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A Theoretical Investigation of the Configurations $(3d+4s)^6\,4p$ in Neutral Manganese (Mn I)*

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Experimental levels of the configurations $(3d+4s)^6 4p$ in Mn I were compared with corresponding calculated values. On fitting 228 experimental levels by means of 20 free parameters an rms error of only 170 cm^{-1} was obtained.

It was shown that the correction parameters β and T were not significant.

Key words: Energy levels Mn I; g-factors Mn I; interactions between configurations Mn I; manganese spectrum; Mn I configurations $(3d+4s)^6 4p$.

Introduction

Theoretical investigations of odd configurations for trebly- and doubly-ionized atoms of the iron group have been reported by the author [1–4] [1, 2].

The configurations $(3d+4s)^n 4p$ have also been considered previously for the arc spectra of calcium, scandium, titanium, vanadium, and chromium [5–9].

The configurations $(d+s)^6 p$ comprise 281 terms splitting into 777 levels. In AEL [10], the experimental data include 217 odd levels of which 81 have experimental g-values. Since in the paper of Catalàn, Meggers and Garcia-Riquelme [11], 49 additional odd levels and 83 additional g-values for the odd levels are given, it is used as our source for the experimental data. In this paper, 47 odd terms splitting into 163 levels are assigned to the configurations $3d^6 4p + 3d^5 4s4p$, 27 odd terms splitting into 72 levels are given without configuration assignments, and an additional 15 odd levels have no term designations.

After examining the final parameters obtained for the first spectra investigated thus far [6–8], it was evident that only for the parameters [3] B, B', C, C' and α is it meaningful to use linear extrapolation in order to obtain the starting values for Mn I. Then, by neglecting the values of C and α for Sc I, we have initially

$$\begin{aligned} B &= 750 \\ B' &= 830 \\ C &= 2{,}850 \\ C' &= 3{,}210 \\ \alpha = \alpha' &= 73 \end{aligned} \tag{1}$$

For the other interaction parameters the final values obtained [8] for Cr I were used as initial values here.

The initial value for the height of the configuration $3d^5 4s4p$ was obtained from the ^8P term.

From references [12] and [13] [4]

$$^6S(^3P)\,^8P_{\mathrm{C.G.}} = A' - 35B' - 5G'_{ds} - G'_{ps} = 18572 \tag{2}$$

Thus, from (1)

$$A' = 61730 \tag{3}$$

The initial value for the height of $3d^6 4p$ was obtained from the term $(^5\mathrm{D})\,^6\mathrm{D}$. The interaction [13] of this term with the terms:

$$^4\mathrm{P}(^5\mathrm{P})\,^6\mathrm{D} \quad \text{equals} \quad \frac{3\sqrt{2}}{10}(K-J)$$

$$^4\mathrm{D}(^5\mathrm{D})\,^6\mathrm{D} \quad \text{equals} \quad -\sqrt{70}(H+[K-J]/10)$$

$$^4\mathrm{F}(^5\mathrm{F})\,^6\mathrm{D} \quad \text{equals} \quad \frac{2\sqrt{7}}{5}(K-J)$$

The diagonal matrix element for the electrostatic interaction [12, 13] of $d^6(^5\mathrm{D})p\,^6\mathrm{D}$ is $A - 21B - 7F_2 + 6\alpha$.

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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 $3d^6 4p$, primed parameters to $3d^5 4s4p$, and doubly primed parameters to $3d^4 4s^2 4p$.

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

However, since the matrices on tape for d^6p were those of Ishidzu and Obi [14] we had, in addition, a contribution of $-10G_1-35G_3$ (see sections 3, 4 [13]). Then, since

$$({}^5\mathrm{D})z\,{}^6\mathrm{D}_{\mathrm{C.G.}}=41950, \qquad {}^4\mathrm{P}({}^5\mathrm{P})y\,{}^6\mathrm{D}_{\mathrm{C.G.}}=47750$$

$${}^4\mathrm{D}({}^5\mathrm{D})x\,{}^6\mathrm{D}_{\mathrm{C.G.}}=52840, \quad {}^4\mathrm{F}({}^5\mathrm{F})w\,{}^6\mathrm{D}_{\mathrm{C.G.}}=62760$$

we obtain by using second-order perturbation theory

$$A-21B-7F_2-10G_1-35G_3+6\alpha-\frac{9(K-J)^2}{50\times 5{,}800}$$

$$-\frac{70}{10{,}890}\left(H+\frac{[K-J]}{10}\right)^2-\frac{28(K-J)^2}{25\times 20{,}810}=41950 \tag{4}$$

From the previously determined values of the other parameters we obtain

$$A=61800 \tag{5}$$

Since in V I and Cr I [7–8], the results were greatly improved by considering the configuration $3d^{n-2}4s^24p$ and its interactions with $3d^{n-1}4s4p$ and $3d^n4p$, a similar investigation was attempted for Mn I. Racah and Shadmi [15] 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 using the values of D''(Sc), D''(Ti), D''(V), and D''(Cr) [6–8], a parabola was fitted and extrapolated to obtain

$$D''(\mathrm{Mn})=25960. \tag{6}$$

The expressions (7), (8), and (9) of reference [7] must be modified for the complementary configurations. The matrices of B, C, and α for the configurations d^np, $d^{n-1}sp$, and $d^{n-2}s^2p$ are equal to the corresponding matrices of the complementary configurations $d^{10-n}s^2p$, $d^{11-n}sp$, and $d^{12-n}p$, respectively [13]. Also, the matrices of G'_{ds} and G'_{ps} for $d^{n-1}sp$ are equal to the corresponding matrices of $d^{11-n}sp$. As the weighted average of the terms of d^9p is given by $M(d^9p)=M(d^9s^2p)=F_0+(G_1+7/2G_3)$, as given in eq (6) of reference [16], we obtain by comparing with eqs (9), (8), and (7) of [7]:

$$M(d^{12-n}p)=A+(7/18)(n-2)(n-3)(C-2B)$$
$$+(2/3)(n-2)(12-n)\alpha+(n-2)(G_1+7/2G_3) \tag{7}$$

$$M'(d^{11-n}sp)=A'+(7/18)(n-1)(n-2)(C'-2B')$$
$$+(2/3)(n-1)(11-n)\alpha'$$
$$+(n-1)(G'_1+7/2G'_3-G'_{ds}/2-G'_{ps}/2) \tag{8}$$

$$M''(d^{10-n}s^2p)=A''+(7/18)(n)(n-1)(C''-2B'')$$
$$+2/3(n)(10-n)\alpha''+n(G''_1+7/2G''_3) \tag{9}$$

For the configuration d^5sp, when d^5 is considered as comprising five electrons, eq (8), [7] should be used to obtain the center of gravity of the configuration, whereas for d^5 consisting of five holes in the d-shell, eq (7) is the appropriate expression. As expected, the two values differ by $-10G_1-35G_3$, [13].

By assuming that the parameters of the three configurations are in arithmetic progression, we obtain from eq (9), [7]

$$M''(d^4s^2p)=A''+8110 \tag{10}$$

Since in the calculation of the matrices for the configurations $(d+s)^6p$, the configuration d^5sp was considered as five holes in the d-shell we obtain from (8)

$$M'(d^5sp)=69420 \tag{11}$$

Thus from (6), (10), (11), and (5)

$$A''=87270 \tag{12}$$

Results and Discussion

Four iterations were required to reach convergence of the diagonalization and the least squares procedures. Finally the parameter values varied by less than their standard deviations.

The effect of β here was even smaller than for Cr I, [8]. When β was allowed to change freely, the rms error was 167 cm^{-1} with

$$\beta=\beta'=\beta''=-56\pm 44 \tag{13}$$

With β eliminated, the rms error remained at 167 cm^{-1}.

In the least-squares solution of the final iteration in the "uniform treatment" [5] (see ref. [6]), 67 experimental terms splitting into 219 levels and 9 unclassified odd levels were inserted to yield an rms error of only 170 cm^{-1}. The experimental and calculated values of the levels and g-factors obtained from the final least-squares solution of the uniform treatment, are compared in table A of the Appendix. The calculated values, percentage compositions, and g-factors for 469 of the 777 predicted levels are given. All calculated levels up to 81000 cm^{-1} are included. The terms based on $\mathrm{B}^1\mathrm{S}$, $\mathrm{B}^3\mathrm{P}$, $\mathrm{B}^1\mathrm{D}$, $\mathrm{B}^3\mathrm{F}$ and $\mathrm{B}^1\mathrm{G}$ of d^6p as well as the terms obtained from ${}^2\mathrm{S}+{}^1\mathrm{P}$, ${}^2\mathrm{P}+{}^{1,3}\mathrm{P}$, $\mathrm{B}^2\mathrm{D}+{}^{1,3}\mathrm{P}$, $\mathrm{C}^2\mathrm{D}+{}^{1,3}\mathrm{P}$, $\mathrm{B}^2\mathrm{F}+{}^1\mathrm{P}$, $\mathrm{A}^2\mathrm{G}+{}^1\mathrm{P}$, $\mathrm{B}^2\mathrm{G}+{}^{1,3}\mathrm{P}$ and ${}^2\mathrm{H}+{}^1\mathrm{P}$ are not inserted since they are very high and strongly mixed with terms of d^4s^2p. The lowest predicted levels of d^4s^2p based on $d^4s^2\,{}^5\mathrm{D}$ are included, but must be considered only as rough approximations due to the high uncertainty in A''.

The final parameters with their standard errors in the uniform treatment are given in table 1.

Since the value of G'_{ps} is much larger than that of G'_{ds} the $p-s$ interaction is the stronger. Consequently,

[5] The parameters A, 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 $K'=K+764$ (fixed difference).

the terms of d^5sp are coupled as $d^5(v_1S_1L_1)sp(^{1,3}\mathrm{P})SL$ and not $d^5s(S_2L_1)pSL$ as given in AEL.

TABLE 1. *Parameters for* Mn I $(3d+4s)^6 4p$

Parameter	Initial value	Final value
A	61800	63216 ± 292
A'	61730	63028 ± 318
A''	87270	89176 ± 1433
B	750	800 ± 14
B'	830	861 ± 4
B''	910	922 (Arith. Progress.)
C	2850	2772 ± 17
C'	3210	3140 ± 9
C''	3570	3508 (Arith. Progress.)
$G'_{ds}=G$	1590	1532 ± 22
F_2	187	193 ± 7
F'_2	275	314 ± 8
F''_2	363	435 (Arith. Progress.)
G_1	224	227 ± 7
G'_1	236	245 ± 6
G''_1	248	263 (Arith. Progress.)
$G_3=G'_3=G''_3$	16	18 ± 1
G'_{ps}	6155	6631 ± 60
$\alpha=\alpha'=\alpha''$	73	73 ± 2
$H=H'$	157	70 ± 6
$J=J'$	954	1294 ± 34
K	2311	2599 ± 36
K'	3011	3363 (Fixed Diff.)
$\zeta_d=\zeta'_d=\zeta''_d$	247	321 ± 28
$\zeta_p=\zeta'_p=\zeta''_p$	184	212 ± 60
rms error	....	169.9

The three high experimental terms $z\,^2$K, $x\,^2$I and $v\,^2$H are above 68500, and were not included in the least-squares solution. It is doubtful to which corresponding theoretical terms they should be assigned, and, in addition, 5 of these 6 levels are given with question marks [11]. Below 68500 the following 16 levels were not included:

1. The three levels of $3d^6(a\,^5\mathrm{D})4p\ x\,^6\mathrm{P}$
2. The three levels of $3d^54s(b\,^5\mathrm{D})4p\ w\,^4\mathrm{P}$
3. The two levels of $y\,^2$I
4. The two levels of $x\,^2$H
5. The six unclassified odd levels $55924_{2\frac{1}{2}}$, $63320_{3\frac{1}{2}}$?, $63372_{2\frac{1}{2}}$, $66600_{3\frac{1}{2}}$, $66655_{2\frac{1}{2}}$?, and $66910_{2\frac{1}{2}}$?.

The calculated levels of $(^5\mathrm{D})x\,^6\mathrm{P}$ are on the average higher by 750 than the experimental levels of $x\,^6$P. Most, or all of this difference can be attributed to the interaction between $3d^6(a\,^5\mathrm{D})4p\ x\,^6\mathrm{P}$ and $3d^54s(a\,^7\mathrm{S})5p\ w\,^6\mathrm{P}$, since the difference between the unperturbed terms $x\,^6$P and $w\,^6$P is very small. Since this interaction was not considered explicitly here, the levels of $x\,^6$P have not been inserted.

Below 62000 five ^{4}P terms are predicted while six experimental terms $z\,^4$P, $y\,^4$P, $x\,^4$P, $w\,^4$P, $v\,^4$P, and $u\,^4$P are given, [11]. The lower terms $z\,^4$P, $y\,^4$P, and $x\,^4$P corresponded very closely to the theoretical terms with the same designations. The others were not inserted until the least-squares solution of the last iteration. Then, it became apparent that the superfluous term is $w\,^4$P. Moreover, by noting the experimental values of the terms $3d^54s(a\,^7\mathrm{S})4p\ z\,^8\mathrm{P}$, $3d^54s(a\,^7\mathrm{S})5p\ y\,^8\mathrm{P}$ and $3d^54s(a\,^5\mathrm{S})4p\ z\,^4\mathrm{P}$, by assuming that the values of the parameters for $(3d+4s)^65p$ are about half of those for $(3d+4s)^64p$, and by performing a calculation similar to that of $w\,^5$P of Cr I (see ref. [7]), the term $3d^54s(a\,^5\mathrm{S})5p\,^4\mathrm{P}$ is predicted at the height of 55500, i.e., about the same as $w\,^4$P. Thus $w\,^4$P should be assigned as $3d^5(^6\mathrm{S})4s5p(^3\mathrm{P})\,^4\mathrm{P}$.

The only term to which the levels $y\,^2$I could conceivably be assigned is $^4\mathrm{F}(^3\mathrm{P})^6\mathrm{G}$ with deviations of about $-400cm^{-1}$. However, as the experimental levels $y\,^2$I are based on combinations which include doublets, [11], they were not assigned to ^{6}G.

The level $x\,^2\mathrm{H}_{5\frac{1}{2}}$ could conceivably be fitted to the predicted level $^2\mathrm{I}(^3\mathrm{P})^2\mathrm{I}_{5\frac{1}{2}}$. However, rather than break up the term $x\,^2$H with this doubtful assignment, both levels have been neglected.

None of the 15 miscellaneous odd levels was used in the least-squares calculation until the last iteration. The six levels listed as item 5 above, did not have corresponding experimental levels to which they could be assigned.

The following changes in assignment have been made.

1. $d^5s(b\,^3\mathrm{P})pv\,^4\mathrm{P} \longrightarrow {}^4\mathrm{D}(^3\mathrm{P})\,^4\mathrm{P}$
2. $d^6(a\,^3\mathrm{H})py\,^4\mathrm{G} \longrightarrow {}^4\mathrm{G}(^1\mathrm{P})\,^4\mathrm{G}$
3. $d^6(a\,^3\mathrm{P})pw\,^4\mathrm{D}_{5/2,\,7/2} \longrightarrow (\mathrm{A}^3\mathrm{F})\,^4\mathrm{D}_{5/2,\,7/2}$
4. $d^6(a\,^3\mathrm{P})pz\,^2\mathrm{D}_{3/2,\,5/2} \longrightarrow (\mathrm{A}^3\mathrm{P})\,^4\mathrm{D}_{3/2,\,5/2}$
5. $d^6(a\,^3\mathrm{P})pw\,^4\mathrm{D}_{3/2} \longrightarrow (\mathrm{A}^3\mathrm{P})^2\mathrm{D}_{3/2}$
6. $d^6(a\,^3\mathrm{F})pv\,^4\mathrm{D}_{5/2} \longrightarrow (\mathrm{A}^3\mathrm{P})^2\mathrm{D}_{5/2}$
7. $d^6(a\,^3\mathrm{F})pv\,^4\mathrm{D}_{7/2} \longrightarrow (\mathrm{A}^3\mathrm{P})^4\mathrm{D}_{7/2}$
8. $w\,^4\mathrm{G}_{5/2,\,7/2} \longrightarrow (\mathrm{A}^3\mathrm{F})\,^2\mathrm{F}_{5/2,\,7/2}$
9. $w\,^4\mathrm{G}_{9/2} \longrightarrow (\mathrm{A}^3\mathrm{F})\,^2\mathrm{G}_{9/2}$
10. $w\,^4\mathrm{G}_{11/2} \longrightarrow (^3\mathrm{H})^2\mathrm{H}_{11/2}$
11. $z\,^2\mathrm{F}_{5/2,\,7/2} \longrightarrow {}^4\mathrm{G}(^1\mathrm{P})\,^4\mathrm{F}_{5/2,\,7/2}$
12. $y\,^2\mathrm{G}_{9/2} \longrightarrow {}^4\mathrm{G}(^1\mathrm{P})^4\mathrm{F}_{9/2}$
13. $y\,^2\mathrm{F}_{5/2,\,7/2} \longrightarrow (^3\mathrm{G})^4\mathrm{G}_{5/2,\,7/2}$
14. $x\,^2\mathrm{F}_{5/2,\,7/2} \longrightarrow \mathrm{A}^2\mathrm{F}(^3\mathrm{P})^4\mathrm{G}_{5/2,\,7/2}$
15. $y\,^2\mathrm{H}_{9/2} \longrightarrow \mathrm{A}^2\mathrm{F}(^3\mathrm{P})\,^4\mathrm{G}_{9/2}$
16. $d^6(a\,^3\mathrm{H})pz\,^2\mathrm{H}_{11/2} \longrightarrow \mathrm{A}^2\mathrm{F}(^3\mathrm{P})^4\mathrm{G}_{11/2}$
17. $d^5s(a\,^5\mathrm{D})pw\,^6\mathrm{D}_{1/2-9/2} \longrightarrow {}^4\mathrm{F}(^3\mathrm{P})^6\mathrm{F}_{1/2-9/2}$
18. $d^6(a\,^3\mathrm{G})pw\,^4\mathrm{H} \longrightarrow {}^4\mathrm{G}(^1\mathrm{P})^4\mathrm{H}$
19. $w\,^2\mathrm{D}_{3/2,\,5/2} \longrightarrow {}^4\mathrm{P}(^1\mathrm{P})\,^4\mathrm{D}_{3/2,\,5/2}$
20. $x\,^2\mathrm{G}_{7/2,\,9/2} \longrightarrow \mathrm{A}^2\mathrm{F}(^3\mathrm{P})^4\mathrm{F}_{7/2,\,9/2}$
21. $u\,^2\mathrm{G}_{7/2,\,9/2} \longrightarrow \mathrm{A}^2\mathrm{G}(^3\mathrm{P})\,^4\mathrm{F}_{7/2,\,9/2}$

In the changes 1, 2, and 18 the theoretical assignments of the core $(d+s)^6$ did not correspond to the experimental assignments. However, in each case the theoretical eigenfunctions contained, also, a considerable mixture (20%–30%) of the experimental term.

The eigenfunctions of the levels of $(\mathrm{A}^3\mathrm{P})^4\mathrm{D}$, $(\mathrm{A}^3\mathrm{F})^4\mathrm{D}$, and $(\mathrm{A}^3\mathrm{P})^2\mathrm{D}$ are mixed quite strongly. When the levels of these three terms were fitted so that the experimental and theoretical designations corresponded, the deviations were very high (600–700). After several variations, taking into consideration the deviations of the levels, the correspondence of the g-factors and the splitting of the terms, it was found that with the

383-876 O - 70 - 4

changes 3, 4, 5, 6, and 7, the most favorable results were obtained.

It is apparent that the levels of $w\,^4G$ could not be assigned to a theoretical term ^4G (see table A of the appendix). After introducing the changes 8, 9, and 10, the theoretical term $(A^3F)^2F$ has deviations of 110 and 77, with the experimental g-factor of 1.13 for $w\,^4G_{7/2}$, corresponding closely to the calculated value of 1.057 for $(A^3F)^2F_{7/2}$. The theoretical term $(A^3F)y\,^2G$ has deviations of 103 and 188; the experimental g-factors of 0.93 and 1.020 correspond to the calculated values of 0.940 and 0.941, respectively. It should be noted that had $y\,^2G_{9/2}$ been assigned to $(A^3F)y\,^2G_{9/2}$, the deviations would have been about 103 and 418. Finally, the level $(^3H)^2H_{11/2}$ has a deviation of 128 and the experimental g-factor for $w\,^4G_{11/2}$ corresponds to the calculated value of 1.087 for $(^3H)^2H_{11/2}$.

The changes 11 and 12 were performed in the last iteration. The calculated levels of $^4G(^1P)^4F_{5/2,\,7/2,\,9/2}$ correspond closely to the experimental levels $z\,^2F_{5/2,\,7/2}$ and $y\,^2G_{9/2}$ (see table A of the appendix).

Changes 13 and 14 were performed since the levels of $y\,^2F$ and $x\,^2F$ could not be assigned to theoretical terms ^2F, and furthermore, the theoretical terms $(^3G)^4G$ and $A^2F(^3P)^4G$ had until then no corresponding experimental levels.

By using the changes 15 and 16, not only are the deviations for $A^2F(^3P)^4G$ and $(^3H)^2H$ lower, but also the splitting of the experimental levels correspond well to the intervals between the experimental levels assigned to these two terms.

Originally, the levels of $w\,^6D$ were assigned to the theoretical term with the same designation. However, the average deviation then was over 600, whereas from the change 17, the average deviation for the levels of $^4F(^3P)^6F$ becomes only 101. In addition, the four unclassified odd levels at 63584, 63524, 63546, and 63375 can now be assigned to the theoretical levels $^4F(^3P)^6D_{3/2,\,5/2,\,7/2,\,9/2}$ with an average deviation of only 63.

The theoretical term ^2D nearest to the experimental term $w\,^2D$ is $A^2F(^3P)^2D$ at 67500. Thus, the levels $w\,^2D$ were assigned to $^4P(^1P)^4D_{3/2,\,5/2}$. Although the deviations are 322 for both levels, the experimental g-factor of 1.30 for $w\,^2D_{5/2}$ corresponds closely to the calculated g-factor of 1.366 for $^4P(^1P)^4D_{5/2}$.

The experimental terms $x\,^2G$ and $u\,^2G$ could not be assigned to theoretical ^2G terms (see table A of the appendix). The changes 20 and 21 reduce the deviations for $A^2F(^3P)^4F_{7/2,\,9/2}$ to 76 and 28; the experimental g-factor of 1.307 for $x\,^2G_{9/2}$ corresponds to the calculated value of 1.317 for $A^2F(^3P)^4F_{9/2}$. For $A^2G(^3P)^4F_{7/2,\,9/2}$ the deviations are 154 and 157; the experimental g-factor of 1.320 for $u\,^2G_{9/2}$ corresponds to the calculated value of 1.321 for $A^2G(^3P)^4F_{9/2}$. Table 2 below indicates how the 9 unclassified odd levels inserted were assigned.

It was ascertained that each of the 9 unclassified odd levels is based upon at least 3 combinations with even levels [11]. It should be emphasized that all those levels whose experimental and theoretical assignments did not correspond, as well as the unclassified levels, were not inserted into the least-squares calculation until the parameters were determined by the other levels (whose assignments were not questioned).

For 25 of the 27 experimental terms given without configuration assignments [11], the theoretical assignments are given in table A in the appendix ($y\,^2I$ and $x\,^2H$ were not inserted).

For the lower-lying levels there was excellent agreement between the experimental and calculated Landé g-factors. The experimental g-factors of 0.826 for $x\,^4D_{3/2}$, 1.770 for $z\,^4S_{3/2}$, 1.94 for $u\,^4P_{1/2}$ and 0.46 for $v\,^2G_{7/2}$ are quite different from the theoretical g-factors. However, as the calculated g-factors for the above 4 levels are very close to the theoretical values, the discrepancies are rather large. The experimental g-factor of 1.043 for $y\,^6F_{7/2}$ seems to be a misprint as the g-factor quoted in AEL for this level is 1.403, and, furthermore, the theoretical and calculated g-factors are 1.397 and 1.411, respectively.

Below 68300 (the limit of the experimental data inserted) there are 326 predicted levels. Thus, excluding $w\,^6P$, there are 95 theoretical levels without corresponding experimental levels to assign to them. The lowest of these are the levels of $^4G(^3P)^3G$ and $^4G(^3P)^6H$ at around 46000. It is hoped that the present theoretical investigation will provide a stimulus for further experimental work on this very complex spectrum.

In table 3 the orders of the submatrices of $(d+s)^6p$ are given.

TABLE 2. *Unclassified odd levels of* Mn I

Level	Assignment	Deviation	Obs. g-factor	Calc. g-factor
$61744_{11/2}$	$(^3G)^4G_{11/2}$	−20		1.252
$63375_{9/2}$	$^4F(^3P)^6D_{9/2}$	−15		1.547
$63524_{5/2}$	$^4F(^3P)^6D_{5/2}$	54		1.632
$63546_{7/2}$	$^4F(^3P)^6D_{7/2}$	115		1.573
$63584_{3/2}$	$^4F(^3P)^6D_{3/2}$	69		1.789
$65769_{9/2}$	$(^3G)^2G_{9/2}$	2	1.12	1.115
$66504_{3/2}$	$^4P(^1P)^4S_{3/2}$	177		1.975
$66981_{7/2}$	$^4D(^1P)^4D_{7/2}$	−283	1.33	1.421
$67009_{5/2}$	$^4D(^1P)^4P_{5/2}$	−127		1.565

TABLE 3. *Orders of the submatrices of* $(d+s)^6p$

J	Order
1/2	85
3/2	147
5/2	169
7/2	155
9/2	113
11/2	67
13/2	30
15/2	10
17/2	1

Appendix

The entries in table A of the Appendix may be described as follows: 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 (for $d^5\ {}^2D$ by A, B, and C), the lower calculated term being designated by A. The terms of d^5sp are denoted by $d^5\nu_1S_1L_1(sp\ {}^{1,3}P)SL$. The terms of d^6p are differentiated from those of d^4s^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" and "Calc. g", are self-evident. In the column "Percentage", for each calculated level either the three highest contributions or all those contributions exceeding six percent are given.

Whenever the experimental and calculated term designations differ, the experimental designation is entered in the column "CMG" (Catalan, Meggers, Garcia-Riquelme, [11]) with the notation of C. E. Moore, [10]. In many instances the exchanges involve complete terms rather than isolated levels. Unless specified otherwise, the entries in the column "CMG" 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 terms.

TABLE A. *Observed and Calculated Levels of* Mn I $(3d+4s)^6 4p$

Name	J	Percentage	CMG Config.	CMG Desig.	Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O−C	Obs. g	Calc. g
$^6S(^3P)\,^8P$	5/2	100	$3d^54s(a\,^7S)4p$	$z\,^8P$	18402	18468	−66	2.284	2.285
	7/2	100			18532	18573	−41	1.938	1.936
	9/2	100			18705	18712	−7	1.779	1.778
$^6S(^3P)\,^6P$	3/2	97	$3d^54s(a\,^7S)4p$	$z\,^6P$	24779	24816	−37	2.364	2.400
	5/2	97			24788	24809	−21	1.875	1.886
	7/2	97			24802	24799	3	1.714	1.714
$^6S(^3P)\,^4P$	1/2	98	$3d^54s(a\,^5S)4p$	$z\,^4P$	31125	31077	48	2.668	2.666
	3/2	98			31076	31023	53	1.732	1.733
	5/2	98			31001	30940	61	1.600	1.600
$^6S(^1P)\,^6P$	3/2	$88+10(^5D)\,^6P$	$3d^54s(a\,^5S)4p$	$y\,^6P$	35690	35742	−52	2.400	2.399
	5/2	$88+10(^5D)\,^6P$			35726	35770	−44	1.886	1.885
	7/2	$87+11(^5D)\,^6P$			35770	35800	−30	1.712	1.714
$(^5D)\,^6D$	1/2	$95+4\,^4D(^3P)\,^6D$			42199	42334	−135	3.317	3.325
	3/2	$95+4\,^4D(^3P)\,^6D$			42144	42256	−112	1.867	1.862
	5/2	$94+4\,^4D(^3P)\,^6D$			42054	42131	−77	1.653	1.654
	7/2	$94+4\,^4D(^3P)\,^6D$			41933	41966	−33	1.587	1.585
	9/2	$95+4\,^4D(^3P)\,^6D$			41789	41781	8	1.556	1.554
$(^5D)\,^6F$	1/2	$81+17\,^4G(^3P)\,^6F$			43673	43580	93	−0.602	−0.659
	3/2	$80+17\,^4G(^3P)\,^6F$			43644	43547	97	1.068	1.068
	5/2	$80+16\,^4G(^3P)\,^6F$			43596	43490	106	1.310	1.315
	7/2	$80+15\,^4G(^3P)\,^6F$			43524	43405	119	1.395	1.396
	9/2	$80+15\,^4G(^3P)\,^6F$			43429	43290	139	1.431	1.433
	11/2	$83+15\,^4G(^3P)\,^6F$			43314	43154	160	1.464	1.454
$(^5D)\,^4F$	3/2	$90+6\,^4G(^3P)\,^4F$			44815	45136	−321	0.400	0.408
	5/2	$89+6\,^4G(^3P)\,^4F$			44696	44975	−279	1.030	1.037
	7/2	$88+6\,^4G(^3P)\,^4F$			44523	44746	−223	1.240	1.245
	9/2	$89+6\,^4G(^3P)\,^4F$			44289	44442	−153	1.317	1.336
$^4G(^3P)\,^6G$	3/2	98				45613			0.002
	5/2	97				45619			0.848
	7/2	95				45630			1.133
	9/2	94				45647			1.264
	11/2	94				45671			1.336
	13/2	95				45703			1.381
$(^5D)\,^4D$	1/2	93			46170	46070	100	0.000	0.006
	3/2	92			46084	45960	124	1.200	1.202
	5/2	89			45941	45768	173	1.372	1.380
	7/2	$82+8(^5D)\,^6P$			45754	45481	273	1.427	1.458

Table A. *Observed and Calculated Levels of* Mn I $(3d+4s)^6 4p$ – Continued

Name	J	Percentage	CMG Config.	CMG Desig.	Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O–C	Obs. g	Calc. g
$(^5D)^6P$	3/2	$67+21\,^4P(^3P)^6P$			(45259)	46136		(2.399)	2.395
	5/2	$66+20\,^4P(^3P)^6P+5\,^4D(^3P)^6P$			(45156)	45924		(1.885)	1.874
	7/2	$60+17\,^4P(^3P)^6P+11(^5D)^4D$			(44994)	45640		(1.717)	1.680
$^4G(^3P)^6H$	5/2	98				46012			0.296
	7/2	97				46058			0.836
	9/2	96				46111			1.079
	11/2	96				46165			1.209
	13/2	97				46215			1.285
	15/2	100				46255			1.333
$(^5D)^4P$	1/2	91			47299	47288	11	2.666	2.661
	3/2	90			47155	47112	43	1.732	1.729
	5/2	90			46901	46808	93	1.595	1.596
$^4P(^3P)^6D$	1/2	$83+15\,^4D(^3P)^6D$	$3d^5 4s(a\,^5P)4p$	$y\,^6D$	47452	47648	−196	3.174	3.311
	3/2	$82+14\,^4D(^3P)^6D$			47467	47686	−219		1.852
	5/2	$80+14\,^4D(^3P)^6D$			47754	47754	0	1.820	1.642
	7/2	$77+12\,^4D(^3P)^6D+5\,^4G(^3P)^6F$			47775	47864	−89	1.594	1.570
	9/2	$63+18\,^4G(^3P)^6F+9\,^4D(^3P)^6D$			47904	48020	−116	1.540	1.522
$^4G(^3P)^6F$	1/2	$76+19(^5D)^6F$	$3d^5 4s(a\,^5G)4p$	$y\,^6F$	48318	48272	46	−0.496	−0.650
	3/2	$76+18(^5D)^6F$			48301	48261	40	1.068	1.078
	5/2	$76+17(^5D)^6F$			48271	48241	30	1.319	1.326
	7/2	$73+16(^5D)^6F+7\,^4P(^3P)^6D$			48226	48212	14	1.403	1.411
	9/2	$60+23\,^4P(^3P)^6D+12(^5D)^6F$			48168	48195	−27	1.432	1.465
	11/2	$80+16(^5D)^6F$			48021	48025	−4	1.460	1.454
$^4P(^3P)^6S$	5/2	99				48210			1.997
$^4P(^3P)^6P$	3/2	$69+20(^5D)^6P$	$3d^5 4s(a\,^5P)4p$	$v\,^6P$	50099	50084	15	2.398	2.392
	5/2	$65+20(^5D)^6P+8\,^4D(^3P)^6P$			50013	49925	88	1.888	1.879
	7/2	$62+19(^5D)^6P+13\,^4D(^3P)^6P$			49888	49691	197	1.711	1.712
$^4G(^3P)^4H$	7/2	97	$3d^5 4s(a\,^5G)4p$	$z\,^4H$	50065	50189	−124		0.667
	9/2	96			50073	50199	−126		0.970
	11/2	96			50081	50211	−130		1.133
	13/2	96			50095	50226	−131	1.22	1.231
$^4G(^3P)^4F$	3/2	92	$3d^5 4s(a\,^5G)4p$	$y\,^4F$	50383	50475	−92		0.401
	5/2	92			50373	50474	−101	1.03	1.029
	7/2	92			50359	50475	−116	1.242	1.238
	9/2	92			50341	50476	−135	1.318	1.333
$^4D(^3P)^6F$	1/2	$92+5\,^4G(^3P)^6F$	$3d^5 4s(a\,^5D)4p$	$x\,^6F$	50819	50761	58	−0.62	−0.650
	3/2	92			50863	50805	58	1.07	1.073
	5/2	92			50931	50873	58	1.316	1.319
	7/2	92			51015	50952	63		1.400
	9/2	93			51100	51027	73		1.435
	11/2	94			51169	51074	95		1.453
$^4G(^3P)^4G$	5/2	92	$3d^5 4s(a\,^5G)4p$	$z\,^4G$	51516	51478	38		0.573
	7/2	92			51531	51499	32		0.985
	9/2	92			51546	51524	22		1.172
	11/2	92			51561	51552	9	1.273	1.273
$^4P(^3P)^4P$	1/2	$72+15\,^4D(^3P)^4P$	$3d^5 4s(a\,^5P)4p$	$x\,^4P$	51553	51647	−94	2.664	2.684
	3/2	$71+16\,^4D(^3P)^4P$			51446	51529	−83	1.728	1.735
	5/2	$70+18\,^4D(^3P)^4P$			51305	51370	−65	1.591	1.600
$^4D(^3P)^6P$	3/2	$86+7\,^4P(^3P)^6P$	$3d^5 4s(b\,^5D)4p$	$u\,^6P$	52015	52275	−260		2.370
	5/2	$68+19\,^4D(^3P)^6D+7\,^4P(^3P)^6P$			52129	52334	−205		1.832
	7/2	$43+30\,^4D(^3P)^6D+13\,^4P(^3P)^6P$			52253	52320	−67	1.71	1.639
$^4D(^3P)^6D$	1/2	$75+15\,^4P(^3P)^6D$	$3d^5 4s(a\,^5D)4p$	$x\,^6D$	52883	52681	202		3.240
	3/2	$71+14\,^4P(^3P)^6D$			52884	52651	233		1.860
	5/2	$56+18\,^4D(^3P)^6P+10\,^4P(^3P)^6D$			52884	52656	228		1.693

TABLE A. *Observed and Calculated Levels of* Mn I $(3d+4s)^6 4p$ – Continued

Name	J	Percentage	CMG Config.	CMG Desig.	Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O–C	Obs. g	Calc. g
	7/2	47+37 ^{4}D(^{3}P)^{6}P + 8 ^{4}P(^{3}P)^{6}D			52870	52705	165	1.57	1.649
	9/2	82+13 ^{4}P(^{3}P)^{6}D			52748	52318	440	1.552	1.555
^{4}P(^{3}P)^{4}D	1/2	86	$3d^5 4s(a\,^5P)4p$	$y\,^4$D	53101	52995	106		0.058
	3/2	85			53103	53032	71		1.224
	5/2	84			53109	53078	31		1.384
	7/2	86			53124	53136	−12	1.423	1.437
^{4}G(^{3}P)^{2}H	9/2	97				53637			0.910
	11/2	97				53579			1.091
^{4}G(^{3}P)^{2}F	5/2	93				53803			0.858
	7/2	93				53850			1.144
^{4}P(^{3}P)^{4}S	3/2	76+19(A^{3}P)^{4}S	$3d^5 4s(a\,^5P)4p$	$z\,^4$S	54219	54099	120	1.770	1.966
^{4}P(^{3}P)^{2}P	1/2	46+33 ^{4}D(^{3}P)^{4}D + 10 ^{4}D(^{3}P)^{2}D				54729			0.404
	3/2	57+14 ^{4}D(^{3}P)^{2}P + 14 ^{4}D(^{3}P)^{4}D				54603			1.336
^{4}D(^{3}P)^{4}D	1/2	50+31 ^{4}P(^{3}P)^{2}P				53377			0.275
	3/2	67+13 ^{4}P(^{3}P)^{2}P	$3d^5 4s(b\,^5D)4p$	$x\,^4$D	55280	55172	108	0.826	1.202
	5/2	84			55186	55002	184	1.365	1.371
	7/2	86+7 ^{4}F(^{3}P)^{4}D			55108	54894	214	1.407	1.427
^{4}D(^{3}P)^{4}F	3/2	84				55403			0.450
	5/2	88				55469			1.040
	7/2	48+41 ^{4}G(^{3}P)^{2}G				55446			1.076
	9/2	67+24 ^{4}G(^{3}P)^{2}G				55456			1.273
^{4}G(^{3}P)^{2}G	7/2	47+42 ^{4}D(^{3}P)^{4}F				55493			1.054
	9/2	65+25 ^{4}D(^{3}P)^{4}F				55490			1.171
^{4}P(^{3}P)^{2}D	3/2	82+6(A^{3}P)^{2}D + 6(A^{3}F)^{2}D				56660			0.783
	5/2	81+7(A^{3}P)^{2}D				56507			1.190
^{4}D(^{3}P)^{4}P	1/2	63+21 ^{4}P(^{3}P)^{4}P	$3d^5 4s(b\,^3P)4p$	$v\,^4$P	57228	57402	−174	2.671	2.639
	3/2	48+20(A^{3}P)^{4}S + 14 ^{4}P(^{3}P)^{4}P			57361	57607	−246	1.736	1.819
	5/2	56+26 ^{4}P(^{3}P)^{4}P			57487	57717	−230	1.590	1.596
(A^{3}P)^{4}S	3/2	32+32 ^{4}P(^{3}P)^{4}S + 15 ^{4}D(^{3}P)^{4}P	$3d^5 4s(b\,^3P)4p$	$y\,^4$S	57512	57520	−8	2.000	1.900
^{4}G(^{1}P)^{4}G	5/2	57+30(^{3}H)^{4}G	$3d^6(a\,^3H)4p$	$y\,^4$G	58160	58039	121	0.578	0.575
	7/2	56+31(^{3}H)^{4}G			58137	58016	121	0.980	0.984
	9/2	55+32(^{3}H)^{4}G			58110	57990	120	1.168	1.170
	11/2	54+35(^{3}H)^{4}G			58075	57955	120	1.269	1.271
^{4}D(^{3}P)^{2}D	3/2	78+8(A^{3}P)^{2}D + 5 ^{4}F(^{3}P)^{2}D				58359			0.807
	5/2	64+23(A^{3}P)^{2}D				58057			1.202
^{4}P(^{3}P)^{2}S	1/2	84+10(A^{3}P)^{2}S				58450			2.001
(^{3}H)^{4}H	7/2	60+24 ^{4}G(^{3}P)^{4}H + 11 ^{2}I(^{3}P)^{4}H			58520	58563	−43	0.665	0.674
	9/2	59+23 ^{4}G(^{3}P)^{4}H + 11 ^{2}I(^{3}P)^{4}H			58486	58534	−48	0.968	0.970
	11/2	60+24 ^{4}G(^{3}P)^{4}H + 11 ^{2}I(^{3}P)^{4}H			58427	58481	−54	1.133	1.130
	13/2	62+24 ^{4}G(^{3}P)^{4}H + 12 ^{2}I(^{3}P)^{4}H			58339	58404	−65	1.228	1.228
(^{3}H)^{4}I	9/2	49+47 ^{2}I(^{3}P)^{4}I			58867	58902	−35	0.73	0.736
	11/2	49+45 ^{2}I(^{3}P)^{4}I			58851	58901	−50		0.970
	13/2	50+43 ^{2}I(^{3}P)^{4}I			58843	58903	−60	1.09	1.109
	15/2	55+44 ^{2}I(^{3}P)^{4}I			58853	58918	−65		1.199
^{4}D(^{3}P)^{2}F	5/2	59+15(A^{3}P)^{2}D + 7 ^{4}D(^{3}P)^{2}D				59033			0.973
	7/2	77+8(^{3}G)^{2}F + 8(A^{3}F)^{2}F				58930			1.147
(A^{3}P)^{4}P	1/2	55+15 ^{4}D(^{3}P)^{4}P + 11 A^{2}D(^{3}P)^{4}P			59568	59341	227	1.94	2.240
	3/2	46+14 ^{4}D(^{3}P)^{4}P + 10 A^{2}D(^{3}P)^{4}P			59384	59140	244	1.608	1.600
	5/2	52+21 ^{4}D(^{3}P)^{4}P + 10 A^{2}D(^{3}P)^{4}P			59117	58852	265	1.558	1.566

Name	J	Percentage	CMG		Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O – C	Obs. g	Calc. g
			Config.	Desig.					
$(A^3F)^4D$	1/2	$44+23\,{}^4P({}^3P){}^4D+9(A^3P){}^4D$			59527	59562	– 35		0.374
	3/2	$39+20\,{}^4P({}^3P){}^4D+8(A^3P){}^4D$			59528	59515	13		1.261
	5/2	$34+16\,{}^4P({}^3P){}^4D+16(A^3P){}^2D$	$3d^6(a\,{}^3P)4p$	$w\,{}^4D$	59600	59501	99	1.277	1.306
	7/2	$33+38(A^3P){}^4D+13\,{}^4P({}^3P){}^4D$	$3d^6(a\,{}^3P)4p$	$w\,{}^4D$	59340	59089	251	1.362	1.413
${}^2I({}^3P){}^4K$	11/2	98				59599			0.776
	13/2	98				59673			0.967
	15/2	99				59759			1.092
	17/2	100				59861			1.176
$(A^3F)^4F$	3/2	$44+17\,{}^4G({}^1P){}^4F+15(A^3P){}^2D$			59416	59754	– 338	0.39	0.519
	5/2	$44+15\,{}^4G({}^1P){}^4F+11(A^3F){}^4G$			59361	59697	– 336	1.11	0.957
	7/2	$43+16\,{}^4G({}^1P){}^4F+12(A^3F){}^4G$			59290	59590	– 300	1.325	1.193
	9/2	$41+17(A^3F){}^4G+14\,{}^4G({}^1P){}^4F$			59257	59512	– 255	1.327	1.275
$(A^3F)^4G$	5/2	$52+18({}^3H){}^4G+9(A^3F){}^4F$			59818	59783	35	0.584	0.671
	7/2	$46+16({}^3H){}^4G+10(A^3F){}^4F$			59784	59731	53	0.990	1.081
	9/2	$43+16(A^3F){}^4F+14({}^3H){}^4G$			59732	59726	6	1.169	1.218
	11/2	$57+22({}^3H){}^4G$			59653	59574	79	1.239	1.255
$(A^3P)^2D$	3/2	$49+11(A^3F){}^4F+7(A^3F){}^4D$	$3d^6(a\,{}^3P)4p$	$w\,{}^4D$	59990	59909	81	1.194	0.780
	5/2	$24+23\,{}^4D({}^3P){}^2F+11\,{}^4D({}^3P){}^2D$	$3d^6(a\,{}^3F)4p$	$v\,{}^4D$	59481	59169	312	1.281	1.152
$({}^3H)^2I$	11/2	$87+6\,{}^2I({}^3P){}^2I$			59828	60024	– 196	0.93	0.935
	13/2	$89+6\,{}^2I({}^3P){}^2I$			59617	59785	– 168	1.074	1.079
$(A^3P)^4D$	1/2	$65+11A^2F({}^3P){}^4D+7(A^3F){}^4D$			60142	60507	– 365	0.17	0.052
	3/2	$59+12A^2F({}^3P){}^4D+8(A^3F){}^4D$	$3d^6(a\,{}^3P)4p$	$z\,{}^2D$	60396	60510	– 114	0.91	1.186
	5/2	$56+10(A^3F){}^4D+8A^2F({}^3P){}^4D$			60102	60332	– 230	1.31	1.367
	7/2	$30+24(A^3F){}^4D+9(A^3F){}^4F$	$3d^6(a\,{}^3F)4p$	$v\,{}^4D$	59470	59953	– 483	1.386	1.366
$({}^3H)^2G$	7/2	$42+14(A^3F){}^2F+12({}^3G){}^2G$			60739	60675	64		0.943
	9/2	$49+17({}^3G){}^2G+7\,{}^4G({}^3P){}^2G$			60668	60633	35	1.112	1.098
${}^2I({}^3P){}^4H$	7/2	$58+15\,{}^4G({}^1P){}^4H+14({}^3G){}^4H$	$3d^54s({}^3I)4p$	$x\,{}^4H$	60957	60804	153		0.702
	9/2	$55+16\,{}^4G({}^1P){}^4H+13({}^3G){}^4H$			60956	60816	140		0.986
	11/2	$58+19\,{}^4G({}^1P){}^4H+15({}^3G){}^4H$			60934	60794	140	1.134	1.131
	13/2	$59+20\,{}^4G({}^1P){}^4H+16({}^3G){}^4H$			60891	60752	139	1.228	1.227
$A^2D({}^3P){}^4F$	3/2	$58+23A^2F({}^3P){}^4F+7\,{}^4G({}^1P){}^4F$		$w\,{}^4F$	60761	60853	– 92		0.405
	5/2	$58+20A^2F({}^3P){}^4F+7\,{}^4G({}^1P){}^4F$			60820	60944	– 124		1.024
	7/2	$58+21A^2F({}^3P){}^4F+8\,{}^4G({}^1P){}^4F$			60903	61075	– 172		1.228
	9/2	$57+18A^2F({}^3P){}^4F+12\,{}^4G({}^1P){}^4F$			60939	61226	– 287		1.321
${}^2I({}^3P){}^4I$	9/2	$34+29({}^3H){}^4I+11({}^3H){}^2H$	$3d^54s({}^3I)4p$	$y\,{}^4I$	61211	61071	140	0.75	0.820
	11/2	$42+40({}^3H){}^4I+7({}^3H){}^2H$			61226	61136	90		0.984
	13/2	$49+46({}^3H){}^4I$			61226	61182	44		1.109
	15/2	$54+43({}^3H){}^4I$			61204	61178	26	1.20	1.199
${}^4D({}^3P){}^2P$	1/2	$49+23(A^3P){}^2P+20\,{}^4P({}^3P){}^2P$				61235			0.686
	3/2	$41+28(A^3P){}^2P+21\,{}^4P({}^3P){}^2P$				61476			1.319
$(A^3F)^2F$	5/2	$64+8\,{}^4D({}^3P){}^2F$		$w\,{}^4G$	61471	61361	110		0.863
	7/2	$35+16(A^3F){}^2G+13({}^3H){}^2G$		$w\,{}^4G$	61481	61404	77	1.13	1.057
$(A^3F)^2G$	7/2	$63+5({}^3H){}^2G$		$y\,{}^2G$	61786	61683	103	0.93	0.940
	9/2	$30+18({}^3H){}^4I+15({}^3H){}^2H$		$w\,{}^4G$	61485	61297	188	1.020	0.941
${}^4G({}^1P){}^4F$	3/2	$25+14(A^3F){}^4F+12A^2F({}^3P){}^4F$				61859			0.547
	5/2	$21+15A^2D({}^3P){}^4D+11A^2F({}^3P){}^4F$		$z\,{}^2F$	61727	61817	– 90		1.094
	7/2	$17+12A^2D({}^3P){}^4D+10A^2F({}^3P){}^4F$		$z\,{}^2F$	61711	61833	– 122		1.225
	9/2	$13+14({}^3G){}^4F+11\,{}^4D({}^1P){}^1F$		$y\,{}^2G$	61715	61760	– 45		1.235
$({}^3H)^2H$	9/2	$31+25(A^3F){}^2G+7\,{}^2I({}^3P){}^2H$				61826			1.082
	11/2	$55+13\,{}^2I({}^3P){}^2H+9({}^3G){}^2H$		$w\,{}^4G$	61469	61341	128	1.164	1.087

TABLE A. *Observed and Calculated Levels of* Mn I $(3d+4s)^6 4p$ – Continued

Name	J	Percentage	CMG		Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O−C	Obs. g	Calc. g
			Config.	Desig.					
$A^2D(^3P)^4D$	1/2	$53+15\,^4P(^1P)^4D+8\,^4F(^3P)^6F$				62109			0.034
	3/2	$27+10\,^4P(^1P)^4P+8\,^4P(^1P)^4D$				62178			1.184
	5/2	$26+11A^2D(^3P)^4P+7\,^4F(^3P)^6G$				62166			1.217
	7/2	$32+13\,^4P(^1P)^4D+10(^3G)^4G$				62165			1.269
$^4P(^1P)^4P$	1/2	$37+25(^5D)^4P^*+11(^3D)^4P$				61994			2.627
	3/2	$20+15(^5D)^4P^*+12\,^4D(^1P)^4P$				62162			1.451
	5/2	$45+22(^5D)^4P^*+9\,^4D(^1P)^4P$				62505			1.528
$^2I(^3P)^2K$	13/2	96				62182			0.934
	15/2	96				62285			1.068
$^4F(^3P)^6G$	3/2	$84+7A^2F(^3P)^4F$				62267			0.141
	5/2	$79+12A^2D(^3P)^4P$				62278			0.972
	7/2	87				62302			1.135
	9/2	96				62330			1.272
	11/2	97				62368			1.341
	13/2	98				62416			1.383
$(^3G)^4G$	5/2	$28+12(A^3F)^4G+10(^3H)^4G$		$y\,^2F$	62075	62283	−208	0.58	0.781
	7/2	$31+10(A^3F)^4G+9(^3H)^4G$		$y\,^2F$	62034	62256	−222		1.102
	9/2	$39+12(A^3F)^4G+11(^3H)^4G$				62060			1.174
	11/2	$44+16(A^3F)^4G+11(^3H)^4G$	Unclassified		61744	61764	−20		1.252
$(A^3P)^2P$	1/2	$42+29\,^4D(^3P)^2P$			62391	62328	63	0.81	0.760
	3/2	$33+28\,^4D(^3P)^2P$			62355	62370	−15	1.24	1.386
$A^2D(^3P)^4P$	1/2	$53+18\,^4P(^1P)^4P+12\,^4F(^3P)^6D$				62619			2.607
	3/2	$51+20\,^4P(^1P)^4P+7\,^4F(^3P)^6D$				62547			1.688
	5/2	$45+7\,^4P(^1P)^4P+7A^2D(^3P)^4D$				62239			1.350
$(^3G)^4F$	3/2	$25+14A^2F(^3P)^4F+14(A^3F)^2D$			62390	62561	−171		0.494
	5/2	$24+19A^2F(^3P)^4F+10\,^4D(^1P)^4F$			62487	62621	−134		1.050
	7/2	$27+28A^2F(^3P)^4F+11\,^4D(^1P)^4F$			62505	62668	−163		1.240
	9/2	$29+37A^2F(^3P)^4F+10\,^4G(^1P)^4F$			62393	62566	−173	1.35	1.330
$^2I(^3P)^2H$	9/2	$76+6(A^1G)^2H$				62620			0.924
	11/2	$75+6(A^1G)^2H$				62541			1.102
$A^2F(^3P)^4G$	5/2	$56+13(^3G)^4G+11(A^3F)^2D$		$x\,^2F$	63140	62815	325		0.723
	7/2	$68+8(^3G)^4G$		$x\,^2F$	63289	62980	309		0.998
	9/2	$61+10\,^4G(^1P)^4H+7(^3G)^4H$		$y\,^2H$	63348	63072	276		1.135
	11/2	$63+10\,^4G(^1P)^4H+7(^3G)^4H$	$3d^6(^3H)4p$	$z\,^2H$	63289	63045	244	1.127	1.245
$^4F(^3P)^6F$	1/2	82	$3d^54s(a\,^5F)4p$	$w\,^6D$	62768	62916	−148		0.563
	3/2	82			62788	62887	−99		1.093
	5/2	81			62761	62852	−91		1.332
	7/2	83			62851	62820	31		1.405
	9/2	85			62671	62809	−138		1.427
	11/2	88				62855			1.442
$(A^3F)^2D$	3/2	$65+7(^3G)^4F$		$y\,^2D$	63114	63053	61	0.758	0.740
	5/2	$53+8A^2F(^3P)^4G+7(^3G)^4F$			63081	62988	93	1.24	1.132
$^4G(^1P)^4H$	7/2	$42+26(^3G)^4H+12(^3H)^4H$	$3d^6(a\,^3G)4p$	$w\,^4H$	63395	63218	177	0.70	0.693
	9/2	$35+21(^3G)^4H+19A^2F(^3P)^4G$			63445	63242	203		1.020
	11/2	$31+21(^3G)^4H+20A^2F(^3P)^4G$			63458	63223	235	1.14	1.245
	13/2	$44+30(^3G)^4H+11(^3H)^4H$			63364	63184	180	1.231	1.225
$^4F(^3P)^6D$	1/2	$78+8A^2D(^3P)^4P$				63537			3.131
	3/2	$81+6A^2D(^3P)^4P$	Unclassified		63584	63513	69		1.789
	5/2	86	Unclassified		63524	63470	54		1.632
	7/2	87	Unclassified		63546	63431	115		1.573
	9/2	89	Unclassified		63375	63390	−15		1.547
$(^3G)^2H$	9/2	$72+10(^3H)^2H$			63548	63611	−63	0.92	0.915
	11/2	$65+13(^3H)^2H$		$y\,^2H$	63449	63459	−10		1.091

Name	J	Percentage	CMG Config.	CMG Desig.	Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O−C	Obs. g	Calc. g
$A^2D(^3P)^2D$	3/2	$50+27A^2F(^3P)^2D$		$x\,^2D$	63845	63588	257		0.781
	5/2	$57+16A^2F(^3P)^2D$			63765	63665	100		1.198
$(A^3P)^2S$	1/2	$79+9\,^4P(^3P)^2S$				63778			2.034
$^2I(^3P)^2I$	11/2	$86+9(^1I)^2I$				63836			0.931
	13/2	$84+9(^1I)^2I$				63835			1.086
$A^2F(^3P)^4D$	1/2	$59+16A^2D(^3P)^2P+10(A^3P)^4D$		$u\,^4D$	64639	64555	84	0.22	0.151
	3/2	$61+13A^2D(^3P)^2P+10(A^3P)^4D$			64684	64634	50	1.22	1.234
	5/2	$59+8A^2D(^3P)^2F$			64713	64769	−56		1.281
	7/2	$70+7(A^3P)^4D+7A^2D(^3P)^2F$			64410	64508	−98	1.42	1.386
$A^2F(^3P)^4F$	3/2	$34+20A^2D(^3P)^4F+8\,^4D(^1P)^4F$				64769			0.441
	5/2	$27+19A^2D(^3P)^4F+7\,^4D(^1P)^4F$				64694			1.036
	7/2	$21+14A^2D(^3P)^4F+10A^2F(^3P)^4D$		$x\,^2G$	64649	64573	76		1.215
	9/2	$30+17A^2D(^3P)^4F+9\,^4D(^1P)^4F$		$x\,^2G$	64585	64557	28	1.307	1.317
$A^2D(^3P)^2F$	5/2	$56+8A^2F(^3P)^4D$		$w\,^2F$	64823	64936	−113		0.925
	7/2	$45+15(^3G)^4H+9A^2F(^3P)^4F$			64988	64858	130		1.022
$(^3G)^4H$	7/2	$38+12\,^2I(^3P)^4H+9(^3H)^4H$		$v\,^4H$	64920	64867	53		0.817
	9/2	$52+18\,^2I(^3P)^4H+13(^3H)^4H$			64888	64802	86	0.974	0.974
	11/2	$51+19\,^2I(^3P)^4H+14(^3H)^4H$			64820	64760	60	1.137	1.133
	13/2	$48+21\,^2I(^3P)^4H+16(^3H)^4H$			64732	64693	39	1.236	1.229
$A^2F(^3P)^2G$	7/2	$58+15(^3G)^2G$		$w\,^2G$	65305	65319	−14		0.929
	9/2	$52+27(^3G)^2G$			65262	65388	−126	1.13	1.120
$^4P(^1P)^4D$	1/2	$20+26A^2D(^3P)^2P+18(^3D)^4D$				65451			0.252
	3/2	$21+19(^3D)^4D+17A^2D(^3P)^4D$		$w\,^2D$	65962	65640	322		1.224
	5/2	$20+27(^3D)^4D+23A^2D(^3P)^4D$		$w\,^2D$	65947	65625	322	1.30	1.366
	7/2	$18+27(^3D)^4D+21A^2D(^3P)^4D$				65638			1.395
$A^2D(^3P)^2P$	1/2	$29+19A^2F(^3P)^4D+10(^3D)^4D$				65688			0.296
	3/2	$48+9(^3D)^4D$				65365			1.281
$(^3G)^2F$	5/2	$55+11A^2F(^3P)^2F+9(A^3F)^2F$		$v\,^2F$	65649	65806	−157		0.838
	7/2	$33+19(^3G)^2G+14A^2F(^3P)^2G$			65617	65451	166	1.015	1.045
$(^3G)^2G$	7/2	$29+20(^3G)^2F+9A^2F(^3P)^2F$				66040			1.005
	9/2	$43+32A^2F(^3P)^2G+12(^3H)^2G$	Unclassified		65769	65767	2	1.12	1.115
$(^3H)^4G$	5/2	$10+15A^2G(^3P)^4G+14\,^4F(^3P)^4G$		$v\,^4G$	65873	66039	−166		0.604
	7/2	$10+14A^2G(^3P)^4G+12\,^4G(^1P)^4G$			65876	65993	−117		0.974
	9/2	$12+15A^2G(^3P)^4G+13\,^4G(^1P)^4G$			65909	66002	−93	1.160	1.160
	11/2	$13+15A^2G(^3P)^4G+13\,^4G(^1P)^4G$			65887	65985	−98	1.259	1.263
$A^2F(^3P)^2F$	5/2	$25+18\,^4F(^3P)^4G+15(A^1G)^2F$		$u\,^2F$	66021	66316	−295		0.756
	7/2	$34+21(A^1G)^2F+12(^3G)^2F$			66149	66269	−120	1.14	1.096
$^4P(^1P)^4S$	3/2	$62+27(A^3P)^4S$	Unclassified		66504	66327	177		1.975
$A^2G(^3P)^4H$	7/2	$31+23\,^2H(^3P)^4H+8(^3H)^4H$		$u\,^4H$	66334	66337	−3	0.764	0.776
	9/2	$28+19\,^2H(^3P)^4H+7(^3H)^4H$			66356	66357	−1	1.022	1.033
	11/2	$39+27\,^2H(^3P)^4H+7(^3H)^4H$			66419	66448	−29		1.137
	13/2	$46+32\,^2H(^3P)^4H+7\,^2H(^3P)^4I$			66569	66538	31	1.23	1.221
$(A^1G)^2G$	7/2	$23+16\,^4F(^3P)^4G+8\,^2H(^3P)^4G$		$v\,^2G$	66738	66630	108	0.46	0.999
	9/2	$22+11A^2G(^3P)^4H+8(^3D)^4F$			66631	66452	179	1.13	1.143
$(^3D)^4F$	3/2	$27+25\,^4D(^1P)^4F+12(^3G)^4F$		$u\,^4F$	66844	66559	285	0.46	0.411
	5/2	$15+12\,^4F(^3P)^4G+9\,^4D(^1P)^4F$			66838	66555	283		0.909
	7/2	$14+17\,^4F(^3P)^4G+15\,^4D(^1P)^4F$			66783	66576	207	1.21	1.114
	9/2	$8+11(A^1G)^2G+10\,^4F(^3P)^4G$			66855	66572	283	1.33	1.209
$^4F(^3P)^4G$	5/2	$19+10(^3D)^4F+9\,^2H(^3P)^4G$		$u\,^4G$	66395	66662	−267	0.611	0.810
	7/2	$12+15(A^1G)^2G+7(^3D)^4F$			66454	66630	−176	0.932	0.999

TABLE A. *Observed and Calculated Levels of* Mn I (3d + 4s)^{6}4p – Continued

Name	J	Percentage	CMG Config.	CMG Desig.	Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O–C	Obs. g	Calc. g
	9/2	34 + 13^{2}H(^{3}P)^{4}G + 7A^{2}F(^{3}P)^{4}G			66523	66760	−237	1.13	1.195
	11/2	54 + 17^{2}H(^{3}P)^{4}G + 8A^{2}F(^{3}P)^{4}G			66574	66819	−245	1.24	1.256
^{2}H(^{3}P)^{4}I	9/2	90				67045			0.745
	11/2	88				67144			0.981
	13/2	89				67229			1.116
	15/2	96				67280			1.198
(^{1}I)^{2}H	9/2	34 + 42 (A^{1}G)^{2}H + 9^{2}H(^{3}P)^{2}H		w ^{2}H	67577	67394	183	0.90	0.912
	11/2	39 + 35(A^{1}G)^{2}H + 9^{2}H(^{3}P)^{2}H			67505	67371	134	1.09	1.094
^{4}D(^{1}P)^{4}P	1/2	25 + 18^{4}D(^{1}P)^{4}D + 13^{4}P(^{1}P)^{4}P				67627			1.411
	3/2	22 + 16^{4}D(^{1}P)^{4}D + 12^{4}P(^{1}P)^{4}P				67685			1.472
	5/2	42 + 18^{4}P(^{1}P)^{4}P + 5^{4}D(^{1}P)^{4}D	Unclassified		67009	67136	−127		1.565
A^{2}F(^{3}P)^{2}D	3/2	51 + 29A^{2}D(^{3}P)^{2}D				67555			0.769
	5/2	54 + 25A^{2}D(^{3}P)^{2}D				67443			1.197
^{4}D(^{1}P)^{4}D	1/2	19 + 22^{4}D(^{1}P)^{4}P + 15^{4}P(^{1}P)^{4}D				67726			1.257
	3/2	20 + 21^{4}D(^{1}P)^{4}P + 16^{4}P(^{1}P)^{4}D				67533			1.466
	5/2	33 + 27^{4}P(^{1}P)^{4}D				67572			1.392
	7/2	40 + 30^{4}P(^{1}P)^{4}D	Unclassified		66981	67264	−283	1.33	1.421
(^{1}I)^{2}K	13/2	92 + 7^{2}I(^{1}P)^{2}K				67903			0.935
	15/2	91 + 8^{2}I(^{1}P)^{2}K				68137			1.068
A^{2}G(^{3}P)^{4}F	3/2	31 + 28^{4}F(^{3}P)^{4}D + 8^{4}F(^{3}P)^{4}F				68151			0.747
	5/2	36 + 30^{4}F(^{3}P)^{4}D				68204			1.138
	7/2	45 + 21^{4}F(^{3}P)^{4}D		u ^{2}G	68339	68185	154		1.276
	9/2	58 + 13^{4}F(^{3}P)^{4}F		u ^{2}G	68286	68129	157	1.320	1.321
^{4}F(^{3}P)^{4}D	1/2	76 + 7^{4}D(^{1}P)^{4}D				68240			0.019
	3/2	47 + 24A^{2}G(^{3}P)^{4}F				68239			0.877
	5/2	42 + 22A^{2}G(^{3}P)^{4}F				68073			1.230
	7/2	55 + 18A^{2}G(^{3}P)^{4}F				67992			1.371
^{2}H(^{3}P)^{4}G	5/2	17 + 13A^{2}G(^{3}P)^{4}G + 13(^{3}D)^{2}F		t ^{4}G	67965	68294	−329		0.736
	7/2	18 + 16A^{2}G(^{3}P)^{4}G + 14(^{3}G)^{4}G			67891	68251	−360		1.057
	9/2	16 + 14A^{2}G(^{3}P)^{4}G + 13(^{3}G)^{4}G			67819	68184	−365		1.222
	11/2	23 + 22A^{2}G(^{3}P)^{4}G + 18(^{3}G)^{4}G			67753	68175	−422	1.266	1.260
(^{1}I)^{2}I	11/2	53 + 19^{2}I(^{1}P)^{2}I + 18^{2}H(^{3}P)^{2}I				68363			0.938
	13/2	55 + 19^{2}I(^{1}P)^{2}I + 19^{2}H(^{3}P)^{2}I				68364			1.082
(^{3}D)^{2}F	5/2	37 + 8A^{2}G(^{3}P)^{4}G				68455			0.792
	7/2	44 + 14A^{2}F(^{3}P)^{2}F + 10A^{2}D(^{3}P)^{2}F				68668			1.156
^{4}F(^{3}P)^{4}F	3/2	51 + 25(^{3}D)^{4}F + 7A^{2}F(^{3}P)^{4}F				68583			0.432
	5/2	44 + 22(^{3}D)^{4}F + 7A^{2}F(^{3}P)^{4}F				68589			0.970
	7/2	36 + 16(^{3}D)^{4}F + 7A^{2}F(^{3}P)^{4}F				68559			1.164
	9/2	36 + 20(^{3}D)^{4}F + 9A^{2}F(^{3}P)^{4}F				68484			1.284
(^{5}D)^{6}F*	1/2	95				68426			−0.662
	3/2	95				68514			1.068
	5/2	95				68656			1.314
	7/2	96				68852			1.396
	9/2	96				69100			1.433
	11/2	96				69396			1.454
(^{3}D)^{2}P	1/2	70 + 13A^{2}D(^{3}P)^{2}P + 7(^{3}D)^{4}P				68851			0.852
	3/2	44 + 22(^{3}D)^{2}D + 7(^{3}D)^{4}P				68698			1.204
(^{3}D)^{2}D	3/2	48 + 23(^{3}D)^{2}P + 7A^{2}F(^{3}P)^{2}D				68833			0.968
	5/2	52 + 23 (^{3}D)^{4}P				68799			1.318
(A^{1}G)^{2}H	9/2	39 + 30(^{1}I)^{2}H + 12A^{2}G(^{3}P)^{2}H				68864			0.915
	11/2	43 + 25(^{1}I)^{2}H + 10A^{2}G(^{3}P)^{2}H				68862			1.090

TABLE A. *Observed and Calculated Levels of* Mn I $(3d+4s)^6 4p$ – Continued

Name	J	Percentage	CMG Config.	CMG Desig.	Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O−C	Obs. g	Calc. g
$(^3D)^4P$	1/2	$63+16(^5D)^4P^*+8(^3D)^2P$				68927			2.455
	3/2	$62+15(^5D)^4P^*+9(^3D)^2P$				68960			1.678
	5/2	$45+23(^3D)^2D+12(^5D)^4P^*$				69107			1.438
$(A^1G)^2F$	5/2	$31+29A^2F(^3P)^2F+14(^3D)^2F$				69282			0.896
	7/2	$32+26(^3D)^2F+24A^2F(^3P)^2F$				69279			1.142
$^2H(^3P)^4H$	7/2	$50+42A^2G(^3P)^4H$				69396			0.680
	9/2	$48+42A^2G(^3P)^4H$				69409			0.982
	11/2	$46+42A^2G(^3P)^4H$				69440			1.133
	13/2	$47+37A^2G(^3P)^4H$				69514			1.211
$(^5D)^6P^*$	3/2	97				69615			2.397
	5/2	96				69805			1.883
	7/2	97				70051			1.713
$(^3D)^4D$	1/2	$47+16^4D(^1P)^4D+12(^5D)^4D^*$				69722			0.008
	3/2	$47+16^4D(^1P)^4D+12(^5D)^4D^*$				69757			1.200
	5/2	$47+17^4D(^1P)^4D+12(^5D)^4D^*$				69822			1.369
	7/2	$40+15^4D(^1P)^4D+10^4F(^3P)^2G$				69958			1.349
$^2H(^3P)^2I$	11/2	$76+13^2I(^1P)^2I$				69909			0.932
	13/2	$75+11^2I(^1P)^2I$				70049			1.091
$^4F(^3P)^2G$	7/2	$55+8A^2G(^3P)^4G+7(^3D)^4D$				70044			0.982
	9/2	$55+16A^2G(^3P)^4G$				70088			1.118
$A^2G(^3P)^4G$	5/2	$46+15^4F(^3P)^4G+15^2H(^3P)^4G$				70225			0.603
	7/2	$37+13^4F(^3P)^2G+12^2H(^3P)^4G$				70305			0.972
	9/2	$35+30^4F(^3P)^2G+10^2H(^3P)^4G$				70312			1.145
	11/2	$45+17^4F(^3P)^4G+12^2H(^3P)^4G$				70090			1.259
$A^2G(^3P)^2G$	7/2	$32+30(A^1G)^2G+15^2H(^3P)^2G$				70594			0.913
	9/2	$30+31(A^1G)^2G+16^2H(^3P)^2G$				70664			1.111
$A^2G(^3P)^2F$	5/2	$37+16^4F(^3P)^2F+15(A^1D)^2F$				70747			0.865
	7/2	$41+22(A^1D)^2F+9^4F(^3P)^2F$				70809			1.118
$(A^1S)^2P$	1/2	$60\quad 17A^2D(^1P)^2P+12(A^3P)^2P$				70991			0.667
	3/2	$61+16A^2D(^1P)^2P+8(A^3P)^2P$				70707			1.330
$^4D(^1P)^4F$	3/2	$18+37B^2F(^3P)^4F+22A^2G(^3P)^4F$				71171			0.408
	5/2	$20+32B^2F(^3P)^4F+22A^2G(^3P)^4F$				71161			1.028
	7/2	$21+27B^2F(^3P)^4F+22A^2G(^3P)^4F$				71136			1.235
	9/2	$23+22A^2G(^3P)^4F+21B^2F(^3P)^4F$				71090			1.326
$B^2F(^3P)^4F$	3/2	$45+23(^3D)^4F+11(^3G)^4F$				71355			0.409
	5/2	$49+22(^3D)^4F+9(^3G)^4F$				71384			1.025
	7/2	$52+22(^3D)^4F+7(^3G)^4F$				71423			1.232
	9/2	$60+21(^3D)^4F+5(^3G)^4F$				71505			1.325
$A^2G(^3P)^2H$	9/2	$67+9^2I(^1P)^2H$				71548			0.933
	11/2	$74+10^2I(^1P)^2H$				71578			1.094
$^4F(^3P)^2D$	3/2	$81+6^4D(^3P)^2D$				71743			0.802
	5/2	$62+19A^2F(^1P)^2D$				71653			1.169
$^2H(^3P)^2H$	9/2	$41+32A^2F(^1P)^2G$				71865			1.018
	11/2	$75+10B^2F(^3P)^4G$				71937			1.094
$^4F(^3P)^2F$	5/2	$67+12A^2G(^1P)^2F+7(^3D)^2F$				71993			0.871
	7/2	$55+9^2H(^3P)^2G+8A^2G(^1P)^2F$				71770			1.085
$(A^1D)^2P$	1/2	$70+22A^2D(^1P)^2P$				71896			0.655
	3/2	$62+24A^2D(^1P)^2P$				71948			1.324
$B^2F(^3P)^4G$	5/2	$71+22^2H(^3P)^4G$				72034			0.582
	7/2	$70+21^2H(^3P)^4G$				72070			0.995

TABLE A. *Observed and Calculated Levels of* Mn I $(3d+4s)^6 4p$ – Continued

Name	J	Percentage	CMG Config.	CMG Desig.	Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O–C	Obs. g	Calc. g
	9/2	$66+22\,^2H(^3P)^4G$				72150			1.162
	11/2	$63+23\,^2H(^3P)^4G+7\,^2H(^3P)^2H$				72207			1.258
$A\,^2F(^1P)^2G$	7/2	$48+13\,^4F(^3P)^2F$				72059			0.940
	9/2	$39+38\,^2H(^3P)^2H$				71830			1.015
$(A\,^1D)^2D$	3/2	$24+30(^5D)^6D^*+13B\,^2F(^3P)^2D$				72405			1.163
	5/2	$26+28B\,^2F(^3P)^4D+6\,^4F(^3P)^2D$				72462			1.279
$(^5D)^6D^*$	1/2	91				72218			3.257
	3/2	$59+13B\,^2F(^3P)^4D+8(A\,^1D)^2D$				72340			1.537
	5/2	81				72502			1.588
	7/2	$59+28B\,^2F(^3P)^4D$				72759			1.525
	9/2	93				72940			1.548
$B\,^2F(^3P)^4D$	1/2	$74+8\,^4F(^1P)^4D+7(^5D)^4D^*$				72541			0.070
	3/2	$60+9\,^4F(^1P)^4D+6(^5D)^4D^*$				72619			1.162
	5/2	$50+13(A\,^1D)^2D+8(^5D)^6D^*$				72742			1.341
	7/2	$49+36(^5D)^6D^*+12\,^4F(^1P)^4D$				72675			1.486
$A\,^2F(^1P)^2D$	3/2	$62+19(A\,^1D)^2D$				73191			0.807
	5/2	$63+13(A\,^1D)^2D$				73138			1.199
$(A\,^1D)^2F$	5/2	$34+29A\,^2G(^1P)^2F+9(^1F)^2F$				73327			0.883
	7/2	$39+33A\,^2G(^1P)^2F$				73226			1.150
$(^5D)^4F^*$	3/2	$55+19\,^4F(^1P)^4F$				73302			0.409
	5/2	$51+20\,^4F(^1P)^4F$				73371			1.021
	7/2	$53+21\,^4F(^1P)^4F$				73454			1.241
	9/2	$52+24\,^4F(^1P)^4F$				73553			1.340
$(^5D)^4D^*$	1/2	$33+30\,^4F(^1P)^4D+8(^5D)^4P^*$				73654			0.081
	3/2	$23+20\,^4F(^1P)^4D+13(^5D)^4P^*$				73634			1.398
	5/2	$33+31\,^4F(^1P)^4D$				73690			1.373
	7/2	$32+33\,^4F(^1P)^4D$				73756			1.421
$(^5D)^4P^*$	1/2	$37+25\,^2S(^3P)^4P+13\,^4D(^1P)^4P$				73503			2.610
	3/2	$24+17\,^2S(^3P)^4P+11(^5D)^4D^*$				73738			1.527
	5/2	$35+31\,^2S(^3P)^4P+11\,^4D(^1P)^4P$				74013			1.586
$^2I(^1P)^2K$	13/2	95				74054			0.934
	15/2	96				74121			1.067
$B\,^2F(^3P)^2G$	7/2	$48+33\,^2H(^3P)^2G$				75010			0.891
	9/2	$50+32\,^2H(^3P)^2G$				75004			1.112
$^2S(^3P)^4P$	1/2	$57+9(^3D)^4P+8(^5D)^4P^*$				75173			2.665
	3/2	$54+10(^5D)^4P^*+9(^3D)^4P$				75301			1.732
	5/2	$49+13(^5D)^4P^*+9(^3D)^4P$				75522			1.599
$B\,^2F(^3P)^2F$	5/2	$79+9(A\,^1D)^2F$				75729			0.858
	7/2	$81+10(A\,^1D)^2F$				75908			1.141
$^2I(^1P)^2I$	11/2	$62+25(^1I)^2I$				76017			0.928
	13/2	$64+25(^1I)^2I$				76095			1.077
$A\,^2D(^1P)^2D$	3/2	$35+36(^1F)^2D+11(A\,^1D)^2D$				76204			0.803
	5/2	$36+32(^1F)^2D+8(A\,^1D)^2D$				76213			1.169
$^2I(^1P)^2H$	9/2	$59+8(^3G)^2H$				76332			0.915
	11/2	$60+7(^1I)^2H$				76379			1.087
$A\,^2D(^1P)^2F$	5/2	$27+25A\,^2F(^1P)^2F+10(^1F)^2F$				76798			0.883
	7/2	$29+22B\,^2F(^3P)^2G+20A\,^2F(^1P)^2F$				76568			1.065
$(^1F)^2G$	7/2	$28+15A\,^2F(^1P)^2F+10(^1F)^2F$				77082			0.982
	9/2	$40+26B\,^2F(^3P)^2G+12\,^2H(^3P)^4G$				77606			1.110

TABLE A. *Observed and Calculated Levels of* Mn I $(3d+4s)^6 4p$ – Continued

Name	J	Percentage	CMG		Obs. Level (cm^{-1})	Calc. Level (cm^{-1})	O–C	Obs. g	Calc. g
			Config.	Desig.					
$A^2D(^1P)^2P$	1/2	$36+36\,^2S(^3P)^2P$				77273			0.666
	3/2	$30+21\,^2S(^3P)^2P+12(A\,^1S)^2P$				77281			1.192
$(^1F)^2F$	5/2	$13+21\,^4F(^1P)^4G+16A^2D(^1P)^2F$				77726			0.858
	7/2	$23+23(^1F)^2G+10A^2F(^1P)^2G$				77129			1.001
$B^2F(^3P)^2D$	3/2	$33+19\,^2S(^3P)^2P+13A^2D(^1P)^2D$				78098			0.950
	5/2	$42+10(^1F)^2F$				77553			1.106
$^4F(^1P)^4G$	5/2	$60+18A^2D(^1P)^2F$				78360			0.666
	7/2	$50+19A^2F(^1P)^2G+14A^2D(^1P)^2P$				78111			0.982
	9/2	86				78231			1.169
	11/2	88				78232			1.270
$^4F(^1P)^4F$	3/2	$58+15(^5D)^4F^*$				78678			0.412
	5/2	$56+16(^5D)^4F^*$				78723			1.026
	7/2	$55+17(^5D)^4F^*$				78754			1.235
	9/2	$55+19(^5D)^4F^*$				78805			1.331
$^2S(^3P)^2P$	1/2	$48+25A^2D(^1P)^2P$				79255			0.668
	3/2	$43+26A^2D(^1P)^2P+16(A\,^1D)^2P$				79392			1.297
$A^2F(^1P)^2F$	5/2	$35+21(^1F)^2F$				79499			0.875
	7/2	$28+35\,^4F(^1P)^4G$				79523			1.139
$^2H(^3P)^2G$	7/2	$44+25(^1F)^2G$				80349			0.900
	9/2	$40+23(^1F)^2G$				80309			1.092
$(^1F)^2D$	3/2	$34+22A^2F(^1P)^2D+11(A\,^1D)^2D$				80306			0.823
	5/2	$28+22A^2F(^1P)^2D+13(A\,^1D)^2D$				80348			1.195
$^4F(^1P)^4D$	1/2	$30+41(B\,^3P)^4D+21(^5D)^4D^*$				80728			0.006
	3/2	$30+39(B\,^3P)^4D+21(^5D)^4D^*$				80897			1.195
	5/2	$33+38(B\,^3P)^4D+20(^5D)^4D^*$				81133			1.361
	7/2	$25+23(B\,^3P)^4D+23B^2D(^3P)^4D$				81627			1.386

The approximate time for the diagonalization routine on the I.B.M. 7040 computer was 7 hrs.

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