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A Theoretical Investigation of the Configurations $(3d+4s)^8 4p$ in Neutral Cobalt (Co I)*

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Experimental levels of the configurations $(3d+4s)^8 4p$ were compared with corresponding calculated values. On fitting 154 levels by means of 19 free parameters an rms error of only 164 cm^{-1} was obtained.

Key words: Cobalt; configurations $(3d+4s)^8 4p$; energy levels; g-factors; interactions between configurations.

1. Introduction

Theoretical investigations of odd configurations $3d^n 4p$ for trebly and doubly ionized atoms of the iron group have been published by the author [1, 2][1,2]. In the calculations of doubly ionized Sc, Ti, and V the configurations $3d^{n-1}4s4p$ were added [3], and for Cu II other odd configurations were also included [4].

The configurations $(3d+4s)^3 4p$ were considered previously for the arc spectrum of titanium by Rohrlich [5], as well as by Smith and Siddall [6]. The configurations $3d^9 4s4p$ in Cu I were investigated by Martin and Sugar [7]. Wilson [8] derived from a Hartree-Fock procedure a set of radial parameters for Cu I $3d^9 4s4p$, which predicted satisfactorily the positions of seventeen low levels of Cu I. The configurations $(3d+4s)^n 4p$ were investigated for the arc spectra of calcium, scandium, titanium, vanadium, chromium, manganese, and iron by the author [9–13].

For the configurations $(3d+4s)^3 4p$ of Ti I, Rohrlich obtained an rms error of 1109 cm^{-1} before the advent of high-speed computers. He found it necessary to reject several terms which, however, fit very nicely in the recent investigations of Ti I, [6], [9]. Smith and Siddall obtained an rms error of 355 cm^{-1}, whereas in the author's investigation the rms error was further reduced to 261 cm^{-1}. One main reason for this considerable improvement is due to the fact that the author was able to identify experimental levels of the configuration $3d4s^2 4p$ and thus consider explicitly the interactions of this configuration with the configurations $3d^2 4s4p$ and $3d^3 4p$. Secondly, Smith and Siddall restricted their analysis to the electrostatic approximation, whereas the author included the spin-orbit interactions.

The configurations $(d+s)^8 p$ comprise 165 terms splitting into 438 levels. In AEL [14], 50 terms splitting into 139 levels are assigned to the configurations $3d^8 4p + 3d^7 4s4p$, 8 terms splitting into 19 levels are given without configuration assignments, and in addition, there are 37 undesignated odd levels.

Since only the parameters[3] B', C, C', and α vary monotonically from Ca I to Fe I, only the initial values of these parameters were obtained by linear extrapolation. Then, neglecting C and α for Sc I we obtain initially:

$$\begin{aligned} B' &= 1{,}000 \\ C &= 3{,}660 \\ C' &= 3{,}770 \\ \alpha' &= \alpha = 85 \end{aligned} \qquad (1)$$

The initial values of the other parameters were assumed to be equal to the final values for Fe I [13].

The initial value for the height of the configuration $3d^7 4s4p$ can be obtained either from $^6F_{C.\,G.}$ or $^6G_{C.\,G.}$ (they differ only by $4F_2'$). Then, from the electrostatic matrix of ^6F [15],

$$^6F_{C.\,G.} = A' - 15B' - 3G_{ds}' - 3F_2' - G_{ps}' + 12\alpha' = 24180 \qquad (2)$$

and

$$A' = 50800 \qquad (3)$$

The initial value for the height of $3d^8 4p$ was obtained from the terms ^2D of $3d^8 4p$. By using the fact that the

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[1] Figures in brackets indicate literature references at the end of this paper.

[2] The reader is referred to these papers for an explanation of the method used, notation, and significance of the various parameters.

The numerical values of all levels and parameters are in cm^{-1}.

[3] Unprimed parameters refer to the configuration $3d^8 4p$, primed parameters to $3d^7 4s4p$ and doubly primed to $3d^6 4s^2 4p$.

trace of a matrix equals the sum of its eigenvalues we obtain, [16, 14]

$$3A-4B+2C+4F_2+10G_3+20\alpha=3d^8(a\,^3\mathrm{F})4p\,y\,^2\mathrm{D}_{\mathrm{C.G.}}+3d^8(^1\mathrm{D})4p\,x\,^2\mathrm{D}_{\mathrm{C.G.}}+3d^8(^3\mathrm{P})4p\,x\,^2\mathrm{D}_{\mathrm{C.G.}}=126318 \quad (4)$$

From the previously determined values of the other parameters, we obtain

$$A=39790 \quad (5)$$

Racah and Shadmi [17], found that the parameter D'', the difference between the weighted averages of the terms $3d^{n-2}4s^2$ and $3d^{n-1}4s$ in the second spectra of the iron group, was a linear function of the atomic number with a quadratic correction. By assuming that $D''[(d+s)^n p]$ in the first spectra obeys a similar relationship as a function of atomic number, a parabola is drawn to pass through the points determined by D''(Sc I), D''(Ti I) [9] and D''(Fe I) [13], and extrapolated for Co I, (Sc I and Fe I have experimental levels belonging to $3d^{n-2}4s^24p$, whereas in Ti I, eigenfunctions of some of the higher levels to which experimental levels are assigned contain considerable contributions of $3d4s^24p$ so that the standard deviation in A'' was only 234).

By substituting into eqs (8) and (9) of reference [12] the final values of the parameters for Fe I [13], and adding $-10G_1''-35G_3''$ to eq (9) (see ref. [12]) since the matrices of d^6s^2p, i.e., d^6p, on tape are those calculated by Ishidzu and Obi [18], who did not use the convention that for the case of an almost complete shell and an electron outside the shell, one subtracts from the energy matrix the interaction of the outer electron with the closed shell (see section 3, [19]), we obtain

$$D''(\mathrm{Fe})=36420 \quad (6)$$

By using the values of D''(Ti) and D''(Sc) given by eqs (11) and (14) of reference [10], with the above value for D''(Fe) to obtain the parabola through these three points, and extrapolating

$$D''(\mathrm{Co})=42410 \quad (7)$$

From eqs (8) and (9) of reference [12] and again adding $-10G_1''-35G_3''$ to eq (9), reference [12], we obtain

$$A''=87980 \quad (8)$$

2. Discussion and Results

Although the configuration $3d^64s^24p$ is very high, it markedly influences the results. In the calculations of $3d^84p+3d^74s4p$ the rms error was 209 cm^{-1}, whereas the inclusion of $3d^64s^24p$ reduced the rms error in the uniform treatment[4] to 164 cm^{-1}. Furthermore, the terms obtained from $(4F)+{}^1\mathrm{P}$[5] had very high deviations when considering only $3d^84p+3d^74s4p$. In particular, in $3d^84p+3d^74s4p$ the mean deviation of the term $^4\mathrm{F}(^1\mathrm{P})x\,^4\mathrm{D}$ was -643, whereas with the three configurations the mean deviation was only -50. This great improvement can be attributed to the fact that when $(3d+4s)^84p$ was considered G'_{ps} assumed a much higher value (7038 ± 56 cm^{-1} versus 6571 ± 62 cm^{-1}).

The experimental data for Co I are not sufficient to permit A'', the height of $3d^64s^24p$, to change freely. Thus in the final variation the value of A'' was held fixed at 85220 so that with the final values of the parameters, D'' should approximately equal its original value of 42410. The final parameters in the uniform treatment are given in table 1.

TABLE 1. *Parameters for* Co I $(3d+4s)^84p$ (*in units of* cm^{-1})

Parameter	Initial Value	Final Value
A	39790	39264 ± 122
A'	50800	50677 ± 69
A''	87980	85220 (Fixed)
B	740	833 ± 8
B'	1000	956 ± 6
B''	1260	1079 (Arith. Progress.)
C	3660	3744 ± 63
C'	3770	3875 ± 18
C''	3880	4006 (Arith. Progress.)
$G'_{ds}=G$	1540	1607 ± 33
F_2	170	218 ± 10
F_2'	300	303 ± 7
F_2''	430	388 (Arith. Progress.)
G_1	200	196 ± 9
G_1'	240	199 ± 7
G_1''	280	202 (Arith. Progress.)
$G_3=G_3'=G_3''$	20	14 ± 2
G'_{ps}	7120	7038 ± 56
$\alpha=\alpha'=\alpha''$	85	71 ± 3
$H=H'$	85	72 ± 6
$J=J'$	1180	1245 ± 50
K	2460	2331 ± 55
K'	3352	3223 (Fixed Diff.)
$\zeta_d=\zeta_d'=\zeta_d''$	410	517 ± 17
$\zeta_p=\zeta_p'=\zeta_p''$	200	236 ± 53
rms error		164.2 cm^{-1}

The comparison of the experimental and calculated values of the levels and g-factors obtained from the final least-squares of the uniform treatment is given in table A of the Appendix. The calculated values, percentage compositions, and g-factors of all the 258 predicted levels of $3d^84p+3d^74s4p$ are given in table A. The 25 lowest levels of $3d^64s^24p$, based on $3d^6(^5\mathrm{D})$ are also quoted. However, the latter values as well as those higher levels of $3d^84p+3d^74s4p$ containing significant contributions of $3d^64s^24p$ must be considered as only approximate.

[4] The parameters A, A', G'_{ds} and G'_{ps} are allowed to change freely. The parameters B, C, F_2, and G_1 are in arithmetic progression. The parameters G_3, α, ζ_d, and ζ_p are kept equal, and for the parameters of the interactions between configurations H' is kept equal to H, J' to J, G to G'_{ds} and $K'=K+892$ (fixed difference).

[5] See the appendix of this paper for the theoretical term designations.

Of the unclassified odd levels only the levels 1°, 2°, 3°, 7°, 10°, 11°, 12°, 15°, and 23° were included. Besides the 28 unclassified odd levels, the following 13 levels were also neglected in the least-squares:

1. The level $3d^8(^3P)4p$: $y\,^2S_{1/2}$
2. The level $3d^8(^3P)4p$: $x\,^2P_{1/2}$
3. The level $3d^8(^3P)4p$: $w\,^2P_{1/2}$
4. The four levels of $3d^74s(^3D)4p$: $s\,^4D$
5. The level $t^2F_{7/2}$:
6. The level $s\,^2F_{5/2}$:
7. The four levels of $v\,^4F$

It is evident from table A that one of the terms $y\,^2S$ and $x\,^2S$ cannot be assigned to a corresponding theoretical term ^2S. The theoretical term ^2S, calculated at 48010, contains contributions with the same assignments as $y\,^2S$ and $x\,^2S$, and the experimental values of the two terms are very close. However, $x\,^2S$ was accepted since the correspondence between the calculated and experimental *g*-factors is better for x^2S than for y^2S.

The levels of the term $^4P(^3P)^2P$ are calculated at 48966 and 48453. Thus, when the experimental level $x\,^2P_{3/2}$ is assigned to $^4P(^3P)^2P_{3/2}$, the deviation is only -119. However, the level $x\,^2P_{1/2}$, which is given as uncertain in AEL, would yield a deviation of around -800, which is incompatible with the results for the other levels. Furthermore, the level $w\,^2S$, which cannot be assigned to a theoretical level ^2S, fits with a deviation of only -128 when assigned to $^4P(^3P)^2P_{1/2}$. Although the agreement between the experimental and calculated *g*-factors is not very good here, it should be noted that the experimental *g*-factor of 1.50 for $w\,^2S$ is given as uncertain in AEL.

The theoretical term ^2P following $^4P(^3P)^2P$ in height, is the term $^2P(^3P)^2P$ to which the levels of $v\,^2P$ correspond. Thus, the experimental levels of $w\,^2P$ cannot be assigned to a theoretical term ^2P. The level $w\,^2P_{3/2}$ is assigned to the previously vacant theoretical level $^2P(^3P)^2D_{3/2}$ yielding a deviation of only -60. The experimental *g*-factor of 1.099 corresponds to the calculated value of 0.991. The only theoretical level to which $w\,^2P_{1/2}$ could conceivably be assigned is $^2P(^3P)^2S$. However, as the resulting deviation would then be greater than 600, and since the agreement between the experimental *g*-factor of 1.365 and the calculated *g*-factor of 1.882 is also very poor, the level $w\,^2P_{1/2}$ was not inserted into the least-squares.

It is immediately evident from table A that the experimental levels of $s\,^4D$ have no corresponding vacant theoretical levels to which they could be assigned.

The levels of the term $A^2D(^3P)^2F$ are calculated at 52491 and 52784. Thus, it is evident that the experimental levels $t\,^2F_{5/2}$ and $s\,^2F_{7/2}$ should be grouped together and assigned to the theoretical term $A^2D(^3P)^2F$. The resulting deviations are 305 and 320 with excellent agreement between the experimental and calculated *g*-factors of both levels. The two remaining levels $t\,^2F_{7/2}$ and $s\,^2F_{5/2}$, both of which are given as uncertain in AEL, have no corresponding theoretical levels to which they could be assigned.

The experimental levels $v\,^4F$ cannot be assigned to a theoretical term ^4F. Conceivably, the levels $v\,^4F_{3/2,5/2,7/2}$ could be fitted to the theoretical levels $^4P(^1P)^4D_{3/2,5/2,7/2}$ and the level $v\,^4F_{9/2}$ could be assigned to $^2H(^3P)^2H_{9/2}$. Besides the danger of performing changes in term designations for such high levels, it is important to note that in the paper of Russell, King, and Moore [20], these levels are considered as doubtful.

The following table indicates how the nine unclassified odd levels were assigned:

TABLE 2. *Unclassified Odd Levels of* Co I

Level	Assignment	Deviation	Observed *g*-Factor	Calculated *g*-Factor
$1^\circ_{7/2}$	$^4P(^3P)^6P_{7/2}$	205	1.40	1.709
$2^\circ_{5/2}$	$^4P(^3P)^6P_{5/2}$	165	1.863	1.866
$3^\circ_{7/2}$	$^2G(^3P)^4H_{7/2}$	-1		0.680
$7^\circ_{5/2}$	$^2P(^3P)^2D_{5/2}$	-218		1.163
$10^\circ_{7/2}$	$A^2D(^3P)^4F_{7/2}$	58	1.260	1.257
$11^\circ_{5/2}$	$A^2D(^3P)^4F_{5/2}$	-7	1.079	1.107
$12^\circ_{3/2}$	$A^2D(^3P)^4F_{3/2}$	87	0.569	0.680
$15^\circ_{7/2}$	$^2H(^3P)^4H_{7/2}$	-48		0.690
$23^\circ_{3/2}$	$A^2D(^3P)^2P_{3/2}$	180	1.353	1.363

The unclassified levels 4°, 5°, 8°, 13°, 14°, 16°, 17°, 18°, 19°, 20°, 21°, and 22° have no corresponding theoretical levels to which they could be assigned.

For the level 6° the *J*-value is questioned. For *J* equal to 9/2 the level $6^\circ_{7/2?}$ could be assigned to either $^2H(^3P)^4I_{9/2}$ or $^2H(^3P)^4G_{9/2}$.

The level 9° probably should be assigned to $A^2D(^3P)^4F_{9/2}$ to complete with 10°, 11°, and 12° the term $A^2D(^3P)^4F$. However, unlike the levels 10°, 11°, and 12°, the level 9° is given as uncertain in AEL, and there is no experimental *g*-factor to confirm this assignment. Furthermore, the levels 10°, 11°, and 12° have combinations with levels of 9 even terms, whereas 9° is based on combinations with the levels of only 2 even terms [20]. Although the level 9° was not included in the least-squares calculations, it is inserted in parentheses adjacent to the calculated value of $A^2D(^3P)^4F_{9/2}$ in table A.

The following changes in assignment were performed:

1. AEL $3d^74s(a\,^5P)4pz\,^4P$ ⟶ $(^3P)^4P$
2. $^2G(^3P)^2F$ ⟷ $(^1D)^2F$
3. AEL $3d^8(^3P)4py\,^4P$ ⟶ $^2P(^3P)^4P$
4. AEL $3d^74s(^3P)4px\,^4P_{3/2}$ ⟶ $(^3P)^4S_{3/2}$
5. AEL $3d^8(^3P)4pv\,^4D_{3/2}$ ⟶ $^4P(^3P)^4P_{3/2}$
6. AEL $3d^74s(^3P)4py\,^4S_{3/2}$ ⟶ $(^3P)^4D_{3/2}$
7. AEL $3d^74s(^3P)4pv\,^2D_{3/2}$ ⟶ $(^3P)^2D_{3/2}$
8. AEL $3d^8(^3P)4pw\,^2D_{3/2}$ ⟶ $^4P(^3P)^2D_{3/2}$
9. AEL $3d^74s(^3P)4py\,^2P$ ⟶ $(^3P)^2P$
10. AEL $3d^74s(^3P)4px\,^2S$ ⟶ $(^3P)^2S$
11. AEL $v\,^2F_{5/2,7/2}$ ⟶ $^2H(^3P)^4G_{5/2,7/2}$
12. AEL $3d^8(^3P)4px\,^4S$ ⟶ $^2P(^3P)^4S$

13. AEL $3d^7 4s(^3P)4pt\,^4D$ ⟶ $A^2D(^3P)^4D$
14. AEL $w\,^2S_{1/2}$ ⟶ $^4P(^3P)^2P_{1/2}$
15. AEL $3d^8(^3P)4px\,^2P_{3/2}$ ⟶ $^4P(^3P)^2P_{3/2}$
16. AEL $3d^7 4s(^3P)4pw\,^2P_{3/2}$ ⟶ $^2P(^3P)^2D_{3/2}$
17. $^2H(^3P)^2G$ ⟷ $(^1G)^2G$
18. AEL $3d^7 4s(^3H)4px\,^2H_{9/2,11/2}$ ⟶ $^2H(^3P)^4H_{9/2,11/2}$

Although in most changes of assignment the theoretical eigenfunctions are mixed strongly, in the changes 1, 2, 3, 9, 10, 12, 13, and 15 the compositions of the theoretical levels contain only small contributions of the experimental assignments (see table A).

The experimental *g*-factor of $y\,^4S$ is 1.273. Since the theoretical *g*-factor of ^4S is 2.000, $y\,^4S$ could be assigned to a theoretical term ^4S if the latter would have significant contributions of terms with low theoretical *g*-factors (such as $^4F_{3/2}$, $^2D_{3/2}$). However, this is not so in the present case and thus after several variations it was ascertained that the best agreement in the values and *g*-factors of the levels $^4P(^3P)^4P$, $(^3P)^4D$ and $(^3P)^4S$ is obtained after performing the changes 4, 5, and 6.

The grouping of the levels of w^2D and v^2D as given in AEL, is incongruous with the calculated values of the levels of $(^3P)w\,^2D$ and $^4P(^3P)v\,^2D$. Thus, the changes 7 and 8 were performed.

The levels of $v\,^2F$ cannot be assigned to a theoretical term ^2F. However, when the two levels of $v\,^2F$ are assigned to the two lowest levels of $^2H(^3P)^4G$, not only is there excellent agreement between the experimental and calculated values of the levels (for each level the deviation is only − 24), but there is also a close correspondence between the experimental and calculated *g*-factors (the experimental *g*-factors of 0.619 and 1.173 correspond to the calculated values of 0.619 and 1.008, respectively). This change is indicated by 11.

The changes 14 and 16 were discussed previously.

The change 18 is similar to change 11. Although there is no corresponding theoretical term ^2H to which the levels of $x\,^2H$ could be assigned, there is excellent agreement between the calculated and experimental values of the levels and *g*-factors when the levels $x\,^2H$ are assigned to the theoretical levels $^2H(^3P)^4H_{9/2,11/2}$. To the theoretical level $^2H(^3P)^4H_{7/2}$, the level $15^0_{7/2}$ (based on 10 combinations with even levels, [20]), is assigned to yield a deviation of only − 48.

Below the limit of the experimental levels inserted, there are 21 theoretical levels with no corresponding experimental levels. The lowest of these is the level $^4P(^3P)^6S$ calculated at 34642.

With very few exceptions the agreement between the experimental and calculated *g*-factors is excellent.

Appendix

Table A. Observed and Calculated Levels and g-Factors

In the column "Name" the calculated designation of the term is given. Whenever the terms of the parent d^n have different seniorities these are denoted by the letters *A* and *B*, the lower calculated term being designated by *A*. The terms of d^7sp are denoted by $d^7 v_1 S_1 L_1 (sp\,^{1,3}P)SL$. The terms of d^8p are differentiated from those of d^6s^2p by using a star for the latter terms.

The entries in the columns "*J*", "Obs. Level (cm^{-1})", "Calc. Level (cm^{-1})", "Obs. *g*-Factor" and "Calc. *g*-Factor" are self-evident. In the column "Percentage", for each calculated level either the three highest contributions or all those contributions exceeding five percent are given.

Whenever the experimental and calculated term designations differ, the experimental designation is entered in the column "AEL" using the notation of C. E. Moore, [14]. In many instances the exchanges involve complete terms rather than isolated levels. Unless specified otherwise, the entries in the column "AEL" pertain to exchanges in terms.

The column "O–C" gives the difference between the observed and calculated values of the levels.

The entries are in increasing energy of the calculated levels.

TABLE A. *Observed and calculated levels of* Co I $(3d+4s)^8 4p$

Name	*J*	Percentage	AEL Config.	AEL Desig.	Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O−C	Obs. *g*-Factor	Calc. *g*-Factor
$^4F(^3P)^6F$	1/2	99	$3d^7 4s(a\,^5F)4p$	$z\,^6F$	25233	25240	−7	−0.622	−0.631
	3/2	95			25041	25061	−20	1.118	1.080
	5/2	$90+7\,^4F(^3P)^6D$			24733	24775	−42	1.336	1.328
	7/2	$84+12\,^4F(^3P)^6D$			24326	24397	−71	1.436	1.412
	9/2	$78+18\,^4F(^3P)^6D$			23856	23961	−105	1.481	1.452
	11/2	97			23612	23635	−23	1.466	1.451
$^4F(^3P)^6D$	1/2	94	$3d^7 4s(a\,^5F)4p$	$z\,^6D$	26250	26404	−154	3.286	3.297
	3/2	91			26063	26210	−147	1.812	1.810
	5/2	$87+6\,^4F(^3P)^6F$			25740	25881	−141	1.612	1.615
	7/2	$83+11\,^4F(^3P)^6F$			25269	25407	−138	1.550	1.555
	9/2	$78+17\,^4F(^3P)^6F$			24628	24770	−142	1.569	1.529

TABLE A. *Observed and calculated levels of* Co I (3d+4s)^{8}4p – Continued

Name	J	Percentage	AEL Config.	AEL Desig.	Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O–C	Obs. g-Factor	Calc. g-Factor
^{4}F(^{3}P)^{6}G	3/2	97	$3d^74s(a\,^5$F$)4p$	$z\,^6$G	26598	26425	173	0.006	0.042
	5/2	95			26450	26273	177	0.876	0.882
	7/2	94			26232	26049	183	1.150	1.156
	9/2	94			25938	25749	189	1.281	1.278
	11/2	96			25569	25375	194	1.354	1.344
	13/2	100			25139	24941	198	1.40	1.384
^{4}F(^{3}P)^{4}F	3/2	85+13(^{3}F)^{4}F	$3d^74s(a\,^5$F$)4p$	$z\,^4$F	29563	29561	2	0.410	0.408
	5/2	82+13(^{3}F)^{4}F			29216	29217	−1	1.033	1.026
	7/2	80+13(^{3}F)^{4}F			28777	28779	−2	1.247	1.234
	9/2	82+15(^{3}F)^{4}F			28346	28328	18	1.330	1.331
^{4}F(^{3}P)^{4}G	5/2	94	$3d^74s(a\,^5$F$)4p$	$z\,^4$G	30103	30044	59	0.577	0.583
	7/2	91			29735	29680	55	0.995	0.991
	9/2	90			29270	29219	51	1.175	1.175
	11/2	95			28845	28765	80	1.276	1.273
^{4}F(^{3}P)^{4}D	1/2	65+31(^{3}F)^{4}D	$3d^74s(a\,^5$F$)4p$	$z\,^4$D	30743	30790	−47	−0.006	0.003
	3/2	62+33(^{3}F)^{4}D			30444	30482	−38	1.192	1.192
	5/2	57+36(^{3}F)^{4}D			29949	29969	−20	1.359	1.362
	7/2	53+42(^{3}F)^{4}D			29295	29289	6	1.425	1.425
^{4}F(^{3}P)^{2}G	7/2	41+29(^{3}F)^{4}F+11(^{3}F)^{2}G	$3d^74s(b\,^3$F$)4p$	$z\,^2$G	32733	32850	−117	0.899	0.990
	9/2	47+29(^{3}F)^{4}G+13(^{3}F)^{4}F			31700	31822	−122	1.126	1.121
^{4}F(^{3}P)^{2}F	5/2	71+26(^{3}F)^{2}F	$3d^74s(b\,^3$F$)4p$	$z\,^2$F	32782	32962	−180	0.870	0.863
	7/2	66+28(^{3}F)^{2}F			31871	32061	−190	1.177	1.153
(^{3}F)^{4}D	1/2	59+36^{4}F(^{1}P)^{4}D			33449	33533	−84	0.012	0.003
	3/2	56+37^{4}F(^{1}P)^{4}D			33151	33209	−58	1.195	1.193
	5/2	51+41^{4}F(^{1}P)^{4}D			32654	32680	−26	1.366	1.364
	7/2	46+45^{4}F(^{1}P)^{4}D			32028	31982	44	1.395	1.416
(^{3}F)^{4}G	5/2	52+30(^{3}F)^{4}F			33674	33608	66	0.704	0.777
	7/2	34+31(^{3}F)^{2}G+11(^{3}F)^{4}F			33173	33185	−12	1.039	1.040
	9/2	53+28(^{3}F)^{2}G+8^{4}F(^{3}P)^{2}G			32465	32414	51	1.154	1.171
	11/2	94			32431	32296	135	1.287	1.273
^{4}F(^{3}P)^{2}D	3/2	53+37(^{3}F)^{2}D	$3d^74s(b\,^3$F$)4p$	$z\,^2$D	34352	34423	−71	0.787	0.781
	5/2	53+42(^{3}F)^{2}D			33463	33497	−34	1.186	1.198
(^{3}F)^{4}F	3/2	67+24^{4}F(^{1}P)^{4}F			34196	34205	−9	0.430	0.430
	5/2	38+42(^{3}F)^{4}G			33946	33937	9	0.900	0.824
	7/2	25+33(^{3}F)^{4}G+24^{4}F(^{3}P)^{2}G			33467	33445	22	1.155	1.055
	9/2	51+22^{4}F(^{1}P)^{4}F+14^{4}F(^{3}P)^{2}G			32842	32791	51	1.313	1.278
(^{3}F)^{2}G	7/2	50+21(^{3}F)^{4}G+21^{4}F(^{3}P)^{2}G			34134	34179	−45	0.917	0.921
	9/2	56+27^{4}F(^{3}P)^{2}G+11(^{3}F)^{4}G			33440	33420	20	1.165	1.159
^{4}P(^{3}P)^{6}S	5/2	99				34642			1.998
(^{3}F)^{2}F	5/2	53+18(^{3}F)^{2}D+16^{4}F(^{3}P)^{2}F			36330	36250	80	0.892	0.948
	7/2	61+25^{4}F(^{3}P)^{2}F			35451	35236	215	1.145	1.144
(^{3}F)^{2}D	3/2	53+40^{4}F(^{3}P)^{2}D			36875	36923	−48	0.794	0.805
	5/2	35+36^{4}F(^{3}P)^{2}D			36092	36049	43	1.186	1.118

Name	J	Percentage	AEL		Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O−C	Obs. g-Factor	Calc. g-Factor
			Config.	Desig.					
^{4}P(^{3}P)^{6}D	1/2	94				39184			3.314
	3/2	92				39093			1.846
	5/2	92				38991			1.655
	7/2	92				38902			1.583
	9/2	96				38847			1.555
^{4}P(^{3}P)^{4}S	3/2	74+10(^{3}P)^{4}S	$3d^74s(a\ ^5P)4p$	$z\ ^4S$	40622	40240	382	2.017	1.918
^{4}F(^{1}P)^{4}D	1/2	62+24(^{3}P)^{4}D	$3d^74s(b\ ^3F)4p$	$x\ ^4D$	41102	41141	−39	0.026	0.012
	3/2	62+23(^{3}P)^{4}D			40828	40863	−35	1.240	1.204
	5/2	63+21(^{3}P)^{4}D			40346	40395	−49	1.370	1.369
	7/2	65+18(^{3}P)^{4}D			39649	39726	−77	1.428	1.428
^{4}P(^{3}P)^{6}P	3/2	90+6^{4}P(^{3}P)^{4}S				40992			2.291
	5/2	93		2^0	41105	40940	165	1.863	1.866
	7/2	97		1^0	41041	40836	205	1.40	1.709
^{4}F(^{1}P)^{4}F	3/2	61+27^{2}G(^{3}P)^{4}F	$3d^74s(b\ ^3F)4p$	$x\ ^4F$	42797	42396	401	0.406	0.408
	5/2	59+24^{2}G(^{3}P)^{4}F			42434	42046	388	1.024	1.052
	7/2	63+23^{2}G(^{3}P)^{4}F			41918	41571	347	1.248	1.234
	9/2	66+19^{2}G(^{3}P)^{4}F			41226	40917	309	1.319	1.330
(^{3}P)^{4}P	1/2	66+14^{2}P(^{3}P)^{4}P+11^{4}P(^{3}P)^{4}P	$3d^74s(a\ ^5P)4p$	$z\ ^4P$	41970	42048	−78	2.51	2.520
	3/2	64+12^{4}P(^{3}P)^{4}P+9^{2}P(^{3}P)^{4}P			41983	41972	11	1.732	1.665
	5/2	65+12^{4}P(^{3}P)^{4}P+9^{2}P(^{3}P)^{4}P			41969	41932	37	1.627	1.548
^{4}F(^{1}P)^{4}G	5/2	93	$3d^74s(b\ ^3F)4p$	$x\ ^4G$	43200	43350	−150	0.649	0.581
	7/2	92			42811	42962	−151	1.004	0.988
	9/2	93			42269	42439	−170	1.169	1.174
	11/2	95			41529	41747	−218	1.291	1.272
^{2}G(^{3}P)^{4}H	7/2	95		3^0	42988	42989	−1		0.680
	9/2	90				42775			0.977
	11/2	92				42632			1.135
	13/2	98				42565			1.229
(^{1}D)^{2}P	1/2	42+25(^{3}P)^{2}P+7^{2}P(^{3}P)^{2}P			43130	43084	46	0.727	0.846
	3/2	31+23(^{1}D)^{2}D+22^{4}P(^{3}P)^{4}D			43538	43544	−6	1.120	1.175
^{4}P(^{3}P)^{4}D	1/2	75+9^{2}P(^{3}P)^{4}D	$3d^74s(a\ ^5P)4p$	$w\ ^4D$	43436	43444	−8	0.169	0.101
	3/2	58+9(^{1}D)^{2}D			43264	43298	−34	1.191	1.186
	5/2	46+28(^{1}D)^{2}F			43243	43218	25	1.101	1.168
	7/2	88+3(^{1}D)^{2}F			43399	43346	53	1.334	1.417
(^{1}D)^{2}F	5/2	37+36^{4}P(^{3}P)^{4}D+10^{2}G(^{3}P)^{2}F	$3d^74s(^3G)4p$	$x\ ^2F$	43426	43371	55	1.119	1.108
	7/2	45+20^{2}G(^{3}P)^{4}F+16^{2}G(^{3}P)^{2}F			43555	43602	−47	1.229	1.174
(^{1}D)^{2}D	3/2	40+33(^{1}D)^{2}P+5(^{3}P)^{2}P			43911	43957	−46	1.127	1.070
	5/2	52+20^{2}G(^{3}P)^{4}F			43922	44113	−191	1.230	1.147
^{4}P(^{3}P)^{2}S	1/2	61+21(^{3}P)^{2}S	$3d^74s(^3P)4p$	$z\ ^2S$	44455	44185	270	2.10	1.908
^{2}G(^{3}P)^{4}F	3/2	68+18^{4}F(^{1}P)^{4}F+7(^{3}F)^{4}F	$3d^74s(^3G)4p$	$w\ ^4F$	44556	44745	−189	0.415	0.412
	5/2	29+23^{2}G(^{3}P)^{4}G+23(^{1}D)^{2}D			44202	44333	−131	0.950	0.970
	7/2	39+23(^{1}D)^{2}F+11^{2}G(^{3}P)^{4}G			43848	43979	−131	1.197	1.183
	9/2	71+15^{4}F(^{1}P)^{4}F+5(^{3}F)^{4}F			43295	43523	−228	1.295	1.318

Name	J	Percentage	AEL		Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O−C	Obs. g-Factor	Calc. g-Factor
			Config.	Desig.					
^{2}G(^{3}P)^{4}G	5/2	69 + 19 ^{2}G(^{3}P)^{4}F	$3d^7 4s(^3G)4p$	$w\,^4G$	44568	44561	7	0.676	0.703
	7/2	77 + 11 ^{2}G(^{3}P)^{4}F			44394	44343	51	1.004	1.013
	9/2	85 + 5 ^{2}G(^{3}P)^{4}F			44183	44100	83	1.163	1.169
	11/2	93			43952:	43851	101	1.279	1.266
^{2}P(^{3}P)^{4}P	1/2	44 + 40 ^{4}P(^{1}P)^{4}P	$3d^8(^3P)4p$	$y\,^4P$	44858	45215	−357	2.371	2.523
	3/2	37 + 40 ^{4}P(^{1}P)^{4}P			44658	44948	−290	1.674	1.680
	5/2	33 + 42 ^{4}P(^{1}P)^{4}P			44480	44708	−228	1.557	1.565
^{2}G(^{3}P)^{2}H	9/2	87	$3d^7 4s(^3G)4p$	$x\,^2H$	45111	44988	123	0.897	0.907
	11/2	90			45540	45380	160	1.097	1.091
(^{3}P)^{2}D	3/2	72 + 7 (^{1}D)^{2}D + 6 ^{4}P(^{3}P)^{2}D	$3d^7 4s(^3P)4p$	$v\,^2D$	46186	46017	169	1.218	0.853
	5/2	70 + 8 ^{4}P(^{3}P)^{2}D	$3d^8(^3P)4p$	$w\,^2D$	45688	45397	291	1.219	1.170
(^{3}P)^{4}S	3/2	32 + 25 ^{4}P(^{3}P)^{4}S + 13 (^{3}P)^{2}P	$3d^7 4s(^3P)4p$	$x\,^4P$	45905	45906	−1	1.674	1.794
^{4}P(^{3}P)^{4}P	1/2	44 + 22 (^{3}P)^{4}P + 15 ^{2}P(^{3}P)^{4}P	$3d^7 4s(^3P)4p$	$x\,^4P$	45957	45864	93	2.522	2.613
	3/2	30 + 18 (^{3}P)^{4}P + 16 ^{2}P(^{3}P)^{4}P	$3d^8(^3P)4p$	$v\,^4D$	46260	46151	109	1.508	1.714
	5/2	30 + 24 ^{2}P(^{3}P)^{4}P + 16 (^{3}P)^{4}P	$3d^7 4s(^3P)4p$	$x\,^4P$	46003	46168	−165	1.543	1.566
^{2}G(^{3}P)^{2}G	7/2	79 + 10 ^{2}H(^{3}P)^{2}G	$3d^7 4s(^3G)4p$	$x\,^2G$	45767	45931	−164	0.898	0.896
	9/2	80 + 10 ^{2}H(^{3}P)^{2}G			46032	46211	−179	1.131	1.113
(^{3}P)^{4}D	1/2	27 + 21 A^{2}D(^{3}P)^{4}D + 17 ^{2}P(^{3}P)^{4}D			46502	46489	13	0.161	0.149
	3/2	14 + 16 (^{3}P)^{2}P + 12 (^{1}D)^{2}P	$3d^7 4s(^3P)4p$	$y\,^4S$	46563	46654	−91	1.273	1.200
	5/2	28 + 25 ^{2}P(^{3}P)^{4}D + 11 ^{4}F(^{1}P)^{4}D			46330	46485	−155	1.365	1.361
	7/2	44 + 22 ^{2}P(^{3}P)^{4}D + 11 ^{4}F(^{1}P)^{4}D			45971	46229	−258	1.424	1.406
^{4}P(^{3}P)^{2}D	3/2	61 + 14 ^{2}P(^{3}P)^{2}D + 7 (^{3}P)^{4}D	$3d^8(^3P)4p$	$w\,^2D$	46455	46803	−348	0.869	0.893
	5/2	45 + 20 ^{2}G(^{3}P)^{2}F + 9 (^{3}P)^{4}D	$3d^7 4s(^3P)4p$	$v\,^2D$	46672	46695	−23	1.233	1.130
^{2}G(^{3}P)^{2}F	5/2	33 + 22 ^{4}P(^{3}P)^{2}D + 14 (^{1}D)^{2}F	$3d^8(^1D)4p$	$w\,^2F$	47129	46944	185	0.858	0.971
	7/2	36 + 31 ^{2}P(^{3}P)^{4}D + 11 (^{1}D)^{2}F			47225	47062	163	1.229	1.310
(^{3}P)^{2}P	1/2	46 + 30 (^{1}D)^{2}P + 10 ^{4}P(^{3}P)^{2}P	$3d^7 4s(^3P)4p$	$y\,^2P$	47091	47215	−124	0.656	0.671
	3/2	27 + 12 (^{1}D)^{2}P + 9 (^{3}P)^{4}D			46685	46471	214	1.352	1.394
^{2}P(^{3}P)^{4}D	1/2	37 + 21 (^{3}P)^{2}S + 20 (^{3}P)^{4}D		$u\,^4D$	47905	48010	−105	0.016	0.691
	3/2	47 + 18 (^{3}P)^{4}D + 10 A^{2}D(^{3}P)^{4}F			47612	47554	58	1.122	1.105
	5/2	45 + 13 ^{4}P(^{3}P)^{2}D + 11 (^{3}P)^{4}D			47394	47365	29	1.324	1.319
	7/2	26 + 23 A^{2}D(^{3}P)^{4}D + 21 ^{2}G(^{3}P)^{2}F			46873	46806	67	1.352	1.394
^{2}H(^{3}P)^{4}I	9/2	94				48081			0.739
	11/2	94				47874			0.968
	13/2	97				47717			1.108
	15/2	100				47613			1.200
(^{3}P)^{2}S	1/2	35 + 26 ^{2}P(^{3}P)^{4}D + 15 ^{4}P(^{3}P)^{2}S	$3d^7 4s(^3P)4p$	$x\,^2S$	48026	48010	16	1.699	1.193
^{2}H(^{3}P)^{4}G	5/2	81 + 7 ^{2}G(^{3}P)^{2}F		$v\,^2F$	48616:	48640	−24	0.619	0.619
	7/2	84 + 4 ^{2}G(^{3}P)^{2}F		$v\,^2F$	48317	48341	−24	1.173	1.008
	9/2	92				47996			1.171
	11/2	95				47626			1.272

TABLE A. *Observed and calculated levels of* Co I (3d+4s)^{8}4p – Continued

Name	J	Percentage	AEL		Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O–C	Obs. g-Factor	Calc. g-Factor
			Config.	Desig.					
A^{2}D(^{3}P)^{4}D	1/2	52+16(^{3}P)^{4}D	$3d^74s$(^{3}P)$4p$	$t\,^4$D	48572	48893	−321	0.452	0.198
	3/2	21+22^{2}P(^{3}P)^{4}S+12(^{3}P)^{4}D			48546	48742	−196	1.050	1.254
	5/2	52+19(^{3}P)^{4}D			48444	48796	−352	1.340	1.339
	7/2	51+18(^{3}P)^{4}D			48217	48573	−356	1.211	1.386
^{4}P(^{3}P)^{2}P	1/2	69+12^{2}P(^{3}P)^{2}S+10(^{3}P)^{2}P		$w\,^2$S	48838	48966	−128	1.50:	0.840
	3/2	40+15^{2}P(^{3}P)^{4}S+11A^{2}D(^{3}P)^{4}D	$3d^8$(^{3}P)$4p$	$x\,^2$P	48334	48453	−119	1.436	1.369
^{2}P(^{3}P)^{4}S	3/2	48+26A^{2}D(^{3}P)^{4}D+8(^{3}P)^{4}D	$3d^8$(^{3}P)$4p$	$x\,^4$S	48754	48946	−192	1.728	1.623
^{2}P(^{3}P)^{2}D	3/2	29+34^{4}P(^{3}P)^{2}P+24A^{2}D(^{3}P)^{4}F	$3d^74s$(^{3}P)$4p$	$w\,^2$P	49025	49085	−60	1.099	0.991
	5/2	32+34A^{2}D(^{3}P)^{4}F+10^{2}P(^{3}P)^{4}D		7^0	48829	49047	−218		1.163
A^{2}D(^{3}P)^{4}F	3/2	50+15^{2}P(^{3}P)^{2}D+11A^{2}D(^{3}P)^{2}D		12^0	50105	50018	87	0.569	0.680
	5/2	43+24^{2}P(^{3}P)^{2}D		11^0	49847	49854	−7	1.079	1.107
	7/2	75+6^{2}P(^{3}P)^{4}D		10^0	49484	49426	58	1.260	1.257
	9/2	98		9^0	(49198:)	49108	(90)		1.333
^{2}H(^{3}P)^{2}I	11/2	90				50080			0.936
	13/2	67+31^{2}H(^{3}P)^{4}H				50435			1.126
(^{1}G)^{2}H	9/2	81+9^{2}H(^{3}P)^{2}H			50211	50124	87	0.899	0.915
	11/2	69+17^{2}H(^{3}P)^{2}H			50376	50389	−13	1.091	1.085
^{2}P(^{3}P)^{2}S	1/2	68+13^{4}P(^{3}P)^{2}P				50417			1.882
(^{1}G)^{2}G	7/2	38+37^{2}H(^{3}P)^{2}G	$3d^74s$(^{3}H)$4p$	$w\,^2$G	50611	50556	55	0.82	0.908
	9/2	40+38^{2}H(^{3}P)^{2}G			50593	50616	−23	1.10	1.095
(^{1}G)^{2}F	5/2	57+17A^{2}D(^{3}P)^{2}F			50712	50771	−59	0.905	0.909
	7/2	60+12A^{2}D(^{3}P)^{2}F+8^{2}G(^{3}P)^{2}F			50579	50693	−114	1.125	1.120
^{2}P(^{3}P)^{2}P	1/2	71+13A^{2}D(^{3}P)^{4}D		$v\,^2$P	50945	50972	−27	0.732	0.707
	3/2	53+15A^{2}D(^{3}P)^{4}D			50925	50861	64	1.340	1.331
^{2}H(^{3}P)^{4}H	7/2	89+5(^{1}G)^{2}G		15^0	51185	51233	−48		0.690
	9/2	86+5(^{1}G)^{2}G	$3d^74s$(^{3}H)$4p$	$x\,^2$H	50903	51048	−145	0.941	0.982
	11/2	86+11(^{1}G)^{2}H	$3d^74s$(^{3}H)$4p$	$x\,^2$H	50703	50828	−125	1.110	1.128
	13/2	68+30^{2}H(^{3}P)^{2}I				50573			1.184
A^{2}D(^{3}P)^{4}P	1/2	66+12^{2}P(^{3}P)^{4}P	$3d^74s$(^{3}D)$4p$	$w\,^4$P	52355	52180	175	2.304	2.414
	3/2	57+17^{2}P(^{3}P)^{2}P			52014	51784	230	1.616	1.617
	5/2	73+13^{2}P(^{3}P)^{2}P			51160	50950	210	1.578	1.564
A^{2}D(^{3}P)^{2}F	5/2	58+17(^{1}G)^{2}F		$t\,^2$F	52796	52491	305	0.883	0.897
	7/2	75+11^{2}G(^{3}P)^{2}F		$s\,^2$F	53104	52784	320	1.136	1.149
A^{2}D(^{3}P)^{2}D	3/2	51+21^{2}P(^{3}P)^{2}D		$u\,^2$D	53075	52884	191	0.823	0.816
	5/2	49+18^{2}P(^{3}P)^{2}D			53196	53964	232	1.206	1.180
^{2}H(^{3}P)^{2}G	7/2	44+30(^{1}G)^{2}G+22^{2}G(^{3}P)^{2}G	$3d^8$(^{1}G)$4p$	$v\,^2$G	53374	53288	86	0.888	0.889
	9/2	44+28(^{1}G)^{2}G+24^{2}G(^{3}P)^{2}G			53276	53214	62	1.124	1.111
A^{2}D(^{3}P)^{2}P	1/2	93				53764			0.750
	3/2	87		23^0	54165	53985	180	1.353	1.363

TABLE A. *Observed and calculated levels of* Co I (3d + 4s)^{8}4p – Continued

Name	J	Percentage	AEL Config.	AEL Desig.	Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O–C	Obs. g-Factor	Calc. g-Factor
^{2}H(^{3}P)^{2}H	9/2	91 + 6(^{1}G)^{2}H				54608			0.910
	11/2	88 + 6(^{1}G)^{2}H				54821			1.092
^{4}P(^{1}P)^{4}D	1/2	82 + 10(^{5}D)^{4}D*				55223			0.094
	3/2	80 + 10(^{5}D)^{4}D*				55057			1.224
	5/2	81 + 11(^{5}D)^{4}D*				54867			1.377
	7/2	85 + 12(^{5}D)^{4}D*				54693			1.427
^{4}P(^{1}P)^{4}S	3/2	58 + 27(^{3}P)^{4}S				55395			1.961
^{4}P(^{1}P)^{4}P	1/2	70 + 19(^{5}D)^{4}P*				55825			2.561
	3/2	61 + 17(^{5}D)^{4}P*				55792			1.729
	5/2	70 + 21(^{5}D)^{4}P*				55421			1.587
^{2}G(^{1}P)^{2}H	9/2	93				57733			0.914
	11/2	91				57103			1.088
(^{5}D)^{6}D*	1/2	99				58371			3.328
	3/2	99				58244			1.864
	5/2	98				58035			1.655
	7/2	97				57754			1.585
	9/2	99				57426			1.554
^{2}G(^{1}P)^{2}F	5/2	84 + 4(^{1}D)^{2}F				58878			0.859
	7/2	80 + 4(^{1}D)^{2}F				58189			1.138
^{2}G(^{1}P)^{2}G	7/2	74 + 11(^{1}G)^{2}G				59402			0.892
	9/2	68 + 13^{2}H(^{1}P)^{2}G				58698			1.105
^{2}P(^{1}P)^{2}P	1/2	65 + 17A^{2}D(^{1}P)^{2}P				60923			0.776
	3/2	65 + 13A^{2}D(^{1}P)^{2}D				60947			1.231
(^{5}D)^{6}F*	1/2	99				61723			−0.659
	3/2	98				61647			1.066
	5/2	98				61517			1.312
	7/2	97				61332			1.394
	9/2	96				61091			1.432
	11/2	100				60812			1.455
^{2}P(^{1}P)^{2}D	3/2	83 + 6^{2}P(^{1}P)^{2}P				61733			0.854
	5/2	79 + 8A^{2}D(^{1}P)^{2}F				61014			1.175
^{2}F(^{3}P)^{4}G	5/2	94				61635			0.579
	7/2	93				61764			0.990
	9/2	94				61941			1.175
	11/2	95				62174			1.270
^{2}F(^{3}P)^{4}F	3/2	94				62192			0.416
	5/2	91				62335			1.035
	7/2	95				62483			1.232
	9/2	60 + 27^{2}H(^{1}P)^{2}G				62848			1.250
^{2}H(^{1}P)^{2}I	11/2	96				62729			0.929
	13/2	98				62101			1.077

TABLE A. *Observed and calculated levels of* Co I $(3d+4s)^8 4p$ – Continued

Name	J	Percentage	AEL		Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O–C	Obs. g-Factor	Calc. g-Factor
			Config.	Desig.					
$^2F(^3P)^4D$	1/2	93				62496			0.002
	3/2	92				62487			1.189
	5/2	89				62485			1.359
	7/2	87				62484			1.436
$^2P(^1P)^2S$	1/2	$70+14\,^2P(^3P)^2P$				62732			1.816
$A\,^2D(^1P)^2D$	3/2	$69+10\,^2P(^1P)^2P$				63531			0.862
	5/2	$78+8\,^2F(^3P)^2D$				62568			1.186
$^2H(^1P)^2G$	7/2	$60+11(^5D)^4F^*$				63467			0.949
	9/2	$36+31\,^2F(^3P)^4F+17(^5D)^4F^*$				62864			1.221
$(^5D)^6P^*$	3/2	97				63870			2.363
	5/2	98				63447			1.878
	7/2	93				62815			1.697
$A\,^2D(^1P)^2F$	5/2	$66+16\,^2F(^3P)^2D$				64160			0.970
	7/2	89				63306			1.141
$(^5D)^4F^*$	3/2	93				63975			0.427
	5/2	89				63699			1.054
	7/2	$77+8\,^2H(^1P)^2G$				63330			1.209
	9/2	$77+10\,^2H(^1P)^2G$				62810			1.305
$^2F(^3P)^2D$	3/2	$68+12(^5D)^4D^*$				64398			0.857
	5/2	$49+14(^5D)^4D^*$				64410			1.175
$(^5D)^4D^*$	1/2	$73+9\,^4P(^1P)^4D$				64715			0.055
	3/2	$61+13\,^2F(^3P)^2D$				64573			1.131
	5/2	$53+24\,^2F(^3P)^2D$				64226			1.312
	7/2	$68+7(^5D)^4F^*$				63916			1.415
$^2H(^1P)^2H$	9/2	$78+13\,^2F(^1P)^2G$				64952			0.937
	11/2	90				64391			1.091
$^2F(^3P)^2G$	7/2	$85+10\,^2H(^1P)^2G$				64832			0.890
	9/2	$78+14\,^2H(^1P)^2H$				64886			1.088
$A\,^2D(^1P)^2P$	1/2	$66+12\,^2P(^3P)^2P$				65449			0.694
	3/2	78				64135			1.347
$^2F(^3P)^2F$	5/2	96				66808			0.859
	7/2	96				66717			1.143
$(^5D)^4P^*$	1/2	$78+20\,^4P(^1P)^4P$				68813			2.662
	3/2	$78+20\,^4P(^1P)^4P$				68540			1.732
	5/2	$77+21\,^4P(^1P)^4P$				68061			1.599
$^2F(^1P)^2G$	7/2	$87+9(^3H)^2G^*$				75095			0.890
	9/2	$87+9(^3H)^2G^*$				75389			1.111
$^2F(^1P)^2D$	3/2	88				75783			0.801
	5/2	$73+15\,^2F(^3P)^2F$				75894			1.143

TABLE A. *Observed and calculated levels of* Co I $(3d+4s)^8 4p$—Continued

Name	J	Percentage	AEL Config.	AEL Desig.	Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O−C	Obs. g-Factor	Calc. g-Factor
$^2F(^1P)^2F$	5/2	$75+15{}^2F(^1P)^2D$				76244			0.915
	7/2	$90+6(^3G)^2F^*$				76512			1.142
$(^1S)^2P$	1/2	$89+9A^2D(^1P)^2D$				76561			0.667
	3/2	$88+10A^2D(^1P)^2D$				76836			1.333
$B^2D(^3P)^4P$	1/2	97				79901			2.664
	3/2	95				79919			1.733
	5/2	96				79977			1.599
$B^2D(^3P)^4F$	3/2	95				80762			0.401
	5/2	95				80885			1.028
	7/2	94				81057			1.237
	9/2	93				81278			1.332
$B^2D(^3P)^2P$	1/2	$65+17B^2D(^3P)^4D+9(A^3P)^4D^*$				84473			0.477
	3/2	$79+12B^2D(^3P)^4D$				84186			1.298
$B^2D(^3P)^2F$	5/2	$75+13B^2D(^3P)^4D$				84381			0.945
	7/2	$75+19B^2D(^3P)^4D$				84408			1.199
$B^2D(^3P)^4D$	1/2	$71+23B^2D(^3P)^2P$				84201			0.171
	3/2	$73+10B^2D(^3P)^2P$				84393			1.183
	5/2	$78+12B^2D(^3P)^2F$				84538			1.297
	7/2	$45+18B^2D(^3P)^2F$				85100			1.387
$B^2D(^3P)^2D$	3/2	96				86758			0.803
	5/2	96				86672			1.200
$B^2D(^1P)^2P$	1/2	$56+32(^3D)^2P^*$				93582			0.669
	3/2	$55+35(^3D)^2P^*$				93960			1.332
$B^2D(^1P)^2F$	5/2	$41+23(^3G)^2F^*+20(^3D)^2F^*$				96929			0.868
	7/2	$42+22(^3D)^2F^*+20(^3G)^2F^*$				96971			1.142
$B^2D(^1P)^2D$	3/2	$49+41(^3D)^2D^*$				98049			0.805
	5/2	$51+36(^3D)^2D^*$				98457			1.199

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