F91
25	3956.416	Er I	M64b
70	3956.75	Pr II	MCS75
140	3957.67	Gd II	MCS75
1000 P	3957.74	Pm II	RCWM80
40	3957.791	Dy II	NG00
1000 P,l	3957.85	Pa II	BW92b
110	3958.00	Nd II	MCS75
150	3958.10	Tm II	MCS75
700 P	3958.201	Ti I	F91
150	3958.220	Zr II	J98

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
400	3958.86	Rh I	MCS75
200	3959.3000	Th I	PE83
500 P	3959.44	Pr I	MCS75
90*	3959.44	Gd II	MCS75
40	3959.51	Cs II	S81
90*	3959.52	Gd II	MCS75
60	3959.68	Ho I	MCS75
200	3960.913	Ce II	C73
1000 P	3961.520	Al I	KM91b
90	3962.21	Nd II	MCS75
14 w	3962.35	In II	PC38
90	3962.45	Pr II	MCS75
25	3962.590	Dy I	NG00
120	3962.851	Ti I	F91
400*	3962.98	Sm II	RAVS90
400*	3963.03	Sm II	RAVS90
250	3963.12	Nd II	MCS75
30	3963.63	Os I	MCS75
90	3963.694	Cr I	K53
110	3964.2064	U I	PKE80
110	3964.26	Pr II	MCS75
120	3964.269	Ti I	F91
20	3964.729	He I	M60a
300 c	3964.81	Pr II	MCS75
1000	3964.827	Cm I	WHGC76
25	3965.20	Cs II	S81
60 d	3966.09	Nb I	MCS75
120	3966.28	Gd I	MCS75
100	3966.3570	Pt I	SRSA92
120	3966.5211	U II	SPMR72
110 c	3966.57	Pr II	MCS75
140	3966.659	Zr I	J98
200	3967.044	Ce II	C73
700 P	3967.3921	Th I	PE83
300	3968.256	Zr I	J98
70	3968.26	Gd II	MCS75
600 P	3968.384	Dy II	NG00
60	3968.46	Lu I	MCS75
1000 P	3968.4673	Ca II	L99
150	3969.00	Gd I	MCS75
80	3969.748	Cr I	K53
300 s	3970.07	Pa II	BW92b
8	3970.072	H I	RCWM80
200	3970.528	Sm II	K35
100	3971.16	Pr II	MCS75
400	3971.397	Sm II	K35
60	3971.67	Pr II	MCS75
500 P,c,w	3971.96	Eu II	MCS75
120 c	3972.14	Pr II	MCS75
300	3972.1545	Th I	PE83
80	3972.71	Gd I	MCS75
200 P	3973.036	Er I	M64b
400 P	3973.2562	O II	MKM93
200	3973.30	Nd II	MCS75
200	3973.502	Zr I	J98
250 P	3973.575	Er I	M64b
140	3973.69	Nd II	MCS75
70	3973.98	Gd II	MCS75
20	3974.25	Cs II	S81
400	3974.665	Sm I	K35

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
130	3974.719	Er II	M64b
60	3974.85	Pr II	MCS75
60	3975.294	Zr I	J98
40	3975.31	Rh I	MCS75
25	3975.88	Ho I	MCS75
250	3976.270	Sm II	K35
30	3976.31	Ir I	MCS75
250	3976.430	Sm II	K35
80	3976.674	Cr I	K53
400 P,d	3976.845	Tb II	B01
140	3976.85	Nd II	MCS75
40 c	3976.93	Ho I	MCS75
60	3977.019	Er I	M64b
25	3977.23	Os I	MCS75
11 c	3978.15	Rb II	R75
50	3978.449	Ru I	K59
120	3978.564	Dy II	NG00
250	3979.200	Sm II	K35
150	3979.33	Gd I	MCS75
7	3979.356	Ar II	N73
50	3979.420	Ru I	K59
140	3979.49	Nd II	MCS75
250	3980.0896	Th I	PE83
500	3980.38	Br II	K40
500	3980.74	Pm II	RCWM80
9 h	3981.580	Ag I	PZ01
600 P	3981.761	Ti I	F91
300	3981.82	Pa I	BW92b
300	3981.875	Tb II	B01
60	3981.926	Dy II	NG00
1000 P	3982.23	Pa I	BW92b
80	3982.331	Er I	M64b
70	3982.480	Ti I	F91
300 P	3982.592	Y II	NJK91
200	3982.7140	O II	MKM93
200	3983.138	Sm II	K35
70	3983.651	Dy II	NG00
50	3983.901	Cr I	K53
1000 P,c	3983.931	Hg II	SR01
40	3984.210	Dy II	NG00
10	3984.339	Cr I	K53
25	3984.40	Rh I	MCS75
200	3984.671	Ce II	C73
80	3984.862	Ru I	K59
500 P,c	3984.97	Tc I	BMC67
250	3985.7924	U II	PKE80
200	3986.682	Sm II	K35
300 P,l	3986.89	Np I	FTBC76
60	3987.655	Er I	M64b
100	3987.84	Gd I	MCS75
1000 P	3987.99	Yb I	MT78
500 P	3988.52	La II	MCS75
250 c	3989.68	Pr II	MCS75
700 P	3989.758	Ti I	F91
8	3989.984	Cr I	K53
400*	3990.002	Sm II	K35
400* P	3990.025	Sm I	K35
250	3990.10	Nd II	MCS75
40	3990.570	V I	DA78
50 P	3990.885	Yb I	MT78

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	3991.118	Cr I	K53
140	3991.127	Zr II	J98
8	3991.677	Cr I	K53
200	3991.7309	Th I	PE83
200	3991.74	Nd II	MCS75
70	3992.16	Pr II	MCS75
200	3992.381	Ce II	C73
70	3992.69	Gd I	MCS75
20	3992.802	V I	DA78
10	3992.846	Cr I	K53
200	3993.308	Sm II	K35
1000 P,l	3993.57	Cf II	RCWM80
250	3993.818	Ce II	C73
70	3994.16	Gd II	MCS75
100	3994.51	Tc I	BMC67
130	3994.5494	Th II	PE83
200	3994.68	Nd II	MCS75
300	3994.79	Pr II	MCS75
12	3994.792	Ar II	N73
30	3994.840	Kr II	HP70a
50 P	3995.00	N II	M75a
300	3995.05	Pm II	RCWM80
1000 P	3995.100	Cm I	WHGC76
300	3995.308	Co I	PT96
25	3995.61	Rh I	MCS75
400 P	3995.75	La II	MCS75
40	3996.15	Rh I	MCS75
80	3996.32	Gd II	MCS75
200	3996.52	Tm II	MCS75
11	3996.5674	Pt I	SRSA92
250 P	3996.601	Sc I	AV77
70	3996.688	Dy II	NG00
110 c	3997.04	Pr II	MCS75
30 h	3997.793	Kr II	HP70a
1000 P	3998.636	Ti I	F91
40	3998.726	V I	DA78
1000 P,r	3998.96	Pm II	RCWM80
140	3998.965	Zr II	J98
60	3999.12	Pr II	MCS75
800 P	3999.237	Ce II	C73
40	3999.58	Ho I	MCS75
120 c	4000.173	Pr II	G90
400 P	4000.449	Dy II	NG00
250	4001.24	K II	D26
8	4001.443	Cr I	K53
25	4003.39	Ho I	MCS75
250	4003.769	Ce II	C73
100	4004.02	Nd II	MCS75
140	4004.702	Pr II	G90
130	4005.2094	U I	PKE80
250	4005.232	Ce I	M75c
40	4005.2419	Fe I	NJLT94
300	4005.474	Tb II	B01
25	4005.837	Dy I	NG00
250 P	4006.52	Te II	HM64
60	4007.596	Zr I	J98
1000 P	4007.965	Er I	M64b
400	4008.2102	Th I	PE83
70	4008.33	Gd I	MCS75
400	4008.691	Pr II	G90

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
1000 P	4008.75	W I	MCS75
120	4008.927	Ti I	F91
400	4009.0573	Th I	PE83
1	4009.27	He I	M60a
25	4009.656	Ti I	F91
500	4009.96	Pm II	RCWM80
120	4010.601	Pr II	G90
50	4012.00	Tc I	BMC67
700 P	4012.25	Nd II	MCS75
800 P	4012.387	Ce II	C73
500 P	4012.4952	Th I	PE83
80	4012.533	Er I	M64b
100	4012.70	Nd II	MCS75
300 l	4012.96	Pa II	BW92b
60	4013.7145	Pt II	SRSA92
30	4013.822	Dy I	NG00
15	4013.857	Ar II	N73
250	4014.897	Ce II	C73
60	4015.22	W I	MCS75
250	4015.39	La I	MCS75
140	4015.391	Pr II	G90
1000	4016.17	Cm I	WHGC76
30	4017.22	Tc I	BMC67
90	4017.71	Gd I	MCS75
120	4017.7163	U II	PKE80
60	4018.106	Mn I	CMG64
300 s	4018.21	Pa II	BW92b
1000 P	4019.1289	Th II	PE83
12	4019.632	Pb I	WA68
10 s	4020.252	Am I	FT57
900 P	4020.387	Sc I	AV77
200 P	4020.512	Er I	M64b
100	4020.76	Tc I	BMC67
200	4020.87	Nd II	MCS75
120	4020.96	Pr II	MCS75
200	4021.34	Nd II	MCS75
30	4021.548	Er I	M64b
200	4021.78	Nd II	MCS75
140	4022.168	Ru I	K59
90	4022.712	Pr II	G90
200	4023.00	Nd II	MCS75
250	4023.14	Gd I	MCS75
200	4023.231	Sm II	K35
150	4023.35	Gd I	MCS75
900 P	4023.678	Sc I	AV77
25	4023.715	Dy I	NG00
50	4023.832	Ru I	K59
110	4023.977	Zr I	J98
20	4024.230	Tm I	SMC73
250	4024.487	Ce II	C73
150	4024.571	Ti I	F91
250 P	4024.726	F II	P69
200	4024.912	Zr I	J98
200 P	4025.010	F II	P69
250 P	4025.491	F II	P69
70	4025.54	Pr II	MCS75
50	4026.191	He I	M60a
5	4026.36	He I	M60a
250	4027.0091	Th I	PE83
300	4027.201	Zr I	J98

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
40	4027.21	Ho I	MCS75
250	4028.15	Gd I	MCS75
250	4028.404	Ce II	C73
30	4028.86	Ho I	MCS75
70	4028.947	Zr I	J98
20	4029.49	Rb II	R75
70	4029.675	Zr II	J98
70 c	4029.72	Pr II	MCS75
140	4030.032	Zr I	J98
300	4030.16	Pa II	BW92b
20	4030.38	Sr I	MCS75
25 h	4030.511	Ti I	F91
10	4030.622	Sc I	AV77
1000 P	4030.755	Mn I	CMG64
400	4030.8424	Th I	PE83
200	4030.88	Gd I	MCS75
250	4031.332	Ce II	C73
1000 P,c	4031.63	Tc I	BMC67
300 P	4031.69	La II	MCS75
140 c	4031.753	Pr II	MCS75
1000	4031.76	Cm I	WHGC76
200	4031.82	Nd II	MCS75
300 P	4032.284	Tb I	B01
70	4032.52	Nb I	MCS75
500 P	4032.984	Ga I	ND82
400 P	4033.027	Tb II	B01
700 P	4033.068	Mn I	CMG64
150	4033.49	Gd I	MCS75
15	4033.809	Ar II	N73
200	4033.827	Pr II	G90
400 P	4034.485	Mn I	CMG64
200	4034.63	Ac I	MFT57
200	4035.110	Sm II	K35
70	4035.40	Gd I	MCS75
1000	4035.45	Cf I	RCWM80
7	4035.460	Ar II	N73
60	4035.729	Mn I	CMG64
10 s	4035.808	Am I	FT57
110	4035.887	Zr I	J98
400	4036.0479	Th I	PE83
100 s	4036.365	Am II	FT57
150	4037.33	Gd II	MCS75
30	4037.59	Xe II	H39
25	4037.62	Ho I	MCS75
80	4037.90	Gd II	MCS75
140	4038.455	Pr II	G90
10	4039.098	Cr I	K53
11	4039.19	Eu I	MCS75
50	4039.25	Tc I	BMC67
90	4039.341	Pr II	G90
90	4039.826	Y I	P77
80	4039.85	Cs II	S81
600 P	4040.752	Ce II	C73
600 P	4040.80	Nd II	MCS75
300 P	4040.81	Ho I	MZH78
40	4040.931	Au I	ED71
30	4041.31	N II	M75a
200 P	4041.357	Mn I	CMG64
70	4042.219	Zr I	J98
250	4042.578	Ce II	C73
200	4042.723	Sm II	K35
300 P	4042.7496	U I	PKE80
50	4042.894	Ar II	N73
200	4042.905	Sm II	K35
300 P	4042.91	La II	MCS75
150	4043.570	Zr I	J98
90	4043.71	Gd I	MCS75
10	4043.803	Sc I	AV77
700 P	4044.14	K I	R56
1	4044.418	Ar I	N73
40	4044.474	Tm I	SMC73
140	4044.560	Zr I	J98
250	4044.813	Pr II	G90
300	4045.01	Gd I	MCS75
300 P,c	4045.47	Ho II	MZH78
110	4045.59	W I	MCS75
70	4045.612	Zr II	J98
300 P	4045.8125	Fe I	NJLT94
800 P	4045.970	Dy I	NG00
200	4046.337	Ce II	C73
400 P	4046.563	Hg I	BAL50
300 s	4046.93	Pa II	BW92b
70	4046.955	Er I	M64b
70	4047.082	Pr II	G90
200	4047.160	Sm II	K35
700 P	4047.21	K I	R56
25 c	4047.52	Ho I	MCS75
130	4047.6117	U I	PKE80
250	4047.628	Y I	P77
120	4047.797	Sc I	AV77
90	4048.2876	Th I	PE83
1000	4048.29	Cm I	WHGC76
110	4048.666	Zr II	J98
40	4048.747	Mn I	CMG64
8	4048.784	Cr I	K53
500 c	4049.11	Tc I	BMC67
150	4049.43	Gd II	MCS75
1000	4049.65	Cm I	WHGC76
250 P	4049.86	Gd II	MCS75
300 P	4050.0412	U II	PKE80
60	4050.476	Zr I	J98
70	4050.566	Dy II	NG00
200	4050.8872	Th I	PE83
30	4050.955	V I	DA78
90	4051.13	Pr II	MCS75
150	4051.15	Nd II	MCS75
30	4051.347	V I	DA78
130	4051.402	Ru I	K59
300	4051.54	Pm II	RCWM80
4	4052.283	Yb I	MT78
30	4052.921	Ar II	N73
90	4053.29	Gd II	MCS75
200	4053.500	Ce II	C73
500 P	4053.64	Gd I	MCS75
900 P	4053.87	Ho I	MZH78
60	4054.050	Ru I	K59
90	4054.45	Lu I	MCS75
30	4054.48	Ho II	MCS75
250 P	4054.544	Sc I	AV77
150	4054.72	Gd I	MCS75

Finding List—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
400		4054.860	Pr II	G90
40		4055.011	Ti I	F91
200		4055.027	Zr I	J98
600	r	4055.20	Pm II	RCWM80
90		4055.465	Er II	M64b
9	h	4055.476	Ag I	PZ01
70		4055.548	Mn I	CMG64
150		4055.704	Zr I	J98
300		4055.836	Ce I	M75c
9		4056.012	Mo I	WB88
1000	P,s	4056.20	Pa II	BW92b
400		4056.537	Pr II	G90
10		4056.593	Sc I	AV77
25	w	4056.94	In II	PC38
100		4057.037	Kr II	HP70a
25		4057.064	V I	DA78
70	l	4057.46	Xe II	H39
30		4057.55	Ho I	MCS75
1000	P	4057.807	Pb I	WA68
500	P	4058.22	Gd I	MCS75
90		4058.800	Pr II	G90
40		4058.936	Mn I	CMG64
1000	P,c	4058.94	Nb I	MCS75
250		4059.2529	Th I	PE83
40		4059.515	Er I	M64b
60		4059.779	Er II	M64b
140		4059.88	Gd I	MCS75
150		4059.96	Nd II	MCS75
50		4060.262	Ti I	F91
25		4060.31	Ho I	MCS75
300	P	4060.33	La I	MCS75
20		4060.79	Nb I	MCS75
900	P	4061.09	Nd II	MCS75
150		4061.40	Ta I	MCS75
90		4061.523	Zr I	J98
400	P	4061.558	Tb I	B01
150	s	4061.60	Ac II	MFT57
25		4061.737	Mn I	CMG64
50		4062.077	Mo I	WB88
15	P	4062.136	Pb I	WA68
200		4062.5440	U II	PKE80
70		4062.59	Gd II	MCS75
200		4062.64	Cu I	S48
700*	P	4062.804	Pr II	G90
700*	P	4062.806	Pr II	G90
100		4062.84	Hf I	MCS75
200		4063.10	Ac I	MFT57
200		4063.39	Gd II	MCS75
400		4063.4071	Th I	PE83
25		4063.530	Mn I	CMG64
150		4063.5942	Fe I	NJLT94
20		4063.928	V I	DA78
400		4064.151	Zr I	J98
25		4064.209	Ti I	F91
30		4064.456	Ru I	K59
300*		4064.55	Sm II	RAVS90
300*		4064.57	Sm II	RAVS90
60		4065.068	Au I	ED71
110		4065.09	Ho II	MCS75
25		4065.095	Ti I	F91

Finding List—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
100		4065.128	Kr II	HP70a
30		4065.7046	Pt II	SRSA92
11		4065.9283	Pt I	SRSA92
30		4066.69	Os I	MCS75
200		4066.737	Sm II	K35
120		4067.91	Ta I	MCS75
80		4068.05	Ho I	MCS75
110		4068.35	Gd I	MCS75
70		4068.367	Ru I	K59
20		4068.78	Cs II	S81
70		4069.2014	Th II	PE83
200		4069.28	Nd II	MCS75
150		4069.4612	Th I	PE83
80	P	4069.882	Mo I	WB88
80		4069.95	W I	MCS75
11		4070.280	Mn I	CMG64
90*		4070.29	Gd II	MCS75
90*		4070.39	Gd II	MCS75
1000	P,s	4070.40	Pa II	BW92b
20		4071.536	V I	DA78
120		4071.7380	Fe I	NJLT94
300		4071.773	Ce II	C73
30		4071.83	Ho I	MCS75
70		4072.005	Ar II	N73
250		4072.157	O II	MKM93
25		4072.385	Ar II	N73
600	P	4072.698	Zr I	J98
110		4073.119	Dy II	NG00
30		4073.13	Ho I	MCS75
70		4073.20	Gd II	MCS75
500		4073.475	Ce II	C73
30		4073.51	Ho I	MCS75
600	P	4074.36	W I	MCS75
90		4074.925	Zr I	J98
130		4075.12	Nd II	MCS75
90		4075.5030	Th I	PE83
400		4075.698	Ce II	C73
600	P	4075.84	Pm II	RCWM80
400		4075.844	Ce II	C73
200		4075.845	Sm II	K35
400	P	4075.862	O II	MKM93
60		4076.524	Zr I	J98
8		4076.628	Ar II	N73
90		4076.730	Ru I	K59
300	P	4077.35	La II	MCS75
900	P	4077.359	Y I	P77
1000	P	4077.71	Sr II	MCS75
30		4077.880	Er I	M64b
300	P	4077.965	Dy II	NG00
70		4078.305	Zr I	J98
150		4078.44	Gd II	MCS75
110		4078.470	Ti I	F91
600	P	4078.70	Gd I	MCS75
400	h	4079.072	Bi II	DLW02
25		4079.241	Mn I	CMG64
25		4079.415	Mn I	CMG64
12		4079.574	Ar II	N73
800	P	4079.73	Nb I	MCS75
100	c	4079.77	Pr II	MCS75
500		4080.599	Ru I	K59

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
100 c	4080.980	Pr II	G90
600 P	4081.209	Zr I	J98
200	4081.219	Ce II	C73
50	4081.243	Er II	M64b
200	4081.3678	Th I	PE83
40	4081.44	Mo I	MCS75
9 c	4081.4669	Pt I	SRSA92
150	4081.85	Pr II	MCS75
1000 s	4082.24	Es	WLGC74
8	4082.387	Ar II	N73
250 P	4082.387	Sc I	AV77
40	4082.455	Ti I	F91
60	4082.78	Rh I	MCS75
40	4082.945	Mn I	CMG64
250	4083.219	Ce II	C73
100	4083.341	Pr II	G90
40	4083.634	Mn I	CMG64
25	4083.67	Ho I	MCS75
110	4083.70	Gd I	MCS75
200	4083.705	Y I	P77
30 c	4083.88	Rb II	R75
30	4084.373	Mo I	WB88
15	4084.86	Nb I	MCS75
25	4085.336	Dy I	NG00
140	4085.4341	Th I	PE83
150	4085.56	Gd II	MCS75
500 P	4086.10	Pm II	RCWM80
150	4086.5205	Th II	PE83
600 P	4086.72	La II	MCS75
15	4087.150	Sc I	AV77
250 P	4087.632	Er I	M64b
150	4088.337	Kr II	HP70a
1000 P,s	4088.44	Ac II	MFT57
500	4088.71	Tc I	BMC67
120	4088.7264	Th I	PE83
1000 P,s	4089.291	Am II	FT57
250	4089.61	La I	MCS75
25	4089.68	Yb I	MT78
400 P	4090.1319	U II	PKE80
140	4090.41	Gd I	MCS75
90	4090.571	V I	DA78
13	4092.2522	Pt I	SRSA92
250	4092.266	Sm II	K35
150	4092.684	V I	DA78
250	4092.71	Gd I	MCS75
60 P	4093.16	Hf II	MCS75
1000 P	4094.187	Tm I	SMC73
150	4094.7470	Th II	PE83
70	4095.477	V I	DA78
700 P	4095.67	Tc I	BMC67
25	4096.100	Dy I	NG00
110	4096.820	Pr II	G90
80	4097.787	Ru I	K59
80	4098.099	Er I	M64b
70	4098.400	Pr II	G90
300 P	4098.61	Gd II	MCS75
80	4098.729	Kr II	HP70a
30 h	4098.89	Xe II	H39
1000	4099.12	Cf I	RCWM80
250	4099.784	V I	DA78
25	4100.22	Ho I	MCS75
140	4100.26	Gd I	MCS75
250	4100.3414	Th I	PE83
30	4100.40	Nb I	MCS75
600 P,c	4100.717	Pr II	G90
400 P	4100.92	Nb I	MCS75
15	4101.74	H I	RCWM80
900 P	4101.7504	In I	DMZ53
50	4102.151	V I	DA78
1000 P	4102.364	Y I	P77
120	4102.70	W I	MCS75
200	4103.074	F II	P69
150	4103.216	F II	P69
200 P	4103.305	Dy II	NG00
200	4103.508	F II	P69
200	4103.710	F II	P69
1000 P	4103.80	Ho I	MZH78
150	4103.870	F II	P69
50	4103.874	Dy I	NG00
50	4103.912	Ar II	N73
20 c	4104.28	Rb II	R75
20	4104.382	V I	DA78
20	4104.767	V I	DA78
250	4105.155	V I	DA78
1000 P	4105.841	Tm I	SMC73
6	4106.384	Y I	P77
30	4106.50	Ho I	MCS75
200*	4107.277	Sm II	K35
200*	4107.387	Sm II	K35
25	4107.462	Mo I	WB88
300 l	4107.59	Es	WLGC74
60	4108.394	Zr I	J98
200	4108.4198	Th II	PE83
300 P	4108.62	Ho I	MZH78
250	4109.08	Nd II	MCS75
30	4109.248	Kr II	HP70a
500 P	4109.46	Nd II	MCS75
200	4109.778	V I	DA78
50	4110.22	Tc I	BMC67
90	4110.48	Nd II	MCS75
70	4111.340	Dy II	NG00
700 P	4111.780	V I	DA78
30	4112.00	Ho I	MCS75
40	4112.02	Os I	MCS75
30	4112.708	Ti I	F91
150	4112.741	Ru I	K59
400 P	4112.7545	Th I	PE83
1000	4113.29	Cm I	WHGC76
20	4113.506	V I	DA78
150	4113.70	Na II	W71
500	4115.08	Tc I	BMC67
400 P	4115.180	V I	DA78
500 P	4115.7589	Th I	PE83
150	4116.0974	U II	PKE80
25	4116.361	Er I	M64b
150	4116.473	V I	DA78
250 P	4116.7137	Th II	PE83
30	4116.73	Ho I	MCS75
20	4116.90	Nb I	MCS75
300	4117.62	Pa I	BW92b

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	4118.141	Ce II	C73
300 c	4118.457	Pr II	G90
25	4118.546	Er I	M64b
500	4118.551	Sm II	K35
60	4118.6745	Pt I	SRSA92
130	4118.774	Co I	PT96
250	4119.215	O II	MKM93
30	4119.27	Tc I	BMC67
20	4119.446	V I	DA78
7 h	4119.464	Yb II	M67
20	4120.093	Mo I	WB88
150	4120.20	Ho I	MCS75
12	4120.82	He I	M60a
2	4120.99	He I	M60a
200	4121.318	Co I	PT96
120	4121.68	Rh I	MCS75
300	4121.933	B II	O70
500 P	4123.23	La II	MCS75
150	4123.503	V I	DA78
300 P	4123.81	Nb I	MCS75
300	4123.873	Ce II	C73
400	4124.22	Tc I	BMC67
400 P	4124.73	Lu I	MCS75
150	4125.65	Ho I	MCS75
7	4126.513	Cr I	K53
500 P	4127.16	Ho I	MZH78
300	4127.371	Ce II	C73
300	4127.4120	Th I	PE83
250 P	4128.064	V I	DA78
50 P,h	4128.067	Si II	S61b
50	4128.27	Tc I	BMC67
900 P	4128.299	Y I	P77
150	4128.87	Rh I	MCS75
40	4129.423	Dy II	NG00
40	4129.43	Nb I	MCS75
600 P,c,w	4129.70	Eu II	MCS75
1000	4129.71	Cm I	WHGC76
50	4129.93	Nb I	MCS75
20	4130.352	Dy I	NG00
250 P	4130.37	Gd II	MCS75
25 P	4130.649	Ba II	KL99
70	4130.771	Pr II	G90
70 P,h	4130.893	Si II	S61b
200	4131.0021	Th I	PE83
40	4131.504	Er I	M64b
100	4131.724	Ar II	N73
250 P	4131.989	V I	DA78
40	4132.0581	Fe I	NJLT94
130	4132.28	Gd II	MCS75
9	4132.427	Ba I	KL99
60 P,h	4132.498	Cl II	RK74
2*	4132.624	Li I	REB95
2*	4132.625	Li I	REB95
80	4132.7533	Th II	PE83
20 h	4132.984	Sc I	AV77
500	4133.005	Pu I	BFG84
800 P	4133.802	Ce II	C73
25	4133.850	Dy I	NG00
300	4134.0681	Th I	PE83
150	4134.16	Gd I	MCS75
200	4134.485	V I	DA78
30	4134.54	Ho I	MCS75
250	4134.72	K II	D26
200	4134.768	Cd II	SP49
200	4135.27	Rh I	MCS75
90	4135.33	Nd II	MCS75
90	4135.78	Os I	MCS75
20 c	4136.11	Rb II	R75
150	4136.22	Ho I	MCS75
30	4136.45	Re I	MCS75
140	4137.10	Nb I	MCS75
60	4137.46	W I	MCS75
600 P	4137.649	Ce II	C73
110	4138.334	Tm I	SMC73
30	4139.44	Nb I	MCS75
150	4139.71	Nb I	MCS75
40	4139.85	Tc I	BMC67
500	4140.041	Pu I	BFG84
25 h	4140.272	Sc I	AV77
10 s	4140.959	Am I	FT57
300 c	4141.224	Pr II	G90
25	4142.19	Ho I	MCS75
200	4142.397	Ce II	C73
800 P	4142.841	Y I	P77
50	4142.914	Er II	M64b
50	4143.100	Dy II	NG00
500 P	4143.112	Pr II	G90
20	4143.21	Nb I	MCS75
100	4143.55	Mo I	MCS75
3	4143.76	He I	M60a
80	4143.8682	Fe I	NJLT94
200	4144.160	Ru I	K59
13	4144.36	Re I	MCS75
200	4144.412	Tb II	B01
300	4144.95	Tc I	BMC67
200	4144.996	Ce II	C73
150	4145.08	Tc I	BMC67
80	4145.122	Kr II	HP70a
60	4145.737	Ru I	K59
60	4146.060	Dy I	NG00
1000 l	4147.134	Bk II	WC78
30	4148.97	Ho I	MCS75
25	4149.066	Yb I	MT78
250	4149.19	K II	D26
200 P	4149.198	Zr II	J98
200	4149.831	Sm II	K35
300	4149.895	Ce II	C73
110	4149.9870	Th II	PE83
50	4150.12	Nb I	MCS75
500	4151.091	Pu I	BFG84
500 P	4151.108	Er I	M64b
500	4151.443	Pu I	BFG84
400	4151.969	Ce II	C73
120	4151.97	La II	MCS75
300	4152.209	Sm II	K35
30	4152.341	Sc I	AV77
300 P	4152.58	Nb I	MCS75
60 c,w	4152.61	Ho II	MCS75
60	4152.640	Zr I	J98
50	4152.82	Pb II	WRSH74

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	4153.064	S II	KM93
300 P	4153.9710	U I	PKE80
60	4154.08	Lu I	MCS75
25	4154.37	Rh I	MCS75
10	4155.946	Li II	DM01
600 P	4156.08	Nd II	MCS75
12	4156.086	Ar II	N73
90	4156.26	Nd II	MCS75
120 P	4156.6483	U I	PKE80
70 l	4158.04	Xe II	H39
200	4158.5352	Th I	PE83
11	4158.590	Ar I	N73
70	4161.200	Zr II	J98
4	4161.80	Sr II	MCS75
250	4162.665	S II	KM93
900 P	4163.03	Ho I	MZH78
50	4163.47	Nb I	MCS75
7	4163.627	Cr I	K53
300 P	4163.66	Nb I	MCS75
300 c	4164.156	Pr II	G90
1	4164.180	Ar I	N73
50	4164.5491	Pt I	SRSA92
250 P	4164.66	Nb I	MCS75
50 h	4165.187	Sc I	AV77
400	4165.600	Ce II	C73
500	4165.61	Tc I	BMC67
250	4165.7661	Th I	PE83
3	4166.001	Ba II	KL99
110	4166.366	Zr I	J98
200	4166.881	Ce II	C73
2	4167.271	Mg I	KM91a
250	4167.513	Y I	P77
80	4167.514	Ru I	K59
400 P	4167.974	Dy I	NG00
4	4168.033	Pb I	WA68
200 P	4168.13	Nb I	MCS75
700 P,s	4168.40	Ac II	MFT57
200	4169.478	Sm II	K35
50	4169.68	Tc I	BMC67
500	4169.77	Te II	HM64
200	4170.27	Tc I	BMC67
500 P	4170.52	Po I	C66a
50	4171.17	W I	MCS75
300 P	4171.5886	U II	PKE80
120	4171.822	Pr II	G90
25	4171.931	Dy I	NG00
1000 P	4172.042	Ga I	JL67
140	4172.246	Pr II	G90
250	4172.53	Tc I	BMC67
300 P	4173.20	Ho I	MZH78
40	4173.23	Os I	MCS75
200	4174.133	Y I	P77
500 P	4174.34	Hf I	MCS75
7	4174.56	Yb I	MT78
8	4174.808	Cr I	K53
800	4175.28	Se II	G62
500 P	4175.54	Gd I	MCS75
150	4175.61	Nd II	MCS75
20	4175.63	Os I	MCS75
300 l	4176.18	Pa II	BW92b
50	4176.28	Tc I	BMC67
100 l	4176.94	Es I	WLGC74
400 P	4177.32	Nd II	MCS75
600 P	4177.528	Y II	NJK91
150	4178.0597	Th II	PE83
8	4179.27	Cr I	K53
12	4179.297	Ar II	N73
1000 P	4179.391	Pr II	G90
20	4179.408	V I	DA78
120	4179.59	Nd II	MCS75
1000 P	4179.98	Ac I	MFT57
300 h	4180.10	Xe II	H39
20	4180.809	Yb II	M67
1000 P	4180.90	Se II	G62
1	4181.884	Ar I	N73
10	4182.22	Eu I	MCS75
500 P	4183.12	Ac I	MFT57
60	4183.721	Dy I	NG00
300 P	4184.25	Gd II	MCS75
90	4184.25	Lu II	MCS75
20	4184.44	Nb I	MCS75
250	4185.449	O II	MKM93
15	4185.819	Mo I	WB88
50	4186.117	Ti I	F91
250	4186.24	K II	D26
40	4186.51	Tc I	BMC67
1000 P	4186.596	Ce II	C73
800 P	4186.821	Dy I	NG00
400 P	4187.32	La I	MCS75
200	4187.559	Zr I	J98
900 P	4187.615	Tm I	SMC73
200 s	4188.121	Am II	FT57
250	4188.128	Sm II	K35
90 P	4188.324	Mo I	WB88
500 P	4189.479	Pr II	G90
1000 P,s	4189.692	Bk II	WC78
400	4189.789	O II	MKM93
700	4190.082	As II	LA71
70	4190.697	Er I	M64b
3	4190.713	Ar I	N73
500 P	4190.78	Gd I	MCS75
80	4190.88	Nb I	MCS75
1	4191.029	Ar I	N73
90	4191.07	Gd II	MCS75
110 c	4191.605	Pr II	G90
150	4191.63	Gd I	MCS75
140 P	4191.640	Dy I	NG00
50	4192.07	Nb I	MCS75
25	4192.4231	Pt I	SRSA92
300	4192.92	Pm II	RCWM80
200	4193.0164	Th I	PE83
40	4193.08	Rb II	R75
150 h	4193.15	Xe II	H39
60	4194.35	Ho I	MCS75
400 P	4194.40	Ac I	MFT57
110	4194.760	Zr I	J98
110	4194.792	B II	O70
400 P	4194.846	Dy I	NG00
50	4195.09	Nb I	MCS75
80	4195.66	Nb I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
200	4196.330	Ce II	C73
40	4196.50	Rh I	MCS75
150	4196.55	La II	MCS75
1000 P,s	4197.441	Bk II	WC78
50	4197.572	Ru I	K59
50	4198.015	Dy I	NG00
6	4198.317	Ar I	N73
20	4198.51	Nb I	MCS75
250	4198.715	Ce II	C73
50	4198.864	Ru I	K59
700 P	4199.892	Ru I	K59
60	4199.92	Tm II	MCS75
11	4200.674	Ar I	N73
60	4201.17	Pr II	MCS75
40	4201.301	Dy I	NG00
150	4201.451	Zr I	J98
20	4201.52	Nb I	MCS75
11 P	4201.80	Rb I	RE80
30	4202.0293	Fe I	NJLT94
40	4202.240	Dy I	NG00
250*	4202.926	Ce II	C73
250*	4202.956	Ce II	C73
250	4203.051	Sm II	K35
600 P	4203.727	Tm I	SMC73
200	4203.749	Tb I	B01
70	4204.86	Gd II	MCS75
1000 P,c,w	4205.05	Eu II	MCS75
50	4205.31	Nb I	MCS75
120	4205.88	Ta I	MCS75
140	4206.020	Ru I	K59
1000 P	4206.481	Pu I	BFG84
500 P,c	4206.719	Pr II	G90
1000 P	4207.66	Cm II	WHGC76
500	4208.234	Pu I	BFG84
100	4208.315	Pr II	G90
100 h	4208.48	Xe II	H39
150	4208.8907	Th II	PE83
110	4208.980	Zr II	J98
30 h	4209.47	Xe II	H39
100 s	4209.69	Ac II	MFT57
20	4209.853	V I	DA78
200	4210.9232	Th I	PE83
8 h	4210.960	Ag I	PZ01
400	4211.14	Rh I	MCS75
30	4211.238	Dy I	NG00
1000 P	4211.62	Cm I	WHGC76
1000 P	4211.714	Dy I	NG00
40	4211.86	Os I	MCS75
60	4211.862	Pr II	G90
150	4212.00	Gd II	MCS75
500	4212.062	Ru I	K59
9	4212.814	Ag I	PZ01
100	4212.9537	Pd I	ELLW98
20	4213.14	Cs II	S81
110	4213.180	Dy I	NG00
100 h	4213.72	Xe II	H39
110	4213.863	Zr I	J98
70	4214.445	Ru I	K59
20	4214.73	Nb I	MCS75
110	4215.02	Gd II	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
250 P	4215.159	Dy I	NG00
700 P	4215.52	Sr II	MCS75
6 P	4215.53	Rb I	RE80
30	4215.60	Xe II	H39
40	4216.1836	Fe I	NJLT94
70	4217.20	Gd II	MCS75
1000 P,l	4217.23	Pa II	BW92b
80	4217.263	Ru I	K59
15	4217.799	Y I	P77
60	4217.810	Pr II	G90
25	4217.94	Nb I	MCS75
300 P	4218.092	Dy I	NG00
100	4218.425	Er I	M64b
8 d	4218.565	Yb II	M67
8	4218.665	Ar II	N73
150	4219.745	Ne II	P71
90	4220.0651	Th I	PE83
30	4220.629	Y I	P77
200	4220.659	Sm II	K35
30	4220.675	Ru I	K59
12	4221.08	Re I	MCS75
300 P	4221.110	Dy I	NG00
30	4222.212	Dy I	NG00
30	4222.29	Ho I	MCS75
110	4222.3677	U I	PKE80
400	4222.598	Ce II	C73
8	4222.637	Ar II	N73
40	4222.671	Tm I	SMC73
700 P	4222.931	Pr II	G90
250	4222.97	K II	D26
100 h	4223.00	Xe II	H39
30	4223.47	Ho I	MCS75
1000	4223.89	Br II	K40
70	4225.03	Gd I	MCS75
150 P	4225.154	Dy I	NG00
250	4225.328	Sm II	K35
700 P	4225.346	Pr II	G90
	4225.655	Fr I	ABDJ90
250	4225.67	K II	D26
1000 P	4225.85	Gd I	MCS75
1000 P	4226.727	Ca I	R68
8	4226.988	Ar II	N73
200 P	4227.13	Ho I	MZH78
90	4227.3872	Th I	PE83
70 c	4227.46	Re I	MCS75
200	4227.747	Ce II	C73
600 P	4227.750	Zr I	J98
30	4228.158	Ar II	N73
25	4229.15	Nb I	MCS75
25	4229.52	Ho II	MCS75
200	4229.704	Sm II	K35
50	4230.309	Ru I	K59
7	4231.972	Yb I	MT78
40	4232.024	Dy I	NG00
20	4232.20	Cs II	S81
250	4232.38	Nd II	MCS75
30	4232.458	V I	DA78
50	4232.589	Mo I	WB88
60	4233.114	Pr II	G90
100	4233.850	Ne II	P71

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
10	4234.41	Cs II	S81
14	4235.154	Mn I	CMG64
20	4235.300	Mn I	CMG64
140	4235.4636	Th I	PE83
200	4235.929	Y I	P77
60	4236.056	Zr I	J98
60 c	4236.153	Pr II	G90
300	4236.745	Sm II	K35
30	4237.220	Ar II	N73
15	4238.053	Sc I	AV77
500 P,c	4238.19	Tc I	BMC67
130 h	4238.25	Xe II	H39
200	4238.38	La II	MCS75
70	4238.78	Gd II	MCS75
600 P	4239.309	Zr I	J98
40	4239.856	Dy I	NG00
300	4239.909	Ce II	C73
200	4240.335	Zr I	J98
200	4241.010	Pr II	G90
70	4241.058	Ru I	K59
200	4241.197	Zr I	J98
200 P	4241.6646	U II	PKE80
300	4241.683	Zr I	J98
20	4241.78	N II	M75a
300 P	4242.15	Tm II	MCS75
1000	4242.38	Cf I	RCWM80
70	4243.058	Ru I	K59
70	4243.507	Pr II	G90
30	4243.78	Ho I	MCS75
60	4244.36	W I	MCS75
1000 P	4244.40	Rb II	R75
100 P,c	4244.92	Pb II	WRSH74
150 h	4245.38	Xe II	H39
30	4245.912	Dy I	NG00
200	4246.227	F II	P69
200	4246.385	F II	P69
200	4246.590	F II	P69
30	4246.736	Ru I	K59
150	4246.774	F II	P69
500 P	4246.820	Sc II	JL80
150	4246.844	F II	P69
400 P	4247.38	Nd II	MCS75
150 c	4247.631	Pr II	G90
1000 P,s	4248.083	Pa II	G67
300	4248.668	Ce II	C73
50	4250.580	Kr II	HP70a
120	4250.649	Ne II	P71
30	4250.7871	Fe I	NJLT94
1	4251.185	Ar I	N73
100	4251.201	Y I	P77
30 l	4251.57	Xe II	H39
200	4251.73	Gd II	MCS75
150	4252.44	Nd II	MCS75
100	4253.37	Gd II	MCS75
200	4253.5385	Th I	PE83
70	4253.61	Gd II	MCS75
1000 P	4254.331	Cr I	K53
150 P,c,w	4254.38	Ho I	MZH78
100	4254.402	Pr II	G90
200	4255.779	Ce II	C73

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
120	4256.2537	Th I	PE83
500 P	4256.393	Sm II	K35
11	4257.669	Mn I	CMG64
6	4259.362	Ar I	N73
800 P,h	4259.413	Bi II	DLW02
150	4260.12	Gd I	MCS75
200	4260.3330	Th I	PE83
80	4260.4746	Fe I	NJLT94
150 P	4260.85	Os I	MCS75
500	4261.11	Te II	HM64
500	4261.886	Pu I	BFG84
300	4262.019	Ga II	IL85
50	4262.05	Nb I	MCS75
300	4262.09	Gd I	MCS75
800 P	4262.27	Tc I	BMC67
300	4262.677	Sm II	K35
40	4262.69	Tc I	BMC67
40	4263.133	Ti I	F91
250	4263.40	K II	D26
60	4264.05	Ho I	MCS75
140	4264.70	Cs II	S81
100	4265.550	Am I	FT57
11	4265.928	Mn I	CMG64
25	4266.02	Nb I	MCS75
30	4266.04	Ho I	MCS75
3	4266.286	Ar I	N73
200	4266.340	Tb I	B01
1000	4266.45	Cm I	WHGC76
25	4266.527	Ar II	N73
140	4266.60	Gd I	MCS75
100	4267.00	Gd I	MCS75
400 P	4267.003	C II	MG93
500 P,c	4267.258	C II	MG93
90	4268.015	Zr I	J98
15	4268.10	Ir I	MCS75
50	4268.638	V I	DA78
60	4269.093	Pr II	G90
9	4269.279	Mo I	WB88
150	4269.38	W I	MCS75
200	4270.186	Ce II	C73
20	4270.69	Nb I	MCS75
40	4271.550	V I	DA78
25	4271.716	Tm I	SMC73
120	4271.7607	Fe I	NJLT94
4	4272.169	Ar I	N73
150 c	4272.273	Pr II	G90
150	4273.14	Rb II	R75
70	4273.3574	Th II	PE83
150	4273.9694	Kr I	K93
30	4274.588	Ti I	F91
800 P	4274.806	Cr I	K53
200	4274.97	Tc II	BMC67
700	4274.98	Tl II	ES36
30	4276.906	Mo I	WB88
40	4276.953	V I	DA78
200 w	4277.13	Cs II	S81
40	4277.239	Mo I	WB88
110	4277.3139	Th II	PE83
200 P	4277.528	Ar II	N73
4	4277.738	Yb I	MT78

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
30	4278.90	Tc I	BMC67
300*	4279.678	Sm II	K35
300*	4279.747	Sm II	K35
90 c	4280.07	Pr II	MCS75
400 P	4280.27	La I	MCS75
100	4280.49	Gd II	MCS75
500 P	4280.789	Sm II	K35
10	4281.100	Mn I	CMG64
150	4282.0413	Th II	PE83
150	4282.198	Zr I	J98
400	4282.208	Sm I	K35
120	4282.4028	Fe I	NJLT94
150 c	4282.456	Pr II	G90
30	4282.698	Ti I	F91
300	4282.833	Sm I	K35
7	4282.898	Ar II	N73
15	4282.9674	Kr I	K93
30	4283.097	Ba I	KL99
40	4284.047	V I	DA78
70	4284.330	Ru I	K59
130	4284.52	Nd II	MCS75
90	4285.82	Gd I	MCS75
110	4286.003	Ti I	F91
50	4286.556	Er I	M64b
25	4286.99	Nb I	MCS75
110	4287.402	Ti I	F91
30 c	4287.97	Rb II	R75
50	4288.38	Cs II	S81
50	4288.631	Mo I	WB88
90	4288.71	Rh I	MCS75
120	4289.070	Ti I	F91
500 P	4289.258	Am I	FT57
500 P	4289.733	Cr I	K53
600 P	4289.935	Ce II	C73
110	4290.929	Ti I	F91
300 s	4291.345	Pa II	G67
30	4291.82	V I	MCS75
25	4292.134	Mo I	WB88
200	4292.923	Kr II	HP70a
1000	4293.00	Cm I	WHGC76
30	4293.215	Mo I	WB88
12	4293.880	Mo I	WB88
20	4293.95	Os I	MCS75
15	4293.97	Rb II	R75
500 P	4294.61	W I	MCS75
150	4294.787	Zr I	J98
150	4294.79	Hf I	MCS75
110	4295.748	Ti I	F91
50	4295.932	Ru I	K59
150 h	4296.40	Xe II	H39
400	4296.680	Ce II	C73
1000 P	4296.743	Sm I	K35
1000 P	4297.06	Tc I	BMC67
90	4297.3066	Th I	PE83
300	4297.714	Ru I	K59
600 P	4297.78	Pm II	RCWM80
15	4298.365	Tm I	SMC73
250	4298.665	Ti I	F91
14	4298.73	Eu I	MCS75
25	4298.905	Er I	M64b
90 c	4298.965	Pr II	G90
200	4299.170	F II	P69
25	4299.202	Ti I	F91
90	4299.29	Gd I	MCS75
40	4299.60	Nb I	MCS75
25	4299.629	Ti I	F91
140	4299.8393	Th I	PE83
3	4300.101	Ar I	N73
200	4300.327	Ce II	C73
70	4300.49	Kr II	DHM33
400	4300.554	Ti I	F91
8	4300.650	Ar II	N73
40	4300.99	Nb I	MCS75
500	4301.079	Ti I	F91
700 P,h	4301.697	Bi II	DLW02
250 P	4302.11	W I	MCS75
40 h	4302.290	Y I	P77
500	4302.527	Ca I	R68
90	4302.878	Zr I	J98
1000 P	4303.58	Nd II	MCS75
60	4303.61	Pr II	MCS75
250	4305.00	K II	D26
7 P	4305.45	Sr II	MCS75
300	4305.764	Pr II	G90
800 P	4305.907	Ti I	F91
7	4305.966	Yb I	MT78
250	4306.34	Gd I	MCS75
200	4306.722	Ce II	C73
1000	4306.80	Tl II	ES36
150	4307.1762	Th I	PE83
80	4307.604	Ru I	K59
500	4307.741	Ca I	R68
250	4307.76	Rn I	R33
120	4307.9023	Fe I	NJLT94
50	4308.630	Dy II	NG00
200	4309.012	Sm II	K35
250	4309.10	K II	D26
25	4309.239	Ar II	N73
200	4309.620	Y II	NJK91
40 s	4309.652	Am II	FT57
150 h	4310.51	Xe II	H39
25	4311.27	Nb I	MCS75
20	4311.40	Os I	MCS75
13	4311.50	Ir I	MCS75
400 P	4313.84	Gd I	MCS75
150	4314.082	Sc II	JL80
110	4314.40	Gd I	MCS75
150	4314.800	Ti I	F91
20	4315.110	Au I	ED71
90	4315.2543	Th I	PE83
250	4317.138	O II	MKM93
150 h	4317.81	Kr II	DHM33
200	4318.4157	Th I	PE83
30	4318.441	Ru I	K59
70	4318.5513	Kr I	K93
50	4318.629	Ti I	F91
700 P	4318.847	Tb I	B01
500	4318.936	Sm II	K35
300	4319.530	Sm I	K35
150	4319.5794	Kr I	K93

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	4319.871	Ru I	K59
80	4320.52	Gd I	MCS75
120	4320.745	Sc II	JL80
90*	4321.11	Gd II	MCS75
90*	4321.20	Gd I	MCS75
200	4322.224	Tb I	B01
50 h	4322.98	Kr II	DHM33
400 s	4324.570	Am II	FT57
1	4324.62	Na I	R56
90	4324.998	Sc II	JL80
25	4325.126	Ti I	F91
	4325.361	Fr I	ABDJ90
15	4325.419	Li II	HM59
15	4325.471	Li II	HM59
300*	4325.57	Gd II	MCS75
300*	4325.69	Gd I	MCS75
200	4325.76	Nd II	MCS75
150	4325.7622	Fe I	NJLT94
20	4325.868	Dy I	NG00
30	4326.137	Mo I	WB88
20	4326.33	Nb I	MCS75
1000 P	4326.472	Tb I	B01
4	4326.633	Mn II	IV64
11	4327.0533	Pt I	SRSA92
400 P	4327.12	Gd I	MCS75
90	4327.93	Nd II	MCS75
400	4329.016	Sm II	K35
1000 P	4329.03	Cf I	RCWM80
1000 l	4329.580	Bk I	WC78
80	4329.58	Gd I	MCS75
300	4330.016	Sm I	K35
40	4330.026	V I	DA78
300 l	4330.52	Xe II	H39
1000 P	4330.82	Cm I	WHGC76
70	4331.200	Ar II	N73
25	4331.37	Nb I	MCS75
15	4332.030	Ar II	N73
200	4332.117	Tb I	B01
40	4332.825	V I	DA78
3	4333.561	Ar I	N73
500 P	4333.74	La II	MCS75
250	4333.973	Pr II	G90
300	4334.153	Sm II	K35
1000	4335.22	Cf I	RCWM80
1	4335.338	Ar I	N73
600 P	4336.137	Sm I	K35
300 P	4336.455	Tb I	B01
300	4336.54	Pm II	RCWM80
200	4337.2774	Th I	PE83
40	4337.566	Cr I	K53
200	4337.646	Tb I	B01
300	4337.773	Ce II	C73
600 P	4338.435	Tb I	B01
100	4338.70	Nd II	MCS75
70	4338.702	Pr II	G90
60	4339.223	Hg I	BAL50
60	4339.45	Cr I	K53
20	4339.74	Cr I	K53
30 P	4340.462	H I	MK00a
250	4340.609	Tb I	B01

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500 P	4340.64	Ra II	R34a
60	4341.008	V I	DA78
150	4341.127	Zr I	J98
140 P	4341.6865	U II	PKE80
50	4342.073	Ru I	K59
300	4342.12	Pm II	RCWM80
100	4342.18	Gd II	MCS75
120 c,w	4344.30	Pr II	MCS75
110	4344.30	Gd II	MCS75
90	4344.51	Cr I	K53
1	4345.168	Ar I	N73
1000	4345.69	Cm I	WHGC76
500 P	4346.46	Gd I	MCS75
200	4346.62	Gd I	MCS75
11	4346.96	Rb II	R75
90 c	4347.491	Pr II	G90
100	4347.494	Hg I	BAL50
250	4347.801	Sm II	K35
300	4347.888	Zr I	J98
250 P	4348.064	Ar II	N73
40 h	4348.783	Y I	P77
90	4349.0722	Th I	PE83
250	4349.426	O II	MKM93
300 P	4349.60	Rn I	R33
200	4349.788	Ce II	C73
70	4350.399	Pr II	G90
150 P	4350.73	Ho I	MZH78
20	4351.055	Cr I	K53
130	4351.29	Nd II	MCS75
15	4351.3597	Kr I	K93
1000	4351.504	Bk I	WC78
20	4351.57	Nb I	MCS75
120	4351.77	Cr I	K53
3	4351.906	Mg I	KM91a
15	4352.205	Ar II	N73
50	4352.74	Pb II	WRSH74
80	4352.871	V I	DA78
60	4354.130	Ru I	K59
90	4354.4824	Th I	PE83
90	4354.91	Pr II	MCS75
4	4355.09	Eu II	MCS75
1000 P	4355.477	Kr II	HP70a
130 P,h	4355.7400	U I	PKE80
110	4356.33	Hf I	MCS75
300 P	4356.837	Tb I	B01
150	4358.17	Nd II	MCS75
1000 P	4358.328	Hg I	BAL50
7	4358.69	Re I	MCS75
130	4359.13	Ac II	MFT57
140	4359.3719	Th I	PE83
30	4359.647	Cr I	K53
80 c	4359.788	Pr II	G90
250 P	4359.928	Tm I	SMC73
60 P	4360.663	Be II	J61a
90	4360.800	Zr I	J98
100 P	4360.988	Be II	J61a
80	4361.204	Ru I	K59
200	4362.040	Sm II	K35
130 P	4362.0510	U I	PKE80
8	4362.066	Ar II	N73

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
80	4362.6416	Kr I	K93
300 P	4362.912	Sm I	K35
80	4363.30	Cs II	S81
1000 P	4363.636	Bk I	WC78
800	4364.00	Te II	HM64
250	4364.650	Ce II	C73
1000	4365.63	Br II	K40
140	4365.9301	Th I	PE83
15	4367.832	Ar II	N73
250	4368.334	Pr II	G90
70 h	4369.20	Xe II	H39
150 r	4369.64	Pm I	RD67
70	4369.69	Kr II	DHM33
120	4369.862	Ne II	P71
70	4370.753	Ar II	N73
25	4371.279	Cr I	K53
25	4371.329	Ar II	N73
60	4371.62	Pr II	MCS75
200	4372.200	Ru I	K59
30	4372.93	Cl II	RK74
40	4373.04	Cs II	S81
30 l	4373.78	Xe II	H39
200	4373.83	Gd I	MCS75
140	4374.1239	Th I	PE83
70	4374.462	Sc II	JL80
400 P	4374.80	Rh I	MCS75
900 P	4374.933	Y II	NJK91
80	4375.9302	Fe I	NJLT94
15	4375.954	Ar II	N73
130	4376.1216	Kr I	K93
30	4377.12	Rb II	R75
200	4378.236	Sm II	K35
1000 P	4379.230	V I	DA78
70	4379.400	Ne II	P71
150	4379.550	Ne II	P71
50	4379.667	Ar II	N73
300	4380.423	Sm I	K35
70	4381.630	Mo I	WB88
300 P	4381.8616	Th II	PE83
250	4382.164	Ce II	C73
200 P	4383.5449	Fe I	NJLT94
300 P,l	4384.53	Ac I	MFT57
600 P	4384.710	V I	DA78
25	4384.974	Cr I	K53
15	4385.057	Ar II	N73
100	4385.059	Ne II	P71
80	4385.393	Ru I	K59
120	4385.650	Ru I	K59
130	4385.66	Nd II	MCS75
20	4386.397	Er I	M64b
500 P,l	4386.41	Ac II	MFT57
140 P	4386.434	Tm I	SMC73
100 P,c	4386.46	Pb II	WRSH74
100 h	4386.54	Kr II	DHM33
200	4386.826	Ce II	C73
10	4387.929	He I	M60a
250	4388.16	K II	D26
150 r	4388.49	Pm I	RD67
400 P	4389.980	V I	DA78
1	4390.03	Na I	R56

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
150	4390.440	Ru I	K59
10	4390.572	Mg II	KM91a
400	4390.858	Sm II	K35
250 P	4391.1105	Th II	PE83
500	4391.660	Ce II	C73
12	4391.83	Pt I	MCS75
200	4391.991	Ne II	P71
600	4392.81	Na II	W71
90	4392.9740	Th I	PE83
150 h	4393.20	Xe II	H39
1	4393.34	Na I	R56
100	4393.5858	U I	PKE80
20	4393.922	Ti I	F91
20	4394.420	Tm I	SMC73
20	4394.86	Os I	MCS75
30	4395.004	Ti II	HJLW82
300 P	4395.223	V I	DA78
150 l	4395.77	Xe II	H39
14	4396.495	Tm I	SMC73
400 P	4396.71	Ac I	MFT57
200	4397.341	Sm I	K35
150	4397.990	Ne II	P71
200	4398.008	Y II	NJK91
30	4399.9663	Kr I	K93
25	4400.097	Ar II	N73
120	4400.572	V I	DA78
300	4400.77	Pa I	BW92b
100	4400.83	Nd II	MCS75
70	4400.986	Ar II	N73
250	4401.174	Sm I	K35
90	4401.5812	Th I	PE83
300 P	4401.86	Gd I	MCS75
200* d	4403.06	Sm II	K35
200* d	4403.13	Sm I	K35
110	4403.14	Gd I	MCS75
120	4404.7505	Fe I	NJLT94
500	4404.894	Pu I	BFG84
400	4405.12	Na II	W71
40 w	4405.26	Cs II	S81
80	4405.825	Pr II	G90
200	4406.638	V I	DA78
70 l	4406.88	Xe II	H39
250	4407.633	V I	DA78
300 P	4408.195	V I	DA78
400 P	4408.501	V I	DA78
300	4408.820	Pr II	G90
140	4408.8828	Th I	PE83
150	4409.299	Ne II	P71
60	4409.340	Er I	M64b
150	4410.028	Ru I	K59
20	4410.21	Nb I	MCS75
90	4411.06	Nd II	MCS75
110	4411.16	Gd I	MCS75
200	4411.585	Sm I	K35
90 P	4411.695	Mo I	WB88
100 r	4412.47	Pm I	RD67
100	4413.215	Ne II	P71
80	4413.770	Pr II	G90
200	4414.16	Gd I	MCS75
150	4414.73	Gd I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
13	4414.887	Mn I	CMG64
400 P	4414.905	O II	MKM93
30	4415.1226	Fe I	NJLT94
1000	4415.63	Cd II	SP49
50 l	4416.07	Xe II	H39
50	4416.469	V I	DA78
250	4416.974	O II	MKM93
30	4417.273	Ti I	F91
1000 P	4417.96	Pm II	RCWM80
300	4418.778	Ce II	C73
300	4419.332	Sm I	K35
50	4419.608	Er II	M64b
150 P	4420.47	Os I	MCS75
400	4420.526	Sm II	K35
80	4420.71	P II	M59
250	4421.138	Sm II	K35
100	4421.389	Ne II	P71
50	4421.566	V I	DA78
300 P	4422.41	Gd I	MCS75
1000	4423.011	Bk I	WC78
200	4423.90	La I	MCS75
700 P	4424.339	Sm II	K35
25	4424.571	Er I	M64b
15	4425.1901	Kr I	K93
500 P	4425.441	Ca I	R68
130	4426.001	Ar II	N73
40	4426.002	V I	DA78
25	4426.769	Er I	M64b
110	4427.098	Ti I	F91
60	4427.2979	Fe I	NJLT94
100	4428.516	Ne II	P71
25	4428.517	V I	DA78
100	4428.634	Ne II	P71
250 c	4429.128	Pr II	G90
200	4429.265	Ce II	C73
40	4429.59	Tc I	BMC67
300	4429.664	Sm I	K35
20	4429.800	V I	DA78
200	4429.90	La II	MCS75
50	4430.189	Ar II	N73
250 P	4430.63	Gd I	MCS75
150	4430.904	Ne II	P71
150	4430.942	Ne II	P71
15	4430.996	Ar II	N73
150	4431.685	Kr II	HP70a
400	4432.51	Pm II	RCWM80
15	4433.838	Ar II	N73
400	4433.885	Sm II	K35
400	4434.323	Sm II	K35
30	4434.949	Mo I	WB88
500 P	4434.960	Ca I	R68
250 P,c,w	4435.56	Eu II	MCS75
500 P	4435.688	Ca I	R68
300	4436.13	Pa I	BW92b
40	4436.133	V I	DA78
100	4436.27	Ra II	R34a
200	4436.812	Kr II	HP70a
11 h	4437.269	Au I	ED71
3	4437.55	He I	M60a
50	4437.830	V I	DA78
25	4439.19	Yb I	MT78
7	4439.461	Ar II	N73
40	4439.745	Ru I	K59
400 s	4441.357	Am II	FT57
70	4441.68	V I	MCS75
130	4441.74	Br I	T63
300	4441.812	Sm I	K35
300	4442.276	Sm I	K35
50	4442.55	Pt I	MCS75
50	4444.192	V I	DA78
400	4445.153	Sm I	K35
500	4445.41	Pm II	RCWM80
9	4445.55	Pt I	MCS75
110	4446.39	Nd II	MCS75
150	4446.527	F II	P69
150	4446.722	F II	P69
600	4446.90	Pm II	RCWM80
30 P	4447.03	N II	M75a
20	4447.18	Nb I	MCS75
200	4447.188	F II	P69
1000	4447.77	Cm I	WHGC76
150 h	4448.13	Xe II	H39
12	4448.879	Ar II	N73
110	4449.143	Ti I	F91
40	4449.322	Ru I	K59
200	4449.322	Ce II	C73
30	4449.705	Dy II	NG00
12	4449.738	Mo I	WB88
140	4449.826	Pr II	G90
200	4450.727	Ce II	C73
70	4450.894	Ti I	F91
250	4451.57	Nd II	MCS75
30	4451.575	Mn I	CMG64
50	4452.006	V I	DA78
300	4452.727	Sm II	K35
110	4453.312	Ti I	F91
40	4453.698	Ti I	F91
100	4453.9175	Kr I	K93
800 P	4453.95	Pm II	RCWM80
300	4454.629	Sm II	K35
600 P	4454.781	Ca I	R68
500	4455.23	Na II	W71
120	4455.317	Ti I	F91
600 P	4455.887	Ca I	R68
400 P	4456.605	Ca I	R68
120	4457.049	Ne II	P71
15	4457.354	Mo I	WB88
140	4457.426	Ti I	F91
30	4457.470	V I	DA78
140	4458.0015	Th I	PE83
10	4458.263	Mn I	CMG64
700	4458.469	As II	LA71
250	4458.517	Sm II	K35
1000 P	4459.16	Cm I	WHGC76
150	4459.25	Rn I	R33
80	4459.752	V I	DA78
100	4460.031	Ru I	K59
700 P	4460.204	Ce II	C73
150	4460.331	V I	DA78
40	4461.6528	Fe I	NJLT94

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
20	4462.033	Mn I	CMG64
300 h	4462.19	Xe II	H39
50	4462.360	V I	DA78
400 P	4462.73	Ac I	MFT57
140	4462.99	Nd II	MCS75
130	4463.6900	Kr I	K93
11	4464.679	Mn I	CMG64
40	4465.805	Ti I	F91
700	4466.348	As II	LA71
1000 P	4466.457	Bk I	WC78
110	4467.08	Gd I	MCS75
500 P	4467.342	Sm II	K35
200	4468.663	Pr II	G90
11	4469.47	Rb II	R75
30	4469.705	V I	DA78
500 P	4470.886	Sm I	K35
30	4471.236	Ti I	F91
400	4471.237	Ce II	C73
200	4471.479	He I	M60a
25	4471.68	He I	M60a
110	4472.101	B II	O70
120	4472.3297	U II	PKE80
130	4472.61	Br I	T63
110	4472.851	B II	O70
300	4473.23	Pm II	RCWM80
150	4474.13	Gd I	MCS75
20	4474.570	Mo I	WB88
30	4474.759	Ar II	N73
250	4475.014	Kr II	HP70a
15	4475.720	Y I	P77
200	4476.12	Gd I	MCS75
20	4476.952	Y I	P77
15	4477.442	Y I	P77
250	4477.72	Br I	T63
800	4478.63	Te II	HM64
200	4478.657	Sm II	K35
200	4479.358	Ce II	C73
150 l	4480.86	Xe II	H39
14 P	4481.126	Mg II	KM91a
70	4481.258	Ti I	F91
60	4481.26	Tm II	MCS75
13 P	4481.325	Mg II	KM91a
40	4481.53	Tc I	BMC67
150 r	4481.60	Pm I	RD67
70	4481.811	Ar II	N73
130	4482.1693	Th I	PE83
5 h	4482.422	Yb I	MT78
200	4483.891	Ce II	C73
70	4484.19	W I	MCS75
250	4486.905	Ce II	C73
120	4487.06	Tc I	BMC67
30	4487.460	Y I	P77
25	4488.253	Au I	ED71
30	4488.889	V I	DA78
30	4489.087	Ti I	F91
130 h	4489.88	Kr II	DHM33
400	4490.87	Na II	W71
140	4493.077	Tb I	B01
300	4493.21	Po I	C66a
1	4494.18	Na I	R56
800	4494.230	As II	LA71
30	4496.145	Ti I	F91
200	4496.456	Pr II	G90
30	4496.85	Cr I	K53
100	4497.13	Gd I	MCS75
1	4497.66	Na I	R56
15	4498.76	Pt I	MCS75
9	4498.897	Mn I	CMG64
200	4498.9401	Th I	PE83
250	4499.108	Sm I	K35
600	4500.15	Pm II	RCWM80
120	4501.55	Cs II	S81
9	4502.223	Mn I	CMG64
100	4502.3543	Kr I	K93
90	4505.2167	Th I	PE83
50	4505.948	Y I	P77
90	4506.21	Gd I	MCS75
250	4506.413	Ce I	M75c
150	4507.109	Zr I	J98
700 P,l	4507.20	Ac II	MFT57
800	4507.659	As II	LA71
150	4508.48	Rn I	R33
1000 P,l	4509.450	Am II	FT57
150	4510.153	Pr II	G90
70	4510.5259	Th II	PE83
3	4510.733	Ar I	N73
140 d	4510.98	Ta I	MCS75
1000 P	4511.2972	In I	DMZ53
100	4512.733	Ti I	F91
50	4513.31	Re I	MCS75
40	4515.98	Tc I	BMC67
130	4518.021	Ti I	F91
400 P	4518.57	Lu I	MCS75
15	4519.595	Tm I	SMC73
200	4519.633	Sm II	K35
250 P	4519.66	Gd I	MCS75
8	4520.90	Pt I	MCS75
120	4521.1939	Th I	PE83
30 l	4521.86	Xe II	H39
1	4522.323	Ar I	N73
90	4522.37	La II	MCS75
30	4522.57	Tm II	MCS75
50 P	4522.57	Eu II	MCS75
100	4522.720	Ne II	P71
9	4522.73	Re I	MCS75
130	4522.796	Ti I	F91
400	4522.84	Tc I	BMC67
200	4523.077	Ce II	C73
130 h	4523.14	Kr II	DHM33
30	4523.41	Nb I	MCS75
110 P	4524.734	Sn I	B64
2	4524.926	Ba II	KL99
600	4525.20	Pm II	RCWM80
200	4525.59	Br I	T63
20	4526.458	Cr I	K53
200 P	4526.74	Cs II	S81
90	4527.239	Y I	P77
250	4527.25	Nd I	MCS75
100	4527.305	Ti I	F91
250	4527.349	Ce II	C73

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
150 r	4527.70	Pm I	RD67
40	4527.783	Y I	P77
250	4528.472	Ce II	C73
800 P	4529.21	Pm II	RCWM80
30	4530.34	Rb II	R75
7	4530.552	Ar II	N73
20	4530.72	Cr I	K53
150 P	4533.11	Ra II	R34a
800	4533.239	Ti I	F91
200	4533.799	Sm I	K35
70 c	4534.154	Pr II	G90
500	4534.775	Ti I	F91
300	4535.567	Ti I	F91
12	4535.714	Cr I	K53
150	4535.742	Zr I	J98
150	4535.918	Ti I	F91
70	4535.923	Pr II	G90
150	4536.039	Ti I	F91
1000 P	4536.146	Pu II	BFG84
14	4536.796	Mo I	WB88
100	4537.7545	Ne I	SS04
200	4537.81	Gd I	MCS75
40	4538.97	Cs II	S81
80	4539.53	Tc I	BMC67
250	4539.745	Ce II	C73
12	4540.50	Cr I	K53
12	4540.715	Cr I	K53
500	4542.89	Br II	K40
700	4543.483	As II	LA71
130 P	4543.6255	U II	PKE80
200	4543.948	Sm II	K35
7	4544.607	Cr I	K53
90	4544.687	Ti I	F91
130	4545.052	Ar II	N73
30	4545.395	V I	DA78
30	4545.946	Cr I	K53
30	4546.82	Nb I	MCS75
120	4548.763	Ti I	F91
20	4550.41	Os I	MCS75
25	4552.42	Pt I	MCS75
120	4552.453	Ti I	F91
30	4552.85	Tc I	BMC67
60	4553.008	Zr I	J98
1000 P	4554.033	Ba II	KL99
500	4554.514	Ru I	K59
60	4555.124	Zr I	J98
15 P,c	4555.28	Cs I	K62b
90	4555.483	Ti I	F91
120	4555.8127	Th I	PE83
70 h	4556.61	Kr II	DHM33
40	4557.05	Tc I	BMC67
500	4557.78	Te II	HM64
300	4559.67	Nd I	MCS75
200	4560.283	Ce II	C73
25	4560.716	V I	DA78
600 P	4562.358	Ce II	C73
5 h	4563.95	Yb I	MT78
7	4564.405	Ar II	N73
25	4564.53	Nb I	MCS75
80	4564.54	Tc I	BMC67

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
110	4565.94	Hf I	MCS75
200	4567.91	La I	MCS75
100	4569.057	Ne II	P71
300	4570.02	La I	MCS75
110	4570.9722	Th I	PE83
5	4571.096	Mg I	KM91a
200	4571.77	Rb II	R75
300	4572.281	Ce II	C73
12 P	4572.664	Be I	KM97
40	4573.08	Nb I	MCS75
130	4574.31	Ta I	MCS75
150 r	4575.27	Pm I	RD67
140	4575.513	Zr I	J98
1000 P,l	4575.590	Am II	FT57
40 P	4576.209	Yb I	MT78
40	4577.178	V I	DA78
250	4577.209	Kr II	HP70a
150	4577.72	Rn I	R33
25	4577.775	Dy I	NG00
40	4578.45	Tc I	BMC67
40	4578.69	Tb II	MCS75
50	4579.051	Pb II	WRSH74
130	4579.350	Ar II	N73
20	4580.045	Cr I	K53
50	4580.403	V I	DA78
90	4581.29	Gd I	MCS75
200	4581.581	Sm I	K35
30	4581.62	Nb I	MCS75
300	4581.729	Sm I	K35
50	4582.27	Pb II	WRSH74
11	4582.355	Yb I	MT78
100	4582.978	Kr II	HP70a
90	4583.07	Gd I	MCS75
150	4584.440	Ru I	K59
70	4586.370	V I	DA78
200	4586.62	Nd I	MCS75
110 P	4588.04	P II	M59
4	4589.211	Yb I	MT78
130 P	4589.364	Dy I	NG00
110 P	4589.86	P II	M59
130	4589.898	Ar II	N73
8	4590.834	Yb I	MT78
300	4590.972	O II	MKM93
20	4591.405	Cr I	K53
50 h	4592.80	Kr II	DHM33
8 P,c	4593.17	Cs I	K62b
200 s	4593.307	Am II	FT57
40	4593.35	Tc I	BMC67
250	4593.924	Ce II	C73
1000 P	4594.03	Eu I	MCS75
110	4594.119	V I	DA78
130	4595.4206	Th I	PE83
250	4596.175	O II	MKM93
13	4596.528	Y I	P77
100	4597.55	Pm I	RD67
250 d	4598.80	Hf I	MCS75
90	4598.90	Gd I	MCS75
25	4599.017	Tm I	SMC73
100 r	4600.25	Pm I	RD67
25	4600.745	Cr I	K53

Finding List—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
300	s	4601.43	Pa II	BW92b
30		4601.48	N II	M75a
130	P	4602.08	P II	M59
15	P	4602.831	Li I	REB95
30*	P	4602.898	Li I	REB95
30*		4602.902	Li I	REB95
1000	P	4603.79	Cs II	S81
200		4603.82	Nd I	MCS75
300		4605.45	Ac II	MFT57
200	r	4605.66	Pm I	RD67
70	P	4606.606	Er I	M64b
80		4606.77	Nb I	MCS75
20		4607.16	N II	M75a
1000	P	4607.33	Sr I	MCS75
80	h	4607.512	Au I	ED71
1000	P	4608.40	Cm I	WHGC76
250		4608.45	K II	D26
150		4609.38	Rn I	R33
200	P	4609.567	Ar II	N73
100	r	4609.85	Pm I	RD67
200		4609.87	Nd I	MCS75
12		4609.874	Mo I	WB88
60		4612.258	Dy I	NG00
12		4613.36	Cr I	K53
300	P	4613.93	Ac I	MFT57
110		4614.50	Gd I	MCS75
150		4615.292	Kr II	HP70a
30		4615.94	Tm II	MCS75
30		4616.120	Cr I	K53
40	c	4616.17	Cs II	S81
40		4616.86	Tc I	BMC67
150	r	4617.02	Pm I	RD67
120		4617.268	Ti I	F91
300	P	4619.166	Kr II	HP70a
100		4619.51	Ta I	MCS75
100	r	4619.75	Pm I	RD67
20		4619.777	V I	DA78
50		4620.0361	Ag II	KLLT01
14	c	4620.14	In II	PC38
100		4620.86	Hf I	MCS75
20		4621.39	N II	M75a
100		4621.57	Pm I	RD67
20		4621.721	Si II	S61b
600	P	4621.94	Nd I	MCS75
30	c	4622.42	Rb II	R75
60		4623.097	Ti I	F91
200	r	4623.68	Pm I	RD67
100		4624.41	Pm I	RD67
200	r	4625.29	Pm I	RD67
30		4626.181	Cr I	K53
15		4626.464	Mo I	WB88
900	P	4627.22	Eu I	MCS75
200		4627.98	Nd I	MCS75
500		4628.157	Ce II	C73
300		4628.19	Pa I	BW92b
25		4629.336	Ti I	F91
30		4630.11	Nb I	MCS75
40	P	4630.54	N II	M75a
40		4630.57	Tc I	BMC67
400		4632.28	Pr I	MCS75

Finding List—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
500	P	4632.320	Ce I	BWCC91
150	r	4633.45	Pm I	RD67
250	P	4633.885	Kr II	HP70a
200		4633.982	Zr I	J98
1000	P	4634.24	Nd I	MCS75
400		4635.68	Pr I	MCS75
90		4636.64	Gd I	MCS75
12		4637.233	Ar II	N73
120		4637.50	Tc I	BMC67
20	c	4638.16	In II	PC38
30		4639.360	Ti I	F91
500	P	4639.55	Pr I	MCS75
30		4639.660	Ti I	F91
25		4639.939	Ti I	F91
700	P	4641.10	Nd I	MCS75
500		4641.12	Te II	HM64
300	P	4641.810	O II	MKM93
400		4641.88	K I	R56
40		4641.98	Tb II	MCS75
200		4642.235	Sm II	K35
400		4642.37	K I	R56
30		4643.08	N II	M75a
150	r	4643.36	Pm I	RD67
200		4643.698	Y I	P77
100	r	4643.76	Pm I	RD67
12	c	4644.58	In II	PC38
50	P	4645.31	Tb II	MCS75
200		4645.405	Sm I	K35
80		4646.151	Cr I	K53
400		4646.40	Nd I	MCS75
100	r	4647.03	Pm I	RD67
70		4647.594	Ru I	K59
80		4648.33	Tc I	BMC67
110		4648.57	Rb II	R75
30		4648.95	Nb I	MCS75
10	l	4649.119	Am I	FT57
400	P	4649.135	O II	MKM93
250		4649.491	Sm I	K35
600	P	4649.67	Nd I	MCS75
300		4650.509	Ce I	M75c
200		4651.12	Cu I	S48
30		4651.285	Cr I	K53
40		4652.155	Cr I	K53
150	r	4653.41	Pm I	RD67
10	l	4653.448	Am I	FT57
90		4653.54	Gd I	MCS75
900	P	4654.37	Te II	HM64
400		4654.73	Nd I	MCS75
20	c	4655.62	In II	PC38
90		4656.468	Ti I	F91
20	w	4656.74	In II	PC38
130		4657.901	Ar II	N73
130		4658.02	Lu I	MCS75
20	h	4658.319	Y I	P77
700	P	4658.876	Kr II	HP70a
70		4659.87	W I	MCS75
80	c	4660.21	Tc I	BMC67
100	r	4660.79	Pm I	RD67
300		4661.633	O II	MKM93
800	P	4661.88	Eu I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500 P,l	4662.790	Am I	FT57
1000 P	4663.056	Al II	KM91b
150 r	4663.46	Pm I	RD67
200	4663.556	Sm I	K35
30	4663.83	Nb I	MCS75
2	4664.811	Na I	R56
300 r	4665.19	Pm I	RD67
20	4666.24	Nb I	MCS75
600	4666.800	Al II	KM91b
110	4667.584	Ti I	F91
5 h	4668.477	Ag I	PZ01
2	4668.560	Na I	R56
80	4669.30	Tc I	BMC67
200	4669.396	Sm II	K35
300	4670.747	Sm I	K35
150 r	4671.23	Pm I	RD67
30	4671.651	Li II	HM59
10	4671.705	Li II	HM59
40	4672.09	Nb I	MCS75
20	4673.161	Er I	M64b
140 P	4673.329	Be II	J61a
200 P	4673.423	Be II	J61a
250	4674.599	Sm II	K35
200	4674.848	Y I	P77
15	4675.03	Rh I	MCS75
30	4675.37	Nb I	MCS75
50	4675.619	Er II	M64b
110	4676.0555	Th I	PE83
250	4676.235	O II	MKM93
100 r	4677.92	Pm I	RD67
80	4678.056	Li II	HM59
150 r	4678.09	Pm I	RD67
100 P	4678.149	Cd I	BA56
25	4678.290	Li II	HM59
500	4678.70	Br II	K40
100 P	4680.1359	Zn I	GL00
150	4680.406	Kr II	HP70a
70	4680.51	W I	MCS75
200 l	4681.651	Am I	FT57
150 P	4681.88	Ta I	MCS75
120	4681.908	Ti I	F91
15	4681.920	Tm I	SMC73
500 P	4682.28	Ra II	R34a
200 r	4682.92	Pm I	RD67
90	4683.33	Gd I	MCS75
600 P	4683.45	Nd I	MCS75
200	4684.04	Nd I	MCS75
25 w	4684.8	In II	PC38
20	4685.14	Nb I	MCS75
4 P,c	4685.3769	He II	MK00b
3 P,c	4685.4072	He II	MK00b
15* P,c	4685.7038	He II	MK00b
15* P,c	4685.7044	He II	MK00b
12 P,c	4685.8041	He II	MK00b
1000	4686.91	Te II	HM64
700 P	4687.799	Zr I	J98
500 P	4687.80	Pr I	MCS75
150	4688.450	Zr I	J98
250	4688.733	Sm I	K35
200	4690.35	Nd I	MCS75
30	4691.301	Kr II	HP70a
25	4691.331	Ti I	F91
40	4694.13	S I	KM93
150	4694.33	Gd I	MCS75
70	4694.360	Kr II	HP70a
800 P	4695.77	Pr I	MCS75
500	4696.38	Te II	HM64
400	4696.44	Nd I	MCS75
20	4696.800	Y I	P77
100 r	4696.80	Pm I	RD67
90	4697.42	Gd I	MCS75
12	4698.46	Cr I	K53
25	4698.760	Ti I	F91
400 l	4699.700	Am II	FT57
40	4702.41	Tb II	MCS75
150	4704.3949	Ne I	SS04
500 P	4704.92	Br II	K40
600 P,h	4705.285	Bi II	DLW02
250	4705.352	O II	MKM93
200	4705.78	Ac I	MFT57
500	4706.53	Te II	HM64
100 l	4706.802	Am I	FT57
40	4706.92	Tc I	BMC67
250	4706.96	Nd I	MCS75
20	4707.248	Mo I	WB88
10	4708.02	Cr I	K53
120	4708.8594	Ne I	SS04
130	4709.482	Ru I	K59
400	4709.52	Pr I	MCS75
100	4710.0650	Ne I	SS04
500 P	4710.074	Zr I	J98
200	4711.68	Sb II	C66b
150	4712.0633	Ne I	SS04
30	4713.146	He I	M60a
4	4713.38	He I	M60a
150	4715.344	Ne I	SS04
500 P	4716.097	Sm I	K35
500 P	4716.58	Ac I	MFT57
80	4717.77	Tc I	BMC67
12	4718.43	Cr I	K53
500 P	4719.02	Nd I	MCS75
150 c	4719.28	Tc I	BMC67
300 s	4720.16	Ac II	MFT57
7	4721.591	Ar II	N73
100	4721.76	Rn I	R33
250 P	4722.1569	Zn I	GL00
50	4722.28	Sr I	MCS75
70 P,c	4722.527	Bi I	GMV85
150	4723.4382	Th I	PE83
11	4726.08	Yb II	M67
200 P	4726.868	Ar II	N73
300 r	4728.36	Pm I	RD67
500 P	4728.423	Sm I	K35
15	4728.514	Y I	P77
150 r	4728.68	Pm I	RD67
20	4729.209	Sc I	AV77
300	4730.267	Bi II	DLW02
11	4730.45	Rb II	R75
500 P	4730.67	Pr I	MCS75
600 P	4730.78	Se I	RG34

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
25	4731.441	Mo I	WB88
250	4731.77	Nd I	MCS75
15	4732.053	Ar II	N73
70 P	4733.335	Tm I	SMC73
25	4734.109	Sc I	AV77
60	4734.152	Xe I	HM33
400 P,r	4734.27	Pm I	RD67
100	4735.906	Ar II	N73
700 P	4736.69	Pr I	MCS75
700	4737.05	Tl II	ES36
7	4737.33	Cr I	K53
30	4737.647	Sc I	AV77
1000 P	4739.002	Kr II	HP70a
400	4739.03	Se I	RG34
400	4739.475	Zr I	J98
400	4740.61	Tc I	BMC67
150	4740.91	K I	R56
30	4741.024	Sc I	AV77
1000 P	4741.806	Ge II	S63a
30	4741.92	Sr I	MCS75
300	4742.25	Se I	RG34
90	4743.65	Gd I	MCS75
50	4743.821	Sc I	AV77
250	4744.16	Pr I	MCS75
250	4744.35	K I	R56
150 r	4745.13	Pm I	RD67
70 P	4752.53	Tb II	MCS75
40	4752.72	Tc I	BMC67
50	4752.7320	Ne I	SS04
15	4752.790	Y I	P77
200	4753.93	K I	R56
40	4754.048	Mn I	CMG64
11	4755.30	Rb II	R75
15	4756.09	Cr I	K53
50	4756.8059	U I	PKE80
300	4757.39	K I	R56
150 r	4757.73	Pm I	RD67
50	4757.844	Ru I	K59
40	4758.118	Ti I	F91
70	4758.70	Gd I	MCS75
700 P,r	4759.00	Pm I	RD67
40	4759.269	Ti I	F91
25	4760.183	Mo I	WB88
500 P	4760.27	Sm I	K35
40	4760.978	Y I	P77
30	4762.376	Mn I	CMG64
100	4762.435	Kr II	HP70a
1000 P,r	4762.57	Pm I	RD67
70	4763.64	Cs II	S81
250 P	4764.865	Ar II	N73
1000 l	4765.40	Bk I	WC78
300 P	4765.744	Kr II	HP70a
11	4765.856	Mn I	CMG64
500	4766.05	Te II	HM64
20	4766.426	Mn I	CMG64
100	4767.24	Gd I	MCS75
25	4768.649	Cl II	RK74
150	4771.54	Tc I	BMC67
250	4772.313	Zr I	J98
400 P,r	4773.46	Pm I	RD67
300 P	4775.95	Rb II	R75
10	4779.354	Sc I	AV77
250	4779.46	Nd I	MCS75
200 r	4781.29	Pm I	RD67
70	4781.318	Cl II	RK74
9 h	4781.867	Yb I	MT78
60 c	4782.83	Rb II	R75
400	4783.103	Sm I	K35
30	4783.432	Mn I	CMG64
20	4784.32	Sr I	MCS75
500	4784.87	Te II	HM64
60	4784.921	Zr I	J98
500 P	4785.48	Br II	K40
200	4785.864	Sm I	K35
200	4786.49	K I	R56
9	4786.61	Yb II	M67
60	4786.78	Tb I	MCS75
15	4786.875	Y I	P77
80	4788.363	Li II	HM59
100	4788.3968	Ag II	KLLT01
100	4788.9258	Ne I	SS04
10	4789.324	Cr I	K53
100	4789.93	Es	WLGC74
50	4790.2195	Ne I	SS04
300	4791.05	K I	R56
50	4792.583	Au I	ED71
15	4792.619	Xe I	HM33
25	4793.99	Os I	MCS75
600 P	4794.55	Cl II	RK74
600 P,r	4798.98	Pm I	RD67
20	4799.301	Y I	P77
250	4799.75	K I	R56
150 P	4799.912	Cd I	BA56
140	4800.50	Hf I	MCS75
500 P,r	4801.36	Pm I	RD67
100 h	4802.21	Es	WLGC74
20	4803.29	N II	M75a
300	4804.35	K I	R56
70	4805.872	Zr I	J98
200 P	4806.020	Ar II	N73
50	4807.02	Xe I	HM33
200 r	4809.54	Pm I	RD67
150 P	4810.06	Cl II	RK74
400 P	4810.5321	Zn I	GL00
100	4811.76	Kr II	DHM33
350 P,r	4811.85	Pm I	RD67
70 P	4811.88	Sr I	MCS75
200	4812.22	Ac II	MFT57
1000 P	4814.608	Ge II	S63a
200	4815.630	Zr I	J98
500 P	4816.68	Br II	K40
14	4819.249	Mo I	WB88
90	4819.471	Cl II	RK74
300	4820.34	Pa I	BW92b
25	4820.410	Ti I	F91
400	4820.74	Tc I	BMC67
70	4821.69	Gd I	MCS75
300	4822.547	Ce I	M75c
40	4823.528	Mn I	CMG64
80	4824.288	Zr I	J98

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
100	4825.18	Kr II	DHM33
1000 P	4825.91	Ra I	R34b
500	4827.14	Te II	HM64
100	4827.338	Ne I	SS04
40	4828.159	Be II	J61a
300	4829.23	K II	D26
40	4829.71	Xe I	HM33
250	4830.19	Cs II	S81
14	4830.513	Mo I	WB88
800	4831.28	Te II	HM64
250 P	4832.077	Kr II	HP70a
60	4832.08	Sr I	MCS75
40	4834.37	Tc I	BMC67
40	4835.39	Tc I	BMC67
350 P,r	4837.66	Pm I	RD67
80	4839.866	Y I	P77
60	4840.873	Ti I	F91
600 P	4841.701	Sm I	K35
800	4842.90	Te II	HM64
30	4843.29	Xe I	HM33
90	4843.81	W I	MCS75
700 P	4844.33	Xe II	HP87
800	4844.941	Se II	G62
60	4845.668	Y I	P77
250 P	4846.612	Kr II	HP70a
400	4847.774	Ce I	M75c
50	4847.810	Ar II	N73
300	4849.86	K I	R56
60	4851.362	Zr I	J98
25	4851.489	V I	DA78
40	4852.682	Y I	P77
800 P	4853.59	Tc I	BMC67
300	4854.861	Y II	NJK91
40	4856.010	Ti I	F91
300	4856.09	K I	R56
50	4857.20	Kr II	DHM33
30	4859.841	Y I	P77
700 P,r	4860.74	Pm I	RD67
30 P	4861.2786	H I	MK00a
10 P	4861.2870	H I	MK00a
60 P	4861.3615	H I	MK00a
300 s	4861.49	Pa I	BW92b
70	4863.1724	Th II	PE83
300	4863.48	K I	R56
40	4864.733	V I	DA78
600	4865.12	Te II	HM64
300 r	4865.72	Pm I	RD67
15	4865.910	Ar II	N73
1000	4866.24	Te II	HM64
400	4866.73	Tc I	BMC67
400	4866.74	Nd I	MCS75
10	4867.62	Eu I	MCS75
12	4868.018	Mo I	WB88
25	4868.259	Ti I	F91
50	4869.163	Ru I	K59
400	4869.76	K I	R56
200	4870.04	Cs II	S81
30	4870.127	Ti I	F91
7	4870.79	Cr I	K53
400 l	4872.220	Am II	FT57

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
150 r	4872.42	Pm I	RD67
50 P	4872.49	Sr I	MCS75
9	4874.10	Ag I	S40
50	4875.486	V I	DA78
30	4876.32	Sr I	MCS75
500	4878.132	Ca I	R68
8	4879.53	Pt I	MCS75
250 P	4879.864	Ar II	N73
50 c	4880.05	Cs II	S81
15	4881.320	Li II	HM59
15	4881.386	Li II	HM59
5	4881.490	Li II	HM59
60	4881.555	V I	DA78
700 P	4883.682	Y II	NJK91
700 P	4883.81	Nd I	MCS75
500 P	4883.971	Sm I	K35
100	4884.9170	Ne I	SS04
50	4885.081	Ti I	F91
15 c	4885.59	Rb II	R75
6	4887.013	Cr I	K53
100 r	4887.02	Pm I	RD67
25	4889.042	Ar II	N73
40 c,w	4889.14	Re I	MCS75
500	4891.07	Nd I	MCS75
300	4891.92	Tc I	BMC67
350 P,r	4892.52	Pm I	RD67
400 P	4896.77	Cl II	RK74
500 P	4896.93	Nd I	MCS75
50	4899.908	Ti I	F91
90	4899.92	La II	MCS75
6	4899.927	Ba II	KL99
20	4900.080	Er II	M64b
600 P	4900.118	Y II	NJK91
250	4901.53	Nd I	MCS75
400	4901.84	Nd I	MCS75
40	4903.066	Ru I	K59
7	4904.752	Ar II	N73
250 P	4904.776	Cl II	RK74
60	4904.88	Lu I	MCS75
300	4906.99	Pr I	MCS75
14	4907.18	Eu I	MCS75
40	4908.51	Tc I	BMC67
80	4909.57	Tc I	BMC67
700	4909.734	Cu II	R69
400	4910.400	Sm I	K35
15	4911.40	Eu I	MCS75
80 P	4911.6269	Zn II	GL00
400	4913.41	Nd I	MCS75
40	4913.615	Ti I	F91
400	4914.02	Pr I	MCS75
50	4916.51	Xe I	HM33
140 P	4917.731	Cl II	RK74
250	4918.986	Sm I	K35
60	4919.8157	Th II	PE83
50	4920.5029	Fe I	NJLT94
110	4920.98	La II	MCS75
110	4921.79	La II	MCS75
20	4921.931	He I	M60a
13	4922.276	Cr I	K53
50	4923.152	Xe I	HM33

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
120 P	4924.0132	Zn II	GL00
900 P	4924.53	Nd I	MCS75
500 P	4924.60	Pr I	MCS75
400	4930.62	Br II	K40
600	4931.698	Cu II	R69
350 P,r	4932.99	Pm I	RD67
12	4933.209	Ar II	N73
300 P	4934.077	Ba II	KL99
20	4934.115	Er II	M64b
40 P	4935.500	Yb I	MT78
400	4936.00	Pr I	MCS75
30 P	4939.01	Ho I	MZH78
800 P	4939.74	Pr I	MCS75
400	4940.30	Pr I	MCS75
110	4940.376	B II	O70
300	4942.02	K I	R56
300	4943.44	Ce I	MCS75
110	4943.53	P II	M59
500 P	4944.83	Nd I	MCS75
100	4945.59	Kr II	DHM33
500 P	4949.77	La I	MCS75
400	4950.82	K I	R56
1000 P	4951.37	Pr I	MCS75
400	4952.85	Cs II	S81
500	4953.724	Cu II	R69
600 P	4954.78	Nd I	MCS75
400	4956.15	K I	R56
14	4957.175	Tm I	SMC73
20	4957.347	Dy II	NG00
150	4957.5967	Fe I	NJLT94
300 h	4958.29	Es	WLGC74
500 P,r	4959.46	Pm I	RD67
120 P	4962.26	Sr I	MCS75
80	4963.98	N I	M75a
400	4965.03	K I	R56
70	4965.080	Ar II	N73
8	4966.902	Yb I	MT78
20 P	4967.94	Sr I	MCS75
5	4971.665	Li I	REB95
70 l	4971.71	Xe II	H39
10	4971.748	Li I	REB95
80	4972.60	Cs II	S81
130	4972.71	Xe II	H39
300	4975.75	Pr I	MCS75
250	4976.34	Tc I	BMC67
2	4978.541	Na I	R56
25	4979.97	Ho I	MCS75
500	4981.35	Tl II	ES36
700 P	4981.730	Ti I	F91
5	4982.813	Na I	R56
100	4988.77	Xe II	H39
20 l	4990.786	Am I	FT57
600 P	4991.066	Ti I	F91
30 l	4991.17	Xe II	H39
80	4992.024	Ni II	S70
20	4994.36	N II	M75a
400	4994.627	Ce I	BWCC91
60	4995.477	Cl II	RK74
1000 P,r	4997.10	Pm I	RD67
80	4999.47	La II	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500	4999.501	Ti I	F91
10 s	5000.21	Am I	FT57
30	5000.988	Ti I	F91
110	5001.14	Lu I	MCS75
30	5001.48	N II	M75a
40 P	5005.15	N II	M75a
50	5005.1587	Ne I	SS04
3	5005.416	Pb I	WA68
250	5005.60	K II	D26
500 P	5007.206	Ti I	F91
20	5007.234	Er I	M64b
30	5007.32	N II	M75a
600 P	5009.098	Ce I	M75c
15	5009.334	Ar II	N73
20	5009.77	Tm II	MCS75
20	5010.62	N II	M75a
15	5013.17	Eu I	MCS75
30	5013.281	Ti I	F91
400 P	5014.186	Ti I	F91
300	5014.275	Ti I	F91
150	5015.04	Gd I	MCS75
100	5015.678	He I	M60a
70	5016.160	Ti I	F91
25	5017.163	Ar II	N73
60	5017.2540	Th II	PE83
300	5018.59	Pr I	MCS75
500 P	5019.76	Pr I	MCS75
300	5019.971	Ca II	ER56
110	5020.024	Ti I	F91
200 l	5020.96	Am II	FT57
70	5022.40	Kr II	DHM33
110	5022.866	Ti I	F91
15	5022.91	Eu I	MCS75
70	5024.843	Ti I	F91
40	5025.569	Ti I	F91
500 P	5026.96	Pr I	MCS75
50	5027.3433	Ag II	KLLT01
50	5027.3841	U I	PKE80
20	5028.280	Xe I	HM33
10	5029.54	Eu I	MCS75
250	5033.38	Pr I	MCS75
20	5034.22	Tm II	MCS75
150	5035.902	Ti I	F91
110	5036.463	Ti I	F91
50	5037.7512	Ne I	SS04
15	5037.915	Li II	HM59
90	5038.396	Ti I	F91
150 P	5039.955	Ti I	F91
300	5040.846	Ce I	M75c
130 P	5041.026	Si II	S61b
20	5042.049	Er II	M64b
250 P	5042.58	Pb II	WRSH74
250	5043.80	Cs II	S81
300	5043.83	Pr I	MCS75
9	5044.04	Pt I	MCS75
250	5044.279	Sm I	K35
300 P,s	5044.66	Np I	FTBC76
70	5044.92	Xe II	H39
30	5045.10	N II	M75a
800 P	5045.52	Pr I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
70	5046.583	Zr I	J98
10	5047.74	He I	M60a
60	5049.7960	Th II	PE83
300	5050.57	La I	MCS75
600	5051.793	Cu II	R69
1000 s	5052.08	Es	WLGC74
90	5053.28	W I	MCS75
400	5053.40	Pr I	MCS75
130 P	5055.981	Si II	S61b
250	5056.27	K II	D26
250	5056.46	La I	MCS75
40	5057.340	Ru I	K59
1000 P,r	5058.31	Pm I	RD67
20	5059.48	Pt I	MCS75
15	5060.895	Tm I	SMC73
25	5062.037	Ar II	N73
11	5064.306	Sc I	AV77
200 P	5064.651	Ti I	F91
100	5064.904	Zr I	J98
200 P	5067.9737	Th I	PE83
4	5069.144	Yb I	MT78
25	5070.257	Sc I	AV77
50	5070.58	Pb II	WRSH74
300	5071.200	Sm I	K35
300	5071.775	Ce I	M75c
12	5074.34	Yb I	MT78
50	5074.53	Pb II	WRSH74
11	5075.820	Sc I	AV77
130	5078.252	Zr I	J98
140 P	5078.264	Cl II	RK74
800 P	5078.54	Tl II	ES36
50	5078.96	Nb I	MCS75
300	5080.62	Xe II	H39
90	5081.561	Sc I	AV77
50	5083.721	Sc I	AV77
400	5084.23	K I	R56
50	5085.549	Sc I	AV77
500 P,h	5085.822	Cd I	BA56
80	5086.52	Kr II	DHM33
500 P	5087.12	Pr I	MCS75
15	5087.123	Sc I	AV77
700 P	5087.418	Y II	NJK91
12	5089.930	Sc I	AV77
7	5090.495	Ar II	N73
400 r	5094.83	Pm I	RD67
25	5095.30	Nb I	MCS75
300	5096.28	Tc I	BMC67
15	5096.721	Sc I	AV77
400	5097.17	K I	R56
400	5099.20	K I	R56
25	5099.274	Sc I	AV77
300 r	5100.77	Pm I	RD67
15	5101.119	Sc I	AV77
100 s	5102.93	Es	WLGC74
200 P	5103.45	Gd I	MCS75
150 P	5105.54	Cu I	S48
300	5106.23	La I	MCS75
70	5110.384	Pr II	G90
110	5110.763	Pr II	G90
50	5111.64	Pb II	WRSH74

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500	5112.25	K I	R56
400	5112.703	Ce I	M75c
25	5113.439	Ti I	F91
15	5114.37	Eu I	MCS75
14	5116.648	Sc I	AV77
300	5117.162	Sm I	K35
1000 l	5118.24	Bk I	WC78
130 P	5119.29	I I	KC59
30	5120.415	Ti I	F91
15 c	5120.80	In II	PC38
11 w	5121.75	In II	PC38
200	5122.136	Sm I	K35
100	5122.42	Xe II	H39
500 P,h	5124.356	Bi II	DLW02
30	5125.70	Xe II	H39
130 h	5125.73	Kr II	DHM33
1000 P,r	5127.34	Pm I	RD67
12 c	5128.442	Hg II	SR01
15	5129.10	Eu I	MCS75
80	5129.536	Pr II	G90
500	5129.569	Ce I	M75c
130	5130.60	Nd II	MCS75
700 P	5133.44	Pr I	MCS75
20	5133.52	Eu I	MCS75
400 P	5135.09	Lu I	MCS75
20	5135.199	Y I	P77
1000 s	5135.53	Bk II	WC78
50	5136.558	Ru I	K59
250	5139.81	Pr I	MCS75
30	5141.783	Ar II	N73
600 P,h	5144.492	Bi II	DLW02
50	5144.9384	Ne I	SS04
300	5145.16	C II	MG93
25	5145.308	Ar II	N73
600 P	5145.42	La I	MCS75
30	5145.459	Ti I	F91
700 P,r	5146.30	Pm I	RD67
30	5147.477	Ti I	F91
1	5148.838	Na I	R56
250	5149.993	Ce I	BWCC91
200	5151.09	C II	MG93
110 P	5152.08	Rb II	R75
800 P	5152.14	Tl II	ES36
25	5152.184	Ti I	F91
200 P	5153.24	Cu I	S48
1	5153.402	Na I	R56
400	5153.86	Pm II	RCWM80
50	5155.140	Ru I	K59
200 P	5155.84	Gd I	MCS75
130 P	5156.56	Ta I	MCS75
140	5158.6041	Th I	PE83
400	5158.69	La I	MCS75
800 P	5159.686	Ce I	M75c
25	5160.07	Eu I	MCS75
15	5160.33	Nb I	MCS75
120	5160.7309	Th I	PE83
150 P,c	5161.20	I II	MC60
800 P	5161.484	Ce I	M75c
1000 P,s	5161.74	Es I	WLGC74
150	5161.81	Tc I	BMC67

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
15	5164.38	Nb I	MCS75
15	5164.767	Er II	M64b
8	5165.773	Ar II	N73
20	5166.70	Eu I	MCS75
12 P	5167.322	Mg I	KM91a
250	5167.4883	Fe I	NJLT94
300	5169.71	Pm II	RCWM80
1000	5170.61	Bk I	WC78
80	5171.026	Ru I	K59
500	5171.58	Pm II	RCWM80
50	5171.5962	Fe I	NJLT94
40 P	5172.684	Mg I	KM91a
140 P	5173.740	Ti I	F91
120	5173.905	Pr II	G90
1000	5173.96	Cf I	RCWM80
500	5174.554	Ce I	M75c
150	5174.81	Tc I	BMC67
300	5175.419	Sm I	K35
13 c	5175.42	In II	PC38
800 P	5177.31	La I	MCS75
30	5178.82	Xe II	H39
1000	5179.08	Cf I	RCWM80
100	5181.86	Hf I	MCS75
500	5182.36	Br II	K40
90	5183.42	La II	MCS75
70 P	5183.604	Mg I	KM91a
110	5187.459	Ce II	C73
1	5187.746	Ar I	N73
100	5188.04	Xe II	H39
500	5188.848	Ca I	R68
15	5188.898	Er II	M64b
130	5191.37	Xe II	H39
90	5191.45	Nd II	MCS75
30	5192.10	Xe II	H39
120	5192.62	Nd II	MCS75
25 h	5192.86	Si II	S61b
150 P	5192.969	Ti I	F91
300	5194.05	Pm II	RCWM80
300	5194.43	Pr I	MCS75
1000	5197.55	Bk I	WC78
90	5197.77	Gd I	MCS75
150	5199.1637	Th I	PE83
20	5199.85	Eu I	MCS75
300	5200.409	Y II	NJK91
10	5200.96	Eu I	MCS75
1	5201.437	Pb I	WA68
70 h	5202.41	Si II	S61b
9	5202.63	Os I	MCS75
1000 P,l	5204.40	Es I	WLGC74
250 P	5204.505	Cr I	K53
15	5204.768	Hg II	SR01
500 P	5205.722	Y II	NJK91
400 P	5206.021	Cr I	K53
11	5206.44	Eu I	MCS75
70	5206.561	Pr II	G90
500	5208.09	Pm II	RCWM80
150	5208.32	Kr II	DHM33
600 P	5208.415	Cr I	K53
90 P	5209.078	Ag I	PZ01
800 P,h	5209.325	Bi II	DLW02

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
70 c	5209.58	Cs II	S81
200 P	5210.384	Ti I	F91
15	5210.547	Sc I	AV77
5	5211.604	Yb I	MT78
1000 P	5211.86	La I	MCS75
500	5211.877	Ce I	BWCC91
1000 P	5212.53	Bk I	WC78
300	5213.23	Nd I	MCS75
70 P	5215.10	Eu I	MCS75
40 l	5215.99	Am II	FT57
7	5216.814	Ar II	N73
300 P	5217.94	Cl II	RK74
250 P	5218.20	Cu I	S48
70	5219.048	Pr II	G90
1000	5219.24	Cf I	RCWM80
12	5219.634	Sc I	AV77
500	5219.65	Ga II	IL85
110	5220.108	Pr II	G90
130 P	5221.355	Cl II	RK74
20	5222.20	Sr I	MCS75
700 P	5223.461	Ce I	M75c
25	5223.49	Eu I	MCS75
30	5224.304	Ti I	F91
90	5224.66	W I	MCS75
25	5224.933	Ti I	F91
30	5225.11	Sr I	MCS75
800 P	5227.04	Cs II	S81
100	5227.1509	Fe I	NJLT94
1000 P	5227.533	Se II	G62
25	5227.66	Pt I	MCS75
300	5227.97	Pr I	MCS75
40	5228.12	Tb I	MCS75
30	5229.27	Sr I	MCS75
500	5229.745	Ce I	M75c
25	5230.259	Au I	ED71
200 P	5231.1597	Th I	PE83
700 P	5234.27	La I	MCS75
500	5236.26	Pm II	RCWM80
300	5236.66	Pm II	RCWM80
15	5238.206	Mo I	WB88
500	5238.26	Br II	K40
40	5238.55	Sr I	MCS75
11	5239.24	Eu I	MCS75
20	5240.800	Y I	P77
6	5244.11	Yb I	MT78
150 c	5245.71	I II	MC60
700 P	5245.916	Ce I	M75c
400	5246.33	Pm II	RCWM80
14	5247.58	Cr I	K53
300	5249.38	Cs II	S81
130	5249.59	Nd II	MCS75
70	5251.18	Gd I	MCS75
500	5253.46	La I	MCS75
70 P	5256.90	Sr I	MCS75
300 P	5258.24	Ac I	MFT57
12	5258.364	Sc I	AV77
130	5259.737	Pr II	G90
150	5260.44	Xe II	H39
150	5261.95	Xe II	H39
25	5264.16	Cr I	K53

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500	5265.557	Ca I	R68
9	5265.73	Cr I	K53
20	5266.40	Eu I	MCS75
120	5269.5376	Fe I	NJLT94
500	5270.270	Ca I	R68
60	5270.28	Be II	J61a
80	5270.3564	Fe I	NJLT94
400 h	5270.512	Bi II	DLW02
500	5270.64	Pm II	RCWM80
100 P	5270.81	Be II	J61a
25	5270.95	Re I	MCS75
500	5271.19	La I	MCS75
250	5271.403	Sm I	K35
15	5271.53	Nb I	MCS75
1000 P	5271.95	Bk I	WC78
40	5271.96	Eu I	MCS75
10	5272.48	Eu I	MCS75
110	5273.43	Nd II	MCS75
110	5274.05	Cs II	S81
100	5274.230	Ce II	C73
80	5275.51	Tc I	BMC67
30 c,w	5275.56	Re I	MCS75
8 h	5277.04	Yb I	MT78
1000 b,s	5279.01	Cf I	RCWM80
14	5282.82	Eu I	MCS75
70	5285.07	Tc I	BMC67
11	5291.26	Eu I	MCS75
200	5291.67	Nd I	MCS75
70 c	5292.024	Pr II	G90
700 P	5292.22	Xe II	H39
150	5292.52	Cu I	S48
70	5292.620	Pr II	G90
130	5293.17	Nd II	MCS75
11	5294.64	Eu I	MCS75
80	5296.13	P II	M59
400	5296.563	Ce I	M75c
15	5296.69	Cr I	K53
30	5298.29	Cr I	K53
25	5301.02	Pt I	MCS75
800	5305.347	Se II	G62
60 P	5307.116	Tm I	SMC73
70	5308.66	Kr II	DHM33
100	5309.27	Xe II	H39
300	5313.87	Xe II	H39
15	5318.60	Nb I	MCS75
90	5319.82	Nd II	MCS75
1000 s	5320.09	Cf I	RCWM80
50	5320.20	Tc I	BMC67
80	5322.772	Pr II	G90
500	5323.28	K I	R56
80	5328.0386	Fe I	NJLT94
400	5328.082	Ce I	M75c
15	5328.36	Cr I	K53
30	5328.5317	Fe I	NJLT94
60	5330.7775	Ne I	SS04
500	5332.07	Br II	K40
30 P	5332.339	Sn II	B64
150	5333.41	Kr II	DHM33
9	5335.15	Yb II	M67
1000	5337.48	Cd II	SP49
500 P	5338.22	I II	MC60
1000 s	5339.13	Cf I	RCWM80
700	5339.33	Xe II	H39
500	5339.69	K I	R56
50	5341.0239	Fe I	NJLT94
100	5341.0938	Ne I	SS04
500	5342.97	K I	R56
60	5343.2834	Ne I	SS04
100	5343.5812	Th I	PE83
30	5344.17	Nb I	MCS75
250 P,c	5345.15	I II	MC60
40	5345.77	Cr I	K53
20	5348.30	Cr I	K53
100 c	5349.13	Cs II	S81
15	5349.342	Sc I	AV77
500	5349.472	Ca I	R68
900 P	5350.46	Tl I	MCS75
20	5350.74	Nb I	MCS75
8	5352.95	Yb II	M67
14	5354.40	Rh I	MCS75
50 P	5354.88	Tb I	MCS75
25	5356.097	Sc I	AV77
50 P	5357.61	Eu I	MCS75
600	5359.57	K I	R56
20	5360.513	Mo I	WB88
11	5361.61	Eu I	MCS75
70	5363.20	Xe II	H39
50	5367.64	Pb II	WRSH74
70	5368.07	Xe II	H39
8	5368.99	Pt I	MCS75
200	5370.99	Cs II	S81
40	5371.4897	Fe I	NJLT94
50	5372.099	Pb II	WRSH74
150	5372.39	Xe II	H39
12	5375.373	Sc I	AV77
10	5376.94	Eu I	MCS75
1000	5378.13	Cd II	SP49
150	5380.34	C I	J66
1000 P	5380.98	Np II	FTBC76
200	5381.89	Cd II	SP49
500 d	5384.85	Tl II	ES36
8	5390.79	Pt I	MCS75
1000	5392.03	Bk I	WC78
15	5392.058	Sc I	AV77
80 P	5392.119	Cl II	RK74
10	5392.80	Xe I	HM33
11	5392.94	Eu I	MCS75
1000	5394.24	Bk I	WC78
30	5397.1279	Fe I	NJLT94
400	5397.638	Ce I	M75c
200	5400.23	Ra I	R34b
200 P	5400.5618	Ne I	SS04
70	5402.57	Lu I	MCS75
100 s	5402.62	Am I	FT57
40	5402.77	Eu I	MCS75
200	5406.81	Ra I	R34b
1000 P	5408.88	Cf I	RCWM80
70	5409.78	Cr I	K53
5 c	5411.52	He II	GM65
50	5414.55	Na II	W71

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500	5416.36	Ga II	IL85
1000 P	5419.15	Xe II	H39
300	5420.380	Ce I	BWCC91
600 P	5423.23	Cl II	RK74
60	5423.507	Cl II	RK74
100 s	5424.70	Am I	FT57
80 P	5425.253	Hg II	SR01
80	5425.91	P II	M59
140 P	5428.667	S II	KM93
1	5431.532	Rb I	B59
250 P	5432.815	S II	KM93
150	5435.83	I II	MC60
12 w	5436.70	In II	PC38
20	5438.226	Y I	P77
250	5438.96	Xe II	H39
110 P	5443.37	Cl II	RK74
60	5444.205	Cl II	RK74
100	5445.45	Xe II	H39
12	5446.195	Sc I	AV77
400	5449.239	Ce I	BWCC91
1000	5449.63	Bk I	WC78
70	5450.45	Xe II	H39
80	5450.74	P II	M59
25	5450.84	Sr I	MCS75
30	5451.51	Eu I	MCS75
25	5452.94	Eu I	MCS75
400 P	5453.828	S II	KM93
700 P	5455.15	La I	MCS75
30	5457.022	Cl II	RK74
130	5460.39	Xe II	H39
500 P	5460.735	Hg I	BAL50
100 P,c	5464.62	I II	MC60
90 P	5465.497	Ag I	PZ01
1 c	5465.94	Cs I	K62b
70 h	5466.432	Si II	S61b
70	5466.466	Y I	P77
70 h	5466.868	Si II	S61b
1000 l	5467.47	Bk I	WC78
70	5468.17	Kr II	DHM33
9	5471.555	Ag I	PZ01
300	5472.61	Xe II	H39
150 P	5473.620	S II	KM93
9	5475.77	Pt I	MCS75
120 P	5476.69	Lu II	MCS75
9	5478.50	Pt I	MCS75
110 P	5480.84	Sr I	MCS75
30	5482.012	Sc I	AV77
300 P	5483.56	Li II	HM59
500 P	5484.50	Li II	HM59
1000 s	5484.58	Bk I	WC78
25	5484.628	Sc I	AV77
400 P	5485.11	Li II	HM59
11	5488.65	Eu I	MCS75
30 l	5494.86	Xe II	H39
1	5495.874	Ar I	N73
25 h	5496.45	Si II	S61b
700 P	5501.34	La I	MCS75
1	5502.88	Cs I	K62b
30	5503.464	Y I	P77
50	5504.17	Sr I	MCS75
250 P	5506.494	Mo I	WB88
500	5506.72	Br II	K40
150 P	5509.718	S II	KM93
11	5510.52	Eu I	MCS75
70	5512.049	Ce II	C73
1000	5512.22	Bk II	WC78
40	5512.523	Ti I	F91
20 c	5513.00	In II	PC38
25	5514.230	Sc I	AV77
30	5514.343	Ti I	F91
40	5514.531	Ti I	F91
30	5520.519	Sc I	AV77
40	5521.83	Sr I	MCS75
60	5522.78	Rb II	R75
14 w	5523.28	In II	PC38
9	5523.53	Os I	MCS75
70	5525.53	Xe II	H39
25	5526.785	Sc II	JL80
70	5527.561	Y I	P77
200	5531.07	Xe II	H39
120	5531.16	Pr I	MCS75
200 P	5533.031	Mo I	WB88
30	5534.81	Sr I	MCS75
1000 P	5535.481	Ba I	KL99
1000 l	5537.93	Bk I	WC78
5 h	5539.053	Yb I	MT78
30	5540.05	Sr I	MCS75
50 c	5544.25	Pb II	WRSH74
800 P	5546.08	Pm II	RCWM80
20	5547.44	Eu I	MCS75
100	5550.60	Hf I	MCS75
100	5552.12	Hf I	MCS75
200	5555.85	Ra I	R34b
300	5556.252	Ce I	BWCC91
130 P	5556.466	Yb I	MT78
1000 l	5556.80	Bk I	WC78
1000 s	5557.09	Bk I	WC78
1	5558.702	Ar I	N73
30 P	5561.910	Sn II	B64
120 c	5562.06	Pr I	MCS75
80	5562.2253	Kr I	K93
50	5562.7662	Ne I	SS04
400	5563.02	Cs II	S81
500	5564.966	Ce I	M75c
400	5565.965	Ce I	M75c
10	5566.62	Xe I	HM33
400 P	5568.12	Sb II	C66b
200	5569.26	Ac I	MFT57
300 P	5570.2894	Kr I	K93
14	5570.33	Eu I	MCS75
90 P	5570.444	Mo I	WB88
800 P	5576.02	Pm II	RCWM80
800	5576.35	Te II	HM64
20 h	5576.66	Si II	S61b
13 c	5576.90	In II	PC38
20	5577.14	Eu I	MCS75
20	5577.416	Y I	P77
11	5580.03	Eu I	MCS75
13	5580.3873	Kr I	K93
1000	5581.21	Bk I	WC78

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
60	5581.874	Y I	P77
500	5581.971	Ca I	R68
200 l	5584.21	Am II	FT57
100	5587.0263	Th I	PE83
500 P	5588.757	Ca I	R68
30 P	5588.815	Sn II	B64
300 c	5589.02	Tc I	BMC67
500	5590.120	Ca I	R68
400	5593.302	Al II	KM91b
500	5594.468	Ca I	R68
250	5595.875	Ce I	BWCC91
100 s	5598.13	Am I	FT57
500	5598.487	Ca I	R68
15	5599.42	Rh I	MCS75
600 P	5601.280	Ce I	M75c
150 P	5606.151	S II	KM93
1	5606.733	Ar I	N73
100 P,c	5608.85	Pb II	WRSH74
300 P,l	5615.51	Es I	WLGC74
100	5616.67	Xe II	H39
200 c	5620.45	Tc I	BMC67
400	5620.54	Nd I	MCS75
500 P	5625.69	I II	MC60
30	5627.631	V I	DA78
60	5630.138	Y I	P77
25	5631.406	Tm I	SMC73
60	5631.676	Sn I	B64
11	5632.463	Mo I	WB88
2	5635.21	Cs I	K62b
60 c	5635.99	Rb II	R75
25	5636.233	Ru I	K59
11 w	5636.70	In II	PC38
25 h	5639.48	Si II	S61b
200	5639.77	Sb II	C66b
150 P	5639.972	S II	KM93
150	5642.13	Tc I	BMC67
30	5644.132	Ti I	F91
80	5644.94	Tc I	BMC67
20	5645.80	Eu I	MCS75
300	5648.25	La I	MCS75
800 P	5649.26	Te II	HM64
15	5649.5618	Kr I	K93
1	5650.704	Ar I	N73
500	5655.140	Ce I	M75c
1000 l	5656.54	Bk I	WC78
50	5656.6588	Ne I	SS04
1000 P	5659.03	Bk I	WC78
100	5659.38	Xe II	H39
120	5659.985	S II	KM93
20 h	5660.66	Si II	S61b
500 P	5660.81	Ra I	R34b
90 h	5661.57	Pr I	MCS75
25	5662.147	Ti I	F91
3 c	5664.02	Cs I	K62b
500	5666.20	Te II	HM64
30	5666.63	N II	M75a
9	5667.34	Ag I	S40
200	5667.56	Xe II	H39
150 c	5668.46	Pr I	MCS75
130 P,h	5669.562	Si II	S61b

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
600 P	5669.959	Ce I	M75c
25	5670.847	V I	DA78
50	5670.91	Xe II	H39
70	5671.828	Sc I	AV77
50 P	5675.835	Tm I	SMC73
250 d	5675.97	Nd I	MCS75
30	5676.02	N II	M75a
200 P	5677.105	Hg II	SR01
300	5677.752	Ce I	BWCC91
40 P	5679.56	N II	M75a
130	5681.89	Kr II	DHM33
4	5682.633	Na I	R56
60	5684.484	Si I	RA65
20	5686.21	N II	M75a
50	5686.856	Sc I	AV77
1	5688.193	Na I	R56
7	5688.205	Na I	R56
40 h	5688.81	Si II	S61b
15	5689.146	Mo I	WB88
70 h	5690.35	Kr II	DHM33
100 c	5690.91	I II	MC60
300	5692.943	Ce I	BWCC91
10	5695.75	Xe I	HM33
80	5696.22	Gd I	MCS75
800 P	5696.993	Ce I	M75c
100	5698.529	V I	DA78
30 d	5699.15	Rb II	R75
1000 P	5699.226	Ce I	M75c
70	5699.61	Xe II	H39
50	5700.186	Sc I	AV77
150	5700.24	Cu I	S48
25 h	5701.37	Si II	S61b
1000	5702.24	Bk I	WC78
80	5703.586	V I	DA78
15	5706.714	Y I	P77
50	5706.997	V I	DA78
150	5707.61	Pr I	MCS75
1000 P	5708.12	Te II	HM64
80	5708.397	Si I	RA65
3	5709.91	In I	P38
200 c	5710.53	I II	MC60
20	5710.77	N II	M75a
5	5711.088	Mg I	KM91a
40	5711.793	Sc I	AV77
500	5712.382	Pu I	BFG84
70	5716.10	Xe II	H39
10	5717.314	Sc I	AV77
600 P	5719.031	Ce I	M75c
400 h	5719.138	Bi II	DLW02
50	5719.2248	Ne I	SS04
12	5719.99	Yb I	MT78
6	5721.93	Os I	MCS75
1	5724.121	Rb I	B59
70	5725.31	Tc I	BMC67
1000	5726.05	Cf I	RCWM80
150	5726.91	Xe II	H39
70	5727.046	V I	DA78
3	5727.68	In I	P38
200	5729.29	Nd I	MCS75
20	5731.248	V I	DA78

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
70 l	5732.05	Ac II	MFT57
70	5736.55	Lu I	MCS75
20	5737.065	V I	DA78
250	5740.66	La I	MCS75
50	5748.2985	Ne I	SS04
150	5751.03	Xe II	H39
20	5751.409	Mo I	WB88
150	5752.50	N I	M75a
800	5755.85	Te II	HM64
100	5758.65	Xe II	H39
130	5758.97	Ac II	MFT57
120 P	5760.5508	Th I	PE83
20	5762.801	Er I	M64b
4	5763.57	Pt I	MCS75
20	5764.287	Tm I	SMC73
70	5764.4188	Ne I	SS04
30	5765.20	Eu I	MCS75
500	5769.34	La I	MCS75
50	5769.598	Hg I	BAL50
400	5773.122	Ce I	BWCC91
100	5776.39	Xe II	H39
80	5777.619	Ba I	KL99
250	5779.28	Pr I	MCS75
6	5780.82	Os I	MCS75
150	5782.13	Cu I	S48
600	5782.38	K I	R56
15	5783.69	Eu I	MCS75
300	5788.143	Ce I	BWCC91
400	5789.24	La I	MCS75
60	5790.663	Hg I	BAL50
9 H	5791.00	Cr I	K53
600 P	5791.34	La I	MCS75
20	5791.839	Mo I	WB88
30 P	5798.860	Sn II	B64
25 h	5800.47	Si II	S61b
700	5801.75	K I	R56
50	5804.4496	Ne I	SS04
30	5806.74	Si II	S61b
600	5812.15	K I	R56
300	5812.919	Ce I	M75c
100	5813.63	Ra II	R34a
50	5814.16	Cs II	S81
30	5815.96	Xe II	H39
50	5820.1558	Ne I	SS04
30	5823.89	Xe I	HM33
500	5823.93	Pm II	RCWM80
15	5824.80	Xe I	HM33
30 P	5826.786	Er I	M64b
50 P,c,w	5830.98	Eu I	MCS75
250	5831.14	Cs II	S81
700	5831.89	K I	R56
15	5832.8566	Kr I	K93
10	5834.31	Re I	MCS75
110	5835.13	Pr I	MCS75
25	5837.374	Au I	ED71
1 c	5838.83	Cs I	K62b
13	5840.12	Pt I	MCS75
5	5844.84	Pt I	MCS75
5	5845.14	Cs I	K62b
1000	5846.07	Cm I	WHGC76
200 P	5852.4879	Ne I	SS04
12 c	5853.15	In II	PC38
40	5853.675	Ba II	KL99
600	5857.452	Ca I	R68
20	5858.267	Mo I	WB88
250	5862.491	Ce I	BWCC91
50	5866.448	Ti I	F91
50 h	5868.40	Si II	S61b
300 c	5868.79	Pm II	RCWM80
500 P	5870.9160	Kr I	K93
12	5871.279	Hg II	SR01
50	5872.8275	Ne I	SS04
90	5874.72	Pr I	MCS75
10	5875.02	Xe I	HM33
500 P	5875.6148	He I	M02
250 P	5875.6404	He I	M02
120 P	5875.9663	He I	M02
90	5877.36	Ta I	MCS75
300 P,l	5878.04	Np I	FTBC76
90	5878.10	Pr I	MCS75
90	5879.04	Pr I	MCS75
100	5881.8952	Ne I	SS04
90 c	5884.72	Pr I	MCS75
30	5888.310	Mo I	WB88
1	5888.584	Ar I	N73
20 c	5888.939	Hg II	SR01
300	5889.77	C II	MG93
1000 P	5889.950	Na I	R56
100	5893.29	Xe II	H39
1000 P	5893.389	Ge II	S63a
100	5894.3607	Zn II	GL00
10	5894.99	Xe I	HM33
6	5895.624	Pb I	WA68
500 P	5895.924	Na I	R56
30	5899.291	Ti I	F91
5	5902.4623	Ne I	SS04
25 w	5903.4	In II	PC38
70	5905.13	Xe II	H39
5	5906.4294	Ne I	SS04
1000 P	5910.71	Bk I	WC78
300 P	5910.85	Ac II	MFT57
1	5912.085	Ar I	N73
25	5915.22	Si II	S61b
70 P	5915.385	U I	PKE80
14 w	5915.4	In II	PC38
110	5920.76	Pr I	MCS75
100 c	5924.47	Tc I	BMC67
500	5925.63	Cs II	S81
150	5926.301	Ce I	BWCC91
200	5928.342	Ce I	BWCC91
400	5930.62	La I	MCS75
30	5931.78	N II	M75a
60 c	5931.93	Tc I	BMC67
10	5934.17	Xe I	HM33
250	5937.720	Ce I	BWCC91
600 P	5940.857	Ce I	M75c
30 P	5941.65	N II	M75a
90	5944.02	Ta I	MCS75
50	5944.8342	Ne I	SS04
150	5945.53	Xe II	H39

Finding List—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
400	c	5946.49	Pm II	RCWM80
50	P	5948.545	Si I	RA65
800	P	5949.48	Tl II	ES36
250		5950.25	I II	MC60
1000	P	5952.41	Cm I	WHGC76
40		5953.156	Ti I	F91
150		5956.42	Pm I	RCWM80
25	h	5956.965	Au I	ED71
80		5957.561	Si II	S61b
50		5965.4710	Ne I	SS04
25		5965.824	Ti I	F91
6		5966.07	Eu II	MCS75
40	c,w	5967.10	Eu I	MCS75
100		5971.13	Xe II	H39
14		5971.264	Tm I	SMC73
15		5972.75	Eu I	MCS75
50		5974.6273	Ne I	SS04
500		5974.68	Te II	HM64
60		5975.5340	Ne I	SS04
700	P	5976.46	Xe II	H39
30		5978.538	Ti I	F91
80		5978.929	Si II	S61b
25	P,c	5982.85	Ho I	MZH78
14		5983.60	Rh I	MCS75
110		5986.14	Pr I	MCS75
120*	c	5987.14	Pr I	MCS75
120*	c	5987.29	Pr II	MCS75
15		5987.9074	Ne I	SS04
70		5992.22	Kr II	DHM33
20		5992.83	Eu I	MCS75
10		5993.8502	Kr I	K93
80		5997.087	Ba I	KL99
40		5999.008	Ti I	F91
400		6000.120	Cu II	R69
5		6001.862	Pb I	WA68
150		6001.901	Ce I	M75c
200	P	6004.52	Lu I	MCS75
500	P	6005.57	Sb II	C66b
150		6005.861	Ce I	BWCC91
400		6006.410	Al II	KM91b
150		6006.817	Ce I	BWCC91
70		6008.92	Xe II	H39
10	c	6010.49	Cs I	K62b
10		6012.56	Eu I	MCS75
150		6013.22	C I	J66
200		6013.419	Ce I	BWCC91
40		6018.15	Eu I	MCS75
500	P	6021.041	Ge II	S63a
11		6021.787	Mn I	CMG64
110	P	6024.18	P II	M59
300		6024.193	Ce I	BWCC91
100		6024.271	Y I	P77
4		6026.04	Pt I	MCS75
15		6029.00	Eu I	MCS75
100	P	6029.9969	Ne I	SS04
40		6030.645	Mo I	WB88
2		6032.127	Ar I	N73
80		6034.04	P II	M59
1		6034.09	Cs I	K62b
300	l	6035.78	Pa I	BW92b

Finding List—Continued

Intensity		Wavelength (Å)	Spectrum	Ref
300		6036.20	Xe II	H39
40		6039.728	V I	DA78
110	P	6043.12	P II	M59
1		6043.223	Ar I	N73
30		6043.378	Ce II	C73
100		6043.39	Pm I	RCWM80
100		6045.39	Ta I	MCS75
150		6047.397	Ce I	BWCC91
90		6049.26	Pr I	MCS75
7		6049.51	Eu II	MCS75
700	P	6051.15	Xe II	H39
1000	P,l	6054.64	Am I	FT57
30		6054.674	Sn I	B64
60		6055.03	Lu I	MCS75
400		6055.13	Pr I	MCS75
1000	P	6055.84	Se II	G62
10		6056.1263	Kr I	K93
13		6057.36	Eu I	MCS75
90		6057.995	Ce I	M75c
1000		6058.90	Cm I	WHGC76
1		6059.372	Ar I	N73
50		6069.06	Pm I	RCWM80
40		6069.117	Sn I	B64
90		6069.484	Ce I	M75c
1		6070.755	Rb I	B59
90		6072.006	Ce I	BWCC91
400		6073.198	Al II	KM91b
100	P	6074.3377	Ne I	SS04
100	c	6074.98	I II	MC60
200	P	6075.74	Pb II	WRSH74
200		6079.67	Sb II	C66b
110		6080.44	B II	O70
200	P	6081.409	Pb II	WRSH74
40		6081.440	V I	DA78
20		6083.84	Eu I	MCS75
80		6085.23	Tc I	BMC67
70		6087.82	P II	M59
110	P	6090.208	V I	DA78
90		6093.192	Ce I	M75c
200		6093.50	Xe II	H39
14	c	6095.95	In II	PC38
30		6096.1631	Ne I	SS04
500	P	6097.59	Xe II	H39
150		6099.142	Cd I	BA56
20		6099.35	Eu I	MCS75
300	P	6100.21	Pm I	RCWM80
130		6101.43	Xe II	H39
500	P	6102.722	Ca I	R68
300	P	6103.542	Li I	REB95
400*	P	6103.654	Li I	REB95
400*		6103.667	Li I	REB95
12	c	6108.66	In II	PC38
250		6110.783	Ba I	KL99
25		6111.650	V I	DA78
90		6114.07	Gd I	MCS75
30		6114.923	Ar II	N73
30		6115.08	Xe II	H39
11		6118.78	Eu I	MCS75
50		6119.528	V I	DA78
250		6120.27	K II	D26

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
100	6120.68	Tc I	BMC67
600 P	6122.219	Ca I	R68
120	6123.673	Ce I	BWCC91
200 P	6127.457	Zr I	J98
100 c	6127.49	I II	MC60
10	6128.4499	Ne I	SS04
100	6128.61	Cs II	S81
13 w	6128.7	In II	PC38
13 w	6129.4	In II	PC38
300 P	6130.00	Sb II	C66b
100	6130.80	Tc I	BMC67
20 w	6132.1	In II	PC38
25	6135.363	V I	DA78
300 P	6141.713	Ba II	KL99
100 P	6143.0626	Ne I	SS04
130	6143.201	Zr I	J98
15	6146.435	Hg II	SR01
30	6146.45	Xe II	H39
150*	6148.23	Pr I	MCS75
150*	6148.24	Pr II	MCS75
500	6148.60	Br I	T63
250 P,c	6149.475	Hg II	SR01
40	6149.604	Sn I	B64
400	6150.384	Cu II	R69
200 h	6151.76	Pm I	RCWM80
500	6154.222	Cu II	R69
2	6154.225	Na I	R56
20	6154.446	Sn I	B64
40	6155.134	Si I	RA65
130	6155.98	O I	M75b
150	6156.77	O I	M75b
150	6158.18	O I	M75b
50	6159.89	Pb II	S75
3	6160.747	Na I	R56
600 P	6162.172	Ca I	R68
300	6162.56	Pa I	BW92b
100 P	6163.5939	Ne I	SS04
200 l	6164.75	Ac II	MFT57
70	6165.59	P II	M59
30 l	6167.83	Ac II	MFT57
500	6169.055	Ca I	R68
600	6169.559	Ca I	R68
100 P	6169.8221	Th I	PE83
500	6170.27	As II	LA71
50	6172.278	Ar II	N73
6	6173.05	Eu II	MCS75
15	6178.30	Xe I	HM33
10	6178.76	Eu I	MCS75
12	6179.66	Xe I	HM33
15	6182.1460	Ne I	SS04
30	6182.42	Xe I	HM33
80	6182.6217	Th I	PE83
400 h	6183.42	Al II	KM91b
90	6186.173	Ce I	BWCC91
25 c,w	6188.13	Eu I	MCS75
120	6191.720	Y I	P77
80	6192.66	Tc I	BMC67
500	6192.798	Pu I	BFG84
150	6194.07	Xe II	H39
13	6195.07	Eu I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
10	6198.26	Xe I	HM33
60	6199.024	P I	S80
11 c	6199.08	Rb II	R75
40	6199.191	V I	DA78
300 P	6200.30	Ra I	R34b
400	6201.463	Al II	KM91b
1 c	6206.309	Rb I	B59
90	6208.985	Ce I	BWCC91
25	6210.66	Sc I	AV77
15	6213.10	Cs I	K62b
40	6214.5778	Zn II	GL00
300	6216.35	Pa I	BW92b
40	6216.370	V I	DA78
500	6216.939	Cu II	R69
100 P	6217.2812	Ne I	SS04
3	6217.60	Cs I	K62b
500	6219.844	Cu II	R69
25 P	6221.019	Er I	M64b
120 P	6221.87	Lu II	MCS75
30	6222.579	Y I	P77
15 w	6228.3	In II	PC38
90	6228.936	Ce I	M75c
50	6229.64	Pm I	RCWM80
40	6230.803	V I	DA78
40	6237.320	Si I	RA65
130 P	6239.651	F I	L49
14	6239.80	Sc I	AV77
100	6242.83	Ac II	MFT57
60	6243.110	V I	DA78
8	6243.120	Ar II	N73
1000	6243.35	Cm I	WHGC76
400 P	6243.36	Al II	KM91b
30	6243.813	Si I	RA65
60 c	6244.18	Tc I	BMC67
30	6244.468	Si I	RA65
50	6247.56	Fe II	RMW44
1000 P	6249.93	La I	MCS75
25	6251.823	V I	DA78
40	6254.188	Si I	RA65
50	6258.099	Ti I	F91
50	6258.705	Ti I	F91
11	6258.90	Sc I	AV77
15	6259.087	Dy I	NG00
40	6261.096	Ti I	F91
20	6262.25	Eu I	MCS75
100 P	6266.4950	Ne I	SS04
150	6270.82	Xe II	H39
13	6272.024	Ce II	C73
700	6273.349	Cu II	R69
130	6277.54	Xe II	H39
50 P	6278.170	Au I	ED71
30	6284.41	Xe II	H39
10	6286.01	Xe I	HM33
100	6286.06	Pm I	RCWM80
90	6295.574	Ce I	BWCC91
1 c	6298.325	Rb I	B59
15	6299.77	Eu I	MCS75
80	6300.86	Xe II	H39
600	6301.009	Cu II	R69
4	6303.41	Eu II	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
800 P	6304.661	Pu I	BFG84
10	6304.7889	Ne I	SS04
15 w	6304.8	In II	PC38
30	6305.65	Sc I	AV77
250	6307.29	K II	D26
50	6308.29	Pm I	RCWM80
90	6310.013	Ce I	BWCC91
50	6318.06	Xe I	HM33
5	6318.37	Pt I	MCS75
120 c	6322.36	Pr I	MCS75
100	6323.84	Pm I	RCWM80
5	6326.58	Pt I	MCS75
30	6328.1646	Ne I	SS04
1000 P	6334.05	Ga II	IL85
100	6334.4278	Ne I	SS04
400	6335.701	Al II	KM91b
130	6343.96	Xe II	H39
10	6346.742	Mg II	KM91a
130 P	6347.103	Si II	S61b
100 P	6348.508	F I	L49
11 c,w	6350.04	Eu I	MCS75
800	6350.73	Br I	T63
5 c	6354.55	Cs I	K62b
400	6354.72	Cd II	SP49
200	6356.35	Xe II	H39
300 l	6358.61	Pa I	BW92b
140 c	6359.03	Pr I	MCS75
300 P	6359.86	Ac I	MFT57
500	6359.98	Cd II	SP49
15 w	6362.3	In II	PC38
30 P	6362.3458	Zn I	GL00
100 P	6371.359	Si II	S61b
70	6375.28	Xe II	H39
1000 P	6376.71	Cm I	WHGC76
500	6377.840	Cu II	R69
300	6379.25	Pa I	BW92b
100 P	6382.9917	Ne I	SS04
1	6384.717	Ar I	N73
50	6390.31	Pm I	RCWM80
110	6393.18	Pr I	MCS75
600 P	6394.23	La I	MCS75
100	6396.56	Ga I	JL67
30	6397.99	Xe II	H39
11 c,w	6400.93	Eu I	MCS75
200 P	6402.248	Ne I	SS04
100 l	6405.11	Am I	FT57
140 P	6408.47	Sr I	MCS75
15	6410.04	Eu I	MCS75
300	6410.99	La I	MCS75
140	6411.23	Pr I	MCS75
13	6411.32	Eu I	MCS75
70	6413.45	Ga I	JL67
80	6413.651	F I	L49
2	6416.307	Ar I	N73
900 P	6419.23	Ga II	IL85
100	6420.18	Kr II	DHM33
15	6421.0270	Kr I	K93
600	6423.884	Cu II	R69
90	6430.067	Ce I	M75c
100	6430.79	Ta I	MCS75
500 h	6431.93	Pm I	RCWM80
100	6435.022	Y I	P77
14	6437.64	Eu II	MCS75
1000 P	6438.470	Cd I	BA56
300 l	6438.97	Pa I	BW92b
700 P	6439.073	Ca I	R68
800	6444.29	Se II	G62
200	6446.20	Ra I	R34b
500	6448.559	Cu II	R69
500	6449.744	Pu I	BFG84
600	6449.810	Ca I	R68
80	6450.36	Ta I	MCS75
50 P	6453.542	Sn II	B64
800 P	6455.89	Ga II	IL85
100	6455.90	Tc I	BMC67
130	6455.98	O I	M75b
300	6455.99	La I	MCS75
30	6456.2889	Kr I	K93
120	6456.38	Fe II	RMW44
300	6456.874	Ca II	ER56
100 P	6457.2824	Th I	PE83
11	6457.96	Eu I	MCS75
90	6458.031	Ce I	BWCC91
110 P	6458.33	Rb II	R75
130 P	6459.99	P II	M59
20	6460.261	Tm I	SMC73
60 c	6461.93	Tc I	BMC67
700 P	6462.566	Ca I	R68
80	6462.6131	Th I	PE83
60	6463.12	Lu II	MCS75
400	6464.94	Cd II	SP49
15 w	6469.0	In II	PC38
30	6469.70	Xe I	HM33
600	6470.168	Cu II	R69
600	6471.660	Ca I	R68
15	6472.84	Xe I	HM33
500	6481.437	Cu II	R69
40 P	6482.05	N II	M75a
90	6482.70	N I	M75a
8	6483.082	Ar II	N73
150	6485.37	Ta I	MCS75
120	6486.55	Pr I	MCS75
800 P	6486.707	Pu I	BFG84
200	6487.32	Ra I	R34b
12	6487.76	Xe I	HM33
1000 P	6488.853	Pu I	BFG84
20	6489.06	Yb I	MT78
110 h	6491.75	Pr I	MCS75
600 P	6493.780	Ca I	R68
80	6495.53	Cs II	S81
200 P	6496.898	Ba II	KL99
10	6498.72	Xe I	HM33
250 P	6498.760	Ba I	KL99
600	6499.649	Ca I	R68
130 P	6503.46	P II	M59
80 P	6504.00	Sr I	MCS75
20 h	6504.18	Xe I	HM33
150 P	6506.5281	Ne I	SS04
130 P	6507.97	P II	M59
100	6512.83	Xe II	H39

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	6514.21	Na II	W71
50	6517.25	Pm I	RCWM80
300 P,d	6520.45	Pm I	RCWM80
6	6523.45	Pt I	MCS75
110 P	6527.312	Ba I	KL99
70	6528.65	Xe II	H39
70	6530.70	Na II	W71
80 h	6531.3418	Th I	PE83
10	6532.8822	Ne I	SS04
10	6533.16	Xe I	HM33
500	6535.271	Pu I	BFG84
100 w	6536.44	Cs II	S81
12 c	6541.20	In II	PC38
50	6542.20	Pm I	RCWM80
200	6543.16	La I	MCS75
70	6544.04	Na II	W71
50 l	6544.16	Am I	FT57
500	6544.207	Pu I	BFG84
250	6544.57	Br I	T63
70	6545.75	Na II	W71
11 d	6545.973	Mg II	KM91a
12	6547.89	Be II	J61a
25	6550.26	Sr I	MCS75
1000	6554.41	Cm I	WHGC76
11	6555.62	Rb II	R75
80	6555.645	Ce I	BWCC91
12	6558.36	Be II	J61a
700 c	6559.80	Br I	T63
8 c	6560.10	He II	GM65
60	6560.81	Rb II	R75
9	6562.680	Au I	ED71
90 P	6562.7110	H I	MK00a
30 P	6562.7248	H I	MK00a
180 P	6562.8518	H I	MK00a
50	6570.07	Kr II	DHM33
500 P	6572.777	Ca I	R68
400 P	6578.05	C II	MG93
200	6578.51	La I	MCS75
250	6582.17	Br I	T63
300	6582.88	C II	MG93
8	6586.51	Cs I	K62b
300	6595.01	Xe II	H39
100 P	6595.325	Ba I	KL99
10	6595.56	Xe I	HM33
130	6597.25	Xe II	H39
400 P	6598.15	Pm I	RCWM80
80	6598.66	Pm I	RCWM80
30	6598.84	Xe II	H39
100 P	6598.9529	Ne I	SS04
400 h	6600.339	Bi II	DLW02
30 P	6604.91	Ho I	MZH78
70	6606.37	Pm I	RCWM80
500	6608.947	Pu I	BFG84
40 P	6610.56	N II	M75a
140	6616.67	Pr I	MCS75
50	6617.26	Sr I	MCS75
70	6619.66	I I	KC59
1000	6622.83	Cf I	RCWM80
500	6624.292	Cu II	R69
80 w	6625.23	Pm I	RCWM80

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	6627.23	Rn I	R33
2	6628.66	Cs I	EW70
1000	6631.26	Cf I	RCWM80
700 c	6631.62	Br I	T63
8	6638.221	Ar II	N73
7	6639.740	Ar II	N73
1000	6640.17	Cm I	WHGC76
500	6641.396	Cu II	R69
15	6643.698	Ar II	N73
25	6645.11	Eu II	MCS75
90	6646.57	Cs II	S81
70	6649.81	Pm I	RCWM80
15	6652.0927	Ne I	SS04
400	6659.05	Pm II	RCWM80
250 P,c	6660.20	Pb II	WRSH74
13 c,w	6660.84	Nb I	MCS75
50	6661.68	Pm I	RCWM80
8	6666.359	Ar II	N73
80 c	6667.51	Pm I	RCWM80
10	6667.82	Yb I	MT78
15	6668.92	Xe I	HM33
50	6675.270	Ba I	KL99
3	6677.282	Ar I	N73
70 h	6677.47	Pm I	RCWM80
1000	6677.90	Cf I	RCWM80
200 P	6678.1517	He I	M02
50	6678.2762	Ne I	SS04
250	6682.28	Br I	T63
12	6684.293	Ar II	N73
50	6685.55	Pm I	RCWM80
50	6685.68	Pm I	RCWM80
1000	6686.87	Cm I	WHGC76
15	6687.571	Y I	P77
20	6690.481	F I	L49
200 P,l	6691.27	Ac I	MFT57
130	6692.13	Br I	T63
50 P	6693.842	Ba I	KL99
100	6694.32	Xe II	H39
40	6696.015	Al I	KM91b
10	6699.2296	Kr I	K93
60	6700.33	Pm I	RCWM80
90	6704.272	Ce I	BWCC91
1000 P	6706.85	Cm I	WHGC76
500 P	6707.775	Li I	REB95
1000 P	6707.926	Li I	REB95
7	6710.42	Pt I	MCS75
70	6714.67	Pm I	RCWM80
7	6717.0430	Ne I	SS04
50	6717.26	Pm I	RCWM80
600	6717.685	Ca I	R68
50	6720.71	Pm I	RCWM80
50 c	6723.28	Cs I	S81
100	6724.47	Cs II	S81
500	6725.78	Cd II	SP49
1000	6726.68	Cm I	WHGC76
70	6727.50	Pm I	RCWM80
20	6728.01	Xe I	HM33
60	6743.71	Pm I	RCWM80
90 c	6747.09	Pr I	MCS75
90	6749.91	Pm I	RCWM80

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
90	6750.48	Pm I	RCWM80
70	6751.81	Rn I	R33
4	6752.834	Ar I	N73
40	6757.16	S I	KM93
13	6760.02	Pt I	MCS75
300	6772.29	Pm II	RCWM80
70	6773.984	F I	L49
30 l	6775.07	Rb II	R75
50	6788.71	Xe II	H39
30	6790.37	Xe II	H39
30 P	6791.05	Sr I	MCS75
300 h	6792.75	Pa I	BW92b
1000	6793.15	Cm I	WHGC76
20	6793.704	Y I	P77
25	6794.58	Tb II	MCS75
140 c,w	6798.60	Pr I	MCS75
40 P	6799.60	Yb I	MT78
13	6802.72	Eu I	MCS75
300	6805.74	Xe II	H39
500 h	6809.196	Bi II	DLW02
200	6812.57	I II	MC60
3	6824.65	Cs I	EW70
30	6826.913	U I	PKE80
20	6827.32	Xe I	HM33
80	6833.30	Pm I	RCWM80
90	6834.264	F I	L49
40	6842.60	Pt I	MCS75
30 P	6844.186	Sn II	B64
500 P	6856.030	F I	L49
7	6861.269	Ar II	N73
30	6864.54	Eu I	MCS75
9	6865.686	Ba I	KL99
80	6866.23	Ta I	MCS75
3	6867.48	He I	M60a
80	6870.215	F I	L49
5	6870.45	Cs I	EW70
4	6871.289	Ar I	N73
10	6872.11	Xe I	HM33
70 P	6878.38	Sr I	MCS75
30	6882.16	Xe I	HM33
800 P	6887.710	Pu I	BFG84
20 P,w	6891.56	In II	PC38
20 P	6892.59	Sr I	MCS75
1000	6894.59	Cf I	RCWM80
150 P	6902.475	F I	L49
15	6904.6788	Kr I	K93
60	6909.816	F I	L49
25	6910.22	Xe II	H39
800	6911.08	K I	R56
80	6924.813	Ce I	BWCC91
10	6925.53	Xe I	HM33
1000 P	6927.10	Cf II	RCWM80
1000 P	6929.4673	Ne I	SS04
300 P,s	6930.31	Np I	FTBC76
500	6936.28	K I	R56
1	6937.664	Ar I	N73
800	6938.77	K I	R56
250 h	6942.11	Xe II	H39
1000 P	6945.72	Pa I	BW92b
400	6955.50	Cs II	S81
50 s	6955.58	Am I	FT57
300	6960.09	Pa I	BW92b
300 h	6961.78	Pa I	BW92b
300	6964.18	K I	R56
500	6964.67	K I	R56
300 P	6965.431	Ar I	N73
40	6966.349	F I	L49
1000 P,s	6972.09	Np I	FTBC76
80	6973.30	Cs I	K62b
10	6976.18	Xe I	HM33
150	6979.67	Cs II	S81
200	6980.22	Ra I	R34b
10	6982.749	Be I	KM97
15	6983.49	Cs I	K62b
80	6986.015	Ce I	BWCC91
90 P	6989.6553	Th I	PE83
700	6990.88	Xe II	H39
300 s	6992.73	Pa I	BW92b
150	7002.23	O I	M75b
40	7003.567	Si I	RA65
130	7005.19	Br I	T63
40	7005.883	Si I	RA65
300	7024.0504	Ne I	SS04
4	7030.251	Ar I	N73
800 P	7032.4131	Ne I	SS04
60	7034.903	Si I	RA65
500 P	7037.469	F I	L49
11	7040.20	Eu I	MCS75
1000 l	7040.85	Bk I	WC78
20	7051.2923	Ne I	SS04
700 P	7055.42	Rn I	R33
100	7059.1074	Ne I	SS04
200 P	7059.943	Ba I	KL99
10	7061.75	Ce II	C73
300	7062.065	Se I	E72
100 P	7065.1771	He I	M02
60 P	7065.2153	He I	M02
20 P	7065.7086	He I	M02
300 P	7067.218	Ar I	N73
3	7068.736	Ar I	N73
80 P	7070.10	Sr I	MCS75
1000 l	7074.52	Cf I	RCWM80
300	7076.27	Pa I	BW92b
6	7077.10	Eu II	MCS75
25	7081.90	Hg I	F54
50	7082.15	Xe II	H39
10	7086.35	Ce II	C73
150 P	7097.727	Zr I	J98
300 h	7100.94	Pa I	BW92b
80	7102.922	Zr I	J98
1	7107.478	Ar I	N73
1000	7107.85	Bk I	WC78
13	7113.73	Pt I	MCS75
1000 P,s	7114.89	Pa I	BW92b
200	7118.50	Ra I	R34b
50	7119.60	Xe I	HM33
30	7120.331	Ba I	KL99
1	7125.820	Ar I	N73
300 P	7127.890	F I	L49
250	7131.81	Hf I	MCS75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
500 P	7141.21	Ra I	R34b
30 P	7147.042	Ar I	N73
15 s	7147.50	Xe II	H39
700	7148.147	Ca I	R68
70	7149.03	Xe II	H39
130 w	7149.54	Cs II	S81
1000 P	7162.69	Cm I	WHGC76
150	7164.83	Xe II	H39
50	7165.545	Si I	RA65
50	7168.8952	Th I	PE83
150 P	7169.092	Zr I	J98
300 h	7171.55	Pa I	BW92b
800 P	7173.9381	Ne I	SS04
	7179.866	Fr I	ABDJ90
130	7179.90	F II	P69
20 P,w	7182.89	In II	PC38
20	7190.776	Sn II	B64
100	7193.60	Pb II	S75
10	7194.81	Eu II	MCS75
9	7195.230	Ba I	KL99
600	7202.194	Ca I	R68
150 P	7202.360	F I	L49
2	7206.980	Ar I	N73
60	7208.0063	Th I	PE83
10	7209.134	Be I	KM97
30	7209.434	Ti I	F91
130 h	7211.79	F II	P69
80	7213.13	Kr II	DHM33
150	7213.200	Ne II	P71
10	7217.55	Eu II	MCS75
15	7224.104	Kr I	KH69
200	7225.16	Ra I	R34b
300	7227.13	Pa I	BW92b
13	7228.53	Cs I	EW70
4	7228.965	Pb I	WA68
400 P	7231.32	C II	MG93
150	7235.188	Ne II	P71
500 P	7236.42	C II	MG93
300 P	7237.10	Hf I	MCS75
200	7240.87	Hf I	MCS75
800 P	7245.1666	Ne I	SS04
40	7250.625	Si I	RA65
1000	7252.50	Bk I	WC78
90	7252.710	Ce I	BWCC91
130	7254.15	O I	M75b
150	7254.45	O I	M75b
40	7256.620	Cl I	RK69
500	7258.049	Pu I	BFG84
300 P	7268.11	Rn I	R33
60 P	7272.936	Ar I	N73
40	7275.294	Si I	RA65
12 c	7276.5	In II	PC38
2	7279.90	Cs I	EW70
20	7279.96	Cs I	EW70
1 l	7279.997	Rb I	B59
150 P	7280.296	Ba I	KL99
50	7281.35	He I	M60a
30	7284.34	Xe II	H39
13	7287.258	Kr I	KH69
100 P	7289.1730	Si I	MKMD94

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
130	7289.78	Kr II	DHM33
300 P	7290.40	Ac I	MFT57
70	7291.00	Rn I	R33
9	7301.17	Eu II	MCS75
70	7301.80	Xe II	H39
1000	7306.94	Bk I	WC78
1000 s	7307.90	Cf I	RCWM80
40	7309.41	Sr I	MCS75
150 P	7311.019	F I	L49
1	7311.716	Ar I	N73
1	7316.005	Ar I	N73
300	7318.79	Pa I	BW92b
700	7326.146	Ca I	R68
50	7331.957	F I	L49
150 c,w	7334.18	La I	MCS75
70	7339.30	Xe II	H39
150	7343.945	Ne II	P71
500	7345.670	Cd I	BA56
6	7346.508	Hg II	SR01
130 P	7348.51	Br I	T63
20 c	7350.6	In II	PC38
2	7353.293	Ar I	N73
1000 P,l	7368.25	Pa I	BW92b
12	7370.22	Eu II	MCS75
6	7372.118	Ar I	N73
7	7380.426	Ar II	N73
300	7383.980	Ar I	N73
10	7386.00	Xe I	HM33
2	7387.685	Mg I	KM91a
15	7392.405	Ba I	KL99
1	7392.980	Ar I	N73
15	7393.79	Xe I	HM33
1000	7394.26	Bk I	WC78
90	7397.764	Ce I	BWCC91
100 P	7398.688	F I	L49
6	7400.22	Cr I	K53
70	7402.06	I I	KC59
700	7404.354	Cu II	R69
90 P	7405.7740	Si I	MKMD94
130	7407.02	Kr II	DHM33
2	7408.173	Rb I	B59
50	7409.082	Si I	RA65
25	7414.114	Cl I	RK69
60	7415.946	Si I	RA65
100 P	7423.497	Si I	RA65
150	7423.64	N I	M75a
10	7425.541	Kr I	KH69
40	7425.645	F I	L49
5	7426.57	Eu II	MCS75
40	7428.9405	Th I	PE83
1	7435.368	Ar I	N73
70	7435.78	Kr II	DHM33
200 P	7442.29	N I	M75a
1000 P	7450.00	Rn I	R33
60	7452.49	Tc I	BMC67
8	7462.35	Cr I	K53
200 P	7468.31	N I	M75a
70	7468.99	I I	KC59
9	7469.51	Er I	MCS75
300 h	7471.89	Pa I	BW92b

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
30	7472.4386	Ne I	SS04
50	7478.7691	Zn II	GL00
20	7482.723	F I	L49
15	7486.862	Kr I	KH69
25	7488.075	Ba I	KL99
300	7488.8712	Ne I	SS04
25	7489.155	F I	L49
100	7492.102	Ne II	P71
1000 P,h	7493.15	Pa I	BW92b
600 P	7503.869	Ar I	N73
50	7510.728	Au I	ED71
500 P	7512.96	Br I	T63
400	7514.652	Ar I	N73
150	7522.818	Ne II	P71
100	7524.46	Kr II	DHM33
300	7535.7741	Ne I	SS04
120	7539.23	La I	MCS75
80	7540.26	Tc I	BMC67
130	7544.0443	Ne I	SS04
60 P	7547.072	Cl I	RK69
100	7548.45	Xe II	H39
50	7552.235	F I	L49
15	7555.09	Ho I	MCS75
300 h	7558.26	Pa I	BW92b
14	7558.33	Tm I	SMC73
50	7558.97	Pb II	S75
500	7572.923	Pu I	BFG84
50	7573.384	F I	L49
150 P	7578.909	S II	KM93
15	7583.91	Eu I	MCS75
20	7584.68	Xe I	HM33
150	7587.4136	Kr I	K93
60	7588.4648	Zn II	GL00
300	7601.304	Ca II	R68
300	7601.5457	Kr I	K93
70	7607.170	F I	L49
1000 P,h	7608.20	Pa I	BW92b
40 c	7608.90	Cs I	K62b
25	7618.57	Xe II	H39
2 l	7618.933	Rb I	B59
150	7624.40	Hf I	MCS75
1000 P	7626.79	Pa I	BW92b
120 P	7629.740	S II	KM93
50	7632.56	Pb II	S75
700 P	7635.106	Ar I	N73
1000 P,s	7635.18	Pa I	BW92b
50	7641.16	Kr II	DHM33
50	7642.02	Xe I	HM33
10	7643.91	Xe I	HM33
50	7647.3794	Th I	PE83
500	7652.333	Cu II	R69
3	7657.603	Mg I	KM91a
3	7659.152	Mg I	KM91a
3	7659.902	Mg I	KM91a
700	7664.648	Cu II	R69
1000 P	7664.8991	K I	E99
1000 P	7669.34	Pa I	BW92b
70	7670.66	Xe II	H39
80 P	7672.085	Ba I	KL99
12	7672.419	Cl I	RK69
300	7679.20	Pa I	BW92b
150	7685.2459	Kr I	K93
30 P	7687.772	Ag I	PZ01
2	7691.550	Mg I	KM91a
200	7694.5401	Kr I	K93
1000 P	7698.9645	K I	E99
40 P	7699.49	Yb I	MT78
40	7717.581	Cl I	RK69
1000 P	7720.47	Cm I	WHGC76
400	7723.761	Ar I	N73
300	7724.207	Ar I	N73
1	7724.6233	Ne I	SS04
40	7732.4886	Zn II	GL00
300 P,l	7735.14	Np I	FTBC76
80	7735.69	Kr II	DHM33
12 c	7740.7	In II	PC38
120	7740.738	Ne II	P71
15	7741.425	Sn II	B64
50 P	7744.970	Cl I	RK69
70	7746.64	Rn I	R33
25	7746.827	Kr I	KH69
1000 P,h	7749.19	Pa I	BW92b
200 P	7754.696	F I	L49
3	7757.651	Rb I	B59
1	7759.436	Rb I	B59
300 P,l	7765.75	Np I	FTBC76
11	7769.163	Cl I	RK69
300 P	7771.94	O I	M75b
250 P	7774.17	O I	M75b
250 P	7775.39	O I	M75b
500	7778.738	Cu II	R69
50	7780.478	Ba I	KL99
20	7787.04	Xe II	H39
300 P,l	7791.38	Np I	FTBC76
800	7792.26	Ga II	IL85
80 c	7793.04	Tc I	BMC67
150 P	7800.212	F I	L49
1000 c,P	7800.27	Rb I	J61b
10	7802.65	Xe I	HM33
400 P	7803.02	Br I	T63
500	7805.184	Cu II	R69
1000	7807.659	Cu II	R69
1	7809.78	Na I	R56
300 P	7809.82	Rn I	R33
1	7816.15	He I	M60a
80	7817.72	Tc I	BMC67
11	7821.363	Cl I	RK69
700	7825.654	Cu II	R69
8	7830.746	Cl I	RK69
30	7836.134	Al I	KM91b
200	7838.12	Ra I	R34b
2	7839.0529	Ne I	SS04
140	7845.35	Hf I	MCS75
50	7848.80	Si II	S61b
70	7849.72	Si II	S61b
25	7852.52	Cs II	S81
130	7854.8234	Kr I	K93
200 l	7866.10	Ac I	MFT57
300	7872.95	Pa I	BW92b
12	7877.054	Mg II	KM91a

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
15	7878.215	Cl I	RK69
10	7881.32	Xe I	HM33
30	7887.40	Xe I	HM33
13	7896.366	Mg II	KM91a
12	7899.310	Cl I	RK69
500	7902.553	Cu II	R69
1000 s	7903.90	Bk I	WC78
25	7905.747	Ba I	KL99
12	7911.329	Ba I	KL99
30	7913.4251	Kr I	K93
9	7915.084	Cl I	RK69
100	7923.90	S I	KM93
15	7924.645	Cl I	RK69
120	7926.201	Ne II	P71
3	7927.1177	Ne I	SS04
30	7928.5988	Kr I	K93
25	7932.349	Si I	RA65
150	7933.13	Cu I	S48
70	7933.22	Kr II	DHM33
10	7933.894	Cl I	RK69
8	7935.012	Cl I	RK69
13	7936.9961	Ne I	SS04
400 P,c	7938.68	Br I	T63
80	7943.1814	Ne I	SS04
50	7943.88	Cs I	K62b
30	7944.001	Si I	RA65
250 P	7944.555	Hg II	SR01
300 l	7945.56	Pa I	BW92b
500 c,P	7947.60	Rb I	J61b
600 P	7948.176	Ar I	N73
200	7955.37	K I	R56
150	7956.83	K I	R56
250	7962.62	Po I	C66a
50	7967.34	Xe I	HM33
80 P	7967.371	S II	KM93
40	7973.62	Kr II	DHM33
130	7978.57	Br I	T63
40	7978.9731	Th I	PE83
15	7982.401	Kr I	KH69
800	7988.163	Cu II	R69
400	7989.94	Br I	T63
110	7994.73	Hf I	MCS75
200	7997.44	Cs II	S81
14	7997.854	Cl I	RK69
300	8000.96	Se I	RG34
600 P	8006.157	Ar I	N73
20	8012.98	Cs II	S81
700 P	8014.786	Ar I	N73
11	8015.611	Cl I	RK69
60	8015.73	Cs I	EW70
80	8016.01	F II	P69
250 P	8019.70	Ra II	R34a
9	8025.57	Ce II	C73
10	8029.67	Xe I	HM33
1000 P	8039.34	Pa I	BW92b
130 P	8043.74	I I	KC59
80 c	8047.13	Cs II	S81
70	8049.00	Rn I	R33
20	8057.26	Xe I	HM33
250	8059.5048	Kr I	K93

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
15	8061.34	Xe I	HM33
250 P	8070.099	Zr I	J98
300	8078.11	K I	R56
8	8078.94	Cs I	EW70
70	8079.04	Cs I	EW70
250	8079.62	K I	R56
60	8082.4580	Ne I	SS04
100	8084.345	Ne II	P71
8	8084.508	Cl I	RK69
11	8085.562	Cl I	RK69
100	8086.05	La I	MCS75
15	8086.672	Cl I	RK69
200	8092.63	Cu I	S48
150	8096.75	Ni II	S70
300 P	8099.51	Rn I	R33
1000 P,h	8099.84	Pa I	BW92b
10	8101.98	Xe I	HM33
600 P	8103.693	Ar I	N73
700 P	8104.3655	Kr I	K93
1000 P	8112.9012	Kr I	K93
20	8114.030	Sn I	B64
1000 P	8115.311	Ar I	N73
40	8118.5492	Ne I	SS04
60	8120.367	Ce I	BWCC91
120	8121.48	Ni II	S70
150 P	8126.232	Li I	REB95
300 P	8126.453	Li I	REB95
12	8128.9108	Ne I	SS04
6	8129.26	F I	L49
400	8131.52	Br I	T63
10	8132.967	Kr I	KH69
110	8132.984	Zr I	J98
170	8136.4054	Ne I	SS04
1000 P	8141.29	Cf I	RCWM80
50 h	8151.80	Xe II	H39
130	8153.75	Br I	T63
300	8154.00	Br I	T63
	8169.418	Fr I	ABDJ90
10	8171.02	Xe I	HM33
6	8179.339	F I	L49
60 P	8183.256	Na I	R56
90	8184.87	N I	M75a
90	8188.02	N I	M75a
500 P	8190.0566	Kr I	K93
12	8194.420	Cl I	RK69
10 P	8194.790	Na I	R56
110 P	8194.824	Na I	R56
1000 P	8199.04	Pa I	BW92b
11	8199.128	Cl I	RK69
11	8200.21	Cl I	RK69
400	8201.720	Ca II	ER56
70	8202.72	Kr II	DHM33
70	8206.34	Xe I	HM33
9	8210.239	Ba I	KL99
90 P	8212.038	Cl I	RK69
30	8212.57	Tb I	MCS75
80	8212.571	Zr I	J98
3	8213.034	Mg I	KM91a
10	8213.987	Mg II	KM91a
25	8214.726	F I	L49

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
140	8216.34	N I	M75a
13	8218.365	Kr I	KH69
15	8220.445	Cl I	RK69
100 P	8221.742	Cl I	RK69
130	8221.82	O I	M75b
90	8223.14	N I	M75a
7	8224.74	Pt I	MCS75
13 c	8227.0	In II	PC38
30	8230.773	F I	L49
1000 P	8231.635	Xe I	HP70b
11	8234.636	Mg II	KM91a
50	8240.05	I I	KC59
1000	8241.77	Cf II	RCWM80
90	8242.39	N I	M75a
500	8248.797	Ca II	ER56
400	8250.18	K I	R56
300	8251.74	K I	R56
4 P	8254.070	Be I	KM97
30	8259.3790	Ne I	SS04
500 P	8263.2426	Kr I	K93
300	8264.522	Ar I	N73
100	8264.807	Ne II	P71
200	8264.96	Br I	T63
70	8266.0772	Ne I	SS04
50	8266.52	Xe I	HM33
10	8267.1162	Ne I	SS04
300 P	8270.96	Rn I	R33
1000 P	8271.87	Pa I	BW92b
15	8272.353	Kr I	KH69
1000 P,c	8272.44	Br I	T63
50 P	8273.509	Ag I	PZ01
700 P	8280.117	Xe I	HP70b
250	8281.0522	Kr I	K93
500	8283.160	Cu II	R69
800 P	8298.1099	Kr I	K93
20	8298.581	F I	L49
300	8300.3258	Ne I	SS04
500	8309.602	Pu I	BFG84
120 P	8314.594	S II	KM93
100	8314.995	Ne II	P71
120	8324.69	La I	MCS75
50	8330.4494	Th I	PE83
90 P	8333.307	Cl I	RK69
1000	8333.85	Cf II	RCWM80
250	8334.70	Br I	T63
250 P	8335.15	C I	J66
300 P,l	8339.12	Np I	FTBC76
130 P	8343.70	Br I	T63
2	8346.120	Mg I	KM91a
130	8346.53	La I	MCS75
200	8346.823	Xe I	HP70b
30	8347.24	Xe II	H39
300 s	8358.98	Pa I	BW92b
2	8361.69	He I	M60a
50	8365.7466	Ne I	SS04
300 s	8369.60	Pa I	BW92b
100	8372.106	Ne II	P71
1000 P	8372.88	Np I	FTBC76
500 P	8375.94	Cl I	RK69
800 P	8377.6080	Ne I	SS04
120	8390.22	K I	R56
	8391.44	K I	R56
1	8392.27	Ar I	M73
1000 P	8392.37	Cm I	WHGC76
130 c	8393.30	I I	KC59
50	8395.68	Pb II	WRSH74
400	8408.210	Ar I	N73
200	8409.191	Xe I	HP70b
15	8412.430	Kr I	KH69
30	8417.1606	Ne I	SS04
80	8417.54	K I	R56
250	8418.4274	Ne I	SS04
40	8420.00	K I	R56
20	8422.624	Sn I	B64
1000	8423.49	Cf II	RCWM80
600	8424.648	Ar I	N73
20	8426.504	Ti I	F91
80 P	8428.254	Cl I	RK69
60	8434.959	Ti I	F91
30	8435.648	Ti I	F91
30	8438.74	N II	M75a
300 h	8441.04	Pa I	BW92b
250 P	8446.25	O I	M75b
300 P	8446.36	O I	M75b
500 P	8446.55	Br I	T63
300 P	8446.76	O I	M75b
40	8463.3575	Ne I	SS04
11	8467.341	Cl I	RK69
13	8484.4435	Ne I	SS04
700	8495.3598	Ne I	SS04
50	8495.829	Ce I	BWCC91
600	8498.018	Ca II	ER56
400	8503.45	K I	R56
400	8505.11	K I	R56
500 P	8508.8728	Kr I	K93
500	8511.061	Cu II	R69
15 h	8515.19	Xe II	H39
70	8520.95	Rn I	R33
1000 P,c	8521.13	Cs I	EJN64
400	8521.442	Ar I	N73
1000 P	8529.96	Np I	FTBC76
300	8532.	Bi II	CM34
1000 P,h	8532.66	Pa I	BW92b
700 P	8542.089	Ca II	ER56
15	8544.6958	Ne I	SS04
90	8545.44	La I	MCS75
11	8550.438	Cl I	RK69
30	8552.531	Sn I	B64
25	8556.7803	Si I	BE93
60 P	8559.998	Ba I	KL99
120	8567.74	N I	M75a
1000	8568.83	Cf II	RCWM80
30	8571.3524	Ne I	SS04
1000 P,s	8572.96	Pa I	BW92b
100 P	8575.24	Cl I	RK69
20	8576.01	Xe I	HM33
400 P	8585.97	Cl I	RK69
400	8591.2584	Ne I	SS04
140	8594.00	N I	M75a
300 P	8600.07	Rn I	R33

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
20	8603.96	Rb II	R75
15 h	8604.23	Xe II	H39
25	8607.950	U I	PKE80
15	8608.31	Cs II	S81
150	8629.24	N I	M75a
1000 P	8630.189	Pu I	BFG84
350	8634.6470	Ne I	SS04
250	8638.66	Br I	T63
300 h	8639.91	Pa I	BW92b
60	8647.0411	Ne I	SS04
25	8648.54	Xe I	HM33
1	8649.92	Na I	R56
1	8650.89	Na I	R56
300 h	8653.51	Pa I	BW92b
600 P	8654.3831	Ne I	SS04
80	8655.5220	Ne I	SS04
120	8655.89	N I	M75a
700 P	8662.140	Ca II	ER56
130	8667.944	Ar I	N73
100	8668.256	Ne II	P71
50	8675.83	Rn I	R33
130	8679.4925	Ne I	SS04
150 P	8680.28	N I	M75a
150	8681.9211	Ne I	SS04
150 P	8683.40	N I	M75a
120	8686.15	N I	M75a
20	8686.26	Cl I	RK69
4	8688.91	Sr II	NOL73
7	8691.282	U I	PKE80
10	8692.20	Xe I	HM33
40	8694.71	S I	KM93
300 s	8696.23	Np I	FTBC76
20	8696.86	Xe I	HM33
120	8703.25	N I	M75a
30	8704.1116	Ne I	SS04
140	8711.70	N I	M75a
2	8712.689	Mg I	KM91a
15 h	8716.19	Xe II	H39
2	8717.825	Mg I	KM91a
120	8718.83	N I	M75a
10	8734.980	Mg II	KM91a
1000 P	8735.27	Pa I	BW92b
3	8736.021	Mg I	KM91a
30	8739.39	Xe I	HM33
30	8741.529	P I	S80
11	8745.663	Mg II	KM91a
9	8757.760	U I	PKE80
120	8758.183	Te I	MV75
10	8758.20	Xe I	HM33
250 P,c	8761.41	Cs I	EJN64
150	8763.96	K I	R56
25	8764.110	Kr I	KH69
120	8767.05	K I	R56
100	8771.6563	Ne I	SS04
7	8771.860	Ar II	N73
40	8772.866	Al I	KM91b
50	8773.896	Al I	KM91b
1000 P	8776.7505	Kr I	K93
600 P	8780.6226	Ne I	SS04
400 P	8783.7533	Ne I	SS04

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
130 c	8793.47	Br I	T63
5	8801.370	Be I	KM97
2	8806.757	Mg I	KM91a
500 P	8819.411	Xe I	HP70b
200	8819.96	Br I	T63
10	8824.318	Mg II	KM91a
300	8825.22	Br I	T63
6	8830.9072	Ne I	SS04
11	8835.080	Mg II	KM91a
5	8849.91	Ar I	M73
300	8853.8668	Ne I	SS04
40	8857.50	I I	KC59
30	8862.32	Xe I	HM33
20	8865.3063	Ne I	SS04
150	8865.7552	Ne I	SS04
400	8897.62	Br I	T63
500	8902.19	K I	R56
500	8904.02	K I	R56
300 s	8906.02	Np I	FTBC76
20	8908.73	Xe I	HM33
400	8912.07	Ca II	ER56
11	8912.921	Cl I	RK69
8	8915.013	Ba I	KL99
300	8918.86	Se I	MV74
60	8919.5006	Ne I	SS04
4 h	8922.56	Yb II	M67
200	8923.31	K I	R56
3	8923.569	Mg I	KM91a
150	8925.44	K I	R56
500	8927.36	Ca II	ER56
300	8928.6934	Kr I	K93
20	8930.83	Xe I	HM33
300	8942.70	Np I	FTBC76
1000 P,c	8943.47	Cs I	EJN64
15	8948.063	Cl I	RK69
100	8952.252	Xe I	HP70b
70 P	8967.6403	Th I	PE83
10	8981.05	Xe I	HM33
20	8987.57	Xe I	HM33
20	8988.5564	Ne I	SS04
300 s	9004.75	Np I	FTBC76
300 l	9006.31	Np I	FTBC76
1000 P,l	9016.18	Np I	FTBC76
70	9022.40	I I	KC59
10	9038.982	Cl I	RK69
12	9045.433	Cl I	RK69
40	9045.45	Xe I	HM33
40	9048.2501	Th I	PE83
50	9050.82	Pb II	WRSH74
200 P	9058.33	I I	KC59
2	9063.27	He I	M60a
50	9063.43	Pb II	WRSH74
10	9073.166	Cl I	RK69
1	9075.394	Ar I	N73
100	9079.462	Ne II	P71
220	9094.83	C I	J66
150	9111.80	C I	J66
150	9113.91	I I	KC59
40	9121.146	Cl I	RK69
1000 P	9122.967	Ar I	N73

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
700	9130.	Tl II	ES36
1	9130.5	Tl I	MM52
300 l	9141.30	Np I	FTBC76
120	9148.6716	Ne I	SS04
1	9153.88	Na I	R56
50	9162.65	Xe I	HM33
400	9166.06	Br I	T63
10	9167.52	Xe I	HM33
300 P	9172.32	Cs I	EJN64
200	9173.63	Br I	T63
250	9178.16	Br I	T63
15	9191.731	Cl I	RK69
50	9193.85	P I	S80
15	9194.638	Ar I	N73
90	9201.7591	Ne I	SS04
90	9208.53	Cs I	EJN64
2	9210.34	He I	M60a
150 P	9212.865	S I	KM93
12 w	9213.0	In II	PC38
500	9213.900	Ca II	R68
14	9218.250	Mg II	KM91a
60	9220.0601	Ne I	SS04
30 c	9220.75	Cs II	S81
20	9221.5801	Ne I	SS04
400	9224.499	Ar I	N73
20	9226.6903	Ne I	SS04
100 P	9228.092	S I	KM93
1000 l	9228.52	Cf I	RCWM80
80 P	9237.538	S I	KM93
150 P	9238.48	Kr II	DHM33
13	9244.265	Mg II	KM91a
2	9246.499	Mg I	KM91a
5	9255.778	Mg I	KM91a
150	9260.81	O I	M75b
150	9260.84	O I	M75b
150	9260.94	O I	M75b
130	9262.58	O I	M75b
200	9262.67	O I	M75b
200	9262.77	O I	M75b
500	9265.42	Br I	T63
150	9265.94	O I	M75b
200 P	9266.01	O I	M75b
9	9275.5196	Ne I	SS04
30	9278.88	P I	S80
200	9287.563	Ne II	P71
20	9288.856	Cl I	RK69
11	9291.531	Ar I	N73
150 P,h,l	9293.82	Kr II	DHM33
80	9300.8527	Ne I	SS04
70	9304.94	P I	S80
8	9310.5839	Ne I	SS04
400	9311.998	Ca II	R68
30	9313.9726	Ne I	SS04
400	9319.560	Ca II	R68
500	9320.650	Ca II	R68
200	9320.86	Br I	T63
70 h	9320.99	Kr II	DHM33
30	9323.50	P I	S80
70	9326.5068	Ne I	SS04
150	9327.02	Rn I	R33
10 d	9327.545	Mg II	KM91a
1000	9337.70	Cf I	RCWM80
10	9340.542	Mg II	KM91a
300	9347.24	K I	R56
120	9349.25	K I	R56
250	9351.59	K I	R56
50	9354.220	Ar I	N73
100	9361.95	Kr II	DHM33
15	9362.082	Kr I	KH69
50	9370.119	Ba I	KL99
3 h	9370.27	In I	JL67
15	9373.3078	Ne I	SS04
10	9374.76	Xe I	HM33
300 P,s	9379.33	Np I	FTBC76
120	9386.80	N I	M75a
140	9392.79	N I	M75a
70 h	9402.82	Kr II	DHM33
400 P	9405.73	C I	J66
4	9414.964	Mg I	KM91a
500	9416.967	Ca I	R68
50	9425.3788	Ne I	SS04
50	9426.71	I I	KC59
40	9427.15	I I	KC59
1000 s	9429.13	Bk I	CWBC77
3	9429.814	Mg I	KM91a
3	9432.764	Mg I	KM91a
50	9435.069	P I	S80
3	9438.783	Mg I	KM91a
50	9441.86	P I	S80
20	9452.098	Cl I	RK69
30	9452.83	P I	S80
30	9459.2095	Ne I	SS04
10	9463.61	He I	M60a
1	9465.94	Na I	R56
300 P,l	9468.66	Np I	FTBC76
70 h	9470.93	Kr II	DHM33
50	9476.928	Y II	NJK91
11	9479.32	Rb II	R75
50	9486.6818	Ne I	SS04
70	9493.56	P I	S80
20	9513.38	Xe I	HM33
4	9516.60	He I	M60a
150	9518.68	Sb I	SM02
6 h	9520.198	Hg II	SR01
90 P	9525.73	P I	S80
3	9526.17	He I	M60a
1	9529.27	He I	M60a
150	9533.071	Pu I	BFG84
60	9534.1629	Ne I	SS04
80 P	9545.18	P I	S80
5	9545.97	H I	RCWM80
30	9547.4049	Ne I	SS04
90 P	9563.439	P I	S80
400	9567.965	Ca II	R68
120	9577.013	Ne II	P71
150 P	9577.52	Kr II	DHM33
100 P	9581.42	Li II	SO82
15 h	9591.35	Xe II	H39
20	9592.222	Cl I	RK69
600	9595.70	K I	R56

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
600	9597.83	K I	R56
150	9597.92	As I	HA85
500	9599.235	Ca II	R68
300	9601.815	Ca II	R68
1	9603.42	He I	M60a
150 P,h	9605.80	Kr II	DHM33
15	9608.894	Ba I	KL99
40	9609.04	P I	S80
130 h	9619.61	Kr II	DHM33
150	9626.65	As I	HA85
12	9631.892	Mg II	KM91a
11	9632.431	Mg II	KM91a
20	9638.939	P I	S80
1000	9649.51	Cf I	RCWM80
40 d	9653.06	I I	KC59
70 P,d	9657.04	Bi I	GMV85
700 P	9657.786	Ar I	N73
150	9658.44	C I	J66
70	9663.34	Kr II	DHM33
180	9665.4197	Ne I	SS04
30	9676.24	P I	S80
300 s	9679.13	Np I	FTBC76
15	9685.32	Xe I	HM33
20 c	9689.05	Rb II	R75
15 l	9698.68	Xe II	H39
3	9702.60	He I	M60a
70 h	9711.60	Kr II	DHM33
10	9718.16	Xe I	HM33
200 P	9722.742	Te I	MV75
70	9731.73	I I	KC59
80 P	9734.750	P I	S80
80 P	9750.77	P I	S80
300	9751.7610	Kr I	K93
130	9784.503	Ar I	N73
30	9790.21	P I	S80
90 P	9796.85	P I	S80
200	9799.700	Xe I	HP70b
150 P	9803.14	Kr II	DHM33
20 h	9805.184	Sn I	B64
100	9808.860	Ne II	P71
200	9833.78	As I	HA85
40	9850.381	Sn I	B64
300	9854.74	Ca II	ER56
80	9856.314	Kr I	KH69
400	9861.280	Cu II	R69
1000 l	9862.39	Bk II	CWBC77
400	9864.137	Cu II	R69
20	9868.92	Te I	MV75
500	9890.63	Ca II	ER56
130	9896.40	Br I	T63
20	9903.68	P I	S80
250	9923.03	As I	HA85
300 P	9923.190	Xe I	HP70b
300 l	9930.55	Np I	FTBC76
400	9931.39	Ca II	ER56
150	9949.14	Sb I	SM02
250	9949.67	K I	R56
200	9954.14	K I	R56
25	9956.30	Te I	MV75
1	9961.28	Na I	R56

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
6	9977.86	In I	JL67
2	9983.20	Mg I	KM91a
3	9986.48	Mg I	KM91a
3	9993.21	Mg I	KM91a
14	9994.79	Cs II	S81
200	10024.01	As I	HA85
300	10024.36	Cs I	EW70
6	10027.73	He I	M60a
2	10031.16	He I	M60a
40	10032.139	Ba I	KL99
7	10036.66	Sr II	S38a
7	10049.4	H I	RCWM80
250 P	10051.41	Te I	MV75
5	10052.06	Ar I	M73
400	10054.938	Cu II	R69
150	10091.01	Te I	MV75
300 P,l	10091.99	Np I	FTBC76
14	10092.16	Mg II	KM91a
80	10112.48	N I	M75a
90	10114.64	N I	M75a
12	10119.92	Be II	J61a
80	10123.41	Cs I	EW70
400	10123.60	Cs I	EW70
15 c	10123.6	He II	GM65
1000	10126.20	Bk I	CWBC77
1	10138.50	He I	M60a
200 P	10139.76	Hg I	BAL50
15	10157.91	U I	BW92b
30 c	10176.02	Cs II	S81
300 P	10221.46	Kr II	DHM33
400	10223.04	Ca II	R68
11	10257.03	In I	JL67
13	10259.55	U I	BW92b
120	10260.849	Sb I	SM02
2	10290.458	Pb I	WA68
1000	10292.44	Bk I	CWBC77
4	10295.4174	Ne I	SS04
400	10307.45	Se I	MV74
1000 s	10308.41	Cf I	CWBV77
10	10311.23	He I	M60a
2	10311.54	He I	M60a
1000 P	10327.26	Se I	MV74
20 P	10327.31	Sr II	S38a
30	10329.701	Y II	NJK91
1	10332.72	Ar I	M73
25	10379.66	Cs II	S81
700 P	10386.36	Se I	MV74
200 P	10455.451	S I	KM93
30 P	10456.757	S I	KM93
400	10457.96	Br I	T63
130 P	10459.406	S I	KM93
70	10466.54	I I	KC59
30	10467.177	Ar II	N73
50	10470.054	Ar I	N73
400	10479.63	K I	R56
13	10480.93	Cs II	S81
200	10482.15	K I	R56
300	10487.11	K I	R56
30	10493.57	Te I	MV75
1	10498.965	Pb I	WA68

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
50	10504.51	Cs II	S81
5	10506.50	Ar I	M73
50	10529.52	P I	S80
1000 P	10542.98	Cm I	WHGC76
30	10554.93	U I	BW92b
80	10562.4075	Ne I	SS04
1000 l	10568.83	Cf I	CWBV77
1000 l	10570.53	Bk I	CWBC77
1	10572.28	Na I	R56
70	10581.57	P I	S80
20	10585.140	Si I	BE93
300	10594.38	Pa I	BW92b
20	10603.427	Si I	BE93
30	10605.150	Y II	NJK91
1000 s	10614.84	Cf I	CWBV77
20	10660.970	Si I	BE93
3	10667.65	He I	M60a
6	10673.565	Ar I	N73
400	10677.246	Sb I	SM02
2	10683.034	Ar II	N73
150	10691.25	C I	J66
3 h	10717.42	In I	JL67
1	10733.87	Ar I	M73
300	10741.898	Sb I	SM02
6 h	10744.31	In I	JL67
2	10746.44	Na I	R56
1	10749.29	Na I	R56
1	10759.16	Ar I	M73
1000 P	10792.25	Cm I	WHGC76
60	10798.0429	Ne I	SS04
20 w	10807.88	Cs II	S81
6	10811.08	Mg I	KM91a
2	10812.896	Ar II	N73
300 P,s	10817.45	Np I	FTBC76
20	10827.088	Si I	BE93
150 P	10829.0911	He I	M02
500 P	10830.2501	He I	M02
1000 P	10830.3398	He I	M02
2	10834.87	Na I	R56
10	10838.37	Xe I	HM33
250	10839.571	Sb I	SM02
90	10844.4772	Ne I	SS04
20	10869.539	Si I	BE93
150	10879.698	Sb I	SM02
9	10913.05	He I	L70
11	10914.23	Mg II	KM91a
4	10914.88	Sr II	S38a
3	10917.10	He I	L70
70	10918.34	Te I	MV75
300	10923.32	Pa I	BW92b
12	10938.1	H I	RCWM80
10	10951.78	Mg II	KM91a
4	10953.32	Mg I	KM91a
4	10957.30	Mg I	KM91a
5	10965.45	Mg I	KM91a
120	11012.728	Sb I	SM02
700	11019.87	K I	R56
600	11022.67	K I	R56
2	11032.10	Mg I	KM91a
2	11033.66	Mg I	KM91a
400 P	11089.56	Te I	MV75
1	11106.46	Ar I	M73
300 P	11143.0200	Ne I	SS04
10	11167.84	U I	BW92b
500 P	11177.5240	Ne I	SS04
40	11183.23	P I	S80
15	11187.108	Kr I	KH69
1	11197.21	Na I	R56
50	11230.2547	Th I	PE83
90	11252.83	Ge I	HA64
50	11253.189	Al I	KM91b
60	11254.926	Al I	KM91b
30	11257.711	Kr I	KH69
25	11259.126	Kr I	KH69
60	11266.082	Sb I	SM02
200	11286.34	O I	M75b
200	11286.91	O I	M75b
150	11287.02	O I	M75b
150	11287.32	O I	M75b
1000 P,l	11293.14	Bk I	CWBC77
150	11295.10	O I	M75b
200	11297.68	O I	M75b
1000	11300.19	Cf I	CWBV77
200	11302.38	O I	M75b
5 P	11381.45	Na I	R56
15	11384.13	U I	BW92b
150	11390.4339	Ne I	SS04
12 P	11403.78	Na I	R56
90	11409.1343	Ne I	SS04
11	11454.407	Sn I	B64
80	11457.481	Kr I	KH69
250 P	11487.23	Te I	MV75
11	11488.109	Ar I	N73
1000 P,l	11500.30	Bk I	CWBC77
50 P	11512.82	Tl I	MM52
300 P	11522.7459	Ne I	SS04
150	11525.0194	Ne I	SS04
90	11536.3445	Ne I	SS04
1000 s	11575.34	Bk I	CWBC77
30	11601.5366	Ne I	SS04
25	11607.5752	Fe I	NJLT94
130	11614.0807	Ne I	SS04
70	11614.81	Ge I	HA64
9	11616.152	Sn I	B64
4 c	11626.4	He II	GM65
300	11646.78	Pa I	BW92b
100 P	11660.028	B I	EL01
50 P	11662.452	B I	El01
6	11668.710	Ar I	N73
1000	11681.85	Cf I	CWBV77
30	11688.0017	Ne I	SS04
25	11689.9756	Fe I	NJLT94
700 P	11690.21	K I	R56
300 l	11695.15	Np I	FTBC76
50 P,d	11710.83	Bi I	GMV85
250	11714.76	Ge I	HA64
11	11739.591	Sn I	B64
9	11742.01	Xe I	H73
90	11748.22	C I	JL65
140 P	11753.32	C I	JL65

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
110 P	11754.76	C I	JL65
150	11766.7924	Ne I	SS04
600 P	11769.62	K I	R56
700 P	11772.83	K I	R56
300 P,l	11776.64	Np I	FTBC76
130	11789.0435	Ne I	SS04
30	11789.8891	Ne I	SS04
1000 P	11791.73	Pa I	BW92b
25	11792.425	Kr I	KH69
1000 P,s	11793.09	Bk I	CWBC77
250	11819.377	Kr I	KH69
8 P	11828.17	Mg I	KM91a
1000	11834.28	Cm I	CBV76
15	11859.42	U I	BW92b
12	11863.229	Sb I	SM02
60	11882.8467	Fe I	NJLT94
30	11908.83	U I	BW92b
9	11932.82	Sn I	B64
1000 P	11941.33	Cf I	CWBV77
50	11949.12	Ga I	JL67
30	11969.12	He I	L70
100	11973.0498	Fe I	NJLT94
50 P	11984.201	Si I	BE93
70	11984.912	Ne I	SS04
30	11991.562	Si I	BE93
100	11997.105	Kr I	KH69
60 P	12031.503	Si I	BE93
200	12066.334	Ne I	SS04
500 P	12069.20	Ge I	HA64
25	12077.224	Kr I	KH69
5	12083.65	Mg I	KM91a
20	12095.36	Be II	J61a
20	12103.535	Si I	BE93
40	12109.78	Ga I	JL67
6	12112.326	Ar I	N73
30	12127.3016	Th I	PE83
1	12139.738	Ar I	N73
300 s	12148.18	Np I	FTBC76
1000 s	12159.05	Bk I	CWBC77
1000 P,l	12183.05	Cf II	CWBV77
90	12186.82	N I	M75a
150	12231.212	Pu I	BFG84
30	12231.9446	Th I	PE83
40	12235.24	Xe I	H73
10	12257.76	Xe I	H73
15	12270.692	Si I	BE93
300	12279.01	Pa I	BW92b
1	12343.393	Ar I	N73
1000 s	12352.72	Cf I	CWBV77
300 P,s	12377.42	Np I	FTBC76
400 P	12391.58	Ge I	HA64
6	12402.827	Ar I	N73
300 l	12407.99	Np I	FTBC76
	12432.24	K I	R56
1000 s	12437.48	Cf I	CWBV77
6	12439.321	Ar I	N73
3	12456.12	Ar I	N73
40	12459.389	Ne I	SS04
150	12464.02	O I	M75b
1000	12464.99	Cm I	CBV76
200 P	12469.62	N I	M75a
6	12487.663	Ar I	N73
	12522.11	K I	R56
20	12527.52	He I	L70
150	12570.04	O I	M75b
30	12590.20	Xe I	H73
11	12604.29	Cs II	S81
250 P	12623.399	Xe I	HP70b
30	12646.5347	Th I	PE83
5	12679.17	Na I	R56
60	12689.201	Ne I	SS04
4	12702.281	Ar I	N73
1	12733.418	Ar I	N73
20 c	12735.52	Cs II	S81
50	12784.99	He I	L70
1000 P,l	12787.41	Cf I	CWBV77
20	12790.57	He I	L70
6	12802.739	Ar I	N73
500	12816.04	Ca I	R68
20 P	12818.07	H I	MK00a
7	12845.96	He I	L70
15	12861.892	Kr I	KH69
500	12909.10	Ca I	R68
80	12912.014	Ne I	SS04
1 P	12912.59	In I	JL67
1	12933.195	Ar I	N73
14	12956.659	Ar I	N73
10	12968.45	He I	L70
14	12981.01	Sn I	B64
2	12984.89	He I	L70
1000	13004.56	Cm I	CBV76
6	13008.264	Ar I	N73
40 P	13013.2	Tl I	MM52
600	13033.57	Ca I	R68
90	13107.61	Ge I	HA64
60	13123.378	Al I	KM91b
50	13150.708	Al I	KM91b
250 P	13163.89	O I	M75b
250 P	13164.85	O I	M75b
200	13165.11	O I	M75b
200	13177.412	Kr I	KH69
25	13185.16	U I	BW92b
6	13213.99	Ar I	N73
40	13219.241	Ne I	SS04
6	13228.107	Ar I	N73
3	13230.90	Ar I	N73
300	13234.09	Pa I	BW92b
1	13235.17	Rb I	J61b
60	13247.75	Te I	MV75
1000	13258.18	Cm I	CBV76
14	13272.64	Ar I	N73
1000	13289.84	Cm I	CBV76
30	13313.210	Ar I	N73
1000 l	13329.98	Cf II	CWBV77
1000 s	13362.98	Cf I	CWBV77
30	13367.111	Ar I	N73
1000 P,l	13376.89	Cf II	CWBV77
	13377.86	K I	R56
	13397.09	K I	R56
50	13424.31	Cs I	S81

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
120	13429.61	N I	M75a
1 P	13429.96	In I	JL67
14	13459.2	Sn I	B64
1000 l	13474.44	Cf I	CWBV77
1000	13480.54	Cm I	CBV76
1000	13498.36	Bk I	CWBC77
1	13499.41	Ar I	N73
30	13504.191	Ar I	N73
1000 P	13522.40	Pa I	BW92b
25	13544.15	Xe I	H73
50	13570.21	Hg I	H53
200 P	13581.33	N I	M75a
600 P,c	13588.29	Cs I	S81
1000	13590.01	Cm I	CBV76
1	13599.333	Ar I	N73
140	13602.56	Cs I	S81
150	13622.415	Kr I	KH69
11	13622.659	Ar I	N73
400 P	13634.220	Kr I	KH69
1000	13644.77	Cm I	CBV76
200	13657.06	Xe I	H73
130	13658.394	Kr I	KH69
1	13665.01	Rb I	J61b
40	13673.51	Hg I	H53
6	13678.550	Ar I	N73
40 c	13692.91	Cs II	S81
30	13711.036	Kr I	KH69
30	13718.577	Ar I	N73
100	13738.851	Kr I	KH69
90	13758.81	Cs I	S81
1000	13789.52	Cm I	CBV76
300 l	13834.33	Np I	FTBC76
14 c	13868.82	Cs II	S81
1000	13908.46	Cm I	CBV76
10	13961.58	U I	BW92b
25	13974.027	Kr I	KH69
90	14045.657	Kr I	KH69
6	14093.640	Ar I	N73
25	14104.298	Kr I	KH69
120	14142.44	Xe I	H73
1000 s	14196.93	Bk I	CWBC77
1000	14235.27	Cm I	CBV76
80	14240.96	Xe I	H73
25	14241.64	P I	S80
1000	14334.52	Cm I	CBV76
1000 P	14344.76	Pa I	BW92b
40	14364.99	Xe I	H73
30	14402.22	Kr I	KH69
300 P	14426.793	Kr I	KH69
40	14513.51	Te I	MV75
15	14517.84	Kr I	KH69
1000	14563.41	Cm I	CBV76
1000	14580.23	Cm I	CBV76
6	14643.92	Be I	KM97
6	14644.75	Be I	KM97
14	14660.81	Xe I	H73
900 P,c	14694.91	Cs I	S81
300 P	14732.816	Xe I	HP70b
250	14734.436	Kr I	KH69
11 P	14752.41	Rb I	J61b
90	14762.672	Kr I	KH69
80	14765.472	Kr I	KH69
1	14767.48	Na I	R56
1000 l	14772.49	Cf II	CWBV77
1	14779.73	Na I	R56
400	14817.93	Se I	MV74
200	14822.38	Ge I	HA64
5	14877.53	Mg I	KM91a
500	14917.47	Se I	MV74
70	14961.894	Kr I	KH69
60 P	14999.852	Ba I	KL99
20	15005.307	Kr I	KH69
1000	15018.13	Cm I	CBV76
6 P	15025.00	Mg I	KM91a
5	15040.25	Mg I	KM91a
3	15046.50	Ar I	N73
4	15047.71	Mg I	KM91a
12	15083.64	He I	L70
10	15099.72	Xe I	H73
600	15151.44	Se I	MV74
	15163.08	K I	R56
	15168.40	K I	R56
1	15172.69	Ar I	N73
25	15209.526	Kr I	KH69
50	15230.714	Ne I	SS04
300	15239.615	Kr I	KH69
1000 s	15281.32	Cf I	CWBV77
9 P	15288.43	Rb I	J61b
2	15289.48	Rb I	J61b
20 c	15293.80	Cs II	S81
50	15295.82	Hg I	H53
20	15326.480	Kr I	KH69
250	15334.958	Kr I	KH69
15 c	15356.61	Cs II	S81
120	15372.037	Kr I	KH69
250	15418.39	Xe I	H73
25	15429.78	Th I	GBCZ74
60	15452.45	Te I	MV75
400	15471.00	Se I	MV74
30	15474.026	Kr I	KH69
90	15546.23	Te I	MV75
15	15557.13	Xe I	H73
1000	15587.12	Cf II	CWBV77
400	15618.40	Se I	MV74
200	15619.966	Y I	P77
1000	15675.92	Cf I	CWBV77
30	15681.02	Kr I	KH69
40	15711.52	P I	S80
8	15730.1	Cl I	RK69
20	15820.09	Kr I	KH69
25	15831.75	Th I	GBCZ74
14	15869.7	Cl I	RK69
25	15888.431	Si I	BE93
25	15979.54	Xe I	H73
1	15989.49	Ar I	N73
10	16039.90	Xe I	H73
100	16053.28	Xe I	H73
5	16157.72	Be I	HJ69
1	16373.85	Na I	R56
1	16388.85	Na I	R56

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
140	16403.90	Te I	MV75
11 c	16426.14	Cs II	S81
90	16482.92	P I	S80
1	16519.86	Ar I	N73
13	16535.63	Cs I	S81
12	16554.49	Xe I	H73
30	16590.07	P I	S80
400	16659.44	Se I	MV74
30	16726.513	Kr I	KH69
150	16728.15	Xe I	H73
30	16750.429	Al I	KM91b
1000 P	16759.06	Cf II	CWBV77
300	16785.128	Kr I	KH69
600	16813.78	Se I	MV74
5	16819.5	Ag I	S40
150	16853.488	Kr I	KH69
50	16890.38	C I	JL65
400 P	16890.441	Kr I	KH69
250	16896.753	Kr I	KH69
150	16897.369	Pu I	BFG84
300	16935.806	Kr I	KH69
14	16940.58	Ar I	N73
200	17002.47	He I	L70
25	17012.32	Cs I	S81
50	17072.79	Hg I	H53
100	17098.771	Kr I	KH69
5	17108.63	Mg I	KM91a
400	17123.808	Y I	P77
20	17161.929	Ne I	SS04
80	17303.54	Te I	MV75
25	17307.66	Th I	GBCZ74
150	17325.77	Xe I	H73
250	17366.720	Y I	P77
120	17367.606	Kr I	KH69
25	17381.91	Th I	GBCZ74
20	17404.443	Kr I	KH69
600 P	17422.838	Y I	P77
25	17481.04	Th I	GBCZ74
25	17584.52	Th I	GBCZ74
25	17616.854	Kr I	KH69
1000 s	17626.25	Cf I	CWBV77
500	17663.292	Y I	P77
110	17842.737	Kr I	KH69
1000 P	17903.209	Y I	P77
120	18002.229	Kr I	KH69
200	18021.21	O I	M75b
20	18035.812	Ne I	SS04
1000 P	18049.810	Y I	P77
40	18083.181	Ne I	SS04
9	18083.263	Ne I	SS04
1000	18115.296	Y I	P77
6	18143.54	Be I	KM97
400 P	18167.315	Kr I	KH69
900	18181.765	Y I	P77
15	18221.087	Ne I	SS04
13	18227.016	Ne I	SS04
200	18243.63	O I	M75b
140	18276.642	Ne I	SS04
100	18282.614	Ne I	SS04
110	18291.59	Te I	MV75

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
70	18303.967	Ne I	SS04
20	18359.094	Ne I	SS04
60	18384.826	Ne I	SS04
90	18389.937	Ne I	SS04
15	18399.786	Kr I	KH69
40	18402.836	Ne I	SS04
60	18422.402	Ne I	SS04
13	18458.640	Ne I	SS04
5 P	18465.25	Na I	R56
40	18475.800	Ne I	SS04
300	18478.61	Pa I	BW92b
1	18555.55	He I	M60a
25	18580.896	Kr I	KH69
70	18591.541	Ne I	SS04
100	18597.698	Ne I	SS04
16	18618.908	Ne I	SS04
20	18625.159	Ne I	SS04
6 c	18636.8	He II	GM65
500	18685.34	He I	L70
50	18696.294	Kr I	KH69
200	18697.23	He I	L70
2*	18703.01	Li I	REB95
2*	18703.11	Li I	REB95
2*	18703.14	Li I	REB95
1000 l	18718.69	Cf I	CWBV77
40 P,c	18751.01	H I	MK00a
30	18785.460	Kr I	KH69
40	18788.13	Xe I	H73
30	18797.703	Kr I	KH69
25	18811.88	Th I	GBCZ74
600	19046.14	Ca I	R68
1000 h	19068.71	Cf I	CWBV77
100	19089.38	He I	L70
1000	19309.20	Ca I	R68
1000 l	19336.96	Cf I	CWBV77
1000	19452.99	Ca I	R68
900	19505.72	Ca I	R68
20	19543.08	He I	L70
1000 l	19576.84	Cf I	CWBV77
1000	19776.79	Ca I	R68
700	19853.10	Ca I	R68
700	19862.22	Ca I	R68
12	20138.47	Cs I	S81
15	20187.19	Xe I	H73
25	20209.878	Kr I	KH69
300	20262.24	Xe I	H73
1000 l	20393.38	Cf I	CWBV77
50	20423.964	Kr I	KH69
25	20446.971	Kr I	KH69
500 P	20581.287	He I	M02
1	20616.23	Ar I	N73
1000 s	20869.98	Cf I	CWBV77
1	20986.11	Ar I	N73
30	21041.27	Ne I	SS04
40	21043.73	Te I	MV75
80	21120.07	He I	L70
10	21121.43	He I	L70
20	21132.03	He I	L70
100	21165.471	Kr I	KH69
800 P	21260.444	Y I	P77

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
800 P	21442.56	Se I	MV74
25	21470.09	Xe I	H73
500	21473.48	Se I	MV74
5	21655.3	H I	RCWM80
30	21708.11	Ne I	SS04
300	21902.513	Kr I	KH69
40	22052.1	Sc I	AV77
1	22056.44	Na I	R56
40	22065.4	Sc I	AV77
13	22247.36	Ne I	SS04
13	22428.14	Ne I	SS04
20	22485.775	Kr I	KH69
80	22530.38	Ne I	SS04
700 P	22543.828	Y I	P77
500	22624.93	Ca I	R68
600	22651.23	Ca I	R68
13	22661.79	Ne I	SS04
14	22811.86	Cs I	S81
20	23037.98	Cs I	S81
25	23100.48	Ne I	SS04
1	23133.20	Ar I	N73
120	23193.33	Xe I	H73
25	23253.07	Hg I	PBT55
50 P	23253.56	Ba I	KL99
40	23260.27	Ne I	SS04
11	23279.54	Xe I	H73
30	23340.416	Kr I	KH69
60	23344.47	Cs I	S81
1	23348.41	Na I	R56
50	23372.96	Ne I	SS04
1	23379.13	Na I	R56
30	23565.33	Ne I	SS04
170	23636.48	Ne I	SS04
12	23701.66	Ne I	SS04
60	23709.13	Ne I	SS04
110	23951.40	Ne I	SS04
50	23956.43	Ne I	SS04
1	23966.52	Ar I	N73
60	23978.16	Ne I	SS04
500 P	23990.450	Y I	P77
11	24098.57	Ne I	SS04
20	24161.43	Ne I	SS04
30	24249.61	Ne I	SS04
70	24251.21	Cs I	S81
20	24260.506	Kr I	KH69
30	24292.221	Kr I	KH69
70	24365.01	Ne I	SS04
40	24371.61	Ne I	SS04
14	24374.96	Cs I	S81
400	24385.99	Se I	MV74
20	24447.86	Ne I	SS04
30	24459.39	Ne I	SS04
17	24776.49	Ne I	SS04
200	24824.71	Xe I	H73
400	24920.894	Y I	P77
30	24928.89	Ne I	SS04
600	25127.43	Se I	MV74
20	25145.84	Xe I	H73
13	25161.70	Ne I	SS04
9	25220.37	Cs II	S81
100	25233.820	Kr I	KH69
60 P	25514.88	Ba I	KL99
50	25524.33	Ne I	SS04
15 d	25763.51	Cs I	SAV81
8	25764.73	Cs I	SAV81
8	26251.5	H I	RCWM80
200	26269.08	Xe I	H73
250	26510.86	Xe I	H73
10 P	26877.67	Li I	REB95
5 P	26878.36	Li I	REB95
25	28381.54	Xe I	H73
6	28386.20	Ne I	SS04
80	28582.25	Xe I	H73
30	28610.55	Kr I	KH69
150	28655.72	Kr I	KH69
25	28769.71	Kr I	KH69
25	28822.49	Kr I	KH69
50	29236.69	Kr I	KH69
11 c	29310.06	Cs I	S81
30	29384.41	Xe I	H73
15	29448.06	Xe I	H73
10	29649.58	Xe I	H73
10	29813.62	Xe I	H73
50 P	30103.27	Cs I	S81
6	30200.49	Ne I	SS04
60	30253.14	Xe I	H73
150	30475.46	Xe I	H73
10	30504.12	Xe I	H73
50	30663.54	Kr I	KH69
50	30794.18	Xe I	H73
3 c	30908.5	He II	GM65
10 c	30953.06	Cs I	S81
50	30979.16	Kr I	KH69
600 P	31069.23	Xe I	HP70b
12	31336.01	Xe I	H73
60	31607.91	Xe I	H73
5	31778.70	Be I	HJ69
10	32293.08	Xe I	H73
200	32739.26	Xe I	H73
8	33173.09	Ne I	SS04
17	33352.38	Ne I	SS04
400	33666.69	Xe I	H73
5	33899.81	Ne I	SS04
4	33903.02	Ne I	SS04
12	33913.10	Ne I	SS04
15	34014.67	Xe I	H73
4	34131.34	Ne I	SS04
40	34335.27	Xe I	H73
6	34471.43	Ne I	SS04
15	34744.00	Xe I	H73
20 P	34900.13	Cs I	S81
500 P	35070.26	Xe I	HP70b
11	35246.92	Xe I	H73
8	35834.81	Ne I	SS04
3	36131.00	Cs I	S81
25	36209.21	Xe I	H73
15	36231.74	Xe I	H73
40	36508.36	Xe I	H73
80	36788.83	Xe I	H73
14	38685.98	Xe I	H73

Finding List—Continued

Intensity	Wavelength (Å)	Spectrum	Ref
20	38737.82	Xe I	H73
25	38939.60	Xe I	H73
80	39300.6	Kr I	HPCA67
200	39486.52	Kr I	KH69
40	39557.25	Kr I	KH69
15	39572.60	Kr I	KH69
250	39588.4	Kr I	HPCA67
200	39589.6	Kr I	HPCA67
80	39954.8	Kr I	HPCA67
12	39955.14	Xe I	H73
50	39966.6	Kr I	HPCA67
	40158.37	K I	L70b
200	40306.1	Kr I	HPCA67
4	40478.90	He I	L70
15	40511.6	H I	RCWM80
40	40685.16	Kr I	KH69
4	46525.1	H I	RCWM80
6	74578	H I	RCWM80
3	123685	H I	RCWM80

5. Indices

5.1. Index by Atomic Number

5.2. Index by Chemical Symbol