JOURNAL OF RESEARCH of the National Bureau of Standards — A. Physics and Chemistry
Vol. 73A, No. 2, March–April 1969

Configurations $3d^n4p$ in Singly Ionized Atoms of the Iron Group*

C. Roth [1]

Experimental levels of the configuration $3d^n4p$ in the second spectra of the iron group were compared with corresponding calculated values. Besides the electrostatic and spin-orbit interactions the α, β and T corrections were considered in the individual and general treatments. The insertion of the parameters β and T improved the results by about 21 percent. The rms error on fitting 703 levels by means of 21 free interaction parameters was 231 cm^{-1}. Altogether 912 energy levels were predicted.

Key words: Configurations $3d^n4p$; β and T corrections; energy levels; interaction parameters; iron group; second spectra.

1. Introduction

The configurations $3d^n+3d^{n-1}4s$ in the second spectra of the iron group were considered by Racah and Shadmi [1].[2] Individual and general treatments including the α, β and T corrections were performed for the configurations $3d^n4p$ of the third spectra of the iron group by the author [2]. The configurations $3d^n4p$ in the second spectra of the iron group were considered by Racah and Spector [3], but only in the Russell-Saunders approximation. In the present investigation the spin-orbit interaction was inserted and, in addition, the effects of β and T were considered.

Racah and Trees [4–6] have shown that second order effects caused by perturbations on the configuration l^n by configurations differing from l^n by two electrons can be described by a model interaction of the form

$$\sum_{i<j} 2\alpha(\bar{l}_i\cdot\bar{l}_j)+\beta q_{ij},$$

where q_{ij} is the seniority operator [7]. For the configuration d^n this becomes

$$\alpha[L(L+1)-6n]+\beta Q,$$

where Q is the total seniority operator [7]. If the constant $-6n\alpha$ is incorporated into the height of the configuration the above correction reduces to

$$\alpha L(L+1)+\beta Q.$$

The $\alpha L(L+1)$ correction was first introduced by Trees [4]. The effect of the βQ correction was studied by Racah and Shadmi [8] in the even configurations $(3d+4s)^n$ of the second spectra of V, Cr, and Fe.

Trees and Jorgensen [9] have shown that the main perturbing configuration on $3s^23p^63d^n$ is the configuration $3s^23p^43d^{n+2}$. Trees [10] also remarked that the configuration $3s3p^63d^{n+1}$ should give a perturbation of the same magnitude as $3s^23p^43d^{n+2}$. This perturbation is not included in $\sum_{i<j} 2\alpha(\bar{l}_i\cdot\bar{l}_j)+\beta q_{ij}$, since now the configurations differ by only one electron. By second-order perturbation theory this effect depends upon the ratio $H^2/\Delta E$, where H is the interaction parameter that appears in the nondiagonal term,

$$H=\frac{R^2(3d\ 3d,\ 3d\ 3s)}{35},$$

and ΔE is the energy difference between the two configurations. The parameter $H^2/\Delta E$ is denoted by T. When calculating the model interaction one uses second-order perturbation theory of degenerate configurations which permits the introduction of these interactions before diagonalizing the energy matrices of the separate configurations. Hence the algebraic matrices of T are not diagonal. It should be noted that T represents a three-body interaction whereas α and β represent two-body interactions.

Rajnak and Wybourne [11], by using second-order perturbation theory obtained expressions for the matrix elements of the electrostatic interaction between the l^n configuration and the different species of perturbing configurations differing from l^n by one or two electrons or electron-holes. Effective three-body interactions were considered to account for the perturbation due to one-electron excitations. Racah and Stein [12] developed an elegant method which considerably simplified the calculations of Rajnak and Wybourne.

The electrostatic and spin-orbit interaction matrices for the configurations d^np were available from the

*An invited paper.
[1] Present address: McGill University, Montreal, Canada.
[2] Figures in brackets indicate the literature references at the end of this paper.

matrix library at the Hebrew University. To these matrices the author added the algebraic matrices of the parameters β and T using the program ADDCONF of Racah.

In the first part (the individual treatment, ILS), the algebraic matrices multiplied by radial parameters are diagonalized using the program of Racah [13]. Besides the eigenvalues, the diagonalization routine also yields the derivatives of the eigenvalues with respect to the parameters, the squares of the eigenvectors (percentage compositions) and the calculated Lande g values. The appropriate experimental levels are then fitted to the eigenvalues and using the derivatives obtained in the diagonalization, least squares are performed. In these calculations the improved values of the theoretical energy levels, the corrected values of the parameters including their statistical deviations and the sum of the squares of the differences between the observed and calculated levels are obtained. Then the rms error is defined as

$$\Delta=\sqrt{\frac{\sum_{i=1}^{n}\Delta_i^2}{n-m}}$$

where the Δ_i are the differences between the observed and calculated levels, n is the number of known levels and m is the number of free parameters. The value of Δ is also given by the least squares routine. The same derivatives can be used for several variations in the least squares either imposing different conditions on the parameters or inserting the experimental levels with different assignments. These latter variations are particularly important since they help to determine whether certain experimental levels may be inserted with changed assignments, or in some cases even rejected. The parameters of that variation which yields the best results are used to perform a new diagonalization. This iterative process is continued until mathematical convergence is attained.

If the parameters obtained from the individual treatments can be expressed in terms of simple interpolation formulas a general diagonalization is performed. Then in the general least squares (GLS) all the configurations $3d^n4p$ are considered as one problem by forcing the interaction parameters to vary linearly, or perhaps linearly with small quadratic corrections.

2. Parameters

For the d–d interaction the Slater parameters F^2 and F^4 were replaced by

$$B=\frac{1}{441}[9F^2(dd)-5F^4(dd)]=F_2(dd)-5F_4(dd)$$

$$C=\frac{5}{63}F^4(dd)=35F_4(dd).$$

For the d-p interaction the parameters F_2, G_1, and G_3 are given by

$$F_2=\frac{1}{35}F^2(dp),\ G_1=\frac{1}{15}G^1(dp)\text{ and }G_3=\frac{3}{245}G^3(dp).$$

The parameters of the spin-orbit interactions for the electrons d and the electron p are denoted by ζ_d and ζ_p, respectively. The three correction parameters mentioned previously are denoted by α, β, and T. Finally, the additive parameter chosen to normalize to zero the lowest energy value for a particular configuration, is denoted by A.

3. Discussion and Results

The electrostatic parameters for the initial diagonalization were taken from Racah and Spector [3]. Since d^n is the core of the configuration d^np, approximate values for the parameters B, C, α, and ζ_d could be obtained from Shadmi [16] in the treatment of the configurations $3d^n+3d^{n-1}4s$ in the third spectra of the iron group. As B, C, and α are already given [3], we only need to take the values of ζ_d from Shadmi. We then obtain [16]

$$\zeta_d(d^np)=387+95(n-5)+9[(n-5)^2-10].$$

The initial values of ζ_p were obtained by using the experimental levels of Ca II-$4p$ and Zn II-$3d^{10}4p$ for $\zeta_p(p)$ and $\zeta_p(d^{10}p)$, and then interpolating.

Thus, initially,

$$\zeta_p(d^np)=43n+149.$$

Using interpolative values for the interaction parameters, the energy matrices for the configurations d^np were diagonalized. Individual least squares were then performed for the configurations Sc II-dp, Ti II-d^2p, V II-d^3p, Cr II-d^4p, Mn II-d^5p, Fe II-d^6p, Co II-d_p^F, Ni II-d^8p and Cu II-d^9p, by means of which we determined how to fit the experimental levels.

General least squares were then considered in which 372 theoretical terms splitting into 912 levels were taken into account. Initially, 224 experimental terms splitting into 599 levels were fitted. As the matrices in the initial diagonalization did not include the matrices of β and T, we only considered one variation in the GLS. With 28 free parameters, the rms error was 295.

The parameters obtained from the GLS were used in the diagonalizations of the second iteration. There the matrices of β and T were already included, but the initial values of the parameters β and T were zero. However, derivatives with respect to these two parameters were obtained enabling the study of the effects of β and T on a particular configuration and in the general problem. With β and T eliminated in the GLS the rms error in the second iteration was 293. When β and T were allowed to vary linearly from configuration to configuration the rms error was reduced to 233. In that variation the values of β and T were

$$\beta(d^np)=-465\pm32-(9\pm22)(n-5)$$

$$T(d^np)=-3.4\pm0.2+(0\pm0.2)(n-5).$$

As in the configurations d^np of the third spectra, the insertion of β and T caused the value of α to drop. With β and T eliminated α had the values

$$\alpha_1(d^np) = (75.1 \pm 1.4) + (6.1 \pm 1.1)(n-5).$$

When β and T were allowed to vary linearly we obtained

$$\alpha_2(d^np) = (41.3 \pm 2.0) + (5.9 \pm 1.7)(n-5).$$

As for the configurations d^np in the third spectra the values of C increased notably when β and T were permitted to vary linearly. With β and T eliminated we had

$$C_1(d^np) = (3216.0 \pm 8.3) + (293.2 \pm 6.5)(n-5)$$

whereas for β and T changing linearly, we obtained

$$C_2(d^np) = (3413.2 \pm 15.1) + (320 \pm 10.2)(n-5).$$

This result is as expected since if we consider the basis configuration d^2 the only term affected by β is ^{1}S which contains 7C.

The above values of 233 and 293 for the rms errors in the GLS with and without β and T respectively, should be compared with the value of 361 obtained by Racah and Spector [3].

From the results of Iglesias and Velasco [14], we inserted an additional 49 terms splitting into 104 levels in the spectrum of Mn II$-3d^54p$. In the GLS with β and T allowed to vary linearly the rms error on fitting 273 terms splitting into 703 levels by means of 32 free parameters was 231. The fact that the rms error dropped in the GLS seems to indicate that the levels of Iglesias and Velasco are indeed valid levels.

In the plots of the parameters versus atomic number in figures 1–8, the values given are from the individual least squares (the vertical lines indicate the rms errors in the values of the parameters). The straight lines (for ζ_d the parabola) give the values of the parameters from the corresponding general least squares. From the graphs it is apparent that the assumption of linearity (for ζ_d with a small quadratic correction) is valid here.

Unless specified otherwise the source of the experimental data is "Atomic Energy Levels," Vols. **I** and **II** by C. E. Moore [15], henceforth referred to as AEL.

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

We now wish to discuss briefly the results for each configuration.

Ca II-$4p$

This configuration consists of only one term splitting into two levels. It is useful in providing a value for ζ_p.

Sc II-$3d4p$

In Sc II-dp, all the predicted levels are given in AEL. In the individual least squares we initially fitted the 6 terms splitting into 12 levels by using the 4 electrostatic parameters A, F_2, G_1 and G_3, and the spin-orbit parameters ζ_d and ζ_p. The rms error was 478. This very high value can be attributed to the fact that there is a strong interaction between the configurations dp and sp. The 4 levels of the terms ^{1}P and ^{3}P were thus not considered in the GLS.

The 8 levels of the terms ^{1}D, ^{3}D, ^{1}F, and ^{3}F fitted well in the GLS. The experimental g values also fitted nicely to the calculated values.

Ti II-$3d^24p$

In the configuration d^2p there are 19 theoretical terms splitting into 45 levels. The only experimental term missing for Ti II is (^{1}S)^{2}P.

In the individual least squares a rms error of 319 was obtained, which seems to indicate that this configuration is strongly perturbed by the configuration $3d4s4p$. There were no changes in assignment.

Since there are no observed levels based on the term $3d^2\ ^1$S, we can have only 4 electrostatic parameters of the core, i.e., A, B, C and α to determine the parents ^{3}P, ^{1}D, ^{3}F, and ^{1}G of d^2. If we give either β or T freedom, then the problem is overdefined.

The above value of 319 for the rms error should be compared with the value of 421 obtained by Racah and Spector [3].

V II$-3d^34p$

In the configuration d^3p there are 48 predicted terms splitting into 110 levels. The experimental data for V II$-3d^34p$ is almost complete. There are only 5 terms missing, all based on the parent term $3d^3B^2$D. In addition to the 43 terms splitting into 101 levels, which are assigned to d^3p, there are 7 additional odd levels whose configuration assignments are not given.

The level 1°_4 at 62761.9 definitely does not belong to the configuration d^3p as there is no calculated level in that vicinity to which it could be assigned.

In the individual least squares several attempts were made to fit the nine high levels (above 75,000) given in AEL. However, we could not come to a definite conclusion whether any or all of these levels belong to d^3p. Thus, it was decided not to insert any of these high levels in the individual least squares, which were then performed with 42 terms splitting into 98 levels. Since no levels based upon the term d^3B^2D (the only term having a nonvanishing value of Q) were inserted into the individual least squares, the only meaningful variation was to let both β and T to equal zero. The rms error in the second iteration was then 269, which should be compared with Racah and Spector's value of 390 [3].

The high levels were again considered in the GLS. When these experimental levels were compared with the calculated levels in the GLS closest to them, the deviations in each case were greater in magnitude than 600. When the levels were actually inserted into the GLS, the values of β were

$$\beta(d^np) = -495 \pm 32 + (92 \pm 21)(n-5).$$

Thus for V II$-d^3p$, this would cause β to have a value of -679, which is not reasonable. It is probable that most or all of these high levels belong to the configuration d^2sp.

The following changes in assignment were performed:

1. $(a\,^4F)z\,^5D_3 \leftrightarrow (a\,^4F)z\,^3D_3$
2. $(a\,^4P)z\,^3P_{0,1,2} \leftrightarrow (a\,^4P)y\,^5D_{0,1,2}$
3. $(a\,^2G)z\,^1G_4 \leftrightarrow (a\,^2G)y\,^3F_4$
4. $(a\,^2P)z\,^1P_1 \leftrightarrow (a\,^2D)y\,^1P$

In all four exchanges there was strong mixing between the eigenfunctions of the levels involved.

The agreement between the experimental and calculated g values is quite good except for the case of $(^4P)y\,^5D_4$. This level is 98 percent $(^4P)\,^5D$, and the remaining 2 percent are also ^5D. Thus, the calculated g value exactly equals the theoretical g value of 1.500 for pure LS compling. The value of 2.28 given in AEL for this level seems definitely wrong, as 1.5 is the highest theoretical g value for any level of J equal to 4 in the configuration d^3p.

Cr II-$3d^44p$

The configuration d^4p comprises 68 theoretical terms splitting into 180 levels; in AEL, 51 experimental terms splitting into 139 levels are given. We included all the experimental levels, but performed the following changes in assignment:

1. $(a\,^5D)z\,^4P_{5/2} \leftrightarrow (a\,^5D)z\,^6D_{5/2}$
2. $(a\,^3H)z\,^4G_{5/2,\,7/2,\,9/2,\,11/2} \leftrightarrow (a\,^3F)y\,^4G_{5/2,\,7/2,\,9/2,\,11/2}$
3. AEL $(a\,^3P)z\,^2D_{3/2} \rightarrow (A^3P)z\,^2P_{3/2}$
4. AEL $(a\,^3P)z\,^2P_{3/2} \rightarrow (A^3F)y\,^4F_{3/2}$
5. AEL $(a\,^3P)z\,^2D_{5/2} \rightarrow (A^3F)y\,^4F_{5/2}$
6. AEL $(a\,^3F)y\,^4F_{3/2,\,5/2} \rightarrow (A^3F)z\,^2D_{3/2,\,5/2}$
7. AEL $(a\,^3G)x\,^4F_{3/2} \rightarrow (A^3P)\,^2D_{3/2}$
8. AEL $(a\,^3F)y\,^2D_{5/2} \rightarrow (A^3P)\,^2D_{5/2}$
9. AEL $(a\,^3F)y\,^2D_{3/2} \rightarrow (^3G)x\,^4F_{3/2}$
10. $(a\,^1I)y^2I_{13/2} \leftrightarrow (^1I)z\,^2K_{13/2}$
11. $(a\,^1G)w\,^2H_{9/2,\,11/2} \leftrightarrow (^1I)x\,^2H_{9/2,\,11/2}$
12. AEL $(a\,^3D)x\,^2F_{5/2,\,7/2} \rightarrow (A^1G)x\,^2F_{5/2,\,7/2}$
13. AEL $(a\,^1G)w\,^2F_{5/2,\,7/2} \rightarrow (^3D)w\,^2F_{5/2,\,7/2}$
14. AEL $(b\,^3F)u\,^2G_{7/2,\,9/2} \rightarrow (B^3F)\,^4G_{7/2,\,9/2}$

In the first instance, the eigenfunctions of the levels $z\,^4P_{5/2}$ and $z\,^6D_{5/2}$ were mixed considerably. Without the exchange the splittings of the two terms $z\,^4P$ and $z\,^6D$ were very bad, whereas after the exchange they were excellent.

Although the eigenfunctions of the levels of the terms $z\,^4G$ and $y\,^4G$ are mixed slightly, it is apparent that the parents of these two terms are not correct in AEL and thus should be exchanged as indicated in 2.

In the first diagonalization the term $(A^3F)^2D$ was at 67,000 and the term $(A^3P)^2D$ at around 69,500. Thus, the parents of $z\,^2D$ and $y\,^2D$ do not seem to be correct as given in AEL and so we made the exchange $(a\,^3P)z\,^2D \leftrightarrow (a\,^3F)y\,^2D$. Some high deviations of around 600–700 still appeared in the individual least squares for the terms $(A^3P)^2P$, $(A^3F)^2D$, $(A^3F)^4F$, $(A^3P)^2D$ and $(^3G)^4F$. However, by making the changes 3, 4, 5, 6, 7, 8, and 9 the agreement of all the levels involved was improved considerably. Although these changes are quite numerous, it should be emphasized that in most cases the eigenfunctions of the levels involved were strongly mixed.

The eigenfunctions of the levels $(^1I)z\,^2K_{13/2}$ and $(^1I)y\,^2I_{13/2}$ are mixed considerably. The exchange 10 improved the agreement of these 2 levels as well as the splittings of the terms $z\,^2K$ and $y\,^2I$.

Theoretically, the term $(A^1G)^2H$ is predicted at around 74,500, whereas the term $(^1I)^2H$ is predicted at around 77,500. Thus, it is necessary to exchange $x\,^2H$ and $w\,^2H$ as indicated in 11. Changes 12 and 13 are similar to 11.

The term $(B^3F)^2G$ is predicted at around 94,000. Thus, if the experimental levels of $u\,^2G$ are fitted to the theoretical levels of the same term designation, then the resulting deviations are about -3000. However, the term $(B^3F)^4G$ is predicted at 91,000. Therefore, if the levels of $u\,^2G$ are fitted to $(B^3F)^4G_{7/2,\,9/2}$, the agreement is excellent as the deviations in the general least squares are then only 194 and 223 (in the individual least squares they are 141 and 160).

Most of the changes in this investigation, and especially the change in assignment 14, indicate that poor agreement can be obtained by using the Russell-Saunders approximation. In the L–S approximation [3] the rms error was 550, which was partly attributed to the fact that the term $(B^3F)\,u\,^2G$ had a very large deviation. This term was then neglected altogether and subsequently the rms error was reduced to 384. Actually, the levels $u\,^2G$ can be fitted very nicely if assigned to $(B^3F)^4G$.

In the GLS of Racah and Spector [3], deviations of 735 and 1117 were obtained for the terms $(a\,^1D)w\,^2D$ and $(a\,^1D)v\,^2F$, respectively. The deviations we obtained were much lower. In the GLS, the deviations for $w\,^2D$ were 348 and 307, whereas for $v\,^2F$ they were 461 and 451. In these two cases the deviations were reduced because of β and T, since in the GLS with β and T eliminated the deviations for these two terms were of about the same magnitude as those obtained by Racah and Spector [3].

In the individual least squares of the first iteration the rms error was 292. In the second iteration, with β and T eliminated, the rms error was reduced to 287. When β and T were allowed to change freely, the rms error dropped to 200. In that variation the values of β and T were

$$\beta = -495 \pm 64$$

$$T = -4.1 \pm 0.4.$$

The agreement between the experimental and calculated g values is very good.

Mn II – $3d^54p$

From 88 theoretical terms splitting into 214 levels, only 20 experimental terms splitting into 66 levels are given in AEL. In the individual least squares, the following change in assignment was performed

1. $(a\,^4G)z\,^5F_{1,2} \leftrightarrow (a\,^4P)z\,^5D_{1,2}$

There was some mixing between the eigenfunctions of the levels involved and the deviations as well as the

splittings of the terms $z\,^5$D and $z\,^5$F were improved considerably after the exchange.

The two Lande g values for the levels $(a\,^4G)z\,^5G_2$ and $(a\,^4G)z\,^5H_3$, given in AEL, seem to be misprints. The calculated g value for the level $z\,^5G_2$ is 0.338, whereas the theoretical g value for $^5G_2$ is 0.333. Thus, the experimental value of 1.31 does not fit for this level. Similarly the calculated g value for $z\,^5H_3$ is 0.519, and the theoretical g value for $^5H_3$ is 0.500. Again, the experimental value of 1.30 cannot be accepted for this level. We tried to refer to the original work on the measurements of the g-values, but this work was performed by Catalan and the results were not published.

In the first iteration, the rms error in the individual least squares was 180. In the second iteration with β and T eliminated, the rms error was reduced to 172. As explained by Racah [17], the parameter T has very little significance in the configuration d^5p. Thus, we only considered the variation with β free and T eliminated. Then, the rms error was reduced to 167, with β having a value of -410 ± 97.

We tried to fit the levels of Iglesias and Velasco [14] in the individual as well as the general least squares. Iglesias and Velasco assign 50 new terms splitting into 108 levels to the configuration $3d^54p$. Of these, the three levels of the term w^5P should be assigned to $3d^5(a\,^6S)5p^5P$. This follows simply from the fact that these three levels are not new and were already given in AEL with that assignment. They definitely do not belong to the configuration $3d^54p$. In addition, the level x^5F_1 at 81237 was rejected as it would fit only with a deviation of -1300 in the GLS. Then, by inserting 104 new levels in the individual least squares of the second iteration with T eliminated and β free, the rms error increased from 167 to 226. In that variation, the value of β was -356 ± 37. In the GLS the 104 new levels fitted very well and the rms error did not rise by the insertion of these levels. Also, the experimental g values of Iglesias and Velasco fitted well to the calculated g values.

The following changes in assignment were made for the 104 new levels:

1. $(^4F)x\,^5F_2 \leftrightarrow (^4F)y\,^5G_2$
2. $(^4F)x\,^5F_3 \leftrightarrow (A^2D)x\,^3D_3$
3. $(^4F)x\,^5F_4 \leftrightarrow (A^2F)y\,^3G_4$
4. $(A^2G)y\,^1G_4 \leftrightarrow (^4F)v\,^3F_4$
5. $(A^2G)v\,^3G_5 \leftrightarrow (A^2G)y\,^1H_5$

When the levels of the term x^5F were assigned to the theoretical levels of $(^4F)x\,^5F$ the deviations were around -1000 for the levels of J equal 2–5, and almost -1500 for $x\,^5F_1$. Several variations were attempted to reduce these deviations. However, in all cases the magnitude of the deviation for $x\,^5F_1$ was always greater than 1000. Thus, we rejected this level. After the exchanges 1, 2, and 3 the agreement between the observed and calculated values of the levels and g factors of the terms $y\,^5$G, $x\,^3$D and $y\,^3$G is very good. The agreement of the four remaining levels of x^{5}F is also quite good. However, here the experimental and calculated splittings of $(^4F)x\,^5F$ do not correspond as closely as for the other three terms, $y\,^3$G, $x\,^3$D and $y\,^5$G.

The changes 4 and 5 were accepted because of the subsequent improvements in the fitting of all the levels involved. The calculated intervals between the levels of the terms $v\,^3$F and $v\,^3$G also corresponded more closely to the experimental intervals after the changes.

All the new levels of Iglesias and Velasco [14] are of unspecified parentage. In table 16 the calculated percentage composition of each level is indicated.

Fe II $-3d^64p$

In the configuration d^6p there are 68 theoretical terms splitting into 180 levels. In AEL, 54 experimental terms splitting into 149 levels are given. All the experimental levels were inserted, with the following changes in assignment:

1. $(a\,^3H)z\,^4H_{9/2,\,11/2,\,13/2} \longleftrightarrow (a\,^3H)z\,^4I_{9/2,\,11/2,\,13/2}$
2. $(a\,^3D)x\,^2F_{5/2,\,7/2} \longrightarrow (A^1G)^2F_{5/2,\,7/2}$

As in most instances of changes in assignment, here also the eigenfunctions of the levels involved in both changes are mixed considerably.

The term whose experimental assignment is $(a\,^3D)x\,^2F$, is fitted to $(A^1G)^2F$, whereas the levels of $w\,^2$F are fitted to $(A^3D)^2F$. The other terms, with no specified parentage in AEL, i.e., $x\,^2$H and $w\,^2$H, are assigned to $(A^1G)x\,^2H$ and $(^1I)w\,^2H$, respectively.

In the first iteration the rms error in the individual least squares was 277. In the second iteration with β and T allowed to change freely the rms error was reduced to 176. In that variation the values of β and T were

$$\beta=-525\pm39$$

$$T=-3.5\pm0.3.$$

The value of 176 should be compared with the rms error of 366 in the $L-S$ approximation [3].

In AEL, 29 very high odd levels are given without any configuration assignment. It is possible to assign several of these levels to the configuration $3d^64p$. However, it is quite likely that most or all of these levels actually belong to the configurations $3d^54s4p$ and/or $3d^65p$. Thus, we did not insert any of them in the least squares calculations.

At this opportunity we wish to point out a misprint in AEL. The term $y\,^6$P should be labeled as $3d^54s(a\,^7S)4p$, and not as $3d^6(a\,^7S)4p$.

Co II $-3d^74p$

From 48 theoretical terms, splitting into 110 levels, only 11 experimental terms splitting into 37 levels are given in AEL. All known terms are based on ^{4}P and ^{4}F of $3d^7$. Thus, the parameters C and α must be kept fixed in the least squares calculations in order to obtain meaningful results. The 37 experimental levels fitted without changes in assignment. The agreement between the experimental and calculated g values was very good. In the individual least squares, the rms error was 148. As expected, this is only a small improvement from the value of 158 obtained by Racah and Spector [3]. The level $3d^7(a\,^4P)4py^5D_1$, which is given with a question mark in AEL, fits nicely to the calculated level with the same assignment.

Ni II — $3d^8 4p$

As in Ti II — $3d^2 4p$, the only term missing in this configuration is $3d^8(^1S)4p\,^2P$. The 18 experimental terms split into 43 levels. There were no changes in assignment, and the rms error in the individual least squares was 158 for both iterations. As in Ti II, since there are no levels based on $d^8\,^1S$, the parameters β and T must be eliminated in the individual least squares. The two levels of the term $(^1G)x\,^2F$, which are given as uncertain in AEL, fit quite well, although in the last GLS the deviation for the level $(^1G)x\,^2F_{5/2}$ was −526.

There is considerable sharing in g values between the experimental levels $(^3P)y\,^2P_{1/2}$ and $(^3P)z\,^2S_{1/2}$. This is evident from the fact that the experimental g value of $y\,^2P_{1/2}$ is given as 1.039, whereas the theoretical g value for $^2P_{1/2}$ is 0.667 and the theoretical g value for $^2S_{1/2}$ is 2.000. However, the calculated eigenfunction of $(^3P)^2P$ has only 5 percent of $(^3P)^2S$ and so the experimental g value of 1.039 fits poorly to the calculated value of 0.730. Although the experimental values of the two levels $y\,^2P_{1/2}$ and $z\,^2S_{1/2}$ differ by 380, the calculated levels in the GLS differ by 923.

The agreement between the experimental and calculated g values of the other levels is very good.

Cu II — $3d^9\,4p$

In this configuration all the 6 theoretical terms splitting into 12 levels are known experimentally. The following changes in assignment were performed:

1. $^3D_2 \leftrightarrow {}^1D_2$
2. $^3D_3 \leftrightarrow {}^1F_3$

The above changes are analogous to those of Zn III — $3d^9 4p$ [2], and again the eigenfunctions of the levels involved are mixed. In the individual least squares the rms error was 119.

The agreement between the observed and calculated g-factors of the $^3D_1$ and $^1P_1$ levels in the general treatment is poor. However, in the individual treatment of the configuration Cu II — $3d^9\,4p$ the agreement for all the g-factors is excellent.[3] Thus, since the parameters were forced to be linear in the general treatment the theoretical levels $^3D_1$ and $^1P_1$ were not mixed properly.

Zn II — $3d^{10}\,4p$

This configuration consists of only 1 term splitting into 2 levels and is useful in obtaining a value for ζ_p.

4. Table Entries

4.1. Parameters: Tables 1–10

In the general diagonalization all the parameters with the exception of ζ_d had approximate expressions of the form

$$P(d^n p) = P + (n-5)\Delta P.$$

In the general least squares then only P and ΔP were the independent parameters.

For ζ_d we had

$$\zeta_d(d^n p) = \zeta_d + (n-5)\Delta_1\zeta_d + [(n-5)^2 - 10]\Delta_2\zeta_d.$$

Here ζ_d, $\Delta_1\zeta_d$ and $\Delta_2\zeta_d$ were the independent parameters in the general least squares.

The numerical values of the parameters for the initial general diagonalization are given in the column GDIAG 1.

The columns ILS1 and GLS1 give the values of the parameters of the initial iteration with β and T eliminated, in the individual and general least squares, respectively. The columns ILS2 and GLS2 give the values of the parameters of the second iteration with β and T eliminated, in the individual and general least squares, respectively. The columns ILS′2 and GLS′2 give the values of the parameters of the second iteration with β and T free to change in the individual and general least squares, respectively.

[3] Results to be published soon in a paper dealing specifically with the odd configurations of Cu II.

TABLE 1. *Parameters of* Sc II — 3d4p

Parameters	GDIAG 1	ILS 1 (All levels)	GLS 1	GLS 2	GLS′ 2
A	29588	28972 ± 154	28926	28948	29071
F_2	287	244 ± 27	285	293	285
G_1	354	345 ± 39	330	334	335
G_3	21	14 ± 13	26	26	26
α	55	Fix 55	51	49	25
ζ_d	61	160 ± 194	54	51	55
ζ_p	192	−56 ± 490	191	192	197
Δ	....	478	....	....	....

TABLE 2. *Parameters of* Ti II – $3d^24p$

Parameter	GDIAG 1	ILS 1	GLS 1	ILS 2	GLS 2	GLS′ 2
A	37585	37568 ± 94	37596	37569 ± 94	37608	38241
B	685	694 ± 9	701	697 ± 9	692	718
C	2291	2358 ± 69	2336	2349 ± 69	2327	2420
F_2	299	288 ± 9	295	286 ± 9	302	295
G_1	348	329 ± 12	326	328 ± 12	331	330
G_3	24	26 ± 4	28	25 ± 4	28	28
α	60	57 ± 10	57	57 ± 10	56	30
β	....	....	....	Fix 0	Fix 0	−426
T	....	....	....	Fix 0	Fix 0	−3.2
ζ_d	93	132 ± 55	116	134 ± 55	118	123
ζ_p	235	209 ± 137	229	216 ± 138	230	226
Δ	....	320	....	319	....	....

TABLE 3. *Parameters of* V II – $3d^34p$

Parameter	GDIAG 1	ILS 1	GLS 1	ILS 2	GLS 2	GLS′ 2
A	49601	49698 ± 90	49661	49750 ± 79	49628	50344
B	750	755 ± 5	763	764 ± 5	756	773
C	2605	2602 ± 26	2630	2629 ± 24	2625	2749
F_2	311	319 ± 8	306	306 ± 7	312	306
G_1	342	325 ± 8	323	326 ± 7	327	325
G_3	27	34 ± 3	30	34 ± 3	30	30
α	65	63 ± 4	63	60 ± 4	62	34
β	....	....	....	Fix 0	Fix 0	−436
T	....	....	....	Fix 0	Fix 0	−3.2
ζ_d	143	199 ± 44	185	183 ± 39	191	197
ζ_p	278	209 ± 99	267	196 ± 89	268	255
Δ	....	284	....	269	....	....

TABLE 4. *Parameters of* Cr II – $3d^4 4p$

Parameter	GDIAG 1	ILS 1	GLS 1	ILS 2	ILS′ 2	GLS 2	GLS′ 2
A	68645	68493 ± 125	68679	68502 ± 123	69338 ± 116	68673	69142
B	815	818 ± 5	825	816 ± 5	833 ± 4	820	828
C	2919	2959 ± 17	2923	2961 ± 16	3092 ± 19	2922	3078
F_2	323	314 ± 7	316	316 ± 6	310 ± 5	321	316
G_1	336	321 ± 7	320	324 ± 7	321 ± 5	323	320
G_3	30	31 ± 2	32	30 ± 2	32 ± 2	31	32
α	70	66 ± 3	69	64 ± 3	34 ± 4	68	38
β	....	....	....	....	−495 ± 64	....	−445
T	....	....	....	....	−4.1 ± 0.4	....	−3.2
ζ_d	211	208 ± 46	262	230 ± 38	283 ± 31	270	277
ζ_p	321	378 ± 81	305	362 ± 74	309 ± 55	306	283
Δ	....	292	....	287	200	....	....

TABLE 5. *Parameters of* Mn II – $3d^5 4p$ [a]

Parameter	GDIAG 1	ILS 1 (66 levels)	GLS 1	ILS 2	ILS′ 2	GLS 2	GLS′ 2
A	73570	74544 ± 229	73829	73790 ± 151	73244 ± 133	73774	73586
B	880	904 ± 7	887	886 ± 4	874 ± 4	884	884
C	3233	3151 ± 17	3216	3220 ± 13	3334 ± 16	3220	3407
F_2	335	318 ± 9	327	313 ± 7	320 ± 6	331	326
G_1	330	302 ± 7	317	311 ± 6	300 ± 5	320	315
G_3	33	36 ± 2	33	37 ± 2	38 ± 2	33	34
α	75	74 ± 3	75	73 ± 2	59 ± 2	75	43
β	....	....	....	Fix 0	−356 ± 37	Fix 0	−456
T	....	....	....	Fix 0	Fix 0	Fix 0	−3.3
ζ_d	297	452 ± 78	347	394 ± 48	412 ± 38	354	364
ζ_p	364	446 ± 85	343	311 ± 78	361 ± 62	344	312
Δ	....	180	....	285	226	....	....

[a] The parameters in ILS 1 and GLS 1 were obtained by not considering the levels of Iglesias and Velasco [14].

The parameters in ILS 2 and ILS′ 2 for Mn II as well as GLS 2 and GLS′ 2 were obtained by using the new levels of Iglesias and Velasco.

TABLE 6. *Parameters of* Fe II—$3d^6 4p$

Parameter	GDIAG 1	ILS 1	GLS 1	ILS 2	ILS′ 2	GLS 2	GLS′ 2
A	64940	65176 ± 112	65089	65086 ± 112	65040 ± 73	65056	64998
B	945	954 ± 4	950	951 ± 4	942 ± 3	949	939
C	3547	3506 ± 16	3509	3511 ± 16	3745 ± 20	3518	3736
F_2	347	353 ± 6	338	351 ± 6	344 ± 4	340	336
G_1	324	326 ± 7	314	321 ± 7	309 ± 4	316	310
G_3	36	34 ± 2	35	34 ± 2	36 ± 1	35	36
α	80	84 ± 3	81	83 ± 3	45 ± 3	81	47
β	....	....	....	Fix 0	−525 ± 39	Fix 0	−465
T	....	....	....	Fix 0	−3.5 ± 0.3	Fix 0	−3.3
ζ_d	401	462 ± 39	439	463 ± 39	451 ± 25	446	457
ζ_p	407	374 ± 71	381	377 ± 70	377 ± 44	382	340
Δ	....	277	....	270	176	....	....

TABLE 7. *Parameters of* Co II—$3d^7 4p$

Parameter	GDIAG 1	ILS 1	GLS 1	ILS 2	GLS 2	GLS′ 2
A	60888	60900 ± 51	61060	60919 ± 61	61069	61176
B	1010	992 ± 4	1012	996 ± 5	1013	994
C	3861	Fix 3861	3802	Fix 3802	3815	4064
F_2	359	364 ± 7	348	363 ± 8	350	347
G_1	318	304 ± 8	311	305 ± 8	313	305
G_3	39	36 ± 2	37	37 ± 3	37	38
α	85	Fix 85	87	Fix 88	87	51
β	....	....	....	Fix 0	Fix 0	−475
T	....	....	....	Fix 0	Fix 0	−3.3
ζ_d	523	502 ± 28	539	502 ± 28	542	557
ζ_p	450	277 ± 75	419	262 ± 78	420	369
Δ	....	149	....	148	....	....

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TABLE 8. *Parameters of* Ni II – $3d^84p$

Parameter	GDIAG 1	ILS 1	GLS 1	ILS 2	GLS 2	GLS′ 2
A	61720	61922 ± 55	61789	61921 ± 54	61786	62007
B	1075	1058 ± 6	1074	1057 ± 6	1077	1049
C	4175	4207 ± 44	4096	4208 ± 45	4113	4393
F_2	371	346 ± 6	359	346 ± 6	359	357
G_1	312	300 ± 6	308	300 ± 6	309	300
G_3	42	45 ± 3	39	45 ± 3	38	40
α	90	68 ± 6	93	68 ± 6	94	56
β	....	....	....	Fix 0	Fix 0	−485
T	....	....	....	Fix 0	Fix 0	−3.3
ζ_d	663	638 ± 30	646	638 ± 30	646	663
ζ_p	493	344 ± 62	457	343 ± 62	458	398
Δ	....	158	....	158	....	....

TABLE 9. *Parameters of* Cu II – $3d^94p$

Parameter	GDIAG 1	ILS 1	GLS 1	ILS 2	GLS 2	GLS′ 2
A	70281	69798 ± 56	69225	69802 ± 42	69226	69465
F_2	383	341 ± 9	370	344 ± 7	369	367
G_1	306	313 ± 11	304	305 ± 7	305	295
G_3	45	38 ± 8	41	38 ± 6	40	42
α	95	Fix 95	100	Fix 100	100	61
ζ_d	821	766 ± 52	761	802 ± 43	756	727
ζ_p	536	589 ± 93	495	502 ± 82	496	426
Δ	....	154	....	119	....	....

TABLE 10. *General parameters of the second spectra of the iron group*

Parameter	GDIAG 1	GLS 1	GLS 2	GLS′2
B	880	887.4 ± 1.9	884.5 ± 2.1	883.6 ± 1.9
ΔB	65	62.1 ± 1.2	64.1 ± 1.3	55.2 ± 1.2
C	3233	3216.0 ± 8.3	3220.1 ± 8.9	3406.7 ± 12.8
ΔC	314	293.2 ± 6.5	297.6 ± 6.3	328.8 ± 9.7
F_2	335	327.1 ± 2.7	330.6 ± 2.6	326.2 ± 2.3
ΔF_2	12	10.6 ± 1.3	9.5 ± 1.4	10.3 ± 1.2
G_1	330	317.2 ± 2.8	319.8 ± 3.0	314.8 ± 2.3
ΔG_1	-6	-3.1 ± 1.5	-3.6 ± 1.4	-5.3 ± 1.3
G_3	33	33.4 ± 1.0	33.1 ± 1.0	34.1 ± 0.8
ΔG_3	3	1.8 ± 0.6	1.8 ± 0.5	2.1 ± 0.6
α	75	75.1 ± 1.4	74.6 ± 1.3	42.6 ± 2.1
$\Delta \alpha$	5	6.1 ± 1.1	6.3 ± 1.1	4.3 ± 1.7
β	....	....	Fix 0	-455.5 ± 29.0
$\Delta \beta$	....	....	Fix 0	-9.9 ± 29.7
T	....	....	Fix 0	-3.3 ± 0.2
ΔT	....	....	Fix 0	0.0 ± 0.2
ζ_d	387	384.8 ± 26.5	385.4 ± 28.6	396.1 ± 24.0
$\Delta_1 \zeta_d$	95	88.4 ± 7.6	87.9 ± 8.1	89.9 ± 6.8
$\Delta_2 \zeta_d$	9	3.8 ± 3.8	3.1 ± 3.6	3.2 ± 3.3
ζ_p	364	343.1 ± 31.6	344.1 ± 30.9	311.8 ± 26.7
$\Delta \zeta_p$	43	38.0 ± 14.7	38.1 ± 14.1	28.6 ± 13.2
Δ	....	295.2	294.3	231.4

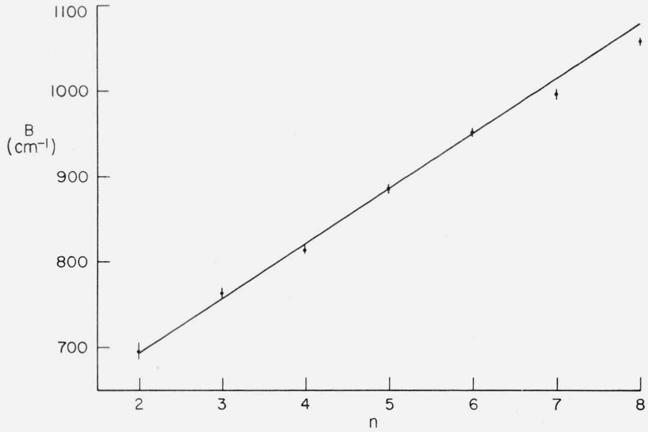

FIGURE 1. *Initial interpolation of parameter* B *with values obtained from individual diagonalizations of* $3d^n4p$ *configurations.*

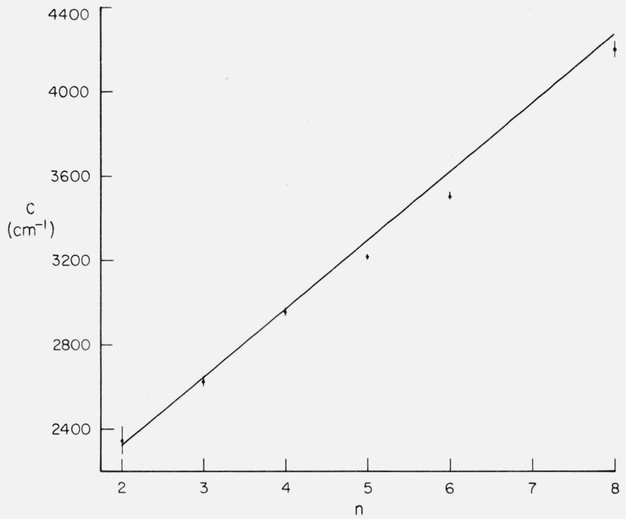

FIGURE 2. *Initial interpolation of parameter* C *with values obtained from individual diagonalizations of* $3d^n4p$ *configurations.*

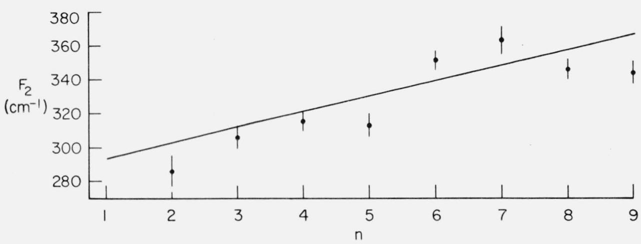

FIGURE 3. *Initial interpolation of parameter* F_2 *with values obtained from individual diagonalizations of* $3d^n4p$ *configurations.*

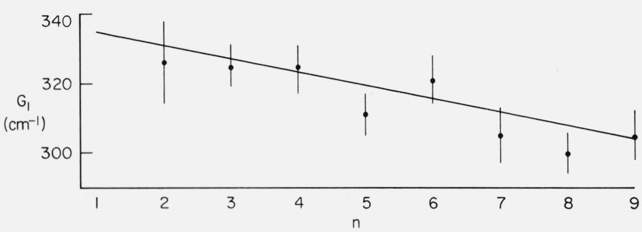

FIGURE 4. *Initial interpolation of parameter* G_1 *with values obtained from individual diagonalizations of* $3d^n4p$ *configurations.*

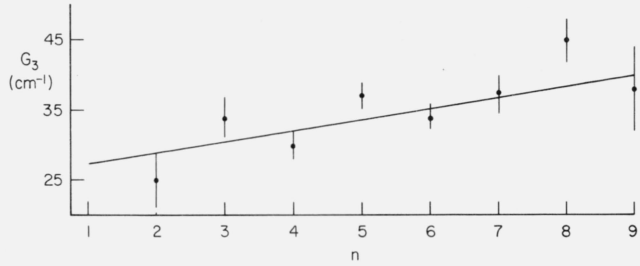

FIGURE 5. *Initial interpolation of parameter* G_3 *with values obtained from individual diagonalizations of* $3d^n4p$ *configurations.*

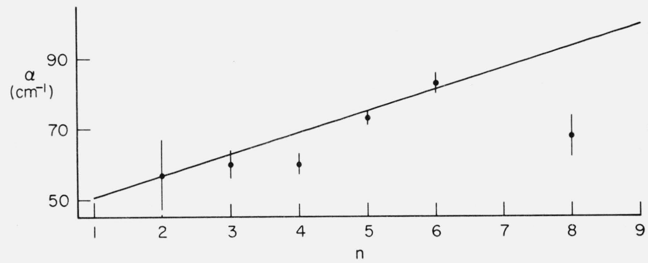

FIGURE 6. *Initial interpolation of parameter* α *with values obtained from individual diagonalizations of* $3d^n4p$ *configurations.*

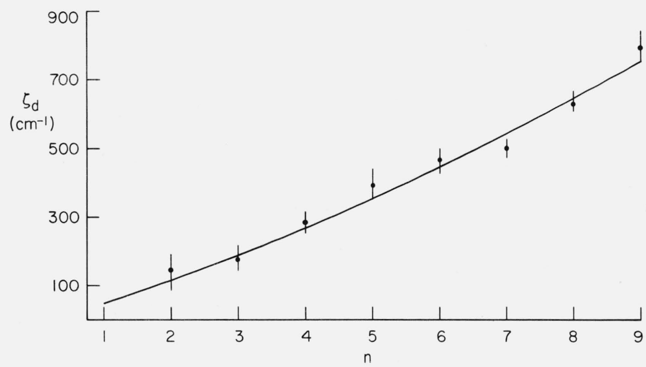

FIGURE 7. *Initial interpolation of parameter* ζ_d *with values obtained from individual diagonalizations of* $3d^n4p$ *configurations.*

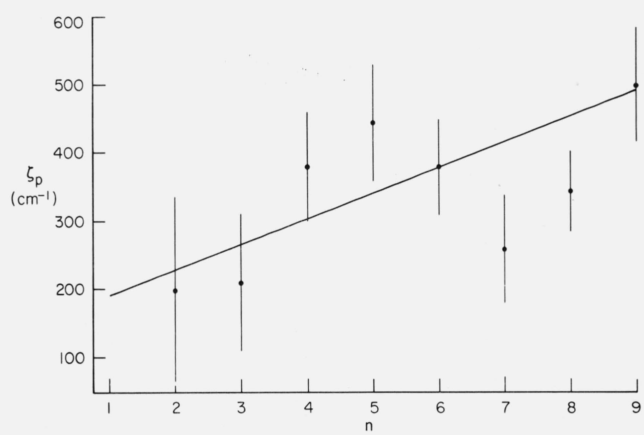

FIGURE 8. *Initial interpolation of parameter* ζ_p *with values obtained from individual diagonalizations of* $3d^n4p$ *configurations.*

4.2. Levels: Tables 11–21

In the column "NAME" the calculated designation of the term is given. Whenever terms of the parent d^n have different seniorities these are denoted by the letters A and B (for $d^5\,{}^2D$ by A, B and C), the lower calculated term being designated by A. Whenever a calculated term has a corresponding experimental term, the small letters z, y, x . . . are used as in AEL [15].

The entries in the columns "J", "OBS LEVEL (cm^{-1})" and "CALC. LEVEL (cm^{-1})" are self-evident. In the column "PERCENTAGE", for each calculated level either the three highest contributions or all those contributions exceeding 5 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. Moore [15]. 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 columns "OBS. g-FACTOR" and "CALC. g-FACTOR" give the values of the observed and calculated Lande g-factors, respectively.

The entries are in ascending order of magnitude of the calculated terms. The values of the levels and parameters are in cm^{-1}.

TABLE 11. *Observed and calculated levels of* Ca II 4p

NAME	*J*	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. *g*-FACTOR	CALC. *g*-FACTOR
$(^1S)z\ ^2P$	1/2	100		25192	25196	−4		0.667
	3/2	100		25414	25410	4		1.333

TABLE 12. *Observed and calculated levels of* Sc II 3d4p

NAME	*J*	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. *g*-FACTOR	CALC. *g*-FACTOR
$(^2D)z\ ^1D$	2	99		26081	26371	−290	1.00	0.997
$(^2D)z\ ^3F$	2	97		27444	27553	−109	0.65	0.678
	3	97		27602	27690	−88	1.10	1.093
	4	100		27841	27908	−67	1.25	1.250
$(^2D)z\ ^3D$	1	100		27918	27916	2	0.51	0.501
	2	98		28021	28009	12	1.16	1.158
	3	97		28161	28131	30	1.33	1.325
$(^2D)z\ ^3P$	0	100			30366			
	1	99			30351			1.498
	2	100			30348			1.499
$(^2D)z\ ^1F$	3	100		32350	31839	511	1.00	1.000
$(^2D)z\ ^1P$	1	99			32118			1.003

TABLE 13. *Observed and calculated levels of* Ti II-$3d^24p$

NAME	*J*	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O−C	OBS. *g*-FACTOR	CALC. *g*-FACTOR
$(^3F)z\ ^4G$	5/2	99		29544	29482	62	0.57:	0.576
	7/2	99		29734	29670	64	0.98:	0.984
	9/2	100		29968	29901	67		1.172
	11/2	100		30241	30174	67		1.273
$(^3F)z\ ^4F$	3/2	99		30837	30714	123	0.40:	0.405
	5/2	99		30959	30834	125	1.03:	1.028
	7/2	99		31114	30996	118	1.24:	1.238
	9/2	100		31301	31188	113		1.332
$(^3F)z\ ^2F$	5/2	$86+8(^1D)^2F$		31207	31406	−199	0.86:	0.861
	7/2	$90+8(^1D)^2F$		31491	31676	−185	1.14:	1.143
$(^3F)z\ ^2D$	3/2	$76+10(^3F)^4D+9(^3P)^2D$		31756	32141	−385	0.92	0.841
	5/2	$64+23(^3F)^4D+8(^3P)^2D$		32026	32393	−367	1.20	1.231
$(^3F)z\ ^4D$	1/2	98		32532	32598	−66	0.00	0.002
	3/2	$89+9(^3F)^2D$		32603	32665	−62	1.20	1.163
	5/2	$71+23(^3F)^2D$		32698	32781	−83	1.37	1.357
	7/2	95		32767	32848	−81	1.43:	1.425
$(^3F)z\ ^2G$	7/2	96		34543	34215	328	0.89:	0.887
	9/2	95		34748	34422	326	1.11:	1.114
$(^3P)z\ ^2S$	1/2	99		37431	37589	−158	2.09	1.996
$(^1D)z\ ^2P$	1/2	98		39675	39524	151	0.67:	0.673
	3/2	92		39603	39328	275	1.21	1.322
$(^1D)y\ ^2F$	5/2	$88+8(^3F)^2F$		39927	39479	448	0.86:	0.866
	7/2	90		40075	39596	479	1.14:	1.145
$(^3P)z\ ^4S$	3/2	$83+13(^1D)^2D$		40027	40058	−31		1.814
$(^1D)y\ ^2D$	3/2	$63+14(^3P)^4S+7(^1D)^2D$		39233	39878	−645	0.80:	1.019
	5/2	$74+12(^3P)^4D+7(^3P)^2D$		39477	40082	−605	1.20:	1.208
$(^3P)y\ ^4D$	1/2	97		40330	40165	165		0.008
	3/2	$90+7(^1D)^2D$		40426	40262	164		1.166
	5/2	$88+9(^1D)^2D$		40582	40410	172		1.348
	7/2	95		40798	40623	175		1.426
$(^3P)z\ ^4P$	1/2	100		41997	41964	33		2.663
	3/2	99		42069	42023	46		1.730
	5/2	99		42209	41172	37		1.596
$(^1G)y\ ^2G$	7/2	96		43741	43660	81	0.89:	0.886
	9/2	96		43781	43689	92	1.11:	1.108
$(^3P)x\ ^2D$	3/2	$80+12(^1D)^2D+6(^3F)^2D$		44915	44780	135	0.80:	0.803
	5/2	$81+11(^1D)^2D+6(^3F)^2D$		44902	44759	143	1.20:	1.201
$(^1G)z\ ^2H$	9/2	99		45674	45231	443		0.909
	11/2	100		45905	45463	442		1.091
$(^3P)y\ ^2P$	1/2	99		45473	45851	−378	0.66:	0.666
	3/2	98		45549	45932	−383	1.33:	1.329
$(^1G)x\ ^2F$	5/2	98		47625	48254	−629	0.86:	0.858
	7/2	98		47467	48075	−608	1.14:	1.142
$(^1S)^2P$	3/2	98			62345			0.666
	5/2	99			62639			1.332

TABLE 14. *Observed and calculated levels of* V II – $3d^34p$

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
$(^4F)z\ ^5G$	2	100		34593	34569	24	0.31	0.334
	3	100		34746	34735	11	0.93	0.917
	4	100		34947	34952	−5	1.14	1.150
	5	100		35193	35218	−25	1.16	1.267
	6	100		35483	35532	−49		1.333
$(^4F)z\ ^5F$	1	$71+26(^4F)^3D$		36489	36610	−121	0.35	0.166
	2	$79+16(^4F)^3D$		36674	36769	−95	1.08	1.046
	3	$92+5(^4F)^3D$		36919	36973	−54	1.24	1.262
	4	99		37151	37194	−43		1.349
	5	99		37352	37430	−78	1.40:	1.398
$(^4F)z\ ^3D$	1	$46+27(^4F)^5F+23(^4F)^5D$		36955	37081	−126	0.24	0.596
	2	$35+43(^4F)^5D+18(^4F)^5F$		37041	37174	−133	1.08	1.280
	3	$65+27(^4F)^5D$	$(a\ ^4F)z\ ^5D$	37521	37774	−253	1.47	1.379
$(^4F)z\ ^5D$	0	98		37201	37187	14		
	1	$74+20(^4F)^3D$		37259	37299	−40	1.39	1.239
	2	$52+41(^4F)^3D$		37369	37494	−125	1.39	1.338
	3	$69+22(^4F)^3D+7(^4F)^5F$	$(a\ ^4F)z\ ^3D$	37205	37356	−151	1.32	1.444
	4	97		37531	37630	−99	1.44	1.496
$(^4F)z\ ^3G$	3	$94+5(^2G)^3G$		39234	39002	232	0.84	0.753
	4	$93+5(^2G)^3G$		39404	39208	196	1.03	1.054
	5	$93+5(^2G)^3G$		39613	39467	146	1.19	1.203
$(^4F)z\ ^3F$	2	96		40002	40140	−138	0.65	0.667
	3	96		40196	40365	−169	1.02	1.081
	4	96		40430	40638	−208	1.22	1.252
$(^4P)z\ ^5P$	1	99		46755	46401	354	2.28	2.490
	2	98		46880	46526	354	1.65	1.820
	3	99		47052	46701	351	1.58	1.661
$(^4P)y\ ^5D$	0	$62+30(^4P)^3P$	$(a\ ^4P)z\ ^3P$	46586	46567	19		
	1	$69+27(^4P)^3P$		46690	46646	44	1.44	1.496
	2	$52+40(^4P)^3P$		46740	46750	−10	1.48	1.501
	3	98	$(a\ ^4P)y\ ^5D$	47181	47040	141	1.48:	1.498
	4	98		47420	47282	138	(2.28)	1.500
$(^4P)z\ ^3P$	0	$51+36(^4P)^5D+6(^2P)^1S$	$(a\ ^4P)y\ ^5D$	47028	47011	17		
	1	$62+29(^4P)^5D+6(A\ ^2D)^3P$		47108	47079	29	1.43	1.507
	2	$45+46(^4P)^5D$		47102	47040	62	1.47	1.506
$(^2G)z\ ^3H$	4	$89+11(^2H)^3H$		47056	46979	77	0.78	0.801
	5	$88+11(^2H)^3H$		47297	47228	69	1.01	1.032
	6	$89+11(^2H)^3H$		47608	47543	65	1.13	1.167
$(^2G)y\ ^3G$	3	$89+6(^4F)^3G$		48580	48644	−64	0.67	0.761
	4	$91+6(^4F)^3G$		48731	48792	−61	1.02	1.052
	5	$86+6(^4F)^3G+5(^2G)^1H$		48853	48920	−67	1.22	1.186
$(^2P)z\ ^1S$	0	$92+8(^4P)^3P$		48258	49030	−772		
$(^2G)z\ ^1G$	4	$55+38(^2G)^3F$	$(a\ ^2G)y\ ^3F$	49269	49384	−115	1.18	1.106
$(^2G)y\ ^3F$	2	$71+19(A\ ^2D)^3F+6(^2P)^1D$		49202	49410	−208	0.63	0.692
	3	$69+12(^2G)^1F+12(A\ ^2D)^3F$		49211	49445	−224	0.99	1.061
	4	$47+42(^2G)^1G+\ (A\ ^2D)^3F$	$(a\ ^2G)z\ ^1G$	49724	49768	−44	0.96	1.132
$(^2G)z\ ^1H$	5	$75+17(^2H)^1H+6(^2G)^3G$		49593	49547	46	0.95	1.011
$(^4P)z\ ^5S$	2	97		49731	49690	41		1.986
$(^2G)z\ ^1F$	3	$70+12(^2G)^3F+11(A\ ^2D)^1F$		49568	49920	−352	0.97	1.012
$(^2P)z\ ^1D$	2	$50+28(A\ ^2D)^1D+10(^2G)^3F$		49898	50249	−351	0.93	0.996

TABLE 14. *Observed and calculated levels of* V II—3d³4p—Continued

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm⁻¹)	CALC. LEVEL (cm⁻¹)	O−C	OBS. g-FACTOR	CALC. g-FACTOR
(²P)y ³P	0	71 + 28(A²D)³P		50662	50412	250		
	1	66 + 29(A²D)³P		50739	50504	235	1.39	1.492
	2	57 + 25(A²D)³P + 8(²P)³D		51123	50942	181	1.51	1.447
(²P)y ³D	1	72 + 21(⁴P)³D + 6(⁴F)³D		50474	50818	−344	0.49	0.511
	2	59 + 14(⁴P)³D + 7(²P)³P		50775	51136	−361	1.11	1.186
	3	67 + 23(⁴P)³D + 6(⁴F)³D		51086	51394	−308	1.27	1.324
(²H)y ³H	4	87+ 10(²G)³H		52083	51838	245	0.70	0.802
	5	88 + 11(²G)³H		52154	51914	240	0.98	1.032
	6	88 + 11(²G)³H		52253	52022	231	1.04:	1.164
(⁴P)x ³D	1	64 + 19(²P)³D + 7(A²D)³D		52604	52244	360	0.63	0.558
	2	62 + 18(²P)³D + 9(A²D)³F		52700	52200	500	1.10	1.110
	3	65 + 24(²P)³D		52767	52228	539	1.26	1.320
(²P)z ³S	1	89 + 7(⁴P)³S		52181	52417	−236	1.85	1.972
(A²D)x ³F	2	69 + 15(²G)³F + 7(⁴P)³D		52246	52279	−33	0.68	0.735
	3	77 + 15(²G)³F		52392	52428	−36	1.07	1.101
	4	85 + 14(²G)³F		52658	52577	81	1.18:	1.230
(A²D)z ¹P	1	67 + 22(²P)¹P + 6(⁴P)³D	(a²P)z ¹P	52804	52564	240	0.92	0.974
(²H)z ³I	5	99		52878	52524	354	0.84:	0.836
	6	99		53077	52726	351	0.98:	1.025
	7	100		53320	52976	344	1.11:	1.143
(A²D)w ³D	1	90		53751	53433	318	0.49:	0.522
	2	93		53869	53597	272	1.10	1.172
	3	93		53927	53726	201	1.37	1.326
(²H)y ¹G	4	84 + 13(²F)¹G		54144	54564	−420	1.00	1.002
(A²D)x ³P	0	63 + 26(²P)³P + 11(⁴P)³P		54813	54737	79		
	1	59 + 24(²P)³P + 12(⁴P)³P		54718	54634	84		1.504
	2	60 + 26(²P)³P + 12(⁴P)³P		54716	54598	118		1.498
(A²D)y ¹F	3	82 + 11(²G)¹F		55142	54752	390	0.94	1.006
(²H)z ¹I	6	99		55403	54902	501	1.01:	1.001
(²H)y ¹H	5	78 + 19(²G)¹H		55499	55204	295	1.03:	1.005
(²H)x ³G	3	93		55350	55756	−406	0.82	0.765
	4	93		55304	55779	−475	1.02	1.042
	5	92		55207	55702	−495	1.15	1.196
(⁴P)y ³S	1	56 + 23(²P)¹P + 7(²P)³S		55663	55860	−197	1.92	1.646
(²P)y ¹P	1	48 + 33(⁴P)³S + 16(A²D)¹P	(a ²D)y ¹P	56171	56180	−9	1.05:	1.329
(A²D)y ¹D	2	61 + 37(²P)¹D		57343	57107	236	0.98	1.002
(²F)w ³F	2	97		62085	62485	−400	0.58:	0.670
	3	96		62133	62495	−362	1.00	1.076
	4	96		62176	62520	−344	1.36:	1.248
(²F)w ³G	3	95		64057	63669	388	0.72:	0.751
	4	94		64131	63737	394	1.02	1.053
	5	97		64229	63820	409		1.200
(²F)x ¹D	2	84 + 14(B²D)¹D		64586	64881	−295	1.03:	0.999
(²F)v ³D	1	96		64931	65315	−384	0.46:	0.501
	2	95		64804	65181	−377	1.02:	1.162
	3	95		64604	64972	−368	1.22:	1.330
(²F)x ¹G	4	86 + 13(²H)¹G		65790	65568	222	0.94	1.002

TABLE 14. *Observed and calculated levels of* V II-$3d^34p$—Continued

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O−C	OBS. g-FACTOR	CALC. g-FACTOR
$(^2F)x\ ^1F$	3	96		66304	66922	−618	0.95	1.001
$(B^2D)^3D$	1	97			76394			0.503
	2	96			76395			1.166
	3	97			76426			1.331
$(B^2D)^1D$	2	$66+27(B^2D)^3F$			77554			0.916
$(B^2D)^3F$	2	$72+24(B^2D)^1D$			77776			0.755
	3	97			77732			1.085
	4	99			77815			1.250
$(B^2D)^3P$	0	100			79552			
	1	99			79451			1.497
	2	99			79246			1.498
$(B^2D)^1F$	3	98			79612			1.001
$(B^2D)^1P$	1	100			83501			1.000

TABLE 15. *Observed and calculated levels of* Cr II—$3d^44p$

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O−C	OBS. g-FACTOR	CALC. g-FACTOR
$(^5D)z\ ^6F$	1/2	100		46824	46697	127	−0.689	−0.665
	3/2	100		46906	46785	121	1.124	1.067
	5/2	100		47041	46930	111	1.314	1.314
	7/2	100		47228	47131	97	1.378	1.397
	9/2	100		47465	47384	81	1.416	1.434
	11/2	100		47752	47688	64		1.454
$(^5D)z\ ^6P$	3/2	38		48399	48190	209	2.382	2.388
	5/2	98		48491	48328	163	1.875	1.881
	7/2	100		48632	48529	103	1.710	1.714
$(^5D)z\ ^4P$	1/2	$67+31(^5D)^6D$		48750	48782	−32	2.844	2.874
	3/2	$55+42(^5D)^6D$		49006	49038	−32	1.802	1.799
	5/2	$71+27(^5D)^6D$	$(a\ ^5D)z\ ^6D$	49706	49798	−92	1.624	1.617
$(^5D)z\ ^6D$	1/2	$69+31(^5D)^4P$		49493	49470	23	3.155	3.124
	3/2	$58+41(^5D)^4P$		49565	49574	−9	1.824	1.811
	5/2	$73+26(^5D)^4P$	$(a\ ^5D)z\ ^4P$	49352	49371	−19	1.628	1.643
	7/2	99		49646	49649	−3	1.577	1.585
	9/2	98		49838	49881	−43	1.570	1.552
$(^5D)z\ ^4F$	3/2	97		51584	51365	219	0.406	0.402
	5/2	97		51670	51473	197	1.025	1.031
	7/2	96		51789	51627	162	1.248	1.241
	9/2	96		51943	51828	115	1.338	1.337
$(^5D)z\ ^4D$	1/2	98		54418	54541	−123	0.007	0.001
	3/2	98		54500	54641	−141	1.178	1.200
	5/2	98		54626	54796	−170	1.376	1.371
	7/2	98		54785	54991	−206	1.430	1.428
$(^3H)z\ ^4H$	7/2	$82+16(^3G)^4H$		63601	63787	−186	0.680	0.671
	9/2	$80+16(^3G)^4H$		63707	63900	−193	1.030	0.966
	11/2	$80+15(^3G)^4H$		63849	64062	−213	1.138	1.127
	13/2	$83+13(^3G)^4H$		64031	64277	−246	1.234	1.226
$(A^3P)y\ ^4D$	1/2	$87+7(A^3F)^4D$		63802	63692	110	0.000	0.022
	3/2	$86+8(A^3F)^4D$		64062	63970	92	1.199	1.202
	5/2	$85+10(A^3F)^4D$		64449	64390	59	1.380	1.371
	7/2	$80+14(A^3F)^4D$		64924	64920	4	1.411	1.427

TABLE 15. *Observed and calculated levels of* Cr II – 3d⁴4p – Continued

NAME	*J*	PERCENTAGE	AEL	OBS. LEVEL (cm⁻¹)	CALC. LEVEL (cm⁻¹)	O–C	OBS. *g*-FACTOR	CALC. *g*-FACTOR
$(^3H)z\ ^4I$	9/2	96		65218	64938	280		0.738
	11/2	95		65420	65151	269		0.973
	13/2	96		65618	65363	255		1.112
	15/2	100		65813	65566	247		1.200
$(A^3P)z\ ^2S$	1/2	$73+7(A^3P)^4P$		65030	65316	−286		2.010
$(A^3F)z\ ^4G$	5/2	$79+14(^3G)^4G$	$(a\ ^3H)z^4G$	66157	65233	−76	0.593	0.574
	7/2	$70+12(^3G)^4G+9(A^3F)^2G$		65257	65371	−114	0.920	0.975
	9/2	$59+10(^3G)^4G+8(A^3F)^2G$		65384	65534	−150	1.120	1.157
	11/2	$73+13(^3G)^4G$		65710	65814	−104	1.265	1.269
$(^3H)z\ ^2G$	7/2	$49+33(A^3F)^2G+7(^3G)^2G$		65543	65804	−261		0.898
	9/2	$41+31(A^3F)^2G+17(A^3F)^4G$		65680	65922	−242		1.121
$(A^3P)y\ ^4P$	1/2	$76+13(A^3P)^2S$		66257	66208	49	2.545	2.413
	3/2	90		66355	66255	100	1.671	1.723
	5/2	92		66727	66746	−19	1.502	1.582
$(A^3P)z\ ^2P$	1/2	$79+14(A^3P)^2S$		66872	67104	−232		0.880
	3/2	$53+15(A^3F)^2D+10(A^3P)^2D$	$(a\ ^3P)z\ ^2D$	66650	66988	−338		1.158
$(A^3F)y\ ^4F$	3/2	$51+21(A^3P)^2P+14(A^3F)^2D$	$(a\ ^3P)z\ ^2P$	67070	67130	−60		0.783
	5/2	$71+13(A^3F)^2D$	$(a\ ^3P)z\ ^2D$	67012	67170	−158		1.036
	7/2	$76+10(^3H)^4G$		67394	67272	122		1.188
	9/2	$63+18(^3H)^4G$		67449	67329	120		1.277
$(^3H)z\ ^2I$	11/2	93		67506	67303	203		0.933
	13/2	95		67589	67443	146		1.079
$(A^3F)z\ ^2D$	3/2	$28+32(A^3F)^4F+16(A^3P)^2D$	$(a^3F)y\ ^4F$	67380	67483	−103		0.848
	5/2	$50+18(A^3F)^4F+13(A^3F)^2D$		67387	67399	−12		1.171
$(^3H)y\ ^4G$	5/2	$66+13(A^3F)^4G+12(^3G)^4G$	$(a\ ^3F)y\ ^4G$	67344	67572	−228		0.609
	7/2	$60+18(A^3F)^4F+11(A^3F)^4G$		67334	67445	−111		1.033
	9/2	$51+32(A^3F)^4F+9(A^3F)^4G$		67354	67483	−129		1.223
	11/2	$65+22(A^3F)^4G+10(^3G)^4G$		67369	67442	−73		1.264
$(A^3P)z\ ^4S$	3/2	$70+17(A^3P)^2P$		68306	67813	493	1.978	1.748
$(A^3F)x\ ^4D$	1/2	$88+11(A^3P)^4D$		67860	68104	−244		0.007
	3/2	$84+12(A^3P)^4D$		67870	68124	−254		1.190
	5/2	$77+13(A^3P)^4D$		67868	68125	−257		1.339
	7/2	$69+19(A^3P)^4D$		67876	68142	−266		1.397
$(^3H)z\ ^2H$	9/2	$81+12(A^1G)^2H$		68477	68547	−70		0.913
	11/2	$84+10(A^1G)^2H$		68738	68856	−118		1.094
$(^3G)y\ ^4H$	7/2	$83+16(^3H)^4H$		68844	68712	132		0.671
	9/2	$82+14(^3H)^4H$		68993	68886	107		0.971
	11/2	$82+13(^3H)^4H$		69171	69077	94		1.131
	13/2	$85+13(^3H)^4H$		69388	69296	92		1.228
$(A^3F)z\ ^2F$	5/2	$50+21(^3G)^2F+13(^3D)^2F$		68583	68751	−168		0.898
	7/2	$59+18(^3G)^2F+11(^3D)^2F$		68760	68932	−172		1.155
$(A^3P)y\ ^2D$	3/2	$65+28(A^3F)^2D$	$(a\ ^3G)x\ ^4F$	69348	68940	408		0.795
	5/2	$66+20(A^3F)^2D$	$(a\ ^3F)y\ ^2D$	69954	69484	470		1.170
$(^3G)x\ ^4F$	3/2	$81+13(^3D)^4F$	$(a\ ^3F)y\ ^2D$	69639	69892	−253		0.418
	5/2	$71+11(^3D)^4F$	$(a\ ^3G)x\ ^4F$	69478	69885	−407		0.998
	7/2	$60+11(A^3F)^2G+9(^3D)^4F$		69506	69854	−348		1.157
	9/2	$60+13(A^3F)^2G+9(^3D)^4F$		69498	69837	−339		1.266
$(A^3F)y\ ^2G$	7/2	$42+25(^3H)^2G+11(^3G)4F$		69903	70044	−141		0.951
	9/2	$37+25(^3H)^2G+15(^3G)^4F$		70108	70277	−169		1.148
$(^3G)y\ ^2H$	9/2	$57+19(^3G)^4G+7(^3H)^4G$		70394	70436	−42		1.000
	11/2	$47+34(^3G)^4G+10(^3H)^4G$		70399	70483	−84		1.171

TABLE 15. *Observed and calculated levels of* Cr II – 3d⁴4p – Continued

NAME	*J*	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. *g*-FACTOR	CALC. *g*-FACTOR
(^{3}G)*x* ^{4}G	5/2	60 + 17(^{3}H)^{4}G + 11(^{3}G)^{2}F		70317	70396	−79		0.636
	7/2	61 + 19(^{3}H)^{4}G + 10(^{3}G)^{4}F		70427	70540	−113		1.016
	9/2	44 + 22(^{3}G)^{2}H + 13(^{3}H)^{4}G		70679	70753	−74		1.109
	11/2	41 + 38(^{3}G)^{2}H + 11(^{3}H)^{4}G		70880	70949	−69		1.191
(^{3}G)*y* ^{2}F	5/2	45 + 32(A^{3}F)^{2}F + 5(^{3}G)^{4}G		70585	70605	−20		0.844
	7/2	59 + 20(A^{3}F)^{2}F		70852	70932	−80		1.140
(^{3}G)*x* ^{2}G	7/2	79 + 11(^{3}H)^{2}G		72649	72768	−119		0.894
	9/2	75 + 13(^{3}H)^{2}G + 9(A^{1}G)^{2}G		72717	72862	−145		1.111
(^{3}D)*w* ^{4}D	1/2	96		73407	73701	−294		0.023
	3/2	91		73412	73697	−285		1.173
	5/2	87		73436	73711	−275		1.352
	7/2	89		73486	73760	−274		1.412
(A^{1}G)*x* ^{2}H	9/2	82 + 11(^{3}H)^{2}H	(*a* ^{1}I)*x* ^{2}H	74456	74094	362		0.912
	11/2	72 + 11(^{1}I)^{2}I + 10(^{3}H)^{2}H		74707	74342	365		1.071
(^{1}I)*y* ^{2}I	11/2	85 + 12(A^{1}G)^{2}H		74422	74206	216		0.945
	13/2	64 + 35(^{1}I)^{2}K	(*a* ^{1}I)*z* ^{2}K	74743	74438	305		1.027
(^{3}D)*w* ^{4}F	3/2	82 + 13(^{3}G)^{4}F		74273	74244	29		0.442
	5/2	48 + 40(^{3}D)^{4}P		74319	74281	38		1.271
	7/2	89 + 6(^{3}D)^{4}F		74424	74341	83		1.412
	9/2	86 + 13(^{3}G)^{4}F		74505	74428	77		1.333
(^{1}I)*z* ^{2}K	13/2	65 + 33(^{1}I)^{2}I	(*a* ^{1}I)*y* ^{2}I	74424	74156	268		0.983
	15/2	100		74959	74556	403		1.067
(A^{1}G)*x* ^{2}F	5/2	77 + 7(^{3}D)^{2}F	(*a*^{3}D)*x* ^{2}F	74436	74594	−158		0.859
	7/2	64 + 19(^{3}D)^{4}F		74114	74322	−208		1.162
(^{3}D)*x* ^{4}P	1/2	96		74921	74725	196		2.644
	3/2	93		74718	74571	147		1.716
	5/2	53 + 30(^{3}D)^{4}F + 9(^{3}D)^{4}D		74484	74338	146		1.373
(^{3}D)*y* ^{2}P	1/2	55 + 40(A^{1}S)^{2}P		74854	74881	−27		0.667
	3/2	61 + 33(A^{1}S)^{2}P		74985	74983	2		1.335
(A^{1}G)*w* ^{2}G	7/2	82 + 8(^{3}G)^{2}G		75717	75768	−51		0.893
	9/2	80 + 12(^{3}G)^{2}G		75810	75889	−79		1.111
(^{3}D)*w* ^{2}F	5/2	72 + 13(A^{1}G)^{2}F + 8(^{3}G)^{2}F	(*a* ^{1}G)*w* ^{2}F	76988	77136	−148		0.858
	7/2	73 + 12(A^{1}G)^{2}F + 7(^{3}G)^{2}F		76879	77009	−130		1.142
(^{1}I)*w* ^{2}H	9/2	90 + 8(^{3}G)^{2}H	(*a* ^{1}G)*w* ^{2}H	77270	77490	−220		0.910
	11/2	88 + 8(^{3}G)^{2}H		77079	77281	−202		1.090
(A^{1}S)*x* ^{2}P	1/2	48 + 32(^{3}D)^{2}P + 15(A^{1}D)^{2}P		77778	77769	9		0.667
	3/2	31 + 26(^{3}D)^{2}D + 12(^{3}D)^{2}P		77714	77732	−18		1.111
(^{3}D)*x* ^{2}D	3/2	48 + 22(A^{1}S)^{2}P + 10(^{3}D)^{2}P		78110	78094	16		1.013
	5/2	65 + 26(A^{1}D)^{2}D		77935	77972	−37		1.200
(A^{1}D)*w* ^{2}D	3/2	74 + 13(^{3}D)^{2}D		80288	79940	348		0.813
	5/2	65 + 21(^{3}D)^{2}D		80420	80113	307		1.189
(A^{1}D)*v* ^{2}F	5/2	86		81233	80772	461		0.869
	7/2	89		81432	80981	451		1.143
(A^{1}D)*w* ^{2}P	1/2	89 + 9(^{3}D)^{2}P		82854	82749	105		0.668
	3/2	78 + 11(^{3}D)^{2}P		82920	82838	82		1.332
(^{1}F)*u* ^{2}F	5/2	89		84605	84264	341		0.859
	7/2	87		84677	84332	345		1.139
(^{1}F)*v* ^{2}G	7/2	95		85573	85372	201		0.893
	9/2	97		85940	85702	238		1.112

TABLE 15. *Observed and calculated levels of* Cr II – $3d^44p$ – Continued

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm⁻¹)	CALC. LEVEL (cm⁻¹)	O–C	OBS. g-FACTOR	CALC. g-FACTOR
$(^1F)v\ ^2D$	3/2	$79+12(B^3P)^2D$		86511	87233	−722		0.800
	5/2	$75+13(B^3P)^2D+9(B^3F)^2D$		86507	86774	−267		1.189
$(B^3F)^4F$	3/2	97			89391			0.419
	5/2	93			89405			1.054
	7/2	95			89422			1.243
	9/2	98			89456			1.331
$(B^3P)^4P$	1/2	95			89869			2.594
	3/2	$88+6(B^3P)^4D$			89725			1.688
	5/2	$82+7(B^3P)^4D$			89706			1.547
$(B^3P)^4D$	1/2	$70+26(B^3F)^4D$			90491			0.070
	3/2	$61+24(B^3F)^4D$			90408			1.204
	5/2	$51+20(B^3F)^4D$			90288			1.368
	7/2	$69+26(B^3F)^4D$			90160			1.419
$(B^3F)^4G$	5/2	94			90702			0.591
	7/2	95	$(b\ ^3F)u\ ^2G$	90986	90792	194		0.991
	9/2	98	$(b\ ^3F)u\ ^2G$	91103	90880	223		1.172
	11/2	99			90950			1.273
$(B^3P)^2D$	3/2	$53+21(B^3F)^2D+17(^1F)^2D$		91557	91280	277		0.829
	5/2	$50+18(^1F)^2D+15(B^3F)^2D$		91426	91119	307		1.220
$(B^3F)^2F$	5/2	$85+5(B^3F)^4G$			91473			0.847
	7/2	$87+5(B^1G)^2F$			91395			1.141
$(B^3P)^4S$	3/2	97			92759			1.993
$(B^3F)^2G$	7/2	98			93805			0.989
	9/2	98			93611			1.111
$(B^3F)^4D$	1/2	$72+27(B^3P)^4D$			93975			0.004
	3/2	$72+27(B^3P)^4D$			93929			1.200
	5/2	$72+27(B^3P)^4D$			93828			1.370
	7/2	$73+27(B^3P)^4D$			93650			1.427
$(B^3P)^2P$	1/2	92			94788			0.696
	3/2	94			94530			1.333
$(B^3P)^2S$	1/2	98			96187			1.969
$(B^1G)^2H$	9/2	$86+12(B^1G)^2G$			97179			0.935
	11/2	98			97523			1.091
$(B^1G)^2G$	7/2	97			97589			0.892
	9/2	$86+12(B^1G)^2H$			97744			1.086
$(B^3F)^2D$	3/2	$70+29(B^3P)^2D$			98249			0.801
	5/2	$71+29(B^3P)^2D$			98110			1.192
$(B^1G)^2F$	5/2	$86+6(B^3F)^2F$			99314			0.865
	7/2	$87+8(B^3F)^2F$			99110			1.141
$(B^1D)^2P$	1/2	96			111658			0.667
	3/2	95			111442			1.332
$(B^1D)^2F$	5/2	95			112845			0.859
	7/2	96			113144			1.143
$(B^1D)^2D$	3/2	99			115404			0.802
	5/2	99			115535			1.199
$(B^1S)^2P$	1/2	97			131229			0.667
	3/2	97			131613			1.333

TABLE 16. *Observed and calculated levels of* Mn II – $3d^54p$

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
$(^6S)z\ ^7P$	2	100		38366	38071	295	2.32	2.332
	3	100		38543	38221	322	1.94?	1.916
	4	100		38807	38443	364	1.76	1.750
$(^6S)z\ ^5P$	1	99		43557	43340	217	2.49	2.499
	2	98		43484	43262	222	1.83	1.834
	3	98		43370	43143	227	1.67	1.667
$(^4G)z\ ^5G$	2	97		64456	64579	−123	1.31	0.338
	3	93		64473	64598	−125	1.26	0.900
	4	$91+7(^4G)^5H$		64494	64620	−126		1.133
	5	$90+8(^4G)^5H$		64519	64657	−138		1.253
	6	$92+6(^4G)^5H$		64550	64699	−149		1.325
$(^4G)z\ ^5H$	3	95		65483	65163	320	1.30	0.519
	4	$92+7(^4G)^5G$		65566	65254	312	1.21	0.918
	5	$92+8(^4G)^5G$		65658	65351	307		1.113
	6	$94+6(^4G)^5G$		65754	65444	310		1.221
	7	100		65847	65522	325		1.286
$(^4P)z\ ^5D$	0	$83+16(^4D)^5D$		66625	66666	−41		
	1	$73+14(^4D)^5D+9(^4G)^5F$	$(a\ ^4G)z\ ^5F$	66645	66671	−26		1.335
	2	$54+26(^4G)^5F+10(^4D)^5D$		66677	66692	−15		1.336
	3	$52+35(^4G)^5F+9(^4D)^5D$	$(a\ ^4P)z\ ^5D$	67009	67080	−71	1.45	1.414
	4	$78+11(^4D)^5D+9(^4G)^5F$		67295	67305	−10	1.49	1.485
$(^4G)z\ ^5F$	1	$82+9(^4P)^5D+5(^4D)^5F$	$(a\ ^4P)z\ ^5D$	65894	66989	−95		0.164
	2	$64+26(^4P)^5D$		66901	67013	−112		1.168
	3	$56+27(^4P)^5D+7(^4D)^5F$	$(a\ ^4G)z\ ^5F$	66686	66733	−47		1.333
	4	$83+6(^4D)^5F+6(^4P)^5D$		66643	66755	−112		1.358
	5	93		66542	66702	−160	1.40	1.399
$(^4P)z\ ^5S$	2	95		66929	67048	−119		1.974
$(^4G)z\ ^3H$	4	98		67910	67778	132	0.78	0.801
	5	98		67846	67739	107	1.03	1.034
	6	97		67744	67662	82	1.16	1.168
$(^4G)z\ ^3F$	2	92		67767	67960	−193	0.66	0.670
	3	92		67812	68014	−202	1.08	1.086
	4	93		67866	68079	−213	1.25	1.251
$(^4P)y\ ^5P$	1	$83+8(^4D)^5P+5(^4P)^3P$		68496	68521	−25		2.422
	2	$74+12(^4D)^5P+7(^4P)^3P$		68417	68402	15		1.792
	3	$74+20(^4D)^5P$		68284	68233	51	1.65	1.656
$(^4P)z\ ^3P$	0	$80+15(^4D)^3P$		69319	69396	−77		
	1	$74+15(^4D)^3P+6(^4P)^5P$		69216	69269	−53	1.49	1.554
	2	$68+16(^4D)^3P+9(^4P)^5P$		69045	69061	−16	1.49	1.536
$(^4D)y\ ^5F$	1	$86+8(^4G)^5F$		70150	70143	7		0.029
	2	$85+7(^4G)^5F$		70231	70224	7		1.014
	3	$84+6(^4G)^5F$		70343	70334	9		1.258
	4	$90+6(^4G)^5F$		70497	70480	17	1.39?	1.352
	5	$91+5(^4G)^5F$		70657	70565	92	1.40	1.396
$(^4G)z\ ^3G$	3	96		70518	70531	−13	0.75	0.751
	4	96		70546	70571	−25	1.15?	1.051
	5	95		70527	70608	−81	1.20	1.204
$(^4P)z\ ^3D$	1	89		71078	71142	−64	0.50	0.513
	2	$83+5(^4D)^5D$		70940	71006	−66	1.16	1.169
	3	$79+5(^4D)^5F$		70745	70818	−73	1.33	1.332
$(^4D)x\ ^5P$	1	$60+26(^4D)^5D+6(^4P)^5D$		71264	71695	−431		2.146
	2	$46+33(^4D)^5D+11(^4P)^5P$		71323	71649	−326		1.686
	3	$52+21(^4D)^5D+18(^4P)^5P$		71390	71566	−176		1.608

TABLE 16. *Observed and calculated levels of* Mn II – 3d^{5}4p – Continued

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
(^{4}D)y ^{5}D	0	81 + 16(^{4}P)^{5}D		72322	71915	407		
	1	52 + 29(^{4}D)^{5}P + 10(^{4}P)^{5}D		72321	71984	337		1.821
	2	44 + 37(^{4}D)^{5}P + 9(^{4}P)^{5}D		72307	72106	201		1.624
	3	57 + 23(^{4}D)^{5}P + 11(^{4}P)^{5}D		72247	72194	53		1.532
	4	84 + 13(^{4}P)^{5}D		72011	71530	481	1.48	1.496
(^{4}D)y ^{3}D	1	89 + 5(^{4}F)^{3}D		73385	73219	166		0.511
	2	87 + 5(^{4}F)^{3}D		73396	73206	190		1.174
	3	31 + 5(^{4}F)^{3}D		73395	73165	230		1.340
(^{4}D)y ^{3}F	2	91		73785	73789	−4	0.75	0.681
	3	88		73781	73793	−12	1.09	1.099
	4	92		73683	73687	−4	1.24	1.253
(^{4}P)z ^{3}S	1	96		73911	73842	69		1.985
(^{4}D)y ^{3}P	0	81 + 16(^{4}P)^{3}P		75563	75865	−302		
	1	78 + 16(^{4}P)^{3}P		75720	76039	−319		1.512
	2	77 + 19(^{4}P)^{3}P		75919	76256	−337		1.499
(^{2}I)z ^{3}K	6	91 + 8(^{2}I)^{3}I	z ^{3}K	77842	77627	215	0.909	0.872
	7	91 + 5(^{2}I)^{3}I		77946	77837	109	1.050	1.024
	8	100		77820	78083	−263	1.14	1.125
(^{2}I)z ^{3}I	5	90 + 5(^{2}I)^{1}H	z ^{3}I	78085	78182	−97	0.83	0.846
	6	88 + 8(^{2}I)^{3}K		78341	78369	−28	1.014	1.012
	7	81 + 8(^{2}I)^{1}K + 7(^{2}I)^{3}K		78475	78323	152	1.13	1.122
(^{2}I)z ^{1}K	7	88 + 11(^{2}I)^{3}I	z ^{1}K	79147	79029	118	1.003	1.015
(^{2}I)z ^{1}H	5	78 + 6(^{2}I)^{3}I + 6(A^{2}G)^{1}H	z ^{1}H	79113	79452	−339	1.011	0.992
(A^{2}D)z ^{1}D	2	44 + 24(A^{2}F)^{1}D + 18(A^{2}D)^{3}F	z ^{1}D	78913	79541	−628	0.938	0.923
(A^{2}D)x ^{3}F	2	44 + 29(A^{2}F)^{3}F + 14(A^{2}D)^{1}D	x ^{3}F	79458	79207	251	0.734	0.760
	3	60 + 34(A^{2}F)^{3}F		79513	79573	−60	1.075	1.067
	4	66 + 30(A^{2}F)^{3}F		79913	79925	−12	1.24	1.230
(^{2}I)y ^{3}H	4	92	y ^{3}H	79801	80080	−279	0.81	0.809
	5	90		79740	80048	−308	1.03	1.032
	6	94		79592	79920	−328	1.16	1.164
(A^{2}F)z ^{1}G	4	53 + 24(A^{2}F)^{3}G + 8(^{2}H)^{1}G	z ^{1}G	81280	81144	136	1.010	1.027
(A^{2}D)z ^{1}F	3	45 + 35(A^{2}F)^{3}G + 10(A^{2}F)^{3}F	z ^{1}F	81221	81239	−18	0.92	0.919
(A^{2}D)x ^{3}P	0	92 + 4(^{4}F)^{5}D	x ^{3}P	81713	81549	164		
	1	74 + 12(A^{2}D)^{3}D + 6(A^{2}F)^{3}D		81322	81252	70		1.291
	2	77 + 12(A^{2}F)^{3}D		81148	81039	109	1.372	1.422
(A^{2}D)x ^{3}D	1	69 + 15(A^{2}D)^{3}P + 8(^{4}F)^{5}F		81732	81706	26	0.44	0.619
	2	45 + 44(^{4}F)^{5}G		81813	81746	67	0.90	0.781
	3	58 + 11 (^{4}F)^{5}G + 6(A^{2}D)^{3}F	x ^{5}F	81052	81032	20	1.24	1.208
(^{4}F)y ^{5}G	2	43 + 33(A^{2}D)^{3}D + 11(A^{2}F)^{3}F	x ^{5}F	81054	81030	23		0.728
	3	73 + 13(A^{2}F)^{3}G + 11(A^{2}D)^{3}D	y ^{5}G	81781	81607	174	0.92	0.945
	4	55 + 19(A^{2}F)^{3}G + 11(A^{2}F)^{1}G		81863	81703	160	1.20	1.116
	5	71 + 26(A^{2}F)^{3}G		82117	81896	221	1.28	1.248
	6	96		82142	81846	296	1.36	1.328
(^{2}I)z^{1}I	6	94	z ^{1}I	81803	81877	−74	1.00	1.005
(A^{2}F)y ^{3}G	3	48 + 25(A ^{2}D)^{1}F + 6(^{4}F)^{5}G	y ^{3}G	82388	82416	−28	0.906	0.923
	4	36 + 34(^{4}F)^{5}G + 28(A^{2}F)^{3}F	x ^{5}F	81994	81909	85	1.25	1.145
	5	68 + 24(^{4}F)^{5}G	y ^{3}G	81886	81652	234		1.218
(^{4}F)x ^{5}F	1	82 + 8(A^{2}D)^{3}D			82501			0.111
	2	77 + 7(^{4}F)^{5}D + 6(A^{2}F)^{3}F	y ^{5}G	82193	82432	−239		1.008
	3	74 + 10(^{4}F)^{5}D + 8(A^{2}F)^{3}D	x ^{3}D	81660	82002	−342	1.32	1.264
	4	83 + 9(^{4}F)^{5}D	y ^{3}G	82100	82353	−253		1.351
	5	91	x ^{5}F	82232	82402	−170	1.296	1.389

TABLE 16. *Observed and calculated levels of* Mn II – 3d^{5}4p – Continued

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
$(A^2F)w\,^3D$	1	$56+35(A^2D)^1P$	$w\,^3D$	82939	82655	284	0.51	0.698
	2	$80+6(^4F)^5D+6(A^2D)^3P$		83071	82813	258	1.21	1.203
	3	$57+21(A^2F)^3F+9(^4F)^5F$		82419	82417	2	1.336	1.237
$(A^2F)w\,^3F$	2	$46+16(A^2D)^3F+8(^4F)^5G$	$w\,^3F$	82918	82974	−56	0.70	0.726
	3	$36+35(A^2F)^3D+14(A^2D)^3D$		82936	82759	177	1.12	1.203
	4	$33+23(A^2D)^3F+11(A^2F)^3G$		82831	82730	101	1.22	1.185
$(^4F)x\,^5D$	0	$94+4(A^2D)^3P$	$x\,^5D$	82839	83408	−568		
	1	$91+4(A^2D)^3P$		82775	83395	−620		1.447
	2	$82+5(A^2F)^3D+5(^4F)^5F$		82735	83400	−665		1.448
	3	$85+8(^4F)^5F$		82713	83311	−598	1.46	1.649
	4	$86+9(^4F)^5F$		82605	83196	−591	1.47	1.481
$(^4F)x\,^3G$	3	$69+17(^2H)^3G+9(A^2F)^3G$	$x\,^3G$	83934	84138	−204	0.76	0.758
	4	$46+16(^2H)^3H+16(A^2G)^3H$		83875	84225	−350	1.02	0.975
	5	$40+21(A^2G)^3H+20(^2H)^3H$		83912	84128	−216	1.20	1.122
$(A^2D)z\,^1P$	1	$58+30(A^2F)^3D$	$z\,^1P$	84268	84254	14	0.96	0.829
$(A^2G)x\,^3H$	4	$31+31(^2H)^3H+23(^4F)^3G$	$x\,^3H$	84307	84056	251	0.81	0.892
	5	$32+31(^4F)^3G+23(^2H)^3H$		84428	84311	117	1.103	1.108
	6	$46+45(^2H)^3H+7(^2H)^3I$		84644	84558	86	1.15	1.155
$(^2H)y\,^3I$	5	$89+5(^2H)^3H$	$y\,^3I$	85448	85179	269	0.82	0.851
	6	$89+5(^2H)^3H$		85636	85373	263	1.05	1.033
	7	97		85811	85564	247	1.12	1.142
$(A^2F)y\,^1D$	2	$64+32(A^2D)^1D$	$y\,^1D$	85368	85497	−129	1.03	0.994
$(^2H)w\,^3G$	3	$18+35(A^2G)^3G+22(A^2F)^1F$	$w\,^3G$	85735	85634	101	0.75	0.843
	4	$32+44(A^2G)^3G+10(^4F)^3G$		85674	85531	143	1.051	1.050
	5	$34+40(A^2G)^3G+11(^4F)^3G$		85543	85423	120	1.19	1.193
$(A^2G)y\,^1G$	4	$37+19(^2H)^1G+16(A^2F)^1G$	$v\,^3F$	85759	85744	15	1.15	1.055
$(A^2F)y\,^1F$	3	$51+14(A^2G)^3G+13(^2H)^3G$	$y\,^1F$	86062	85999	63		0.924
$(^4F)v\,^3F$	2	$43+24(A^2G)^3F+22(^4F)^3D$	$v\,^3F$	85989	86148	−159	0.77	0.801
	3	$40+24(^4F)^3D+23(A^2G)^3F$		85953	86105	−152	1.06	1.150
	4	$49+17(A^2G)^3F+12(A^2G)^1G$	$y\,^1G$	86449	86475	−26	1.092	1.186
$(^4F)v\,^3D$	1	$85+8(A^2F)^3D$	$v\,^3D$	86208	86345	−137	0.58	0.512
	2	$62+18(^4F)^3F+6(A^2G)^3F$		86190	86391	−201		1.034
	3	$57+20(^4F)^3F+10(A^2G)^3F$		86303	86448	−145	1.15	1.252
$(^2H)y^1I$	6	$90+5(^2H)^3H$	$y\,^1I$	86869	86658	211	1.02	1.010
$(^2H)w\,^3H$	4	$49+45(A^2G)^3H$	$w\,^3H$	87941	87745	196	0.82	0.813
	5	$44+47(A^2G)^3H$		87996	87775	221	1.03	1.042
	6	$43+49(A^2G)^3H+5(^2H)^1I$		88198	87997	201	1.16	1.157
$(A^2G)u\,^3F$	2	$51+26(^4F)^3F+17(A^2F)^3F$	$(w\,^3F)$	87859	88012	−153		0.673
	3	$51+25(^4F)^3F+16(A^2F)^3F$		87718	87876	−158	1.06	1.076
	4	$55+21(^4F)^3F+15(A^2F)^3F$		87580	87727	−147	1.23	1.240
$(A^2G)v\,^3G$	3	$43+21(A^2F)^3G+17(^4F)^3G$	$v\,^3G$	89126	88835	291	0.78	0.767
	4	$45+18(A^2F)^3G+13(^2H)^3G$		89097	88850	247	1.08	1.050
	5	$40+20(A^2F)^3G+14(^2H)^3G$	$y\,^1H$	88772	88644	128		1.174
$(A^2G)y\,^1H$	5	$66+24(^2H)^1H$	$v\,^3G$	89063	89022	41	1.14	1.009
$(^2H)x\,^1H$	5	$60+24(A^2G)^1H+11(^2I)^1H$	$x\,^1H$	89760	89366	394	1.02	1.010
$(B^2F)x\,^1G$	4	$48+19(A^2G)^1G+15(^2H)^1G$	$x\,^1G$	89465	89533	−68		1.013
$(B^2F)t\,^3F$	2	$75+13(A^2G)^3F+5(A^2F)^1D$	$t\,^3F$	89519?	89400	119		0.692
	3	$76+8(A^2G)^3F+7(A^2G)^1F$		89571	89498	73	1.14	1.072
	4	$77+8(A^2G)^3F+7(^4F)^3F$		89800	89675	125		1.234

TABLE 16. *Observed and Calculated Levels of* Mn II – 3d^{5}4p – Continued

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
(A^{2}G)x ^{1}F	3	76 + 6(A^{2}F)^{3}F	x ^{1}F	89950	90108	−158		1.002
(B^{2}F)x ^{1}D	2	85 + 7(B^{2}F)^{3}F	x ^{1}D	90597	90356	241	1.02	0.980
(B^{2}F)u ^{3}G	3	59 + 33(^{2}H)^{3}G	u ^{3}G	91018	90906	112	0.71	0.762
	4	62 + 30(^{2}H)^{3}G		91179	91077	102		1.055
	5	66 + 29(^{2}H)^{3}G		91302	91280	22	1.24	1.200
(B^{2}F)u ^{3}D	1	93 + 4(^{4}F)^{3}D	u ^{3}D	92061	92026	35		0.506
	2	91 + 5(^{4}F)^{3}D		92040	92117	−77	1.17	1.167
	3	83 + 8(^{4}F)^{3}D + 6(B^{2}F)^{3}D		92083	92229	−146		1.331
(^{2}H)w ^{1}G	4	37 + 41(B^{2}F)^{1}G + 20(B^{2}G)^{1}G	w ^{1}G	92517	92410	107	1.01	1.055
(^{2}S)w ^{3}P	0	89 + 9(B^{2}D)^{3}P	(v ^{3}P)	93720	93546	174		
	1	88 + 9(B^{2}D)^{3}P		93868	93676	192		1.491
	2	88 + 10(B^{2}D)^{3}P		94231	93975	256		1.498
(B^{2}F)w ^{1}F	3	95	w ^{1}F	94182	93907	275	1.00	1.002
(^{2}S)y ^{1}P	1	84 + 13(B^{2}D)^{1}P	y ^{1}P	95081	95585	−504		1.004
(B^{2}D)^{3}F	2	86 + 10(B^{2}D)^{3}D			100195			0.716
	3	79 + 16(B^{2}D)^{3}D			100330			1.121
	4	95			100574			1.249
(B^{2}D)^{3}D	1	96			100430			0.513
	2	87 + 9(B^{2}D)^{3}F			100511			1.125
	3	81 + 17(B^{2}D)^{3}F			100651			1.289
(B^{2}D)v ^{1}F	3	88 + 7(B^{2}G)^{1}F	(u ^{1}F)	101588	101350	238	1.04	1.005
(B^{2}D)^{3}P	0	90 + 9(^{2}S)^{3}P			101931			
	1	87 + 10(^{2}S)^{3}P			101927			1.477
	2	86 + 10(^{2}S)^{3}P			101934			1.490
(B^{2}D)^{1}P	1	85 + 10(^{2}S)^{1}P			102651			1.009
(B^{2}D)w ^{1}D	2	94	w ^{1}D	103600	103153	447		1.001
(B^{2}G)^{3}H	4	96			106755			0.803
	5	95			106873			1.038
	6	99			107058			1.167
(B^{2}G)^{3}G	3	81 + 17(B^{2}G)^{3}F			107675			0.811
	4	65 + 32(B^{2}G)^{3}F			107927			1.117
	5	94			107940			1.191
(B^{2}G)^{3}F	2	96			108080			0.667
	3	79 + 18(B^{2}G)^{3}G			107995			1.023
	4	63 + 33(B^{2}G)^{3}G			107637			1.181
(B^{2}G)^{1}H	5	96			108854			1.005
(B^{2}G)v^{1}G	4	96	v ^{1}G	109474	109408	66		1.004
(B^{2}G)^{1}F	3	90 + 9(C^{2}D)^{1}F			110566			0.999
(^{2}P)^{3}P	0	81 + 19(C^{2}D)^{3}P			118425			
	1	80 + 19(C^{2}D)^{3}P			118522			1.502
	2	80 + 19(C^{2}D)^{3}P			118782			1.499
(^{2}P)^{1}S	0	100			119886			
(^{2}P)^{3}D	1	96			120907			0.502
	2	73 + 19(^{2}P)^{1}D			120878			1.127
	3	95			121159			1.333

Table 16. *Observed and calculated levels of* Mn II – $3d^5 4p$ – *Continued*

NAME	*J*	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. *g*-FACTOR	CALC. *g*-FACTOR
$(^2P)^1D$	2	$65 + 22(^2P)^3D + 10(C^2D)^1D$			121475			1.037
$(^2P)^3S$	1	99			122607			1.993
$(^2P)^1P$	1	$85 + 12(C^2D)^1P$			123766			1.002
$(C^2D)^3F$	2	95			127282			0.678
	3	93			127364			1.090
	4	97			127562			1.250
$(C^2D)^3D$	1	96			128251			0.504
	2	94			128408			1.154
	3	93			128591			1.325
$(C^2D)^1D$	2	$69 + 15(C^2D)^3P + 13(^2P)^1D$			128920			1.047
$(C^2D)^3P$	0	$81 + 19(^2P)^3P$			129837			
	1	$81 + 19(^2P)^3P$			129667			1.499
	2	$66 + 16(^2P)^3P + 14(C^2D)^1D$			129433			1.202
$(C^2D)^1F$	3	96			129762			1.002
$(C^2D)^1P$	1	$86 + 13(^2P)^1P$			132851			0.999

Table 17. *Observed and calculated levels of* Fe II – $3d^6 4p$

NAME	*J*	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})		OBS. *g*-FACTOR	CALC. *g*-FACTOR
$(^5D)z\ ^6D$	1/2	100		39109	39219	[illegible]0	3.35	3.327
	3/2	99		39013	39106	[illegible]3	1.86	1.864
	5/2	98		38859	38924	−65	1.653	1.655
	7/2	98		38660	38686	−26	1.584	1.586
	9/2	99		38459	38431	28	1.542	1.554
$(^5D)z\ ^6F$	1/2	99		42440	42165	275	−0.647	−0.667
	3/2	98		42401	42114	287	1.04	1.068
	5/2	98		42335	42026	309	1.304	1.315
	7/2	97		42237	41899	338	1.399	1.397
	9/2	97		42115	41730	385	1.43	1.433
	11/2	100		41968	41520	448		1.454
$(^5D)z\ ^6P$	3/2	99		43621	44090	−469	2.398	2.395
	5/2	98		43239	43687	−448	1.869	1.878
	7/2	96		42658	43077	−419	1.702	1.706
$(^5D)z\ ^4D$	1/2	96		45206	45144	62	−0.021	−0.001
	3/2	94		45044	44975	69	1.15	1.185
	5/2	91		44785	44698	87	1.35	1.361
	7/2	$89 + 6(^5D)^4F$		44447	44331	116	1.40	1.423
$(^5D)z\ ^4F$	3/2	96		45290	45448	−158	0.445	0.422
	5/2	93		45080	45210	−130	1.069	1.048
	7/2	$91 + 6(^5D)^4D$		44754	44850	−96	1.29	1.253
	9/2	97		44233	44306	−73	1.32	1.335
$(^5D)z\ ^4P$	1/2	99		47626	47798	−172	2.70	2.664
	3/2	99		47390	47534	−144	1.717	1.732
	5/2	98		46967	47062	−95	1.592	1.599
$(A^3P)z\ ^4S$	3/2	$63 + 35(A^3P)^4P$		59663	59859	−196	1.89	1.887

TABLE 17. *Observed and calculated levels of* Fe II – $3d^64p$ – *Continued*

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
$(^3H)z\ ^4G$	5/2	$43+50(A^3F)^4G$		61042	61099	−57	0.799	0.587
	7/2	$41+44(A^3F)^4G$		60957	60984	−27	0.969	0.977
	9/2	$34+32(A^3F)^4G+15(^3H)^4I$		60807	60821	−14	1.155	1.089
	11/2	$53+33(A^3F)^4G+5(^3G)^4G$		60625	60711	−86	1.24	1.253
$(^3H)z\ ^4I$	9/2	$56+16(^3H)^4H+16(^3H)^4G$	$(a\ ^3H)z\ ^4H$	60989	61007	−18		0.887
	11/2	$60+24(^3H)^4H+6(^3H)^4G$		60888	60871	17		1.038
	13/2	$64+26(^3H)^4H+5(^3H)^2I$		60838	60830	8		1.144
	15/2	100		61347	61068	279		1.200
$(A^3P)y\ ^4P$	1/2	93		61035	61366	−331	2.613	2.522
	3/2	$38+32(A^3P)^4S+20(A^3P)^4D$		61333	61539	−206	1.74	1.632
	5/2	$76+18(A^3P)^4D$		60402	60593	−191	1.58	1.539
$(^3H)z\ ^4H$	7/2	$68+9(^3H)^2G+8(^3G)^4H$		61157	61361	−204	0.720	0.737
	9/2	$55+27(^3H)^4I+6(^3H)^2G$	$(a\ ^3H)z\ ^4I$	61513	61511	2		0.926
	11/2	$61+31(^3H)^4I+5(^3G)^4H$		61587	61579	8		1.082
	13/2	$64+29(^3H)^4I+5(^3G)^4H$		61528	61519	9		1.192
$(A^3P)z\ ^2D$	3/2	$44+17(A^3P)^4D+11(A^3P)^4P$		62126	62360	−234	1.019	1.068
	5/2	$67+12(A^3P)^4P+9(A^3P)^4D$		61093	61234	−141	1.01	1.257
$(A^3F)y\ ^4F$	3/2	$83+6(^3D)^4F$		62245	62376	−131	0.43	0.466
	5/2	$82+5(^3D)^4F$		62152	62299	−147	1.025	1.030
	7/2	$86+6(^3H)^4H$		62066	62208	−142	1.198	1.190
	9/2	$86+4(^3D)^4F$		62158	62237	−79	1.33	1.314
$(^3H)z\ ^2G$	7/2	$49+12(^3G)^2G+11(A^3F)^4F$		62322	62556	−234		0.941
	9/2	$65+16(^3G)^2G+6(^3H)^4H$		62083	62354	−271	1.097	1.096
$(^3H)z\ ^2I$	11/2	94		62662	62672	−10	0.910	0.931
	13/2	93		62293	62307	−14	1.069	1.080
$(A^3P)y\ ^4D$	1/2	92		62829	62801	28		0.122
	3/2	$57+26(A^3P)^2D$		62962	63028	−66	1.14	1.092
	5/2	$70+15(A^3P)^2D$		62690	62657	33	1.349	1.358
	7/2	96		61726	61481	245	1.411	1.421
$(A^3F)x\ ^4D$	1/2	$87+8(^3D)^4D$		63560	63831	−271	0.013	0.009
	3/2	$87+8(^3D)^4D$		63465	63724	−259	1.21	1.187
	5/2	$84+8(^3D)^4D$		63273	63516	−243	1.351	1.345
	7/2	$76+7(^3D)^4D$		62945	63193	−248	1.385	1.371
$(A^3F)y\ ^4G$	5/2	$37+36(^3H)^4G+20(A^3F)^2F$		64088	64194	−106	0.617	0.651
	7/2	$43+36(^3H)^4G+16(A^3F)^2F$		64041	64096	−55	0.975	0.998
	9/2	$48+34(^3H)^4G+12(A^3F)^2G$		63949	63940	9	1.15	1.164
	11/2	$62+32(^3H)^4G$		63876	63832	44	1.24	1.265
$(A^3F)z\ ^2F$	5/2	$52+15(^3H)^4G$		64425	64556	−131	0.82	0.782
	7/2	$53+11(^3G)^2F+5(^3H)^4G$		64286	64415	−129	1.135	1.097
$(A^3P)z\ ^2P$	1/2	$66+24(A^3P)^2S$		64807	64873	−66		1.012
	3/2	89		64834	65087	−253	1.329	1.324
$(A^3F)y\ ^2G$	7/2	$79+5(A^3F)^2F$		65110	65126	−16	0.896	0.907
	9/2	$75+6(^3G)^2H$		64832	64802	30	1.101	1.102
$(^3H)z\ ^2H$	9/2	$52+29(^3G)^2H+7(^1I)^2H$		65556	65662	−106	0.913	0.928
	11/2	$23+32(^3G)^2H+26(^3G)^4G$		65364	65567	−203	1.066	1.143
$(^3G)x\ ^4G$	5/2	$83+6(A^3F)^2F$		66078	66029	49	0.62	0.622
	7/2	$78+11(^3G)^4F$		65931	65879	52	1.00	1.021
	9/2	$61+28(^3G)^4F$		65696	65654	42		1.223
	11/2	$60+22(^3H)^2H+8(^3G)^2H$		65580	65490	90		1.214
$(A^3P)z\ ^2S$	1/2	$75+21(A^3P)^2P$		66249	65980	269		1.669

TABLE 17. *Observed and calculated levels of* Fe II – $3d^64p$ – Continued

NAME	*J*	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. *g*-FACTOR	CALC. *g*-FACTOR
$(^3G)y\ ^4H$	7/2	$82+11(^3H)^4H$		66672	66376	296	0.69	0.690
	9/2	$79+8(^3H)^4H+4(^3H)^2H$		66589	66296	293	0.959	0.985
	11/2	$75+11(^3H)^2H+7(^3H)^4H$		66464	66176	288	1.13	1.133
	13/2	$89+9(^3H)^4H$		66412	66012	400		1.228
$(^3G)x\ ^4F$	3/2	$69+11(A^3F)^2D+10(^3D)^4F$		66613	66636	−23		0.468
	5/2	$67+11(A^3F)^2D+10(^3D)^4F$		66522	66566	−44	1.02	1.018
	7/2	$68+11(^3G)^4G+10(^3D)^4F$		66377	66437	−60	1.21	1.189
	9/2	$54+26(^3G)^4G+7(^3D)^4F$		66013	66068	−55		1.261
$(A^3F)y\ ^2D$	3/2	$69+14(A^3P)^2D+11(^3G)^4F$		67274	67422	−148	0.719	0.741
	5/2	$75+8(^3G)^4F$		67001	67128	−127	1.16	1.176
$(^3G)y\ ^2H$	9/2	$56+36(^3H)^2H$		68001	68266	−265	0.907	0.918
	11/2	$52+40(^3H)^2H$		67516	67752	−236	1.07	1.095
$(^3G)y\ ^2F$	5/2	$61+15(^3D)^2F+14(A^3F)^2F$		69651	69686	−35	0.857	0.864
	7/2	$59+13(A^3F)^2F+9(^3G)^2G$		69607	69619	−12	1.13	1.112
$(^3G)x\ ^2G$	7/2	$69+14(^3H)^2G+5(^3G)^2F$		70524	70415	109	0.87	0.924
	9/2	$77+18(^3H)^2G$		70315	70189	126	1.11	1.107
$(^1I)z\ ^2K$	13/2	99		70987	70999	−12		0.935
	15/2	100		71433	71373	60	1.05	1.067
$(A^1G)x\ ^2H$	9/2	$83+10(^1I)^2H$	$x\ ^2H$	72130	71956	174	0.91	0.917
	11/2	$78+18(^1I)^2H$		72262	72178	84	1.08	1.091
$(^3D)w\ ^4P$	1/2	$73+17(^3D)^4D+5(^3D)^2P$		72213	72220	−7		2.049
	3/2	$78+9(^3D)^4D+4(^3D)^2P$		72043	72066	−23	1.66	1.613
	5/2	92		71965	71982	−17		1.585
$(^3D)w\ ^4F$	3/2	$77+15(^3G)^4F$		72169	72101	68		0.458
	5/2	$78+14(^3G)^4F$		72239	72184	55		1.035
	7/2	$72+12(^3G)^4F$		72352	72298	54		1.235
	9/2	$85+11(^3G)^4F$		72651	72510	141		1.329
$(^3D)w\ ^4D$	1/2	$57+23(^3D)^4P+10(^3D)^2P$		72430	72418	12		0.720
	3/2	$69+13(^3D)^4P+7(^3D)^2P$		72525	72510	15		1.272
	5/2	$82+8(A^3F)^4D$		72620	72613	7		1.353
	7/2	$50+19(A^1G)^2F+13(^3D)^2F$		72652	72628	24		1.301
$(A^1G)w\ ^2G$	7/2	$69+12(^3D)^4D$		73143	72956	187	0.91	0.992
	9/2	$87+4(^3H)^2G$		73092	72940	152		1.105
$(A^1G)x\ ^2F$	5/2	$44+32(^3D)^2F+8(A^3F)^2F$	$(a\ ^3D)x\ ^2F$	73055	73049	6		0.877
	7/2	$31+25(^3D)^4D+20(A^1G)^2G$		73016	73065	−49		1.163
$(^3D)y\ ^2P$	1/2	$63+15(^3D)^4D+15(A^1S)^2P$		73187	73150	37		0.558
	3/2	$68+15(A^1S)^2P+11(^3D)^4D$		73189	73076	113		1.319
$(^1I)w\ ^2H$	9/2	$79+12(B^1G)^2H$	$w\ ^2H$	73751	73978	−227		0.912
	11/2	$63+20(B^1G)^2H+10(^1I)^2I$		73604	73705	−101		1.075
$(^1I)y\ ^2I$	11/2	$89+9(^1I)^2H$		73970	74161	−191		0.941
	13/2	99		73967	74163	−196		1.076
$(^3D)x\ ^2D$	3/2	93		74498	74562	−64		0.807
	5/2	93		74607	74683	−76		1.202
$(^3D)w\ ^2F$	5/2	$49+40(A^1G)^2F$	$w\ ^2F$	75915	75728	187	0.844	0.861
	7/2	$55+32(A^1G)^2F$		75601	75370	231	1.125	1.143
$(A^1S)x\ ^2P$	1/2	$66+17(^3D)^2P+10(A^1D)^2P$		76578	76654	−76		0.670
	3/2	$62+23(A^1D)^2P$		76130	76258	−128	1.34	1.332
$(A^1D)v\ ^2F$	5/2	$79+6(A^1D)^2D$		77743	77892	−149		0.883
	7/2	$85+8(A^1G)^2F$		78138	78274	−136	1.13	1.144

TABLE 17. *Observed and calculated levels of* Fe II – 3d^{6}4p – *Continued*

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
(A^{1}D)w ^{2}D	3/2	63 + 19(A^{1}D)^{2}P		78487	78543	−56		0.956
	5/2	80 + 11(^{1}F)^{2}D		78691	78700	−9		1.176
(A^{1}D)w ^{2}P	1/2	84 + 10(A^{1}S)^{2}P		78842	78607	235		0.670
	3/2	51 + 26(A^{1}D)^{2}D		79244	78920	324		1.178
(^{1}F)v ^{2}G	7/2	94		83305	83154	151		0.891
	9/2	96		83871	83627	244		1.112
(^{1}F)v ^{2}D	3/2	85 + 8(A^{1}D)^{2}D		84360	84563	−203		0.804
	5/2	80 + 13(A^{1}D)^{2}D		83869	84131	−262		1.198
(^{1}F)u ^{2}F	5/2	92		86548	86346	202		0.865
	7/2	92		86483	86286	197		1.146
(B^{3}P)v ^{4}D	1/2	56 + 43(B^{3}F)^{4}D		86389	86642	−253		0.003
	3/2	53 + 45(B^{3}F)^{4}D		86544	86799	−255		1.197
	5/2	50 + 49(B^{3}F)^{4}D		86768	87005	−237		1.366
	7/2	41 + 46(B^{3}F)^{4}D		86930	87176	−246		1.424
(B^{3}P)^{2}S	1/2	95			89360			2.014
(B^{3}F)^{4}G	5/2	98			89755			0.573
	7/2	98			89891			0.984
	9/2	97			90015			1.171
	11/2	98			90116			1.272
(B^{3}P)^{4}S	3/2	95			90836			1.983
(B^{3}P)^{4}P	1/2	94			91777			2.622
	3/2	90			92046			1.710
	5/2	81 + 8(B^{3}P)^{2}D			92471			1.543
(B^{3}F)u ^{2}G	7/2	91		92603	92556	47		0.902
	9/2	91		92427	92273	154		1.122
(B^{3}F)u ^{2}D	3/2	51 + 40(B^{3}P)^{2}D		92216	92317	−101		0.813
	5/2	56 + 30(B^{3}P)^{2}D		92696	92781	−85		1.213
(B^{3}F)^{4}D	1/2	55 + 40(B^{3}P)^{4}D			92757			0.039
	3/2	43 + 37(B^{3}P)^{4}D + 13(B^{3}F)^{4}F			92914			1.107
	5/2	31 + 40(B^{3}F)^{4}F + 23(B^{3}P)^{4}D			93099			1.241
	7/2	38 + 30(B^{3}F)^{4}D + 30(B^{3}F)^{4}F			93596			1.366
(B^{3}F)u ^{4}F	3/2	82 + 8(B^{3}F)^{4}D		93329	93168	161		0.532
	5/2	53 + 22(B^{3}F)^{4}D + 22(B^{3}P)^{4}D		93396	93368	28		1.192
	7/2	65 + 19(B^{3}P)^{4}D + 12(B^{3}F)^{4}D		93488	93217	271		1.286
	9/2	94 + 5(B^{3}F)^{2}G		93485	93386	99		1.321
(B^{3}P)^{2}D	3/2	37 + 38(B^{3}F)^{2}D + 17(B^{3}P)^{2}P			94092			0.889
	5/2	61 + 35(B^{3}F)^{2}D			94679			1.207
(B^{3}P)^{2}P	1/2	93			94531			0.665
	3/2	77 + 13(B^{3}P)^{2}D + 5(B^{3}F)^{2}D			95112			1.232
(B^{3}F)t ^{2}F	5/2	97		96280	95406	874		0.858
	7/2	94		96357	95427	930		1.142
(B^{1}G)^{2}H	9/2	97			97972			0.912
	11/2	98			98338			1.091
(B^{1}G)^{2}F	5/2	92			99483			0.858
	7/2	68 + 24(B^{1}G)^{2}G			99159			1.081
(B^{1}G)^{2}G	7/2	72 + 21(B^{1}G)^{2}F			99896			0.952
	9/2	96			99796			1.110
(B^{1}D)^{2}D	3/2	98			115424			0.803
	5/2	98			115541			1.197

TABLE 17. *Observed and calculated levels of* Fe II – $3d^64p$ – Continued

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
$(B^1D)^2F$	5/2	96			117913			0.860
	7/2	97			118266			1.143
$(B^1D)^2P$	1/2	96			119387			0.667
	3/2	95			119218			1.331
$(B^1S)^2P$	1/2	96			138558			0.667
	3/2	96			139013			1.333

TABLE 18. *Observed and calculated levels of* Co II – $3d^74p$

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
$(^4F)z\,^5F$	1	97		46786	46706	80	0.06	0.038
	2	$91+7(^4F)^5D$		46453	46383	70	1.058	1.022
	3	$83+13(^4F)^5D$		45972	45920	52	1.303	1.273
	4	$73+22(^4F)^5D$		45379	45355	24	1.407	1.377
	5	96		45198	45014	184	1.396	1.394
$(^4F)z\,^5G$	2	$93+3(^4F)^5F+3(^4F)^5D$		48388	48012	376	0.35	0.391
	3	$90+5(^4F)^5F$		48151	47767	384	0.92	0.943
	4	$87+6(^4F)^3F+6(^4F)^3G$		47807	47413	394	1.154	1.159
	5	$84+11(^4F)^3G$		47346	46947	399	1.260	1.264
	6	100		47078	46531	547	1.350	1.333
$(^4F)z\,^5D$	0	$94+6(^4P)^5D$		47995	48188	−193		
	1	$92+6(^4P)^5D$		47848	48022	−174	1.42	1.464
	2	$85+5(^4F)^5F+5(^4P)^5D$		47537	47672	−135	1.43	1.420
	3	$80+11(^4F)^5F+5(^4F)^5G$		47039	47125	−86	1.43	1.445
	4	$72+20(^4F)^3F+4(^4F)^5G$		46321	46354	−33	1.442	1.455
$(^4F)z\,^3G$	3	$75+22(^4F)^3F$		50036	50105	−69	0.811	0.834
	4	$59+36(^4F)^3F$		49348	49343	5	1.111	1.129
	5	$88+12(^4F)^5G$		48556	48546	10	1.19	1.207
$(^4F)z\,^3F$	2	$94+3(^2G)^3F$		50914	50849	65	0.689	0.678
	3	$69+22(^4F)^3G$		50382	50335	47	1.059	1.017
	4	$60+34(^4F)^3G$		49698	49647	51	1.197	1.178
$(^4F)z\,^3D$	1	95		52684	52650	34	0.524	0.501
	2	94		52230	52170	60	1.167	1.157
	3	$92+4(^4F)^3F$		51512	51412	100	1.33	1.321
$(^4P)z\,^5S$	2	99		56011	56328	−317	2.00	1.996
$(^4P)y\,^5D$	0	$92+6(^4F)^5D$		61458	61579	−121		
	1	$87+6(^4F)^5D$		61348?	61461	−113		1.502
	2	$88+5(^4F)^5D$		61260	61347	−87	1.490	1.490
	3	$89+5(^4F)^5D$		61241	61281	−40	1.504	1.493
	4	$95+4(^4F)^5D$		61388	61331	57	1.442	1.499
$(^4P)z\,^3S$	1	$60+16(^4P)^5P+12(^2P)^3S$		62440	62647	−207		2.020
$(^2G)^3H$	4	$83+8(^2G)^3G+6(^2G)^3F$			63511			0.852
	5	$78+15(^2G)^1H+5(^2G)^3G$			63103			1.033
	6	97			63234			1.164
$(^4P)z\,^5P$	1	$77+19(^4P)^3S$		63665	63865	−200	2.62	2.349
	2	$67+21(^4P)^3D+4(^2P)^3P$		63367	63598	−231	1.86	1.630
	3	$82+13(^4P)^3D$		63344	63564	−220	1.67	1.610

TABLE 18. *Observed and Calculated Levels of* Co II – 3d⁷4p – Continued

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
$(^4P)y\,^3D$	1	$81+7(^2P)^3D$		63865	64147	−282		0.592
	2	$57+27(^4P)^5P+4(^4P)^5D$		63616	63858	−242	1.33	1.358
	3	$77+14(^4P)^5P$		63587	63776	−189		1.381
$(^2G)^1G$	4	$46+23(^2G)^3F+19(^2G)^3G$			64511			1.064
$(^2G)^1H$	5	$48+32(^2G)^3G+20(^2G)^3H$			64849			1.070
$(^2G)^3F$	2	95			65022			0.674
	3	$83+10(^2G)^3G$			64410			1.044
	4	$66+12(^2G)^3H+9(^2G)^1G$			63684			1.153
$(^2P)^3P$	0	$57+20(A^2D)^3P+16(^4P)^3P$			64683			
	1	$59+17(A^2D)^3P+9(^4P)^3P$			65146			1.485
	2	$45+35(^4P)^3P+5(^2P)^3D$			65187			1.437
$(^2G)^3G$	3	$85+9(^2G)^3F$			65220			0.794
	4	$67+22(^2G)^1G+6(^2H)^1G$			65249			1.029
	5	$62+35(^2G)^1H$			64573			1.125
$(^4P)^3P$	0	$63+24(^2P)^3P+12(^2P)^1S$			65887			
	1	$83+8(^2P)^3P$			65947			1.469
	2	$53+23(^2P)^3P+18(A^2D)^3P$			65521			1.500
$(^2G)^1F$	3	$72+18(A^2D)^1F$			65898			0.997
$(^2P)^1D$	2	$37+19(^2P)^3D+12(^4P)^3D$			67369			1.063
$(^2P)^3D$	1	$68+18(A^2D)^3D+5(^4P)^3D$			67820			0.569
	2	$54+21(^2P)^1D+11(A^2D)^3D$			68024			1.124
	3	$81+10(A^2D)^3F$			67398			1.312
$(^2P)^1S$	0	$81+18(^4P)^3P$			68337			
$(^2H)^3I$	5	97			68759			0.839
	6	$75+24(^2H)^1I$			68281			1.019
	7	100			68413			1.143
$(A^2D)^3D$	1	$50+25(^2P)^1P+16(^2P)^3D$			69188			0.656
	2	$67+11(^2P)^3D+6(^2P)^1D$			69430			1.133
	3	$85+8(A^2D)^3F$			68860			1.314
$(^2H)^3G$	3	$85+4(A^2D)^3F$			69499			0.781
	4	92			69020			1.053
	5	95			68421			1.199
$(^2H)^1I$	6	$75+24(^2H)^3I$			69652			1.008
$(A^2D)^3F$	2	$75+9(A^2D)^3D$			70599			0.774
	3	$70+8(^2P)^3D+6(A^2D)^3D$			70262			1.095
	4	98			69898			1.248
$(^2P)^3S$	1	$53+16(^2P)^1P+10(A^2D)^3D$			70486			1.599
$(^2P)^1P$	1	$38+27(^2P)^3S+12(A^2D)^1P$			70812			1.262
$(A^2D)^1D$	2	$39+32(A^2D)^3P+13(^2P)^1D$			72351			1.225
$(^2H)^3H$	4	96			72205			0.807
	5	96			71895			1.034
	6	99			71586			1.166
$(A^2D)^1F$	3	$72+16(^2G)^1F+7(A^2D)^3F$			72609			1.014
$(A^2D)^3P$	0	$79+17(^2P)^3P$			73472			
	1	$68+12(^2P)^3P+10(^2P)^1P$			73153			1.448
	2	$46+30(A^2D)^1D+13(^2P)^1D$			72351			1.225
$(^2H)^1G$	4	$76+22(^2G)^1G$			73235			0.997

TABLE 18. *Observed and calculated levels of* Co II – $3d^7 4p$ – *Continued*

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
$(A^2D)^1P$	1	$86+8(^2P)^1P$			74510			1.045
$(^2H)^1H$	5	97			74714			1.001
$(^2F)^1D$	2	$62+32(^2F)^3F$			83192			0.895
$(^2F)^3G$	3	$89+5(^2F)^3F+5(^2H)^3G$			83157			0.768
	4	$87+7(^2F)^3F$			83460			1.063
	5	96			83888			1.200
$(^2F)^3F$	2	$65+30(^2F)^1D$			83915			0.783
	3	$90+5(^2F)^3G$			83930			1.073
	4	$60+30(^2F)^1G+8(^2F)^3G$			84177			1.158
$(^2F)^3D$	1	95			84403			0.501
	2	$89+6(^2F)^1D$			84433			1.156
	3	92			84312			1.324
$(^2F)^1G$	4	$68+30(^2F)^3F$			84454			1.079
$(^2F)^1F$	3	98			87762			1.002
$(B^2D)^3P$	0	99			101199			
	1	99			101191			1.494
	2	99			101247			1.498
$(B^2D)^3F$	2	97			102024			0.669
	3	98			102357			1.083
	4	98			102770			1.250
$(B^2D)^1P$	1	96			104543			0.991
$(B^2D)^1F$	3	98			104681			1.004
$(B^2D)^3D$	1	96			106136			0.514
	2	$57+41(B^2D)^1D$			106216			1.095
	3	97			106763			1.329
$(B^2D)^1D$	2	$56+41(B^2D)^3D$			106593			1.070

TABLE 19. *Observed and calculated levels of* Ni II $3d^8 4p$

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
$(^3F)z\ ^4D$	1/2	96		54176	54237	−61	−0.005	0.003
	3/2	$94+4(^3P)^4D$		53635	53717	−82	1.186	1.187
	5/2	93		52739	52860	−121	1.356	1.360
	7/2	94		51558	51742	−184	1.420	1.423
$(^3F)z\ ^4G$	5/2	$94+5(^3F)^4F$		55019	54767	252	0.616	0.601
	7/2	$81+10(^3F)^4F+8(^3F)^2G$		54263	54078	185	1.02	1.006
	9/2	$67+23(^3F)^2G+10(^3F)^4F$		53365	53274	91	1.156	1.174
	11/2	100		53497	53110	387	1.305	1.273
$(^3F)z\ ^4F$	3/2	95		56425	56417	8	0.412	0.423
	5/2	$87+6(^3F)^4G+4(^3F)^2F$		56075	56027	48	0.985	1.006
	7/2	$76+10(^3F)^2F+9(^3F)^4G$		55418	55360	58	1.184	1.203
	9/2	$80+19(^3F)^2G$		54557	54546	11	1.26	1.289
$(^3F)z\ ^2G$	7/2	$84+8(^3F)^4G+7(^3F)^2F$		56372	56481	−109	0.940	0.916
	9/2	$58+32(^3F)^4G+10(^3F)^4F$		55300	55245	55	1.152	1.153

TABLE 19. *Observed and calculated levels of* Ni II – $3d^84p$ – *Continued*

NAME	*J*	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. *g*-FACTOR	CALC. *g*-FACTOR
$(^3F)z\ ^2F$	5/2	$74+20(^3F)^2D+4(^3F)^4F$		58493	58544	−51	0.946	0.934
	7/2	$81+11(^3F)^4F+6(^3F)^2G$		57080	57159	−79	1.154	1.136
$(^3F)z\ ^2D$	3/2	$89+7(^1D)^2D$		58706	58617	89	0.795	0.796
	5/2	$74+20(^3F)^2F+4(^1D)^2D$		57420	57361	59	1.116	1.131
$(^3P)z\ ^4P$	1/2	$85+11(^1D)^2P+4(^3P)^2P$		67031	66905	126	2.331	2.366
	3/2	$73+12(^1D)^2P+7(^1D)^2D$		66580	66525	55	1.550	1.580
	5/2	$73+20(^1D)^2D$		66571	66462	109	1.48	1.484
$(^1D)y\ ^2F$	5/2	$84+8(^3P)^4P+4(^3P)^2D$		67694	67591	103	0.960	0.934
	7/2	$86+9(^3P)^4D$		68131	67950	181	1.200	1.170
$(^1D)y\ ^2D$	3/2	$65+18(^3P)^4P+7(^3F)^2D$		68154	68214	−60	1.02	1.014
	5/2	$74+19(^3P)^4P+4(^1D)^2F$		68735	68695	40	1.26	1.260
$(^1D)z\ ^2P$	1/2	$61+23(^3P)^2P+15(^3P)^4P$		68281	68234	47	1.008	0.971
	3/2	$64+15(^1D)^2D+11(^3P)^2P$		68966	68944	22	1.305	1.282
$(^3P)y\ ^4D$	1/2	$95+4(^3F)^4D$		70748	70779	−31		0.012
	3/2	$91+4(^3F)^4D$		70707	70715	−8	1.190	1.188
	5/2	$83+9(^3P)^2D+4(^1D)^2F$		70635	70645	−10	1.32	1.336
	7/2	$87+9(^1D)^2F$		70777	70726	51	1.38	1.399
$(^3P)x\ ^2D$	3/2	$82+11(^3P)^2P$		72375	72365	10	0.844	0.880
	5/2	$87+10(^3P)^4D$		71771	71877	−106	1.240	1.211
$(^3P)y\ ^2P$	1/2	$70+24(^1D)^2P+5(^3P)^2S$		73903	73647	256	1.039	0.730
	3/2	$67+16(^1D)^2P+13(^3P)^2D$		72985	72725	260	1.326	1.267
$(^3P)z\ ^2S$	1/2	$94+4(^1D)^2P$		74283	74570	−287		1.919
$(^3P)z\ ^4S$	3/2	97		74300	74589	−289		1.982
$(^1G)z\ ^2H$	9/2	100		75150	75088	62	0.903	0.910
	11/2	100		75722	75538	184	1.119	1.091
$(^1G)x\ ^2F$	5/2	95		75890?	76416	−526		0.858
	7/2	$94+4(^1D)^2F$		75917?	76047	−130	1.16	1.143
$(^1G)y\ ^2G$	7/2	99		79823	80133	−310		0.890
	9/2	100		79924	80227	−303		1.111
$(^1S)x\ ^2P$	1/2	99			105888			0.667
	3/2	99			106418			1.333

TABLE 20. *Observed and calculated levels of* Cu II $3d^94p$

NAME	*J*	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. *g*-FACTOR	CALC. *g*-FACTOR
$(^2D)z\ ^3P$	0	100		68850	68638	212		
	1	98		67917	67812	105	1.49	1.483
	2	99		66419	66496	−77	1.49	1.495
$(^2D)z\ ^3F$	2	95		69868	69735	133	0.67	0.688
	3	$71+27(^2D)^1F$		68448	68528	−80	1.06	1.065
	4	100		68731	68534	197	1.23	1.250
$(^2D)z\ ^1F$	3	$66+20(^2D)^3F$	$(^2D)\ ^3D_3$	70842	70941	−99		1.062
$(^2D)z\ ^1D$	2	$61+35(^2D)^3D$	$(^2D)\ ^3D_2$	71494	71764	−270	1.08	1.047
$(^2D)z\ ^3D$	1	$75+23(^2D)^1P$		73102	73164	−62	0.47	0.636
	2	$61+38(^2D)^1D$	$(^2D)\ ^1D$	73353	73507	−154	0.99	1.103
	3	$85+9(^2D)^3F$	$(^2D)\ ^1F$	71920	72055	−135		1.290
$(^2D)z\ ^1P$	1	$76+24(^2D)^3D$		73596	73365	231	1.04	0.881

TABLE 21. *Observed and calculated levels of* Zn II $3d^{10}4p$

NAME	J	PERCENTAGE	AEL	OBS. LEVEL (cm^{-1})	CALC. LEVEL (cm^{-1})	O–C	OBS. g-FACTOR	CALC. g-FACTOR
$(^1S)z\ ^2P$	1/2	100		48481	48485	−4		0.667
	3/2	100		49354	49350	4		1.333

This paper was supported in part by the National Bureau of Standards, Washington, D.C.

The author wishes to acknowledge with everlasting gratitude and appreciation the unremitting kind interest in this work by the late Professor Giulio Racah.

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