Energy Levels of Cobalt, Co I through Co XXVII

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The energy levels of the cobalt atom in all of its stages of ionization, derived from analyses of atomic spectra, have been critically compiled. In cases where only line classifications are reported in the literature, level values have been derived. Electron configurations, term designations, *J*-values, experimental *g*-values, leading percentages and ionization energies are included.

Key words: Atomic energy levels; atomic spectra; cobalt; cobalt energy levels; spectra.

Contents

1. Introduction

At the time of the compilation of atomic energy levels by Bacher and Goudsmit in 1932, only the first 2 of the 27 spectra of cobalt had been studied. By 1952, Moore was able to compile levels for nine spectra of cobalt. At that time, oxygen was the heaviest atom for which some levels of all stages of ionization were known.

A great amount of new experimental work has been carried out since then, particularly in the higher stages of ionization. Today, energy level values and ionization potentials are available for nearly every stage of ionization of cobalt. This is the result of the development of more energetic light sources, which was stimulated by the need to interpret new spectroscopic observations of the sun at short wavelengths from rocket- and satellite-borne spectrographs. A new impetus for the interpretation of spectra of highly-ionized atoms has arisen from the investigation of hot laboratory plasmas generated to achieve controlled nuclear fusion.

As a result of these activities there is a substantial increase in spectroscopic information. Consequently, the earlier compilations of energy levels need revision. The NBS Atomic Energy Levels Data Center has undertaken to provide new compilations of energy levels, the program at present being concentrated on the elements hydrogen through nickel. The material on each atom and its ions is being published as a separate paper. Already completed are the compilations for the following elements: iron by Reader and Sugar (1975); calcium, chromium, scandium, and vanadium by Sugar and Corliss (1979, 1977, 1980, 1978); manganese, nickel, titanium, and potassium by Corliss and Sugar (1977, 1981, 1979a, 1979b); and aluminum, magnesium, and sodium by Martin and Zalubas (1979, 1980, 1981). The present work on cobalt completes a series of compilations for the iron period (K through Ni).

The present compilation comprises the energy levels of the cobalt atom and all of its ions. The first six spectra have been rather thoroughly investigated. For many of the higher ions the original papers do not give energy level values, but only classifications of observed lines. In these cases we have derived the level values. Generally we have used only published papers as sources of data. Unpublished data have been included when they constituted a substantial improvement over material in the literature.

Ionization energies found in the literature are usually given in eV or in cm^{-1}. The conversion factor, 8065.479 ± 0.021 cm^{-1}/eV, given by Cohen and Taylor (1973), is used here. In a few cases where adequate data were available but the ionization energy was not derived, we carried out the calculation. For a large number of ions, no suitable series are known. In these cases we have quoted values obtained by Lotz (1967) by a method of successive differences along isoelectronic sequences. Although uncertainties are not provided with these extrapolated values, we assume they are accurate to a few units of the last significant figure given.

Nearly all of the data are the result of observations of various types of laboratory light sources. However, they are sometimes supplemented by data obtained from solar observations. This is particularly true where spin-forbidden lines are needed to establish the absolute energy of a system of excited levels and also where parity-forbidden transitions between levels of a ground configuration are used to obtain accurate relative energies for the low levels. Whenever both solar data and equivalent laboratory data are available preference is generally given to the laboratory measurements.

When no observations are available to connect independent systems of levels, an estimate of the connecting energy is frequently made. Those level values affected by the estimate are denoted by $+x$ following the value. The value of x is the systematic error of the estimate. For Co XXVI and Co XXVII, which are isoelectronic with He I and H I, respectively, we give (in brackets) only calculated level values since they are at present more accurate than experimental x-ray wavelengths from which level values may be obtained.

For convenient general sources of wavelengths of cobalt lines we refer the reader to the compilation by Kelly and Palumbo (1973), to the tables of spectral lines in the CRC Handbook of Chemistry and Physics (1980), and to Tables of Spectral Line Intensities by Meggers, Corliss, and Scribner (1975).

We have included under the heading "Leading Percentages" the results of calculations that express the percentage composition of levels in terms of the basis states of a single configuration, or more than one configuration where configuration interaction has been included. Where these results contradict an experimentally based designation, we have accepted the theoretical term labeling of a level to conform with its calculated leading percentages. In cases where the leading percentage is low, no designation is given in the "Term" column.

In the "Leading percentages" column we give first the percentage of the basis state corresponding to the level's name (for unnamed levels, the term follows the percentages); next, the second largest percentage together with the related basis state.

Of course, a new calculation based on a different approximation, such as the introduction of configuration-interaction where none had been used before, might yield a different set of percentages. For some levels the percentages may change drastically in a new calculation. In the present tables, the percentages are taken mostly from published parametric calculations. When only *ab initio* calculations are found in the literature, we have used them if there appears to be a reasonable correspondence with the experimental data.

For configurations of equivalent *d*-electrons, several terms of the same *LS* type may occur. These are theoretically distinguished by their seniority number. In the present compilations they are designated in the notation of Nielson and Koster (1963). For example, in the $3d^5$ configuration there are three ^2D terms with seniorities of 1, 3, and 5. These terms are denoted as $^2D1$, $^2D2$, and $^2D3$, respectively, by Nielson and Koster. Martin, Zalubas, and Hagan (1978) give a complete summary of the coupling notations used here, tables of the allowed terms for equivalent electrons, etc. The prefixing of terms by lower case letters (for example $a\ ^5D$, $z\ ^5G$, etc.) has been dropped except for Co I, II, and III where its use in connection with tables of classified lines is established in the literature. These prefixes should not be confused with those used to indicate seniority.

In assembling the data for each spectrum, we referred to the following bibliographies:

i. Papers cited by Moore (1952)
ii. C. E. Moore (1969)
iii. L. Hagan and W. C. Martin (1972).
iv. L. Hagan (1977)
v. R. Zalubas and A. Albright (1980)
vi. Card file of publications since June 1979 maintained by the NBS Atomic Energy Levels Data Center

A selection of data that is the most accurate and reliable has been made. The text for each ion does not always include a complete review of the literature but is intended to credit the major contributions. This compilation includes all material available to us as of October 1980.

Acknowledgments

Throughout this work we have made extensive use of the bibliographical files and reprint collection maintained in the Atomic Energy Levels Data Center by Romuald Zalubas and Arlene Albright. Our thanks are extended to them for generous cooperation. The compilation has also benefited greatly from the preprints that were provided by many of our colleagues.

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Co I

$Z=27$

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^2\ ^4F_{9/2}$

Ionization energy = 63 430 cm^{-1} (7.864 eV)

The first regularities in the arc spectrum of cobalt were announced by Walters (1924) who classified 88 lines in 12 multiplets of the quartet system. The work was then taken up by Catalán who published a series of papers culminating in a rather complete analysis by Catalán and Antunes (1936). Meanwhile Russell, King, and Moore (1940) undertook the analysis by using wavelengths assembled from various sources covering the range of 1814 Å–11 895 Å and including the very precise interferometric determinations of Burns and Sullivan (1942). Their results are reported here.

The five-place g-values for the seven low levels were measured by Childs and Goodman (1968) in an atomic beam with an accuracy of 2 parts in the fifth place. The three-place g-values were calculated by Dorothy Weeks in 1951 from measurements of plates made at the Massachusetts Institute of Technology under the direction of G. R. Harrison. The two-place g-values were measured by R. B. King for the analysis by Russell et al.

The configuration assignments for the terms of $3d^8 4s$ and $3d^7 4s^2$ are those given by Racah (1942). The leading percentages of the $3d^8 4s$ terms are from the Hartree-Fock calculation of Vizbaraite, Rudzikas, and Grabauskas (1968).

The $3d^7 4s4p$ and $3d^8 4p$ configurations have been calculated by Roth (1970), with configuration interaction. We give his identifications and leading percentages. Roth distinguished the two ^2D terms of the $3d^7$ core by the letters a and b, rather than by seniority. The percentages include the sum of seniority states contributing to the term.

The alphabetic prefixing of terms with lower case letters for distinguishing terms of the same type has been retained from Russell et al. except where the levels were reinterpreted by Roth on the basis of his theoretical treatment. When the leading component is less than 40% the level name is usually omitted, but the prefix is included in the percentage column.

The ionization energy given here was obtained by Catalán and Velasco (1952) from a study of regularities along the iron period of the elements. It agrees well with the mean of the values found by Catalán and Antunes and by Russell et al. It is probably accurate to a part in a thousand.

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Co I

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^7 4s^2$	$a\ ^4F$	9/2	0.00	1.33289			
		7/2	816.00	1.23778			
		5/2	1 406.84	1.02826			
		3/2	1 809.33	0.39940			
$3d^8(^3F)4s$	$b\ ^4F$	9/2	3 482.82	1.33343	100		
		7/2	4 142.66	1.23661	98		
		5/2	4 690.18	1.02709	100		
		3/2	5 075.83	0.404	100		
$3d^8(^3F)4s$	$a\ ^2F$	7/2	7 442.41	1.147	98		
		5/2	8 460.81	0.862	100		
$3d^7 4s^2$	$a\ ^4P$	5/2	13 795.52	1.604			
		3/2	14 036.28	1.722			
		1/2	14 399.28	2.651			
$3d^8(^3P)4s$	$b\ ^4P$	5/2	15 184.04	1.515	84	16	$(^1D)\ ^2D$
		3/2	15 744.04	1.476	98		
		1/2	16 195.68	2.682	100		

Co I—Continued

Configuration	Term	J	Level (cm⁻¹)	g	Leading percentages		
$3d^7\,4s^2$	$a\ ^2G$	9/2	16 467.90	1.109			
		7/2	17 233.68	0.883			
$3d^8(^1D)4s$	$a\ ^2D$	3/2	16 470.60	1.101	96		
		5/2	16 778.16	1.296	83	16	$(^3P)\ ^4P$
$3d^8(^3P)4s$	$a\ ^2P$	3/2	18 389.57	1.300	98		
		1/2	18 775.01	0.695	100		
$3d^7\,4s^2$	$b\ ^2P$	3/2	20 500.71	1.284			
		1/2	21 215.90	0.680			
$3d^7\,4s^2$	$a\ ^2H$	11/2	21 780.47	1.100			
		9/2	22 475.36	0.921			
$3d^7\,4s^2$	$b\ ^2D$	5/2	21 920.09	1.180			
		3/2	23 152.57	0.955			
$3d^8(^1G)4s$	$b\ ^2G$	9/2	23 184.23	1.098	100		
		7/2	23 207.76	0.883	100		
$3d^7(^4F)4s4p(^3P°)$	$z\ ^6F°$	11/2	*23 611.78*	1.466	97		
		9/2	*23 855.62*	1.481	78	18	$^6D°$
		7/2	*24 326.11*	1.436	84	12	$^6D°$
		5/2	*24 733.28*	1.336	90	7	$^6D°$
		3/2	*25 041.16*	1.118	95		
		1/2	*25 232.79*	-0.622	99		
$3d^7(^4F)4s4p(^3P°)$	$z\ ^6D°$	9/2	*24 627.79*	1.569	78	17	$^6F°$
		7/2	*25 269.25*	1.550	83	11	$^6F°$
		5/2	*25 739.93*	1.612	87	6	$^6F°$
		3/2	*26 063.11*	1.812	91		
		1/2	*26 250.49*	3.286	94		
$3d^7(^4F)4s4p(^3P°)$	$z\ ^6G°$	13/2	*25 138.88*	1.40	100		
		11/2	*25 568.68*	1.354	96		
		9/2	*25 937.59*	1.281	94		
		7/2	*26 232.05*	1.150	94		
		5/2	*26 450.02*	0.876	95		
		3/2	*26 597.64*	0.006	97		
$3d^9$	$c\ ^2D$	5/2	27 497.06	1.200			
		3/2	28 470.51	0.907			
$3d^7(^4F)4s4p(^3P°)$	$z\ ^4F°$	9/2	*28 345.86*	1.330	82	15	$3d^8(^3F)4p\ ^4F°$
		7/2	*28 777.27*	1.247	80	13	
		5/2	*29 216.37*	1.033	82	13	
		3/2	*29 563.17*	0.410	85	13	
$3d^7(^4F)4s4p(^3P°)$	$z\ ^4G°$	11/2	*28 845.22*	1.276	95		
		9/2	*29 269.73*	1.175	90		
		7/2	*29 735.18*	0.995	91		
		5/2	*30 102.96*	0.577	94		
$3d^7(^4F)4s4p(^3P°)$	$z\ ^4D°$	7/2	*29 294.52*	1.425	53	42	$3d^8(^3F)4p\ ^4D°$
		5/2	*29 948.76*	1.359	57	36	
		3/2	*30 443.63*	1.192	62	33	
		1/2	*30 742.65*	-0.006	65	31	

Co I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^{7}(^{4}F)4s4p(^{3}P^{\circ})$	$z\ ^{2}G^{\circ}$	9/2	31 699.69	1.126	47		29	$3d^{8}(^{3}F)4p\ ^{4}G^{\circ}$
		7/2	32 733.07	0.899	41		29	$3d^{8}(^{3}F)4p\ ^{4}F^{\circ}$
$3d^{7}(^{4}F)4s4p(^{3}P^{\circ})$	$z\ ^{2}F^{\circ}$	7/2	31 871.15	1.777	66		28	$3d^{8}(^{3}F)4p\ ^{2}F^{\circ}$
		5/2	32 781.71	0.870	71		26	
$3d^{8}(^{3}F)4p$	$y\ ^{4}D^{\circ}$	7/2	32 027.50	1.395	46		45	$3d^{7}(^{4}F)4s4p(^{1}P^{\circ})\ ^{4}D^{\circ}$
		5/2	32 654.50	1.366	51		41	
		3/2	33 150.68	1.195	56		37	
		1/2	33 449.18	0.012	59		36	
$3d^{8}(^{3}F)4p$	$y\ ^{4}G^{\circ}$	11/2	32 430.59	1.287	94			
		9/2	32 464.73	1.154	53		28	$^{2}G^{\circ}$
		7/2	33 173.36	1.039	34		31	$^{2}G^{\circ}$
		5/2	33 674.38	0.704	52		30	$^{4}F^{\circ}$
$3d^{8}(^{3}F)4p$	$y\ ^{4}F^{\circ}$	9/2	32 841.99	1.313	51		22	$3d^{7}(^{4}F)4s4p(^{1}P^{\circ})\ ^{4}F^{\circ}$
		3/2	34 196.21	0.430	67		24	
$3d^{8}(^{3}F)4p$	$y\ ^{2}G^{\circ}$	9/2	33 439.72	1.165	56		27	$3d^{7}(^{4}F)4s4p(^{3}P^{\circ})\ ^{2}G^{\circ}$
		7/2	34 133.59	0.917	50		21	
$3d^{7}(^{4}F)4s4p(^{3}P^{\circ})$	$z\ ^{2}D^{\circ}$	5/2	33 462.83	1.186	53		42	$3d^{8}(^{3}F)4p\ ^{2}D^{\circ}$
		3/2	34 352.42	0.787	53		37	
$3d^{8}(^{3}F)4p$		7/2	33 466.87	1.155	33	$^{4}G^{\circ}$	25	$3d^{8}(^{3}F)4p\ ^{4}F^{\circ}$
$3d^{8}(^{3}F)4p$		5/2	33 945.90	0.900	42	$^{4}G^{\circ}$	38	$3d^{8}(^{3}F)4p\ ^{4}F^{\circ}$
$3d^{8}(^{3}F)4p$	$y\ ^{2}F^{\circ}$	7/2	35 450.56	1.145	61		25	$3d^{7}(^{4}F)4s4p(^{3}P^{\circ})\ ^{2}F^{\circ}$
		5/2	36 329.86	0.892	53		18	$3d^{8}(^{3}F)4p\ ^{2}D^{\circ}$
$3d^{8}(^{3}F)4p$	$y\ ^{2}D^{\circ}$	5/2	36 092.44	1.186	35		36	$3d^{7}(^{4}F)4s4p(^{3}P^{\circ})\ ^{2}D^{\circ}$
		3/2	36 875.13	0.794	53		40	
$3d^{7}(^{4}F)4s4p(^{1}P^{\circ})$	$x\ ^{4}D^{\circ}$	7/2	39 649.16	1.428	65		18	$3d^{8}(^{3}P)4p\ ^{4}D^{\circ}$
		5/2	40 345.95	1.370	63		21	
		3/2	40 827.77	1.240	62		23	
		1/2	41 101.80	0.026	62		24	
$3d^{7}(^{4}P)4s4p(^{3}P^{\circ})$	$z\ ^{4}S^{\circ}$	3/2	40 621.62	2.017	74		10	$3d^{8}(^{3}P)4p\ ^{4}S^{\circ}$
$3d^{7}(^{4}P)4s4p(^{3}P^{\circ})$	$^{6}P^{\circ}$	7/2	41 041.43	1.40	97			
		5/2	41 104.96	1.863	93			
$3d^{7}(^{4}F)4s4p(^{1}P^{\circ})$	$x\ ^{4}F^{\circ}$	9/2	41 225.76	1.319	66		19	$(^{2}G)\ (^{3}P^{\circ})\ ^{4}F^{\circ}$
		7/2	41 918.41	1.248	63		23	
		5/2	42 434.23	1.024	59		24	
		3/2	42 796.67	0.406	61		27	
$3d^{7}(^{4}F)4s4p(^{1}P^{\circ})$	$x\ ^{4}G^{\circ}$	11/2	41 528.53	1.291	95			
		9/2	42 269.32	1.169	93			
		7/2	42 811.44	1.004	92			
		5/2	43 199.65	0.649	93			
$3d^{8}(^{3}P)4p$	$z\ ^{4}P^{\circ}$	5/2	41 968.89	1.627	65		12	$3d^{7}(^{4}P)4s4p(^{3}P^{\circ})\ ^{4}P^{\circ}$
		1/2	41 969.90	2.51	66		14	$3d^{7}(^{2}P)4s4p(^{3}P^{\circ})\ ^{4}P^{\circ}$
		3/2	41 982.66	1.732	64		12	$3d^{7}(^{4}P)4s4p(^{3}P^{\circ})\ ^{4}P^{\circ}$

Co I—Continued

Configuration	Term	J	Level (cm⁻¹)	g	Leading percentages			
$3d^7(^2G)4s4p(^3P^\circ)$	$^4H^\circ$	7/2	42 988.12		95			
$3d^8(^1D)4p$	$z\ ^2P^\circ$	1/2	43 130.24	0.727	42		25	$3d^8(^3P)4p\ ^2P^\circ$
$3d^7(^4P)4s4p(^3P^\circ)$	$w\ ^4D^\circ$	5/2	43 242.95	1.101	46		28	$3d^8(^1D)4p\ ^2F^\circ$
		3/2	43 263.57	1.191	58		9	$3d^8(^1D)4p\ ^2D^\circ$
		7/2	43 398.62	1.334	88		3	$3d^8(^1D)4p\ ^2F^\circ$
		1/2	43 435.58	0.169	75		9	$3d^7(^2P)4s4p(^3P^\circ)\ ^4D^\circ$
$3d^7(^2G)4s4p(^3P^\circ)$	$w\ ^4F^\circ$	9/2	43 295.32	1.295	71		15	$3d^7(^4F)4s4p(^1P^\circ)\ ^4F^\circ$
		7/2	43 847.98	1.197	39		23	$3d^8(^1D)4p\ ^2F^\circ$
		3/2	44 555.71	0.415	68		18	$3d^7(^4F)4s4p(^1P^\circ)\ ^4F^\circ$
$3d^8(^1D)4p$		5/2	43 425.71	1.119	37	$x\ ^2F^\circ$	36	$3d^7(^4P)4s4p(^3P^\circ)\ ^4D^\circ$
$3d^8(^1D)4p$		3/2	43 537.71	1.120	31	$z\ ^2P^\circ$	23	$3d^8(^1D)4p\ ^2D^\circ$
$3d^8(^1D)4p$	$x\ ^2F^\circ$	7/2	43 555.22	1.229	45		20	$3d^7(^2G)4s4p(^3P^\circ)\ ^4F^\circ$
$3d^8(^1D)4p$	$x\ ^2D^\circ$	3/2	43 911.36	1.127	40		33	$3d^8(^1D)4p\ ^2P^\circ$
		5/2	43 921.89	1.230	52		20	$3d^7(^2G)4s4p(^3P^\circ)\ ^4F^\circ$
$3d^7(^2G)4s4p(^3P^\circ)$	$w\ ^4G^\circ$	11/2	43 952.06?	1.279	93			
		9/2	44 183.34	1.163	85		5	$3d^7(^2G)4s4p(^3P^\circ)\ ^4F^\circ$
		7/2	44 394.47	1.004	77		11	
		5/2	44 568.47	0.676	69		19	
	4°	7/2	43 969.90	1.081				
$3d^7(^2G)4s4p(^3P^\circ)$		5/2	44 201.92	0.950	29	$w\ ^4F^\circ$	23	$3d^8(^1D)4p\ ^2D^\circ$
	5°	3/2	44 381.32?					
$3d^7(^4P)4s4p(^3P^\circ)$	$z\ ^2S^\circ$	1/2	44 454.51	2.10	61		21	$3d^8(^3P)4p\ ^2S^\circ$
$3d^7(^4P)4s4p(^1P^\circ)$	$y\ ^4P^\circ$	5/2	44 480.14	1.557	42		33	$(^2P)\ (^3P^\circ)\ ^4P^\circ$
		3/2	44 658.03	1.674	40		37	$(^4P)\ (^3P^\circ)\ ^4P^\circ$
		1/2	44 857.57	2.371	40		44	$(^2P)\ (^3P^\circ)\ ^4P^\circ$
$3d^8(^3F)5s$	$e\ ^4F$	9/2	44 782.13	1.33				
		7/2	45 105.59	1.21				
		5/2	45 876.58	1.01				
		3/2	46 375.17	0.44				
$3d^7(^2G)4s4p(^3P^\circ)$	$z\ ^2H^\circ$	9/2	45 111.48	0.897	87			
		11/2	45 540.28	1.097	90			
$3d^7 4s(^5F)5s$	$e\ ^6F$	11/2	45 676.00	1.475				
		9/2	46 223.01	1.443				
		7/2	46 706.83	1.396				
		5/2	47 090.65	1.301				
		3/2	47 364.73	1.054				
		1/2	47 528.44	-0.666				
$3d^8(^3P)4p$	$^2D^\circ$	5/2	45 688.15	1.219	70		8	$3d^7(^4P)4s4p(^3P^\circ)\ ^2D^\circ$
		3/2	46 186.41	1.218	72		7	$3d^8(^1D)4p\ ^2D^\circ$
$3d^7(^2G)4s4p(^3P^\circ)$	$x\ ^2G^\circ$	7/2	45 766.63	0.898	79		10	$(^2H)\ (^3P^\circ)\ ^2G^\circ$
		9/2	46 032.10	1.131	80		10	

Co I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^8(^3P)4p$		3/2	*45 904.68*	1.674	32	$^4S°$	25	$3d^7(^4P)4s4p(^3P°)\ ^4S°$
$3d^8(^3F)5s$	$e\ ^2F$	7/2	45 924.98	1.14				
		5/2	46 746.00	0.49				
$3d^7(^4P)4s4p(^3P°)$	$x\ ^4P°$	1/2	*45 957.29*	2.522	44		22	$3d^8(^3P)4p\ ^4P°$
		5/2	*46 002.83*	1.543	30		24	$3d^7(^2P)4s4p(^3P°)\ ^4P°$
		3/2	*46 260.02*	1.508	30		18	$3d^8(^3P)4p\ ^4P°$
$3d^8(^3P)4p$	$^4D°$	7/2	*45 971.19*	1.424	44		22	$3d^7(^2P)4s4p(^3P°)\ ^4D°$
		5/2	*46 329.63*	1.365	28		25	$3d^7(^2P)4s4p(^3P°)\ ^4D°$
		1/2	*46 502.15*	0.161	27		21	$3d^7(a\ ^2D)4s4p(^3P°)\ ^4D°$
$3d^7(^4P)4s4p(^3P°)$	$^2D°$	3/2	*46 454.95*	0.869	61		14	$3d^7(^2P)4s4p(^3P°)\ ^2D°$
		5/2	*46 671.94*	1.233	45		20	$3d^7(^2G)4s4p(^3P°)\ ^2F°$
$3d^8(^3P)4p$		3/2	*46 562.87*	1.273	16	$^2P°$	14	$3d^8(^3P)4p\ ^4D°$
$3d^8(^3P)4p$		3/2	*46 685.43*	1.352	27	$y\ ^2P°$	12	$3d^8(^1D)4p\ ^2P°$
$3d^7(^2P)4s4p(^3P°)$		7/2	*46 872.74*	1.332	26	$u\ ^4D°$	23	$3d^7(a\ ^2D)4s4p(^3P°)\ ^4D°$
$3d^8(^3P)4p$	$y\ ^2P°$	1/2	*47 091.14*	0.656	46		30	$3d^8(^1D)4p\ ^2P°$
$3d^7(^2G)4s4p(^3P°)$		5/2	*47 128.96*	0.858	33	$w\ ^2F°$	22	$(^4P)\ (^3P°)\ ^2D°$
$3d^7(^2G)4s4p(^3P°)$		7/2	*47 225.11*	1.229	36	$w\ ^2F°$	31	$(^2P)\ (^3P°)\ ^4D°$
$3d^7(^2P)4s4p(^3P°)$	$u\ ^4D°$	5/2	*47 393.93*	1.324	45		13	$3d^7(^4P)4s4p(^3P°)\ ^2D°$
		3/2	*47 612.18*	1.122	47		18	$3d^8(^3P)4p\ ^4D°$
		1/2	*47 905.26*	0.016	37		21	$3d^8(^3P)4p\ ^2S°$
$3d^7\ 4s(^5F)5s$	$f\ ^4F$	9/2	47 524.47	1.328				
		7/2	48 201.60	1.226				
		5/2	48 718.57	1.041				
		3/2	49 078.43	0.401				
	6°	7/2	*47 839.15*					
	$y\ ^2S°$	1/2	*47 977.94*	2.093				
$3d^8(^3P)4p$		1/2	*48 026.34*	1.699	35	$x\ ^2S°$	26	$3d^7(^2P)4s4p(^3P°)\ ^4D°$
$3d^7(a\ ^2D)4s4p(^3P°)$	$t\ ^4D°$	7/2	*48 217.32*	1.211	51		18	$3d^8(^3P)4p\ ^4D°$
		5/2	*48 443.76*	1.340	52		19	
		1/2	*48 571.77*	0.452	52		16	
$3d^7(^2H)4s4p(^3P°)$	$^4G°$	7/2	*48 317.17*	1.173	84		4	$3d^7(^2G)4s4p(^3P°)\ ^2F°$
		5/2	*48 615.56?*	0.619	81		7	
$3d^7(^4P)4s4p(^3P°)$	$^2P°$	3/2	*48 334.37*	1.436	40		15	$3d^7(^2P)4s4p(^3P°)\ ^4S°$
		1/2	*48 837.72*	1.50	60		12	$3d^7(^2P)4s4p(^3P°)\ ^2S°$
$3d^7(a\ ^2D)4s4p(^3P°)$		3/2	*48 546.07*	1.050	21	$t\ ^4D°$	22	$3d^7(^2P)4s4\ (^3P°)\ ^4S°$
$3d^7(^2P)4s4p(^3P°)$	$x\ ^4S°$	3/2	*48 753.72*	1.728	48		26	$(a\ ^2D)\ (^3P)\ ^4D°$

Co I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^7(^2P)4s4p(^3P^\circ)$		5/2	*48 828.87*		32	$^2D^\circ$	34	$(a\ ^2D)\ (^3P)\ ^4P^\circ$
	8°	3/2	*48 851.58?*					
$3d^7(^2P)4s4p(^3P^\circ)$		3/2	*49 025.42*	1.099	39	$^2D^\circ$	34	$3d^7(^4P)4s4p(^3P^\circ)\ ^2P^\circ$
$3d^7(a\ ^2D)4s4p(^3P^\circ)$	$^4F^\circ$	9/2	*49 197.74?*		98			
		7/2	*49 484.05*	1.260	75		6	$3d^7(^2P)4s4p(^3P^\circ)\ ^4D^\circ$
		5/2	*49 847.08*	1.079	43		24	$3d^7(^2P)4s4p(^3P^\circ)\ ^2D^\circ$
		3/2	*50 105.05*	0.569	50		15	$3d^7(^2P)4s4p(^3P^\circ)\ ^2D^\circ$
	$w\ ^2P^\circ$	1/2	*49 754.73*	1.365				
$3d^8(^1G)4p$	$y\ ^2H^\circ$	9/2	*50 210.80*	0.899	81		9	$3d^7(^2H)4s4p(^3P^\circ)\ ^2H^\circ$
		11/2	*50 375.91*	1.091	69		17	
$3d^8(^1G)4p$	$u\ ^2F^\circ$	7/2	*50 578.73*	1.125	60		12	$3d^7(a\ ^2D)4s4p(^3P^\circ)\ ^2F^\circ$
		5/2	*50 712.45*	0.905	57		17	
$3d^8(^1G)4p$	$w\ ^2G^\circ$	9/2	*50 593.38*	1.10	40		38	$3d^7(^2H)4s4p(^3P^\circ)\ ^2G^\circ$
		7/2	*50 611.22*	0.82	38		37	
$3d^7(^2H)4s4p(^3P^\circ)$	$^4H^\circ$	11/2	*50 703.08*	1.110	86		11	$3d^8(^1G)4p\ ^2H^\circ$
		9/2	*50 902.61*	0.941	86		5	$3d^8(^1G)4p\ ^2G^\circ$
		7/2	*51 184.63*		89		5	$3d^8(^1G)4p\ ^2G^\circ$
	13°	7/2,9/2	*50 738.20*					
	$s\ ^4D^\circ$	7/2	*50 741.66*	1.458				
		5/2	*51 139.38*					
		3/2	*51 847.27*					
		1/2	*52 264.01?*					
	14°	5/2	*50 806.55*	1.136				
$3d^7(^2P)4s4p(^3P^\circ)$	$v\ ^2P^\circ$	3/2	*50 925.11*	1.340	53		15	$(a\ ^2D)\ (^3P^\circ)\ ^4D^\circ$
		1/2	*50 945.47*	0.732	71		13	
$3d^8(^3F)4d$	$e\ ^4P$	5/2	51 042.26	1.59				
		3/2	52 033.26	1.40				
		1/2	52 915.92?					
$3d^8(^3F)4d$	$e\ ^4D$	7/2	51 052.98	1.402				
		5/2	51 560.76	1.354				
		3/2	52 264.49?					
		1/2	52 634.62	1.58				
$3d^8(^3F)4d$	$e\ ^4H$	13/2	51 142.53	1.224				
		11/2	51 174.28	1.147				
		9/2	52 121.21	0.96				
		7/2	52 716.70	0.896				
$3d^7(a\ ^2D)4s4p(^3P^\circ)$	$w\ ^4P^\circ$	5/2	*51 160.03*	1.578	73		13	$(^2P)\ (^3P^\circ)\ ^2P^\circ$
		3/2	*52 014.45*	1.616	57		17	$(^2P)\ (^3P^\circ)\ ^2P^\circ$
		1/2	*52 355.12*	2.304	66		12	$(^2P)\ (^3P^\circ)\ ^4P^\circ$

Co I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^8(^3F)4d$	$g\ ^4F$	9/2	51 170.14	1.337			
		7/2	51 199.58	1.16			
		5/2	52 070.00	1.08			
		3/2	52 702.76?	0.76			
$3d^8(^3F)4d$	$e\ ^2P$	3/2	51 200.60	1.368			
		1/2	52 041.14	0.48			
$3d^8(^3F)4d$	$e\ ^4G$	11/2	51 203.75	1.218			
		9/2	51 267.93	1.083			
		5/2	52 772.30	0.74			
		7/2	52 162.02	1.13			
	16°	5/2	*51 863.18*				
	17°	5/2	*51 989.31?*				
$3d^8(^3F)4d$	$f\ ^2F$	7/2	52 095.00	1.118			
		5/2	52 970.62	1.13			
$3d^8(^3F)4d$	$e\ ^2H$	11/2	52 113.91	1.13			
		9/2	52 775.47	0.97			
$3d^8(^3F)4d$	$e\ ^2G$	9/2	52 156.46	1.12			
		7/2	52 856.68	0.92			
$3d^8(^3F)4d$	$e\ ^2D$	5/2	52 460.10	0.92			
		3/2	53 343.27	0.80			
	18°	7/2	*52 476.64*				
	19°	3/2	*52 498.17*				
	20°	3/2,5/2	*52 526.04*				
$3d^7\ 4s(^3F)5s$	$g\ ^2F$	7/2	52 763.68	0.933			
		5/2	53 704.14	0.923			
$3d^7(a\ ^2D)4s4p(^3P^\circ)$	$^2F^\circ$	5/2	*52 796.13*	0.883	58	17	$3d^8(^1G)4p\ ^2F^\circ$
		7/2	*53 103.78*	1.136	75	11	$3d^7(^2G)4s4p(^3P^\circ)\ ^2F^\circ$
$3d^7\ 4s(^3F)5s$	$h\ ^4F$	9/2	52 864.41	1.307			
		7/2	53 694.57?	1.28			
		5/2	54 258.75?	0.986			
		3/2	54 426.64	0.422			
	21°	7/2,9/2	*53 065.96*				
$3d^7(a\ ^2D)4s4p(^3P^\circ)$	$u\ ^2D^\circ$	3/2	*53 074.92*	0.823	51	21	$3d^7(^2P)4s4p(^3P^\circ)\ ^2D^\circ$
		5/2	*53 195.98*	1.206	49	18	
$3d^7(^2H)4s4p(^3P^\circ)$	$v\ ^2G^\circ$	9/2	*53 276.02*	1.124	44	28	$3d^8(^1G)4p\ ^2G^\circ$
		7/2	*53 373.53*	0.888	44	30	
	22°	7/2	*53 463.10*				

Co I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^7\,4s(^5F)4d$	$f\,^4G$	11/2	53 511.83	1.274	
		9/2	54 158.17	1.25	
		7/2	54 514.67	1.23	
		5/2	55 165.63?		
$3d^7\,4s(^5F)4d$	$f\,^4H$	13/2	53 618.08	1.227	
		11/2	54 315.67	1.168	
		9/2	54 860.93	1.10	
		7/2	55 268.75	0.857	
$3d^7\,4s(^5F)4d$	$f\,^6F$	11/2	53 660.37	1.421	
		9/2	54 356.45	1.403	
		7/2	54 896.57	1.27	
		5/2	55 283.02	1.17	
		3/2	55 577.28?	1.07	
$3d^7\,4s(^5F)4d$	$f\,^4D$	7/2	53 702.13	1.377	
		5/2	54 282.73?		
$3d^7\,4s(^5F)4d$	$e\,^6D$	9/2	53 725.20	1.387	
		7/2	54 352.30	1.48	
		5/2	54 946.90	1.47	
		3/2	55 407.10?	2.14	
$3d^7\,4s(^5F)4d$	$e\,^6G$	13/2	53 728.36?	1.35	
		11/2	54 367.43	1.320	
		9/2	54 682.91	1.23	
		7/2	54 989.62?	1.23	
		5/2	55 449.97	1.199	
		3/2	55 389.73		
$3d^7\,4s(^5F)4d$	$i\,^4F$	9/2	53 788.78	1.316	
		7/2	54 477.07		
		5/2	54 904.99	0.85	
$3d^7\,4s(^5F)4d$	$e\,^6P$	7/2	53 789.12	1.635	
		5/2	54 445.61	1.594	
		3/2	54 949.97	2.134	
$3d^7\,4s(^5F)4d$	$e\,^6H$	15/2	53 822.08	1.34	
		13/2	54 452.38	1.289	
		11/2	54 947.68	1.22	
		9/2	55 312.96	1.108	
		7/2	55 520.64	0.922	
		5/2	55 555.34		
$3d^7\,4s(^5F)4d$	$f\,^4P$	5/2	53 936.68	1.46	

Co I—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^7(a\ ^2D)4s4p(^3P^\circ)$	$^2P^\circ$	3/2	*54 165.35*	1.353	87
	24°	7/2	*54 398.60*		
	1	5/2	54 561.74	1.323	
	2	3/2	55 078.76	1.46	
	3	7/2	55 223.14	1.14	
	4	5/2	55 598.74		
	5	3/2,5/2	55 721.01		
	6	1/2	55 826.81		
	$v\ ^4F^\circ$	9/2	*54 791.2*		
		7/2	*55 314.04?*		
		3/2	*55 622.84*		
		5/2	*55 684.7*		
	25°	9/2	*54 874.08*		
	26°	7/2	*54 932.32*		
	27°	5/2	*55 061.49*	1.539	
	28°	7/2	*55 120.30?*		
	29°	5/2	*55 387.11?*	1.170	
	30°	5/2	*55 508.78*		
	31°	3/2	*55 737.87*		
	32°	3/2	*55 818.91*	1.31	
	33°	3/2,5/2	*55 922.3*		
$3d^8(^3P)5s$	$g\ ^4P$	5/2	56 545.51?		
	$g\ ^4H$	13/2	57 922.06		
		11/2	58 441.03		
		9/2	58 673.73		
		7/2	59 314.82?		
	36°	7/2,9/2	*58 187.39*		
	37°	5/2,7/2	*59 388.89*		
Co II ($^3F_4$)	***Limit***		**63 430**		

Co II

$Z=27$

Fe I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8\ ^3F_4$

Ionization energy = 137 795±10 cm^{-1} (17.083±0.001 eV)

The first analysis of Co II was by Meggers (1928), who measured the spectrum between 2150 and 5000 Å, found eight multiplets and identified 14 lines of Co II in the solar spectrum. The $3d^8\ ^3F$ ground state could not be found until Findlay (1930) extended the observations to 1940 Å. Findlay corrected some of Meggers' assignments on the basis of Zeeman effects he observed in the $3d^7 4s$–$3d^7 4p$ transition array.

The analysis was extended to include terms from the configurations $3d^6 4s^2$, $3d^6 4s4p$, and $3d^7 5s$ by Hagar (1951) and by Velasco and Adames (1966). The latter paper includes a table of about 1500 observed lines and a table of about 450 classified lines.

The present compilation is taken from the papers of Iglesias (1972, 1979). She has extended the analysis to include terms of the configurations $6s$, $7s$, $5p$, $4d$, $5d$, $6d$ and $7d$. She has measured most of the g-values from Zeeman patterns obtained by Catalán at the Massachusetts Institute of Technology in 1949. A few of the g-values are from Findlay.

Roth (1969) has calculated the odd-parity configuration $3d^7 4p$. His leading percentages for the experimental levels are listed here. Roth distinguished repeating terms of the $3d^n$ core by the letters a, b, . . . rather than by seniority. The percentages include the sum of seniority states contributing to the term.

The compositions of levels of the even configurations $3d^8$, $3d^7 4s$, and $3d^6 4s^2$ were calculated by Shadmi, Oreg, and Stein (1968). Percentages are given for only two levels, where the mixing is large. Roth's designation of repeating core terms are used in this work as well.

The ionization energy was calculated by Iglesias from ns and nd series (n=5–7). She obtained an average value of 137 780 cm^{-1}. The two limits differ by 23 cm^{-1}. We have adopted a value we calculated from the 4 members of the ns $^5F_5$ series (n=4–7).

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Co II

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^8$	$a\ ^3F$	4	0.00		
		3	950.51		
		2	1 597.32		
$3d^7(^4F)4s$	$a\ ^5F$	5	3 350.58	1.413	
		4	4 029.00	1.354	
		3	4 560.81	1.258	
		2	4 950.20	0.997	
		1	5 204.82	0.00	
$3d^7(^4F)4s$	$b\ ^3F$	4	9 812.96	1.243	
		3	10 708.47	1.082	
		2	11 321.96	0.68	
$3d^8$	$a\ ^1D$	2	11 651.48	1.111	
$3d^8$	$a\ ^3P$	2	13 260.77	1.415	
		1	13 404.48	1.484	
		0	13 593.32		
$3d^7(^4P)4s$	$a\ ^5P$	3	17 771.71	1.68	
		2	18 031.65	1.839	
		1	18 338.80	2.510	

Co II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^8$	$a\ ^1G$	4	19 190.11				
$3d^7(^2G)4s$	$a\ ^3G$	5	21 624.64	1.186			
		4	22 009.47	1.066			
		3	22 414.60	0.75			
$3d^7(^4P)4s$	$b\ ^3P$	2	24 074.60	1.500			
		1	24 267.57	1.498			
		0	24 411.36				
$3d^7(^2P)4s$	$c\ ^3P$	2	24 886.57	1.49			
		1	25 317.65	1.47			
		0	25 861.60				
$3d^7(^2G)4s$	$b\ ^1G$	4	25 147.37	0.997			
$3d^7(^2H)4s$	$a\ ^3H$	6	27 105.96	1.172			
		5	27 469.13	1.041			
		4	27 902.37	0.803			
$3d^7(a\ ^2D)4s$	$a\ ^3D$	3	27 484.61	1.36			
		2	28 112.06	1.18			
		1	29 268.97	0.77	52	45	$(^2P)\ ^1P$
$3d^7(^2P)4s$	$a\ ^1P$	1	27 585.31	0.83	48	43	$(a\ ^2D)\ ^3D$
$3d^7(^2H)4s$	$a\ ^1H$	5	30 567.36	1.027			
$3d^7(a\ ^2D)4s$	$b\ ^1D$	2	31 199.52	1.02			
$3d^6 4s^2$	$a\ ^5D$	4	40 695.60				
		3	41 314.20				
		2	41 738.3				
		1	42 008.9				
$3d^7(^2F)4s$	$c\ ^3F$	2	40 771.11				
		3	40 879.44				
		4	41 047.06				
$3d^7(^2F)4s$	$a\ ^1F$	3	44 090.94?				
$3d^7(^4F)4p$	$z\ ^5F^\circ$	5	*45 197.78*	1.386	96		
		4	*45 378.85*	1.42	73	22	$(^4F)\ ^5D^\circ$
		3	*45 972.17*	1.30	83	13	$(^4F)\ ^5D^\circ$
		2	*46 452.82*	1.062	91	7	$(^4F)\ ^5D^\circ$
		1	*46 786.53*	0.00	97		
$3d^7(^4F)4p$	$z\ ^5D^\circ$	4	*46 320.96*	1.447	72	20	$(^4F)\ ^3F^\circ$
		3	*47 039.27*	1.442	80	11	$(^4F)\ ^5F^\circ$
		2	*47 537.48*	1.468	85	5	$(^4P)\ ^5D^\circ$
		1	*47 848.89*	1.436	92	6	$(^4P)\ ^5D^\circ$
		0	*47 995.74*		94	6	$(^4P)\ ^5D^\circ$

Co II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages		
$3d^7(^4F)4p$	$z\ ^5G^\circ$	6	47 078.74	1.33	100		
		5	47 345.94	1.260	84	11	$(^4F)\ ^3G^\circ$
		4	47 807.58	1.154	87	6	$(^4F)\ ^3F^\circ$
		3	48 151.07	0.927	90	5	$(^4F)\ ^5F^\circ$
		2	48 388.62	0.341	93	3	$(^4F)\ ^5F^\circ$
$3d^7(^4F)4p$	$z\ ^3G^\circ$	5	48 556.16	1.194	88	12	$(^4F)\ ^5G^\circ$
		4	49 348.43	1.11	59	36	$(^4F)\ ^3F^\circ$
		3	50 036.55	0.80	75	22	$(^4F)\ ^3F^\circ$
$3d^7(^4F)4p$	$z\ ^3F^\circ$	4	49 697.81	1.19	60	34	$(^4F)\ ^3G^\circ$
		3	50 381.86	1.055	69	22	$(^4F)\ ^3G^\circ$
		2	50 914.51	0.688	94	3	$(^2G)\ ^3F^\circ$
$3d^7(^4F)4p$	$z\ ^3D^\circ$	3	51 512.41	1.32	92	4	$(^4F)\ ^3F^\circ$
		2	52 229.92	1.161	94		
		1	52 684.77	0.50	95		
$3d^7(^4P)4p$	$z\ ^5S^\circ$	2	56 010.62	2.01	99		
$3d^7(^4P)4p$	$y\ ^5D^\circ$	3	61 240.96	1.505	89	5	$(^4F)\ ^5D^\circ$
		2	61 260.55	1.502	88	5	
		1	61 350.42	1.51	87	6	
		4	61 388.43	1.51	95	4	
		0	61 458.22		92	6	
$3d^7(^4P)4p$	$z\ ^3S^\circ$	1	62 440.62	2.06	60	16	$(^4P)\ ^5P^\circ$
$3d^7(^4P)4p$	$z\ ^5P^\circ$	3	63 344.50	1.67	82	13	$(^4P)\ ^3D^\circ$
		2	63 367.43	1.697	67	21	$(^4P)\ ^3D^\circ$
		1	63 665.32	2.377	77	19	$(^4P)\ ^3S^\circ$
$3d^7(^2G)4p$	$y\ ^3F^\circ$	4	63 510.40	1.152	66	12	$(^2G)\ ^3H^\circ$
		3	64 360.26	1.06	83	10	$(^2G)\ ^3G^\circ$
		2	65 017.06	0.78	95		
$3d^7(^4P)4p$	$y\ ^3D^\circ$	3	63 587.01	1.35	77	14	$(^4P)\ ^5P^\circ$
		2	63 616.12	1.32	57	27	$(^4P)\ ^5P^\circ$
		1	63 865.30	0.58	81	7	$(^2P)\ ^3D^\circ$
$3d^7(^2G)4p$	$z\ ^3H^\circ$	5	63 306.66	1.03	78	15	$(^2G)\ ^1H^\circ$
		6	63 597.59	1.16	97		
		4	63 792.90	0.86	83	8	$(^2G)\ ^3G^\circ$
$3d^7(^2G)4p$	$z\ ^1G^\circ$	4	64 401.46	1.07	46	23	$(^2G)\ ^3F^\circ$
$3d^7(^2G)4p$	$y\ ^3G^\circ$	5	64 601.72	1.16	62	35	$(^2G)\ ^1H^\circ$
		4	65 154.18	1.06	67	22	$(^2G)\ ^1G^\circ$
		3	65 174.89	0.78	85	9	$(^2G)\ ^3F^\circ$
$3d^7(^2P)4p$	$z\ ^3P^\circ$	0	64 605.65		57	20	$(a\ ^2D)\ ^3P^\circ$
		2	64 914.81	1.430	45	35	$(^4P)\ ^3P^\circ$
		1	65 028.63	1.49	59	17	$(a\ ^2D)\ ^3P^\circ$
$3d^7(^2G)4p$	$z\ ^1H^\circ$	5	64 957.50	1.05	48	32	$(^2G)\ ^3G^\circ$

Co II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages			
$3d^7(^4P)4p$	$y\ ^3P^\circ$	2	65 408.59	1.50	53		23	$(^2P)\ ^3P^\circ$
		0	65 512.12		63		24	
		1	65 657.58	1.50	83		8	
$3d^7(^2G)4p$	$z\ ^1F^\circ$	3	66 017.79	1.01	72		18	$(a\ ^2D)\ ^1F^\circ$
$3d^7(^2P)4p$		2	67 209.42	1.05	37	$z\ ^1D^\circ$	19	$(^2P)\ ^3D^\circ$
$3d^7(^2P)4p$	$x\ ^3D^\circ$	3	67 524.20	1.33	81		10	$(a\ ^2D)\ ^3F^\circ$
		1	67 824.65	0.56	68		18	$(a\ ^2D)\ ^3D^\circ$
		2	67 939.51	1.15	54		21	$(^2P)\ ^1D^\circ$
$3d^7(^2H)4p$	$x\ ^3G^\circ$	5	68 203.39	1.18	95			
		4	68 843.67	1.05	92			
		3	69 356.64	0.78	85		4	$(a\ ^2D)\ ^3F^\circ$
$3d^7(^2H)4p$	$z\ ^3I^\circ$	6	68 311.47	1.02	75		24	$(^2H)\ ^1I^\circ$
		7	68 614.25	1.14	100			
		5	68 829.56	0.81	97			
$3d^7(a\ ^2D)4p$	$w\ ^3D^\circ$	3	69 060.26	1.31	85		8	$(a\ ^2D)\ ^3F^\circ$
		1	69 317.45	0.75	50		25	$(^2P)\ ^1P^\circ$
		2	69 637.27	1.16	67		11	$(^2P)\ ^3D^\circ$
$3d^7(^2H)4p$	$z\ ^1I^\circ$	6	69 617.60	1.02	75		24	$(^2H)\ ^3I^\circ$
$3d^7(a\ ^2D)4p$	$x\ ^3F^\circ$	4	70 186.30	1.26	98			
		3	70 457.93	1.09	70		8	$(^2P)\ ^3D^\circ$
		2	70 775.25	0.78	75		9	$(a\ ^2D)\ ^3D^\circ$
$3d^7(^2P)4p$	$y\ ^3S^\circ$	1	70 266.20		53		16	$(^2P)\ ^1P^\circ$
$3d^7(^2P)4p$		1	70 857.1	0.90	38	$z\ ^1P^\circ$	27	$(^2P)\ ^3S^\circ$
$3d^7(^2H)4p$	$y\ ^3H^\circ$	6	71 404.0	1.16	99			
		5	71 703.2		96			
		4	72 009.0	0.70	96			
$3d^7(a\ ^2D)4p$	$x\ ^3P^\circ$	2	71 846.75		46		30	$(a\ ^2D)\ ^1D^\circ$
		1	73 144.56		68		12	$(^2P)\ ^3P^\circ$
		0	73 440.00		79		17	$(^2P)\ ^3P^\circ$
$3d^7(a\ ^2D)4p$	$y\ ^1F^\circ$	3	72 535.35	1.04	72		16	$(^2G)\ ^1F^\circ$
$3d^7(a\ ^2D)4p$		2	72 654.32?		39	$y\ ^1D^\circ$	32	$(a\ ^2D)\ ^3P^\circ$
$3d^7(^2H)4p$	$y\ ^1G^\circ$	4	73 147.23	1.04	76		22	$(^2G)\ ^1G^\circ$
$3d^7(^2H)4p$	$y\ ^1H^\circ$	5	74 377.07	1.03	97			
$3d^7(a\ ^2D)4p$	$y\ ^1P^\circ$	1	74 522.96	1.03	86		8	$(^2P)\ ^1P^\circ$
$3d^6(^5D)4s4p$	$x\ ^5D^\circ$	4	80 299.5					
		3	80 543.3					
		2	80 788.7					
		1	80 971.5					
		0	81 066.6					

Co II—Continued

Configuration	Term	J	Level (cm⁻¹)	g	Leading percentages
$3d^6(^5D)4s4p$	$y\ ^5F^\circ$	5	*81 970.7*		
		4	*82 343.5*		
		3	*82 627.5*		
		2	*82 830.0*		
		1	*82 959.9*		
$3d^7(^2F)4p$	$w\ ^3G^\circ$	3	*83 110.53*		
		4	*83 398.6*		
		5	*83 877.6*		
$3d^7(^2F)4p$	$w\ ^3F^\circ$	3	*83 862.4 ?*		
		4	*84 140.38?*		
$3d^7(^4F)5s$	$e\ ^5F$	5	84 014.26		
		4	84 586.96	1.32	
		3	85 167.78	1.29	
		2	85 596.28	1.00	
		1	85 876.40		
$3d^7(^2F)4p$	$v\ ^3D^\circ$	3	*84 216.4*		
		2	*84 394.6*		
		1	*84 419.6*		
$3d^6(^5D)4s4p$	$y\ ^5P^\circ$	3	*85 044.3*		
		2	*85 712.6*		
		1	*86 133.8 ?*		
$3d^7(^4F)5s$	$e\ ^3F$	4	85 481.80	1.26	
		3	86 346.85	1.09	
		2	86 940.29	0.68	
$3d^6(^5D)4s4p$	$u\ ^3D^\circ$	3	*86 981.3*		
		2	*87 490.0*		
		1	*87 847.3*		
$3d^6(^5D)4s4p$	$v\ ^3F^\circ$	4	*87 112.5*		
		3	*87 896.2*		
		2	*88 417.5*		
$3d^7(^2F)4p$	$x\ ^1F^\circ$	3	*87 633.0 ?*	1.00	98
$3d^7(^4F)4d$	$f\ ^5F$	5	89 931.64		
		4	90 199.41		
		3	90 753.43		
		2	90 967.82		
		1	91 359.20		
$3d^7(^4F)4d$	$e\ ^5G$	6	90 303.00		
		5	90 697.69		
		4	91 049.62		
		3	91 667.63		
		2	91 929.21		
$3d^7(^4F)4d$	$e\ ^5P$	3	90 464.80		
		2	91 425.12		
		1	91 932.31		

Co II—Continued

Configuration	Term	J	Level (cm⁻¹)	g	Leading percentages
$3d^7(^4F)4d$	$e\ ^5H$	7	90 668.10		
		6	90 975.76		
		5	91 646.58		
		4	92 121.10		
		3	92 406.25		
$3d^7(^4F)4d$	$e\ ^3G$	5	91 327.06		
		4	91 918.35		
		3	92 520.29		
$3d^7(^4F)4d$	$e\ ^5D$	4	91 352.96		
		3	91 958.58		
		2	92 317.51		
$3d^7(^4F)4d$	$e\ ^3D$	3	91 408.7		
		2	92 045.1		
		1	92 639.95		
$3d^7(^4F)4d$	$e\ ^3H$	6	91 623.54		
		5	92 452.30		
		4	93 019.60		
$3d^7(^4F)4d$	$e\ ^3P$	2	93 678.7		
		1	94 405.7		
		0	94 785.4		
$3d^7(^4F)4d$	$f\ ^3F$	4	93 739.04		
		3	94 368.83		
		2	94 744.0		
$3d^7(^4F)5p$	$^5D°$	4	*95 036.19*		
		3	*95 683.50*		
		2	*96 206.0*		
$3d^7(^4F)5p$	$^5F°$	5	*95 456.10*		
		4	*95 976.63*		
		3	*96 496.16*		
		2	*96 891.07*		
		1	*97 153.84*		
$3d^7(^4F)5p$	$^5G°$	6	*95 998.72*		
		5	*96 236.66*		
		4	*96 882.43*		
		3	*97 335.81*		
		2	*97 628.56*		
$3d^7(^4F)5p$	$^3G°$	5	*96 942.21*		
		4	*97 705.16*		
		3	*98 278.64*		
$3d^7(^4F)5p$	$^3F°$	4	*97 062.95*		
		3	*97 967.79*		
		2	*98 648.67*		
$3d^7(^4F)5p$	$^3D°$	3	*97 496.53*		
		2	*98 287.75?*		

Co II—Continued

Configuration	Term	J	Level (cm^{-1})	g	Leading percentages
$3d^7(^4P)5s$	$e\ ^5P$	3	99 022.66		
		2	99 235.28		
		1	99 552.67		
$3d^7(^2G)5s$	$f\ ^3G$	5	101 233.65		
		4	101 451.12		
		3	102 020.46		
$3d^7(^2G)5s$	$e\ ^1G$	4	103 787.43		
$3d^7(^4F)6s$	^5F	5	108 474.38		
		4	108 819.90		
		3	109 528.3		
$3d^7(^4F)6s$	^3F	4	109 442.2		
$3d^7(^4F)5d$	^5F	5	111 013.85?		
		4	111 145.96		
$3d^7(^4F)5d$	^5G	6	111 141.00?		
		5	111 350.14		
$3d^7(^4F)5d$	^5H	7	111 288.03		
		6	111 438.81		
		5	112 210.70		
$3d^7(^4F)5d$	^3H	6	112 155.67		
$3d^7(^4F)7s$	^5F	5	119 311.7		
		4	119 497.4 ?		
		3	120 228.5 ?		
$3d^7(^4F)7s$	^3F	4	120 201.3		
		3	120 867.0 ?		
$3d^7(^4F)6d$	^5G	6	120 681.76		
$3d^7(^4F)6d$	^5H	7	120 760.3		
		6	120 843.7		
		5	121 651.6		
		4	122 169.2 ?		
$3d^7(^4F)6d$	^3H	6	121 612.00		
$3d^7(^4F)7d$	^5H	7	125 920.7 ?		
		6	125 969.5		
Co III ($^4F_{9/2}$)	***Limit***		**137 795**		

Co III

$Z=27$

Mn I isoelectronic sequence

Ground state: $1s^22s^22p^63s^23p^63d^7\ ^4F_{9/2}$

Ionization energy = 270 200 cm^{-1} (33.50 eV)

The analysis is by Shenstone (1960) who observed the spectrum from 650 to 3800 Å. The leading percentages of the levels of the $3d^7$ configuration calculated by Pasternak and Goldschmidt (1972) and of $3d^64s$ by Vizbaraite, Kupliauskas, and Tutlys (1968) are reported here. These two configurations have also been calculated by Shadmi, Caspi, and Oreg (1969) but no percentages are given.

Roth (1968) calculated the percentages for the $3d^64p$ levels. His alphabetic prefixing of $3d^6$ core states denotes the order of similar terms. The percentages contain the sum of the seniority states contributing to the core term.

The ionization energy was estimated by Catalán and Velasco (1952) by means of regularities in spectra of the iron group of elements.

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Co III

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^7$	$a\ ^4F$	9/2	0.0	100		
		7/2	841.2	100		
		5/2	1 451.3	100		
		3/2	1 866.8	100		
$3d^7$	$a\ ^4P$	5/2	15 201.9	100		
		3/2	15 428.2	95	5	$^2P°$
		1/2	15 811.4	98		
$3d^7$	$a\ ^2G$	9/2	16 977.6	98		
		7/2	17 766.2	100		
$3d^7$	$a\ ^2P$	3/2	20 194.9	87	6	$^2D°2$
		1/2	20 918.5?	98		
$3d^7$	$a\ ^2H$	11/2	22 720.3	100		
		9/2	23 434.3	98		
$3d^7$	$a\ ^2D2$	5/2	23 058.8	76	23	$^2D°1$
		3/2	24 236.8	72	19	
$3d^7$	$a\ ^2F$	5/2	37 021.0	100		
		7/2	37 316.5	100		
$3d^6(^5D)4s$	$a\ ^6D$	9/2	46 438.3	100		
		7/2	47 003.1	100		
		5/2	47 415.4	100		
		3/2	47 698.6	100		
		1/2	47 864.8	100		
$3d^6(^5D)4s$	$a\ ^4D$	7/2	55 729.2	100		
		5/2	56 373.8	100		
		3/2	56 794.8	100		
		1/2	57 036.8	100		

Co III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^6(^3P2)4s$	$b\ ^4P$	5/2	70 934.1	61	38	$(^3P1)\ ^4P^\circ$
		3/2	72 341.9	61	37	
		1/2	73 214.5	61	37	
$3d^6(^3H)4s$	$a\ ^4H$	13/2	71 623.1	100		
		11/2	71 873.7	94	6	$(^3G)\ ^4G^\circ$
		9/2	72 083.3	92	7	$(^3G)\ ^4G^\circ$
		7/2	72 270.5	96	4	$(^3G)\ ^4G^\circ$
$3d^6(^3F2)4s$	$b\ ^4F$	9/2	73 286.0	59	16	$(^3F1)\ ^4F^\circ$
		7/2	73 540.2	61	16	
		5/2	73 726.6	67	17	
		3/2	73 861.8	79	20	
$3d^6(^3G)4s$	$a\ ^4G$	11/2	76 518.9	94	6	$(^3H)\ ^4H^\circ$
		9/2	77 121.1	71	17	$(^3F2)\ ^4F^\circ$
		7/2	77 383.1	74	17	$(^3F2)\ ^4F^\circ$
		5/2	77 472.3	83	13	$(^3F2)\ ^4F^\circ$
$3d^6(^3P2)4s$	$b\ ^2P$	3/2	76 791.1	61	37	$(^3P1)\ ^2P^\circ$
		1/2	78 434.3	62	37	
$3d^6(^3H)4s$	$b\ ^2H$	11/2	77 411.6	98	1	$(^3G)\ ^4G^\circ$
		9/2	77 622.9	92	7	$(^3G)\ ^2G^\circ$
$3d^6(^3F2)4s$	$b\ ^2F$	7/2	78 927.8	56	28	$(^3G)\ ^2G^\circ$
		5/2	79 425.3	79	20	$(^3F1)\ ^2F^\circ$
$3d^6(^3G)4s$	$b\ ^2G$	9/2	82 363.3	92	7	$(^3H)\ ^2H^\circ$
		7/2	82 920.7	71	21	$(^3F2)\ ^2F^\circ$
$3d^6(^3D)4s$	$b\ ^4D$	3/2	83 773.4	100		
		1/2	83 789.3	100		
		5/2	83 799.6	100		
		7/2	83 938.9	100		
$3d^6(^1I)4s$	$a\ ^2I$	13/2	85 474.1	100		
		11/2	85 517.3	100		
$3d^6(^1G2)4s$	$c\ ^2G$	9/2	86 283.8	66	34	$(^1G1)\ ^2G^\circ$
		7/2	86 327.1	66	34	
$3d^6(^1D2)4s$	$b\ ^2D$	5/2	91 715.1?	77	21	$(^1D1)\ ^2D^\circ$
$3d^6(^5D)4p$	$z\ ^6D^\circ$	9/2	*98 290.3*	99		
		7/2	*98 545.6*	97		
		5/2	*98 823.2*	98		
		3/2	*99 043.5*	99		
		1/2	*99 182.2*	99		
$3d^6(^5D)4p$	$z\ ^6F^\circ$	11/2	*103 245.0*	100		
		9/2	*103 386.7*	96		
		7/2	*103 501.7*	96		
		5/2	*103 593.7*	97		
		3/2	*103 655.7*	98		
		1/2	*103 690.8*	98		

Co III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^6(^5D)4p$	$z\ ^6P^\circ$	7/2	*105 008.7*	91	7	$(^5D)\ ^4D^\circ$
		5/2	*105 965.1*	94		
		3/2	*106 591.9*	98		
$3d^6(^5D)4p$	$z\ ^4D^\circ$	7/2	*106 489.2*	89	7	$(^5D)\ ^6P^\circ$
		5/2	*106 954.7*	91	5	$(^5D)\ ^6P^\circ$
		3/2	*107 297.0*	94		
		1/2	*107 507.6*	95		
$3d^6(^5D)4p$	$z\ ^4F^\circ$	9/2	*106 764.9*	96		
		7/2	*107 530.1*	96		
		5/2	*108 052.9*	97		
		3/2	*108 403.4*	98		
$3d^6(^5D)4p$	$z\ ^4P^\circ$	5/2	*110 371.2*	98		
		3/2	*110 961.5*	98		
		1/2	*111 283.1*	98		
$3d^6(a\ ^3P)4p$	$z\ ^4S^\circ$	3/2	*123 123.1*	61	36	$(a\ ^3P)\ ^4P^\circ$
$3d^6(^3H)4p$	$z\ ^4G^\circ$	11/2	*124 765.9*	64	27	$(a\ ^3F)\ ^4G^\circ$
		9/2	*125 012.4*	47	33	
		7/2	*125 227.0*	46	40	
		5/2	*125 369.1*	44	44	
$3d^6(a\ ^3P)4p$	$y\ ^4P^\circ$	5/2	*125 003.3*	60	25	$(a\ ^3P)\ ^4D^\circ$
$3d^6(^3H)4p$	$^4I^\circ$	13/2	*125 276.2*	58	31	$(^3H)\ ^4H^\circ$
		11/2	*125 296.2*	59	30	$(^3H)\ ^4H^\circ$
		9/2	*125 421.6*	57	26	$(^3H)\ ^4H^\circ$
		15/2	*126 119.0*	100		
$3d^6(^3H)4p$	$^4H^\circ$	7/2	*125 690.5*	60	14	$(^3H)\ ^2G^\circ$
		9/2	*126 239.4*	41	35	$(^3H)\ ^4I^\circ$
		13/2	*126 475.5*	59	34	$(^3H)\ ^4I^\circ$
		11/2	*126 501.3*	55	36	$(^3H)\ ^4I^\circ$
$3d^6(a\ ^3P)4p$	$z\ ^2D^\circ$	5/2	*125 992.7*	58	25	$(a\ ^3P)\ ^4P^\circ$
		3/2	*127 458.1*	32	23	
$3d^6(a\ ^3P)4p$		3/2	*126 381.8?*	30 $^4P^\circ$	28	$(a\ ^3P)\ ^4D^\circ$
$3d^6(a\ ^3P)4p$	$y\ ^4D^\circ$	7/2	*126 549.3*	80	7	$(a\ ^3F)\ ^4F^\circ$
		5/2	*128 085.2*	60	15	$(a\ ^3P)\ ^2D^\circ$
		3/2	*128 423.1*	42	31	$(a\ ^3P)\ ^2D^\circ$
		1/2	*128 536.3*	90	6	$(a\ ^3P)\ ^4P^\circ$
$3d^6(a\ ^3F)4p$	$y\ ^4F^\circ$	5/2	*126 870.9*	78	6	$(^3D)\ ^4F^\circ$
		7/2	*126 892.1*	48	16	$(a\ ^3P)\ ^4D^\circ$
		3/2	*126 987.6*	86	7	$(^3D)\ ^4F^\circ$
		9/2	*126 998.1*	82		
$3d^6(^3H)4p$	$z\ ^2G^\circ$	9/2	*127 050.8*	59	15	$(^3G)\ ^2G^\circ$
		7/2	*127 317.7*	43	18	$(a\ ^3F)\ ^4F^\circ$
		1/2	*127 224.7?*			

Co III—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages		
$3d^6(^3H)4p$	$z\ ^2I^\circ$	13/2	*127 672.9*	90	7	$(^3H)\ ^4I^\circ$
		11/2	*128 258.9*	92		
$3d^6(a\ ^3F)4p$	$x\ ^4D^\circ$	7/2	*128 017.7*	69	8	$(^3D)\ ^4D^\circ$
		5/2	*128 524.9*	73	9	
		3/2	*128 804.9*	80	10	
		1/2	*128 937.4*	84	11	
$3d^6(a\ ^3F)4p$	$y\ ^4G^\circ$	11/2	*129 556.0*	68	22	$(^3H)\ ^4G^\circ$
		9/2	*129 592.3*	52	25	
		7/2	*129 706.9*	44	26	
		5/2	*129 747.3*	35	27	
$3d^6(a\ ^3F)4p$	$z\ ^2F^\circ$	7/2	*130 183.8*	49	12	$(^3G)\ ^2F^\circ$
		5/2	*130 407.8*	41	19	$(^3H)\ ^4G^\circ$
$3d^6(a\ ^3P)4p$	$z\ ^2P^\circ$	1/2	*130 799.5*	55	34	$(a\ ^3P)\ ^2S^\circ$
		3/2	*130 909.0*	87	6	$(a\ ^1D)\ ^2P^\circ$
$3d^6(a\ ^3F)4p$	$y\ ^2G^\circ$	9/2	*130 801.9*	60	13	$(^3G)\ ^2H^\circ$
		7/2	*131 279.9*	62	17	$(^3G)\ ^4G^\circ$
$3d^6(^3H)4p$	$z\ ^2H^\circ$	11/2	*131 054.2*	23	34	$(^3G)\ ^2H^\circ$
		9/2	*131 538.3*	37	23	
$3d^6(^3G)4p$	$^4F^\circ$	9/2	*131 098.2*	52	32	$(^3G)\ ^4G^\circ$
		7/2	*132 277.1*	44	28	$(^3G)\ ^4G^\circ$
		5/2	*132 489.0*	56	18	$(^3G)\ ^4G^\circ$
		3/2	*132 592.4*	71	14	$(^3D)\ ^4F^\circ$
$3d^6(^3G)4p$	$^4G^\circ$	11/2	*131 371.1*	59	19	$(^3H)\ ^2H^\circ$
		7/2	*131 581.6*	38	24	$(^3G)\ ^4F^\circ$
		5/2	*131 883.9*	63	17	$(^3G)\ ^4F^\circ$
		9/2	*131 887.1*	49	24	$(^3G)\ ^4F^\circ$
$3d^6(a\ ^3P)4p$	$z\ ^2S^\circ$	1/2	*132 314.9*	65	29	$(a\ ^3P)\ ^2P^\circ$
$3d^6(^3G)4p$	$y\ ^4H^\circ$	13/2	*132 376.8*	88	10	$(^3H)\ ^4H^\circ$
		11/2	*132 506.2*	74	7	
		9/2	*132 587.0*	76	9	
		7/2	*132 623.8*	74	11	
$3d^6(a\ ^3F)4p$	$y\ ^2D^\circ$	5/2	*133 711.4*	78	13	$(a\ ^3P)\ ^2D^\circ$
		3/2	*134 079.8*	72	19	
$3d^6(^3G)4p$	$y\ ^2H^\circ$	11/2	*134 696.1*	47	45	$(^3H)\ ^2H^\circ$
		9/2	*135 404.0*	50	39	
$3d^6(^3G)4p$	$y\ ^2F^\circ$	5/2	*136 129.1*	54	18	$(^3D)\ ^2F^\circ$
		7/2	*136 290.1*	57	13	
$3d^6(^1I)4p$	$z\ ^2K^\circ$	13/2	*137 363.0*	98		
		15/2	*138 234.3*	100		
$3d^6(^3G)4p$	$x\ ^2G^\circ$	9/2	*137 661.4*	74	18	$(^3H)\ ^2G^\circ$
		7/2	*137 812.4*	72	14	

Co III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^6(^3D)4p$	$x\ ^4P°$	5/2	*138 774.7*	90			
		3/2	*138 970.5*	82		5	$(^3D)\ ^4D°$
		1/2	*139 314.2*	82		8	
$3d^6(a\ ^1G)4p$	$x\ ^2H°$	9/2	*138 921.0*	69		17	$(^1I)\ ^2H°$
		11/2	*139 137.5*	49		44	
$3d^6(^3D)4p$	$w\ ^4D°$	3/2	*139 627.2*	55		18	$(^3D)\ ^2P°$
		1/2	*139 731.0*	53		20	$(^3D)\ ^2P°$
		5/2	*139 743.4*	77		9	$(a\ ^3F)\ ^4D°$
		7/2	*140 645.4*	44		30	$(a\ ^1G)\ ^2F°$
$3d^6(^3D)4p$		7/2	*139 818.7*	27	$^4D°$	22	$(^3D)\ ^4F°$
$3d^6(^3D)4p$	$w\ ^4F°$	3/2	*140 200.1*	72		19	$(^3G)\ ^4F°$
		5/2	*140 211.6*	68		16	$(^3G)\ ^4F°$
		7/2	*140 225.8*	46		14	$(^3D)\ ^4D°$
		9/2	*140 492.4*	54		30	$(a\ ^1G)\ ^2G°$
$3d^6(a\ ^1G)4p$	$w\ ^2G°$	9/2	*140 358.4*	54		29	$(^3D)\ ^4F°$
		7/2	*140 382.9*	61		13	
$3d^6(a\ ^1G)4p$	$x\ ^2F°$	5/2	*140 787.3*	48		21	$(^3D)\ ^2F°$
$3d^6(^1I)4p$	$w\ ^2H°$	11/2	*141 190.5*	33		50	$(a\ ^1G)\ ^2H°$
		9/2	*141 347.3*	68		21	
$3d^6(^1I)4p$	$y\ ^2I°$	13/2	*141 868.8*	99			
		11/2	*141 873.8*	87		9	$(^1I)\ ^2H°$
$3d^6(^3D)4p$	$w\ ^2F°$	7/2	*143 677.1*	61		17	$(a\ ^1G)\ ^2F°$
$3d^6(a\ ^1D)4p$	$v\ ^2F°$	7/2	*146 815.6*	72		15	$(a\ ^1G)\ ^2F°$
$3d^6(a\ ^1D)4p$	$x\ ^2D°$	5/2	*146 950.7*	62		17	$(a\ ^1D)\ ^2F°$
$3d^6(b\ ^3P)4p$	$^4D°$	3/2	*155 702.4*	50		45	$(b\ ^3F)\ ^4D°$
		3/2	*156 047.8?*				
$3d^6(b\ ^3F)4p$	$^4D°$	5/2	*156 291.4*	45		38	$(b\ ^3P)\ ^4D°$
	$v\ ^4P°$	5/2	*161 811.3*				
$3d^6(^5D)4d$	$e\ ^6F$	11/2	168 012.7				
		9/2	168 211.5				
		7/2	168 449.6				
		5/2	168 688.9				
		3/2	168 885.5				
		1/2	169 011.2				
$3d^6(^5D)4d$	$e\ ^6D$	9/2	169 527.7				
		7/2	169 595.9				
		5/2	169 770.3				
		3/2	169 996.0				
		1/2	170 194.7				

Co III—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages
$3d^6(^5D)4d$	$e\ ^6P$	7/2	169 591.0	
		5/2	170 355.5	
		3/2	170 804.6	
$3d^6(^5D)5s$	$f\ ^6D$	9/2	170 535.2	
		7/2	171 079.3	
		5/2	171 466.6	
		3/2	171 740.4	
		1/2	171 941.5	
$3d^6(^5D)4d$	$e\ ^6G$	13/2	170 725.7	
		11/2	171 028.9	
		9/2	171 269.1	
		7/2	171 527.6	
		5/2	171 729.6	
		3/2	171 825.8	
$3d^6(^5D)4d$	$e\ ^4F$	9/2	171 942.6	
		7/2	172 377.0	
		5/2	172 802.7	
		3/2	173 133.5	
$3d^6(^5D)5s$	$f\ ^4D$	7/2	172 583.6	
		5/2	173 194.9	
		3/2	173 609.3	
		1/2	173 851.1	
Co IV ($^5D_4$)	*Limit*		270 200	

Co IV

$Z=27$

Cr I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6\ {}^5D_4$

Ionization energy = 413 500 cm^{-1} (51.3 eV)

In 1974, Poppe, van Kleef, and Raassen reported an observation at 600 Å of the $3d^6\ {}^5D$–$3d^5(^6S)4p\ {}^5P°$ multiplet of Co IV. Poppe has extended the analysis to include all but the high $^1S1$ term of $3d^6$, and most of the $3d^5 4s$ and $3d^5 4p$ configurations. The results are confirmed by parametric calculations of the level structure. Poppe has provided the energy levels and percentage composition to us in advance of publication.

The ionization energy was obtained by extrapolation by Lotz (1967).

References

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Poppe, R., van Kleef, Th. A. M., and Raassen, A. J. J. (1974), Physica **77**, 165.

Co IV

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^6$	^{5}D	4	0.0	100		
		3	639.1	100		
		2	1 077.7	100		
		1	1 357.3	100		
		0	1 493.6	100		
$3d^6$	^{3}P2	2	22 883.3	62	38	^{3}P1
		1	24 729.2	62	37	
		0	25 448.7	62	37	
$3d^6$	^{3}H	6	23 679.5	100		
		5	24 031.8	98	2	^{3}G
		4	24 272.0	93	3	^{3}G
$3d^6$	^{3}F2	4	25 396.0	71	21	^{3}F1
		3	25 735.9	76	21	
		2	25 969.0	79	20	
$3d^6$	^{3}G	5	29 021.8	98	2	^{3}H
		4	29 592.2	95	3	^{3}F2
		3	29 867.5	97	3	^{3}F2
$3d^6$	^{1}I	6	35 942.7	100		
$3d^6$	^{3}D	2	36 348.0	98	1	^{1}D2
		1	36 382.0	100		
		3	36 554.5	100		
$3d^6$	^{1}G2	4	36 683.3	65	33	^{1}G1
$3d^6$	^{1}S2	0	41 441.9	76	23	^{1}S1
$3d^6$	^{1}D2	2	42 341.8	76	22	^{1}D1
$3d^6$	^{1}F	3	50 630.1	99	1	^{3}F1
$3d^6$	^{3}P1	0	58 320.6	63	37	^{3}P2
		1	58 919.8	63	37	
		2	60 098.4	62	38	

Co IV—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^6$	^{3}F1	2	59 748.8	80	20	^{3}F2
		4	59 838.2	77	22	
		3	59 902.8	78	21	
$3d^6$	^{1}G1	4	67 907.0	66	34	^{1}G2
$3d^5(^6S)4s$	^{7}S	3	90 554.4	100		
$3d^6$	^{1}D1	2	91 218.4	78	22	^{1}D2
$3d^5(^6S)4s$	^{5}S	2	102 773.9	100		
$3d^5(^4G)4s$	^{5}G	6	129 134.0	100		
		5	129 195.2	100		
		2	129 222.2	100		
		4	129 223.7	100		
		3	129 228.7	100		
$3d^5(^4P)4s$	^{5}P	3	132 729.1	93	6	(^{4}D) ^{5}D
		2	132 828.7	94	6	
		1	132 952.6	97	3	
$3d^5(^4D)4s$	^{5}D	4	136 362.9	99		
		0	136 399.9	99	1	(^{4}P) ^{3}P
		1	136 519.1	96	3	(^{4}P) ^{5}P
		2	136 611.2	93	6	(^{4}P) ^{5}P
		3	136 612.5	93	6	(^{4}P) ^{5}P
$3d^5(^4G)4s$	^{3}G	5	137 280.9	100		
		3	137 325.6	99		
		4	137 336.4	100		
$3d^5(^4P)4s$	^{3}P	2	140 863.5	92	7	(^{4}D) ^{3}D
		1	141 076.0	95	4	
$3d^5(^4D)4s$	^{3}D	3	144 509.6	99		
		1	144 720.3	96	4	(^{4}P) ^{3}P
		2	144 764.2	93	7	(^{4}P) ^{3}P
$3d^5(^2I)4s$	^{3}I	6	148 098.1	99	1	(^{2}H) ^{3}H
		5	148 105.5	99	1	(^{2}H) ^{3}H
		7	148 106.0	100		
$3d^5(^2D3)4s$	^{3}D	3	150 970.9	57	18	(^{2}F1) ^{3}F
		2	151 040.6	52	16	(^{2}D1) ^{3}D
$3d^5(^2I)4s$	^{1}I	6	152 113.3	99	1	(^{2}H) ^{3}H
$3d^5(^4F)4s$	^{5}F	5	152 126.2	98	1	(^{2}G2) ^{3}G
		4	152 161.1	95	3	(^{2}F1) ^{3}F
		3	152 264.2	90	7	(^{2}F1) ^{3}F
		2	152 351.4	74	19	(^{2}F1) ^{3}F
$3d^5(^2F1)4s$	^{3}F	4	153 265.3	94	4	(^{4}F) ^{5}F
		2	153 524.9	48	20	(^{2}D3) ^{3}D
		3	154 012.2	73	15	(^{2}D3) ^{3}D

Co IV—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^5(^6S)4p$	$^7P°$	2	*155 743.6*	99	1	(^6S) $^5P°$
		3	*156 272.8*	99	1	(^6S) $^5P°$
		4	*157 123.7*	100		
$3d^5(^2D3)4s$	^1D	2	156 395.4	60	18	$(^2D1)$ ^1D
$3d^5(^2F1)4s$	^1F	3	157 513.1	89	4	$(^2G2)$ ^3G
$3d^5(^2H)4s$	^3H	4	158 359.9	78	19	$(^2G2)$ ^3G
		5	158 423.4	76	23	$(^2G2)$ ^3G
		6	158 846.7	98	1	(^2I) ^1I
$3d^5(^2G2)4s$	^3G	3	159 482.3	85	9	(^4F) ^3F
		4	159 638.1	60	20	(^2H) ^3H
		5	159 851.5	73	24	(^2H) ^3H
$3d^5(^4F)4s$	^3F	2	160 351.4	95	2	$(^2F2)$ ^3F
		4	160 404.3	74	20	$(^2G2)$ ^3G
$3d^5(^2H)4s$	^1H	5	162 889.0	97	3	$(^2G2)$ ^3G
$3d^5(^2G2)4s$	^1G	4	163 717.9	62	36	$(^2F2)$ ^3F
$3d^5(^2F2)4s$	^3F	3	163 752.9	98	1	$(^2F1)$ ^3F
		4	163 870.6	61	32	$(^2G2)$ ^1G
$3d^5(^6S)4p$	$^5P°$	3	*164 803.2*	97	1	(^4D) $^5P°$
		2	*165 226.2*	97	1	
		1	*165 488.5*	98	1	
$3d^5(^2F2)4s$	^1F	3	167 856.5	97	1	(^4F) ^3F
$3d^5(^2S)4s$	^3S	1	169 800.9	100		
$3d^5(^2D2)4s$	^3D	2	178 396.5	100		
		3	178 439.4	99		
$3d^5(^2D2)4s$	^1D	2	182 501.4	100		
$3d^5(^2G1)4s$	^3G	5	188 138.4	100		
		4	188 164.4	100		
		3	188 179.4	100		
$3d^5(^2G1)4s$	^1G	4	192 204.9	100		
$3d^5(^4G)4p$	$^5G°$	2	*192 352.8*	94	3	(^4G) $^3F°$
		3	*192 382.0*	88	7	(^4G) $^5H°$
		4	*192 424.3*	85	10	(^4G) $^5H°$
		5	*192 490.2*	85	11	(^4G) $^5H°$
		6	*192 600.3*	88	8	(^4G) $^5H°$
$3d^5(^4G)4p$	$^5H°$	4	*194 351.6*	87	9	(^4G) $^5G°$
		5	*194 644.3*	85	10	
		6	*194 958.0*	89	9	
		7	*195 222.8*	100		

Co IV—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^5(^4G)4p$	$^5F^\circ$	5	195 558.9	85		5	$(^4D)\ ^5F^\circ$
		3	195 712.4	50		21	$(^4P)\ ^5D^\circ$
		4	195 770.5	77		8	$(^4D)\ ^5F^\circ$
		1	196 490.2	73		11	$(^4P)\ ^5D^\circ$
		2	196 550.2	55		23	$(^4P)\ ^5D^\circ$
$3d^5(^4P)4p$	$^5D^\circ$	2	195 606.5	44		25	$(^4G)\ ^5F^\circ$
		1	195 703.1	63		18	$(^4D)\ ^5D^\circ$
		3	196 636.2	42		33	$(^4G)\ ^5F^\circ$
		4	197 322.8	69		18	$(^4D)\ ^5D^\circ$
$3d^5(^4P)4p$	$^5S^\circ$	2	196 846.6	83		6	$(^4P)\ ^3P^\circ$
$3d^5(^4P)4p$		3	198 048.9	33	$^5P^\circ$	33	$(^4G)\ ^3F^\circ$
$3d^5(^4G)4p$	$^3F^\circ$	2	198 084.5	87		3	$(^4F)\ ^3F^\circ$
		3	198 242.2	55		21	$(^4P)\ ^5P^\circ$
		4	198 390.5	89		4	$(^4F)\ ^3F^\circ$
$3d^5(^4P)4p$	$^5P^\circ$	2	198 499.6	62		23	$(^4D)\ ^5P^\circ$
		1	198 670.1	73		15	$(^4D)\ ^5P^\circ$
$3d^5(^4G)4p$	$^3H^\circ$	6	198 567.8	94		2	$(^4G)\ ^5H^\circ$
		5	198 890.9	95		2	$(^2I)\ ^3H^\circ$
		4	199 092.4	96		2	$(^2I)\ ^3H^\circ$
$3d^5(^4P)4p$	$^3P^\circ$	2	199 817.3	58		19	$(^4D)\ ^3P^\circ$
		1	200 193.8	62		19	
		0	200 506.1	70		20	
$3d^5(^4D)4p$	$^5F^\circ$	1	200 723.5	81		14	$(^4G)\ ^5F^\circ$
		2	200 911.1	80		12	
		3	201 176.2	80		9	
		4	201 524.1	83		8	
		5	201 874.2	91		6	
$3d^5(^4G)4p$	$^3G^\circ$	3	202 849.1	49		22	$(^4D)\ ^5D^\circ$
		4	202 883.7	93		2	$(^2F1)\ ^3G^\circ$
		5	202 898.8	94		1	$(^2F1)\ ^3G^\circ$
$3d^5(^4G)4p$		3	203 059.0	44	$^3G^\circ$	25	$(^4D)\ ^5D^\circ$
$3d^5(^4D)4p$	$^5D^\circ$	2	203 370.3	53		17	$(^4P)\ ^3D^\circ$
		4	203 398.0	72		20	$(^4P)\ ^5D^\circ$
		1	203 633.3	52		16	$(^4P)\ ^5D^\circ$
		0	204 177.8	69		21	$(^4P)\ ^5D^\circ$
$3d^5(^4P)4p$	$^3D^\circ$	3	203 560.6	54		15	$(^4D)\ ^5P^\circ$
		2	203 833.4	60		18	
		1	203 972.8	49		34	
$3d^5(^4D)4p$		1	204 485.3	34	$^5P^\circ$	26	$(^4P)\ ^3D^\circ$
$3d^5(^4D)4p$	$^5P^\circ$	2	204 792.8	43		18	$(^4P)\ ^5P^\circ$
$3d^5(^4D)4p$		3	204 845.1	30	$^3D^\circ$	24	$(^4D)\ ^5P^\circ$

Co IV—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^5(^4D)4p$	$^3D^\circ$	3	*205 928.7*	51		23	$(^4D)\ ^5P^\circ$
		2	*205 999.7*	80		8	$(^4F)\ ^3D^\circ$
		1	*206 167.2*	77		9	$(^4F)\ ^3D^\circ$
$3d^5(^4D)4p$	$^3F^\circ$	4	*206 648.3*	86		5	$(^2G2)\ ^3F^\circ$
		3	*206 993.6*	81		6	$(^4P)\ ^3D^\circ$
		2	*207 052.6*	84		5	$(^4P)\ ^3D^\circ$
$3d^5(^4P)4p$	$^3S^\circ$	1	*208 310.4*	94		2	$(^4D)\ ^3P^\circ$
$3d^5(^4D)4p$	$^3P^\circ$	0	*210 392.2*	74		21	$(^4P)\ ^3P^\circ$
		1	*210 724.9*	69		20	
		2	*211 151.7*	67		24	
$3d^5(^2I)4p$	$^3K^\circ$	6	*211 275.3*	71		25	$(^2I)\ ^3I^\circ$
		7	*211 556.6*	59		33	$(^2I)\ ^3I^\circ$
		8	*212 946.5*	100			
$3d^5(^2I)4p$	$^3I^\circ$	5	*211 722.0*	70		16	$(^2I)\ ^1H^\circ$
		6	*212 602.7*	61		26	$(^2I)\ ^3K^\circ$
		7	*213 131.5*	63		36	$(^2I)\ ^3K^\circ$
$3d^5(^2F1)4p$		2	*213 158.6*	25	$^3F^\circ$	21	$(^2D3)\ ^3F^\circ$
$3d^5(^2I)4p$	$^1H^\circ$	5	*213 735.1*	59		24	$(^2I)\ ^3I^\circ$
$3d^5(^2D3)4p$	$^3F^\circ$	3	*213 897.9*	40		25	$(^2F1)\ ^3F^\circ$
		4	*215 006.4*	42		26	$(^2F1)\ ^3F^\circ$
$3d^5(^2D3)4p$		2	*214 059.3*	29	$^3F^\circ$	22	$(^2D3)\ ^1D^\circ$
$3d^5(^2I)4p$	$^3H^\circ$	6	*214 260.5*	82		10	$(^2I)\ ^3I^\circ$
		5	*214 739.1*	82		8	$(^2I)\ ^1H^\circ$
		4	*214 831.6*	86		4	$(^2G2)\ ^3H^\circ$
$3d^5(^2I)4p$	$^1K^\circ$	7	*214 352.1*	93		4	$(^2I)\ ^3K^\circ$
$3d^5(^2D3)4p$	$^3P^\circ$	2	*216 640.4*	46		14	$(^2D1)\ ^3P^\circ$
		1	*216 974.3*	38		23	$(^2D3)\ ^3D^\circ$
$3d^5(^2D1)4s$	^3D	3	216 651.1	77		23	$(^2D3)\ ^3D$
		2	216 686.5	77		23	
		1	216 721.1	76		23	
$3d^5(^2F1)4p$	$^1G^\circ$	4	*216 717.8*	47		13	$(^2H)\ ^1G^\circ$
$3d^5(^2F1)4p$	$^3G^\circ$	3	*217 060.7*	45		21	$(^2D3)\ ^1F^\circ$
		4	*218 414.0*	47		35	$(^2F1)\ ^3F^\circ$
		5	*218 703.5*	67		27	$(^4F)\ ^5G^\circ$
$3d^5(^4F)4p$	$^5G^\circ$	3	*217 508.9*	48		23	$(^2D3)\ ^3D^\circ$
		4	*217 830.7*	79		3	$(^4F)\ ^5F^\circ$
		5	*217 963.0*	58		20	$(^2F1)\ ^3G^\circ$
		6	*218 733.8*	81		15	$(^2I)\ ^1I^\circ$
$3d^5(^4F)4p$		3	*217 585.4*	28	$^5G^\circ$	23	$(^2F1)\ ^3P^\circ$
$3d^5(^2D3)4p$		1	*217 951.4*	36	$^3D^\circ$	24	$(^2D3)\ ^3P^\circ$

Co IV—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages			
$3d^5(^2D3)4p$	$^3D^\circ$	2	*217 993.0*	46		15	$(^2D1)\ ^3D^\circ$
$3d^5(^2F1)4p$	$^3D^\circ$	3	*218 321.2*	51		10	$(^2F2)\ ^3D^\circ$
		1	*219 260.1*	56		19	$(^2D3)\ ^1P^\circ$
		2	*219 453.9*	35		16	$(^2F1)\ ^3F^\circ$
$3d^5(^2I)4p$	$^1I^\circ$	6	*218 560.2*	76		13	$(^4F)\ ^5G^\circ$
$3d^5(^4F)4p$	$^5F^\circ$	4	*218 868.5*	57		25	$(^4F)\ ^5D^\circ$
		3	*218 876.3*	65		22	$(^4F)\ ^5D^\circ$
		2	*219 052.1*	50		20	$(^4F)\ ^5D^\circ$
		5	*219 231.6*	78		6	$(^4F)\ ^5G^\circ$
		1	*219 388.2*	76		7	$(^4F)\ ^5D^\circ$
$3d^5(^2F1)4p$		4	*219 694.2*	23	$^3F^\circ$	22	$(^2D3)\ ^3F^\circ$
$3d^5(^2F1)4p$		2	*219 969.0*	31	$^3F^\circ$	21	$(^2F1)\ ^3D^\circ$
$3d^5(^2F1)4p$		3	*220 052.2*	31	$^3F^\circ$	14	$(^2D3)\ ^1F^\circ$
$3d^5(^2G2)4p$	$^3H^\circ$	4	*220 145.6*	37		36	$(^2H)\ ^3H^\circ$
		5	*226 983.3*	41		34	
		6	*227 737.1*	47		38	
$3d^5(^2H)4p$	$^3H^\circ$	5	*220 423.7*	37		40	$(^2G2)\ ^3H^\circ$
		6	*221 274.1*	43		38	$(^2G2)\ ^3H^\circ$
		4	*226 950.3*	46		40	$(^2G2)\ ^3H^\circ$
$3d^5(^4F)4p$	$^5D^\circ$	4	*220 535.2*	61		27	$(^4F)\ ^5F^\circ$
		3	*220 887.1*	66		21	
		2	*221 058.4*	70		13	
		1	*221 062.2*	80		7	
$3d^5(^2D1)4s$	^1D	2	220 548.5	77		23	$(^2D3)\ ^1D$
$3d^5(^2H)4p$	$^3G^\circ$	5	*220 950.8*	51		14	$(^2G2)\ ^3G^\circ$
		4	*221 068.1*	46		15	$(^2F2)\ ^3G^\circ$
		3	*221 287.7*	43		17	$(^2F2)\ ^3G^\circ$
$3d^5(^2D3)4p$	$^1P^\circ$	1	*222 336.1*	48		21	$(^2F1)\ ^3D^\circ$
$3d^5(^2H)4p$	$^3I^\circ$	5	*222 848.1*	87		4	$(^2H)\ ^3H^\circ$
		6	*223 382.3*	84		6	$(^2H)\ ^1I^\circ$
		7	*223 981.3*	96		2	$(^2I)\ ^3I^\circ$
$3d^5(^2G2)4p$		4	*222 994.2*	24	$^1G^\circ$	18	$(^2G2)\ ^3G^\circ$
$3d^5(^4F)4p$	$^3G^\circ$	5	*223 041.1*	61		19	$(^2G2)\ ^3G^\circ$
		3	*223 192.4*	45		38	
		4	*223 260.7*	47		14	
$3d^5(^2F1)4p$	$^1D^\circ$	2	*223 381.4*	56		29	$(^2D3)\ ^1D^\circ$
$3d^5(^2F1)4p$	$^1F^\circ$	3	*224 038.7*	43		21	$(^2G2)\ ^3F^\circ$
$3d^5(^2G2)4p$	$^3F^\circ$	3	*224 411.0*	38		25	$(^2F1)\ ^1F^\circ$
		2	*224 463.9*	56		18	$(^4F)\ ^3F^\circ$
		4	*224 611.0*	56		11	$(^2G2)\ ^1G^\circ$

Co IV—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages		
$3d^5(^2H)4p$	$^1I°$	6	*225 479.8*	81	8	$(^2H)\ ^3H°$
$3d^5(^4F)4p$	$^3D°$	2	*225 553.4*	64	7	$(^2F2)\ ^3D°$
		3	*225 666.3*	61	10	$(^2F2)\ ^3D°$
		1	*225 780.8*	81	7	$(^4D)\ ^3D°$
$3d^5(^4F)4p$	$^3F°$	4	*225 938.7*	63	25	$(^2F2)\ ^3F°$
		3	*226 367.6*	63	20	
		2	*226 646.1*	57	24	
$3d^5(^2G2)4p$	$^3G°$	5	*227 971.6*	31	22	$(^2F2)\ ^3G°$
		4	*228 208.5*	34	26	
		3	*228 214.7*	34	28	
$3d^5(^2F2)4p$	$^1G°$	4	*228 448.1*	35	15	$(^2G2)\ ^1G°$
$3d^5(^2F2)4p$	$^3F°$	2	*228 736.2*	34	18	$(^2G2)\ ^3F°$
		3	*228 809.0*	55	11	$(^2G2)\ ^1F°$
		4	*229 414.0*	51	12	$(^4F)\ ^3F°$
$3d^5(^2G2)4p$	$^1H°$	5	*229 056.6*	62	20	$(^2H)\ ^1H°$
$3d^5(^2G2)4p$	$^1F°$	3	*229 388.2*	63	6	$(^2F2)\ ^3F°$
$3d^5(^2H)4p$	$^1H°$	5	*229 583.3*	70	23	$(^2G2)\ ^1H°$
$3d^5(^2F2)4p$	$^1D°$	2	*229 890.3*	63	23	$(^2F2)\ ^3F°$
$3d^5(^2F2)4p$	$^3G°$	3	*231 876.6*	42	40	$(^2H)\ ^3G°$
		4	*232 288.1*	51	35	
		5	*232 615.6*	60	30	
$3d^5(^2F2)4p$	$^3D°$	1	*232 133.7*	75	9	$(^2F1)\ ^3D°$
		2	*232 257.0*	75	10	
		3	*232 265.7*	66	11	
$3d^5(^2S)4p$	$^3P°$	1	*233 158.8*	77	12	$(^2D2)\ ^3P°$
		2	*234 109.4*	79	15	
$3d^5(^2F2)4p$	$^1G°$	4	*234 584.4*	39	38	$(^2H)\ ^1G°$
$3d^5(^2F2)4p$	$^1F°$	3	*236 240.4*	90	4	$(^2F1)\ ^1F°$
$3d^5(^2S)4p$	$^1P°$	1	*236 588.9*	74	17	$(^2D2)\ ^1P°$
$3d^5(^2D2)4p$	$^3F°$	2	*243 999.4*	68	22	$(^2D2)\ ^3D°$
		3	*244 285.6*	53	29	$(^2D2)\ ^3D°$
		4	*245 323.9*	92	5	$(^2G2)\ ^3F°$
$3d^5(^2D2)4p$	$^3D°$	2	*244 801.0*	67	22	$(^2D2)\ ^3F°$
		3	*245 361.7*	61	33	
$3d^5(^2D2)4p$	$^1F°$	3	*246 316.4*	76	11	$(^2G1)\ ^1F°$
$3d^5(^2D2)4p$	$^3P°$	2	*247 091.4*	76	15	$(^2S)\ ^3P°$
		1	*247 130.4*	78	14	
		0	*247 138.4*	85	13	

Co IV—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^5(^2D2)4p$	$^1P^\circ$	1	*248 390.4*	74	16	$(^2S)\ ^1P^\circ$
$3d^5(^2D2)4p$	$^1D^\circ$	2	*249 444.1*	89	5	$(^2F2)\ ^1D^\circ$
$3d^5(^2G1)4p$	$^3H^\circ$	4	*253 119.4*	79	11	$(^2G1)\ ^3G^\circ$
		5	*253 446.4*	81	12	$(^2G1)\ ^3G^\circ$
		6	*254 347.1*	98	2	$(^2I)\ ^3H^\circ$
$3d^5(^2G1)4p$	$^3F^\circ$	4	*253 472.8*	75	11	$(^2G1)\ ^3H^\circ$
		3	*253 921.8*	56	37	$(^2G1)\ ^3G^\circ$
		2	*254 722.1*	92	5	$(^2D1)\ ^3F^\circ$
$3d^5(^2G1)4p$	$^3G^\circ$	3	*254 903.0*	60	36	$(^2G1)\ ^3F^\circ$
		4	*255 138.9*	82	9	$(^2G1)\ ^3F^\circ$
		5	*255 307.3*	82	14	$(^2G1)\ ^3H^\circ$
$3d^5(^2G1)4p$	$^1H^\circ$	5	*257 289.6*	92	3	$(^2G1)\ ^3G^\circ$
$3d^5(^2G1)4p$	$^1G^\circ$	4	*257 680.7*	94	2	$(^2G1)\ ^3F^\circ$
$3d^5(^2G1)4p$	$^1F^\circ$	3	*258 840.7*	81	10	$(^2D2)\ ^1F^\circ$
$3d^5(^2P)4p$	$^3P^\circ$	1	*267 508.7*	75	20	$(^2D1)\ ^3P^\circ$
		2	*268 151.4*	74	21	
$3d^5(^2P)4p$	$^3D^\circ$	2	*272 522.3*	59	27	$(^2P)\ ^1D^\circ$
		1	*272 523.8*			
		3	*273 632.6*	90	6	$(^2D1)\ ^3D^\circ$
$3d^5(^2P)4p$	$^1D^\circ$	2	*274 104.5*	51	32	$(^2P)\ ^3D^\circ$
$3d^5(^2P)4p$	$^3S^\circ$	1	*275 594.1*	95	4	$(^2P)\ ^1P^\circ$
$3d^5(^2D1)4p$	$^3F^\circ$	2	*282 925.2*	66	21	$(^2D3)\ ^3F^\circ$
		3	*283 211.1*	63	20	
		4	*284 089.0*	72	23	
$3d^5(^2D1)4p$	$^3D^\circ$	1	*284 496.9*	71	22	$(^2D3)\ ^3D^\circ$
		2	*285 045.7*	64	19	
		3	*285 642.1*	63	19	
$3d^5(^2D1)4p$	$^1D^\circ$	2	*285 928.4*	47	16	$(^2P)\ ^1D^\circ$
$3d^5(^2D1)4p$	$^3P^\circ$	2	*287 239.6*	45	20	$(^2P)\ ^3P^\circ$
$3d^5(^2D1)4p$	$^1F^\circ$	3	*287 698.3*	70	22	$(^2D3)\ ^1F^\circ$
Co V $(^6S_{5/2})$	***Limit***		**413 500**			

Co V

$Z=27$

V I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5\ {}^6S_{5/2}$

Ionization energy = 641 000 cm^{-1} (79.5 eV)

Kruger and Gilroy (1935) observed the $3d^5\ {}^6P$–$3d^4 4p\ {}^6P°$ multiplet of Co V near 356 Å. No further analysis of this spectrum appeared until 1979, when Raassen and van Kleef (1979) published all terms of $3d^5$ and nearly all of $3d^4 4s$ and $3d^4 4p$ along with their calculations of the level values and percentage composition. The $3d^5$–$3d^4 4p$ array lies in the region of 300–450 Å and is measured with an accuracy of ±0.002 Å. The $3d^4 4s$–$3d^4 4p$ array appears from 1100–1500 Å and has been measured with an accuracy of ±0.005 Å. The level values and leading percentages are taken from their paper.

The ionization energy is from Lotz (1967).

References

Kruger, P. G., and Gilroy, H. T. (1935), Phys. Rev. **48**, 720.
Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.
Raassen, A. J. J., and van Kleef, Th. A. M. (1979), Physica **96C**, 367.

Co V

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^5$	^6S	5/2	0.0	100		
$3d^5$	^4G	11/2	37 217.5	100		
		9/2	37 288.8	100		
		5/2	37 289.5	99		
		7/2	37 304.0	100		
$3d^5$	^4P	5/2	40 753.2	93	6	^4D
		3/2	40 890.9	95	5	^4D
		1/2	41 023.8	98	2	^4D
$3d^5$	^4D	7/2	44 709.1	100		
		1/2	44 907.5	98	2	^4P
		5/2	44 984.1	93	6	^4P
		3/2	44 986.7	95	5	^4P
$3d^5$	^2I	11/2	54 339.2	99	1	^2H
		13/2	54 376.6	100		
$3d^5$	$^2D3$	5/2	57 082.6	54	27	$^2F1$
		3/2	57 823.2	72	22	$^2D2$
$3d^5$	$^2F1$	7/2	59 454.9	96	2	^4F
		5/2	60 532.2	58	25	^4F
$3d^5$	^4F	9/2	60 830.3	97	3	$^2G2$
		7/2	60 973.6	96	2	$^2F1$
		3/2	61 213.2	94	4	$^2D3$
		5/2	61 284.5	73	15	$^2F1$
$3d^5$	^2H	9/2	64 742.3	79	20	$^2G2$
		11/2	65 283.8	99	1	^2I
$3d^5$	$^2G2$	7/2	66 228.7	99	1	^4F
		9/2	66 760.4	77	21	^2H
$3d^5$	$^2F2$	5/2	70 502.5	99	1	^4F
		7/2	70 652.8	98	1	$^2F1$

Co v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^5$	^{2}S	1/2	76 864.5	100		
$3d^5$	^{2}D2	3/2	85 573.5	100		
		5/2	85 636.2	99		
$3d^5$	^{2}G1	9/2	95 708.7	100		
		7/2	95 726.5	100		
$3d^5$	^{2}P	3/2	115 437.1	99		
		1/2	115 468.5	100		
$3d^5$	^{2}D1	5/2	125 022.7	77	23	^{2}D3
		3/2	125 068.8	76	23	^{2}D3
$3d^4(^5$D$)4s$	^{6}D	1/2	205 878.9	100		
		3/2	206 108.5	100		
		5/2	206 476.0	100		
		7/2	206 962.2	100		
		9/2	207 548.5	100		
$3d^4(^5$D$)4s$	^{4}D	1/2	216 820.5	100		
		3/2	217 171.0	100		
		5/2	217 713.2	100		
		7/2	218 407.2	100		
$3d^4(^3$P2$)4s$	^{4}P	1/2	235 199.9	59	39	(^{3}P1) ^{4}P
		3/2	236 353.1	60	39	
		5/2	238 106.2	59	37	
$3d^4(^3$H$)4s$	^{4}H	7/2	235 961.1	98		
		9/2	236 158.0	97		
		11/2	236 431.2	98		
		13/2	236 746.0	100		
$3d^4(^3$F2$)4s$	^{4}F	3/2	238 129.6	78	21	(^{3}F1) ^{4}F
		5/2	238 164.6	73	20	
		7/2	238 259.1	74	19	
		9/2	238 390.3	75	18	
$3d^4(^3$G$)4s$	^{4}G	5/2	241 174.1	94		
		7/2	241 582.4	93	5	(^{3}F2) ^{4}F
		9/2	241 875.4	87	6	(^{3}H) ^{2}H
		11/2	241 985.3	86	12	(^{3}H) ^{2}H
$3d^4(^3$H$)4s$	^{2}H	9/2	242 765.0	91	6	(^{3}G) ^{4}G
		11/2	243 455.2	87	12	(^{3}G) ^{4}G
$3d^4(^3$P2$)4s$	^{2}P	1/2	242 340.3	59	38	(^{3}P1) ^{2}P
		3/2	244 485.4	60	38	(^{3}P1) ^{2}P
$3d^4(^3$F2$)4s$	^{2}F	7/2	244 821.2	72	18	(^{3}F1) ^{2}F
		5/2	244 866.7	77	20	(^{3}F1) ^{2}F
$3d^4(^3$G$)4s$	^{2}G	7/2	248 098.9	92		
		9/2	248 698.2	97		

Co v—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages		
$3d^4(^3D)4s$	^4D	7/2	248 855.9	100		
		5/2	249 006.8	99		
		3/2	249 179.7	99		
		1/2	249 300.0	99		
$3d^4(^1G2)4s$	^2G	9/2	251 582.2	65	32	$(^1G1)\ ^2G$
		7/2	251 701.5	63	31	$(^1G1)\ ^2G$
$3d^4(^1I)4s$	^2I	13/2	252 331.9	100		
		11/2	252 385.0	99		
$3d^4(^1S2)4s$	^2S	1/2	255 002.9	78	20	$(^1S1)\ ^2S$
$3d^4(^3D)4s$	^2D	5/2	255 292.5	99		
		3/2	255 484.1	98		
$3d^4(^1D2)4s$	^2D	5/2	261 994.0	78	21	$(^1D1)\ ^2D$
		3/2	262 077.3	77	21	$(^1D1)\ ^2D$
$3d^4(^1F)4s$	^2F	5/2	268 877.0	99		
		7/2	268 885.8	99		
$3d^4(^3P1)4s$	^4P	5/2	276 608.8	61	38	$(^3P2)\ ^4P$
		3/2	277 747.9	60	39	$(^3P2)\ ^4P$
$3d^4(^3F1)4s$	^4F	9/2	277 192.4	80	19	$(^3F2)\ ^4F$
		3/2	277 330.2	78	22	$(^3F2)\ ^4F$
		7/2	277 360.7	79	20	$(^3F2)\ ^4F$
		5/2	277 376.8	78	21	$(^3F2)\ ^4F$
$3d^4(^5D)4p$	$^6F^\circ$	1/2	*278 407.0*	99		
		3/2	*278 703.5*	99		
		5/2	*279 192.4*	99		
		7/2	*279 871.1*	99		
		9/2	*280 748.2*	99		
		11/2	*281 860.6*	100		
$3d^4(^5D)4p$	$^6P^\circ$	3/2	*280 778.7*	94	5	$(^5D)\ ^4P^\circ$
		5/2	*280 923.5*	95		
		7/2	*281 201.4*	99		
$3d^4(^5D)4p$	$^4P^\circ$	1/2	*282 002.8*	71	26	$(^5D)\ ^6D^\circ$
		3/2	*282 995.6*	61	30	
		5/2	*284 259.9*	46	48	
$3d^4(^3F1)4s$	^2F	7/2	283 592.1	80	19	$(^3F2)\ ^4F$
		5/2	283 736.7	79	21	$(^3F2)\ ^4F$
$3d^4(^5D)4p$	$^6D^\circ$	1/2	*285 033.7*	74	26	$(^5D)\ ^4P^\circ$
		3/2	*285 248.1*	68	31	$(^5D)\ ^4P^\circ$
		7/2	*285 335.0*	96		
		5/2	*285 643.0*	50	48	$(^5D)\ ^4P^\circ$
		9/2	*285 855.7*	91	7	$(^5D)\ ^4F^\circ$
$3d^4(^5D)4p$	$^4F^\circ$	3/2	*288 539.7*	95		
		5/2	*288 738.4*	94		
		7/2	*289 029.0*	92		
		9/2	*289 447.5*	88	8	$(^5D)\ ^6D^\circ$

Co v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^4(^1G1)4s$	^2G	9/2	289 449.2	67		33	$(^1G2)\ ^2G$
		7/2	289 495.1	66		33	$(^1G2)\ ^2G$
$3d^4(^5D)4p$	$^4D°$	1/2	*295 510.0*	97			
		3/2	*295 741.8*	97			
		5/2	*296 071.4*	97			
		7/2	*296 430.2*	97			
$3d^4(^3H)4p$	$^4H°$	7/2	*306 046.4*	76		20	$(^3G)\ ^4H°$
		9/2	*306 372.8*	74		19	
		11/2	*306 854.6*	75		17	
		13/2	*307 496.4*	79		14	
$3d^4(^3P2)4p$	$^4D°$	1/2	*306 725.2*	48		32	$(^3P1)\ ^4D°$
		3/2	*307 649.2*	47		32	$(^3P1)\ ^4D°$
		5/2	*308 863.5*	41		28	$(^3P1)\ ^4D°$
		7/2	*309 993.7*	29		28	$(^3F2)\ ^4D°$
$3d^4(^3F2)4p$	$^4G°$	5/2	*309 225.4*	42		23	$(^3G)\ ^4G°$
		11/2	*313 577.1*	54		28	$(^3H)\ ^4G°$
$3d^4(^3F2)4p$		7/2	*309 481.8*	27	$^4G°$	16	$(^3G)\ ^4G°$
$3d^4(^3H)4p$	$^4I°$	9/2	*309 625.8*	58		9	$(^3H)\ ^2G°$
		11/2	*310 649.4*	85		7	$(^3H)\ ^4H°$
		13/2	*311 534.5*	93		6	$(^3H)\ ^4H°$
		15/2	*312 260.6*	100			
$3d^4(^3H)4p$		9/2	*310 031.1*	33	$^4I°$	14	$(^3F2)\ ^4G°$
$3d^4(^3P2)4p$		1/2	*310 357.9*	31	$^4P°$	22	$(^3P1)\ ^2S°$
$3d^4(^3H)4p$	$^4G°$	11/2	*310 842.1*	39		27	$(^3G)\ ^4G°$
		5/2	*312 792.9*	31		24	$(^3F2)\ ^4G°$
		7/2	*313 142.7*	50		31	$(^3F2)\ ^4G°$
		9/2	*313 278.7*	45		38	$(^3F2)\ ^4G°$
$3d^4(^3H)4p$	$^2G°$	7/2	*311 005.7*	40		18	$(^3F2)\ ^2G°$
		9/2	*311 479.6*	33		18	$(^3F2)\ ^2G°$
$3d^4(^3P2)4p$	$^4P°$	3/2	*311 912.5*	43		25	$(^3P1)\ ^4P°$
		5/2	*313 311.0*	50		28	$(^3P1)\ ^4P°$
$3d^4(^3F2)4p$		3/2	*312 235.6*	29	$^4F°$	20	$(^3F2)\ ^2D°$
$3d^4(^3P2)4p$		1/2	*312 518.0*	27	$^4P°$	18	$(^3P1)\ ^2S°$
$3d^4(^3F2)4p$		5/2	*313 083.1*	34	$^4F°$	17	$(^3H)\ ^4G°$
$3d^4(^3F2)4p$	$^4F°$	7/2	*313 626.7*	68		12	$(^3F1)\ ^4F°$
		9/2	*313 817.8*	65		11	$(^3F1)\ ^4F°$
$3d^4(^3P2)4p$		3/2	*313 825.8*	27	$^2P°$	15	$(^3P2)\ ^4S°$
$3d^4(^3F2)4p$		5/2	*314 219.1*	28	$^2D°$	21	$(^3F2)\ ^4F°$
$3d^4(^3F2)4p$		3/2	*314 454.8*	24	$^4F°$	19	$(^3F2)\ ^2D°$
$3d^4(^3F2)4p$		5/2	*314 845.5*	18	$^4D°$	13	$(^3G)\ ^2F°$

Co v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^4(^3P2)4p$		1/2	314 997.3	24	$^2P°$	28	$(^3F2)\ ^4D°$
$3d^4(^3P2)4p$		7/2	315 092.2	19	$^4D°$	13	$(^3F2)\ ^4D°$
$3d^4(^3H)4p$	$^2I°$	11/2	315 216.1	84		6	$(^1I)\ ^2I°$
		13/2	315 289.8	85		8	$(^3G)\ ^4H°$
$3d^4(^3F2)4p$	$^4D°$	3/2	315 255.4	40		13	$(^3F1)\ ^4D°$
$3d^4(^3G)4p$		5/2	315 657.5	22	$^2F°$	20	$(^3F2)\ ^4D°$
$3d^4(^3F2)4p$		1/2	315 868.7	33	$^4D°$	20	$(^3P2)\ ^2P°$
$3d^4(^3H)4p$	$^2H°$	9/2	315 916.7	46		16	$(^3G)\ ^4H°$
		11/2	316 884.4	40		30	$(^3G)\ ^4H°$
$3d^4(^3G)4p$	$^4H°$	7/2	316 132.0	74		19	$(^3H)\ ^4H°$
		9/2	316 936.2	60		14	$(^3H)\ ^2H°$
		11/2	317 669.7	47		33	$(^3H)\ ^2H°$
		13/2	318 344.6	77		15	$(^3H)\ ^4H°$
$3d^4(^3P2)4p$		3/2	316 178.9	24	$^2P°$	13	$(^3P2)\ ^4S°$
$3d^4(^3G)4p$		7/2	316 254.0	18	$^2F°$	15	$(^3D)\ ^2F°$
$3d^4(^3G)4p$	$^4F°$	9/2	316 581.0	60		12	$(^3F2)\ ^4F°$
		3/2	316 761.0	42		14	$(^3D)\ ^4F°$
		5/2	316 859.2	49		14	$(^3D)\ ^4F°$
		7/2	316 911.6	39		17	$(^3F2)\ ^4D°$
$3d^4(^3P2)4p$	$^2D°$	3/2	317 941.0	41		28	$(^3P1)\ ^2D°$
		5/2	319 088.9	45		31	$(^3P1)\ ^2D°$
$3d^4(^3F2)4p$	$^2F°$	5/2	319 497.2	51		27	$(^3G)\ ^2F°$
		7/2	320 234.5	46		36	$(^3G)\ ^2F°$
$3d^4(^3F2)4p$		7/2	319 611.9	28	$^2G°$	15	$(^3H)\ ^2G°$
$3d^4(^3G)4p$	$^2H°$	11/2	319 724.1	43		21	$(^3G)\ ^4G°$
		9/2	320 012.1	46		11	$(^3H)\ ^2G°$
$3d^4(^3G)4p$		9/2	319 915.7	20	$^4G°$	18	$(^3F2)\ ^2G°$
$3d^4(^3G)4p$	$^4G°$	5/2	320 378.1	53		29	$(^3H)\ ^4G°$
		7/2	320 644.6	50		22	$(^3H)\ ^4G°$
		9/2	321 122.2	38		16	$(^3G)\ ^2H°$
		11/2	321 521.4	45		25	$(^3G)\ ^2H°$
$3d^4(^3D)4p$	$^4D°$	1/2	323 018.6	82		7	$(^3D)\ ^2P°$
		3/2	323 076.2	75		10	$(^3D)\ ^4P°$
		7/2	323 690.1	81		5	$(^3D)\ ^4F°$
		5/2	324 205.8	40		44	$(^3D)\ ^4P°$
$3d^4(^3D)4p$	$^4P°$	5/2	323 169.4	47		42	$(^3D)\ ^4D°$
		3/2	325 125.5	78		8	$(^3D)\ ^4D°$
		1/2	325 735.1	89		6	$(^3P2)\ ^4P°$

Co v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
$3d^4(^3G)4p$	$^2G^\circ$	7/2	*324 477.5*	46		24	$(^1G2)\ ^2F^\circ$
		9/2	*324 630.4*	57		20	$(^3H)\ ^2G^\circ$
$3d^4(^1I)4p$	$^2I^\circ$	13/2	*324 571.5*	70		24	$(^1I)\ ^2K^\circ$
		11/2	*324 767.7*	90		5	$(^3H)\ ^2I^\circ$
$3d^4(^1G2)4p$		7/2	*324 818.6*	32	$^2F^\circ$	22	$(^3G)\ ^2G^\circ$
$3d^4(^1G2)4p$	$^2H^\circ$	9/2	*325 584.5*	49		23	$(^1G1)\ ^2H^\circ$
		11/2	*326 267.9*	53		21	$(^1G1)\ ^2H^\circ$
$3d^4(^3D)4p$	$^4F^\circ$	3/2	*325 639.8*	67		21	$(^3G)\ ^4F^\circ$
		5/2	*325 941.4*	55		14	$(^3G)\ ^4F^\circ$
		7/2	*326 285.1*	69		18	$(^3G)\ ^4F^\circ$
		9/2	*326 560.0*	79		18	$(^3G)\ ^4F^\circ$
$3d^4(^1G2)4p$	$^2F^\circ$	5/2	*326 135.6*	41		19	$(^1G1)\ ^2F^\circ$
$3d^4(^1I)4p$	$^2K^\circ$	13/2	*326 428.3*	75		25	$(^1I)\ ^2I^\circ$
		15/2	*327 462.4*	100			
$3d^4(^3D)4p$	$^2P^\circ$	3/2	*326 288.8*	54		28	$(^1S2)\ ^2P^\circ$
		1/2	*331 431.1*	45		29	$(^1S2)\ ^2P^\circ$
$3d^4(^1G2)4p$	$^2G^\circ$	7/2	*328 818.4*	46		30	$(^1G1)\ ^2G^\circ$
		9/2	*329 319.8*	42		30	$(^1G1)\ ^2G^\circ$
$3d^4(^1I)4p$	$^2H^\circ$	11/2	*330 773.4*	74		10	$(^3G)\ ^2H^\circ$
		9/2	*331 484.4*	83		10	$(^3G)\ ^2H^\circ$
$3d^4(^1S2)4p$	$^2P^\circ$	3/2	*331 156.7*	32		20	$(^3D)\ ^2P^\circ$
$3d^4(^3D)4p$	$^2F^\circ$	7/2	*331 624.4*	68		11	$(^3G)\ ^2F^\circ$
		5/2	*332 053.0*	67		13	$(^3G)\ ^2F^\circ$
$3d^4(^3D)4p$	$^2D^\circ$	5/2	*332 114.2*	50		26	$(^1D2)\ ^2D^\circ$
		3/2	*332 906.6*	58		12	$(^1D2)\ ^2D^\circ$
$3d^4(^1D2)4p$	$^2D^\circ$	3/2	*334 690.2*	45		19	$(^3D)\ ^2D^\circ$
		5/2	*335 164.1*	33		25	$(^3D)\ ^2D^\circ$
$3d^4(^1D2)4p$	$^2F^\circ$	5/2	*336 414.8*	52		12	$(^1D1)\ ^2F^\circ$
		7/2	*337 129.9*	53		25	$(^1F)\ ^2F^\circ$
$3d^4(^1F)4p$	$^2F^\circ$	5/2	*340 989.5*	69		12	$(^1D2)\ ^2F^\circ$
		7/2	*341 550.0*	57		21	$(^1D2)\ ^2F^\circ$
$3d^4(^1D2)4p$	$^2P^\circ$	3/2	*341 093.0*	66		13	$(^1D1)\ ^2P^\circ$
		1/2	*341 110.0*	72		14	$(^1D1)\ ^2P^\circ$
$3d^4(^1F)4p$	$^2G^\circ$	7/2	*343 541.4*	89			
		9/2	*344 949.4*	93			
$3d^4(^1F)4p$	$^2D^\circ$	5/2	*345 942.1*	57		16	$(^3P1)\ ^2D^\circ$
		3/2	*347 632.3*	58		13	$(^3P1)\ ^2D^\circ$

Co v—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages			
3d^4(^{3}F1)4p	^{4}F°	5/2	*349 525.8*	68		10	(^{3}F2) ^{4}F°
		3/2	*349 607.6*	72		11	(^{3}F2) ^{4}F°
		7/2	*349 646.9*	71		10	(^{3}F2) ^{4}F°
		9/2	*350 024.0*	84		11	(^{3}F2) ^{4}F°
3d^4(^{3}P1)4p	^{4}P°	3/2	*350 370.6*	36		17	(^{3}P2) ^{4}P°
		1/2	*350 778.2*	40		20	(^{3}P2) ^{4}P°
		5/2	*351 787.7*	42		21	(^{3}P2) ^{4}P°
3d^4(^{3}P1)4p		5/2	*350 532.0*	22	^{4}D°	19	(^{3}P1) ^{4}P°
3d^4(^{3}P1)4p		7/2	*351 248.8*	34	^{4}D°	21	(^{3}F1) ^{4}D°
3d^4(^{3}P1)4p		3/2	*351 609.1*	24	^{4}D°	22	(^{3}P1) ^{4}P°
3d^4(^{3}F1)4p	^{4}G°	5/2	*352 700.2*	46		23	(^{3}F1) ^{2}F°
		7/2	*353 248.7*	38		31	(^{3}F1) ^{2}F°
		9/2	*354 141.7*	72		22	(^{3}F2) ^{4}G°
		11/2	*354 639.6*	76		22	(^{3}F2) ^{4}G°
3d^4(^{1}F)4p	^{2}D°	5/2	*353 735.5*	25		21	(^{3}P1) ^{2}D°
		3/2	*354 116.4*	28		23	(^{3}P1) ^{2}D°
3d^4(^{3}F1)4p	^{2}F°	7/2	*354 218.1*	39		33	(^{3}F1) ^{4}G°
		5/2	*354 579.0*	48		21	(^{3}F1) ^{4}G°
3d^4(^{3}P1)4p	^{4}S°	3/2	*358 499.8*	49		45	(^{3}P2) ^{4}S°
3d^4(^{3}F1)4p	^{4}D°	7/2	*359 767.2*	48		17	(^{3}P1) ^{4}D°
		5/2	*360 339.2*	49		18	(^{3}F2) ^{4}D°
		3/2	*360 614.6*	48		18	(^{3}F2) ^{4}D°
3d^4(^{3}F1)4p	^{2}G°	9/2	*359 796.7*	74		20	(^{3}F2) ^{2}G°
		7/2	*360 490.7*	74		22	(^{3}F2) ^{2}G°
3d^4(^{3}P1)4p	^{2}P°	3/2	*360 117.9*	60		27	(^{3}P2) ^{2}P°
		1/2	*360 857.2*	60		28	(^{3}P2) ^{2}P°
3d^4(^{1}G1)4p	^{2}H°	9/2	*363 716.7*	38		25	(^{1}G1) ^{2}G°
		11/2	*365 937.1*	65		32	(^{1}G2) ^{2}H°
3d^4(^{3}P2)4p	^{2}S°	1/2	*363 977.4*	55		42	(^{3}P1) ^{2}S°
3d^4(^{1}G1)4p	^{2}G°	7/2	*364 229.2*	55		33	(^{1}G2) ^{2}G°
		9/2	*365 660.1*	35		27	(^{1}G1) ^{2}H°
3d^4(^{1}G1)4p	^{2}F°	7/2	*366 848.8*	56		19	(^{1}G2) ^{2}F°
		5/2	*367 276.4*	56		19	(^{1}G2) ^{2}F°
3d^4(^{1}D1)4p	^{2}P°	3/2	*384 045.9*	76		16	(^{1}D2) ^{2}P°
		1/2	*385 108.3*	75		16	(^{1}D2) ^{2}P°
3d^4(^{1}D1)4p	^{2}F°	5/2	*389 423.9*	70		18	(^{1}D2) ^{2}F°
		7/2	*390 959.2*	73		19	(^{1}D2) ^{2}F°
3d^4(^{1}D1)4p	^{2}D°	3/2	*394 614.3*	73		26	(^{1}D2) ^{2}D°
		5/2	*395 250.2*	72		25	(^{1}D2) ^{2}D°
Co VI (^{5}D$_0$)	*Limit*		641 000				

Co VI

$Z=27$

Ti I isoelectronic sequence

Ground state: $1s^22s^22p^63s^23p^63d^4\ ^5D_0$

Ionization energy = 823 000 cm^{-1} (102 eV)

The early work on Co VI was done by Bowen (1938), who reported terms of $3d^4$ and $3d^34p$.

Henrichs and Fawcett (1976) reobserved the $3d^4$–$3d^34p$ transition array in the region of 260–340 Å and classified 200 more lines. Waagen and Meinders (1980) continued the analysis by classifying the $3d^34s$–$3d^34p$ array at higher wavelengths and reevaluated all the levels. They confirmed their results with parametric calculations and provided us with their observed level values and calculated percentage compositions in advance of publication.

The ionization energy is from Lotz (1967).

References

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Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

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Co VI

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^4$	^{5}D	0	0.0	100		
		1	204.0	100		
		2	589.0	100		
		3	1 124.7	100		
		4	1 781.6	100		
$3d^4$	^{3}P2	0	27 166.2	59	39	^{3}P1
		1	28 461.5	60	39	^{3}P1
		2	30 506.1	52	33	^{3}P1
$3d^4$	^{3}H	4	28 376.6	96	2	^{3}G
		5	28 805.9	98	2	^{3}G
		6	29 233.8	100		
$3d^4$	^{3}F2	2	30 554.9	67	19	^{3}F1
		3	30 634.6	73	20	^{3}F1
		4	30 816.7	73	18	^{3}F1
$3d^4$	^{3}G	3	34 025.8	93	6	^{3}F2
		4	34 474.6	92	5	^{3}F2
		5	34 854.8	98	2	^{3}H
$3d^4$	^{3}D	3	41 675.9	100		
		2	41 856.5	99	1	^{1}D2
		1	42 098.0	100		
$3d^4$	^{1}G2	4	41 925.9	65	32	^{1}G1
$3d^4$	^{1}I	6	42 799.6	100		
$3d^4$	^{1}S2	0	45 372.0	78	21	^{1}S1
$3d^4$	^{1}D2	2	52 739.5	78	21	^{1}D1
$3d^4$	^{1}F	3	59 930.0	99	1	^{3}F1

Co vi—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^4$	^{3}P1	2	70 164.3	61	39	^{3}P2
		1	71 624.2	60	40	^{3}P2
		0	72 302.7	60	40	^{3}P2
$3d^4$	^{3}F1	4	70 798.4	80	19	^{3}F2
		2	70 925.6	78	22	^{3}F2
		3	70 998.4	78	21	^{3}F2
$3d^4$	^{1}G1	4	81 027.4	66	33	^{1}G2
$3d^4$	^{1}D1	2	106 531.5	79	21	^{1}D2
$3d^4$	^{1}S1	0	137 619.2	79	21	^{1}S2
$3d^3(^4F)4s$	^{5}F	1	273 324.8	100		
		2	273 727.7	100		
		3	274 319.0	100		
		4	275 088.0	100		
		5	276 008.0	100		
$3d^3(^4F)4s$	^{3}F	2	282 948.0	100		
		3	283 961.0	100		
		4	285 189.0	99		
$3d^3(^4P)4s$	^{5}P	1	293 914.5	99	1	(^{2}P) ^{3}P
		2	294 229.5	98	2	(^{2}P) ^{3}P
		3	295 025.6	100		
$3d^3(^2G)4s$	^{3}G	3	298 620.2	100		
		4	298 974.6	98	1	(^{2}G) ^{1}G
		5	299 534.0	98	1	(^{2}H) ^{3}H
$3d^3(^4P)4s$	^{3}P	1	302 688.8	86	6	(^{2}P) ^{3}P
		2	303 840.9	90	8	(^{2}P) ^{3}P
$3d^3(^2G)4s$	^{1}G	4	303 788.5	92	8	(^{2}H) ^{3}H
$3d^3(^2P)4s$	^{3}P	2	304 909.9	56	26	(^{2}D2) ^{3}D
		1	305 039.0	66	18	(^{2}D2) ^{3}D
		0	305 473.1	84	16	(^{4}P) ^{3}P
$3d^3(^2D2)4s$	^{3}D	1	306 439.2	50	25	(^{2}P) ^{3}P
		3	307 482.7	80	20	(^{2}D1) ^{3}D
		2	307 720.0	52	32	(^{2}P) ^{3}P
$3d^3(^2H)4s$	^{3}H	4	307 627.0	92	7	(^{2}G) ^{1}G
		5	307 692.0	98	2	(^{2}G) ^{3}G
		6	308 029.5	100		
$3d^3(^2P)4s$	^{1}P	1	310 736.8	86	7	(^{2}D2) ^{3}D
$3d^3(^2D2)4s$	^{1}D	2	311 916.0	77	20	(^{2}D1) ^{1}D
$3d^3(^2H)4s$	^{1}H	5	312 551.2	99	1	(^{2}H) ^{3}H
$3d^3(^2F)4s$	^{3}F	4	326 384.3	100		
		3	326 664.9	100		
		2	326 902.8	100		

Co VI—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^3(^2F)4s$	^{1}F	3	330 886.8	100		
$3d^3(^4F)4p$	^{5}G°	2	*353 596.7*	98	1	(^{4}F) ^{3}F°
		3	*354 427.7*	98	1	(^{4}F) ^{3}F°
		4	*355 504.0*	98	1	(^{4}F) ^{5}F°
		5	*356 833.0*	98	1	(^{4}F) ^{5}F°
		6	*358 461.0*	100		
$3d^3(^2D1)4s$	^{3}D	3	354 336.2	80	20	(^{2}D2) ^{3}D
		2	354 591.7	79	21	(^{2}D2) ^{3}D
		1	354 782.8	78	22	(^{2}D2) ^{3}D
$3d^3(^4F)4p$	^{3}D°	1	*356 746.4*	42	36	(^{4}F) ^{5}F°
		2	*360 458.8*	56	29	(^{4}F) ^{5}F°
		3	*361 495.1*	73	8	(^{4}P) ^{3}D°
$3d^3(^4F)4p$	^{5}D°	2	*357 272.5*	42	28	(^{4}F) ^{3}D°
		0	*357 990.6*	95	4	(^{4}P) ^{5}D°
		3	*358 022.2*	67	16	(^{4}F) ^{5}F°
		1	*358 366.5*	76	16	(^{4}F) ^{5}F°
		4	*358 915.0*	88	8	(^{4}F) ^{5}F°
$3d^3(^2D1)4s$	^{1}D	2	358 810.9	79	21	(^{2}D2) ^{1}D
$3d^3(^4F)4p$	^{5}F°	2	*359 037.0*	44	48	(^{4}F) ^{5}D°
		3	*359 833.0*	75	21	(^{4}F) ^{5}D°
		1	*359 902.9*	48	44	(^{4}F) ^{3}D°
		4	*360 591.2*	88	7	(^{4}F) ^{5}D°
		5	*361 268.2*	91	6	(^{4}F) ^{3}G°
$3d^3(^4F)4p$	^{3}G°	3	*364 344.2*	90	6	(^{2}G) ^{3}G°
		4	*365 084.8*	88	5	(^{2}G) ^{3}G°
		5	*366 029.9*	85	8	(^{4}F) ^{5}F°
$3d^3(^4F)4p$	^{3}F°	2	*367 554.5*	93	2	(^{2}D2) ^{3}F°
		3	*368 412.2*	92	2	(^{2}D2) ^{3}F°
		4	*369 316.0*	93	2	(^{2}D2) ^{3}F°
$3d^3(^4P)4p$	^{5}P°	1	*374 556.4*	96	1	(^{4}P) ^{3}P°
		2	*375 249.0*	93	5	(^{4}P) ^{3}P°
		3	*376 365.0*	98	1	(^{4}P) ^{5}D°
$3d^3(^4P)4p$	^{5}D°	0	*375 932.4*	53	36	(^{4}P) ^{3}P°
		1	*376 483.5*	59	34	(^{4}P) ^{3}P°
		2	*378 714.0*	58	30	(^{4}P) ^{3}P°
		3	*379 090.8*	92	4	(^{4}F) ^{5}D°
		4	*380 503.4*	96	4	(^{4}F) ^{5}D°
$3d^4(^4P)4p$	^{3}P°	2	*376 793.0*	50	35	(^{4}P) ^{5}D°
		0	*378 219.1*	39	41	(^{4}P) ^{5}D°
		1	*378 740.0*	53	34	(^{4}P) ^{5}D°
$3d^3(^2G)4p$	^{3}H°	4	*378 002.0*	76	18	(^{2}H) ^{3}H°
		5	*379 143.0*	68	20	(^{2}H) ^{3}H°
		6	*381 073.7*	73	25	(^{2}H) ^{3}H°

Co VI—Continued

Configuration	Term	J	Level (cm⁻¹)	Leading percentages			
$3d^3(^2G)4p$	$^3G°$	3	*380 633.5*	68		11	$(^2G)\ ^3F°$
		4	*381 655.6*	61		23	$(^2G)\ ^3F°$
		5	*382 475.5*	74		10	$(^2G)\ ^3H°$
$3d^3(^2G)4p$		4	*382 556.8*	32	$^3F°$	32	$(^2G)\ ^1G°$
$3d^3(^2G)4p$	$^3F°$	2	*382 756.1*	54		18	$(^2D2)\ ^3F°$
		3	*383 297.4*	58		17	$(^2G)\ ^3G°$
$3d^3(^2P)4p$	$^3P°$	1	*384 063.0*	48		20	$(^2D2)\ ^3P°$
		0	*384 752.0*	41		22	$(^2P)\ ^1S°$
$3d^3(^2G)4p$	$^1G°$	4	*384 784.6*	42		30	$(^2G)\ ^3F°$
$3d^3(^2P)4p$		2	*385 003.3*	25	$^3P°$	16	$(^2P)\ ^1D°$
$3d^3(^4P)4p$	$^5S°$	2	*385 386.0*	49		14	$(^2P)\ ^1D°$
$3d^3(^2G)4p$	$^1F°$	3	*385 480.0*	63		13	$(^2D2)\ ^1F°$
$3d^3(^2G)4p$	$^1H°$	5	*385 802.0*	66		19	$(^2H)\ ^1H°$
$3d^3(^2P)4p$	$^3D°$	1	*386 280.3*	80		6	$(^4P)\ ^3D°$
		2	*387 952.5*	62		10	$(^2P)\ ^1D°$
		3	*388 564.7*	46		23	$(^2D2)\ ^3F°$
$3d^3(^4P)4p$		2	*386 593.8*	38	$^5S°$	20	$(^2P)\ ^3P°$
$3d^3(^2H)4p$	$^3H°$	4	*387 548.3*	59		21	$(^2G)\ ^1G°$
		5	*387 564.7*	73		22	$(^2G)\ ^3H°$
		6	*388 127.8*	71		25	$(^2G)\ ^3H°$
$3d^3(^2D2)4p$	$^1P°$	1	*389 036.0*	39		20	$(^2P)\ ^1P°$
$3d^3(^2D2)4p$	$^3F°$	2	*389 224.5*	43		15	$(^2G)\ ^3F°$
		4	*391 170.3*	71		16	$(^2D1)\ ^3F°$
$3d^3(^4P)4p$		3	*389 610.3*	29	$^3D°$	25	$(^2D2)\ ^3F°$
$3d^3(^4P)4p$	$^3D°$	2	*390 195.8*	52		18	$(^2P)\ ^3D°$
		1	*390 217.5*	41		25	$(^2D2)\ ^3D°$
		3	*390 430.3*	40		34	$(^2P)\ ^3D°$
$3d^3(^2H)4p$	$^3I°$	5	*390 770.1*	89		8	$(^2G)\ ^1H°$
		6	*391 719.4*	96		2	$(^2H)\ ^3H°$
		7	*393 109.7*	100			
$3d^3(^2D2)4p$	$^3D°$	1	*392 070.7*	46		32	$(^4P)\ ^3D°$
		2	*393 127.0*	61		18	$(^4P)\ ^3D°$
		3	*393 920.4*	51		12	$(^4P)\ ^3D°$
$3d^3(^2H)4p$	$^1G°$	4	*393 009.5*	73		17	$(^2F)\ ^1G°$
$3d^3(^2H)4p$	$^1H°$	5	*393 534.6*	69		18	$(^2G)\ ^1H°$
$3d^3(^2D2)4p$	$^3P°$	2	*394 159.0*	35		44	$(^2P)\ ^3P°$
		1	*394 384.3*	42		32	$(^2P)\ ^3P°$
		0	*394 849.6*	45		35	$(^2P)\ ^3P°$

Co VI—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$3d^3(^2D2)4p$	$^1F°$	3	*395 188.5*	46	15	$(^2H)\ ^3G°$
$3d^3(^2H)4p$	$^3G°$	5	*396 235.4*	77	9	$(^2H)\ ^1H°$
		4	*396 420.2*	80	7	$(^2F)\ ^3G°$
		3	*396 569.8*	72	10	$(^2D2)\ ^1F°$
$3d^3(^2H)4p$	$^1I°$	6	*396 559.0*	97	1	$(^2H)\ ^3I°$
$3d^3(^4P)4p$	$^3S°$	1	*399 451.9*	79	10	$(^2P)\ ^1P°$
$3d^3(^2D2)4p$	$^1D°$	2	*400 205.3*	45	42	$(^2P)\ ^1D°$
$3d^3(^2P)4p$	$^1P°$	1	*401 010.3*	60	17	$(^2D2)\ ^1P°$
$3d^3(^2F)4p$	$^3F°$	2	*407 080.0*	90	2	$(^2D1)\ ^3F°$
		3	*407 195.0*	88	4	$(^2F)\ ^3G°$
		4	*407 547.7*	88	5	$(^2F)\ ^3G°$
$3d^3(^2F)4p$	$^3G°$	3	*411 747.1*	82	8	$(^2H)\ ^3G°$
		4	*412 400.0*	84	8	$(^2H)\ ^3G°$
		5	*413 003.8*	93	7	$(^2H)\ ^3G°$
$3d^3(^2F)4p$	$^3D°$	3	*412 885.0*	80	8	$(^2D1)\ ^3D°$
		2	*414 075.6*	76	10	$(^2F)\ ^1D°$
		1	*414 758.0*	90	8	$(^2D1)\ ^3D°$
$3d^3(^2F)4p$	$^1D°$	2	*413 472.2*	61	20	$(^2D1)\ ^1D°$
$3d^3(^2F)4p$	$^1G°$	4	*417 825.9*	79	18	$(^2H)\ ^1G°$
$3d^3(^2F)4p$	$^1F°$	3	*417 926.2*	90	2	$(^2G)\ ^1F°$
$3d^3(^2D1)4p$	$^3D°$	1	*435 466.8*	75	17	$(^2D2)\ ^3D°$
		2	*435 540.0*	73	16	$(^2D2)\ ^3D°$
		3	*436 005.0*	74	15	$(^2D2)\ ^3D°$
$3d^3(^2D1)4p$	$^1D°$	2	*438 159.2*	43	21	$(^2D1)\ ^3F°$
$3d^3(^2D1)4p$	$^3F°$	3	*440 016.0*	68	20	$(^2D2)\ ^3F°$
		2	*440 041.7*	52	18	$(^2D1)\ ^1D°$
		4	*440 943.2*	76	21	$(^2D2)\ ^3F°$
$3d^3(^2D1)4p$	$^3P°$	2	*443 652.0*	74	22	$(^2D2)\ ^3P°$
		1	*444 657.8*	74	23	$(^2D2)\ ^3P°$
		0	*445 191.6*	75	24	$(^2D2)\ ^3P°$
$3d^3(^2D1)4p$	$^1F°$	3	*445 562.1*	74	19	$(^2D2)\ ^1F°$
$3d^3(^2D1)4p$	$^1P°$	1	*452 883.0*	76	23	$(^2D2)\ ^1P°$
Co VII $(^4F_{3/2})$	*Limit*		823 000			

Co VII

$Z=27$

Sc I isoelectronic sequence

Ground state: $1s^22s^22p^63s^23p^63d^3\ ^4F_{3/2}$

Ionization energy = 1 040 000 cm^{-1} (129 eV)

Anderson and Mack (1941) have observed and classified 119 lines between 206 and 241 Å in the $3d^3$–$3d^24p$ transition array. The uncertainty in the level values is about 10 cm^{-1} which corresponds to a random error of about 0.003 Å in the wavelengths.

The doublet system has been questioned by Bowen (1960) on the basis of isoelectronic extrapolations, but the objection does not seem to be well substantiated.

The configurations $3d^3$, $3d^24s$, and $3d^24p$ have been calculated by Kancerevicius, Ramonas, and Uspalis (1976) by the Hartree-Fock method. They confirm the designations by Anderson and Mack.

The ionization energy was derived by Lotz (1967).

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Co VII

Configuration	Term	J	Level (cm^{-1})
$3d^3$	^4F	3/2	0
		5/2	698
		7/2	1 610
		9/2	2 723
$3d^3$	^4P	1/2	21 096
		3/2	21 304
		5/2	22 187
$3d^3$	^2G	7/2	24 151
		9/2	25 063
$3d^3$	$^2D2$	5/2	31 348
		3/2	31 555?
$3d^3$	^2H	9/2	33 251
		11/2	33 873
$3d^2(^3F)4p$	$^4G°$	5/2	*445 761*
		7/2	*447 314*
		9/2	*449 305*
		11/2	*451 810?*
$3d^2(^3F)4p$	$^4F°$	3/2	*446 966*
		5/2	*448 051*
		7/2	*449 440*
		9/2	*450 989*
$3d^2(^3F)4p$	$^2F°$	5/2	*450 865*
		7/2	*452 009*
$3d^2(^3F)4p$	$^4D°$	3/2	*451 215*
		1/2	*451 559*
		5/2	*452 566*
		7/2	*454 157*

Co VII—Continued

Configuration	Term	J	Level (cm^{-1})
$3d^2(^3F)4p$	$^2D^\circ$	3/2	*452 709*
		5/2	*454 482?*
$3d^2(^3F)4p$	$^2G^\circ$	7/2	*459 170*
		9/2	*460 587*
$3d^2(^3P)4p$	$^4S^\circ$	3/2	*465 290*
$3d^2(^3P)4p$	$^4D^\circ$	1/2	*469 358?*
		3/2	*470 375*
		5/2	*471 880*
		7/2	*474 067*
$3d^2(^3P)4p$	$^4P^\circ$	1/2	*474 575*
		3/2	*475 156*
		5/2	*476 592*
$3d^2(^1G)4p$	$^2G^\circ$	7/2	*476 054*
		9/2	*476 288*
$3d^2(^1G)4p$	$^2H^\circ$	9/2	*485 616*
		11/2	*487 584*
Co VIII ($^3F_2$)	*Limit*		1 040 000

Co VIII

$Z=27$

Ca I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2\ {}^3F_2$

Ionization energy = 1 273 000±5000 cm^{-1} (157.8±0.6 eV)

Nineteen lines of the transition array $3d^2$–$3d4f$ in the range of 122–125 Å were classified by Alexander et al. (1966).

New observations were made by Fawcett, Ridgeley, and Ekberg (1980) in the extended range of 102–192 Å. The arrays $3d^2$–$3d4p$, $3d5f$, and $3p^6 3d^2 - 3p^5 3d^3$ were analyzed and new lines of $3d^2$–$3d4f$ were found which unified the earlier system of levels. The uncertainty of about 10 cm^{-1} in the level values derived from these data arises from the reported wavelength uncertainty of ±0.007 Å. Confirmation of the analysis was obtained from parametric calculations of the configurations. The level values and percentage compositions are from this work.

We have derived the ionization energy from the $3d\ nf$ series ($n=4$, 5) and a value for the quantum defect difference $n^*(4f)-n^*(5f)=0.979$ obtained from Fe VIII.

References

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Fawcett, B. C., Ridgeley, A., and Ekberg, J. O. (1980), Phys. Scr. **21**, 155.

Co VIII

Configuration	Term	J	Level (cm^{-1})
$3p^6 3d^2$	^{3}F	2	0
		3	1 430
		4	3 144
$3p^6 3d^2$	^{1}D	2	19 624
$3p^6 3d^2$	^{3}P	0	22 304
		1	22 839
		2	24 055
$3p^6 3d^2$	^{1}G	4	32 360
$3p^6 3d^2$	^{1}S	0	74 247
$3p^6 3d4p$	^{1}D°	2	*542 430*
$3p^6 3d4p$	^{3}D°	1	*542 701*
		2	*544 314*
		3	*545 834*
$3p^6 3d4p$	^{3}F°	2	*547 400*
		3	*548 799*
		4	*551 524*
$3p^6 3d4p$	^{3}P°	1	*554 082*
		0	*554 287*
		2	*554 998*
$3p^5(^2P°)3d^3(^2H)$	^{3}G°	3	*555 699*
		4	*557 817*
		5	*561 346*
$3p^6 3d4p$	^{1}F°	3	*557 736*
$3p^6 3d4p$	^{1}P°	1	*563 271*
$3p^5(^2P°)3d^3(^2H)$	^{1}H°	5	*590 805*

Co VIII—Continued

Configuration	Term	J	Level (cm^{-1})
$3p^5(^2P^\circ)3d^3(^2F)$	$^3D^\circ$	1	598 440
		2	599 641
		3	602 844
$3p^5(^2P^\circ)3d^3(^2F)$	$^1D^\circ$	2	605 841
$3p^5(^2P^\circ)3d^3(^2G)$	$^1F^\circ$	3	608 501
$3p^5(^2P^\circ)3d^3(^4P)$	$^3P^\circ$	0	612 076
		1	613 869
		2	619 010
$3p^5(^2P^\circ)3d^3(^4F)$	$^3F^\circ$	2	616 019
		3	618 348
		4	620 737
$3p^5(^2P^\circ)3d^3(^2P)$	$^1P^\circ$	1	653 446
$3p^5(^2P^\circ)3d^3(^4F)$	$^3D^\circ$	3	656 715
		2	657 020
		1	658 136
$3p^5(^2P^\circ)3d^3(^2H)$	$^1G^\circ$	4	662 151
$3p^5(^2P^\circ)3d^3(^4P)$	$^3S^\circ$	1	678 094
$3p^5(^2P^\circ)3d^3(^2F)$	$^1F^\circ$	3	682 051
$3p^5(^2P^\circ)3d^3(^2D)$	$^1P^\circ$	1	687 584
$3p^6 3d4f$	$^1G^\circ$	4	811 205
$3p^6 3d4f$	$^3F^\circ$	2	812 862
		3	813 298
		4	814 130
$3p^6 3d4f$	$^3G^\circ$	3	817 839
		4	818 958
		5	819 657
$3p^6 3d4f$	$^1D^\circ$	2	818 633
$3p^6 3d4f$	$^3D^\circ$	1	820 599
		2	820 605
		3	820 450
$3p^6 3d4f$	$^1F^\circ$	3	821 881
$3p^6 3d4f$	$^3P^\circ$	2	823 064
		1	823 613
		0	823 928
$3p^6 3d4f$	$^1H^\circ$	5	827 140
$3p^6 3d4f$	$^1P^\circ$	1	827 508
$3p^6 3d5f$	$^1G^\circ$	4	977 281

Co VIII—Continued

Configuration	Term	J	Level (cm^{-1})
$3p^6 3d5f$	$^3F^\circ$	2	*978 005*
		3	*978 307*
		4	*979 360*
$3p^6 3d5f$	$^3G^\circ$	3	*981 316*
		4	*982 728*
		5	*983 219*
$3p^6 3d5f$	$^3D^\circ$	2	*982 716*
		3	*982 933*
$3p^6 3d5f$	$^1F^\circ$	3	*983 954*
$3p^6 3d5f$	$^1H^\circ$	5	*986 549*
Co IX ($^2D_{3/2}$)	***Limit***		**1 273 000**

Co IX

$Z=27$

K I isoelectronic sequence

Ground state: $1s^22s^22p^63s^23p^63d\ ^2D_{3/2}$

Ionization energy = 1 501 300 cm^{-1} (186.13 eV)

The $3d\ ^2D$ ground term and the levels of $3p^53d^2$ and $3p^64p$ are taken from the analysis of Ramonas and Ryabtsev. The transitions lie between 144 and 161 Å and have a reported accuracy of ±0.002 Å.

The $3p^6\ nf$ series was observed by Alexander, Feldman, and Fraenkel (1965). They determined the ionization energy from that series.

The analysis of the $3p^63d$–$3p^53d4s$ array at 100 Å is by Hoory, Goldsmith, Fraenkel and Feldman (1970). Their wavelength accuracy of ±0.005 Å results in a level uncertainty of about ±50 cm^{-1} for the $3p^53d4s$ configuration.

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Hoory, S., Goldsmith, S., Fraenkel, B. S., and Feldman, U. (1970), Astrophys. J. **160**, 781.

Ramonas, A. A., and Ryabtsev, A. N. (1980) Opt. and Spectrosc. **48**, 348.

Co IX

Configuration	Term	J	Level (cm^{-1})
$3p^6\,3d$	^2D	3/2	0
		5/2	2 451
$3p^5(^2P^\circ)3d^2(^1G)$	$^2F^\circ$	5/2	*468 222*
		7/2	*472 140*
$3p^5(^2P^\circ)3d^2(^1D)$	$^2F^\circ$	5/2	*485 123*
		7/2	*499 750*
$3p^5(^2P^\circ)3d^2(^3F)$	$^2F^\circ$	5/2	*580 759*
		7/2	*588 291*
$3p^6\,4p$	$^2P^\circ$	1/2	*625 109*
		3/2	*629 117*
$3p^5(^2P^\circ)3d^2(^3F)$	$^2D^\circ$	5/2	*644 843*
		3/2	*645 408*
$3p^5(^2P^\circ)3d^2(^3P)$	$^2P^\circ$	1/2	*650 182*
		3/2	*654 735*
$3p^6\,4f$	$^2F^\circ$	5/2	*922 590*
		7/2	*922 690*
$3p^5\,3d(^3P^\circ)4s$	$^2P^\circ$	1/2	*986 100*
		3/2	*991 510*
$3p^5\,3d(^3F^\circ)4s$	$^4F^\circ$	7/2	*996 130*
		5/2	*997 900*
$3p^5\,3d(^3F^\circ)4s$	$^2F^\circ$	7/2	*1 003 240*
		5/2	*1 009 670*
$3p^5\,3d(^3D^\circ)4s$	$^4D^\circ$	7/2	*1 024 380*
		5/2	*1 027 170*
$3p^5\,3d(^1F^\circ)4s$	$^2F^\circ$	7/2	*1 038 280*

Co IX—Continued

Configuration	Term	J	Level (cm^{-1})
$3p^5 3d(^3D^\circ)4s$	$^2D^\circ$	3/2	*1 040 830*
		5/2	*1 043 280*
$3p^6 5f$	$^2F^\circ$	5/2	*1 130 660*
		7/2	*1 130 690*
$3p^6 6f$	$^2F^\circ$	5/2	*1 243 970*
		7/2	*1 244 010*
$3p^6 7f$	$^2F^\circ$	5/2,7/2	*1 313 020*
$3p^6 8f$	$^2F^\circ$	5/2,7/2	*1 357 500*
$3p^6 9f$	$^2F^\circ$	5/2,7/2	*1 387 960*
$3p^6 10f$	$^2F^\circ$	5/2,7/2	*1 409 880*
Co X ($^1S_0$)	*Limit*		1 501 300

Co X

$Z=27$

Ar I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^6\ {}^1S_0$

Ionization energy = 2 221 000±3000 cm^{-1} (275.4±0.4 eV)

This spectrum was first observed by Gabriel, Fawcett, and Jordan (1966), who identified the $3p^5 3d\ {}^1P^\circ$ level. The present value for this level is taken from the observations of Goldsmith (1969) and has an uncertainty of ±20 cm^{-1}.

The $3p^5 4s$ and $4d$ configurations are taken from observations of resonance lines by Alexander, Feldman, and Fraenkel (1965) between 71 and 91 Å; level values are uncertain by about 60 cm^{-1}.

The $3p^5 3d$–$3p^5 4f$ transition array has been identified by Fawcett, Cowan, and Hayes (1972) but only one level is connected with the single known level of $3p^5 3d$.

The $4f$ and $5s$ levels given below are from the work of Swartz, Kastner, Goldsmith, and Neupert (1976).

We derived the ionization energy from the $3p^5 4s$ and $3p^5 5s$ configurations with an estimated value for the quantum defect change Δn^* of 1.024 between them obtained from similar spectra.

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Co X

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^6$	^1S	0	0
$3s^2 3p^5 3d$	$^1P^\circ$	1	*629 430*
$3s^2 3p^5 4s$	$^3P^\circ$	1	*1 105 290*
$3s^2 3p^5 4s$	$^1P^\circ$	1	*1 123 670*
$3s^2 3p^5 4d$	$^3P^\circ$	1	*1 380 190*
$3s^2 3p^5 4d$	$^1P^\circ$	1	*1 398 800*
$3s^2 3p^5 ({}^2P^\circ_{1/2}) 4f$	$^2[5/2]$	2	1 525 950
$3s^2 3p^5 5s$	$^3P^\circ$	1	*1 586 870*
$3s^2 3p^5 5s$	$^1P^\circ$	1	*1 604 310*
Co XI ($^2P^\circ_{3/2}$)	*Limit*		**2 221 000**

Co XI

$Z=27$

Cl I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^5\ {}^2P^\circ_{3/2}$

Ionization energy = 2 460 000 cm^{-1} (305 eV)

The ground term and the terms of $3p^4 3d$ are from the measurements of Goldsmith (1969). The uncertainty in these levels is about ± 50 cm^{-1}. The $3s3p^6\ {}^2S$ term was determined by Fawcett and Hatter (1980).

The $3p^4 4s$ terms are from Edlén (1937), except for ${}^4P_{5/2}$ which was identified by Fawcett, Cowan, and Hayes (1972).

Fawcett, Cowan, and Hayes also determined the $3p^4 4d$ terms and a transition array between $3p^4 3d$ and $3p^4 4f$ which is not connected to the present system. The wavelength region of 120 Å and measurement uncertainty of ~0.02 Å result in a level uncertainty of about 150 cm^{-1}.

The ionization energy is from Lotz's (1967) study of isoelectronic sequences.

References

Edlén, B. (1937), Zeits. Phys. **104**, 407.
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Co XI

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^5$	$^2P^\circ$	3/2	*0*
		1/2	*19 380*
$3s3p^6$	^2S	1/2	313 640
$3s^2 3p^4(^1D)3d$	^2S	1/2	582 510
$3s^2 3p^4(^3P)3d$	^2P	3/2	606 420
		1/2	613 480
$3s^2 3p^4(^3P)3d$	^2D	5/2	615 140
		3/2	631 680
$3s^2 3p^4(^3P)4s$	^4P	5/2	1 181 100
		3/2	1 189 920
$3s^2 3p^4(^3P)4s$	^2P	3/2	1 202 070
		1/2	1 211 780
$3s^2 3p^4(^1D)4s$	^2D	5/2	1 226 890
		3/2	1 227 710
$3s^2 3p^4(^3P)4d$	^2D	5/2	1 471 200
$3s^2 3p^4(^1D)4d$	^2D	5/2	1 510 800
		3/2	1 523 400
Co XII ($^3P_2$)	***Limit***		**2 460 000**

Co XII

$Z=27$

S I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^4\ ^3P_2$

Ionization energy = 2 710 000 cm^{-1} (336 eV)

The transition array $3s^2 3p^4$–$3s3p^5$ at 300 Å was interpreted by Fawcett and Hayes (1972) and remeasured with improved accuracy (±0.02 Å) by Fawcett and Hatter (1980). The level $3s3p^5\ ^3P_0$ is determined by an identification labeled tentative. Its position is out of order in the ^{3}P isoelectronic sequence. Since no intersystem lines are known, the calculated positions of $3s^2 3p^4\ ^1D$ and ^1S by Smitt, Svensson, and Outred (1976) are given in brackets. The calculation was made by diagonalizing the energy matrices with extrapolated values for the radial integrals. Their uncertainty appears to be ±20 cm^{-1} which is less than the present experimental uncertainty.

Levels of the $3p^3 3d$ configuration are from the line classifications of Fawcett and Hayes (1972) in the range of 165 Å–180 Å. The wavelength uncertainty is ±0.03 Å.

The $3p^3 4d$ levels are from the observations of Fawcett, Cowan, and Hayes (1972) at 56 Å. The uncertainty is about ±500 cm^{-1}. They also observed levels of $3p^3 4f$ terms, but they are not connected with this system.

The ionization energy is an extrapolated value obtained by Lotz (1967).

References

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Smitt, R., Svensson, L. A., and Outred, M. (1976), Phys. Scr. **13**, 293.

Co XII

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^4$	^{3}P	2	0
		1	15 820
		0	17 070
$3s^2 3p^4$	^{1}D	2	[42 120]
$3s^2 3p^4$	^{1}S	0	[88 880]
$3s3p^5$	^{3}P°	2	*306 640*
		0	*316 430?*
		1	*318 280*
$3s3p^5$	^{1}P°	1	[*390 990*]
$3s^2 3p^3(^2D°)3d$	^{3}P°	2	*569 990*
$3s^2 3p^3(^4S°)3d$	^{3}D°	3	*594 040*
		2	*602 920*
		1	*608 660*
$3s^2 3p^3(^2D°)3d$	^{1}D°	2	[*622 130*]
$3s^2 3p^3(^2D°)3d$	^{1}F°	3	[*630 670*]
$3s^2 3p^3(^2D°)3d$	^{1}P°	1	[*669 160*]
$3s^2 3p^3(^4S°)4d$	^{3}D°	3	[*1 567 400*]
$3s^2 3p^3(^2D°)4d$	^{1}D°	2	[*1 614 400*]
$3s^2 3p^3(^2D°)4d$	^{1}F°	3	[*1 617 700*]
$3s^2 3p^3(^2D°)4d$	^{1}P°	1	[*1 658 800*]
Co XIII ($^4S°_{3/2}$)	*Limit*		**2 710 000**

Co XIII

$Z = 27$

P I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^3\ {}^4S^{\circ}_{3/2}$

Ionization energy = 3 057 000 cm^{-1} (379 eV)

The excited levels of the $3s^2 3p^3$ configuration, given in brackets, are taken from the calculation by Smitt, Svensson, and Outred (1976). They appear to be uncertain by about ±20 cm^{-1}. No experimental connection between terms of this configuration is known.

The $3s^2 3p3d$ levels are from the observations of Fawcett and Hayes (1972) between 174 and 339 Å and are uncertain by about ±90 cm^{-1}. The $3s3p^4$ configuration is obtained from the measurements and classifications of Fawcett and Hayes and of Fawcett and Hatter (1980).

The $3p^2 4d$ observations of Fawcett, Cowan, and Hayes (1972) give levels that appear inconsistent with their isoelectronic sequence, and are omitted here.

The ionization energy is an extrapolated value obtained by Lotz (1967).

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Co XIII

Configuration	Term	*J*	Level (cm^{-1})
$3s^2 3p^3$	$^4S^{\circ}$	3/2	*0*
$3s^2 3p^3$	$^2D^{\circ}$	3/2	[*43 650*]
		5/2	[*49 690*]
$3s^2 3p^3$	$^2P^{\circ}$	1/2	[*79 460*]
		3/2	[*88 170*]
$3s3p^4$	^4P	5/2	295 160
		3/2	307 030
		1/2	312 110
$3s3p^4$	^2D	3/2	365 530
		5/2	368 250
$3s3p^4$	^2P	3/2	418 480
		1/2	423 290
$3s^2 3p^2(^3P)3d$	^4P	5/2	547 890
		3/2	552 880
		1/2	556 820
$3s^2 3p^2(^1D)3d$	^2D	3/2	592 830
		5/2	594 200
$3s^2 3p^2(^1D)3d$	^2P	1/2	608 870
		3/2	618 880
$3s^2 3p^2(^1D)3d$	^2F	7/2	621 710
$3s^2 3p^2(^3P)3d$	^2D	5/2	646 890
		3/2	648 390
Co XIV ($^3P_0$)	*Limit*		**3 057 000**

Co XIV

$Z=27$

Si I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^6 3s^2 3p^2\ ^3P_0$

Ionization energy = 3 315 000 cm^{-1} (411 eV)

The levels of $3s^23p^2$ and $3s3p^3$ are derived from the measurements and classifications of Fawcett and Hayes (1972) and Fawcett and Hatter (1980). Their measurement uncertainty of 0.02 Å corresponds to a level uncertainty of 25 cm^{-1}. The position of $3s^23p3d\ ^1D°$ is from the intersystem line $3s^23p^2\ ^3P_1$–$3s^23p3d\ ^1D_2^°$ observed by Fawcett and Hayes. A transition to $3s^23p^2\ ^1D$ puts that level 240 cm^{-1} above the value calculated by Smitt, Svensson, and Outred (1976) which puts the level value in question. The latter paper provides a predicted position for $3s^23p^2\ ^1S$. This level and those based on it are marked with $+x$.

The $3s^23p3d$ levels are from the observations of Fawcett and Hayes (1972) between 184 and 343 Å and are uncertain by about ±60 cm^{-1}.

The $3p4s$ levels are from the observations of Fawcett, Cowan, and Hayes (1972) and the $3p4d$ and $3p4f$ levels are those of Kastner, Swartz, Bhatia, and Lapides (1978). The uncertainty is about ±100 cm^{-1}. Several tentative identifications are omitted here.

The ionization energy is an extrapolated value obtained by Lotz (1967).

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Co XIV

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p^2$	^3P	0	0
		1	12 030
		2	22 780
$3s^2 3p^2$	^1D	2	55 160?
$3s^2 3p^2$	^1S	0	101 080+x
$3s3p^3$	$^3D°$	2	*311 240*
		3	*315 000*
$3s3p^3$	$^3P°$	2	*357 880*
$3s3p^3$	$^1D°$	2	*392 250*
$3s3p^3$	$^3S°$	1	*446 220*
$3s3p^3$	$^1P°$	1	*472 990*
$3s^2 3p3d$	$^3P°$	2	*520 950*
		1	*530 250*
$3s^2 3p3d$	$^1D°$	2	*536 280*
$3s^2 3p3d$	$^3D°$	1	*544 260*
		3	*546 830*
		2	*547 350*
$3s^2 3p3d$	$^1F°$	3	*597 430*
$3s^2 3p3d$	$^1P°$	1	*612 170*+x

Co XIV—Continued

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p4s$	$^3P°$	2	*1 536 780*
$3s^2 3p4s$	$^1P°$	1	*1 546 160*
$3s^2 3p4d$	$^3D°$	2	*1 805 400*
		3	*1 807 800*
$3s^2 3p4d$	$^3F°$	3	*1 826 800*
$3s^2 3p4d$	$^1F°$	3	*1 837 200*
$3s^2 3p4d$	$^1P°$	1	*1 858 500+x*
$3s^2 3p4f$	^1D	2	1 956 600+x
$3s^2 3p4f$	^1G	4	1 959 800
Co XV ($^2P°_{1/2}$)	*Limit*		**3 315 000**

Co XV

$Z=27$

Al I isoelectronic sequence

Ground state: $1s^22s^22p^63s^23p\ ^2P^\circ_{1/2}$

Ionization energy = 3 580 000 cm^{-1} (444 eV)

The $3s^23p$, $3s3p^2$, and $3s^23d$ levels are from Fawcett and Hayes (1972) and Fawcett and Hatter (1980); the levels are determined with an uncertainty of about 50 cm^{-1}. The $4p$–$4d$ doublet was identified by Edlén (1936). The $4f$ levels are from Fawcett, Cowan, and Hayes (1972) and are uncertain by several hundred cm^{-1}.

The ionization energy was determined by Lotz (1967).

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Co XV

Configuration	Term	J	Level (cm^{-1})
$3s^2 3p$	$^2P^\circ$	1/2	*0*
		3/2	*22 970*
$3s3p^2$	^2D	3/2	322 730
		5/2	325 780
$3s3p^2$	^2S	1/2	390 810
$3s3p^2$	^2P	1/2	417 690
		3/2	426 590
$3s^2 3d$	^2D	3/2	506 230
		5/2	508 760
$3s^2 4d$	^2D	3/2	1 901 800
		5/2	1 903 600
$3s^2 4f$	$^2F^\circ$	5/2	*2 002 800*
		7/2	*2 003 200*
Co XVI ($^1S_0$)	*Limit*		3 580 000

Co XVI

$Z=27$

Mg I isoelectronic sequence

Ground state: $1s^22s^22p^63s^2\ ^1S_0$

Ionization energy = 4 129 200±500 cm^{-1} (511.96±0.06 eV)

The classification of this spectrum was begun by Edlén (1936) who identified the triplets of $3s3d$–$3s4f$, $3s3p$–$3s4d$, and the singlet of $3s^2$–$3s4p$. No estimate of the uncertainty of the measurements was provided.

The $3s5d$ levels were found by Feldman, Katz, Behring, and Cohen (1971) and the $3s3p\ ^1P°$ by Fawcett and Hayes (1972). The rest of the levels were derived from the classifications of Fawcett, Cowan, and Hayes (1972). Thus the $3s3p$–$3p^2$ array measured at 300 Å with an uncertainty of 0.02 Å results in a level uncertainty for the $3p^2$ configuration of 40 cm^{-1}. The higher-lying levels are determined from spectra measured at 60 Å and have an uncertainty of 500 cm^{-1}.

The triplet system has not been connected to the ground state by observed lines. We calculated the position of $3s3p\ ^3P_1^\circ$ relative to $3s3p\ ^1P_1^\circ$ by the method of successive differences along the isoelectronic sequence. The uncertainty, x, is about 200 cm^{-1}.

The $3p3d$–$3p4f$ transition array has been observed at 55 Å by Kastner, Swartz, Bhatia, and Lapides (1978) but it is unconnected with the present configurations.

We calculated the ionization energy from the three member $3snd\ ^3D$ series.

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Co XVI

Configuration	Term	J	Level (cm^{-1})
$3s^2$	^1S	0	0
$3s3p$	$^3P°$	0	*250 410+x*
		1	*257 400+x*
		2	*274 800+x*
$3s3p$	$^1P°$	1	*376 310*
$3p^2$	^3P	0	592 450+x
		1	605 190+x
		2	626 400+x
$3p^2$	^1D	2	597 100
$3s3d$	^3D	1	726 020+x
		2	727 330+x
		3	729 450+x
$3s3d$	^1D	2	812 850
$3p3d$	$^3P°$	2	*1 062 900+x*
$3s4s$	^3S	1	1 970 770+x
$3s4p$	$^1P°$	1	*2 106 020*
$3s4d$	^3D	1	2 258 200+x
		2	2 259 100+x
		3	2 260 600+x
$3s4d$	^1D	2	2 261 600

Co XVI—Continued

Configuration	Term	J	Level (cm⁻¹)
3p4s	$^3P°$	2	*2 303 500+x*
3s4f	$^3F°$	2	*2 342 200+x*
		3	*2 342 400+x*
		4	*2 342 800+x*
3s4f	$^1F°$	3	*2 356 700*
3p4p	^3P	1	2 424 300+x
3p4p	^3D	3	2 428 400+x
3p4d	$^1F°$	3	*2 547 200*
3p4d	$^3D°$	1	*2 555 500+x*
		2	*2 565 700+x*
		3	*2 578 000+x*
3s5d	^3D	1	2 948 000+x
		2	2 948 100+x
		3	2 948 500+x
3s5f	$^3F°$	4	*2 989 200+x*
Co XVII ($^2S_{1/2}$)	*Limit*		**4 129 200**

Co XVII

$Z=27$

Na I isoelectronic sequence

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

Ionization energy = 4 408 500±300 cm^{-1} (546.58±0.04 eV)

Wavelengths for the $3s$–$3p$ and $3p$–$3d$ doublets were measured by Fawcett and Hayes (1972) and by Fawcett, Cowan, and Hayes (1972). From a study of this isoelectronic sequence Edlén (1978) has deduced semi-empirical expressions for the $3s$–$3p$ and $3p$–$3d$ transition energies, resulting in improved values for these wavelengths. The uncertainty is probably less than ±0.01 Å. His results are used here for the $3p$ and $3d$ terms and for the ionization energy which he deduced from the nf series.

The classifications by Edlén (1936) are used to obtain the $4s$, $4p$, $4d$, $4f$, and $5f$ terms. Fawcett, Cowan, and Hayes (1972) identified the doublets $3p$–$5s$ and $3d$–$8f$. The rest of the one-electron configurations are due to the identifications of Feldman, Katz, Behring, and Cohen (1971) whose measurements in the range of 27 Å–41 Å have an estimated uncertainty of ±0.01 Å. Feldman and Cohen (1967) identified the transitions $2p^63s$–$2p^53s^2$.

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Co XVII

Configuration	Term	J	Level (cm^{-1})
$2p^6(^1S)3s$	^2S	1/2	0
$2p^6(^1S)3p$	$^2P°$	1/2	*294 556*
		3/2	*319 957*
$2p^6(^1S)3d$	^2D	3/2	720 224
		5/2	723 932
$2p^6(^1S)4s$	^2S	1/2	2 079 550
$2p^6(^1S)4p$	$^2P°$	1/2	*2 196 500*
		3/2	*2 206 580*
$2p^6(^1S)4d$	^2D	3/2	2 353 690
		5/2	2 355 250
$2p^6(^1S)4f$	$^2F°$	5/2	*2 419 690*
		7/2	*2 420 340*
$2p^6(^1S)5s$	^2S	1/2	2 967 700
$2p^6(^1S)5p$	$^2P°$	1/2	*3 026 100*
		3/2	*3 030 800*
$2p^6(^1S)5d$	^2D	3/2	3 102 200
		5/2	3 103 000
$2p^6(^1S)5f$	$^2F°$	5/2	*3 135 500*
		7/2	*3 135 800*
$2p^6(^1S)6p$	$^2P°$	1/2	*3 463 300*
		3/2	*3 466 200*
$2p^6(^1S)6d$	^2D	3/2	3 505 700
		5/2	3 506 100

Co XVII—Continued

Configuration	Term	J	Level (cm^{-1})
$2p^6(^1S)6f$	$^2F°$	$5/2,7/2$	*3 524 500*
$2p^6(^1S)7d$	^2D	$3/2$	3 747 600
		$5/2$	3 748 000
$2p^6(^1S)7f$	$^2F°$	$5/2,7/2$	*3 758 800*
$2p^6(^1S)8d$	^2D	$5/2$	3 903 900
$2p^6(^1S)8f$	$^2F°$	$5/2,7/2$	*3 910 700*
Co XVIII ($^1S_0$)	*Limit*		4 408 500
$2p^5(^2P°)3s^2$	$^2P°$	$3/2$	*6 317 900*
		$1/2$	*6 430 500*

Co XVIII

$Z=27$

Ne I isoelectric sequence

Ground state: $1s^22s^22p^6\ ^1S_0$

Ionization energy = 11 269 000 cm^{-1} (1397.2 eV)

Only resonance lines are classified by this system of energy levels. Tyrén (1938) identified resonance lines between 12 and 16 Å from the $2s^22p^53s$, $3d$, and $2s2p^6\ 3p$ levels and Feldman and Cohen (1967) identified $4d$. Swartz, Kastner, Rothe, and Neupert (1971) made preliminary identifications of $2s^22p^54s$, $5d$, and $6d$ levels and confirmed the $2s2p^63p$ levels. The spectrum has been remeasured by Gordon, Hobby, and Peacock (1980) with a wavelength uncertainty of about ±0.003 Å. The lines fall in the range of 9–15 Å and the resulting level values have an uncertainty of 2000 cm^{-1}. Their results are used to obtain the present level values. They have added the $2s2p^64p\ ^1P$ term and the $2s^22p^5(^2P^\circ_{3/2})5d\ ^2[1/2]$, level.

The designations for $2p^53s$ and $2p^53d$ correspond with calculated percentages for this isoelectronic sequence (Sc XII and Ni XIX). We adopted the jl-coupling designations for levels of the $2p^5nd$ (n=4,5,6) configurations by comparison with isoelectronic spectra of the rare-gas type.

Kastner, Behring, and Cohen (1975) identified transitions between $2p^53p$ and $2p^54d$, but there is no connection with the levels given here.

We derived the ionization energy from the $2s^22p^5(^2P^\circ_{1/2})nd\ ^2[3/2]^\circ$ series for n=3 to 6. (The $3d$ term is designated $^1P^\circ_1$.)

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Co XVIII

Configuration	Term	J	Level (cm^{-1})
$2s^2 2p^6$	^1S	0	0
$2s^2 2p^5(^2P^\circ_{3/2})3s$	$(3/2,1/2)^\circ$	1	*6 477 900*
$2s^2 2p^5(^2P^\circ_{1/2})3s$	$(1/2,1/2)^\circ$	1	*6 592 400*
$2s^2 2p^5 3d$	$^3P^\circ$	1	*7 122 000*
$2s^2 2p^5 3d$	$^3D^\circ$	1	*7 210 800*
$2s^2 2p^5 3d$	$^1P^\circ$	1	*7 334 600*
$2s2p^6 3p$	$^3P^\circ$	1	*7 894 500*
$2s2p^6 3p$	$^1P^\circ$	1	*7 932 700*
$2s^2 2p^5(^2P^\circ_{3/2})4s$	$(3/2,1/2)^\circ$	1	*8 706 000*
$2s^2 2p^5(^2P^\circ_{1/2})4s$	$(1/2,1/2)^\circ$	1	*8 833 000*
$2s^2 2p^5(^2P^\circ_{3/2})4d$	$^2[3/2]^\circ$	1	*9 003 000*
$2s^2 2p^5(^2P^\circ_{1/2})4d$	$^2[3/2]^\circ$	1	*9 112 000*
$2s^2 2p^5(^2P^\circ_{3/2})5d$	$^2[1/2]^\circ$	1	*9 797 000*
$2s^2 2p^5(^2P^\circ_{3/2})5d$	$^2[3/2]^\circ$	1	*9 819 000*

Co XVIII—Continued

Configuration	Term	J	Level (cm^{-1})
$2s^2 2p^5(^2P^\circ_{1/2})5d$	$^2[3/2]^\circ$	1	*9 934 000*
$2s2p^6 4p$	$(1/2,3/2)^\circ$	1	*9 970 000*
$2s^2 2p^5(^2P^\circ_{3/2})6d$	$^2[3/2]^\circ$	1	*10 275 000*
$2s^2 2p^5(^2P^\circ_{1/2})6d$	$^2[3/2]^\circ$	1	*10 381 000*
Co XIX ($^2P^\circ_{3/2}$)	***Limit***		**11 269 000**

Co XIX

$Z=27$

F I isoelectronic sequence

Ground state: $1s^2 2s^2 2p^5\ ^2P^{\circ}_{3/2}$

Ionization energy = 12 135 000±10 000 cm^{-1} (1486.1±1.2 eV)

An analysis of the $2s^2 2p^5$–$2s^2 2p^4 3s$ and $2s^2 2p^5$–$2s^2 2p^4 3d$ arrays was given by Feldman, Doschek, Cowan, and Cohen (1973). Similar results were reported by Boiko, Pikuz, Safronova, and Fayonov (1978). The spectrum was remeasured by Gordon, Hobby, and Peacock (1980) who give new line identifications in these arrays as well as classifications of the $2s^2 2p^5$–$2s2p^5 3p$, $2s^2 2p^5$–$2s^2 2p^4 4s$ and $2s^2 2p^4 4d$ arrays. The ir wavelengths in the range of 10–14 Å are reported accurate to about ±0.003 Å. We use their results in combination with the ground term $2s^2 2p^5\ ^2P$ interval derived by Edlén (1977) from a semi-empirical study of the F I isoelectronic sequence. The $2s^2 2p^5$–$2s2p^6$ doublet was reported by Doschek, Feldman, Cowan, and Cohen (1974).

We derived the ionization energy from the $2s^2 2p^4(^3P)\ 3s$, $4s\ ^4P$ series, assuming the difference $n^*(4s)-n^*(3s)=1.063$ from the $2p^5\ ns$ series in Co XVIII.

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Co XIX

Configuration	Term	J	Level (cm^{-1})
$2s^2 2p^5$	$^2P^{\circ}$	3/2	*0*
		1/2	*121 950*
$2s2p^6$	^2S	1/2	1 131 850
$2s^2 2p^4(^3P)3s$	^4P	5/2	6 852 100
		3/2	6 966 200
$2s^2 2p^4(^3P)3s$	^2P	3/2	6 880 900
		1/2	6 991 500
$2s^2 2p^4(^1S)3s$	^2S	1/2	7 243 900
$2s^2 2p^4(^1D)3s$	^2D	5/2	7 050 200
		3/2	7 055 300
$2s^2 2p^4(^3P)3d$	^4P	1/2	7 525 000
		3/2	7 542 600
$2s^2 2p^4(^3P)3d$	^2F	5/2	7 552 900
$2s^2 2p^4(^3P)3d$	^4D	3/2	7 620 200
$2s^2 2p^4(^3P)3d$	^2P	3/2	7 632 800
$2s^2 2p^4(^3P)3d$	^2D	5/2	7 642 900
$2s^2 2p^4(^1D)3d$	^2S	1/2	7 701 800
$2s^2 2p^4(^1D)3d$	^2P	3/2	7 726 300
		1/2	7 764 900
$2s^2 2p^4(^1D)3d$	^2D	5/2	7 726 800
		3/2	7 757 700

Co XIX—Continued

Configuration	Term	J	Level (cm^{-1})
$2s^2 2p^4(^1S)3d$	^2D	3/2	7 917 400
$2s2p^5(^3P^\circ)3p$	^4D	5/2	8 143 000
		3/2	8 171 000
$2s2p^5(^3P^\circ)3p$	^2D	5/2	8 189 000
		3/2	8 303 000
$2s2p^5(^3P^\circ)3p$	^4P	5/2	8 227 000
		3/2	8 252 000
$2s2p^5(^3P^\circ)3p$	^2P	3/2	8 218 000
		1/2	8 227 000
$2s2p^5(^3P^\circ)3p$	^2S	1/2	8 323 000
$2s2p^5(^1P^\circ)3p$	^2D	3/2	8 487 000
		5/2	8 515 000
$2s2p^5(^1P^\circ)3p$	^2P	1/2	8 521 000
		3/2	8 531 000
$2s^2 2p^4(^3P)4s$	^2P	3/2	9 280 000
$2s^2 2p^4(^3P)4s$	^4P	3/2	9 394 000
$2s^2 2p^4(^1D)4s$	^2D	5/2	9 462 000
		3/2	9 464 000
$2s^2 2p^4(^3P)4d$	^2D	3/2,5/2	9 545 000
$2s^2 2p^4(^3P)4d$	^4F	3/2,5/2	9 610 000
$2s^2 2p^4(^3P)4d$	^4P	5/2	9 640 000
$2s^2 2p^4(^1D)4d$	^2D	5/2	9 718 000
		3/2	9 732 000
$2s^2 2p^4(^1D)4d$	^2P	3/2	9 718 000
		1/2	9 732 000
$2s^2 2p^4(^1D)4d$	^2S	1/2	9 718 000
$2s^2 2p^4(^1D)4d$	^2F	5/2	9 732 000
$2s^2 2p^4(^1S)4d$	^2D	3/2	9 920 000
Co XX ($^3P_2$)	*Limit*		**12 135 000**

Co XX

$Z=27$

O I isoelectronic sequence

Ground state: $1s^22s^22p^4\ ^3P_2$

Ionization energy = 12 930 000 cm^{-1} (1603 eV)

The $2s^22p^4$–$2s2p^5$ transition array at 100 Å was analyzed by Doschek, Feldman, Cowan, and Cohen (1974). This spectrum was remeasured and intersystem transitions were observed by Lawson and Peacock (1980). The $2p^6$ level is obtained from Lawson and Peacock. The level uncertainty for these configurations is 50 cm^{-1}.

The $2p^33s$, $2p^33d$, and $2p^34d$ levels are from observations and identifications of Gordon, Hobby, and Peacock (1980) and have an uncertainty of 2000 cm^{-1}.

The ionization energy is from Lotz's (1967) extrapolation.

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Co XX

Configuration	Term	J	Level (cm^{-1})
$2s^2 2p^4$	^3P	2	0
		0	83 890
		1	107 420
$2s^2 2p^4$	^1D	2	189 290
$2s^2 2p^4$	^1S	0	363 240
$2s2p^5$	$^3P^\circ$	2	*981 550*
		1	*1 053 290*
		0	*1 108 520*
$2s2p^5$	$^1P^\circ$	1	*1 349 530*
$2p^6$	^1S	0	2 265 740
$2s^2 2p^3(^4S^\circ)3s$	$^3S^\circ$	1	*7 338 000*
$2s^2 2p^3(^2D^\circ)3s$	$^3D^\circ$	1,2	*7 447 000*
		3	*7 487 000*
$2s^2 2p^3(^2D^\circ)3s$	$^1D^\circ$	2	*7 507 000*
$2s^2 2p^3(^2P^\circ)3s$	$^3P^\circ$	0	*7 586 000*
		1	*7 599 000*
		2	*7 668 000*
$2s^2 2p^3(^2P^\circ)3s$	$^1P^\circ$	1	*7 688 000*
$2s^2 2p^3(^4S^\circ)3d$	$^3D^\circ$	3	*7 933 000*
$2s^2 2p^3(^2D^\circ)3d$	$^3D^\circ$	3	*8 098 000*
$2s^2 2p^3(^2D^\circ)3d$	$^3P^\circ$	2	*8 110 000*
$2s^2 2p^3(^2D^\circ)3d$	$^1F^\circ$	3	*8 150 000*
$2s^2 2p^3(^2P^\circ)3d$	$^3F^\circ$	3	*8 157 000*

Co xx—Continued

Configuration	Term	J	Level (cm^{-1})
$2s^2 2p^3(^2P^\circ)3d$	$^3P^\circ$	2	*8 181 000*
		1	*8 237 000*
$2s^2 2p^3(^2P^\circ)3d$	$^3D^\circ$	2	*8 279 000*
$2s^2 2p^3(^2P^\circ)3d$	$^1F^\circ$	3	*8 288 000*
$2s^2 2p^3(^2P^\circ)3d$	$^1D^\circ$	2	*8 288 000*
$2s^2 2p^3(^2P^\circ)3d$	$^1P^\circ$	1	*8 331 000*
$2s^2 2p^3(^4S^\circ)4d$	$^3D^\circ$	2,3	*10 146 000*
		1	*10 160 000*
$2s^2 2p^3(^2D^\circ)4d$	$^3F^\circ$	3	*10 265 000*
$2s^2 2p^3(^2D^\circ)4d$	$^3D^\circ$	2	*10 306 000*
		3	*10 316 000*
$2s^2 2p^3(^2D^\circ)4d$	$^3S^\circ$	1	*10 330 000*
$2s^2 2p^3(^2D^\circ)4d$	$^1F^\circ$	3	*10 335 000*
$2s^2 2p^3(^2D^\circ)4d$	$^1D^\circ$	2	*10 335 000*
$2s^2 2p^3(^2P^\circ)4d$	$^3P^\circ$	2	*10 423 000*
		1	*10 488 000*
$2s^2 2p^3(^2P^\circ)4d$	$^3D^\circ$	2	*10 505 000*
$2s^2 2p^3(^2P^\circ)4d$	$^1F^\circ$	3	*10 505 000*
$2s^2 2p^3(^2P^\circ)4d$	$^1P^\circ$	1	*10 509 000*
Co XXI ($^4S^\circ_{3/2}$)	*Limit*		12 930 000

Co XXI

$Z=27$

N I isoelectronic sequence

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

Ionization energy = 13 990 000 cm^{-1} (1735 eV)

The transition array $2s^2 2p^3$–$2s2p^4$ has been observed by Doschek, Feldman, Cowan, and Cohen (1974) between 77 and 126 Å. New observations of this isoelectronic sequence by Lawson and Peacock (1980) revealed several intersystem lines as well as new allowed lines. They have also identified the transition array $2s2p^4$–$2p^5$. Their results are given here. The energy level uncertainty is ±50 cm^{-1}.

The ionization energy is from Lotz's (1967) extrapolation.

References

Doschek, G. A., Feldman, U., Cowan, R. D., and Cohen, L. (1974), Astrophys. J. **188**, 417.

Lawson, K. D., and Peacock, N. J. (1980), J. Phys. **B13**, 3313.

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Co XXI

Configuration	Term	*J*	Level (cm^{-1})
$2s^2 2p^3$	$^4S^\circ$	3/2	*0*
$2s^2 2p^3$	$^2D^\circ$	3/2	*147 040*
		5/2	*191 530*
$2s^2 2p^3$	$^2P^\circ$	1/2	*280 260*
		3/2	*359 000*
$2s2p^4$	^4P	5/2	799 040
		3/2	879 510
		1/2	903 260
$2s2p^4$	^2D	3/2	1 107 300
		5/2	1 128 160
$2s2p^4$	^2S	1/2	1 267 430
$2s2p^4$	^2P	3/2	1 318 040
		1/2	1 434 220
$2p^5$	$^2P^\circ$	3/2	*2 069 550*
		1/2	*2 197 070*
Co XXII ($^3P_0$)	*Limit*		**13 990 000**

Co XXII

$Z=27$

C I isoelectronic sequence

Ground state: $1s^22s^22p^2\ ^3P_0$

Ionization energy = 14 890 000 cm^{-1} (1846 eV)

The transition arrays $2s^22p^2$–$2s2p^3$ and $2s2p^3$–$2p^4$ were observed and interpreted by Lawson and Peacock (1980). The energy level uncertainty is ±50 cm^{-1}.

The ionization energy is from Lotz's (1967) extrapolation.

References

Lawson, K. D., and Peacock, N. J. (1980), J. Phys. **B13**, 3313.
Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Co XXII

Configuration	Term	J	Level (cm^{-1})
$2s^2 2p^2$	^{3}P	0	0
		1	90 730
		2	138 250
$2s^2 2p^2$	^{1}D	2	281 820
$2s^2 2p^2$	^{1}S	0	415 520
$2s2p^3$	^{5}S°	2	*534 400*
$2s2p^3$	^{3}D°	1	*833 840*
		2	*836 280*
		3	*869 510*
$2s2p^3$	^{3}P°	0	*987 830*
		1	*998 650*
		2	*1 020 290*
$2s2p^3$	^{3}S°	1	*1 170 450*
$2s2p^3$	^{1}D°	2	*1 212 130*
$2s2p^3$	^{1}P°	1	*1 356 870*
$2p^4$	^{3}P	2	1 752 580
		0	1 853 530
		1	1 865 530
$2p^4$	^{1}D	2	1 944 800
$2p^4$	^{1}S	0	2 193 340
Co XXIII (^{2}P°$_{1/2}$)	*Limit*		14 890 000

Co XXIII

$Z=27$

B I isoelectronic sequence

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

Ionization energy = 15 820 000 cm^{-1} (1962 eV)

The transition arrays $2s^2 2p$–$2s2p^2$ and $2s2p^2$–$2p^3$ were observed and interpreted by Lawson and Peacock (1980). The energy level uncertainty is ± 50 cm^{-1}. They made a tentative identification of the transition $^4P_{5/2}$–$^2D_{5/2}$ at 103.80 Å which connects the quartet and doublet systems.

Spector et al. (1980) have reported the terms of the $2s2p3d$ configuration.

The ionization energy is from the extrapolation by Lotz (1967).

References

Lawson, K. D., and Peacock, N. J. (1980), J. Phys. **B13**, 3313.
Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.
Spector, N., Zigler, A., Zmora, H., and Schwob, J. L. (1980), J. Opt. Soc. Am. **70**, 857.

Co XXIII

Configuration	Term	J	Level (cm^{-1})
$2s^2 2p$	$^2P^\circ$	1/2	*0*
		3/2	*139 290*
$2s2p^2$	^4P	1/2	431 560+x
		3/2	499 270+x
		5/2	559 760+x
$2s2p^2$	^2D	3/2	788 520
		5/2	819 150
$2s2p^2$	^2S	1/2	903 260
$2s2p^2$	^2P	1/2	1 050 860
		3/2	1 064 960
$2p^3$	$^4S^\circ$	3/2	*1 338 760+x*
$2p^3$	$^2D^\circ$	3/2	*1 486 350*
		5/2	*1 523 150*
$2p^3$	$^2P^\circ$	1/2	*1 672 130*
		3/2	*1 745 870*
$2s2p(^3P^\circ)3d$	$^4F^\circ$	7/2	*9 672 000+x*
$2s2p(^3P^\circ)3d$	$^4D^\circ$	5/2,7/2	*9 755 000+x*
Co XXIV ($^1S_0$)	*Limit*		15 820 000

Co XXIV

$Z=27$

Be I isoelectronic sequence

Ground state: $1s^2 2s^2\ {}^1S_0$

Ionization energy = 17 090 000 cm^{-1} (2119 eV)

The transition arrays $2s^2$–$2s2p$ and $2s2p$–$2p^2$ were observed and interpreted by Lawson and Peacock (1980). The energy level uncertainty is ±50 cm^{-1}. The rest of the level values are from the observations by Boiko, Pikuz, Safronova, and Faenov (1977) and have an uncertainty of ±3000 cm^{-1}.

The ionization energy is from Lotz (1967).

References

Boiko, V. A., Pikuz, S. A., Safronova, U. I., and Faenov, A. Y. (1977), J. Phys. **B10**, 1253.

Lawson, K. D., and Peacock, N. J. (1980), J. Phys. **B13**, 3313.

Lotz, W. (1967), J. Opt. Soc. Am. **57**, 873.

Co XXIV

Configuration	Term	J	Level (cm^{-1})
$2s^2$	^1S	0	0
$2s2p$	$^3P°$	0	*363 130*
		1	*398 720*
		2	*509 210*
$2s2p$	$^1P°$	1	*799 040*
$2p^2$	^3P	0	1 002 040
		1	1 089 190
		2	1 138 140
$2p^2$	^1D	2	1 289 000
$2p^2$	^1S	0	1 514 350
$2s3s$	^3S	1	9 653 000
$2s3p$	$^3P°$	1	*9 886 000*
$2s3d$	^3D	1	9 965 000
		2	9 971 000
		3	9 986 000
$2s3d$	^1D	2	10 058 000
$2p3s$	$^3P°$	0	*10 065 000*
$2p3p$	^3D	1	10 245 000
		2	10 333 000
		3	10 444 000
$2p3s$	$^1P°$	1	*10 264 000*
$2p3p$	^1P	1	10 320 000
$2p3p$	^3P	1,2	10 425 000
$2p3d$	$^3D°$	2	*10 430 000*
		1	*10 449 000*

Co XXIV—Continued

Configuration	Term	J	Level (cm^{-1})
$2p3p$	^{3}S	1	10 456 000
$2p3d$	^{1}D°	2	*10 539 000*
$2p3p$	^{1}D	2	10 541 000
$2p3d$	^{3}P°	0–2	*10 578 000*
$2p3d$	^{1}F°	3	*10 658 000*
$2p3d$	^{1}P°	1	*10 661 000*
$2s3s$	^{1}S	0	10 620 000
Co XXV ($^2S_{1/2}$)	***Limit***		**17 090 000**

Co XXV

$Z=27$

Li I isoelectronic sequence

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

Ionization energy = 17 897 000±5000 cm^{-1} (2219.0±0.6 eV)

Edlén, (1979a, 1979b) has calculated the level values given here from extrapolations of empirical data. No uncertainty estimate was provided.

The three transitions reported by Spector et al. (1980) are compared with Edlén's predictions below.

	Spector	Edlén
$2s$–$3p\ {}^2S_{1/2}$–${}^2P_{1/2}$	9.839 Å	9.838 Å
$2p$–$3d\ {}^2P_{1/2}$–${}^2D_{3/2}$	10.151	10.159
$2p$–$3d\ {}^2P_{3/2}$–${}^2D_{5/2}$	10.286	10.303

Edlén (1979a) derived the ionization energy from a polarization formula.

References

Edlén, B. (1979a), Phys. Scr. **19**, 255.

Edlén, B. (1979b), Phys. Scr. **20**, 129.

Spector, N., Zigler, A., Zmora, H., and Schwob, J. L. (1980), J. Opt. Soc. Am. **70**, 857.

Co XXV

Configuration	Term	J	Level (cm^{-1})
$2s$	^2S	1/2	0
$2p$	$^2P°$	1/2	[*409 450*]
		3/2	[*561 100*]
$3s$	^2S	1/2	[10 055 000]
$3p$	$^2P°$	1/2	[*10 165 000*]
		3/2	[*10 209 000*]
$3d$	^2D	3/2	[10 253 000]
		5/2	[10 267 000]
$4s$	^2S	1/2	[13 517 000]
$4p$	$^2P°$	1/2	[*13 561 000*]
		3/2	[*13 580 000*]
$4d$	^2D	3/2	[13 597 000]
		5/2	[13 604 000]
Co XXVI ($^1S_0$)	*Limit*		**17 897 000**

Co XXVI

Z=27

He I isoelectronic sequence

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

Ionization energy = 76 983 600±2000 cm^{-1} (9544.83±0.3 eV)

No observations of this spectrum were found. The theoretical values calculated by Ermolaev and Jones (1974) for the singlet and triplet S and P terms of this two-electron ion are quoted through n=5. They have also calculated the mixing coefficients for the $^1P_1$ and $^3P_1$ states which we give as percentage compositions. The uncertainty of the ionization energy is due mostly to the error estimate for the QED correction for the ground state. The dominant error for the excited states is found in the singlet-triplet correction for the $^{1,3}P_1$ terms. the largest being 5000 cm^{-1} in the $1s2p$ configuration.

Reference

Ermolaev, A. M., and Jones, M. (1974), J. Phys. **B7**, 199.

Co XXVI

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
$1s^2$	^1S	0	0			
$1s2s$	^3S	1	[57 864 700]			
$1s2p$	$^3P^\circ$	0	*[58 110 500]*			
		1	*[58 128 200]*	90	10	$^1P^\circ$
		2	*[58 265 900]*			
$1s2s$	^1S	0	[58 129 400]			
$1s2p$	$^1P^\circ$	1	*[58 416 600]*	90	10	$^3P^\circ$
$1s3s$	^3S	1	[68 565 100]			
$1s3p$	$^3P^\circ$	0	*[68 632 900]*			
		1	*[68 637 700]*	89	11	$^1P^\circ$
		2	*[68 679 100]*			
$1s3s$	^1S	0	[68 635 000]			
$1s3p$	$^1P^\circ$	1	*[68 720 200]*	89	11	$^3P^\circ$
$1s4s$	^3S	1	[72 270 900]			
$1s4p$	$^3P^\circ$	0	*[72 299 200]*			
		1	*[72 301 100]*	89	11	$^1P^\circ$
		2	*[72 318 600]*			
$1s4s$	^1S	0	[72 299 200]			
$1s4p$	$^1P^\circ$	1	*[72 335 400]*	89	11	$^3P^\circ$
$1s5s$	^3S	1	[73 976 600]			
$1s5s$	^1S	0	[73 990 800]			

Co xxvi—Continued

Configuration	Term	J	Level (cm^{-1})	Leading percentages		
1*s*5*p*	^{3}P°	0	[*73 990 900*]			
		1	[*73 991 900*]	89	11	^{1}P°
		2	[*74 000 900*]			
1*s*5*p*	^{1}P°	1	[*74 009 400*]	89	11	^{3}P°
Co xxvii ($^2S_{1/2}$)	***Limit***		**76 983 600**			

Co XXVII

$Z=27$

H I isoelectronic sequence

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

Ionization energy = 80 752 200±400 cm^{-1} (10012.08±0.05 eV)

The theoretical values calculated by Erikson (1977) for terms of this hydrogen-like ion are given below through $n=5$. The binding energy of the 1*s* electron is reported with an uncertainty of ±400 cm^{-1}; the levels measured from the ground state taken as zero will also have this uncertainty, although relative values are expected to be more accurate.

No observations of this spectrum are available.

Reference

Erikson, G. W. (1977), J. Phys. Chem. Ref. Data 6, 831.

Co XXVII

Configuration	Term	J	Level (cm^{-1})
1*s*	^{2}S	1/2	0
2*p*	^{2}P°	1/2	[*60 504 940*]
		3/2	[*60 704 260*]
2*s*	^{2}S	1/2	[60 510 330]
3*p*	^{2}P°	1/2	[*71 775 640*]
		3/2	[*71 834 740*]
3*s*	^{2}S	1/2	[71 777 260]
3*d*	^{2}D	3/2	[71 834 630]
		5/2	[71 852 980]
4*p*	^{2}P°	1/2	[*75 712 220*]
		3/2	[*75 737 140*]
4*s*	^{2}S	1/2	[75 712 910]
4*d*	^{2}D	3/2	[75 737 090]
		5/2	[75 745 260]
4*f*	^{2}F°	5/2	[*75 745 240*]
		7/2	[*75 749 310*]
5*p*	^{2}P°	1/2	[*77 530 830*]
		3/2	[*77 543 570*]
5*s*	^{2}S	1/2	[77 531 180]
5*d*	^{2}D	3/2	[77 543 550]
		5/2	[77 547 730]
5*f*	^{2}F°	5/2	[*77 547 720*]
		7/2	[*77 549 800*]
5*g*	^{2}G	7/2	[77 549 800]
		9/2	[77 551 050]
	Limit		**80 752 200**