Energy Levels of Silicon, Si I through Si XIV

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Energy level data are given for the atom and all positive ions of silicon ($Z=14$). These data have been critically compiled, mainly from published material on measurements and analyses of the optical spectra. We have derived or recalculated the levels for a number of the ions. In addition to the level value in cm^{-1} and the parity, the J value and the configuration and term assignments are listed if known. Leading percentages from the calculated eigenvectors are tabulated or quoted wherever available. Ionization energies are given for all spectra.

Key words: atomic energy levels; atomic ions; atomic spectra; electron configurations; ionization potentials; silicon.

Contents

1. Introduction

This compilation is one of a series being published by the NBS Atomic Energy Levels Data Center. The main program of this center is the critical compilation of energy level data, with emphasis at present on the first 28 elements. The more recent publications include compilations for Na I-XI [Martin and Zalubas, 1981], Mg I-XII [Martin and Zalubas, 1980], Al I-XIII [Martin and Zalubas, 1979], K I-XIX [Corliss and Sugar, 1979b], Ca I-XX [Sugar and Corliss, 1979], Sc I-XXI [Sugar and Corliss, 1980], Ti I-XXII [Corliss and Sugar, 1979a], V I-XXIII [Sugar and Corliss, 1978], Cr I-XXIV [Sugar and Corliss, 1977], Mn I-XXV [Corliss and Sugar, 1977], Fe I-XXVI [Corliss and Sugar, 1982], Co I-XXVII [Sugar and Corliss, 1981], and Ni I-XXVIII [Corliss and Sugar, 1981].

C. E. Moore's *Selected Tables of Atomic Spectra,* which include multiplet tables as well as energy levels, were begun with two sections covering Si II, Si III, Si IV [1965], and Si I [1967]. The Si energy-level data compiled here of course incorporate experimental and theoretical results obtained since 1965 and 1967, but unfortunately it has not been possible to include corresponding new multiplet tables in the present program.

Since the general methods used in these compilations were outlined previously [Martin and Zalubas, 1979, 1980], our explanation here is confined mainly to the tables and the material preceding them. The levels for the Si spectra have been compiled from data available to us through August, 1982.

The basic data listed after the main heading for each spectrum include the appropriate isoelectronic sequence (for ions), the configuration and term designation of the ground-state level, and the wavenumber corresponding to the principal ionization energy. The ionization energy is also given in electron-volt (eV) units, an equivalence of 1 eV to 8065.479 ± 0.021 cm^{-1} being used for the conversion [Cohen and Taylor, 1973].

We have tried to describe our use of the data from the references for each spectrum in sufficient detail to make apparent the sources for at least all major groups of levels. More complete references, and references for several types of data not included here, are given in several bibliographic publications [Moore, 1968, Hagan and Martin, 1972, Hagan, 1977, Zalubas and Albright, 1980, Fuhr, Miller, and Martin, 1978, Miller, Fuhr, and Martin, 1980]. Our starting point in collecting the references was Moore's *Atomic Energy Levels,* Vol. I.

The symbols following the references indicate types of data or other content according to a code explained in the "Bibliography on Atomic Energy Levels and Spectra" publi-

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cations [Hagan and Martin, 1972]. These symbols are especially useful for references otherwise listed without comment. We note that "EL," "CL," and "IP" refer to energy levels, classified lines, and ionization potentials, respectively, and "PT" and "AT" refer to theoretical results.

The spectroscopic notations used in energy-level compilations of the AEL Data Center have been described fully [Martin, Zalubas, and Hagan, 1978]. This reference also describes the format of the tables in detail and includes material on coupling schemes, eigenvector percentages, allowed terms, and the Zeeman effect. In general we use the notation and conventions outlined there without comment.

The levels are given in units of cm^{-1} with respect to the ground level at zero. Odd-parity levels are printed in italics. The assignment of a set of levels to a term is indicated by grouping the levels and by listing the configuration and term symbol for only the first (lowest) level of the group. Levels within terms are listed in order of position (*not* J value), and terms are listed in order of lowest levels, ungrouped levels being treated as terms.

The "Leading Percentages" column normally gives one or two percentages from a calculated eigenvector for the level. All percentages are rounded off to the nearest percent, and the % symbol is omitted. If the level has a name (under "Configuration" and "Term"), a first percentage not followed by a term symbol is for this name component. A first percentage followed by a term symbol normally represents the largest component in the eigenvector of a level for which no particular name is appropriate, the configuration and parentage for this component being shown under "Configuration." If two percentages are listed without comment, the second percentage is the largest of the remaining percentages from the same eigenvector as the first percentage. The configuration for the second-percentage term is omitted for a level having both percentages from the same configuration. If the levels of a term group also have second percentages from a common (second) term, this second-percentage term is usually printed only for the first level of the group.

Any variation from the above conventions for the Leading Percentages is made obvious by the notation and is mentioned in the comments.

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3. Tables of Energy Levels

Si I

$Z=14$

Ground state $1s^22s^22p^63s^23p^2\ {}^3\mathrm{P}_0$

Ionization energy 65 747.76 ± 0.25 cm^{-1} (8.151 75 ± 0.000 04 eV)

Wavelengths, Levels, Ionization Energy

Radziemski and Andrew [1965] measured 395 Si I lines between 1976 and 12 271 Å, including 192 interferometric determinations. With these data and unpublished vacuum-ultraviolet wavelengths supplied by A. G. Shenstone, they added 80 new levels to those found earlier by Fowler [1929] and Kiess [1938]. The analysis by Radziemski and Andrew also included a number of revisions of the previous theoretical interpretation and reevaluations of the known levels. Litzén measured 102 lines in the infrared region 10 289–25 854 Å and derived improved values for some of the levels [Litzén, 1964, 1966]. Kaufman, Radziemski, and Andrew [1966] measured about 220 Si I lines in the region 1548–2103 Å with improved accuracy (±0.0010 to ±0.003 Å in most cases), the new data leading to an extension and slight revision of the odd-level analysis. These new measurements were finally combined with those by Litzén and by Radziemski and Andrew to obtain optimal values for the then known levels, most with relative uncertainties of ±0.005 to ±0.02 cm^{-1} [Radziemski et al., 1967]. This 1967 paper includes 100 calculated and 41 measured vacuum-ultraviolet wavelengths (1560–1992 Å), all having uncertainties <0.0016 Å and most <0.0010 Å.

Almost all of the levels given here below 64 000 cm^{-1} are from Radziemski et al. [1967]. These authors list the relative uncertainty for each level, the uncertainty of the $^3\mathrm{P}_0$ ground level being ±0.008 cm^{-1} and the uncertainties of the other three-place levels being ±0.005 to ±0.015 cm^{-1}. The three-place value for the $3s3p^3\ {}^5\mathrm{S}^\circ_2$ level (±0.006 cm^{-1}) is from Radziemski and Andrew's remeasurement of the two transitions to the $3s^23p^2\ {}^3\mathrm{P}_1$ and $^3\mathrm{P}_2$ levels that locate this level [El'yashevich and Nikitina, 1956; Shenstone, see Moore, 1958]. Only a few of the two-place levels of Radziemski et al. have uncertainties greater than ±0.04 cm^{-1}. The few odd levels below 64 000 cm^{-1} that are given to only one place have uncertainties of ±0.2 to ±0.4 cm^{-1}. Several of the $3s^23pnf$ levels for $n=5$–7 are from classifications of lines in the solar spectrum by Lambert and Warner [1968]; the uncertainties are about ±0.05 to ±0.10 cm^{-1}.

Brown et al. [1974] observed the absorption spectrum of Si I from 1517 to 1882 Å and classified most of the lines as transitions from $3s^23p^2\ {}^3\mathrm{P}$ or $^1\mathrm{D}$ ground-configuration levels to $3s^23pns$ and $3s^23pnd$ upper levels having high n values. Further analysis by Brown, Tilford, and Ginter [1975] yielded about 60 additional high levels. Assumption of electric-dipole selection rules limited the upper levels of these transitions to odd-parity levels with J values 0, 1, 2, or 3. The dense group of high odd $3pns$ and $3pnd$ levels given here are from these two references, the highest level of these series also observed in emission being the $J=3$ level at 64 662 cm^{-1}. The absorption-spectra data also included additional levels and several revisions of the earlier analyses in the overlap region, beginning with the nominal $3p6d\ {}^3\mathrm{D}^\circ_2$ level at 62 774.99 cm^{-1}.

The uncertainty of most of the levels from the absorption spectra is estimated to be 0.20 cm^{-1} or less [Brown et al., 1974], the values of most of the levels given by both Brown et al. and Radziemski et al. disagreeing by less than 0.10 cm^{-1}. We have in some cases taken averages of the values from these two references. The higher levels given to one place have larger uncertainties, being derived from weak or blended absorption lines. The high density of the upper $3pns$ and $3pnd$ level system gave a fairly large number of coincidences of two or more levels to within the experimental uncertainty. In general, however, we have given a single position for two different (theoretical) series members only if the level values listed by Brown et al. coincide exactly or if the two values were derived from the same set of observed lines.

Brown et al. [1974] obtained a value of 66 035.00 ± 0.21 cm^{-1} for the Si II $3s^23p\ {}^2\mathrm{P}^\circ_{3/2}$ limit from the longest and least perturbed of the series observed by them, the transitions to the upper levels here designated $3p({}^2\mathrm{P}^\circ_{3/2})nd$ $({}^3/_2,\ {}^5/_2)^\circ_3$. This value and the value for the Si II $3s^23p\ {}^2\mathrm{P}^\circ_{3/2}$–$^2\mathrm{P}^\circ_{1/2}$ ground-term interval, 287.242 ± 0.015 cm^{-1} [see Si II], yields the principal ionization energy given above. Our slight increase of the uncertainty might include the effects of any systematic line shifts (pressure effects, etc.).

A few levels are given well above the upper of the two Si II $3s^23p\ {}^2\mathrm{P}^\circ$ limits (the $^2\mathrm{P}^\circ_{3/2}$ limit). Shenstone found the $3s3p^3\ {}^3\mathrm{S}^\circ_1$ level from transitions to all three of the $^3\mathrm{P}$ ground-term levels (1255–1259 Å), and he derived the $3s3p^24s\ {}^5\mathrm{P}$ and $3s3p^23d\ {}^5\mathrm{P}$ levels by classifying a three-line group for each term as the multiplet of transitions to the $3s3p^3\ {}^5\mathrm{S}^\circ_2$ level [Moore, 1958; Radziemski and Andrew, 1965]. The levels of both $^5\mathrm{P}$ terms have been adjusted to agree with the most accurate measurements of the corresponding lines. Esteva, Mehlman-Balloffet, and Romand classified five vacuum-ultraviolet absorption features as $3s^23p^2\ {}^3\mathrm{P}$—$3s3p^2({}^4\mathrm{P})np\ {}^3\mathrm{D}^\circ$

transitions ($n=4$–8; 944–1085 Å). No fine structures were resolved, probably because of autoionization broadening. We list the first two of the corresponding $^3\mathrm{D}^\circ$ terms ($n=4$, 5) tentatively, pending a more complete interpretation of the Si absorption spectrum in this region. The $3s^23p^2\ ^3\mathrm{P}$ baricenter at 150 cm^{-1} has been assumed as the appropriate lower term position in deriving these $^3\mathrm{D}^\circ$ positions to the nearest 10 cm^{-1}.

Theoretical Interpretation, Even Levels

The $3s^23p^2$ ground configuration has high *LS*-coupling purity, the $^3\mathrm{P}_2$, $^1\mathrm{D}_2$ and $^3\mathrm{P}_0$, $^1\mathrm{S}_0$ intermediate-coupling admixtures being only 0.030% and 0.019%, respectively [Garstang, 1951].

The $3s^23pnp$ and $3s^23pnf$ levels are grouped into terms of the coupling schemes adopted by Radziemski and Andrew. The average purities of most of these configurations in one or more coupling schemes were quoted by Radziemski and Andrew, but eigenvector percentages for the individual levels were not listed. The $3pnp$ levels were assigned J_1j designations for $n \geqslant 6$, and $J_1 l$ coupling was found to be appropriate for all the $3pnf$ configurations.

The $3p(^2\mathrm{P}^\circ_{1/2})nf\ ^2[7/2]$ term is higher than the $(^2\mathrm{P}^\circ_{1/2})\ ^2[5/2]$ term for $n=4$ and 5, but crosses to a position just below the $^2[5/2]$ term for $n=6$. Cowan has pointed out that the observed order of these terms for $n=6$ is that expected for pure $J_1 l$ coupling; his recalculations of the $3pnf$ configurations verified that the $J=3$ levels of these two lower pairs change order between $n=5$ and 6, in agreement with the designations by Radziemski and Andrew.

The $3p7f$ levels are given here with the pair assignments that best match Cowan's predictions, but the resulting order of the two $(^2\mathrm{P}^\circ_{1/2})\ ^2[5/2]$ levels is inverted from the predicted order. These levels and the $(^2\mathrm{P}^\circ_{1/2})7f\ ^2[7/2]_3$ level are listed with question marks. We have omitted the $3pnf$ levels based on solar lines for $n \geqslant 8$ [Lambert and Warner], pending a more complete excitation and analysis of this part of the Si I spectrum in the laboratory.

Theoretical Interpretation, Odd Levels

Almost all of the known odd levels belong to the group of configurations $3s3p^3 + 3s^23pms + 3s^23pnd$ ($m \geqslant 4$, $n \geqslant 3$). Most of the leading percentages given here are from material furnished by Cowan, who has recently calculated the levels of these configurations up through $ms=7s$ and $nd=12d$, with all configuration interactions included. The percentages for the three lowest $^3\mathrm{D}^\circ$ terms are from a calculation by Tatewaki.

The leading percentages for the $3s^23pns$ levels in *LS* coupling are given up through $3p7s$. Since the $3pns$ levels for $n \geqslant 6$ are paired according to J_1j-coupling designations of the $3p(^2\mathrm{P}^\circ_{J_1})ns_{1/2}$ type, the appropriate *LS* term symbol $^1\mathrm{P}^\circ$ or $^3\mathrm{P}^\circ$ is given after the first percentage for the $3p6s$ and $3p7s$ levels. The $3p6s$ and, especially, the $3p7s$ percentages are probably less accurate than the percentages for the lower $3pns$ levels because of the omission of still higher $3pns$ configurations from the calculation.

The $3s3p^3$ configuration extends from the lowest odd term ($^5\mathrm{S}^\circ_2$ at 33 326 cm^{-1}) to three terms predicted to lie above the limit, $^1\mathrm{D}^\circ_2$ (predicted at ~79 300 cm^{-1}), $^3\mathrm{S}^\circ_1$ (predicted at ~80 100 cm^{-1}) and $^1\mathrm{P}^\circ_1$ (predicted at ~84 500 cm^{-1}) [Cowan, 1981]. The predicted $^3\mathrm{S}^\circ_1$ position is sufficiently close to the level Shenstone found at 79 664 cm^{-1} to support his identification. The $^1\mathrm{P}^\circ_1$ and $^1\mathrm{D}^\circ_2$ levels have not been found, possibly because of large autoionization widths. The strengths of the two intercombination resonance lines $3s^23p^2\ ^3\mathrm{P}_{1,2}$—$3s3p^3\ ^5\mathrm{S}^\circ_2$ are determined by a small $3s3p^3\ ^3\mathrm{P}^\circ_2$ component in the eigenvector of the $^5\mathrm{S}^\circ_2$ level [Garstang and Dawe, 1962]; Cowan's calculation gives the value 0.0027% for the mixing percentage.

The interactions of the $3s3p^3\ ^3\mathrm{D}^\circ$ and $^3\mathrm{P}^\circ$ terms with the lower $3s^23pnd\ ^3\mathrm{D}^\circ$ and $^3\mathrm{P}^\circ$ terms, respectively, give rise to by far the largest deviations from single-configuration approximations in the lower part of the odd-level structure. Several different calculations are in broad agreement that the composition of the lowest $^3\mathrm{D}^\circ$ term (~45 300 cm^{-1}) comprises roughly comparable $3s3p^3$ and (total) $3s^23pnd$ contributions [Radziemski and Andrew; Aymar; Tatewaki; Cowan]. The compositions of the lowest few $^3\mathrm{D}^\circ$ terms obtained by Tatewaki from a large configuration-interaction calculation using natural orbitals should be accurate, since these terms have high *LS*-coupling purity and are fairly well separated from possible perturbing levels with significant (intermediate-coupling) $^3\mathrm{D}^\circ$ components not included in the calculation. His results support $3s3p^3$ as the best single-configuration designation for the lowest $^3\mathrm{D}^\circ$ term, as originally suggested by Shenstone [Moore, 1958].

Eigenvector percentages followed by notations of the type "$3pnd\ ^3\mathrm{D}^\circ$" are given for many of the odd levels, including those belonging to several $^3\mathrm{D}^\circ$ terms. Such percentages represent the total $3s^23pnd$ character of a particular *LS* type summed over all the *nd* orbitals included in the calculation ($3 \leqslant n \leqslant 13$ in Tatewaki's calculation; $3 \leqslant n \leqslant 12$ in Cowan's calculation). Our quoting of such $3pnd$ sums as the first percentages for many levels having specific $3pnd$ series labels ($3p3d$, $3p4d$, etc.) in the first column serves to emphasize that the labels may have little significance except as a convenient ordering of the series members.

The $3s3p^3\ ^3\mathrm{D}^\circ$ and $3s^23pnd\ ^3\mathrm{D}^\circ$ percentages account for 94 to 95% of the total composition of each of the three lowest $^3\mathrm{D}^\circ$ terms according to Tatewaki's calculation, with the remaining 5 or 6% being contributed by various configurations having $3s$ excitation (other than $3s3p^3$) that were not included in Cowan's calculation. The inclusion of such configurations would be much less important for most of the levels calculated by Cowan than spin-orbit effects omitted by Tatewaki; the second percentages for the nominal $3p5d$, $3p6d$, and $3p7d\ ^3\mathrm{D}^\circ$ levels from Cowan's results illustrate this point, and meaningful $^3\mathrm{D}^\circ$ designations for most of the best candidate levels to continue this series above $n=7$ were precluded by strong admixtures of other *LS* term types in the eigenvectors.

The $3s3p^3\ ^3\mathrm{P}^\circ$ composition is distributed along a series of terms all having mainly $3s^23pnd\ ^3\mathrm{P}^\circ$ character, so that $3s3p^3\ ^3\mathrm{P}^\circ$ is inappropriate as a term designation. The second term of this series (near 56 700 cm^{-1}) has the largest $3s3p^3\ ^3\mathrm{P}^\circ$ percentage, but has a total $3pnd\ ^3\mathrm{P}^\circ$ percentage of about 73% according to Cowan's calculation; this term is here named by the dominant component, $3p4d$ ^{3}P°, which is seen to contribute 50% of the composition. Only the total $3pnd$ ^{3}P° percentages are listed for the third and higher members of this ^{3}P° series. The third term (near 60 000 cm^{-1}), which has large $3p4d$ and $3p5d$ components but no appropriate series name, is here labeled "*a* ^{3}P°". The fourth and higher terms are labeled $3p5d$, $3p6d$, etc., these particular configuration names constituting more than 50% of the $^3\mathrm{P}^\circ_0$ composition in each case. Cowan's eigenvectors for the corresponding $J=1$ levels along the series also become purer following this same configuration-labeling scheme. Beginning with $3p8d$, the $J=0$ and $J=1$ levels of the series are assigned to the J_1j-coupling terms $(^2\mathrm{P}^\circ_{3/2})nd_{3/2}$ $(^3/_2,^3/_2)^\circ$ (see below). The n values for the $3pnd$ configuration assignments of these higher series members agree with those of Radziemski and Andrew (as revised and extended by Brown et al.), but Radziemski and Andrew's "$3s3p^3$ ^{3}P°" and "$3p4d$ ^{3}P°" terms are here designated "$3p4d$ ^{3}P°" and "*a* ^{3}P°", respectively. Cowan's results on the configurational compositions of the lower members of this series agree qualitatively with the results obtained by Tatewaki and Sasaki [1978], who noted that the $3s3p^3$ contribution to any one of the series members was insufficient to justify a $3s3p^3$ ^{3}P° designation.

As mentioned above, Cowan's eigenvectors for some of the higher $3s^23pnd$ levels included in his calculation indicate that particular *LS* term designations are inappropriate even after summation of the different $3pnd$ contributions. In a multichannel quantum-defect treatment of the higher $3pnd$ series members, Brown et al. [1975] found channel-mixing perturbations among the four $3pnd$ channels for $J=2$ and between two of the three channels for $J=3$. Such levels are tabulated here with their $3s^23pnd$ configurational character in the first column but without term names (the lowest level of this type is at 63 770 cm^{-1}, $J=2$). Total *LS* term percentages from Cowan are given for such levels up to energies where the eigenvectors probably become significantly affected by termination of the included series members (up to about $n=10$). No channel-mixing percentages were derived in the quantum-defect analysis.

The specific $3pnd$ series designations based on total *LS* character are continued to $3p10d$ for the $^3\mathrm{F}^\circ_2$ series, the nominal members for $n\geqslant 7$ having formerly been designated $^1\mathrm{D}^\circ_2$. The eigenvector assignments yielding the new designations are supported by optimal agreement of the predictions with the experimental energies and with the observed relative intensities of absorption transitions from the ground-configuration levels. The designations for the $3pnd$ $^1\mathrm{D}^\circ_2$ series are continued through $n=8$ by a corresponding reassignment of the former $^3\mathrm{F}^\circ_2$ levels for $n=7$ and 8. The $J=3$ level of the $3p9d$ ^{3}F° term as derived from Cowan's predictions was formerly designated $^1\mathrm{F}^\circ_3$.

The higher members of five of the $3pnd$ series are relatively unperturbed, these being the $J=0$ series, the three $J=1$ series, and one of the $J=3$ series [Brown et al., 1974, Brown et al., 1975]. Beginning with $3p8d$ or $3p9d$, we have assigned these levels to J_1j-coupling terms, $3p(^2\mathrm{P}^\circ_{J_1})nd_j$ $(J_1,j)^\circ$, with the following correlations to the LS designations of Brown et al.:

J_1j Term	J	*LS* Term
$(^1/_2,^3/_2)^\circ$	1	^{1}P°
$(^3/_2,^3/_2)^\circ$	1,0	^{3}P°
$(^3/_2,^5/_2)^\circ$	1,3	^{3}D°

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Si I

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3s^2 3p^2$	^{3}P	0	0.000				
		1	77.115				
		2	223.157				
$3s^2 3p^2$	^{1}D	2	6 298.850				
$3s^2 3p^2$	^{1}S	0	15 394.370				
~~$3s3p^3$~~	~~^{5}S°~~	~~2~~	~~*33 326.053*~~	~~100~~			
$3s^2 3p4s$	^{3}P°	0	*39 683.163*	99			
		1	*39 760.285*	98		1	$3p4s$ ^{1}P°
		2	*39 955.053*	99			
$3s^2 3p4s$	^{1}P°	1	*40 991.884*	97		1	$3p3d$ ^{1}P°
$3s3p^3$	^{3}D°	1	*45 276.188*	56		39	$3pnd$ ^{3}D°
		2	*45 293.629*	56		39	
		3	*45 321.848*	56		39	
$3s^2 3p4p$	^{1}P	1	47 284.061				
$3s^2 3p3d$	^{1}D°	2	*47 351.554*	92		4	$3s3p^3$ ^{1}D°
~~$3s^2 3p4p$~~	~~^{3}D~~	~~1~~	~~48 020.074~~				
		2	48 102.323				
		3	48 264.292				
$3s^2 3p4p$	^{3}P	0	49 028.294				
		1	49 060.601				
		2	49 188.617				
$3s^2 3p4p$	^{3}S	1	49 399.670				
$3s^2 3p3d$	^{3}F°	2	*49 850.830*	98		1	$3p3d$ ^{3}P°
		3	*49 933.775*	99		1	$3p4d$ ^{3}F°
		4	*50 054.80*	99		1	$3p4d$ ^{3}F°
$3s^2 3p4p$	^{1}D	2	50 189.389				
$3s^2 3p3d$	^{3}P°	2	*50 499.838*	81		16	$3s3p^3$ ^{3}P°
		1	*50 566.397*	81		16	
		0	*50 602.44*	81		16	
$3s^2 3p4p$	^{1}S	0	51 612.012				
$3s^2 3p3d$	^{1}F°	3	*53 362.24*	96		3	$3p4d$ ^{1}F°
$3s^2 3p3d$	^{1}P°	1	*53 387.334*	92		3	$3p5s$ ^{1}P°
$3s^2 3p3d$	^{3}D°	1	*54 185.264*	80	$3pnd$ ^{3}D°	14	$3s3p^3$ ^{3}D°
		2	*54 205.090*	80		14	
		3	*54 257.582*	80		14	
$3s^2 3p5s$	^{3}P°	0	*54 245.020*	99		1	$3p3d$ ^{3}P°
		1	*54 313.818*	92		6	$3p5s$ ^{1}P°
		2	*54 528.220*	98		1	$3p4d$ ^{3}P°

Si I—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3s^2\,3p5s$	$^1P^\circ$	1	*54 871.031*	89		6	$3p5s\ ^3P^\circ$
$3s^2\,3p4d$	$^1D^\circ$	2	*56 503.346*	86		4	$3p3d\ ^1D^\circ$
$3s^2\,3p4d$	$^3P^\circ$	2	*56 690.903*	50		26	$3s3p^3\ ^3P^\circ$
		1	*56 700.25*	51		27	
		0	*56 733.38*	50		27	
$3s^2\,3p5p$	^1P	1	56 780.427				
$3s^2\,3p5p$	^3D	1	56 978.256				
		2	57 017.496				
		3	57 198.027				
$3s^2\,3p5p$	^3P	0	57 295.881				
		1	57 328.789				
		2	57 468.239				
$3s^2\,3p4d$	$^3F^\circ$	2	*57 372.297*	96		2	$3p4d\ ^1D^\circ$
		3	*57 450.580*	98		1	$3p3d\ ^3F^\circ$
		4	*57 583.657*	98		1	$3p3d\ ^3F^\circ$
$3s^2\,3p5p$	^3S	1	57 541.918				
$3s^2\,3p5p$	^1D	2	57 798.072				
$3s^2\,3p5p$	^1S	0	58 311.659				
$3s^2\,3p(^2P^\circ_{1/2})4f$	$^2[5/2]$	3	58 774.368				
		2	58 775.451				
$3s^2\,3p(^2P^\circ_{1/2})4f$	$^2[7/2]$	3	58 786.860				
		4	58 788.880				
$3s^2\,3p4d$	$^1P^\circ$	1	*58 801.529*	86		6	$3p6s\ ^1P^\circ$
$3s^2\,3p4d$	$^1F^\circ$	3	*58 893.40*	89		5	$3p5d\ ^1F^\circ$
$3s^2\,3p4d$	$^3D^\circ$	2	*59 032.19*	89	$3pnd\ ^3D^\circ$	5	$3s3p^3\ ^3D^\circ$
		1	*59 056.508*	89		5	
		3	*59 118.03*	89		5	
$3s^2\,3p(^2P^\circ_{3/2})4f$	$^2[7/2]$	3	59 034.988				
		4	59 037.043				
$3s^2\,3p(^2P^\circ_{3/2})4f$	$^2[5/2]$	3	59 109.959				
		2	59 110.892				
$3s^2\,3p(^2P^\circ_{3/2})4f$	$^2[9/2]$	5	59 128.40				
		4	59 131.912				
$3s^2\,3p(^2P^\circ_{3/2})4f$	$^2[3/2]$	1	59 190.46				
		2	59 191.072				
$3s^2\,3p(^2P^\circ_{1/2})6s_{1/2}$	$(1/2,1/2)^\circ$	0	*59 221.11*	99	$^3P^\circ$	1	$3p4d\ ^3P^\circ$
		1	*59 273.575*	86	$^3P^\circ$	11	$3p6s\ ^1P^\circ$
$3s^2\,3p(^2P^\circ_{3/2})6s_{1/2}$	$(3/2,1/2)^\circ$	2	*59 506.359*	95	$^3P^\circ$	2	$3p4d\ ^3P^\circ$
		1	*59 636.667*	79	$^1P^\circ$	12	$3p6s\ ^3P^\circ$

Si I—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3s^2\,3pnd$	a $^3P^\circ$	2	*59 917.336*	77	$3pnd\ ^3P^\circ$	16	$3s3p^3\ ^3P^\circ$
		1	*60 010.458*	80		17	
		0	*60 042.50*	82		17	
$3s^2\,3p5d$	$^1D^\circ$	2	*60 300.860*	76		14	$3p5d\ ^3F^\circ$
$3s^2\,3p(^2P^\circ_{1/2})6p_{1/2}$	$(\frac{1}{2},\frac{1}{2})$	1	60 381.278				
		0	60 621.64				
$3s^2\,3p(^2P^\circ_{1/2})6p_{3/2}$	$(\frac{1}{2},\frac{3}{2})$	1	60 487.103				
		2	60 496.358				
$3s^2\,3p5d$	$^3F^\circ$	2	*60 645.441*	84		12	$3p5d\ ^1D^\circ$
		3	*60 705.464*	96		1	$3p5d\ ^1F^\circ$
		4	*60 848.946*	98		1	$3p4d\ ^3F^\circ$
$3s^2\,3p(^2P^\circ_{3/2})6p_{3/2}$	$(\frac{3}{2},\frac{3}{2})$	3	60 704.53				
		1	60 706.558				
		2	60 962.105				
		0	61 198.036				
$3s^2\,3p(^2P^\circ_{3/2})6p_{1/2}$	$(\frac{3}{2},\frac{1}{2})$	2	60 815.925				
		1	60 856.630				
$3s^2\,3p(^2P^\circ_{1/2})5f$	$^2[\frac{5}{2}]$	3	61 303.381				
		2	61 304.283				
$3s^2\,3p(^2P^\circ_{1/2})5f$	$^2[\frac{7}{2}]$	3	61 305.050				
		4	61 306.713				
$3s^2\,3p5d$	$^1P^\circ$	1	*61 305.67*	73		9	$3p7s\ ^1P^\circ$
$3s^2\,3p5d$	$^1F^\circ$	3	*61 423.23*	76		8	$3p6d\ ^1F^\circ$
$3s^2\,3p5d$	$^3D^\circ$	2	*61 447.86*	82	$3pnd\ ^3D^\circ$	13	$3pnd\ ^3P^\circ$
		1	*61 511.77*	57		25	$3p7s\ ^3P^\circ$
		3	*61 574.814*	87		8	$3p5d\ ^1F^\circ$
$3s^2\,3p(^2P^\circ_{1/2})7s_{1/2}$	$(\frac{1}{2},\frac{1}{2})^\circ$	0	*61 538.05*	100	$^3P^\circ$		
		1	*61 595.43*	56	$^3P^\circ$	24	$3pnd\ ^3D^\circ$
$3s^2\,3p(^2P^\circ_{3/2})5f$	$^2[\frac{7}{2}]$	3	61 562.477				
		4	61 563.952				
$3s^2\,3p(^2P^\circ_{3/2})5f$	$^2[\frac{5}{2}]$	3	61 597.404				
		2	61 598.145				
$3s^2\,3p(^2P^\circ_{3/2})5f$	$^2[\frac{9}{2}]$	5	61 614.37				
		4	61 617.17				
$3s^2\,3p(^2P^\circ_{3/2})5f$	$^2[\frac{3}{2}]$	1	61 647.36				
		2	61 647.875				
$3s^2\,3p(^2P^\circ_{3/2})7s_{1/2}$	$(\frac{3}{2},\frac{1}{2})^\circ$	2	*61 823.550*	92	$^3P^\circ$	3	$3p5d\ ^3P^\circ$
		1	*61 881.60*	65	$^1P^\circ$	15	$3p7s\ ^3P^\circ$
$3s^2\,3p5d$	$^3P^\circ$	2	*61 841.94*	72	$3pnd\ ^3P^\circ$	12	$3pnd\ ^3D^\circ$
		1	*61 936.13*	80		7	$3s3p^3\ ^3P^\circ$
		0	*61 960.26*	92		8	$3s3p^3\ ^3P^\circ$

Si I—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3s^2\,3p(^2\mathrm{P}^\circ_{1/2})7p_{1/2}$	$(1/2,1/2)$	1	62 141.8				
		0	62 318.7				
$3s^2\,3p6d$	$^1\mathrm{D}^\circ$	2	*62 156.816*	49		42	$3p6d\ ^3\mathrm{F}^\circ$
$3s^2\,3p(^2\mathrm{P}^\circ_{1/2})7p_{3/2}$	$(1/2,3/2)$	1	62 226.39				
		2	62 231.99				
$3s^2\,3p6d$	$^3\mathrm{F}^\circ$	2	*62 349.93*	54		38	$3p6d\ ^1\mathrm{D}^\circ$
		3	*62 376.820*	92		3	$3p6d\ ^1\mathrm{F}^\circ$
		4	*62 534.08*	98		1	$3p5d\ ^3\mathrm{F}^\circ$
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})7p_{3/2}$	$(3/2,3/2)$	3	62 421.03				
		1	62 450.4				
		2	62 596.32				
		0	62 718.99				
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})7p_{1/2}$	$(3/2,1/2)$	2	62 519.66				
		1	62 545.10				
$3s^2\,3p6d$	$^1\mathrm{P}^\circ$	1	*62 666.25*	58		27	$3pnd\ ^3\mathrm{D}^\circ$
$3s^2\,3p(^2\mathrm{P}^\circ_{1/2})6f$	$^2[7/2]$	3	62 667.823				
		4	62 669.179				
$3s^2\,3p(^2\mathrm{P}^\circ_{1/2})6f$	$^2[5/2]$	3	62 669.164				
		2	62 669.727				
$3s^2\,3p6d$	$^3\mathrm{D}^\circ$	2	*62 774.99*	65	$3pnd\ ^3\mathrm{D}^\circ$	29	$3pnd\ ^3\mathrm{P}^\circ$
		1	*62 925.80*	63		28	$3p6d\ ^1\mathrm{P}^\circ$
		3	*62 936.14*	78		16	$3p6d\ ^1\mathrm{F}^\circ$
$3s^2\,3p6d$	$^1\mathrm{F}^\circ$	3	*62 802.86*	61		12	$3p6d\ ^3\mathrm{D}^\circ$
$3s^2\,3p(^2\mathrm{P}^\circ_{1/2})8s_{1/2}$	$(1/2,1/2)^\circ$	0	*62 806.65*				
		1	*62 813.26*				
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})6f$	$^2[7/2]$	3	62 935.76				
		4	62 936.81				
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})6f$	$^2[5/2]$	3	62 954.46				
		2	62 955.00				
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})6f$	$^2[9/2]$	5	62 966.61				
		4	62 968.49				
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})6f$	$^2[3/2]$	1	62 985.96				
		2	62 986.32				
$3s^2\,3p6d$	$^3\mathrm{P}^\circ$	2	*63 020.42*	61	$3pnd\ ^3\mathrm{P}^\circ$	30	$3pnd\ ^3\mathrm{D}^\circ$
		1	*63 097.36*	87		8	$3pnd\ ^3\mathrm{D}^\circ$
		0	*63 123.36*	95		4	$3s3p^3\ ^3\mathrm{P}^\circ$
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})8s_{1/2}$	$(3/2,1/2)^\circ$	2	*63 093.41*				
		1	*63 130.49*				
$3s^2\,3p7d$	$^3\mathrm{F}^\circ$	2	*63 204.89*	60		30	$3p7d\ ^1\mathrm{D}^\circ$
		3	*63 340.70*	86		5	$3p7d\ ^1\mathrm{F}^\circ$
		4	*63 514.533*	98		1	$3p6d\ ^3\mathrm{F}^\circ$

Si I—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3s^2 3p(^2P^\circ_{1/2})8p_{3/2}$	$(\frac{1}{2},\frac{3}{2})$	2	63 225.5				
$3s^2 3p7d$	$^1D^\circ$	2	*63 356.24*	54		34	$3p7d\ ^3F^\circ$
$3s^2 3p7d$	$^1P^\circ$	1	*63 486.93*	50		34	$3pnd\ ^3D^\circ$
$3s^2 3p(^2P^\circ_{1/2})7f$	$^2[\frac{7}{2}]$	3	63 488.01?				
		4	63 488.91				
$3s^2 3p(^2P^\circ_{1/2})7f$	$^2[\frac{5}{2}]$	2	63 489.44?				
		3	63 490.66?				
$3s^2 3p7d$	$^3D^\circ$	2	*63 575.35*	51	$3pnd\ ^3D^\circ$	39	$3pnd\ ^3P^\circ$
		1	*63 750.39*	51		38	$3p7d\ ^1P^\circ$
		3	*63 760.24*	69		23	$3p7d\ ^1F^\circ$
$3s^2 3p(^2P^\circ_{1/2})9s_{1/2}$	$(\frac{1}{2},\frac{1}{2})^\circ$	0	*63 576.85*				
		1	*63 584.22*				
$3s^2 3p(^2P^\circ_{3/2})8p_{3/2}$	$(\frac{3}{2},\frac{3}{2})$	0	63 618.6				
$3s^2 3p7d$	$^1F^\circ$	3	*63 641.77*	62	$3pnd\ ^1F^\circ$	24	$3pnd\ ^3D^\circ$
$3s^2 3p(^2P^\circ_{3/2})7f$	$^2[\frac{7}{2}]$	3	63 762.20				
		4	63 762.93				
$3s^2 3pnd$		2	*63 770.28*	35	$3pnd\ ^3P^\circ$	31	$3pnd\ ^3D^\circ$
$3s^2 3p(^2P^\circ_{3/2})7f$	$^2[\frac{5}{2}]$	3	63 773.29				
		2	63 773.58				
$3s^2 3p(^2P^\circ_{3/2})7f$	$^2[\frac{9}{2}]$	5	63 781.97				
		4	63 783.31				
$3s^2 3p(^2P^\circ_{3/2})7f$	$^2[\frac{3}{2}]$	1	63 793.52				
		2	63 794.31				
$3s^2 3p7d$	$^3P^\circ$	1	*63 844.65*	81	$3pnd\ ^3P^\circ$	12	$3pnd\ ^3D^\circ$
		0	*63 863.80?*	97		3	$3s3p^3\ ^3P^\circ$
$3s^2 3p8d$	$^3F^\circ$	2	*63 860.44*	51		13	$3p8d\ ^1D^\circ$
		3	*63 945.10*	76		6	$3p8d\ ^1F^\circ$
		4	*64 133.93*	98		1	$3p7d\ ^3F^\circ$
$3s^2 3p(^2P^\circ_{3/2})9s_{1/2}$	$(\frac{3}{2},\frac{1}{2})^\circ$	2	*63 863.84*				
		1	*63 884.61*				
$3s^2 3p8d$	$^1D^\circ$	2	*63 990.67*	54		21	$3p8d\ ^3F^\circ$
$3s^2 3p8d$	$^1P^\circ$	1	*64 020.42*	49	$3pnd\ ^1P^\circ$	40	$3pnd\ ^3D^\circ$
$3s^2 3p(^2P^\circ_{1/2})10s_{1/2}$	$(\frac{1}{2},\frac{1}{2})^\circ$	0	*64 079.74*				
		1	*64 085.87*				
$3s^2 3pnd$		2	*64 104.88*	40	$3pnd\ ^3P^\circ$	38	$3pnd\ ^3D^\circ$
$3s^2 3p8d$	$^1F^\circ$	3	*64 187.80*	48	$3pnd\ ^1F^\circ$	26	$3pnd\ ^3F^\circ$

Si I—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3s^2\,3p9d$	$^3F^\circ$	2	*64 243.30*	57		19	$3p9d\ ^1D^\circ$
		3	*64 351.93*	60		8	$3p8d\ ^3D^\circ$
		4	*64 550.37?*	98		1	$3p8d\ ^3F^\circ$
$3s^2\,3p(^2P^\circ_{3/2})8d_{5/2}$	$(3/2,5/2)^\circ$	1	*64 287.43*	50	$3pnd\ ^1P^\circ$	42	$3pnd\ ^3D^\circ$
		3	*64 295.26*	60	$3pnd\ ^3D^\circ$	38	$3pnd\ ^1F^\circ$
~~$3s^2\,3pnd$~~		~~2~~	~~*64 322.71*~~	~~40~~	~~$3pnd\ ^3D^\circ$~~	~~37~~	~~$3pnd\ ^3P^\circ$~~
$3s^2\,3p(^2P^\circ_{3/2})8d_{3/2}$	$(3/2,3/2)^\circ$	1	*64 337.81*	78	$3pnd\ ^3P^\circ$	18	$3pnd\ ^3D^\circ$
		0	*64 358.52*	98	$3pnd\ ^3P^\circ$	2	$3s3p^3\ ^3P^\circ$
$3s^2\,3p(^2P^\circ_{3/2})10s_{1/2}$	$(3/2,1/2)^\circ$	2	*64 366.68*				
		1	*64 376.18*				
$3s^2\,3p(^2P^\circ_{1/2})9d_{3/2}$	$(1/2,3/2)^\circ$	1	*64 393.66*	42	$3pnd\ ^3D^\circ$	42	$3pnd\ ^1P^\circ$
$3s^2\,3pnd$		2	*64 398.19*	38	$3pnd\ ^1D^\circ$	30	$3pnd\ ^3P^\circ$
$3s^2\,3p(^2P^\circ_{1/2})11s_{1/2}$	$(1/2,1/2)^\circ$	0	*64 425.97*				
		1	*64 432.03*				
$3s^2\,3pnd$		2	*64 488.72*	42	$3pnd\ ^1D^\circ$	29	$3pnd\ ^3P^\circ$
$3s^2\,3p10d$	$^3F^\circ$	2	*64 553.46*	68		16	$3p10d\ ^1D^\circ$
$3s^2\,3p(^2P^\circ_{1/2})10d_{3/2}$	$(1/2,3/2)^\circ$	1	*64 635.82*				
~~$3s^2\,3pnd$~~		~~2~~	~~*64 646.73*~~				
$3s^2\,3pnd$		3	*64 647.46*				
$3s^2\,3p(^2P^\circ_{3/2})9d_{5/2}$	$(3/2,5/2)^\circ$	1	*64 654.97*				
		3	*64 662.04*				
$3s^2\,3p(^2P^\circ_{1/2})12s_{1/2}$	$(1/2,1/2)^\circ$	0	*64 674.61*				
		1	*64 678.93*				
$3s^2\,3pnd$		2	*64 687.77*				
$3s^2\,3p(^2P^\circ_{3/2})9d_{3/2}$	$(3/2,3/2)^\circ$	1	*64 699.46*				
		0	*64 703.23*	99	$3pnd\ ^3P^\circ$	1	$3s3p^3\ ^3P^\circ$
$3s^2\,3p(^2P^\circ_{3/2})11s_{1/2}$	$(3/2,1/2)^\circ$	2	*64 713.05*				
		1	*64 723.88*				
$3s^2\,3pnd$		2	*64 758.61*				
$3s^2\,3pnd$		3	*64 795.43*				
$3s^2\,3pnd$		2	*64 795.56*				
$3s^2\,3p(^2P^\circ_{1/2})11d_{3/2}$	$(1/2,3/2)^\circ$	1	*64 832.70*				
$3s^2\,3pnd$		2	*64 855.48*				
$3s^2\,3p(^2P^\circ_{1/2})13s_{1/2}$	$(1/2,1/2)^\circ$	0	*64 859.23*				
		1	*64 861.02*				
$3s^2\,3pnd$		3	*64 881.45*				
$3s^2\,3pnd$		2	*64 916.64*				
$3s^2\,3p(^2P^\circ_{3/2})10d_{5/2}$	$(3/2,5/2)^\circ$	1	*64 920.15*				
		3	*64 923.97*				
$3s^2\,3pnd$		2	*64 943.94*				
$3s^2\,3p(^2P^\circ_{3/2})10d_{3/2}$	$(3/2,3/2)^\circ$	1	*64 946.12*				
		0	*64 952.58*				
$3s^2\,3p(^2P^\circ_{3/2})12s_{1/2}$	$(3/2,1/2)^\circ$	2	*64 961.67*				
		1	*64 967.34*				

Si I—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3s^2\,3pnd$		3	*64 965.03*	
$3s^2\,3pnd$		2	*64 982.37*	
$3s^2\,3p(^2P^\circ_{1/2})12d_{3/2}$	$(1/2,3/2)^\circ$	1	*64 982.42*	
$3s^2\,3p(^2P^\circ_{1/2})14s_{1/2}$	$(1/2,1/2)^\circ$	0 1	*65 000.11* *65 002.16*	
$3s^2\,3pnd$		2	*65 025.30*	
$3s^2\,3pnd$		2	*65 055.82*	
$3s^2\,3p(^2P^\circ_{1/2})13d_{3/2}$	$(1/2,3/2)^\circ$	1	*65 092.05*	
$3s^2\,3pnd$		2	*65 099.38*	
$3s^2\,3pnd$		3	*65 102.52*	
$3s^2\,3p(^2P^\circ_{1/2})15s_{1/2}$	$(1/2,1/2)^\circ$	1 0	*65 108.74* *65 109.47*	
$3s^2\,3p(^2P^\circ_{3/2})11d_{5/2}$	$(3/2,5/2)^\circ$	1 3	*65 116.72* *65 117.65*	
$3s^2\,3pnd$		2	*65 125.26*	
$3s^2\,3p(^2P^\circ_{3/2})11d_{3/2}$	$(3/2,3/2)^\circ$	1 0	*65 135.28* *65 138.22*	
$3s^2\,3p(^2P^\circ_{3/2})13s_{1/2}$	$(3/2,1/2)^\circ$	2 1	*65 146.14* *65 151.67*	
$3s^2\,3pnd$		2	*65 152.74*	
$3s^2\,3pnd$		3	*65 170.67*	
$3s^2\,3pnd$		2	*65 177.70*	
$3s^2\,3p(^2P^\circ_{1/2})14d_{3/2}$	$(1/2,3/2)^\circ$	1	*65 184.24*	
$3s^2\,3p(^2P^\circ_{1/2})16s_{1/2}$	$(1/2,1/2)^\circ$	0 1	*65 196.82* *65 197.98*	
$3s^2\,3pnd$		2	*65 203.73*	
$3s^2\,3pnd$		3	*65 226.60*	
$3s^2\,3pnd$		2	*65 231.21*	
$3s^2\,3p(^2P^\circ_{1/2})15d_{3/2}$	$(1/2,3/2)^\circ$	1	*65 255.31*	
$3s^2\,3pnd$		2	*65 258.33*	
$3s^2\,3pnd$		3	*65 258.83*	
$3s^2\,3p(^2P^\circ_{3/2})12d_{5/2}$	$(3/2,5/2)^\circ$	1 3	*65 261.50* *65 264.91*	
$3s^2\,3p(^2P^\circ_{1/2})17s_{1/2}$	$(1/2,1/2)^\circ$	0 1	*65 267.35* *65 268.80*	
$3s^2\,3pnd$		2	*65 272.41*	
$3s^2\,3p(^2P^\circ_{3/2})12d_{3/2}$	$(3/2,3/2)^\circ$	1 0	*65 278.23* *65 280.10*	
$3s^2\,3p(^2P^\circ_{3/2})14s_{1/2}$	$(3/2,1/2)^\circ$	2 1	*65 287.04* *65 291.26*	
$3s^2\,3pnd$		2	*65 295.03*	
$3s^2\,3pnd$		3	*65 307.30*	

Si I—Continued

Configuration	Term	*J*	Level (cm^{-1})	Leading percentages
$3s^2 3pnd$		2	*65 311.78*	
$3s^2 3p(^2P^\circ_{1/2})16d_{3/2}$	$(\frac{1}{2},\frac{3}{2})^\circ$	1	*65 316.57*	
$3s^2 3p(^2P^\circ_{1/2})18s_{1/2}$	$(\frac{1}{2},\frac{1}{2})^\circ$	0	*65 324.68*	
		1	*65 325.82*	
$3s^2 3pnd$		2	*65 330.38*	
$3s^2 3pnd$		2	*65 349.50*	
$3s^2 3pnd$		3	*65 349.72*	
$3s^2 3p(^2P^\circ_{1/2})17d_{3/2}$	$(\frac{1}{2},\frac{3}{2})^\circ$	1	*65 365.05*	
$3s^2 3pnd$		2	*65 368.23*	
$3s^2 3pnd$		3	*65 369.94*	
$3s^2 3p(^2P^\circ_{1/2})19s_{1/2}$	$(\frac{1}{2},\frac{1}{2})^\circ$	1	*65 372.80*	
		0	*65 372.98*	
$3s^2 3p(^2P^\circ_{3/2})13d_{5/2}$	$(\frac{3}{2},\frac{5}{2})^\circ$	1	*65 378.02*	
		3	*65 379.19*	
$3s^2 3pnd$		2	*65 382.18*	
$3s^2 3p(^2P^\circ_{3/2})13d_{3/2}$	$(\frac{3}{2},\frac{3}{2})^\circ$	1	*65 388.96*	
		0	*65 390.89*	
$3s^2 3pnd$		2	*65 393.91*	
$3s^2 3p(^2P^\circ_{3/2})15s_{1/2}$	$(\frac{3}{2},\frac{1}{2})^\circ$	2	*65 396.73*	
		1	*65 399.60*	
$3s^2 3pnd$		3	*65 402.24*	
$3s^2 3pnd$		2	*65 407.15*	
$3s^2 3p(^2P^\circ_{1/2})18d_{3/2}$	$(\frac{1}{2},\frac{3}{2})^\circ$	1	*65 407.72*	
$3s^2 3p(^2P^\circ_{1/2})20s_{1/2}$	$(\frac{1}{2},\frac{1}{2})^\circ$	0	*65 413.38*	
		1	*65 414.0*	
$3s^2 3pnd$		2	*65 423.14*	
$3s^2 3pnd$		3	*65 433.14*	
$3s^2 3pnd$		2	*65 433.17*	
$3s^2 3p(^2P^\circ_{1/2})19d_{3/2}$	$(\frac{1}{2},\frac{3}{2})^\circ$	1	*65 441.93*	
$3s^2 3pnd$		2	*65 446.05*	
$3s^2 3p(^2P^\circ_{1/2})21s_{1/2}$	$(\frac{1}{2},\frac{1}{2})^\circ$	0	*65 447.45*	
		1	*65 447.6*	
$3s^2 3pnd$		3	*65 453.23*	
$3s^2 3pnd$		2	*65 460.22*	
$3s^2 3p(^2P^\circ_{3/2})14d_{5/2}$	$(\frac{3}{2},\frac{5}{2})^\circ$	1	*65 468.0*	
		3	*65 471.53*	
$3s^2 3pnd$		3	*65 469.78*	
$3s^2 3pnd$		2	*65 470.7*	
$3s^2 3p(^2P^\circ_{1/2})20d_{3/2}$	$(\frac{1}{2},\frac{3}{2})^\circ$	1	*65 472.0*	
$3s^2 3p(^2P^\circ_{3/2})14d_{3/2}$	$(\frac{3}{2},\frac{3}{2})^\circ$	1	*65 478.35*	
$3s^2 3pnd$		2		
$3s^2 3p(^2P^\circ_{3/2})14d_{3/2}$	$(\frac{3}{2},\frac{3}{2})^\circ$	0	*65 479.14*	

Si I—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3s^2\,3p(^2P^\circ_{3/2})16s_{1/2}$	$(^3/_2,^1/_2)^\circ$	2 1	*65 483.96* *65 486.67*	
$3s^2\,3pnd$		2	*65 488.40*	
$3s^2\,3pnd$		3	*65 494.05*	
$3s^2\,3pnd$		2	*65 496.59*	
$3s^2\,3p(^2P^\circ_{1/2})21d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1	*65 497.91*	
$3s^2\,3pnd$		2	*65 506.81*	
$3s^2\,3pnd$		2	*65 514.3*	
$3s^2\,3pnd$		3		
$3s^2\,3p(^2P^\circ_{1/2})22d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1	*65 519.93*	
$3s^2\,3pnd$		2	*65 522.63*	
$3s^2\,3pnd$		3	*65 528.19*	
$3s^2\,3pnd$		2	*65 532.0*	
$3s^2\,3p(^2P^\circ_{1/2})23d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1	*65 539.72*	
$3s^2\,3pnd$		2	*65 539.81*	
$3s^2\,3pnd$		3	*65 539.99*	
$3s^2\,3p(^2P^\circ_{3/2})15d_{5/2}$	$(^3/_2,^5/_2)^\circ$	1 3	*65 541.20* *65 543.02*	
$3s^2\,3pnd$		2	*65 545.28*	
$3s^2\,3p(^2P^\circ_{3/2})15d_{3/2}$	$(^3/_2,^3/_2)^\circ$	1 0	*65 549.05* *65 550.33*	
$3s^2\,3pnd$		2	*65 551.13*	
$3s^2\,3p(^2P^\circ_{3/2})17s_{1/2}$	$(^3/_2,^1/_2)^\circ$	2 1	*65 554.50* *65 557.35*	
$3s^2\,3pnd$		3	*65 554.77*	
$3s^2\,3p(^2P^\circ_{1/2})24d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1	*65 555.69*	
$3s^2\,3pnd$		2	*65 557.07*	
$3s^2\,3pnd$		2	*65 565.03*	
$3s^2\,3pnd$		3	*65 568.83*	
$3s^2\,3pnd$		2	*65 569.53*	
$3s^2\,3p(^2P^\circ_{1/2})25d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1	*65 571.35*	
$3s^2\,3pnd$		2	*65 575.9*	
$3s^2\,3pnd$		2	[*65 580.7*]	
$3s^2\,3pnd$		3	[*65 580.9*]	
$3s^2\,3p(^2P^\circ_{1/2})26d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1	*65 584.8*	
$3s^2\,3pnd$		2	*65 586.30*	
$3s^2\,3pnd$		3	*65 590.06*	
$3s^2\,3pnd$		2	*65 592.12*	
$3s^2\,3p(^2P^\circ_{1/2})27d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1	*65 596.21*	
$3s^2\,3pnd$		2	*65 597.05*	

Si I—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3s^2\,3pnd$		3	65 597.73	
$3s^2\,3pnd$		2	65 601.9	
$3s^2\,3p(^2P^\circ_{3/2})16d_{5/2}$	$(^3/_2,^5/_2)^\circ$	1		
$3s^2\,3p(^2P^\circ_{3/2})16d_{5/2}$	$(^3/_2,^5/_2)^\circ$	3	65 602.64	
$3s^2\,3pnd$		2	65 605.56	
$3s^2\,3pnd$		3	65 606.56	
$3s^2\,3p(^2P^\circ_{3/2})16d_{3/2}$	$(^3/_2,^3/_2)^\circ$	1	65 608.44	
$3s^2\,3p(^2P^\circ_{1/2})28d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1		
$3s^2\,3p(^2P^\circ_{3/2})16d_{3/2}$	$(^3/_2,^3/_2)^\circ$	0	65 608.63	
$3s^2\,3pnd$		2	[65 609.1]	
$3s^2\,3p(^2P^\circ_{3/2})18s_{1/2}$	$(^3/_2,^1/_2)^\circ$	2	65 612.24	
		1	65 613.95	
$3s^2\,3pnd$		2	[65 613.3]	
$3s^2\,3pnd$		3	65 615.61	
$3s^2\,3p(^2P^\circ_{1/2})29d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1	65 616.3	
$3s^2\,3pnd$		2	65 616.84	
$3s^2\,3pnd$		2	65 621.6	
$3s^2\,3pnd$		3	65 623.93	
$3s^2\,3pnd$		2	65 624.28	
$3s^2\,3p(^2P^\circ_{1/2})30d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1	65 625.2	
$3s^2\,3pnd$		2	65 628.3	
$3s^2\,3pnd$		2	65 630.9	
$3s^2\,3pnd$		3		
$3s^2\,3p(^2P^\circ_{1/2})31d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1	65 633.15	
$3s^2\,3pnd$		2	65 634.5	
$3s^2\,3pnd$		2	65 637.1	
$3s^2\,3pnd$		3	[65 637.9]	
$3s^2\,3p(^2P^\circ_{1/2})32d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1	65 640.16	
$3s^2\,3pnd$		2	65 640.7	
$3s^2\,3pnd$		3	65 642.79	
$3s^2\,3pnd$		2	65 644.03	
$3s^2\,3p(^2P^\circ_{1/2})33d_{3/2}$	$(^1/_2,^3/_2)^\circ$	1	65 646.6	
$3s^2\,3pnd$		2	65 646.99	
$3s^2\,3pnd$		3	65 647.43	
$3s^2\,3pnd$		2	65 649.95	
$3s^2\,3p(^2P^\circ_{3/2})17d_{5/2}$	$(^3/_2,^5/_2)^\circ$	1	65 651.30	
$3s^2\,3pnd$		2	65 652.19	

Si I—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3s^2\,3pnd$		3	*65 652.39*	
$3s^2\,3p(^2P^\circ_{3/2})17d_{5/2}$	$(3/2,5/2)^\circ$	3		
$3s^2\,3p(^2P^\circ_{1/2})34d_{3/2}$	$(1/2,3/2)^\circ$	1	*65 652.4*	
$3s^2\,3pnd$		2	*65 654.15*	
$3s^2\,3p(^2P^\circ_{3/2})17d_{3/2}$	$(3/2,3/2)^\circ$	1	*65 656.3*	
$3s^2\,3pnd$		2		
$3s^2\,3p(^2P^\circ_{3/2})17d_{3/2}$	$(3/2,3/2)^\circ$	0	*65 657.24*	
$3s^2\,3pnd$		3	*65 657.50*	
$3s^2\,3p(^2P^\circ_{1/2})35d_{3/2}$	$(1/2,3/2)^\circ$	1	*65 658.0*	
$3s^2\,3pnd$		2	[*65 658.6*]	
$3s^2\,3p(^2P^\circ_{3/2})19s_{1/2}$	$(3/2,1/2)^\circ$	2	*65 660.26*	
$3s^2\,3pnd$		2	*65 660.9*	
$3s^2\,3p(^2P^\circ_{3/2})19s_{1/2}$	$(3/2,1/2)^\circ$	1	*65 662.00*	
$3s^2\,3pnd$		3		
$3s^2\,3p(^2P^\circ_{1/2})36d_{3/2}$	$(1/2,3/2)^\circ$	1	[*65 662.7*]	
$3s^2\,3pnd$		2	*65 662.80*	
$3s^2\,3pnd$		2	[*65 665.4*]	
$3s^2\,3pnd$		3	*65 666.8*	
$3s^2\,3pnd$		2	*65 667.2*	
$3s^2\,3p(^2P^\circ_{1/2})37d_{3/2}$	$(1/2,3/2)^\circ$	1	*65 667.26*	
$3s^2\,3pnd$		2	*65 669.8*	
$3s^2\,3pnd$		3	*65 670.71*	
$3s^2\,3pnd$		2	*65 670.91*	
$3s^2\,3p(^2P^\circ_{1/2})38d_{3/2}$	$(1/2,3/2)^\circ$	1	*65 671.4*	
$3s^2\,3pnd$		2	*65 672.98*	
$3s^2\,3pnd$		3	[*65 674.4*]	
$3s^2\,3p(^2P^\circ_{1/2})39d_{3/2}$	$(1/2,3/2)^\circ$	1	*65 675.30*	
$3s^2\,3pnd$		3	*65 678.0*	
$3s^2\,3p(^2P^\circ_{1/2})40d_{3/2}$	$(1/2,3/2)^\circ$	1	*65 678.99*	
$3s^2\,3pnd$		3	[*65 681.1*]	
$3s^2\,3p(^2P^\circ_{1/2})41d_{3/2}$	$(1/2,3/2)^\circ$	1	*65 682.2*	
$3s^2\,3pnd$		3	[*65 683.7*]	
$3s^2\,3p(^2P^\circ_{1/2})42d_{3/2}$	$(1/2,3/2)^\circ$	1	[*65 685.2*]	
$3s^2\,3pnd$		3	*65 686.5*	
$3s^2\,3p(^2P^\circ_{1/2})43d_{3/2}$	$(1/2,3/2)^\circ$	1	*65 688.15*	
$3s^2\,3pnd$		3	*65 688.72*	
$3s^2\,3p(^2P^\circ_{1/2})44d_{3/2}$	$(1/2,3/2)^\circ$	1	*65 690.9*	
$3s^2\,3pnd$		3	*65 691.07*	

Si I—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3s^2\,3p(^2P^\circ_{3/2})18d_{5/2}$	$(3/2,5/2)^\circ$	1	65 693.00	
		3	65 693.90	
$3s^2\,3pnd$		3	[65 693.2]	
$3s^2\,3pnd$		2	65 695.2	
$3s^2\,3pnd$		3	65 695.74	
$3s^2\,3p(^2P^\circ_{3/2})18d_{3/2}$	$(3/2,3/2)^\circ$	1	65 697.47	
		0	65 697.58	
$3s^2\,3p(^2P^\circ_{3/2})20s_{1/2}$	$(3/2,1/2)^\circ$	1	65 701.56	
$3s^2\,3p(^2P^\circ_{3/2})19d_{5/2}$	$(3/2,5/2)^\circ$	1	65 728.30	
		3	65 728.86	
$3s^2\,3pnd$		2	65 730.40	
$3s^2\,3p(^2P^\circ_{3/2})19d_{3/2}$	$(3/2,3/2)^\circ$	1	65 732.27	
		0	65 732.30	
$3s^2\,3p(^2P^\circ_{3/2})21s_{1/2}$	$(3/2,1/2)^\circ$	1	65 736.06	
…………	…………	…………	…………	
Si II ($^2P^\circ_{1/2}$)	*Limit*		**65 747.76**	
~~$3s^2\,3p(^2P^\circ_{3/2})20d_{5/2}$~~	~~$(3/2,5/2)^\circ$~~	~~3~~	~~65 758.86~~	
$3s^2\,3pnd$		2	65 760.50	
$3s^2\,3p(^2P^\circ_{3/2})20d_{3/2}$	$(3/2,3/2)^\circ$	1	65 761.36	
$3s^2\,3p(^2P^\circ_{3/2})22s_{1/2}$	$(3/2,1/2)^\circ$	1	65 764.03	
$3s^2\,3p(^2P^\circ_{3/2})21d_{5/2}$	$(3/2,5/2)^\circ$	3	65 784.65	
$3s^2\,3pnd$		2	65 786.0	
$3s^2\,3p(^2P^\circ_{3/2})21d_{3/2}$	$(3/2,3/2)^\circ$	1	65 786.90	
$3s^2\,3p(^2P^\circ_{3/2})23s_{1/2}$	$(3/2,1/2)^\circ$	1	65 789.56	
$3s^2\,3p(^2P^\circ_{3/2})22d_{5/2}$	$(3/2,5/2)^\circ$	3	65 806.94	
$3s^2\,3pnd$		2	65 807.9	
$3s^2\,3p(^2P^\circ_{3/2})22d_{3/2}$	$(3/2,3/2)^\circ$	1	65 808.80	
$3s^2\,3p(^2P^\circ_{3/2})24s_{1/2}$	$(3/2,1/2)^\circ$	1	65 811.24	
$3s^2\,3p(^2P^\circ_{3/2})23d_{5/2}$	$(3/2,5/2)^\circ$	3	65 826.36	
$3s^2\,3pnd$		2	65 827.3	
$3s^2\,3p(^2P^\circ_{3/2})23d_{3/2}$	$(3/2,3/2)^\circ$	1	65 827.98	
$3s^2\,3p(^2P^\circ_{3/2})24d_{5/2}$	$(3/2,5/2)^\circ$	3	65 843.45	
$3s^2\,3p(^2P^\circ_{3/2})24d_{3/2}$	$(3/2,3/2)^\circ$	1	65 844.50	
$3s^2\,3p(^2P^\circ_{3/2})25d_{5/2}$	$(3/2,5/2)^\circ$	3	65 858.50	
$3s^2\,3p(^2P^\circ_{3/2})25d_{3/2}$	$(3/2,3/2)^\circ$	1	65 859.72	
$3s^2\,3p(^2P^\circ_{3/2})26d_{5/2}$	$(3/2,5/2)^\circ$	3	65 871.88	
$3s^2\,3p(^2P^\circ_{3/2})26d_{3/2}$	$(3/2,3/2)^\circ$	1	65 872.83	
$3s^2\,3p(^2P^\circ_{3/2})27d_{5/2}$	$(3/2,5/2)^\circ$	3	65 883.80	
$3s^2\,3p(^2P^\circ_{3/2})27d_{3/2}$	$(3/2,3/2)^\circ$	1	65 884.68	

Si I—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})28d_{3/2}$	$(3/2,3/2)^\circ$	1	65 894.14	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})28d_{5/2}$	$(3/2,5/2)^\circ$	3	65 894.52	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})29d_{5/2}$	$(3/2,5/2)^\circ$	3	65 904.12	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})29d_{3/2}$	$(3/2,3/2)^\circ$	1	65 904.47	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})30d_{5/2}$	$(3/2,5/2)^\circ$	3	65 912.60	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})30d_{3/2}$	$(3/2,3/2)^\circ$	1	65 913.13	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})31d_{3/2}$	$(3/2,3/2)^\circ$	1	65 920.18	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})31d_{5/2}$	$(3/2,5/2)^\circ$	3	65 920.45	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})32d_{5/2}$	$(3/2,5/2)^\circ$	3	65 927.37	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})32d_{3/2}$	$(3/2,3/2)^\circ$	1	65 927.50	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})33d_{5/2}$	$(3/2,5/2)^\circ$	3	65 933.95	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})33d_{3/2}$	$(3/2,3/2)^\circ$	1	65 934.45	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})34d_{5/2}$	$(3/2,5/2)^\circ$	3	65 939.75	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})34d_{3/2}$	$(3/2,3/2)^\circ$	1	65 939.96	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})35d_{3/2}$	$(3/2,3/2)^\circ$	1	65 945.16	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})35d_{5/2}$	$(3/2,5/2)^\circ$	3	65 945.19	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})36d_{5/2}$	$(3/2,5/2)^\circ$	3	65 950.17	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})36d_{3/2}$	$(3/2,3/2)^\circ$	1	65 950.26	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})37d_{5/2}$	$(3/2,5/2)^\circ$	3	65 954.76	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})37d_{3/2}$	$(3/2,3/2)^\circ$	1	65 954.87	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})38d_{5/2}$	$(3/2,5/2)^\circ$	3	65 958.80	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})38d_{3/2}$	$(3/2,3/2)^\circ$	1	65 959.06	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})39d_{5/2}$	$(3/2,5/2)^\circ$	3	65 962.63	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})39d_{3/2}$	$(3/2,3/2)^\circ$	1	65 962.72	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})40d_{3/2}$	$(3/2,3/2)^\circ$	1	65 966.17	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})40d_{5/2}$	$(3/2,5/2)^\circ$	3	65 966.22	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})41d_{5/2}$	$(3/2,5/2)^\circ$	3	65 969.54	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})41d_{3/2}$	$(3/2,3/2)^\circ$	1	65 969.58	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})42d_{5/2}$	$(3/2,5/2)^\circ$	3	65 972.57	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})42d_{3/2}$	$(3/2,3/2)^\circ$	1	65 972.64	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})43d_{5/2}$	$(3/2,5/2)^\circ$	3	65 975.36	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})43d_{3/2}$	$(3/2,3/2)^\circ$	1	65 975.41	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})44d_{3/2}$	$(3/2,3/2)^\circ$	1	65 978.19	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})44d_{5/2}$	$(3/2,5/2)^\circ$	3		
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})45d_{3/2}$	$(3/2,3/2)^\circ$	1	65 980.66	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})45d_{5/2}$	$(3/2,5/2)^\circ$	3	65 980.95	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})46d_{5/2}$	$(3/2,5/2)^\circ$	3	65 982.98	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})46d_{3/2}$	$(3/2,3/2)^\circ$	1	65 983.38	
$3s^2\,3p(^2\mathrm{P}^\circ_{3/2})47d_{5/2}$	$(3/2,5/2)^\circ$	3	65 985.09	

Si I—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3s^2\,3p(^2P^\circ_{3/2})47d_{3/2}$	$(3/2,3/2)^\circ$	1	*65 985.23*	
$3s^2\,3p(^2P^\circ_{3/2})48d_{5/2}$	$(3/2,5/2)^\circ$	3	*65 987.29*	
$3s^2\,3p(^2P^\circ_{3/2})48d_{3/2}$	$(3/2,3/2)^\circ$	1	*65 987.41*	
$3s^2\,3p(^2P^\circ_{3/2})49d_{5/2}$	$(3/2,5/2)^\circ$	3	*65 989.29*	
$3s^2\,3p(^2P^\circ_{3/2})49d_{3/2}$	$(3/2,3/2)^\circ$	1	*65 989.36*	
$3s^2\,3p(^2P^\circ_{3/2})50d_{5/2}$	$(3/2,5/2)^\circ$	3	*65 990.87*	
$3s^2\,3p(^2P^\circ_{3/2})50d_{3/2}$	$(3/2,3/2)^\circ$	1	*65 991.07*	
$3s^2\,3p(^2P^\circ_{3/2})51d_{5/2}$	$(3/2,5/2)^\circ$	3	*65 992.59*	
$3s^2\,3p(^2P^\circ_{3/2})52d_{5/2}$	$(3/2,5/2)^\circ$	3	*65 994.30*	
$3s^2\,3p(^2P^\circ_{3/2})53d_{5/2}$	$(3/2,5/2)^\circ$	3	*65 995.81*	
$3s^2\,3p(^2P^\circ_{3/2})54d_{5/2}$	$(3/2,5/2)^\circ$	3	*65 997.34*	
$3s^2\,3p(^2P^\circ_{3/2})55d_{5/2}$	$(3/2,5/2)^\circ$	3	*65 998.59*	
$3s^2\,3p(^2P^\circ_{3/2})56d_{5/2}$	$(3/2,5/2)^\circ$	3	*66 000.05*	
Si II $(^2P^\circ_{3/2})$	*Limit*		*66 035.00*	
$3s3p^3$	$^3S^\circ$	1	*79 664.0*	100
$3s3p^2(^4P)4s$	^5P	1	81 724.6	
		2	81 826.2	
		3	81 976.16	
$3s3p^2(^4P)4p$	$^3D^\circ$?	1,2,3	*92 330*	
$3s3p^2(^4P)3d$	^5P	3	94 291.73	
		2	94 365.59	
		1	94 413.01	
$3s3p^2(^4P)5p$	$^3D^\circ$?	1,2,3	*100 430*	

Si II

$Z=14$

Al I isoelectronic sequence

Ground state $1s^2 2s^2 2p^6 3s^2 3p\ {}^2\mathrm{P}^\circ_{1/2}$

Ionization energy 131 838.14 ± 0.30 cm^{-1} (16.345 98 ± 0.000 06 eV)

Shenstone observed this spectrum as emitted by several different sources and greatly extended the earlier analyses to classify about 400 lines in the range 711–9413 Å. All but one of the levels given here are from Shenstone's analysis, the values having been adjusted on the basis of more recent measurements of greater accuracy.

Kaufman and Ward remeasured several Si II wavelengths, mainly the basic transitions to the ground ${}^2\mathrm{P}^\circ$ levels from the even doublets in the region 1304–1817 Å. The new observations were later extended to other Si II lines, and the redetermined levels differed slightly from the values derived by Kaufman and Ward [Kaufman, 1973, Kaufman and Edlén, 1974]. On the basis of these results, we have reduced Shenstone's values for the excited doublet levels by 0.26 cm^{-1} and his values for the quartet levels by 0.06 cm^{-1}. ~~The high-excitation $3s3p(^3\mathrm{P}^\circ)4f$ levels were adjusted dif-~~ferently, since the positions of several of these levels were based on transitions to both doublet and quartet lower odd levels. The relative positions within this group have been retained by reducing each level by 0.2 cm^{-1}.

Kaufman and Ward give the ground ${}^2\mathrm{P}^\circ$ interval as 287.242±0.015 cm^{-1}, and the uncertainties of most of the two-place excited levels are between ±0.03 and ±0.10 cm^{-1}. The accuracies of the other levels are limited by larger uncertainties in the wavelengths, in some cases due to autoionization broadening or possible Stark shifts in some of the sources used by Shenstone. Errors of several cm^{-1} would not be surprising for some of the levels, and the uncertainty of the very broad (autoionizing) $3s3p(^3\mathrm{P}^\circ)4p\ {}^2\mathrm{D}$ term at 136 800 cm^{-1} is probably of the order of 100 cm^{-1} (see below).

The effects of several configuration interactions in each parity group were noted by Shenstone. The largest such interaction between the lower configurations, a strong mixing of the $3s3p^2$ and $3s^2 3d\ {}^2\mathrm{D}$ terms, almost cancels the oscillator strength of the nominal $3s^2 3p\ {}^2\mathrm{P}^\circ$—$3s3p^2\ {}^2\mathrm{D}$ resonance lines [Fischer, 1976, 1981]. The leading percentages given for the $3s^2 3p\ {}^2\mathrm{P}^\circ$, $3s^2 4p\ {}^2\mathrm{P}^\circ$, $3s3p^2\ {}^2\mathrm{D}$, $3s^2 3d\ {}^2\mathrm{D}$, $3s^2 4d\ {}^2\mathrm{D}$, and $3s^2 4f\ {}^2\mathrm{F}^\circ$ levels are unpublished multiconfiguration Hartree-Fock results obtained by Fischer [1981] in calculations of the lifetimes of low-lying levels in this isoelectronic sequence. The percentages for the $3s^2 4s\ {}^2\mathrm{S}$ and $3s^2 5s\ {}^2\mathrm{S}$ levels were calculated with the superposition-of-configurations method [Fischer, 1968].

An extension of such calculations to higher configurations would be useful. For example, significant interactions between certain terms of the odd-parity group $3p^3$, $3s3pnd$, and $3s3pms$, can be expected, the principal configurations for some of these terms as given here being questionable. Crossley's suggestion that the $3p^3\ {}^2\mathrm{D}^\circ$ and $3s3p(^3\mathrm{P}^\circ)3d\ {}^2\mathrm{D}^\circ$ designations be reversed has not been adopted, however; as he points out, configuration assignments made according to the leading components in calculated multiconfigurational eigenvectors would not necessarily agree with assignments by his isoelectronic method.

Shenstone derived the principal ionization energy by fitting a Ritz formula to the $3s^2(^1\mathrm{S})ng\ {}^2\mathrm{G}$ series for $n=5$ through 10. His value has been lowered by 0.26 cm^{-1} in accordance with the adjustment described above. The formula fits the $ng\ {}^2\mathrm{G}$ terms to within ±0.10 cm^{-1}, but the accuracy of the derived ionization energy may be limited by systematic effects such as possible Stark shifts; the error ~~listed above is only our order-of-magnitude estimate.~~

With the exception of the $3p^3\ {}^2\mathrm{D}^\circ$ and ${}^2\mathrm{P}^\circ$ levels, the known levels above the principal ionization limit belong to terms based on the Si III $3s3p\ {}^3\mathrm{P}^\circ$ limit. All the configurations located by Shenstone in this region, as well as several other configurations, were included in calculations carried out by Petrini to predict Si II autoionization resonances [Artru et al., 1981]. The calculated position and autoionization width for the $3s3p(^3\mathrm{P}^\circ)4p\ {}^2\mathrm{D}$ term are in agreement with classification of a broad absorption feature observed at 731 Å [Esteva, 1979] as the transition $3s^2 3p\ {}^2\mathrm{P}^\circ$—$3s3p(^3\mathrm{P}^\circ)4p\ {}^2\mathrm{D}$. Since the calculated width is 1200 cm^{-1}, the experimental position is given to the nearest 100 cm^{-1} only and is followed by "*a*" to indicate strong autoionization. The observed feature is assumed to be an inherently blended doublet, the calculated ${}^2\mathrm{D}_{5/2}$–${}^2\mathrm{D}_{3/2}$ interval being only 125 cm^{-1} [Artru et al.]. Magnusson and Zetterberg suggested deletion of Shenstone's level for $3s3p(^3\mathrm{P}^\circ)4p\ {}^2\mathrm{D}_{5/2}$. The corresponding weakly established ${}^2\mathrm{D}_{3/2}$ level is also omitted here, the suggested reassignment to $3s3p(^3\mathrm{P}^\circ)4p\ {}^2\mathrm{S}_{1/2}$ appearing unlikely because the calculated autoionization width of the latter level is 46 cm^{-1} [Artru et al.]. We have also omitted four other levels in this region, following suggestions of Artru et al. and/or Magnusson and Zetterberg.

The $3s3p(^3\mathrm{P}^\circ)4f$ levels are arranged in LS_1-coupling pairs, based on a calculation by Wyart [1980]. The leading percentages in *LS* coupling are also listed, following the word "or." Three interchanges of Shenstone's *LS* term assignments are implied, but in each case the eigenvectors have highly mixed compositions. The tentative level at 157 186.6 cm^{-1} ($J=3/2$) has been omitted as being too far from the corresponding calculated position for the $3s3p(^3P^\circ)4f$ D $^2[2]_{3/2}$ level. The level at 156 811.0 cm^{-1} apparently comprises both levels of the $3s3p(^3P^\circ)4f$ G $^2[4]_{7/2,9/2}$ pair; Shenstone interpreted this level as two "indistinguishably close" levels of the ^{4}G term.

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Si II

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3s^2(^1S)3p$	$^2P^\circ$	1/2	*0.00*	94	3	$3p^3\ ^2P^\circ$
		3/2	*287.24*	94	3	
$3s3p^2$	^4P	1/2	42 824.29			
		~~3/2~~	~~42 932.62~~			
		5/2	43 107.91			
$3s3p^2$	^2D	3/2	55 309.35	66	30	$3s^2(^1S)3d\ ^2D$
		5/2	55 325.18	66	30	
$3s^2(^1S)4s$	^2S	1/2	65 500.47	95	5	$3p^2(^1S)4s\ ^2S$
$3s3p^2$	^2S	1/2	76 665.35			
$3s^2(^1S)3d$	^2D	3/2	79 338.50	68	26	$3s3p^2\ ^2D$
		5/2	79 355.02	68	26	
$3s^2(^1S)4p$	$^2P^\circ$	1/2	*81 191.34*	94	4	$3p^2(^1S)4p\ ^2P^\circ$
		3/2	*81 251.32*	94	4	
$3s3p^2$	^2P	1/2	83 801.95			
		3/2	84 004.26			
$3s^2(^1S)5s$	^2S	1/2	97 972.09	95	5	$3p^2(^1S)5s\ ^2S$
$3s^2(^1S)4d$	^2D	3/2	101 023.05	92	4	$3p^2(^1S)4d\ ^2D$
		5/2	101 024.35	92	4	
$3s^2(^1S)4f$	$^2F^\circ$	7/2	*103 556.03*	95	4	$3p^2(^1S)4f\ ^2F^\circ$
		5/2	*103 556.16*	95	4	
$3s^2(^1S)5p$	$^2P^\circ$	1/2	*103 860.74*			
		3/2	*103 885.25*			
$3s3p(^3P^\circ)3d$	$^2D^\circ$	3/2	*108 778.7*			
		5/2	*108 820.6*			
$3s^2(^1S)6s$	^2S	1/2	111 184.46			
$3s^2(^1S)5d$	^2D	3/2	112 394.56			
		5/2	112 394.72			

Si II—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3s^2(^1S)5f$	$^2F^\circ$	7/2	*113 760.15*	
		5/2	*113 760.32*	
$3s^2(^1S)6p$	$^2P^\circ$	1/2	*113 962.08*	
		3/2	*113 976.72*	
$3s^2(^1S)5g$	^2G	7/2,9/2	114 177.1	
$3s3p(^3P^\circ)3d$	$^4F^\circ$	3/2	*114 265.64*	
		5/2	*114 327.15*	
		7/2	*114 414.58*	
		9/2	*114 529.14*	
$3s3p(^3P^\circ)4s$	$^4P^\circ$	1/2	*116 862.38*	
		3/2	*116 978.38*	
		5/2	*117 178.06*	
$3s^2(^1S)7s$	^2S	1/2	117 914.80	
$3s^2(^1S)6d$	^2D	3/2	118 522.86	
		5/2	118 522.93	
$3s^2(^1S)7p$	$^2P^\circ$	1/2	*119 245.22*	
		3/2	*119 273.81*	
$3s^2(^1S)6f$	$^2F^\circ$	7/2	*119 311.19*	
		5/2	*119 311.34*	
$3s^2(^1S)6g$	^2G	7/2,9/2	119 578.23	
$3s3p(^3P^\circ)4s$	$^2P^\circ$	1/2	*121 444.12*	
		3/2	*121 590.19*	
$3s^2(^1S)8s$	^2S	1/2	121 814.38	
$3s^2(^1S)7d$	^2D	3/2	122 163.48	
		5/2	122 163.54	
$3s^2(^1S)7f$	$^2F^\circ$	7/2	*122 655.25*	
		5/2	*122 655.37*	
$3s^2(^1S)7g$	^2G	7/2,9/2	122 835.13	
$3p^3$	$^4S^\circ$	3/2	*123 033.5*	
$3s^2(^1S)8p$	$^2P^\circ$	1/2	*123 097.63*	
		3/2	*123 138.67*	
$3s^2(^1S)9s$	^2S	1/2	124 276.7	
$3s3p(^3P^\circ)3d$	$^4D^\circ$	5/2	*124 316.9*	
		3/2	*124 325.3*	
		1/2	*124 337.3*	
		7/2	*124 449.5*	
$3s^2(^1S)8d$	^2D	3/2,5/2	124 495.7	

Si II—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3s3p(^3P^\circ)3d$	$^4P^\circ$	5/2 3/2 1/2	*124 567.4* *124 615.6* *124 638.9*	
$3s^2(^1S)8f$	$^2F^\circ$	7/2 5/2	*124 822.08* *124 822.14*	
$3s^2(^1S)8g$	^2G	7/2,9/2	124 948.40	
$3s^2(^1S)9p$	$^2P^\circ$	1/2 3/2	*125 024.9* *125 033.7*	
$3s3p(^3P^\circ)3d$	$^2P^\circ$	3/2 1/2	*126 236.4* *126 279.0*	
$3s^2(^1S)9f$	$^2F^\circ$	5/2,7/2	*126 304.82*	
$3s^2(^1S)9g$	^2G	7/2,9/2	126 396.47	
$3s^2(^1S)10p$	$^2P^\circ$	3/2 1/2	*126 525.8* *126 545.4*	
$3s^2(^1S)10f$	$^2F^\circ$	5/2,7/2	*127 363.50*	
$3s^2(^1S)10g$	^2G	7/2,9/2	127 432.02	
$3s^2(^1S)11f$	$^2F^\circ$	5/2,7/2	*128 145.35*	
$3s^2(^1S)11g$	^2G	7/2,9/2	128 197.9	
$3s3p(^3P^\circ)3d$	$^2F^\circ$	5/2 7/2	*131 677.1* *131 918.8*	
$3s3p(^3P^\circ)4p$	^4D	1/2 3/2 5/2 7/2	131 784.9 131 861.93 131 988.05 132 162.29	
……	……	……	……	
Si III ($^1S_0$)	***Limit***		**131 838.14**	
$3s3p(^3P^\circ)4p$	^2P	1/2 3/2	132 592.1 132 676.2	
$3s3p(^3P^\circ)4p$	^4P	1/2 3/2 5/2	134 016.90 134 079.00 134 213.63	
$3s3p(^3P^\circ)4p$	^4S	3/2	134 905.28	
$3p^3$	$^2D^\circ$	5/2 3/2	*135 297.3* *135 303.5*	
$3s3p(^3P^\circ)4p$	^2D	3/2,5/2	136 800 *a*	
$3p^3$	$^2P^\circ$	3/2 1/2	*143 982.6* *144 004.0*	

Si II—Continued

Configuration	Term	*J*	Level (cm^{-1})	Leading percentages
$3s3p(^3\mathrm{P}^\circ)4d$	$^2\mathrm{D}^\circ$	3/2	*149 871.2*	
		5/2	*149 928.0*	
$3s3p(^3\mathrm{P}^\circ)5s$	$^4\mathrm{P}^\circ$	1/2	*150 321.8*	
		3/2	*150 442.5*	
		5/2	*150 657.5*	
$3s3p(^3\mathrm{P}^\circ)4d$	$^4\mathrm{F}^\circ$	3/2	*151 077.5*	
		5/2	*151 142.1*	
		7/2	*151 239.9*	
		9/2	*151 377.8*	
$3s3p(^3\mathrm{P}^\circ)4d$	$^4\mathrm{D}^\circ$	1/2	*152 418.1*	
		3/2	*152 431.6*	
		5/2	*152 460.8*	
		7/2	*152 535.5*	
$3s3p(^3\mathrm{P}^\circ)4d$	$^4\mathrm{P}^\circ$	5/2	*153 093.6*	
		3/2	*153 184.3*	
		1/2	*153 233.3*	
$3s3p(^3\mathrm{P}^\circ)4f\,\mathrm{F}$	$^2[2]$	5/2	155 571.7	80 or 92 $^2\mathrm{F}$
		3/2	155 623.1	100 or 100 $^4\mathrm{F}$
$3s3p(^3\mathrm{P}^\circ)4f\,\mathrm{F}$	$^2[3]$	7/2	155 609.9	92 or 50 $^4\mathrm{F}$
		5/2	155 633.5	79 or 92 $^4\mathrm{F}$
$3s3p(^3\mathrm{P}^\circ)4f\,\mathrm{F}$	$^2[4]$	7/2	155 665.9	93 or 51 $^2\mathrm{F}$
		9/2	155 695.0	99 or 99 $^4\mathrm{F}$
$3s3p(^3\mathrm{P}^\circ)4f\,\mathrm{G}$	$^2[3]$	5/2	156 676.1	99 or 99 $^4\mathrm{G}$
		7/2	156 683.0	89 or 72
$3s3p(^3\mathrm{P}^\circ)4f\,\mathrm{G}$	$^2[4]$	7/2 9/2	156 811.0	89 or 73 $^2\mathrm{G}$ 95 or 88 $^4\mathrm{G}$
$3s3p(^3\mathrm{P}^\circ)4f\,\mathrm{G}$	$^2[5]$	11/2	156 955.5	100 or 100 $^4\mathrm{G}$
		9/2	156 963.2	96 or 89 $^2\mathrm{G}$
$3s3p(^3\mathrm{P}^\circ)4f\,\mathrm{D}$	$^2[3]$	5/2	157 191.5?	99 or 75 $^2\mathrm{D}$
		7/2	157 310.7	99 or 99 $^4\mathrm{D}$
$3s3p(^3\mathrm{P}^\circ)4f\,\mathrm{D}$	$^2[2]$	3/2		99 or 55 $^4\mathrm{D}$
		5/2	157 411.2	99 or 75 $^4\mathrm{D}$
$3s3p(^3\mathrm{P}^\circ)4f\,\mathrm{D}$	$^2[1]$	3/2	157 461.1	100 or 56 $^2\mathrm{D}$
		1/2	157 483.8	100 or 100 $^4\mathrm{D}$
$3s3p(^3\mathrm{P}^\circ)5d$	$^4\mathrm{F}^\circ$	9/2	*163 907.5?*	
$3s3p(^3\mathrm{P}^\circ)6s$	$^4\mathrm{P}^\circ$	5/2	*164 110.9?*	
$3s3p(^3\mathrm{P}^\circ)5d$	$^4\mathrm{D}^\circ$	7/2	*164 843.9?*	
$3s3p(^3\mathrm{P}^\circ)5d$	$^4\mathrm{P}^\circ$	5/2	*164 965.9?*	
Si III $3s3p(^3\mathrm{P}^\circ_0)$	*Limit*		*184 562.8*	

Si III

$Z=14$

Mg I isoelectronic sequence

Ground state $1s^22s^22p^63s^2\ {}^1\mathrm{S}_0$

Ionization energy 270 139.3±0.7 cm^{-1} (33.49327±0.00012 eV)

Toresson [1960] extended the observations and analysis of this spectrum to include about 360 classified lines over the range 423–9800 Å. The levels are taken from his paper. Comparisons of Toresson's wavelengths for several Si III lines in the 1100–1300 Å region with more accurate determinations by Kaufman [1968] give some discrepancies of ±0.005 Å, corresponding to wavenumber discrepancies of ±0.3 to ±0.4 cm^{-1}. The comparison suggests possible errors of this order in the values of the excited levels with respect to the ground level and also for differences between excited levels connected only by transitions near the above region. The estimated error decreases to less than 0.2 cm^{-1} for experimental wavenumber differences derived from lines above about 3000 Å (33 000 cm^{-1}) and to less than 0.1 cm^{-1} for differences from lines above 5000 Å (20 000 cm^{-1}).

~~Toresson derived the relative positions of the $3p4f$ and~~ $3p5g$ levels, which lie well above the Si IV $3s\ {}^2\mathrm{S}_{1/2}$ ionization limit, by classifying a group of lines near 4355 Å as $3p4f$—$3p5g$ transitions. These levels are given with question marks because their connection with the rest of the Si III system was derived by Toresson from a single line tentatively classified as $3p3d\ {}^1\mathrm{F}^\circ_3$—$3p({}^2\mathrm{P}^\circ)4f\ \mathrm{F}\ {}^2[{}^7\!/_2]_3$. (The possible $3p5f$ level is also based on a single line.) Three levels not experimentally connected with the rest of the $3p4f$, $5g$ group are given with "$+x$." Toresson's tentative LS_1-coupling designations are given for the $3p4f$, $3p5f$ and $3p5g$ levels, although he also assigns these levels to specific $3p\ {}^2\mathrm{P}^\circ$ parent levels ($J_1\,l$ coupling, $J_1=\frac{1}{2}$ or ${}^3\!/_2$). Toresson notes that the $3p4f$ F and $3p5g$ G° assignments would explain the low autoionization probabilities of these levels, since the available continua for these L values have the wrong parities ($3s\epsilon f$ F° and $3s\epsilon g$ G, respectively).

As in other spectra of the Mg I sequence, many of the known terms in Si III are significantly affected by configuration interactions. Most of the calculations that include such effects have been carried out to obtain theoretical oscillator strengths for the important multiplets [Weiss, 1967, Zare, 1967, Trefftz and Zare, 1969, Victor et al., 1976]. The more strongly mixed eigenvectors for terms included in the available calculations have two to several significant components from the group $3snl+3pn'l'+3pn''l''$, where $l'=l+1$ ($l=s, p$, or d) and $l''=l-1$ ($l=p, d$, or f). The leading percentages for the $3s^2\ {}^1\mathrm{S}$, $3p^2\ {}^1\mathrm{S}$, $3s3p\ {}^1\mathrm{P}^\circ$, and $3p3d\ {}^1\mathrm{P}^\circ$ terms are from Zare's 1967 paper, and those for the $3p^2\ {}^1\mathrm{D}$, $3s3d\ {}^1\mathrm{D}$, $3s4d\ {}^1\mathrm{D}$, $3s3d\ {}^3\mathrm{D}$, and $3s4d\ {}^3\mathrm{D}$ terms are from his 1966 paper.

The percentages from Zare's ${}^1\mathrm{P}^\circ$ eigenvector belonging mainly to $3p3d$ are listed with the level at 235 951 cm^{-1}, and the ${}^1\mathrm{P}^\circ$ level at 228 699 cm^{-1} is nominally assigned to the $3p4s$ configuration; this interchange of Toresson's designations was recommended by Trefftz and Zare [1969] and by Victor et al. [1976]. However, in addition to $3p3d$ and $3p4s$ components, the eigenvectors of these levels have significant $3snp$ components; for example, the second largest component in the eigenvector of the nominal $3p3d\ {}^1\mathrm{P}^\circ$ level calculated by Fischer and Godefroid is 10% $3s6p\ {}^1\mathrm{P}^\circ$ ($3p4s$ was not included), and Trefftz's calculation gave $3s7p$ as the leading configuration for this level [Trefftz and Zare, 1969; these authors list the main configurations in the compositions of a number of perturbed terms but not the numerical eigenvector coefficients.] The percentages for the nominal $3s6p\ {}^1\mathrm{P}^\circ$ level ~~are from Fischer and Godefroid, the second percentage refer-~~ring to the total $3pnd$ character of the level. Fischer and Godefroid note the sensitivity of the eigenvectors to relativistic-shift corrections, and Trefftz and Zare point out the model dependence of the eigenvectors for several terms as obtained from their separate calculations.

Toresson found many perturbations in Si III, including higher $3snl$ series members for which no eigenvectors are available. The fine-structure splittings of the $3s6d\ {}^3\mathrm{D}$ and $3s7d\ {}^3\mathrm{D}$ terms are greater than expected, almost surely owing to interaction with $3p4p\ {}^3\mathrm{D}$. The $3s8d\ {}^3\mathrm{D}_1$ and ${}^3\mathrm{D}_2$ levels are values predicted by Toresson using a fine-structure perturbation formula. The $3s5p\ {}^3\mathrm{P}^\circ$ term is inverted by interaction with $3p3d\ {}^3\mathrm{P}^\circ$.

Toresson's indications of the $3p3d\ {}^3\mathrm{F}^\circ$ and ${}^1\mathrm{F}^\circ$ terms as interacting with the $3snf\ {}^3\mathrm{F}^\circ$ and ${}^1\mathrm{F}^\circ$ series, respectively, have been confirmed by calculations [Trefftz and Zare, 1969, Fischer, 1980, Fischer and Godefroid, 1982]. The leading percentages for the ${}^3\mathrm{F}^\circ$ terms are from Fischer's results, the total $3snf$ character being included in each percentage so labeled. The percentages for the nominal $3s5f\ {}^1\mathrm{F}^\circ$ and $3p3d\ {}^1\mathrm{F}^\circ$ levels are from Fischer and Godefroid. Toresson's $3p3d$ configuration assignment for the upper of these levels (235 414 cm^{-1}) is retained for convenience, even though the calculated composition is seen to be 65% $3snf$.

The four levels of each $3snl$ configuration with $l\geqslant5$ coincide to within the accuracy of the observations. Toresson determined the ionization energy by fitting Ritz and core-polarization formulae to the $3snh$ and $3sni$ series. We have increased the error to include a 0.5 cm^{-1} Stark-effect contribution estimated by Toresson and a 0.4 cm^{-1} error of the terms with respect to the ground level. The estimated (standard-deviation) error of the ionization energy in eV includes the error in cm^{-1} and an approximately equal contribution from the conversion factor.

The $3s7i$, $3s8k$, $3s9k$, and $3s9l$ positions, given here in brackets, are from the polarization formula derived by Toresson.

Lott et al. [1966] measured the g values for several Si III levels using pulsed magnetic fields of ~27 T (270 000 gauss). The experimental values were consistent with theoretical Landé values to within the experimental uncertainties of 1–3%.

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Si III

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3s^2$	$^1\mathrm{S}$	0	0.00	95	5	$3p^2\ ^1\mathrm{S}$
$3s3p$	$^3\mathrm{P}^\circ$	0	*52 724.69*			
		1	*52 853.28*			
		2	*53 115.01*			
$3s3p$	$^1\mathrm{P}^\circ$	1	*82 884.41*	94	5	$3p3d\ ^1\mathrm{P}^\circ$
$3p^2$	$^1\mathrm{D}$	2	122 214.52	65	33	$3s3d\ ^1\mathrm{D}$
$3p^2$	$^3\mathrm{P}$	0	129 708.45			
		1	129 841.97			
		2	130 100.52			
$3s3d$	$^3\mathrm{D}$	3	142 943.74	99		
		2	142 945.84	99		
		1	142 948.25	99		
$3s4s$	$^3\mathrm{S}$	1	153 377.05			
$3p^2$	$^1\mathrm{S}$	0	153 444.23	82	9	$3s4s\ ^1\mathrm{S}$
$3s4s$	$^1\mathrm{S}$	0	159 069.61			
$3s3d$	$^1\mathrm{D}$	2	165 765.00	60	26	$3p^2\ ^1\mathrm{D}$
$3s4p$	$^3\mathrm{P}^\circ$	0	*175 230.01*			
		1	*175 263.10*			
		2	*175 336.26*			
$3s4p$	$^1\mathrm{P}^\circ$	1	*176 487.19*			
$3p3d$	$^3\mathrm{F}^\circ$	2	*198 923.15*	75	25	$3snf\ ^3\mathrm{F}^\circ$
		3	*199 026.49*	75	25	
		4	*199 164.10*	75	25	
$3s4d$	$^3\mathrm{D}$	1	201 597.73	99	1	$3p4p\ ^3\mathrm{D}$
		2	201 598.28	99	1	
		3	201 599.48	99	1	

Si III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
3*s*4*d*	^{1}D	2	204 330.79	86		4	3*p*4*p* ^{1}D
3*s*4*f*	^{1}F°	3	*204 828.06*				
3*p*3*d*	^{1}D°	2	*205 029.09*				
3*s*5*s*	^{3}S	1	206 176.08				
3*s*5*s*	^{1}S	0	207 874.09				
3*s*4*f*	^{3}F°	2	*209 531.40*	77	3*snf*	23	3*p*3*d* ^{3}F°
		3	*209 559.33*	77		23	
		4	*209 599.70*	77		23	
3*s*5*p*	^{1}P°	1	*214 532.17*				
3*s*5*p*	^{3}P°	2	*214 989.27*				
		1	*214 994.65*				
		0	*214 995.46*				
3*p*3*d*	^{3}P°	2	*216 190.24*				
		1	*216 288.69*				
		0	*216 350.26*				
3*p*3*d*	^{3}D°	1	*217 385.77*				
		2	*217 439.92*				
		3	*217 489.49*				
3*s*5*f*	^{1}F°	3	*225 526.33*	55		31	3*pnd* ^{1}F°
3*p*4*s*	^{3}P°	0	*226 400.00*				
		1	*226 527.42*				
		2	*226 820.28*				
3*s*5*d*	^{3}D	1	227 081.19				
		2	227 084.21				
		3	227 088.72				
3*s*5*d*	^{1}D	2	227 665.09				
3*p*4*s*	^{1}P°	1	*228 699.75*				
3*s*6*s*	^{3}S	1	229 623.19				
3*s*5*f*	^{3}F°	2	*230 267.7*	98	3*snf*	1	3*p*3*d* ^{3}F°
		3	*230 268.62*				
		4	*230 270.66*				
3*s*5*g*	^{3}G	3	230 301.22				
		4	230 301.66				
		5	230 302.35				
3*s*5*g*	^{1}G	4	230 302.01				
3*s*6*s*	^{1}S	0	230 364.46				
3*s*6*p*	^{1}P°	1	*234 387.64*	69		28	3*pnd* ^{1}P°

Si III—Continued

Configuration	Term	*J*	Level (cm^{-1})	Leading percentages
3*s*6*p*	^{3}P°	0	*234 415.07*	
		1	*234 428.40*	
		2	*234 442.18*	
3*p*3*d*	^{1}F°	3	*235 413.93*	35 3*pnd* 65 3*snf* ^{1}F°
3*p*3*d*	^{1}P°	1	*235 951.09*	70 16 3*p*4*s* ^{1}P°
3*s*6*d*	^{3}D	1	240 262.28	
		2	240 284.28	
		3	240 314.63	
3*s*6*d*	^{1}D	2	240 549.77	
3*s*7*s*	^{3}S	1	242 145.10	
3*s*6*f*	^{3}F°	2	*242 410.88*	
		3	*242 411.27*	
		4	*242 411.70*	
3*s*6*g*	^{3}G	3	242 473.66	
		4	242 473.86	
		5	242 474.81	
3*s*6*g*	^{1}G	4	242 474.27	
3*s*7*s*	^{1}S	0	242 537.95	
3*s*6*h*	^{3}H°,^{1}H°	4,5,5,6	*242 639.38*	
3*p*4*p*	^{1}P	1	242 885.30	
3*s*6*f*	^{1}F°	3	*243 868.50*	
3*p*4*p*	^{3}D	1	244 736.93	
		2	244 866.05	
		3	245 086.58	
3*s*7*p*	^{1}P°	1	*244 871.47*	
3*s*7*p*	^{3}P°	0	*244 928.72*	
		1	*244 933.36*	
		2	*244 943.31*	
3*p*4*p*	^{3}P	0	247 871.66	
		1	247 953.69	
		2	248 168.04	
3*p*4*p*	^{1}D	2	247 935.39	
3*p*4*p*	^{3}S	1	248 772.86	
3*s*7*d*	^{3}D	1	249 093.5	
		2	249 103.90	
		3	249 121.14	
3*s*8*s*	^{3}S	1	249 766.19	

Si III—Continued

Configuration	Term	*J*	Level (cm^{-1})	Leading percentages
3*s*7*f*	^{3}F°	2	*249 774.48*	
		3	*249 774.70*	
		4	*249 774.98*	
3*s*7*g*	^{3}G	3	249 817.32	
		4	249 817.85	
		5	249 818.93	
3*s*7*g*	^{1}G	4	249 817.94	
3*s*8*s*	^{1}S	0	249 857.26	
3*s*7*h*	^{3}H°,^{1}H°	4,5,5,6	*249 937.29*	
3*s*7*i*	^{3}I,^{1}I	5,6,6,7	[249 966.49]	
3*s*7*f*	^{1}F°	3	*250 366.22*	
3*s*7*d*	^{1}D	2	250 636.55	
3*s*8*d*	^{3}D	1	[254 002]	
		2	[254 004]	
		3	254 007.48	
3*s*8*f*	^{3}F°	2	*254 557.03*	
		3	*254 557.26*	
		4	*254 557.64*	
3*s*8*g*	^{1}G	4	254 584.6	
3*s*8*g*	^{3}G	3,4	254 584.8	
		5	254 585.75	
3*s*8*h*	^{3}H°,^{1}H°	4,5,5,6	*254 674.4*	
3*s*8*i*	^{3}I,^{1}I	5,6,6,7	254 694.99	
3*s*8*k*	^{3}K°,^{1}K°	6,7,7,8	[*254 702.29*]	
3*s*8*d*	^{1}D	2	254 766.75	
3*s*8*f*	^{1}F°	3	*254 855.42*	
3*s*9*d*	^{3}D	1,2,3	257 415.6	
3*s*9*f*	^{3}F°	2,3,4	*257 831.4*	
3*s*9*d*	^{1}D	2	257 848.5	
3*s*9*g*	^{3}G	3,4,5	257 853.6	
3*s*9*h*	^{3}H°,^{1}H°	4,5,5,6	*257 922.0*	
3*s*9*i*	^{3}I,^{1}I	5,6,6,7	257 936.99	
3*s*9*k*	^{3}K°,^{1}K°	6,7,7,8	[*257 942.30*]	
3*s*9*l*	^{3}L,^{1}L	7,8,8,9	[257 944.45]	

Si III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3s9f$	$^1F^\circ$	3	258 013.37	
$3p4p$	^1S	0	258 978.66	
$3p4d$	$^1D^\circ$?	2	267 483.87	
$3p4d$	$^3F^\circ$?	4	267 686.48	
		3,2		
……	……	……	……	
Si IV ($^2S_{1/2}$)	*Limit*		**270 139.3**	
$3p(^2P^\circ)4f$ F	$^2[5/2]$?	3?	278 920.68?	
$3p(^2P^\circ)4f$ F	$^2[7/2]$?	3?	278 938.08?	
		4?	278 938.08+x	
$3p5p$	^1P	1	282 291.19?	
$3p(^2P^\circ)5f$ F	$^2[7/2]$?	3?	301 484.51?	
$3p(^2P^\circ)5g$ G°	$^2[9/2]^\circ$?	5?	301 884.14+x	
		4?	301 890.97+x	
$3p(^2P^\circ)5g$ G°	$^2[7/2]^\circ$?	3?	301 887.94?	
		4?	301 892.26?	
Si IV ($^2P^\circ_{1/2}$)	*Limit*		341 426.8	
Si IV ($^2P^\circ_{3/2}$)	*Limit*		341 887.9	

Si IV

$Z=14$

Na I isoelectronic sequence

Ground state $1s^22s^22p^63s\ ^2S_{1/2}$

Ionization energy 364 093.1 ± 0.6 cm^{-1} (45.142 15 ± 0.000 14 eV)

The levels are from Toresson [1960a], who measured the spectrum from 457 to 9018 Å. The $3p$ and $3d$ levels were determined by vacuum-ultraviolet lines and may have errors of about ±0.3 cm^{-1} (see Toresson, 1960b, and our comments for Si III). The $4s$ and $4p$ levels are also connected to the lower levels only through vacuum-ultraviolet transitions. The energy separations within the entire group of levels having $n \geqslant 4$, including the $4s$ and $4p$ levels, were determined by lines above 2000 Å; "the agreement between observed and recalculated wavenumbers indicates an average accuracy of about ±0.1 cm^{-1}" for the relative positions within this group [Toresson, 1960a].

Toresson determined the ionization energy by fitting a core-polarization formula to the $4f$, $5f$, and $5g$ terms. The values of all nl terms with $l > 3$ can be predicted with this formula. The predicted values for terms of this group having higher n and/or l may be more accurate than the experimental values, because of Stark shifts probably included in the latter. The predicted and experimental values of the $8f$, $8g$, $6h$, $7h$, and $7i$ terms differ by more than 0.4 cm^{-1} in each case, the difference for the $7i$ term being 0.99 cm^{-1}.

Fischer calculated multiconfiguration eigenvectors for the $3s$, $3p$, $4s$, and $4p$ terms in connection with a theoretical study of oscillator strengths for the Na I sequence. The least pure of these terms in Si IV, the $3s\ ^2S$ ground level, has only a 0.2% total contribution from the higher (excited core) configurations included in the calculation.

The ^2D levels of both the $3d$ and $4d$ terms are inverted from their normal order, Si IV being the last Na I-like spectrum in which such ^2D inversions are found. The positive fine-structure interval for the $5d$ term (+0.10 cm^{-1}, normal order) is apparently well established by the measurements, although Toresson does not state the uncertainty. He notes that "the observations indicate a positive separation for $6d\ ^2D$ and $7d\ ^2D$, but the values are of the same order of magnitude as the observational errors." Recent theoretical studies of $nd\ ^2D$ fine structures in the Na I sequence have been made by Luc-Koenig and by Lindgren and Mårtensson, both papers including references for earlier calculations.

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Si IV

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$3s$	^2S	$1/2$	0.00	$4f$	$^2F^{\circ}$	$5/2$	*254 127.08*
						$7/2$	*254 129.03*
$3p$	$^2P^{\circ}$	$1/2$	*71 287.54*				
		$3/2$	*71 748.64*	$5s$	^2S	$1/2$	265 417.95
$3d$	^2D	$5/2$	160 374.41	$5p$	$^2P^{\circ}$	$1/2$	*276 503.67*
		$3/2$	160 375.60			$3/2$	*276 579.03*
$4s$	^2S	$1/2$	193 978.89	$5d$	^2D	$3/2$	291 497.50
						$5/2$	291 497.60
$4p$	$^2P^{\circ}$	$1/2$	*218 266.86*				
		$3/2$	*218 428.67*	$5f$	$^2F^{\circ}$	$5/2,7/2$	*293 718.99*
$4d$	^2D	$5/2$	250 008.02	$5g$	^2G	$7/2,9/2$	293 837.92
		$3/2$	250 008.14				

Si IV—Continued

Configuration	Term	*J*	Level (cm^{-1})	Configuration	Term	*J*	Level (cm^{-1})
6*s*	^2S	1/2	299 676.95	7*g*	^2G	7/2,9/2	328 249.64
6*p*	$^2P^\circ$	1/2 3/2	*305 641.10* *305 682.27*	7*h*	$^2H^\circ$	9/2,11/2	*328 257.12*
				7*i*	^2I	11/2,13/2	328 260.76
6*d*	^2D	3/2,5/2	313 914.92	8*s*	^2S	1/2	330 439.66
6*f*	$^2F^\circ$	5/2,7/2	*315 230.27*	8*p*	$^2P^\circ$	1/2 3/2	*332 743.87* *332 759.92*
6*g*	^2G	7/2,9/2	315 305.28				
6*h*	$^2H^\circ$	9/2,11/2	*315 317.36*	8*d*	^2D	3/2,5/2	336 051.55
7*s*	^2S	1/2	318 742.79	8*f*	$^2F^\circ$	5/2,7/2	*336 616.55*
7*p*	$^2P^\circ$	1/2 3/2	*322 312.93* *322 337.83*	8*g*	^2G	7/2,9/2	336 650.69
7*d*	^2D	3/2,5/2	327 361.97	....	....	....	....
7*f*	$^2F^\circ$	5/2,7/2	*328 200.04*	Si V ($^1S_0$)	***Limit***		***364 093.1***

Si V

$Z=14$

Ne I isoelectronic sequence

Ground state $1s^2 2s^2 2p^6\ {}^1S_0$

Ionization energy 1 345 070 ± 25 cm^{-1} (166.769 ± 0.003 eV)

The levels are mainly from Brillet [1976] and Brillet and Artru [1976], who extended the observations and analyses of the resonance-lines spectrum by Söderqvist [1934] and Ferner [1941]. Brillet determined the excited levels to about ±20 cm^{-1} with respect to the $^1S_0$ ground level by measurements of resonance lines from the $2p^5 3s$, $3d$, and $4s$ levels having $J=1$ (90–119 Å). The four $2p^5 5d$ and $6d$ levels ($J=1$) from Ferner's observations of the corresponding resonance lines near 80 Å are probably accurate to about ±80 cm^{-1}.

Brillet lists about 90 lines in the 500–1732 Å region classified as transitions between the $2p^5 3s$, $3p$, $3d$, and $4s$ levels. Brillet and Artru give about 120 additional lines over the range 460–3604 Å whose classifications yielded the $2p^5 4p$, $4d$, $4f$, $5f$, and $5g$ levels. The relative positions of the $2p^5 3s$ and $2p^5 3p$ levels, except $2p^5 3p\ {}^1S_0$, are accurate to about ±0.5 cm^{-1}, and the $2p^5 3p\ {}^1S_0$ level and the $2p^5 3d$ levels are accurate to about ±1 cm^{-1} relative to the other $2p^5 3p$ levels. The $2p^5 4s$ levels are determined to about ±2 cm^{-1} and most of the higher levels to about ±3 cm^{-1} with respect to the lower excited levels. Several of the $2p^5 5f$ levels have larger uncertainties, about ±15 cm^{-1} [Brillet and Artru].

The leading percentages for the $2p^5 3p$ and $3d$ levels are from Brillet's paper. The levels of these configurations are listed as belonging to LS-coupling terms, but the strongly mixed compositions of several of the eigenvectors, such as those for the nominal $2p^5 3p\ {}^1D_2$, $^3P_2$ and $2p^5 3d\ {}^1D^\circ_2$, $^3D^\circ_2$ levels, should be noted. Brillet and Artru give energy parameter values derived by fitting the levels of the $2p^5 4p$, $4d$, $4f$, $5f$, and $5g$ configurations. Leading percentages for the $2p^5 4p$ and $4d$ levels in the $J_1 l$-coupling scheme are taken from their paper, percentages lower than 5% having been omitted in both papers. The $2p^5 4f$, $5f$, and $5g$ configurations have high $J_1 l$-coupling purities. Brillet and Artru note that the experimentally unresolved $2p^5 5g$ pair splittings must be less than "a few cm^{-1}."

The interchange of Ferner's $2p^5 3d\ {}^1P^\circ_1$ and $^3D^\circ_1$ designations is confirmed by the relative intensities of the corresponding two resonance lines and by Brillet's calculation. The corresponding two levels given by Ferner for the $2p^5 5d$ and $6d$ configurations are tabulated here as belonging to $J_1 l$-coupling pair terms by analogy with the $2p^5 4d$ configuration.

The mixing of the $^1P^\circ$ and $^3P^\circ$ components in the eigenvectors of the two $2p^5 3s$ levels having $J=1$ is important in calculations of the strengths of the corresponding resonance lines; the 10% mixtures given here are from Murphy's calculation.

Brillet and Artru derived the ionization energy by fitting a core-polarization formula to the $2p^5 4f$, $5f$, and $5g$ levels.

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Si V

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2p^6$	^1S	0	0			
$2p^5 3s$	$^3P^\circ$	2	*838 017.4*	100		
		1	*840 590.0*	90	10	$^1P^\circ$
		0	*843 070.6*	100		
$2p^5 3s$	$^1P^\circ$	1	*848 511.2*	90	10	$^3P^\circ$
$2p^5 3p$	^3S	1	906 252.3	99		
$2p^5 3p$	^3D	3	917 928.5	100		
		2	918 959.4	86	11	^1D
		1	920 863.9	86	8	^1P

Si v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2p^5\,3p$	^{1}D	2	924 291.7	50	48	^{3}P
$2p^5\,3p$	^{1}P	1	925 947.3	58	28	^{3}P
$2p^5\,3p$	^{3}P	2	927 398.2	48	39	^{1}D
		0	927 805.7	100		
		1	928 405.4	65	33	^{1}P
$2p^5\,3p$	^{1}S	0	962 950	100		
$2p^5\,3d$	^{3}P$^\circ$	0	*1 017 629.0*	100		
		1	*1 018 235.5*	99		
		2	*1 019 537.4*	95		
$2p^5\,3d$	^{3}F$^\circ$	4	*1 021 384*	100		
		3	*1 022 351*	79	19	^{1}F$^\circ$
		2	*1 024 240*	84	9	^{1}D$^\circ$
$2p^5\,3d$	^{1}F$^\circ$	3	*1 025 526*	65	24	^{3}D$^\circ$
$2p^5\,3d$	^{1}D$^\circ$	2	*1 029 340*	51	34	^{3}D$^\circ$
$2p^5\,3d$	^{3}D$^\circ$	1	*1 029 407*	91	8	^{1}P$^\circ$
		3	*1 029 875*	74	16	^{1}F$^\circ$
		2	*1 030 414*	57	38	^{1}D$^\circ$
$2p^5\,3d$	^{1}P$^\circ$	1	*1 036 915*	92	8	^{3}D$^\circ$
$2p^5(^2\mathrm{P}^\circ_{3/2})4s$	$^2[3/2]^\circ$	2	*1 099 374*			
		1	*1 100 739*			
$2p^5(^2\mathrm{P}^\circ_{1/2})4s$	$^2[1/2]^\circ$	0	*1 104 445*			
		1	*1 105 585*			
$2p^5(^2\mathrm{P}^\circ_{3/2})4p$	$^2[1/2]$	1	1 124 243	88	12	$(^2\mathrm{P}^\circ_{1/2})\ ^2[1/2]$
		0	1 133 049	52	48	$(^2\mathrm{P}^\circ_{1/2})\ ^2[1/2]$
$2p^5(^2\mathrm{P}^\circ_{3/2})4p$	$^2[5/2]$	3	1 127 908	100		
		2	1 128 480	83	14	$(^2\mathrm{P}^\circ_{3/2})\ ^2[3/2]$
$2p^5(^2\mathrm{P}^\circ_{3/2})4p$	$^2[3/2]$	1	1 129 479	95	5	$(^2\mathrm{P}^\circ_{1/2})\ ^2[3/2]$
		2	1 130 097	85	15	$(^2\mathrm{P}^\circ_{3/2})\ ^2[5/2]$
$2p^5(^2\mathrm{P}^\circ_{1/2})4p$	$^2[3/2]$	1	1 133 330	94	5	$(^2\mathrm{P}^\circ_{3/2})\ ^2[3/2]$
		2	1 134 184	96		
$2p^5(^2\mathrm{P}^\circ_{1/2})4p$	$^2[1/2]$	1	1 134 185	88	12	$(^2\mathrm{P}^\circ_{3/2})\ ^2[1/2]$
		0	1 144 957	52	48	$(^2\mathrm{P}^\circ_{3/2})\ ^2[1/2]$
$2p^5(^2\mathrm{P}^\circ_{3/2})4d$	$^2[1/2]^\circ$	0	*1 163 210*	100		
		1	*1 163 636*	78	18	$(^2\mathrm{P}^\circ_{3/2})\ ^2[3/2]^\circ$
$2p^5(^2\mathrm{P}^\circ_{3/2})4d$	$^2[3/2]^\circ$	2	*1 164 459*	91	9	$(^2\mathrm{P}^\circ_{1/2})\ ^2[3/2]^\circ$
		1	*1 168 621*	73	16	$(^2\mathrm{P}^\circ_{1/2})\ ^2[3/2]^\circ$
$2p^5(^2\mathrm{P}^\circ_{3/2})4d$	$^2[7/2]^\circ$	4	*1 164 645*	100		
		3	*1 165 183*	90	8	$(^2\mathrm{P}^\circ_{3/2})\ ^2[5/2]^\circ$

Si v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2p^5(^2\mathrm{P}^\circ_{3/2})4d$	$^2[5/2]^\circ$	2	*1 166 166*	94	6	$(^2\mathrm{P}^\circ_{1/2})\ ^2[5/2]^\circ$
		3	*1 166 549*	89	9	$(^2\mathrm{P}^\circ_{3/2})\ ^2[7/2]^\circ$
$2p^5(^2\mathrm{P}^\circ_{1/2})4d$	$^2[5/2]^\circ$	2	*1 170 425*	94	6	$(^2\mathrm{P}^\circ_{3/2})\ ^2[5/2]^\circ$
		3	*1 170 828*	96		
$2p^5(^2\mathrm{P}^\circ_{1/2})4d$	$^2[3/2]^\circ$	2	*1 170 743*	91	9	$(^2\mathrm{P}^\circ_{3/2})\ ^2[3/2]^\circ$
		~~1~~	~~*1 173 988*~~	~~80~~	~~11~~	~~$(^2\mathrm{P}^\circ_{3/2})\ ^2[1/2]^\circ$~~
$2p^5(^2\mathrm{P}^\circ_{3/2})4f$	$^2[3/2]$	1	1 172 483			
		2	1 172 545			
$2p^5(^2\mathrm{P}^\circ_{3/2})4f$	$^2[9/2]$	5	1 172 886			
		4	1 172 895			
$2p^5(^2\mathrm{P}^\circ_{3/2})4f$	$^2[5/2]$	3	1 173 122			
		2	1 173 182			
$2p^5(^2\mathrm{P}^\circ_{3/2})4f$	$^2[7/2]$	3	1 173 520			
		4	1 173 530			
$2p^5(^2\mathrm{P}^\circ_{1/2})4f$	$^2[7/2]$	3	1 178 227			
		4	1 178 241			
$2p^5(^2\mathrm{P}^\circ_{1/2})4f$	$^2[5/2]$	3	1 178 233			
		2	1 178 272			
$2p^5(^2\mathrm{P}^\circ_{3/2})5d$	$^2[3/2]^\circ$	2				
		1	*1 232 850*			
$2p^5(^2\mathrm{P}^\circ_{3/2})5f$	$^2[3/2]$	1	1 234 699			
		2	1 234 708			
$2p^5(^2\mathrm{P}^\circ_{3/2})5f$	$^2[9/2]$	5	1 234 901			
		4	1 234 910			
$2p^5(^2\mathrm{P}^\circ_{3/2})5f$	$^2[5/2]$	3	1 235 029			
		2	1 235 077			
$2p^5(^2\mathrm{P}^\circ_{3/2})5g$	$^2[5/2]^\circ$	2,3	*1 235 163*			
$2p^5(^2\mathrm{P}^\circ_{3/2})5g$	$^2[11/2]^\circ$	5,6	*1 235 221*			
$2p^5(^2\mathrm{P}^\circ_{3/2})5f$	$^2[7/2]$	3	1 235 230			
		4	1 235 238			
$2p^5(^2\mathrm{P}^\circ_{3/2})5g$	$^2[7/2]^\circ$	3,4	*1 235 321*			
$2p^5(^2\mathrm{P}^\circ_{3/2})5g$	$^2[9/2]^\circ$	4,5	*1 235 380*			
$2p^5(^2\mathrm{P}^\circ_{1/2})5d$	$^2[3/2]^\circ$	2				
		1	*1 237 520*			
$2p^5(^2\mathrm{P}^\circ_{1/2})5f$	$^2[5/2]$	3	1 240 110			
		2	1 240 177			
$2p^5(^2\mathrm{P}^\circ_{1/2})5f$	$^2[7/2]$	3	1 240 118			
		4	1 240 122			

Si v—Continued

Configuration	Term	*J*	Level (cm^{-1})	Leading percentages
$2p^5(^2P^\circ_{1/2})5g$	$^2[7/2]^\circ$	3,4	*1 240 373*	
	$^2[9/2]^\circ$	4,5		
$2p^5(^2P^\circ_{3/2})6d$	$^2[3/2]^\circ$	2		
		1	*1 267 380*	
$2p^5(^2P^\circ_{1/2})6d$	$^2[3/2]^\circ$	2		
		1	*1 272 090*	
…………	…………	…………	…………	
Si VI ($^2P^\circ_{3/2}$)	***Limit***		***1 345 070***	
Si VI ($^2P^\circ_{1/2}$)	***Limit***		***1 350 160***	

Si VI

$Z=14$

F I isoelectronic sequence

Ground state $1s^22s^22p^5\ ^2P^\circ_{3/2}$

Ionization energy 1 655 590 ± 150 cm^{-1} (205.27 ± 0.02 eV)

The analyses by Söderqvist [1934] and Ferner [1941] classified some 60 lines in the range 65–103 Å, most as transitions from $2p^4ns$ and $2p^4nd$ levels to the $2p^5\ ^2P^\circ$ ground-term levels. Söderqvist also measured and classified the $2s^22p^5\ ^2P^\circ$—$2s2p^6\ ^2S$ resonance doublet at 246 and 249 Å. Artru and Brillet [1977] remeasured this doublet and also the $2p^5\ ^2P^\circ$—$2p^43s$ lines in the 91–101 Å region. Their observations and analysis of the spectrum from 690 to 1345 Å gave about 70 lines classified as $2p^43s$—$2p^43p$ and $2p^43p$—$2p^43d$ transitions.

The levels are from Artru and Brillet, except for the $2s2p^5(^3P^\circ)3s\ ^2P^\circ$ term and those $2p^4nd$ and $2p^4ns$ levels determined only by Ferner's measurements of transitions to the $2p^5\ ^2P^\circ$ levels ($\lambda < 100$ Å). We have reevaluated the levels of this type for which transitions to the $2p^5\ ^2P^\circ_{1/2}$ level were observed, partly to take into account the lowered value of this level obtained by Artru and Brillet. Eleven of the $2p^43d$ levels are based on the observations below 100 Å, all such values being given to the nearest 10 cm^{-1} only. Ferner gave a total of 24 levels assigned to the $2p^44s$, $2p^44d$, and $2p^45d$ configurations, most of them based on the classification of a single line as a transition to one of the $^2P^\circ$ ground-term levels. We have omitted most of these levels here and listed several others as questionable, pending calculations of the predicted structures consistent with the observations. The designations of two of the remaining levels have been tentatively changed.

Since the series data appeared insufficient for the determination of an accurate ionization energy, we obtained the value given above from an isoelectronic formula of the type used by Edlén [1971]. The three parameters in the formula were evaluated by fitting the ionization energies (derived from series data) for F I, Mg IV, and Al V, the latter two values being accurate to about ±10 and ±15 cm^{-1}, respectively. The Si VI ionization energy obtained from this extrapolation is 800 cm^{-1} higher than the value Ferner derived from his series data.

The $2p^5\ ^2P^\circ$ ground-term interval and the $2s2p^6\ ^2S_{1/2}$ level are accurate to within a few cm^{-1}. Artru and Brillet estimate that the system of $2p^43s$, $2p^43p$, $2p^43d$ levels determined by them is accurate to ±10 cm^{-1} with respect to the ground level and has "an internal consistency of about ±1 cm^{-1}." Most of the levels from Ferner are probably accurate to ±100 cm^{-1}.

Artru and Brillet diagonalized matrices for the even configurations $2s2p^6 + 2s^22p^43s + 2s^22p^43d$ with configuration interaction. They discuss the interactions of the $2s2p^6\ ^2S$ term with $2s^22p^4(^1D)3d\ ^2S$ and $2s^22p^4(^1S)3s\ ^2S$; the percentage mixtures were smaller than 1% and were not given. The leading percentages for the $2p^43d$ levels are from Artru and Brillet's tabulation of all components greater than 5% for this configuration. These calculations confirmed the extension and revisions of the $2p^43d$ group, including some revisons made earlier on the basis of isoelectronic regularities [references given by Artru and Brillet]. Artru and Brillet did not list the percentages for the $2p^43s$ levels, all of which were found to have *LS*-coupling purities greater than 98%.

The percentages for the $2p^43p$ levels are also from a calculation by Artru and Brillet, percentages smaller than 5% having been omitted by them.

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Si VI

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$2s^2\,2p^5$	$^2P^\circ$	3/2	*0*	
		1/2	*5 090*	
$2s2p^6$	^2S	1/2	406 497	

Si VI—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2s^2\,2p^4(^3P)3s$	^4P	5/2	990 516			
		3/2	993 640			
		1/2	995 470			
$2s^2\,2p^4(^3P)3s$	^2P	3/2	1 005 430			
		1/2	1 009 118			
$2s^2\,2p^4(^1D)3s$	^2D	5/2	1 041 416			
		3/2	1 041 472			
$2s^2\,2p^4(^3P)3p$	$^4P^\circ$	5/2	*1 068 813*	98		
		3/2	*1 069 854*	97		
		1/2	*1 071 129*	99		
$2s^2\,2p^4(^3P)3p$	$^4D^\circ$	7/2	*1 078 935*	100		
		5/2	*1 080 700*	91	7	$^2D^\circ$
		3/2	*1 082 215*	96		
		1/2	*1 083 003*	99		
$2s^2\,2p^4(^3P)3p$	$^2D^\circ$	5/2	*1 086 796*	92	7	$^4D^\circ$
		3/2	*1 089 547*	71	19	$^2P^\circ$
$2s^2\,2p^4(^3P)3p$	$^2P^\circ$	1/2		52	27	$(^1D)\ ^2P^\circ$
		3/2	*1 092 171*	47	26	$(^3P)\ ^2D^\circ$
$2s^2\,2p^4(^3P)3p$	$^4S^\circ$	3/2	*1 093 752*	97		
$2s^2\,2p^4(^1S)3s$	^2S	1/2	1 094 449			
$2s^2\,2p^4(^1D)3p$	$^2F^\circ$	5/2	*1 123 540*	99		
		7/2	*1 124 219*	100		
$2s^2\,2p^4(^1D)3p$	$^2D^\circ$	3/2	*1 134 081*	99		
		5/2	*1 134 496*	99		
$2s^2\,2p^4(^1D)3p$	$^2P^\circ$	3/2	*1 147 901*	68	32	$(^3P)\ ^2P^\circ$
		1/2	*1 150 282*	67	32	
$2s^2\,2p^4(^3P)3d$	^4D	7/2	1 181 167	97		
		5/2	1 181 649	97		
		3/2	1 182 311	97		
		1/2	1 182 894	98		
$2s^2\,2p^4(^3P)3d$	^4F	9/2	1 189 844	100		
		7/2	1 191 541	84	15	^2F
		5/2	1 193 223	92	5	^2F
		3/2	1 194 327	97		
$2s^2\,2p^4(^3P)3d$	^4P	1/2	1 194 899	99		
		3/2	1 195 984	97		
		5/2	1 197 727	61	37	^2F
$2s^2\,2p^4(^3P)3d$	^2F	7/2	1 194 987	84	14	^4F
		5/2	1 197 151	51	35	^4P
$2s^2\,2p^4(^3P)3d$	^2P	1/2	1 200 710	87	12	$(^1D)\ ^2P$
		3/2	1 204 740	68	21	$(^3P)\ ^2D$

Si VI—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$2s^2 2p^4(^3P)3d$	^2D	$3/2$	1 201 100	68	22	^2P
		$5/2$	1 202 960	86	6	^2F
$2s^2 2p^4(^1D)3d$	^2G	$7/2$		100		
		$9/2$	1 232 671?	100		
$2s^2 2p^4(^1D)3d$	^2S	$1/2$	1 239 190	95		
$2s^2 2p^4(^1D)3d$	^2P	$3/2$	1 241 050	90	9	$(^3P)\ ^2P$
		$1/2$	1 242 390	85	12	
$2s^2 2p^4(^1D)3d$	^2F	$5/2$	1 242 186	83	16	^2D
		$7/2$	1 242 649	99		
$2s^2 2p^4(^1D)3d$	^2D	$5/2$	1 243 020	77	17	^2F
		$3/2$	1 243 860	91	9	$(^3P)\ ^2D$
$2s^2 2p^4(^1S)3d$	^2D	$5/2$	1 291 510	98		
		$3/2$	1 291 790	98		
$2s^2 2p^4(^3P)4s$	^2P	$3/2$	1 329 900			
		$1/2$				
$2s^2 2p^4(^1D)4s$	^2D	$5/2$	1 371 820?			
		$3/2$				
$2s2p^5(^3P^\circ)3s$	$^2P^\circ$	$3/2$	*1 375 840*			
		$1/2$	*1 378 830*			
$2s^2 2p^4(^3P)4d$	^2P	$1/2$	1 402 490			
		$3/2$?	1 403 050			
$2s^2 2p^4(^3P)4d$	^2D	$3/2$				
		$5/2$	1 404 870?			
$2s^2 2p^4(^1D)4d$	^2D?	$5/2$	1 444 340?			
		$3/2$	1 445 010?			
$2s^2 2p^4(^3P)5d$	^2D	$3/2$				
		$5/2$	1 497 630?			
....	....	....	....			
Si VII ($^3P_2$)	***Limit***		1 655 590			

Si VII

$Z=14$

O I isoelectronic sequence

Ground state $1s^22s^22p^4\ ^3\mathrm{P}_2$

Ionization energy 1 988 000 cm^{-1} (246.5 eV)

The $2s^22p^4\ ^3\mathrm{P}$ and $2s2p^5\ ^3\mathrm{P}^\circ$ levels are from Söderqvist [1934], whose observations and classifications included the basic multiplet of transitions between these terms (272–278 Å). The probable errors of these levels are of the order of a few cm^{-1}. The $2s^22p^4\ ^1\mathrm{D}_2$ level is probably accurate to ±1 cm^{-1}, being derived from the measurement of the $2s^22p^4\ ^3\mathrm{P}_2$—$^1\mathrm{D}_2$ forbidden line in the solar-corona spectrum by Sandlin et al. [1977]. The $2s2p^5\ ^1\mathrm{P}^\circ_1$ level, based on the $2s^22p^4\ ^1\mathrm{D}_2$—$2s2p^5\ ^1\mathrm{P}^\circ_1$ line [Söderqvist, 1934; Ferner, 1941] and the new $2s^22p^4\ ^1\mathrm{D}_2$ value, is probably accurate to ±15 cm^{-1}. We obtained the $2s^22p^4\ ^1\mathrm{S}_0$ value using the $2s^22p^4\ ^1\mathrm{D}_2$—$^1\mathrm{S}_0$ separation derived by Edlén [1980] from an isoelectronic treatment (the $2s^22p^4\ ^1\mathrm{S}_0$—$2s2p^5\ ^1\mathrm{P}^\circ_1$ line was observed by Fawcett et al. [1971] as part of a blend). Edlén's isoelectronic smoothing of the experimental data was also used for the $2s2p^5\ ^1\mathrm{P}^\circ_1$—$2p^6\ ^1\mathrm{S}_0$ separation (to determine the $2p^6\ ^1\mathrm{S}_0$ level), the direct measurement of this separation by Fawcett et al. [1974] differing from Edlén's value by about the experimental uncertainty of 25 cm^{-1}.

Ferner extended the observations and analysis of the spectrum below 100 Å. He included 64 Si VII lines in the range 54–86 Å in his 1941 paper, and six additional lines in the 1948 paper, mostly classified as transitions from $2s^22p^3ns$ and $2s^22p^3nd$ upper odd levels to levels of the $2s^22p^4$ ground configuration. The probable error of the upper levels above 1 000 000 cm^{-1} varies from about ±50 cm^{-1} to more than ±100 cm^{-1} for the higher levels.

We have reevaluated all the levels. The singlet levels given here are higher than Ferner's values by about 430 cm^{-1}, which is the error in Ferner's value for the connection between the singlet and triplet systems. A number of other changes are based on the accurate intersystem connection and comparisons with the Al VI $2s^22p^33d$ structure, which has been calculated [Artru and Kaufman, 1980]. Ferner listed no transitions for two levels he designated $2p^3(^2\mathrm{P}^\circ)3d\ ^3\mathrm{F}^\circ_3$, $^3\mathrm{F}^\circ_2$; we have omitted the $^3\mathrm{F}^\circ_3$ level, but the level at 1 466 490 cm^{-1}, which now classifies two lines as transitions to $2p^4\ ^3\mathrm{P}_2$ and $^1\mathrm{D}_2$, is probably the nominal $2p^3(^2\mathrm{P}^\circ)3d\ ^3\mathrm{D}^\circ_2$ level. Ferner's level for the latter designation has a newly classified transition to $2p^4\ ^1\mathrm{D}_2$ as its strongest line and is here tentatively designated $2p^3(^2\mathrm{P}^\circ)3d\ ^1\mathrm{D}^\circ_2$. Thus the resulting $2p^3(^2\mathrm{P}^\circ)3d\ ^3\mathrm{D}^\circ_2$ and $^1\mathrm{D}^\circ_2$ levels both make intersystem transitions (confirming the new singlet-triplet connection), consistent with the strong $^3\mathrm{D}^\circ_2$, $^1\mathrm{D}^\circ_2$ mixtures in the eigenvectors of the corresponding two levels in Al VI. The levels formerly designated $2p^3(^2\mathrm{P}^\circ)3d\ ^1\mathrm{D}^\circ_2$ and $^1\mathrm{P}^\circ_1$ have been deleted on the basis of the new line classifications.

Although only a few levels are given here with question marks, a number of the $2p^3ns$ and $2p^3nd$ odd levels with $n=4$ or 5 should probably be regarded as tentative. Most of these levels are based on a single line classified as a transition to one of the $2p^4$ ground-configuration levels, and the $2p^4\ ^3\mathrm{P}_2$—$2p^3nl\ ^3\mathrm{P}^\circ_2$ and $2p^4\ ^3\mathrm{P}_2$—$2p^3nl\ ^3\mathrm{D}^\circ_3$ leading-line identifications usually lack confirmation by classifications of additional lines of their multiplets (nl = $4s$, $4d$, $5s$, $5d$). The overall interpretation is of course based on the consistency of the higher series members with the limit (quoted above) that Ferner derived from these $2p^3ns$ and $2p^3nd$ series.

Ferner located the $2s2p^4(^4\mathrm{P})3s\ ^3\mathrm{P}_2$, $2s2p^4(^2\mathrm{D})3s\ ^3\mathrm{D}_3$, and $2s2p^4(^4\mathrm{P})4s\ ^3\mathrm{P}_2$ levels by classifying a transition from each of these levels to the $2s2p^5\ ^3\mathrm{P}^\circ_2$ level. Guennou et al. [1979] observed the spectrum from a laser-generated plasma in the 70–90 Å range and classified a number of additional $2s2p^5\ ^3\mathrm{P}^\circ$ — $2s2p^43s$ lines. The $2s2p^4\ (^4\mathrm{P})\ 3s\ ^3\mathrm{P}$ and $2s2p^4\ (^2\mathrm{S})\ 3s\ ^3\mathrm{S}$ levels given here were evaluated directly from their experimental wavelengths and the $2s2p^5\ ^3\mathrm{P}^\circ$ levels. Ferner's $2s2p^4(^2\mathrm{D})3s\ ^3\mathrm{D}_3$ level was also confirmed by Guennou et al., but no additional lines of the corresponding multiplet were listed. The levels they designated $2s2p^4(^2\mathrm{P})3s\ ^3\mathrm{P}_2$ and $^1\mathrm{P}_1$ are omitted here pending more complete observations.

The ground-configuration $2s^22p^4$ levels are very pure in LS coupling, but the small mixing of the two $J=2$ states and of the two $J=0$ states is important for calculation of forbidden-line transition probabilities. From Garstang's formulae we obtain a 0.32% mixing of the Si VII $2s^22p^4\ ^3\mathrm{P}_2$ and $^1\mathrm{D}_2$ states and, also, 0.32% mixing of the $^3\mathrm{P}_0$ and $^1\mathrm{S}_0$ states.

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Si VII

Configuration	Term	J	Level (cm^{-1})
$2s^{2}2p^{4}$	^{3}P	2	0.0
		1	4 030
		0	5 565
$2s^{2}2p^{4}$	^{1}D	2	46 569.8
~~$2s^{2}2p^{4}$~~	~~^{1}S~~	~~0~~	~~99 341~~
$2s2p^{5}$	$^{3}P^{\circ}$	2	*363 170*
		1	*366 786*
		0	*368 761*
$2s2p^{5}$	$^{1}P^{\circ}$	1	*505 650*
$2p^{6}$	^{1}S	0	849 057
$2s^{2}2p^{3}(^{4}S^{\circ})3s$	$^{3}S^{\circ}$	1	*1 172 470*
$2s^{2}2p^{3}(^{2}D^{\circ})3s$	$^{3}D^{\circ}$	1,2,3	*1 225 150*
$2s^{2}2p^{3}(^{2}D^{\circ})3s$	$^{1}D^{\circ}$	2	*1 235 890*
~~$2s^{2}2p^{3}(^{2}P^{\circ})3s$~~	~~$^{3}P^{\circ}$~~	~~0~~	~~*1 261 530?*~~
		1	*1 261 610*
		2	*1 262 040*
$2s^{2}2p^{3}(^{2}P^{\circ})3s$	$^{1}P^{\circ}$	1	*1 272 720*
$2s^{2}2p^{3}(^{4}S^{\circ})3d$	$^{3}D^{\circ}$	1,2	*1 367 360*
		3	*1 367 560*
$2s^{2}2p^{3}(^{2}D^{\circ})3d$	$^{3}F^{\circ}$?	2	*1 426 050*
$2s^{2}2p^{3}(^{2}D^{\circ})3d$	$^{3}D^{\circ}$	1	
		3	*1 428 020*
		2	*1 428 090*
$2s^{2}2p^{3}(^{2}D^{\circ})3d$	$^{1}P^{\circ}$	1	*1 429 240*
$2s^{2}2p^{3}(^{2}D^{\circ})3d$	$^{3}P^{\circ}$	2	*1 435 460*
		1	*1 436 750*
		0	
$2s^{2}2p^{3}(^{2}D^{\circ})3d$	$^{1}D^{\circ}$	2	*1 436 330?*
$2s^{2}2p^{3}(^{2}D^{\circ})3d$	$^{3}S^{\circ}$	1	*1 441 230*
$2s^{2}2p^{3}(^{2}D^{\circ})3d$	$^{1}F^{\circ}$	3	*1 447 440*
$2s^{2}2p^{3}(^{2}P^{\circ})3d$	$^{3}P^{\circ}$	0	*1 460 290*
		1	*1 460 860*
		2	*1 461 860*
$2s^{2}2p^{3}(^{2}P^{\circ})3d$	$^{3}D^{\circ}$	1	
		2	*1 466 490*
		3	*1 467 390*
$2s^{2}2p^{3}(^{2}P^{\circ})3d$	$^{1}D^{\circ}$?	2	*1 470 050*
~~$2s^{2}2p^{3}(^{2}P^{\circ})3d$~~	~~$^{1}F^{\circ}$~~	~~3~~	~~*1 473 670*~~
$2s2p^{4}(^{4}P)3s$	^{3}P	2	1 499 470
		1	1 502 880
		0	1 504 430
$2s2p^{4}(^{2}D)3s$	^{3}D	3	1 590 930
$2s^{2}2p^{3}(^{2}D^{\circ})4s$	$^{3}D^{\circ}$	3	*1 631 160*
$2s^{2}2p^{3}(^{2}D^{\circ})4s$	$^{1}D^{\circ}$	2	*1 635 390*
$2s^{2}2p^{3}(^{4}S^{\circ})4d$	$^{3}D^{\circ}$	3	*1 643 740*
$2s2p^{4}(^{2}S)3s$	^{3}S	1	1 663 240
~~$2s^{2}2p^{3}(^{2}P^{\circ})4s$~~	~~$^{3}P^{\circ}$~~	~~2~~	~~*1 669 900*~~
$2s^{2}2p^{3}(^{2}P^{\circ})4s$	$^{1}P^{\circ}$	1	*1 672 010*
$2s^{2}2p^{3}(^{2}D^{\circ})4d$	$^{3}D^{\circ}$	3,2	*1 707 090*
$2s^{2}2p^{3}(^{2}D^{\circ})4d$	$^{3}P^{\circ}$	2	*1 711 010*
$2s^{2}2p^{3}(^{2}D^{\circ})4d$	$^{3}S^{\circ}$	1	*1 712 680*
$2s^{2}2p^{3}(^{2}D^{\circ})4d$	$^{1}F^{\circ}$	3	*1 714 180?*
$2s^{2}2p^{3}(^{2}P^{\circ})4d$	$^{3}P^{\circ}$	2	*1 741 130*
$2s^{2}2p^{3}(^{2}P^{\circ})4d$	$^{3}D^{\circ}$	3	*1 744 440*
$2s^{2}2p^{3}(^{2}P^{\circ})4d$	$^{1}F^{\circ}$	3	*1 747 770*
$2s^{2}2p^{3}(^{4}S^{\circ})5d$	$^{3}D^{\circ}$	3	*1 769 040*
$2s^{2}2p^{3}(^{2}D^{\circ})5d$	$^{3}D^{\circ}$	3	*1 834 120*
$2s^{2}2p^{3}(^{2}D^{\circ})5d$	$^{3}P^{\circ}$	2	*1 836 140*
$2s^{2}2p^{3}(^{2}P^{\circ})5s$	$^{1}P^{\circ}$	1	*1 837 780*
$2s2p^{4}(^{4}P)4s$	^{3}P	2	1 887 680
Si VIII ($^{4}S^{\circ}_{3/2}$)	***Limit***		***1 988 000***

Si VIII

$Z=14$

N I isoelectronic sequence

Ground state $1s^22s^22p^3\ ^4S^\circ_{3/2}$

Ionization energy 2 448 200 cm^{-1} (303.54 eV)

Söderqvist's original analysis included classifications of most of the lines of the basic $2s^22p^3$—$2s2p^4$ transition array (215–320 Å). Ferner [1941] remeasured the spectrum in the 215–236 Å region and extended the short-wavelength observations and classifications to include more than forty lines between 50 and 76 Å. Fawcett [1970] classified the $2s2p^4\ ^2P$—$2p^5\ ^2P^\circ$ lines (338–350 Å) first locating the $2p^5\ ^2P^\circ$ levels, and Fawcett et al. [1971] classified four lines observed in the 250 Å region as $2s^22p^3\ ^2P^\circ$—$2s2p^4\ ^2S$ and $2s2p^4\ ^2D$—$2p^5\ ^2P^\circ$ transitions. The first observational connection of the doublet and quartet systems was the identification of a solar coronal line at 1446 Å as the $2s^22p^3\ ^4S^\circ_{3/2}$–$^2D^\circ_{3/2}$ forbidden transition [Gabriel et al., 1971].

The $2s^22p^3\ ^2D^\circ$ levels given here should be accurate to about ±0.5 cm^{-1} with respect to the $^4S^\circ$ ground level, being derived from averages of the wavelengths of the corresponding coronal forbidden lines as measured by Sandlin et al. and by Feldman and Doschek. The $2s^22p^3\ ^2P^\circ$ levels are taken to agree with the $2s^22p^3\ ^2P^\circ_{3/2}$–$^2D^\circ_{5/2}$ and $^2P^\circ_{3/2}$–$^2P^\circ_{1/2}$ separations obtained by Edlén [1982] from an isoelectronic treatment; the $^2P^\circ$ term position and interval are probably accurate to about ±10 and ±5 cm^{-1}, respectively.

We have reevaluated the levels of all the excited configurations using the various observations referenced above and the redetermined ground-configuration levels. Some of the better determined $2s2p^4$ levels are probably accurate to ±10 to ±20 cm^{-1}, whereas the errors of some of the higher levels probably exceed 100 cm^{-1}.

The relatively small negative interval for the $2s2p^4\ ^2D$ term (–30 cm^{-1}) is consistent with the isoelectronic data. The experimental values of the $2s2p^4\ ^2D$ intervals in Na V, Mg VI, Al VII, and P IX are –36, –42, –50, and +45 cm^{-1}, respectively. The Dirac-Fock calculations of Cheng et al. predict a transition from small negative values of these intervals in Na V through Si VIII (with a minimum of –22 cm^{-1} in Al VII) to positive values in P IX and heavier ions.

Ferner gave the levels of $2s^22p^23s$ complete except for the $2p^2(^1S)3s\ ^2S_{1/2}$ level. The $2p^23s\ ^2S$–^2D term separations in lower members of the N I isoelectronic sequence are very close to the corresponding $2p^2\ ^1S$–^1D separations of the parent terms in the C I sequence. Either an isoelectronic extrapolation from Al VII to Si VIII or direct assumption of the Si IX ^1S–^1D separation yields a value of about 55 000 cm^{-1} for the Si VIII $2p^23s\ ^2S$–^2D separation. The predicted position of the $2p^23s\ ^2S$ level is thus near 1 542 000 cm^{-1}; the two $2p^3\ ^2P^\circ$—$2p^23s\ ^2S$ lines would fall within a group of observed Si lines near 69.6 Å, including the line at 69.632 Å classified by Ferner as Si VIII $2p^3\ ^4S^\circ_{3/2}$—$2p^23s\ ^4P_{5/2}$ and nearby lines assigned to Si VII. It appears quite possible that the $2p^3\ ^2P^\circ$—$2p^23s\ ^2S$ doublet contributes to the intensities of a pair of these lines. The value of 1 565 270 cm^{-1} suggested for the $2p^23s\ ^2S$ level by Kastner et al. on the basis of a pair of Ferner's unclassified lines near 68.5 Å is 23 000 cm^{-1} above the position estimated here.

The accurately known doublet-quartet connection allows the apparent classification of eight lines in Ferner's [1941] Si list as Si VIII intersystem transitions (from upper even levels to $2s^22p^3$ ground-configuration levels). We have used some of these new classifications in evaluating the upper levels, but four of the lines have alternative assignments to other Si spectra by Ferner. Ferner classified a line as $2s^22p^3\ ^4S^\circ_{3/2}$—$2s^22p^23d\ ^4D_{1/2}$, but did not include the $^4D_{1/2}$ level in his term list. This level (1 634 640 cm^{-1}) also combines with $2s^22p^3\ ^2D_{3/2}$ and is given here with the J value tentative. Ferner's other level for the $2s^22p^23d\ ^4D$ term ($J=3/2$ or $5/2$) is given here as questionable.

Correction of the intersystem connection has raised the level Ferner designated $2s^22p^2(^1D)3d\ ^2P_{3/2}$ to a value (1 698 150 cm^{-1}) near his $2s2p^3(^5S^\circ)3p\ ^4P$ term (1 698 230 cm^{-1}). We have used question marks to indicate that a single level could account for the lines involved and that the term designation(s) is (are) uncertain.

Most of the $2s^22p^24s$ and $4d$ levels appear questionable, being derived from single weak lines or lines also assigned to other ionization stages. We have added a tentative $J=3/2$ level at 1 989 900 cm^{-1}. Because the series identifications appear uncertain, we give a value for the ionization energy predicted by Edlén's [1971] formula for this isoelectronic sequence. Ferner's value for the ionization energy was 2 451 570 cm^{-1}.

The data for the spectra of the N I sequence above F III are much less complete than for the first three sequence members. New and more complete observations of the spectra and calculations of the important configurations are needed for the higher spectra.

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Si VIII

Configuration	Term	*J*	Level (cm^{-1})
$2s^2 2p^3$	^{4}S°	3/2	*0.0*
$2s^2 2p^3$	^{2}D°	3/2	*69 168.1*
		5/2	*69 420.5*
$2s^2 2p^3$	^{2}P°	1/2	*105 348*
		3/2	*105 890*
$2s2p^4$	^{4}P	5/2	312 670
		3/2	316 250
		1/2	318 140
$2s2p^4$	^{2}D	5/2	430 360
		3/2	430 390
$2s2p^4$	^{2}S	1/2	504 630
$2s2p^4$	^{2}P	3/2	530 430
		1/2	532 800
$2p^5$	^{2}P°	3/2	*820 200*
		1/2	*825 930*
$2s^2 2p^2(^3P)3s$	^{4}P	1/2	1 430 510
		3/2	1 432 870
		5/2	1 436 120
$2s^2 2p^2(^3P)3s$	^{2}P	1/2	1 449 990
		3/2	1 453 900
$2s^2 2p^2(^1D)3s$	^{2}D	5/2	1 486 710
		3/2	1 488 150
$2s^2 2p^2(^3P)3d$	^{2}P	3/2	1 624 990
		1/2	
$2s2p^3(^5S^\circ)3s$	^{4}S°	3/2	*1 628 660*
$2s^2 2p^2(^3P)3d$	^{4}D	7/2	
		5/2	
		3/2?	1 633 370?
		1/2?	1 634 640

Configuration	Term	*J*	Level (cm^{-1})
$2s^2 2p^2(^3P)3d$	^{2}F	5/2	1 634 040
		7/2	1 638 490
$2s^2 2p^2(^3P)3d$	^{4}P	5/2	1 637 470
		3/2	1 638 830
		1/2	1 639 640
$2s^2 2p^2(^3P)3d$	^{2}D	3/2	1 659 320
		5/2	1 660 490
$2s^2 2p^2(^1D)3d$	^{2}F	7/2	1 684 560
		5/2	1 684 810
$2s^2 2p^2(^1D)3d$	^{2}D	3/2	1 685 950
		5/2	1 687 560
$2s^2 2p^2(^1D)3d$?	^{2}P?	1/2	1 696 590
		3/2	1 698 150
$2s2p^3(^5S^\circ)3p$	^{4}P	1/2–5/2	1 698 230?
$2s^2 2p^2(^1D)3d$	^{2}S	1/2	1 703 690?
$2s2p^3(^5S^\circ)3d$	^{4}D°	1/2–7/2	*1 801 730*
$2s^2 2p^2(^3P)4s$	^{2}P	3/2	1 929 190?
		3/2	1 989 900?
$2s^2 2p^2(^3P)4d$	^{2}F	5/2	1 998 960?
		7/2	2 002 980?
$2s^2 2p^2(^3P)4d$	^{4}P	5/2?	1 999 240
		3/2	2 000 520?
		1/2	
$2s^2 2p^2(^3P)4d$	^{2}D	5/2	2 008 700?
$2s^2 2p^2(^1D)4d$	^{2}D	5/2	2 048 680?
Si IX (^{3}P$_0$)	***Limit***		**2 448 200**

Si IX

$Z=14$

C I isoelectronic sequence

Ground state $1s^2 2s^2 2p^2\ ^3P_0$

Ionization energy 2 832 000 ± 1000 cm^{-1} (351.13 ± 0.12 eV)

The relative values of the $2s^2 2p^2\ ^3P_1$, $^3P_2$, and $^1D_2$ levels are based on observed wavelengths of the solar-coronal forbidden lines $^3P_1$–$^1D_2$ [Sandlin et al.] and $^3P_2$–$^1D_2$ [Sandlin et al., Feldman and Doschek]. The $^3P_1$–$^1D_2$ and $^3P_2$–$^1D_2$ separations are probably accurate to ± 0.5 and ± 1 cm^{-1}, respectively. The $^3P_1$, $^3P_2$, and $^1D_2$ levels are probably accurate to about ± 7 cm^{-1} with respect to the $^3P_0$ ground level, the adopted $^3P_0$–$^3P_1$ difference being from an isoelectronic treatment of the data by Edlén [1982a]. The $^3P_0$–$^3P_1$ difference given by Grasdalen and Joyce's observation of the corresponding forbidden line in a nova spectrum, 2550 ± 13 cm^{-1}, agrees with Edlén's value to within the error. We have also adopted Edlén's value for the $2s^2 2p^2\ ^1S$ level, which is expected to be more accurate than a value based on the observed transitions to this level from the $2s2p^3\ ^1P_1^\circ$ and higher levels.

The main lines of the $2s^2 2p^2$—$2s2p^3$ and $2s2p^3$—$2p^4$ transition arrays have been observed. We obtained the $2s2p^3\ ^3D^\circ$, $^3S^\circ$, $^1D^\circ$, and $2p^4\ ^3P$ and ^1D levels using mainly the laboratory observations by Fawcett [1970, 1971, 1975] and the solar-spectrum measurements by Behring et al. Most of these levels are probably accurate to within ± 15 cm^{-1}. Similar determinations of the $2s2p^3\ ^3P^\circ$, $^1P^\circ$, and $2p^4\ ^1S$ levels from the available Si IX measurements would probably yield less accurate values; the values of these levels are from Edlén's [1982b] isoelectronic method.

Edlén [1982b] also estimated the $2s2p^3\ ^5S^\circ$ position given here. This value as well as the levels of the two ^5P terms are followed by "$+x$" to indicate the lack of any observed transitions connecting the quintet system with the triplet and singlet systems.

Ferner's analysis of the short-wavelength spectrum (44–65 Å) gave upper levels from configurations of the types $2s^2 2p3l$ and $2s2p^2 3l$, and one $2s^2 2p4d$ term. We have reevaluated these levels using his wavelengths and the lower levels given here. The values are rounded to the nearest 10 cm^{-1}; the error for some of these high levels might exceed 200 cm^{-1}. Most of these levels classify only one line, the analysis being based on isoelectronic regularities. Pending more complete observations and supporting calculations, we have indicated some levels as tentative, especially those derived from single weak lines or from single lines with anomalous intensities relative to other lines of a proposed multiplet, etc. Ferner's $2s^2 2p3d\ ^3F_2^\circ$ level is omitted.

Edlén's [1971] extrapolation formulae for this isoelectronic sequence yield a value of 2 831 470 cm^{-1} for the Si IX ionization energy. Using a semi-empirical formula for corrections to theoretical values of the ionization energies along the sequence, we obtained a value of 2 832 500 cm^{-1} for Si IX. The value given above is adopted as the average of these results.

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Si IX

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$2s^2 2p^2$	^3P	0	0	$2s2p^3$	$^3D^\circ$	3	*292 232*
		1	2 545.0			2	*292 296*
		2	6 414			1	*292 441*
$2s^2 2p^2$	^1D	2	52 925.9	$2s2p^3$	$^3P^\circ$	1	*344 009*
						0	*344 075*
$2s^2 2p^2$	^1S	0	107 799			2	*344 118*
$2s2p^3$	$^5S^\circ$	2	*150 770+x*	$2s2p^3$	$^3S^\circ$	1	*446 942*

Si IX—Continued

Configuration	Term	J	Level (cm^{-1})
$2p^4$	^{3}P	2	674 764
		1	679 300
		0	681 079
$2p^4$	^{1}D	2	719 502
$2p^4$	^{1}S	0	819 689
$2s2p^3$	^{1}D$^\circ$	2	*440 403*
$2s2p^3$	^{1}P$^\circ$	1	*492 755*
$2s^2\,2p3s$	^{3}P$^\circ$	0	
		1	*1 623 380*
		2	*1 628 500*
$2s^2\,2p3s$	^{1}P$^\circ$	1	*1 640 850*
$2s2p^2(^4\mathrm{P})3s$	^{5}P	1	1 785 020+x
		2	1 787 190+x
		3	1 790 410+x
$2s^2\,2p3d$	^{1}D$^\circ$	2	*1 794 050?*
$2s^2\,2p3d$	^{3}D$^\circ$	1	*1 808 160*
		2	*1 809 040*
		3	*1 811 430*
$2s^2\,2p3d$	^{3}P$^\circ$	2	*1 815 650*
		1	*1 816 900*
		0	*1 817 630*
$2s^2\,2p3d$	^{1}F$^\circ$	3	*1 837 780*
$2s^2\,2p3d$	^{1}P$^\circ$	1	*1 838 560*
$2s2p^2(^4\mathrm{P})3p$	^{3}S$^\circ$	1	*1 858 540?*
$2s2p^2(^4\mathrm{P})3p$	^{3}D$^\circ$	1	
		2	*1 896 130*
		3	*1 898 990*
$2s2p^2(^2\mathrm{D})3s$	^{3}D	1,2,3	1 917 100
$2s2p^2(^4\mathrm{P})3d$	^{5}P	3	1 972 030+x?
		2	1 973 260+x?
		1	1 974 220+x?
$2s2p^2(^4\mathrm{P})3d$	^{3}P	2	1 973 980?
$2s2p^2(^4\mathrm{P})3d$	^{3}F	2	1 985 150?
		3	1 987 100?
		4	1 989 850?
$2s2p^2(^2\mathrm{D})3p$	^{1}F$^\circ$	3	*1 999 890*
$2s2p^2(^2\mathrm{D})3p$	^{1}D$^\circ$	2	*2 009 370*
$2s2p^2(^4\mathrm{P})3d$	^{3}D	2,3	2 011 690?
$2s2p^2(^2\mathrm{D})3d$	^{3}F	2,3,4	2 085 020
$2s2p^2(^2\mathrm{D})3d$	^{3}D	1,2,3	2 093 700
$2s2p^2(^2\mathrm{P})3d$	^{3}F	2,3,4	2 190 870?
$2s^2\,2p4d$	^{3}D$^\circ$	1	
		2	*2 264 220?*
		3	*2 266 350?*
Si X ($^2\mathrm{P}^\circ_{1/2}$)	***Limit***		***2 832 000***

Si X

$Z=14$

B I isoelectronic sequence

Ground state $1s^2 2s^2 2p\ ^2P^\circ_{1/2}$

Ionization energy 3 237 300 ± 450 cm^{-1} (401.38 ± 0.06 eV)

Ferner's analysis [1941, 1948] was based on the classification of 29 lines in the 47–57 Å region as transitions from $2s^2 3l$, $2s2p3l$, and $2p^2 3l$ upper levels to corresponding $2s^2 2p$, $2s2p^2$, and $2p^3$ lower levels. Fawcett [1970] and Fawcett et al. [1971] observed the lines of the $2s^2 2p$—$2s2p^2$ and $2s2p^2$—$2p^3$ arrays (253–551 Å) and correctly located the $2p^3\ ^2D^\circ$ and $^2P^\circ$ levels [Fawcett, 1975]. The lines of the $2s^2 2p$—$2s2p^2$ resonance array (253–356 Å) were also measured in the solar spectrum by Behring et al. [1976]. Hoory et al. [1971] extended the short-wavelength measurements and classifications (34–57 Å) and observed and classified several of the lines in the 253–292 Å region.

We evaluated the levels here by combining data from several sources. The $2s^2 2p\ ^2P^\circ$ interval is from a measurement of the $^2P^\circ_{1/2}$—$^2P^\circ_{3/2}$ infrared coronal line by Münch et al., with an uncertainty of ±2 cm^{-1}. The $2s2p^2$ and $2p^3$ levels all agree within ±10 cm^{-1} with values derived by Edlén [1981] from his treatment of the data for this isoelectronic sequence. The uncertainties of the $2s2p^2$ and $2p^3$ doublet levels are about ±15 to ±30 cm^{-1}, all level values being rounded to the nearest 10 cm^{-1}. The quartet levels are given with an unknown correction "$+x$" relative to the ground level, since no lines connecting the doublet and quartet systems have been classified. The assumed quartet-doublet connection (for $x=0$) is from Edlén's estimate of the $2s^2 2p\ ^2P^\circ_{3/2}$—$2s2p^2\ ^4P_{5/2}$ separation, based on the available isoelectronic data.

Most of the levels assigned by Ferner or by Hoory et al. to configurations of the types $2s^2 nl$ and $2s2pnl$ ($n \geqslant 3$) are derived from single lines classified on the basis of series and/or isoelectronic regularities. Because of the complexity of the observed spectra in the short-wavelength region (~50 Å and below), such classifications of a number of the lines assigned to Si X are doubtful. We have indicated some levels as questionable and have omitted a number of others, mainly from terms lying above about 2 200 000 cm^{-1}.

Ferner obtained a value of 3 237 400 cm^{-1} for the ionization energy by extrapolation using an isoelectronic expression involving the absolute term value of the $2s^2 2p\ ^2P^\circ_{3/2}$ level. The ionization energy obtained by Hoory et al. from the $2s^2 nd\ ^2D$ series ($n=3$–6), quoted above, is in agreement with Ferner's value and thus with the isoelectronic data.

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Si X

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$2s^2 2p$	$^2P^\circ$	1/2	*0.0*	$2p^3$	$^4S^\circ$	3/2	*509 330*$+x$
		3/2	*6 990.6*				
$2s2p^2$	^4P	1/2	161 010$+x$	$2p^3$	$^2D^\circ$	3/2	*575 430*
		3/2	163 490$+x$			5/2	*575 450*
		5/2	167 060$+x$	$2p^3$	$^2P^\circ$	1/2	*646 760*
						3/2	*647 390*
$2s2p^2$	^2D	3/2	287 850				
		5/2	287 880	$2s^2 3d$	^2D	3/2	1 979 260?
						5/2	1 979 730
$2s2p^2$	^2S	1/2	367 670				
				$2s2p(^3P^\circ)3s$	$^4P^\circ$	1/2	*1 992 830*$+x$
$2s2p^2$	^2P	1/2	390 040			3/2	*1 995 140*$+x$
		3/2	394 030			5/2	*1 999 580*$+x$

Si x—Continued

Configuration	Term	J	Level (cm^{-1})
$2s2p(^3P^\circ)3s$	$^2P^\circ$	1/2	*2 031 060?*
		3/2	*2 035 860?*
$2s2p(^3P^\circ)3p$	^2P	1/2	2 064 590
		3/2	2 066 750
$2s2p(^3P^\circ)3p$	^2D	3/2	2 105 750?
		5/2	2 110 260
$2s2p(^3P^\circ)3p$	^2S	1/2	2 132 600
$2s2p(^3P^\circ)3d$	$^4D^\circ$	1/2,3/2	*2 150 900+x*
		5/2	*2 151 360+x*
		7/2	*2 153 830+x*
$2s2p(^3P^\circ)3d$	$^2D^\circ$	3/2	*2 153 700*
		5/2	*2 154 480*
$2s2p(^1P^\circ)3s$	$^2P^\circ$	1/2	
		3/2	*2 158 330*
$2s2p(^3P^\circ)3d$	$^4P^\circ$?	5/2	*2 160 920+x*
		3/2	*2 162 100+x*
		1/2	
$2s2p(^3P^\circ)3d$	$^2F^\circ$	5/2	*2 188 590*
		7/2	*2 193 190*
$2s2p(^3P^\circ)3d$	$^2P^\circ$	3/2	*2 199 210?*
		1/2	*2 201 790?*
$2s2p(^1P^\circ)3p$	^2S?	1/2	2 246 300
$2s2p(^1P^\circ)3d$	$^2F^\circ$	5/2,7/2	*2 299 900?*
$2s2p(^1P^\circ)3d$	$^2D^\circ$	3/2	*2 310 530?*
		5/2	*2 311 390?*
$2p^2(^3P)3d$	^4P	5/2	2 444 460+x?
		3/2	2 446 000+x?
		1/2	
$2s^2\,4d$	^2D	3/2,5/2	2 535 310
$2s^2\,5d$	^2D	5/2	2 790 020
$2s^2\,6d$	^2D	5/2	2 927 720?
....	....	....	....
Si XI ($^1S_0$)	***Limit***		**3 237 300**

Si XI

$Z=14$

Be I isoelectronic sequence

Ground state $1s^22s^2\ ^1S_0$

Ionization energy 3 842 100 cm^{-1} (476.36 eV)

Ferner classified 12 lines (43–50 Å) in the 1941 paper and extended his analysis somewhat in 1948. Tondello observed and classified additional lines [see also Fawcett et al.], and Hoory et al. extended most of the series using more complete measurements in the region 30–52 Å. Fawcett's observations and classifications of lines at longer wavelengths included the important $2s2p$—$2p^2$ array (358–604 Å) [1970] and the $2s3d\ ^3D$—$2s4f\ ^3F^{\circ}$ line at 147.6 Å [1971].

The $2s2p\ ^3P_1^{\circ}$ level should be accurate to about ±10 cm^{-1}, being derived from the $2s^2\ ^1S_0$—$2s2p\ ^3P_1^{\circ}$ intercombination line measured in solar-flare spectra [Widing]. The separations between this level and the $2s2p\ ^3P_0^{\circ}$, $2s2p\ ^3P_2^{\circ}$, and also the $2p^2\ ^3P$ levels are taken from Edlén [1980], who combined the Si XI measurements with requirements of isoelectronic regularity. We give Edlén's values for the $2s2p\ ^1P^{\circ}$ and $2p^2\ ^1D$ and ^1S levels. The r.m.s. difference between Fawcett's wavenumbers for the eight $2s2p$—$2p^2$ lines and Edlén's values is 14 cm^{-1}. The value for the $2s2p\ ^1P^{\circ}$ level agrees exactly with one of the measurements of the $2s^2\ ^1S$—$2s2p\ ^1P^{\circ}$ resonance line in the solar spectrum [Behring et al.].

We have redetermined the $2snl$ and $2pnl$ ($n \geqslant 3$) levels by combining the $2s2p$ and $2p^2$ levels with the short-wavelength measurements, mainly from Ferner and from Hoory et al. The weak line listed by Ferner for the $2s2p\ ^3P_0^{\circ}$—$2s3d\ ^3D_1$ transition yields a $2s3d\ ^3D_2$—$^3D_1$ separation inconsistent with the isoelectronic data. We evaluated the $2s3d\ ^3D_2$ and $^3D_3$ levels by taking the $^3P_1^{\circ}$—$^3D_{1,2}$ and $^3P_2^{\circ}$—$^3D_{2,3}$ lines as (statistical-intensity) blends, assuming an isoelectronically estimated $^3D_1$ position. The $2s3d\ ^3D$ baricenter was then combined with Fawcett's measurement of the $2s3d\ ^3D$—$2s4f\ ^3F^{\circ}$ blend to obtain the $2s4f\ ^3F^{\circ}$ position. The relative intensities of the three lines observed by Träbert et al. [1979b] near 147.5 Å are reversed from those expected for the $2s3d\ ^3D_{1,2,3}$—$2s4f\ ^3F^{\circ}$ multiplet; Träbert [1982] suggests that higher resolution may be required for the interpretation of the Si beam-foil spectrum in this region.

The estimated uncertainty of the wavelength measurements by Hoory et al. (±0.003 Å) corresponds to about ±300 cm^{-1} for the higher series members. The $2s6d\ ^3D$ term of Hoory et al. has been omitted as an apparent misidentification, and a few other levels based on single weak lines and/or inconsistent classifications have also been omitted. Isoelectronic regularities were used in deciding whether to retain certain levels. Several levels are given here as tentative.

We derived a value of 3 842 600 cm^{-1} for the ionization energy by fitting Ritz formulae to the $2snd\ ^3D_3$, $2snd\ ^1D_2$, and $2pnd\ ^1F_3^{\circ}$ series ($n=3$, 4, 5), the latter series approaching the Si XII $2p\ ^2P_{3/2}^{\circ}$ limit. The value obtained from Edlén's [1971] ionization-energy formula for the isoelectronic sequence, 3 842 140 cm^{-1}, is however well within the range of values consistent with the series data. The latter value (rounded to the nearest 100 cm^{-1}) is adopted here, since it is near the average of the above value from the series and a lower value we obtained from semi-empirical formulae for corrections to theoretical values along the sequence.

Glass gives configuration-interaction eigenvectors for the $2s^2$, $2s2p$, and $2p^2$ terms. The configurational purities of these terms are high except for a 5.9% mixing of the $2s^2\ ^1S$ and $2p^2\ ^1S$ terms. Eigenvectors have also been calculated for the $2s3p$ terms [Odabasi]. The $2s3p\ ^1P^{\circ}$ eigenvector includes 10.0% $2p3s\ ^1P^{\circ}$ and 0.97% $2p3d\ ^1P^{\circ}$ contributions. The former interaction presumably accounts for most of the depression of the $2s3p\ ^1P^{\circ}$ level to a position some 3900 cm^{-1} *below* the calculated $2s3p\ ^3P^{\circ}$ term; the largest percentages from other configurations in the $2s3p\ ^3P^{\circ}$ eigenvector are only 0.77% $2p3s\ ^3P^{\circ}$ and 1.3% $2p3d\ ^3P^{\circ}$ [Odabasi]. The $2s3p\ ^3P^{\circ}$ term is the lowest term missing from the analysis.

Transitions of the type $1s^22s^M2p^N$—$1s2s^M2p^{N+1}$ ($M+N=2$) in Be-like ions have been identified as contributing to satellite features near the $1s^2$—$1s2p$ resonance lines of the corresponding He-like ions in the spectra of a number of elements [see, e.g., Boiko et al.]. The levels from *K*-shell excitations given here ($1s2s^22p$, $1s2s2p^2$, and $1s2p^3$ configurations) were derived by combining the calculated wavelengths of such lines near 6.8 Å [Boiko et al.] with experimental values of the lower levels and rounding to the nearest 100 cm^{-1}. The theoretical wavelengths of several features of this type in, for example, Mg IX were confirmed by the measurements of Boiko et al. to within an experimental uncertainty of ±0.002 Å, which would correspond to ±4000 to ±5000 cm^{-1} for the equivalent Si XI features. Safronova and Lisina give a complete list of calculated wavelengths and other quantities for the transition arrays of the above type; only a selection from those upper levels likely to contribute to stronger features is included here. In an analysis of the spectra of foil-excited silicon beams, Träbert et al. [1979a] assigned three features near 6.8 Å to Si XI transitions of the above type, the measured wavelengths being consistent with the calculated values from Boiko et al.

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Si XI

Configuration	Term	J	Level (cm^{-1})
$2s^2$	^{1}S	0	0
$2s2p$	^{3}P$^\circ$	0	*169 802*
		1	*172 144*
		2	*177 318*
$2s2p$	^{1}P$^\circ$	1	*329 679*
$2p^2$	^{3}P	0	443 670
		1	446 494
		2	450 965
$2p^2$	^{1}D	2	495 201
$2p^2$	^{1}S	0	608 758
$2s3s$	^{3}S	1	2 210 700
$2s3s$	^{1}S	0	2 241 810
$2s3p$	^{1}P$^\circ$	1	*2 285 040*
$2s3d$	^{3}D	1	
		2	2 332 050
		3	2 332 520
$2s3d$	^{1}D	2	2 361 290
$2p3s$	^{3}P$^\circ$	2	*2 430 220?*
$2p3s$	^{1}P$^\circ$	1	*2 470 820?*
$2p3p$	^{3}D	3	2 487 320
$2p3p$	^{3}S	1	2 500 420
$2p3p$	^{3}P	0	2 507 170?
		1	2 510 130
		2	2 512 380
$2p3d$	^{1}D$^\circ$	2	*2 525 040*
$2p3p$	^{1}D	2	2 532 420
$2p3d$	^{3}D$^\circ$	1	
		2	*2 547 100*
		3	*2 549 470*
$2p3d$	^{3}P$^\circ$	2	*2 556 770*
		1	*2 558 230*
		0	
$2p3d$	^{1}F$^\circ$	3	*2 582 930*
$2s4p$	^{1}P$^\circ$	1	*2 983 740?*
$2s4d$	^{3}D	1,2	2 998 380
		3	2 998 510
$2s4d$	^{1}D	2	3 007 770
$2s4f$	^{3}F$^\circ$	2,3,4	*3 009 720*
$2p4p$	^{3}D	3	3 180 500?
$2p4p$	^{3}P	2	3 187 370?
$2p4d$	^{1}D$^\circ$	2	*3 193 530?*
$2p4p$	^{1}D	2	3 194 190?
$2p4d$	^{3}D$^\circ$	3	*3 203 130*
$2p4d$	^{3}P$^\circ$	2	*3 204 950?*
$2p4d$	^{1}F$^\circ$	3	*3 214 660*
$2s5d$	^{3}D	2,3	3 304 400
$2s5d$	^{1}D	2	3 308 260
$2p5d$	^{1}F$^\circ$	3	*3 511 520?*
Si XII (^{2}S$_{1/2}$)	***Limit***		**3 842 100**

Si XI—Continued

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
Si XII ($^2P^\circ_{1/2}$)	*Limit*		*4 034 160*	$1s(^2S)2s2p^2(^2D)$	^1D	2	[14 990 300]
Si XII ($^2P^\circ_{3/2}$)	*Limit*		*4 042 340*	$1s(^2S)2s2p^2(^2P)$	^3P	2	[14 999 200]
$1s2s^2 2p$	$^1P^\circ$	1	[*14 748 800*]	$1s(^2S)2s2p^2(^2P)$	^1P	1	[15 062 000]
$1s(^2S)2s2p^2(^2D)$	^3D	3	[14 876 500]	$1s2p^3$	$^1D^\circ$	2	[*15 176 300*]
		2	[14 877 400]				
		1	[14 878 100]	$1s2p^3$	$^3P^\circ$	2	[*15 189 100*]
$1s(^2S)2s2p^2(^4P)$	^3P	0	[14 879 500]	$1s2p^3$	$^1P^\circ$	1	[*15 261 900*]
		1	[14 882 800]				
		2	[14 887 500]				

Si XII

$Z=14$

Li I isoelectronic sequence

Ground state $1s^22s\ ^2S_{1/2}$

Ionization energy 4 221 670 ± 300 cm^{-1} (523.425 ± 0.04 eV)

The $1s^22s$—$1s^22p$ resonance lines have been measured in both laboratory and astrophysical spectra. The $2p\ ^2P^\circ$ levels here are from solar-spectrum observations by Behring et al. and should be accurate to about ±5 cm^{-1}. We have determined the other levels using mainly the short-wavelength observations (25–46 Å) by Feldman et al. and the measurements of the $3l$–$4l'$ lines by Fawcett and Ridgeley. The $3s$, $3p$, and $3d$ levels are probably accurate to about ±300 cm^{-1}, but the probable errors of the $3p\ ^2P^\circ$ and $3d\ ^2D$ fine-structure intervals are less than 100 cm^{-1} (see below).

The $3d\ ^2D$ term position is from Ferner's [1941] wavelengths for the $2p$–$3d$ lines, the $2p\ ^2P^\circ_{3/2}$—$3d\ ^2D_{5/2,3/2}$ line being treated as a blend with statistical intensities. The $3d\ ^2D$ fine-structure interval of 860 cm^{-1} given by these measurements has, however, been decreased to 690 cm^{-1} to agree with observations of the two $3d$–$4f$ lines near 130 Å and an adopted theoretical (hydrogenic) value of 160 cm^{-1} for the $4f\ ^2F^\circ$ interval. The wavenumbers of the $3d\ ^2D_{3/2}$—$4f\ ^2F^\circ_{5/2}$ and $3d\ ^2D_{5/2}$—$4f\ ^2F^\circ_{7/2,5/2}$ lines measured by Fawcett and Ridgeley are probably accurate to about ±60 cm^{-1}; the adjusted $3d\ ^2D$ interval should have a comparable accuracy, and the error of the $4f\ ^2F^\circ$ levels relative to the ground level is probably not significantly greater than that of the $3d\ ^2D$ levels (∼±300 cm^{-1}).

The $4p\ ^2P^\circ$ and $4d\ ^2D$ levels should also be accurate to about ±300 cm^{-1}, being derived from the $3s$–$4p$ and $3p$–$4d$ lines measured by Fawcett and Ridgeley to about ±70 cm^{-1}. The agreement of the $4d\ ^2D$ fine-structure interval with the value expected from the approximate $(n^*)^{\ 3}$ dependence of this quantity confirms the $3p\ ^2P^\circ$ interval to about ± 50 cm^{-1}. The $4p\ ^2P^\circ$ interval is larger than the expected value by about Fawcett and Ridgeley's uncertainty.

The $n=3$ levels and the $4f\ ^2F^\circ$ levels are rounded to the nearest 10 cm^{-1}, and the other $n\geqslant4$ levels are rounded to the nearest 50 cm^{-1}. The $3d$ and $4f$ levels are given in brackets to indicate adjusted or assumed fine-structure intervals. The other $1s^2nl$ levels given in brackets are based on series or other regularities, as explained below.

The $nd\ ^2D$ ($n=3$–7) and $ns\ ^2S$ ($n=2$, 3, 5) terms exhibit regular series behavior to well within the experimental errors; we derived the values 4 222 000 cm^{-1} and 4 221 800 cm^{-1}, respectively, for the Si XIII $1s^2\ ^1S_0$ limit from these two series. The limit value derived by assumption of an almost hydrogenic position for the $4f\ ^2F^\circ$ term should be more accurate, the largest expected error then deriving from the error of the $3d\ ^2D$ term. If the experimental $4f\ ^2F^\circ$ term is taken to lie at the Dirac-Sommerfeld position corrected to include a small polarization energy [Edlén, 1979], we obtain the limit value 4 221 590 cm^{-1}. We have adopted the value 4 221 670±300 cm^{-1} as a weighted average of the limit determinations. This value agrees with the value 4 221 723 cm^{-1} obtained by Edlén from an isoelectronic formula and also, to within the probable errors, with the value 4 221 460 cm^{-1} derived by Ferner by extrapolation of the isoelectronic data for $3d\ ^2D$ available in 1948.

The wavelength of the $2s\ ^2S$—$5p\ ^2P^\circ$ line measured by Feldman et al. (27.909 Å) is 0.010 Å longer than the value predicted by the other members of the $np\ ^2P^\circ$ series ($n=2$–7). We obtained values of the $5p$, $6p$, and $7p\ ^2P^\circ$ levels given here from series formulae derived by fitting the lower members.

The $4s\ ^2S$ and $8d$, $9d\ ^2D$ terms were also obtained from formulae we derived for these series. Feldman et al. did not observe the $2p$–$4s$ line, but the $2p$–$8d$ and $2p$–$9d$ lines (∼26 Å) were observed by Tondello with uncertainties of ±0.03 Å. The corresponding wavelengths calculated from the levels given here should have errors less than 0.01 Å.

Tondello also observed the $3d$–$5f$ line near 89 Å. The $5f\ ^2F^\circ$ position given here was obtained from our value for the limit and a $5f$ term defect derived as described above for $4f$. The higher nf terms and all the nl terms having $l\geqslant4$ can be taken at the Dirac-Sommerfeld positions, the resulting levels then having the same error as the limit (±300 cm^{-1}). Träbert et al. [1979b] included transitions from Si XII $4f$, $5g$, $6h$, and $7i$ terms in their classifications of lines observed by foil excitation.

The $4f\ ^2F^\circ$ fine-structure interval given here is a (hydrogenic) theoretical value, and the ionization limit is partly based on the assumption of a near-hydrogenic absolute energy for the $4f\ ^2F^\circ$ term. The $5f\ ^2F^\circ$ term was derived from the same assumption. With these exceptions all levels have been obtained from the Si XII data or from series formulae derived from those data. The entire spectrum arising from levels below the limit is thus predictable. Edlén has given formulae for predicting the Li I-like spectra based on isoelectronic regularities and extrapolations. The levels from his formulae and the corresponding values here agree to well within the expected uncertainties.

The terms of the lowest configurations having K-shell excitation, $1s2s^2$, $1s2s2p$, and $1s2p^2$, are included in the table. Spectral features due to such configurations have been observed near or blended with the Si XIII $1s^2\ ^1S_0$—$1s2p\ ^1P^\circ$, $^3P^\circ$ resonance lines in the 6.7 Å region. Transitions from the $1s2s2p$ and $1s2p^2$ doublet terms (to $1s^22s\ ^2S$ and $1s^22p\ ^2P^\circ$, respectively) are among the strongest contributors to such features in the spectra of laser-produced plasmas [see, e.g., Aglitskii et al., 1974, and Boiko, et al., 1978a]. Since the experimental wavelengths obtained for such features usually refer to unresolved blends of several lines, we list the levels as derived from energy separations calculated by Vainshtein and Safronova [1975; see also their 1978 paper]. The $1s2s^2$ and $1s2p^2$ levels were evaluated by combining the calculated separations with the $1s^22p$ ^{2}P° levels given here, all the K-excitation levels being rounded to the nearest 100 cm^{-1}. The best available measurements indicate that the calculated levels are probably accurate to within the experimental uncertainties of about ±4000 cm^{-1}. The calculated fine-structure splittings of these terms should be relatively accurate; for example, the splittings of the $1s2s2p$ ^{4}P° and $1s2p^2$ ^{4}P terms here agree with those calculated by Cheng et al. to within 100 cm^{-1}.

The energies of levels of some still higher excited-core configurations, such as those of the type $1s2l3l'$ for example, have also been calculated, and features classified as arising from such levels have been observed as satellites of the Si XIII $1s^2$—$1s2p$ and $1s^2$—$1s3p$ resonance lines [Boiko et al., 1978b, and references therein; a more complete list of calculated wavelengths is given by Vainshtein and Safronova, 1980]. Träbert et al. [1979a] included transitions from K-excitation configurations in their classifications of a number of features observed in foil-excited Si spectra. Träbert and Fawcett [1979] and Wakid et al. [1980] give calculated wavelengths or energy separations involving configurations of the type $1s2lnl'$ (up to $nl'=5p$) and discuss possible classifications of some of the features observed by Träbert et al.

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Si XII

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$1s^2\,2s$	^{2}S	1/2	0	$1s^2\,5p$	^{2}P°	1/2	[*3 584 150*]
$1s^2\,2p$	^{2}P°	1/2	*192 062*			3/2	[*3 584 650*]
		3/2	*200 238*	$1s^2\,5d$	^{2}D	3/2	3 588 900
$1s^2\,3s$	^{2}S	1/2	2 388 870			5/2	3 589 050
$1s^2\,3p$	^{2}P°	1/2	*2 441 940*	$1s^2\,5f$	^{2}F°	5/2,7/2	[*3 589 450*]
		3/2	*2 444 330*	$1s^2\,6p$	^{2}P°	1/2	[*3 779 500*]
$1s^2\,3d$	^{2}D	3/2	[2 463 790]			3/2	[*3 779 800*]
		5/2	[2 464 480]	$1s^2\,6d$	^{2}D	3/2,5/2	3 782 700
$1s^2\,4s$	^{2}S	1/2	[3 202 100]	$1s^2\,7p$	^{2}P°	1/2	[*3 897 150*]
$1s^2\,4p$	^{2}P°	1/2	*3 223 450*			3/2	[*3 897 350*]
		3/2	*3 224 550*	$1s^2\,7d$	^{2}D	3/2,5/2	3 899 150
$1s^2\,4d$	^{2}D	3/2	3 232 700	$1s^2\,8d$	^{2}D	3/2,5/2	[3 974 800]
		5/2	3 233 000	$1s^2\,9d$	^{2}D	3/2,5/2	[4 026 700]
$1s^2\,4f$	^{2}F°	5/2	[*3 233 670*]				
		7/2	[*3 233 830*]	……………	……………	……………	……………
$1s^2\,5s$	^{2}S	1/2	3 573 450	Si XIII ($^1S_0$)	***Limit***		**4 221 670**

Si XII—Continued

Configuration	Term	J	Level (cm^{-1})	Configuration	Term	J	Level (cm^{-1})
$1s2s^2$	^2S	$\frac{1}{2}$	[14 682 800]	$1s(^2S)2s2p(^1P^\circ)$	$^2P^\circ$	$\frac{1}{2}$	*[14 950 000]*
						$\frac{3}{2}$	*[14 952 100]*
$1s(^2S)2s2p(^3P^\circ)$	$^4P^\circ$	$\frac{1}{2}$	*[14 732 300]*				
		$\frac{3}{2}$	*[14 734 400]*	$1s2p^2$	^2D	$\frac{5}{2}$	[15 032 700]
		$\frac{5}{2}$	*[14 739 900]*			$\frac{3}{2}$	[15 033 800]
$1s(^2S)2s2p(^3P^\circ)$	$^2P^\circ$	$\frac{1}{2}$	*[14 880 900]*	$1s2p^2$	^2P	$\frac{1}{2}$	[15 057 200]
		$\frac{3}{2}$	*[14 885 300]*			$\frac{3}{2}$	[15 065 000]
$1s2p^2$	^4P	$\frac{1}{2}$	[14 936 800]	$1s2p^2$	^2S	$\frac{1}{2}$	[15 167 600]
		$\frac{3}{2}$	[14 940 400]				
		$\frac{5}{2}$	[14 944 500]	Si XIII $1s2s(^3S_1)$	*Limit*		[19 057 600]

Si XIII

$Z=14$

He I isoelectronic sequence

Ground state $1s^2\ ^1S_0$

Ionization energy 19 660 800 ± 800 cm^{-1} (2437.65 ± 0.10 eV)

The observations by Aglitskii et al. of the $1s^2\ ^1S_0$—$1s2p\ ^3P_1^\circ$ and $1s^2\ ^1S_0$—$1snp\ ^1P_1^\circ$ ($n=2$–5) lines in the 5–7 Å region, which are probably the most accurate available measurements of these resonance wavelengths, have uncertainties corresponding to about ±3500 cm^{-1} for the $1s^2$—$1s2p$ energy separations. The estimated uncertainty of the calculated levels given here is much smaller, the uncertainty of ±800 cm^{-1} given above for the ionization energy being also the approximate uncertainty of all the excited levels with respect to the ground level. Except as noted below, the $1sns$ and $1snp$ levels for $n=2$–5 have been obtained by combining the term values (binding energies) calculated by Ermolaev and Jones with Safronova's calculated value for the Si XIV $1s\ ^2S_{1/2}$ limit, quoted above. (The limit is rounded to the nearest 10 cm^{-1}, as are several energy differences quoted in this paragraph.) The need for certain higher-order contributions to the Lamb shift of the $1s^2\ ^1S_0$ term included in Safronova's calculation has been confirmed for S XV by recent measurements of the $1s^2\ ^1S_0$—$1s2p\ ^1P_1^\circ$ and $1s^2\ ^1S_0$—$1s2p\ ^3P_1^\circ$ resonance-line wavelengths [Schleinkofer et al., 1982]. The differences between the experimental wavenumbers of these S XV lines and the corresponding wavenumbers obtained by combining Safronova's S XVI $1s\ ^2S_{1/2}$ limit value with the $1s2p$ terms of Ermolaev and Jones, as above, are +450(±730) cm^{-1} for the $^1P_1^\circ$ transition and −680 (±890) cm^{-1} for the $^3P_1^\circ$ transition, the experimental uncertainties of Schleinkofer et al. being quoted in parentheses. We have taken this agreement of the calculated and observed values as experimental confirmation of the calculated energies to within an uncertainty of about ±1000 cm^{-1} for S XV, the equivalent fractional uncertainty for Si XIII being about ±750 cm^{-1}. Ermolaev and Jones' calculated $1s\ ^2S_{1/2}$ limit is 744 cm^{-1} higher than Safronova's value, but a comparison of the wavelengths for several Si XIII $1s^2$—$1snl$ transitions ($n=2$, 3) predicted by Ermolaev's 1977 calculations with corresponding values obtained from the levels here indicates that Ermolaev's revised (unpublished) limit value probably agrees with Safronova's value to within about 200 cm^{-1}.

The best measurements of the resonance lines of Mg XI and Al XII are also more accurate than those for Si XIII [see Martin, 1981, for references], with fractional uncertainties which would correspond to about ±1500 cm^{-1} for Si XIII. The resonance-line wavelengths predicted for these spectra by the same combination of theoretical results as used here are again in excellent agreement with the observations.

The $1s2s\ ^3S_1$—$1s2p\ ^3P_0^\circ$ and $1s2s\ ^3S_1$—$1s2p\ ^3P_2^\circ$ separations have been determined to ±4 and ±3 cm^{-1}, respectively, from measurements of the spectra of foil-excited beams [DeSerio et al.]. The separations of these three levels as calculated by Ermolaev and Jones have here been adjusted to the experimental separations by additions of −12, −11, and +20 cm^{-1} to the $^3S_1$, $^3P_0^\circ$, and $^3P_2^\circ$ levels, respectively. DeSerio et al. include calculations of the above separations and references to other experimental and theoretical results for these separations in Si XIII and other He I-like spectra.

No other Si XIII $1s2l$ term differences have been determined with comparable accuracy, and uncertainties of a few hundred cm^{-1} should probably be assumed for the theoretical values not tested by experiment. Ermolaev and Jones' value for the $1s2p\ ^3P_1^\circ$–$^1P_1^\circ$ separation in S XV agrees to within less than 100 cm^{-1} with two different values for this separation obtained from calculated energies quoted by Schleinkofer et al. The largest discrepancies between the calculations of Si XIII $1s2l$ terms by Safronova as compared with those by Ermolaev and Jones occur for the $1s2s\ ^1S_0$ and $1s2p\ ^1P_1^\circ$ levels; the discrepancies are comparable in magnitude but of opposite sign, so that the respective predicted values for the $1s2s\ ^1S_0$—$1s2p\ ^1P_1^\circ$ separation differ by 702 cm^{-1}. The $1s2s$ and $1s2p$ triplet-singlet mean term values from Safronova's calculations agree with the corresponding values from Ermolaev and Jones to within 200 cm^{-1}.

The $1sns$ and $1snp$ terms for $n=5$–10 and the $1snl$ terms for $n\geqslant3$, $l\geqslant2$ (given complete through $n=6$) were calculated with series formulae [Martin] and the adopted limit. The various theoretical results used in evaluating the formulae constants for all the $l\leqslant3$ series are cited in the reference. The formulae predict the values of all terms below the $1s\ ^2S$ limit, the terms for $l\geqslant4$ being taken at the hydrogenic relativistic positions for $Z_c=13$.

The $1s3d\ ^3D_2$—$^3D_1$ fine-structure interval of 29 cm^{-1} is from Vainshtein and Safronova's [1976] calculation. No calculations of the fine structures of the higher $1snd\ ^3D$ terms are available, and the assumption of relatively small $^3D_2$—$^3D_1$ intervals for these terms may not be correct [Martin].

No lines belonging to Si XIII transition arrays of the type $1snl$—$1sn'l'$ ($2\leqslant n<n'$) have been observed with sufficient accuracy to test the calculated level separations. The predicted separations most likely to be of interest are probably accurate to within errors varying from a few parts in 10^5 to amounts larger than 1 part in 10^4. The levels are given to

the nearest cm^{-1} only to facilitate accurate comparisons of some predictions of possible interest (fine-structure intervals, separations of some higher-lying terms, etc.).

Transitions of the type 1*snl*—2*l*′*nl*″ ($n \geqslant 2$) from doubly-excited configurations in Si XIII can give rise to satellite features near the Si XIV 1*s* ^{2}S—2*p* ^{2}P° resonance doublet at 6.18 Å. Boiko et al., for example, compare experimental and calculated intensities of several such features as observed in spectra of laser-produced plasmas. Most of the satellite lines are classified as blends of two or more transitions, the stronger features being assigned to 2*s*2*p* and 2*p*^{2} upper ~~configurations. The relative positions of the 2*s*^{2},~~ 2*s*2*p*, and 2*p*^{2} configurations given here are from calculations by Vainshtein and Safronova [1976]; their values with respect to the ground level were reduced by 2200 cm^{-1}, so that the wavelengths for the important transitions of the type 1*s*2*l*—2*l*2*l*′ given by the levels here agree with the corresponding wavelengths calculated by Vainshtein and Safronova [1978] to within 0.0002 Å (±500 cm^{-1}). The experimental wavelengths of the stronger features measured by Boiko et al., which are probably accurate to about ±0.0010 to ±0.0015 Å, in general agree with the calculated wavelengths to within such errors. We list the levels to the nearest 100 cm^{-1}.

The still higher configurations of the type 2*l*′*nl*″ ($n \geqslant 3$) can give rise to satellites of both the 1*s*–2*p* and 1*s*–*np* ~~resonance lines of Si XIV, the two transition types being~~ 1*snl*—2*l*′*nl*″ and 1*s*2*l*—2*l*′*nl*″. Some features nearest to the Si XIV 1*s* ^{2}S—2*p* ^{2}P° doublet were classified as blends of Si XIII transitions of the first type (for $n=3$) in the spectra observed by Boiko et al. Vainshtein and Safronova [1980] give calculated wavelengths for such transitions.

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Si XIII

Configuration	Term	J	Level (cm^{-1})
1*s*^{2}	^{1}S	0	0
1*s*2*s*	^{3}S	1	[14 835 945]
1*s*2*p*	^{3}P°	0	[*14 949 760*]
		1	[*14 951 545*]
		2	[*14 958 691*]
1*s*2*s*	^{1}S	0	[14 958 753]
1*s*2*p*	^{1}P°	1	[*15 042 040*]
1*s*3*s*	^{3}S	1	[17 546 734]
1*s*3*p*	^{3}P°	0	[*17 578 029*]
		1	[*17 578 568*]
		2	[*17 580 689*]
1*s*3*s*	^{1}S	0	[17 579 166]
1*s*3*d*	^{3}D	1	[17 598 002]
		2	[17 598 031]
		3	[17 598 849]
1*s*3*d*	^{1}D	2	[17 599 605]
1*s*3*p*	^{1}P°	1	[*17 603 422*]
1*s*4*s*	^{3}S	1	[18 479 389]
1*s*4*p*	^{3}P°	0	[*18 492 307*]
		1	[*18 492 537*]
		2	[*18 493 430*]
1*s*4*s*	^{1}S	0	[18 492 532]
1*s*4*d*	^{3}D	1,2	[18 500 576]
		3	[18 500 926]
1*s*4*d*	^{1}D	2	[18 501 245]
1*s*4*f*	^{3}F°,^{1}F°	2,3,3,4	[*18 501 452*]
1*s*4*p*	^{1}P°	1	[*18 502 736*]
1*s*5*s*	^{3}S	1	[18 907 613]
1*s*5*p*	^{3}P°	0	[*18 914 144*]
		1	[*18 914 262*]
		2	[*18 914 719*]

Si XIII—Continued

Configuration	Term	J	Level (cm^{-1})
$1s5s$	^1S	0	[18 914 246]
$1s5d$	^3D	1,2	[18 918 351]
		3	[18 918 530]
$1s5d$	^1D	2	[18 918 694]
$1s5f$	$^3F^\circ, ^1F^\circ$	2,3,3,4	[*18 918 801*]
$1s5g$	$^3G, ^1G$	3,4,4,5	[18 918 894]
$1s5p$	$^1P^\circ$	1	[*18 919 421*]
$1s6s$	^3S	1	[19 139 084]
$1s6p$	$^3P^\circ$	0	[*19 142 846*]
		1	[*19 142 915*]
		2	[*19 143 179*]
$1s6s$	^1S	0	[19 142 875]
$1s6d$	^3D	1,2	[19 145 268]
		3	[19 145 372]
$1s6d$	^1D	2	[19 145 467]
$1s6f$	$^3F^\circ, ^1F^\circ$	2,3,3,4	[*19 145 529*]
$1s6g$	$^3G, ^1G$	3,4,4,5	[19 145 579]
$1s6h$	$^3H^\circ, ^1H^\circ$	4,5,5,6	[*19 145 610*]
$1s6p$	$^1P^\circ$	1	[*19 145 877*]
$1s7s$	^3S	1	[19 278 195]
$1s7p$	$^3P^\circ$	0	[*19 280 555*]
		1	[*19 280 598*]
		2	[*19 280 764*]
$1s7s$	^1S	0	[19 280 567]
$1s7p$	$^1P^\circ$	1	[*19 282 456*]
$1s8s$	^3S	1	[19 368 266]
$1s8p$	$^3P^\circ$	0	[*19 369 843*]
		1	[*19 369 872*]
		2	[*19 369 984*]
$1s8s$	^1S	0	[19 369 848]
$1s8p$	$^1P^\circ$	1	[*19 371 113*]
$1s9s$	^3S	1	[19 429 907]
$1s9p$	$^3P^\circ$	0	[*19 431 012*]
		1	[*19 431 033*]
		2	[*19 431 111*]
$1s9s$	^1S	0	[19 431 014]
$1s9p$	$^1P^\circ$	1	[*19 431 902*]
$1s10s$	^3S	1	[19 473 934]
$1s10p$	$^3P^\circ$	0	[*19 474 739*]
		1	[*19 474 754*]
		2	[*19 474 811*]
$1s10s$	^1S	0	[19 474 740]
$1s10p$	$^1P^\circ$	1	[*19 475 387*]
Si XIV ($^2S_{1/2}$)	***Limit***		**[19 660 800]**
$2s^2$	^1S	0	[30 812 900]
$2s2p$	$^3P^\circ$	0	[*30 839 900*]
		1	[*30 843 900*]
		2	[*30 853 000*]
$2p^2$	^3P	0	[30 942 600]
		1	[30 947 300]
		2	[30 954 800]
$2p^2$	^1D	2	[31 007 100]
$2s2p$	$^1P^\circ$	1	[*31 014 400*]
$2p^2$	^1S	0	[31 177 700]
Si XIV $2p$($^2P^\circ_{1/2}$)	***Limit***		[*35 826 800*]

Si XIV

$Z=14$

H I isoelectronic sequence

Ground state 1*s* $^2S_{1/2}$

Ionization energy 21 560 658 ± 80 cm^{-1} (2673.202 ± 0.012 eV)

The values of all the levels except 1*s* $^2S_{1/2}$ and 2*s* $^2S_{1/2}$ were obtained by combining term values calculated by Erickson with the ionization energy listed here. Practically all of the uncertainty in the calculated absolute energy of the 1*s* $^2S_{1/2}$ ground level is due to the self-energy contribution to the Lamb shift. The values for this self energy obtained from calculations by Mohr [1974] and by Sapirstein are less than Erickson's value by 57 and 81 cm^{-1}, respectively, for $Z=14$. The ionization energy given here is 57 cm^{-1} greater than Erickson's value, and thus represents Mohr's result for the self energy combined with Erickson's values for all the other contributions. The uncertainty is perhaps somewhat conservatively taken as equal to the largest difference between the three cited calculations of the self energy; the errors estimated by Erickson, Mohr, and Sapirstein for their respective results correspond to ±8, ±19, and ±13 cm^{-1}. The error in the ionization energy also applies to all the excited levels with respect to the ground level. The error for the ionization energy in units of eV includes the uncertainty of the conversion factor.

The position of the 2*s* $^2S_{1/2}$ level is taken to give a 2*s* $^2S_{1/2}$—2*p* $^2P^{\circ}_{1/2}$ Lamb shift of 531 cm^{-1}, in agreement with Mohr's calculation [1975] as evaluated for Si XIV by Kugel and Murnick. Erickson's value for this separation is 537.5 cm^{-1}. We list all levels (to the nearest cm^{-1}) through $n=5$ and the *ns* and *np* levels through $n=10$. Erickson's table of levels is complete through $n=11$ and has the *ns*, *np*, and *nl* ($l=n-1$) levels through $n=20$.

The experimental uncertainties of wavelength measurements made thus far in the region of the Si XIV 1*s*–*np* resonance series are very large in comparison with the estimated errors in the theoretical wavelengths. Aglitskii et al. measured the two wavelengths of the 1*s* ^2S—2*p* $^2P^{\circ}$ doublet near 6.18 Å with stated uncertainties of ±0.0010 Å, which corresponds to ±2600 cm^{-1}. Their results agree with the calculated values of the levels given here to within this uncertainty, but an improvement of the experimental accuracy by about two orders of magnitude would apparently be necessary to test the theoretical results.

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Si XIV

Configuration	Term	*J*	Level (cm^{-1})
1*s*	^2S	1/2	0
2*p*	$^2P^{\circ}$	1/2	[*16 165 987*]
		3/2	[*16 180 140*]
2*s*	^2S	1/2	[16 166 518]
3*p*	$^2P^{\circ}$	1/2	[*19 164 600*]
		3/2	[*19 168 794*]
3*s*	^2S	1/2	[19 164 761]
3*d*	^2D	3/2	[19 168 787]
		5/2	[19 170 178]
4*p*	$^2P^{\circ}$	1/2	[*20 213 538*]
		3/2	[*20 215 307*]
4*s*	^2S	1/2	[20 213 606]
4*d*	^2D	3/2	[20 215 304]
		5/2	[20 215 891]
4*f*	$^2F^{\circ}$	5/2	[*20 215 890*]
		7/2	[*20 216 183*]
5*p*	$^2P^{\circ}$	1/2	[*20 698 801*]
		3/2	[*20 699 706*]
5*s*	^2S	1/2	[20 698 836]
5*d*	^2D	3/2	[20 699 705]
		5/2	[20 700 005]

Si XIV—Continued

Configuration	Term	J	Level (cm^{-1})
$5f$	$^2F^\circ$	$5/2$	[*20 700 005*]
		$7/2$	[*20 700 155*]
$5g$	^2G	$7/2$	[20 700 155]
		$9/2$	[20 700 245]
$6p$	$^2P^\circ$	$1/2$	[*20 962 298*]
		$3/2$	[*20 962 822*]
$6s$	^2S	$1/2$	[20 962 318]
$7p$	$^2P^\circ$	$1/2$	[*21 121 130*]
		$3/2$	[*21 121 460*]
$7s$	^2S	$1/2$	[21 121 143]
$8p$	$^2P^\circ$	$1/2$	[*21 224 195*]
		$3/2$	[*21 224 416*]
$8s$	^2S	$1/2$	[21 224 204]
$9p$	$^2P^\circ$	$1/2$	[*21 294 843*]
		$3/2$	[*21 294 998*]
$9s$	^2S	$1/2$	[21 294 849]
$10p$	$^2P^\circ$	$1/2$	[*21 345 369*]
		$3/2$	[*21 345 482*]
$10s$	^2S	$1/2$	[21 345 373]
	Limit		**[21 560 658]**