Published in final edited form as:

At Data Nucl Data Tables. 2018 ; 119: . doi:10.1016/j.adt.2017.01.002.

Multi-configuration Dirac–Hartree–Fock calculations of forbidden transitions within the $3d^k$ ground configurations of highly charged ions ($Z = 72–83$)

Z.L. Zhao^a, K. Wang^{a,b,c,*}, S. Li^b, R. Si^c, C.Y. Chen^c, Z.B. Chen^d, J. Yan^{b,**}, Yu. Ralchenko^{e,**}

^aHebei Key Lab of Optic–electronic Information and Materials, The College of Physics Science and Technology, Hebei University, Baoding 071002, China

^bInstitute of Applied Physics and Computational Mathematics, Beijing 100088, China

^cShanghai EBIT Lab, Institute of Modern Physics, Department of Nuclear Science and Technology, Fudan University, Shanghai 200433, China

^dCollege of Science, National University of Defense Technology, Changsha 410073, China

^eNational Institute of Standards and Technology, Gaithersburg, MD 20899-8422, USA

Abstract

Extensive self-consistent multi-configuration Dirac–Hartree–Fock (MCDHF) calculations are performed for the $3s^23p^63d^k$ ($k = 1–9$) ground configurations of highly charged ions ($Z = 72–83$). Complete and consistent datasets of excitation energies, wavelengths, line strengths, oscillator strengths, and magnetic dipole (M1) and electric quadrupole (E2) transition rates among all these levels are given. We have compared our results with the results available in the literature and the accuracy of the data is assessed. We predict new energy levels and transition probabilities where no other experimental or theoretical results are available, which will form the basis for future experimental work.

Keywords

Energy levels and transition rates; Multiconfiguration Dirac–Hartree–Fock; Highly charged ions ($Z = 72–83$)

1. Introduction

Highly charged ions (HCI) of high- Z elements are currently the subject of extensive research due to their great importance in atomic physics and fusion applications. From a theoretical viewpoint, complex spectra of high- Z elements provide a crucial test for advanced theories of atomic structure in a regime where strong relativistic and quantum-electrodynamic effects

*Corresponding author at: Hebei Key Lab of Optic–electronic Information and Materials, The College of Physics Science and Technology, Hebei University, Baoding 071002, China. wang_kai10@fudan.edu.cn (K. Wang). **Corresponding authors. yan_jun@iapcm.ac.cn (J. Yan), yuri.ralchenko@nist.gov (Yu. Ralchenko).

Appendix A. Supplementary data

Supplementary material related to this article can be found online at <http://dx.doi.org/10.1016/j.adt.2017.01.002>.

greatly affect ion properties [1–3]. As for fusion applications, heavy elements are routinely used in fusion environments [4–6], and their spectra provide important diagnostic information on plasma parameters. For instance, tungsten ($Z = 74$) is being implemented as the plasma-facing material in the ITER divertor region. As a result, tungsten ions will be transported from the relatively cold divertor region to the plasma core with temperatures on the order of 20 keV. Tungsten atoms will ionize to M-shell and L-shell charge states, and hence useful information for plasma diagnostics can be derived from spectral lines of these tungsten ions [7]. Also, alloys containing tantalum ($Z = 73$) are considered to be another potential candidate for a plasma-facing material in the ITER, and gold ($Z = 79$) hohlraums are often employed as targets for inertial confinement fusion studies. Therefore, physical properties of Ta and Au under the influence of hot plasmas are also being examined [4,6,8,9].

One of the most notable characteristics of HCI emission is that forbidden transitions, which are barely seen in light elements, play an important role in plasma diagnostics because the corresponding radiation intensities are often very sensitive to electron temperature and density. An effort of investigation of extreme-ultraviolet (EUV) spectra from HCI of heavy elements has been initiated at the National Institute of Standards and Technology (NIST). Various forbidden lines are often the most prominent features in such spectra [1–3,10–12]. This paper presents progress in *ab initio* atomic data and theoretical spectra of forbidden transitions within the $(1s^2 2s^2 2p^2) 3s^2 3p^6 3d^k$ ($k = 1–9$) ground configurations of highly charged ions ($Z = 72–83$). The structures are calculated using the multiconfiguration Dirac–Hartree–Fock (MCDHF) and subsequent relativistic configuration interaction (RCI) approach. The calculations yield energy levels, wavelengths, radiative rates, weighted oscillator strengths, and line strengths.

There exist many experimental investigations of forbidden transitions within the $3s^2 3p^6 3d^k$ ($k = 1–9$) ground configurations in these M-shell ions with measurements from EBITs at NIST [1–3, 12–15] and at the Lawrence Livermore National Laboratory [10]. There are also several theoretical studies (see e.g., Refs. [1,2,7,16–18]) on forbidden lines within the ground configurations of these highly charged ions with an open 3d shell. The most comprehensive set of data is presented by Ralchenko et al. [1,2] and Guo et al. [18], who modeled the spectra of Hf ($Z = 72$), Ta ($Z = 73$), W ($Z = 74$), and Au ($Z = 79$) using the Flexible Atomic Code (FAC) [19]. The present work extends the database for forbidden lines in highly charged ions relevant to fusion plasma diagnostics. Extensive comparisons with available theoretical and experimental data are discussed.

2. Calculations

Energy levels and transition properties for the forbidden transitions within the $3s^2 3p^6 3d^k$ ($k = 1–9$) ground configurations of highly charged ions ($Z = 72–83$) were obtained using the MCDHF and subsequent RCI approach (MCDHF/RCI) implemented within a new release [20] of the GRASP2K code [21]. In this method, the atom is represented by atomic state functions (ASF) $\Psi(\gamma J)$, which are linear combinations of a number of configuration state functions (CSF):

$$\Psi(\gamma J) = \sum_i c_i \Phi(\gamma_i J), \quad (1)$$

where the CSFs $\Phi(\gamma_i J)$ are constructed from single-electron Dirac orbitals, which are based on the well known rules of symmetry (parity and angular momenta) [22]. The CSFs are generated as all possible combinations of orbitals in an active set (AS), according to certain constraints, to form a restricted active space (RAS) of CSFs. The first step is to set the reference configurations, which are the $3s^2 3p^6 3d^k$ (with $k = 1, \dots, 9$) configurations in our case, in the future labeled Dirac–Fock (DF). Then the multi-configuration expansions are obtained through single and double excitations from the 3s, 3p and 3d shells of the reference configurations up to a $n_{max} l_{max}$ orbital with $l_{max} = \min(n - 1, 5)$. Because of the rapid expansion of the configuration space, especially for the Ti-, V- and Cr-like ions, we adopt different expansion techniques for different ionic stages: i) for K- and Co-like ions, $3s^{8+k} + 3s^{8+k-1} 4l + 3s^{8+k-2} 4l^2 + 3s^2(3p, 3d)^{6+k-1} nl + 3s^2(3p, 3d)^{6+k-2} n l^2$ with $n = 5, 6, 7$, and $k = 1$ or 9 (here n^m means that m electrons are arbitrarily filled in the n complex); ii) for Ca-, Sc-, Mn- and Fe-like ions, $3s^{8+k} + 3s^{8+k-1} 4l + 3s^{8+k-2} 4l^2 + 3s^2(3p, 3d)^{6+k-1} 5l + 3s^2(3p, 3d)^{6+k-2} 5l^2 + 3s^2 3p^6 3d^{k-1} nl + 3s^2 3p^6 3d^{k-2} n l^2$ with $n = 6, 7$, and $k = 2, 3, 7$ or 8; iii) for Ti-, V- and Cr-like ions, configuration expansions are similar to those of Ca-like ion, but with the highest n up to 6. In order to further reduce the size of the configuration interaction (CI) matrix, we only consider those of the configurations in the above space that directly interact with the reference configurations. Those configurations are used to optimize the atomic orbital (AO) wave functions via the multi-configuration self-consistent-field (MCSCF) method. The AO wave functions with the principle quantum numbers $n = 1, 2, 3$ are optimized together as spectroscopic orbitals with $n - l - 1$ nodes by minimizing the weighted sum (with statistical weights) $\mathcal{F}$ of all energy levels of ground configurations $3s^2 3p^6 3d^k$ together with the $3s^{8+k}$ configurations. Then the AOs of $n = 1, 2, 3$ are fixed, and AOs for $n = 4$ are optimized by minimizing the same $\mathcal{F}$ within the above configuration space expanded to $n_{max} = 4$. In succession, with the AOs of $n = 4$ fixed, the AOs are extended to $n_{max} = 5, 6, 7$ from n to $n + 1$, and the AOs with $n = 4$ are optimized as pseudo-orbitals.

Table 1 displays the computed excitation energies as functions of the increasing active sets and multireference sets for K-like W^{55+} , Ti-like W^{52+} , and Fe-like W^{48+} ions. The first column in the table represents the largest principal quantum number of the active set involved in each step of the MCDHF calculations. As can be seen from Table 1, the MCDHF excitation energies have converged in the last step ($n = 7$ for W^{48+} and W^{55+} ions, and $n = 6$ for W^{52+} ion). For instance, the contributions to the energy of the $d_{3/2}^1$ level, due to electron correlation effects with the $n = 3, 4, 5, 6, 7$ configurations, are 1176, -318, -9, 17, 7 cm^{-1} , respectively. The total contribution 810 cm^{-1} , relative to the DF energy, is about 0.13%. The computed results have also converged for the other ions in the present case when the configurations listed in the previous paragraph were included in the MCDHF calculations, which is not shown in detail here. Furthermore, the relative share of correlation effects in the total excitation energies becomes smaller with increasing Z .

After the AOs are obtained, the same configuration spaces for K- and Co-like ions are used to construct the RCI matrix to calculate the energy levels of ground configurations $3s^2 3p^6 3d^k$

and their eigenvectors with consideration of the Breit interaction as well as the dominant quantum-electrodynamical (QED) corrections — vacuum polarization, finite nuclear mass corrections and self-energy corrections. Larger configuration spaces with additional single and double excitations from the 3p shell to the $n = 6, 7$ orbitals for Ca-, Sc-, Mn- and Fe-like ions, and to the $n = 6$ orbitals for Ti-, V- and Cr-like ions, are used in RCI calculations to take into account more core-excitation correlations, which are important for convergence and accuracy of calculated energy levels and transition properties.

In Table 1 we list the energy levels of K-like W^{55+} , Ti-like W^{52+} , and Fe-like W^{48+} ions, obtained from the MCDHF/RCI calculations with the inclusion of Breit and QED effects. For a majority of levels, our Breit and QED corrected excitation energies are lower than the corresponding Coulomb energies by about 2%. Furthermore, inclusion of the Breit and QED corrections has resulted in a slightly different level orderings, such as for levels 28/29 of Ti-like W^{52+} ion. Elements with nuclear charge $Z = 72-83$ are heavy, and hence relativistic effects should be comparatively more important than the electron correlation effects.

Furthermore, to assess the accuracy of the MCDHF/RCI results we have performed further calculations using a combined RCI and many-body perturbation theory (MBPT) approach implemented in the FAC code [19,23,24]. In the MBPT approach, the Hamiltonian is taken to be the no-pair Dirac–Coulomb–Breit Hamiltonian H_{DCB} . The key feature of the RCI and MBPT approach is the partition of the Hilbert space of the system into two subspaces, i.e., a model space M and an orthogonal space N . The eigenvalues of H_{DCB} can be obtained through solving the eigenvalue problem of a non-Hermitian effective Hamiltonian in the model space M . Taking the first-order perturbation expansion of the effective Hamiltonian within the Rayleigh–Schrödinger scheme, it consists of two parts: one is the exact H_{DCB} matrix in the model space M , and the other includes perturbations from the configurations in the N space up to the second order for the level energies of interest. In the present calculation, the model space M contains configurations $3s^23p^63d^k$ with $k = 1, \dots, 9$ from K-like to Co-like ions. The N space contains all configurations formed by single and double virtual excitations of the M space. For single excitation, configurations with $n \leq 150$ and $l \leq \min(n-1, 25)$ are included. For double excitations, configurations with the inner electron promotion up to $n = 65$ and the outer electron up to $n' = 200$ are considered.

We start the energy structure calculations using an optimized local central potential, which is derived from a Dirac–Fock–Slater self-consistent field calculation with the configurations from the M space. We then perform the MBPT calculations to obtain level energies and radiative transition properties, such as transition wavelengths, line strengths, oscillator strengths, and radiative rates of all transitions among the states by using the length form. In addition to the Hamiltonian H_{DCB} , several high-order corrections such as the finite nuclear size, nuclear recoil, vacuum polarization, and electron self-energy corrections, are also taken into account in the calculations.

3. Results and discussion

3.1. Energy levels and wavelengths

The energy levels obtained using the MCDHF/RCI method described above for the $3s^23p^63d^k$ ($k = 1-9$) ground configurations of highly charged ions ($Z = 72-83$) are presented in Table 2. The symmetry J^π of the level, i.e. the total angular momentum and parity, is given in Table 2. The leading component of the eigenvector in the jj -coupling scheme is used as a label for the energy levels given in Table 2. In the notations adopted, d_- corresponds to the principal quantum number $n = 3$ and $j_- = 3/2$, while d_+ is written for $n = 3$ and $j_+ = 5/2$. The subscript after the right parenthesis is the total J value of the term within the parentheses. The notation $3s^23p^6$ is omitted.

In terms of experimental work and accurate calculations, W ions are currently the most studied ones among all the ions considered here. Therefore, the results from the present calculations are first validated against experimental data and other theoretical predictions for W. In Table 1 excitation energies for W^{48+} , W^{52+} , and W^{55+} ions from the MCDHF/RCI and MBPT calculations in this work are compared with calculated excitation energies from the previous calculations (MCDHF/RCI2) by Quinet [17], and from the calculations by Ralchenko et al. [1], using the RCI theory implemented in the FAC code. Collected in Table 1 are also observed experimental excitation energies from Ralchenko et al. [1], which have been included in the NIST database [25]. The MBPT values from Guo et al. [18] have accuracy similar to the present MBPT results and are therefore omitted in Table 1. The experimental values are available for 11 levels. Our MCDHF/RCI calculations agree with experimental values better than 0.2% for 9 levels. The largest difference is 0.4% for the level $((d_-^3)_{3/2}, (d_+^5)_{5/2})_2$ of W^{48+} . The mean relative energy difference between calculations and observations is 0.17% for MCDHF/RCI in this work, 0.16% for MBPT, and 0.30% for MCDHF/RCI2. Because of the larger extent of electron correlation effects considered in the present MCDHF/RCI calculations via including larger multiconfiguration expansions, our results are slightly better than those of the previous MCDHF/RCI2 calculations. Comparing to experimental data, the accuracy of the MCDHF/RCI and MBPT calculations is at the same level. We also make comparisons between the three calculated results (MCDHF/RCI2, RCI, and MBPT) and the MCDHF/RCI results for levels listed in Table 1. Our MBPT excitation energies agree closely with those from MCDHF/RCI calculations with the mean relative energy difference of 0.11%, whereas the mean difference between the two earlier calculations and the present MCDHF/RCI results are 0.24% for MCDHF/RCI2, and 0.52% for RCI.

To further gauge the quality of the MCDHF/RCI atomic data, in Table 3 our MCDHF/RCI wavelengths of Hf ($Z = 72$), Ta ($Z = 73$), W ($Z = 74$), and Au ($Z = 79$) ions are compared with existing experimental data, as well as with the present MBPT values and the previous calculated results. These experimental values were obtained by Ralchenko et al. [1,2] who observed a total of 158 M1 transitions from extreme ultraviolet EBIT spectra between 9 nm and 25 nm. Our MCDHF and MBPT results are in excellent agreement with observed values, i.e., better than 0.2% for most transitions, as illustrated in Fig. 1 showing the differences as a function of experimental values. For a total of 158 M1 transitions in Table 3,

our MCDHF and MBPT results agree observed values better than 0.2% for 132 and 157 transitions, respectively. For these transitions, Ralchenko et al. [1,2] also reported wavelengths computed using the RCI method developed by Gu [19]. Even if the general agreement between those values and experimental data is rather good, larger discrepancies (up to 0.7%) can be observed. Because of more complete consideration of electron correlation effects in the present MCDHF/RCI calculations via including large configuration sets, as shown in Section 2, our MCDHF/RCI results are slightly better than those of Ralchenko et al. [1,2], and the accuracy of the MCDHF/RCI and MBPT calculations is at the same level.

3.2. Transition rates

In Table 4 we present our wavelengths (λ), Babushkin form of radiative rates (A), weighted oscillator strengths (gf), and line strengths (S) from the MCDHF/RCI calculations, for 11 988 M1 transitions among all levels of the $3s^23p^63d^k$ ($k = 1-9$) ground configurations of highly charged ions ($Z = 72-83$). The corresponding results for 18 192 E2 transitions are given in Table 5. The indices adopted for the lower and upper levels of a transition are given in Table 2.

Since the M1 transitions are comparatively more important and more easily observed in experiment, we discuss these transitions in detail. Furthermore, the corresponding values from the MBPT calculations are not included in Tables 4 and 5 because the results obtained are similar to those from the MCDHF/RCI calculations for a majority of transitions — for examples, see Table 3 and Fig. 2.

Fig. 2 compares the M1 line strengths from the present MCDHF/RCI and MBPT calculations for 5004 relatively strong transitions (A -values $> 10^5 \text{ s}^{-1}$). The two sets of data agree within 2% for 4479 of 5004 transitions, within 5.2% for all transitions. This is highly satisfactory. However, differences between the two calculations for weaker transitions ($< 10^5 \text{ s}^{-1}$) are often larger and up to several orders of magnitude. The differences arise from different amount of electron correlation included in the calculations of the lower and upper levels of the transitions, and the weak transitions are usually more sensitive to cancellation among mixing coefficients. Therefore, their accuracy is always doubtful, as also discussed in detail by Hibbert [26]. However, all of these transitions have very small A -values and cannot be easily observed in experiments. Furthermore their contribution to level-population kinetics is much less important in comparison to those from the stronger transitions. Therefore, the larger differences between the different calculations for some weaker transitions do not affect the overall accuracy of the results. A similar analysis made for the E2 transitions shows that the MCDHF/RCI and MBPT calculations for all relatively strong transitions agree within 5%. Therefore, the accuracy of the E2 transitions is comparable to those of the M1 ones discussed above.

In Table 3 the transition rates for Hf ($Z = 72$), Ta ($Z = 73$), W ($Z = 74$) and Au ($Z = 79$) ions from our present MCDHF/RCI calculations are compared with calculated rates from our MBPT calculations, as well as with the values from the RCI calculations reported by Osin et al. [2]. These transitions listed in Table 3 have been observed by Ralchenko et al. [1,2]. The agreement between the MCDHF/RCI and MBPT results is within 4% for all transitions

listed in Table 3. Similar agreement can be found between the present and previous calculations, except for the $(d_+^2)_4 - ((d_-^3)_{3/2}, (d_+^3)_{5/2})_4$ transition in the Cr-like Au ion. For this transition, the RCI value is an order of magnitude greater than those from the MCDHF/RCI and MBPT calculations, which is due to a misprint in Ref. [2].

The uncertainties for line strengths in the last column of Tables 4 and 5 were calculated as follows. For each transition the absolute value of the difference of the MCDHF and MBPT S -values δS_{ij} was determined. Then, the average of those δS_{ij} values, δS_{av} was calculated for each decade of S -values (i.e., $1 < S_{ij} < 10$, $0.1 < S_{ij} < 1$, etc.). Finally, the larger of δS_{ij} and δS_{av} was accepted as the uncertainty of each particular line strength.

4. Conclusions

In the present work, we carry out systematic calculations for excitation energies and radiative transition properties of the $3s^2 3p^6 3d^k$ ($k = 1-9$) ground configurations of highly charged ions ($Z = 72-83$). The calculations were performed by using the MCDHF and subsequent RCI approach (MCDHF/RCI) implemented within a new release [20] of the GRASP2K code [21], and a very large configuration expansion is used to take into account electron correlation effects.

The present MCDHF/RCI calculations provide a complete and consistent dataset for all levels of the $3s^2 3p^6 3d^k$ ($k = 1-9$) ground configurations of these highly charged ions. Comparisons with available observations and the present MBPT and previous calculations show that the present MCDHF/RCI results are highly accurate: for most excitation energies, the uncertainty should be less than 0.2%; for transition rates, the accuracy is better than 5% for most strong transitions. Since considerably larger amount of correlation effects are considered in the present MCDHF/RCI calculations, the resulting values represent an improvement in accuracy compared with earlier MCDHF/RCI works such as Quinet [17]. Comparing with the present MBPT calculations, the accuracy of the two calculations is at the same level. Thus the present work has significantly increased the amount of available accurate data for forbidden transitions within the $3s^2 3p^6 3d^k$ ($k = 1-9$) ground configurations in highly charged ions.

Explanation of Tables

Table 1.

Energy levels of K-like W^{55+} , Ti-like W^{52+} , and Fe-like W^{48+} ions relative to the ground level (in cm^{-1}).

Sequence	Isoelectronic sequence.
Key	A number assigned to each level.
Level	The jj designation of the level, with $1s^2 2s^2 2p^6 3s^2 3p^6$ omitted. In the notations adopted, d_+ corresponds to the principal quantum number $n = 3$ and $j_- = 3/2$, while d_+ is written for $n = 3$ and $j_+ = 5/2$. The subscript after the right parenthesis is the total J value of the terms inside the parentheses.
DF	Dirac-Fock excitation energies.
Electron correlation	Excitation energies obtained in each step of the MCDHF calculations, where $n = 3$ denotes the orbital set with the maximum principal quantum number $n = 3$, etc.

MCDHF/RCI	Excitation energies from the present MCDHF/RCI calculations.
MBPT	Excitation energies from the present MBPT calculations.
Exp.	Experimental excitation energies from Ralchenko et al. [1].
RCI	Excitation energies from the previous RCI calculations by Ralchenko et al. [1].
MCDHF/RCI2	Excitation energies from the previous MCDHF/RCI calculations by Quinet [17].

Table 2.

Energy levels of the $3s^23p^63d^k$ ($k = 1-9$) ground configurations of highly charged ions ($Z = 72-83$) relative to the ground state (in cm^{-1}) from the present MCDHF/RCI calculations.

Sequence	Isoelectronic sequence.
Z	The nuclear charge.
Key	A number assigned to each level.
Level	The jj designation of the level, with $1s^22s^22p^63s^23p^6$ omitted. In the notations adopted, d_- corresponds to the principal quantum number $n = 3$ and $j_- = 3/2$, while d_+ is written for $n = 3$ and $j_+ = 5/2$. The subscript after the right parenthesis is the total J value of the terms inside the parentheses.
J^π	The symmetry J^π of each level, i.e. the total angular momentum and parity.
Energy(cm^{-1})	Level energies relative to the ground state.

Table 3.

Comparisons of wavelengths (nm) and transition rates (s^{-1}) for some forbidden transitions of Hf ($Z = 72$), Ta ($Z = 73$), W ($Z = 74$) and Au ($Z = 79$) ions. These transitions have been observed by Ralchenko et al. [1,2].

Z	The nuclear charge.
Sequence	Isoelectronic sequence.
i	The number of the lower level.
Lower level	The jj designation of the lower level.
j	The number of the upper level.
Upper level	The jj designation of the upper level.
Exp.	The experimental results obtained by Ralchenko "etal [1,2].
MCDHF/RCI	The results of the present MCDHF/RCI calculations.
MBPT	The results of the present MBPT calculations.
RCI	The results of the RCI calculations by Ralchenko "etal [1,2].

Table 4.

Wavelengths (λ , in nm), transition rates (A , in s^{-1}), weighted oscillator strengths (gf , dimensionless) and line strengths (S , in atomic unit) with the uncertainties (in %), for 11 988 M1 transitions among all levels of the $3s^23p^63d^k$ ($k = 1-9$) ground configurations of highly charged ions ($Z = 72-83$).

Sequence	Isoelectronic sequence.
Z	The nuclear charge.

i	The number of the lower level.
Lower level	The jj designation of the lower level.
j	The number of the upper level.
Lower level	The jj designation of the upper level.
λ	Wavelengths of the present MCDHF/RCI calculations.
A	Transition rates of the present MCDHF/RCI calculations.
gf	Weighted oscillator strengths of the present MCDHF/RCI calculations.
S	Line strengths of the present MCDHF/RCI calculations.
Unc.	Uncertainties (in %) of line strengths.

Table 5.

Wavelengths (λ , in nm), transition rates (A , in s^{-1}), weighted oscillator strengths (gf , dimensionless) and line strengths (S , in atomic unit) with the uncertainties (in %), for 18 192 E2 transitions among all levels of the $3s^23p^63d^k$ ($k = 1-9$) ground configurations of highly charged ions ($Z = 72-83$).

Sequence	Isoelectronic sequence.
Z	The nuclear charge.
i	The number of the lower level.
Lower level	The jj designation of the lower level.
j	The number of the upper level.
Lower level	The jj designation of the upper level.
λ	Wavelengths of the present MCDHF/RCI calculations.
A	Transition rates of the present MCDHF/RCI calculations.
gf	Weighted oscillator strengths of the present MCDHF/RCI calculations.
S	Line strengths of the present MCDHF/RCI calculations.
Unc.	Uncertainties (in %) of line strengths.

Acknowledgments

The authors acknowledge the support of the National Natural Science Foundation of China (Grant Nos. 11674066, 11504421, and 11474034). This work is also supported by China Scholarship Council (Grant No. 201608130201), the Chinese Association of Atomic and Molecular Data, Chinese National Fusion Project for ITER No. 2015GB117000, and China Post-doctoral Science Foundation (Grant No. 2016M593019). The authors express their gratitude to Dr. Alexander Kramida of the National Institute of Standards and Technology, Gaithersburg, USA for the helpful discussions and detailed modifications on this paper. J. Yan would especially like to acknowledge the support from the visiting researcher program at the National Institute of Standards and Technology. K. Wang and S. Li express their gratitude for the support from the visiting researcher program at the Fudan University.

References

1. Ralchenko Yu., Dragani IN, Osin D, Gillaspay JD, Reader J, Phys. Rev. A 83 (2011) 032517.
2. Osin D, Gillaspay JD, Reader J, Ralchenko Yu., Eur. Phys. J. D 66 (2012) 286.
3. Ralchenko Yu., Gillaspay JD, Reader J, Osin D, Curry JJ, Podpaly YA, Phys. Scr. T 156 (2013) 014082.
4. Fischer U, Pereslavitsev P, Möslang A, Rieth M, J. Nucl. Mater 386 (2009) 789–792.

5. Hawryluk RJ, Campbell DJ, Janeschitz G, Thomas PR, Albanese R, Ambrosino R, Bachmann C, Baylor L, Becoulet M, Benfatto I, Bialek J, Boozer A, Brooks A, Budny R, Casper T, Cavinato M, Cordier J-J, Chuyanov V, Doyle E, Evans T, Federici G, Fenstermacher M, Fujieda H, G' al K, Garofalo A, Garzotti L, Gates D, Gribov Y, Heitzenroeder P, Hender TC, Holtkamp N, Humphreys D, Hutchinson I, Ioki K, Johnner J, Johnson G, Kamada Y, Kavin A, Kessel C, Khayrutdinov R, Kramer G, Kukushkin A, Lackner K, Landman I, Lang P, Liang Y, Linke J, Lipschultz B, Loarte A, Loesser GD, Lowry C, Luce T, Lukash V, Maruyama S, Mattei M, Menard J, Merola M, Mineev A, Mitchell N, Nardon E, Nazikian R, Nelson B, Neumeyer C, Park J-K, Pearce R, Pitts RA, Polevoi A, Portone A, Okabayashi M, Rebut PH, Riccardo V, Roth J, Sabbagh S, Saibene G, Sannazzaro G, Schaffer M, Shimada M, Sen A, Sips A, Skinner CH, Snyder P, Stambaugh R, Strait E, Sugihara M, Tsitrone E, Urano J, Valovic M, Wade M, Wesley J, White R, Whyte DG, Wu S, Wykes M, Zakharov L, Nucl. Fusion 49 (2009) 065012.
6. Cook R, Kozioziemski B, Nikroo A, Wilkens H, Bhandarkar S, Forsman A, Haan S, Hoppe M, Huang H, Mapoles E, Moody J, Sater J, Seugling R, Stephens R, Takagi M, Xu H, Laser Part. Beams 26 (2008) 479–487.
7. Clementson J, Beiersdorfer P, Brage T, Gu M, At. Data Nucl. Data Tables 100 (2014) 577–649.
8. Hirai T, Rubel M, Philips V, Huber A, Tanabe T, Wada M, Ohgo T, Pospieszczyk A, Sergienko G, Wienhold P, Physica Scr. T 103 (2003) 59.
9. Glenzer SH, Spears BK, Edwards MJ, Alger ET, Berger RL, Bleuel DL, Bradley DK, Caggiano JA, Callahan DA, Castro C, Casey DT, Choate C, Clark DS, Cerjan CJ, Collins GW, Dewald EL, Nicola J-MGD, Nicola PD, Divol L, Dixit SN, Döppner T, Dylla-Spears R, Dzenitis EG, Fair JE, Frenje LJA, Johnson MG, Giraldez E, Glebov V, Glenn SM, Haan SW, Hammel BA, Hatchett SP, Haynam CA, Heeter RF, Heestand GM, Herrmann HW, Hicks DG, Holunga DM, Horner JB, Huang H, Izumi N, Jones OS, Kalantar DH, Kilkenny JD, Kirkwood RK, Kline JL, Knauer JP, Kozioziemski B, Kritcher AL, Kroll JJ, Kyrala GA, LaFortune KN, Landen OL, Larson DW, Leeper RJ, Pape SL, Lindl JD, Ma T, Mackinnon AJ, MacPhee AG, Mapoles E, McKenty PW, Meezan NB, Michel P, Milovich JL, Moody JD, Moore AS, Moran M, Moreno KA, Munro DH, Nathan BR, Nikroo A, Olson RE, Orth CD, Pak A, Patel PK, Parham T, Petrasso R, Ralph JE, Rinderknecht H, Regan SP, Robey HF, Ross JS, Salmonson JD, Sangster C, Sater J, Schneider MB, Séguin FH, Shaw MJ, Shoup MJ, Springer PT, Stoeffl W, Suter LJ, Thomas CA, Town RPJ, Walters C, Weber SV, Wegner PJ, Widmayer C, Whitman PK, Widmann K, Wilson DC, Wouterghem BMV, MacGowan BJ, Atherton LJ, Moses EI, Plasma Phys. Control. Fusion 54 (2012) 045013.
10. Utter S, Beiersdorfer P, Brown G, Phys. Rev. A 61 (2000) 030503.
11. Ralchenko Yu., Tan JN, Gillaspy JD, Pomeroy JM, Silver E, Phys. Rev. A 74 (2006) 042514.
12. Ralchenko Yu., Draganic I, Tan J, Gillaspy J, Pomeroy J, Reader J, Feldman U, Holland G, J. Phys. B: At. Mol. Opt. Phys 41 (2008) 021003.
13. Porto JV, Kink I, Gillaspy JD, Phys. Rev. A 61 (2000) 054501.
14. Ralchenko Yu., Reader J, Pomeroy JM, Tan JN, Gillaspy JD, J. Phys. B: At., Mol. Opt. Phys 40 (2007) 3861.
15. Dragani IN, Ralchenko Yu., Reader J, Gillaspy JD, Tan JN, Pomeroy JM, Brewer SM, Osin D, J. Phys. B: At., Mol. Opt. Phys 44 (2011) 025001.
16. Fournier K, At. Data Nucl. Data Table 68 (1998) 1–48.
17. Quinet P, J. Phys. B: At., Mol. Opt. Phys 44 (2011) 195007.
18. Guo XL, Huang M, Yan J, Li S, Si R, Li CY, Chen CY, Wang YS, Zou YM, J. Phys. B: At. Mol. Phys 48 (2015) 144020.
19. Gu MF, Can. J. Phys 86 (2008) 675–689.
20. Jönsson P, Gaigalas G, Biero J, Fischer CF, Grant IP, Comput. Phys. Comm 184 (2013) 2197–2203.
21. Jönsson P, He X, Fischer CF, Grant I, Comput. Phys. Comm 177 (2007) 597–622.
22. Grant I, McKenzie B, Norrington P, Mayers D, Pyper N, Comput. Phys. Comm 21 (1980) 207–231.
23. Gu M, At. Data Nucl. Data Tables 89 (2005) 267–293.
24. Gu MF, Holczner T, Behar E, Kahn SM, Astrophys. J 641 (2006) 1227.

25. Kramida A, Ralchenko Yu., Reader J, NIST ASD Team, NIST Atomic Spectra Database (version 5.2), [Online]. Available: Wednesday, 17-Sep-2014 22:29:50 EDT. National Institute of Standards and Technology, Gaithersburg, MD. 2014.
26. Hibbert A, Phys. Scr. T T120 (2005) 71.

NIST Author Manuscript

NIST Author Manuscript

NIST Author Manuscript

HIGHLIGHTS

- Energy levels and transition rates for the $3s^23p^63d^k$ ($k = 1-9$) ground configurations of highly charged ions ($Z = 72-83$) are reported.
- Uncertainties for level energies are less than 0.2% for most levels, and accuracies for transition rates are better than 5% for most transitions.

Fig. 1. Permillage differences between the experimental and theoretical wavelengths for the forbidden transitions of Hf ($Z=72$), Ta ($Z=73$), W ($Z=73$) and Au ($Z=79$) ions. The squares, the circles, and the up-triangles stand for the permillage differences between the experimental wavelengths and the present MCDHF/RCI ones, the present MBPT ones, and the RCI ones [1,2], respectively. The experimental wavelengths are those from Ralchenko et al. [1,2]. The horizontal lines indicate the 0.2% differences of the experimental and theoretical wavelengths.

Fig. 2. Percentage differences of the M1 line strengths from the present MCDHF/RCI and MBPT calculations for 5004 relatively strong transitions. The horizontal line indicates the 2% differences of the two calculations.

Table 1

Energy levels of K-like W^{55+} , Ti-like W^{52+} , and Fe-like W^{48+} ions relative to the ground state. See Explanation of Tables.

Sequence	Key	Level	DF	Electron correlation				Present calculations			Expt.	Other calculations	
				$n = 3$	$n = 4$	$n = 5$	$n = 6$	$n = 7$	MCDHF/RCI	MBPT		RCI	MCDHF/RCI2
K	1	$(d_{-}^1)_{3/2}$	0	0	0	0	0	0	0	0	0	0	0
K	2	$(d_{+}^1)_{5/2}$	638774	639950	639569	639560	639577	639584	625546	626558	626490		624700
Ti	1	$(d_{-}^4)_0$	0	0	0	0	0		0	0	0.0		0
Ti	2	$((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2})_1$	523541	530239	528965	529164	529273		516668	518082	517630		516000
Ti	3	$((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2})_4$	634757	643185	640196	639838	639845		613992	614779		613000	615600
Ti	4	$((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2})_2$	655279	660378	657924	657430	657463		638623	639336		638000	639900
Ti	5	$((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2})_3$	684343	689998	686803	686183	686185		666483	667034	665562.1		668600
Ti	6	$((d_{-}^2)_{2}, (d_{+}^2)_{2})_0$	1121586	1127856	1125942	1126136	1126261		1103102	1104654		1100000	1101600
Ti	7	$((d_{-}^2)_{2}, (d_{+}^2)_{4})_2$	1127460	1136750	1134116	1133925	1134036		1108069	1110009	1109690		1107600
Ti	8	$((d_{-}^2)_{2}, (d_{+}^2)_{4})_4$	1153466	1166761	1163153	1163043	1163151		1127004	1129103	1127270		1127300
Ti	9	$((d_{-}^2)_{2}, (d_{+}^2)_{4})_3$	1167207	1178113	1174372	1174144	1174261		1143407	1145187		1141000	1144000
Ti	10	$((d_{-}^2)_{2}, (d_{+}^2)_{4})_5$	1205952	1221569	1216700	1216247	1216308		1173801	1175594	1173350		1175700
Ti	11	$((d_{-}^2)_{2}, (d_{+}^2)_{4})_6$	1236203	1246999	1243748	1243051	1243109		1197238	1199016		1213000	1215400
Ti	12	$((d_{-}^2)_{2}, (d_{+}^2)_{2})_1$	1241400	1254627	1248980	1248376	1248406		1214642	1215630		1195000	1200000
Ti	13	$((d_{-}^2)_{2}, (d_{+}^2)_{2})_3$	1273004	1280079	1275663	1274723	1274747		1240250	1240981		1240000	1242500
Ti	14	$((d_{-}^2)_{2}, (d_{+}^2)_{2})_4$	1280762	1289861	1285301	1284541	1284549		1243629	1244467		1243000	1245700

Sequence	Key	Level	DF	Electron correlation				Present calculations			Expt.	Other calculations	
				$n = 3$	$n = 4$	$n = 5$	$n = 6$	$n = 7$	MCDHF/RCI	MBPT		RCI	MCDHF/RCI2
Ti	15	$((d_{-}^{2})_{2}, (d_{+}^{2})_{2})_{2}$	1292655	1297908	1294041	1292956	1292973		1258785	1259414		1258000	1260600
Ti	16	$((d_{-}^{2})_{2}, (d_{+}^{2})_{0})_{2}$	1392568	1392394	1389619	1388325	1388217		1359851	1360339		1361000	1361100
Ti	17	$((d_{-}^{2})_{0}, (d_{+}^{2})_{4})_{4}$	1441383	1446479	1441199	1439479	1439392		1404516	1405097	1403950		1408600
Ti	18	$((d_{-}^{2})_{0}, (d_{+}^{2})_{2})_{2}$	1544292	1541778	1537102	1534960	1534794		1506160	1505807		1509000	1510300
Ti	19	$((d_{-}^{2})_{0}, (d_{+}^{2})_{0})_{0}$	1671639	1663551	1660212	1657722	1657461		1633256	1632724		1637000	1636500
Ti	20	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_{4}$	1753348	1765844	1761941	1761713	1761812		1716040	1718484		1715300	1715300
Ti	21	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_{3}$	1762019	1771849	1768396	1768069	1768164		1726902	1729137		1725900	1725900
Ti	22	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_{1}$	1803836	1808649	1805679	1805174	1805234		1768153	1769685		1767100	1767100
Ti	23	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_{5}$	1821629	1836093	1831027	1830421	1830480		1775645	1777827		1776400	1776400
Ti	24	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_{6}$	1829238	1848499	1842599	1841929	1841970		1780809	1783269		1782400	1782400
Ti	25	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_{2}$	1885418	1890655	1886918	1885790	1885796		1842543	1843879		1842900	1842900
Ti	26	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_{3}$	1906239	1911760	1907290	1906165	1906159		1859109	1860164		1860200	1860200
Ti	27	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_{0}$	1976002	1971486	1966978	1965592	1965528		1923958	1923351		1925800	1925800
Ti	28	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{5/2})_{3}$	2028101	2031113	2026036	2024298	2024210		1981124	1981900		1987200	1987200
Ti	29	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{5/2})_{1}$	2027376	2027110	2022518	2020661	2020594		1984926	1985419		1983600	1983600
Ti	30	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{5/2})_{4}$	2036730	2041071	2036003	2034240	2034120		1986139	1987007		1988700	1988700
Ti	31	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{5/2})_{2}$	2069819	2068669	2063536	2061412	2061289		2019600	2019660		2022800	2022800
Ti	32	$(d_{+}^{4})_{4}$	2431574	2439784	2436192	2435605	2435620		2378085	2380495		2376100	2376100

Sequence	Key	Level	DF	Electron correlation					Present calculations			Expt.	Other calculations	
				$n = 3$	$n = 4$	$n = 5$	$n = 6$	$n = 7$	MCDHF/RCI	MBPT	RCI		MCDHF/RCI2	
Ti	33	$(d^4_+)_2$	2516374	2518814	2515024	2513669	2513626		2462037	2463537			2461400	
Ti	34	$(d^4_+)_0$	2723519	2713119	2710358	2708243	2708003		2663437	2663576			2663500	
Fe	1	$(d^4_+)_4$	0	0	0	0	0	0	0	0	0	0	0	
Fe	2	$(d^4_+)_2$	72308	72898	67406	66365	66318	66294	71877	71256	73400		72800	
Fe	3	$(d^4_+)_0$	232312	230875	220176	218073	217905	217834	229215	228176	233000		230700	
Fe	4	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_3$	533575	524993	533383	533636	533661	533670	525603	526129	526650		523200	
Fe	5	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_2$	612227	601723	608794	607734	607720	607704	600612	600683	603120		599700	
Fe	6	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_1$	649796	644830	645520	643401	643378	643349	642204	642131	644700		642700	
Fe	7	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_4$	660721	646911	658996	657780	657718	657684	644199	644031	644760		645000	
Fe	8	$(d^2_-)_2$	1128621	1107273	1125465	1125388	1125393	1125391	1107581	1108165	1106000		1103600	
Fe	9	$(d^2_-)_0$	1329032	1305566	1316993	1314869	1314716	1314646	1304143	1304055	1306000		1301700	

Table 2

Energy levels from the present MCDHF/RCI calculations. See Explanation of Tables.

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
K	72	1	$(d_{-}^{1-})_{3/2}$	$3/2^e$	0.00
K	72	2	$(d_{+}^{1-})_{5/2}$	$5/2^e$	549756.52
K	73	1	$(d_{-}^{1-})_{3/2}$	$3/2^e$	0.00
K	73	2	$(d_{+}^{1-})_{5/2}$	$5/2^e$	586724.05
K	74	1	$(d_{-}^{1-})_{3/2}$	$3/2^e$	0.00
K	74	2	$(d_{+}^{1-})_{5/2}$	$5/2^e$	625546.08
K	75	1	$(d_{-}^{1-})_{3/2}$	$3/2^e$	0.00
K	75	2	$(d_{+}^{1-})_{5/2}$	$5/2^e$	666286.16
K	76	1	$(d_{-}^{1-})_{3/2}$	$3/2^e$	0.00
K	76	2	$(d_{+}^{1-})_{5/2}$	$5/2^e$	709009.31
K	77	1	$(d_{-}^{1-})_{3/2}$	$3/2^e$	0.00
K	77	2	$(d_{+}^{1-})_{5/2}$	$5/2^e$	753781.29
K	78	1	$(d_{-}^{1-})_{3/2}$	$3/2^e$	0.00
K	78	2	$(d_{+}^{1-})_{5/2}$	$5/2^e$	800669.96
K	79	1	$(d_{-}^{1-})_{3/2}$	$3/2^e$	0.00
K	79	2	$(d_{+}^{1-})_{5/2}$	$5/2^e$	849744.11
K	80	1	$(d_{-}^{1-})_{3/2}$	$3/2^e$	0.00

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
K	80	2	$(d^1_+)^{5/2}$	5/2 ^e	901074.28
K	81	1	$(d^1_-)^{3/2}$	3/2 ^e	0.00
K	81	2	$(d^1_+)^{5/2}$	5/2 ^e	954731.56
K	82	1	$(d^1_-)^{3/2}$	3/2 ^e	0.00
K	82	2	$(d^1_+)^{5/2}$	5/2 ^e	1010789.10
K	83	1	$(d^1_-)^{3/2}$	3/2 ^e	0.00
K	83	2	$(d^1_+)^{5/2}$	5/2 ^e	1069320.99
Ca	72	1	$(d^2_-)^2$	2 ^e	0.00
Ca	72	2	$(d^2_-)^0$	0 ^e	177894.83
Ca	72	3	$((d^1_-)^{3/2}, (d^1_+)^{5/2})_3$	3 ^e	511235.31
Ca	72	4	$((d^1_-)^{3/2}, (d^1_+)^{5/2})_2$	2 ^e	591478.76
Ca	72	5	$((d^1_-)^{3/2}, (d^1_+)^{5/2})_4$	4 ^e	618483.33
Ca	72	6	$((d^1_-)^{3/2}, (d^1_+)^{5/2})_1$	1 ^e	628330.90
Ca	72	7	$(d^2_+)^4$	4 ^e	1086796.93
Ca	72	8	$(d^2_+)^2$	2 ^e	1147648.83
Ca	72	9	$(d^2_+)^0$	0 ^e	1333855.52
Ca	73	1	$(d^2_-)^2$	2 ^e	0.00
Ca	73	2	$(d^2_-)^0$	0 ^e	181880.15

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Ca	73	3	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_3$	3 ^e	547010.68
Ca	73	4	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_2$	2 ^e	628667.88
Ca	73	5	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	656390.49
Ca	73	6	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	666541.18
Ca	73	7	$(d_{+}^2)_4$	4 ^e	1159157.64
Ca	73	8	$(d_{+}^2)_2$	2 ^e	1221722.25
Ca	73	9	$(d_{+}^2)_0$	0 ^e	1410916.64
Ca	74	1	$(d_{-}^2)_2$	2 ^e	0.00
Ca	74	2	$(d_{-}^2)_0$	0 ^e	185876.33
Ca	74	3	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_3$	3 ^e	584622.98
Ca	74	4	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_2$	2 ^e	667700.36
Ca	74	5	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	696108.85
Ca	74	6	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	706606.82
Ca	74	7	$(d_{+}^2)_4$	4 ^e	1235207.04
Ca	74	8	$(d_{+}^2)_2$	2 ^e	1299479.68
Ca	74	9	$(d_{+}^2)_0$	0 ^e	1491689.83
Ca	75	1	$(d_{-}^2)_2$	2 ^e	0.00
Ca	75	2	$(d_{-}^2)_0$	0 ^e	189883.96

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ca	75	3	$\left((d^-)_{3/2}, (d^+)_{5/2}\right)_3$	3 ^e	624135.16
Ca	75	4	$\left((d^-)_{3/2}, (d^+)_{5/2}\right)_2$	2 ^e	708639.13
Ca	75	5	$\left((d^-)_{3/2}, (d^+)_{5/2}\right)_4$	4 ^e	737702.65
Ca	75	6	$\left((d^-)_{3/2}, (d^+)_{5/2}\right)_1$	1 ^e	748591.05
Ca	75	7	$(d^+)_4$	4 ^e	1315069.90
Ca	75	8	$(d^+)_2$	2 ^e	1381047.38
Ca	75	9	$(d^+)_0$	0 ^e	1576301.21
Ca	76	1	$(d^-)_2$	2 ^e	0.00
Ca	76	2	$(d^-)_0$	0 ^e	193903.65
Ca	76	3	$\left((d^-)_{3/2}, (d^+)_{5/2}\right)_3$	3 ^e	665611.73
Ca	76	4	$\left((d^-)_{3/2}, (d^+)_{5/2}\right)_2$	2 ^e	751548.63
Ca	76	5	$\left((d^-)_{3/2}, (d^+)_{5/2}\right)_4$	4 ^e	781237.50
Ca	76	6	$\left((d^-)_{3/2}, (d^+)_{5/2}\right)_1$	1 ^e	792558.56
Ca	76	7	$(d^+)_4$	4 ^e	1398874.13
Ca	76	8	$(d^+)_2$	2 ^e	1466554.64
Ca	76	9	$(d^+)_0$	0 ^e	1664879.97
Ca	77	1	$(d^-)_2$	2 ^e	0.00
Ca	77	2	$(d^-)_0$	0 ^e	197936.02

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ca	77	3	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_3$	3 ^e	709117.89
Ca	77	4	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_2$	2 ^e	796494.05
Ca	77	5	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	826779.60
Ca	77	6	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	838574.83
Ca	77	7	$(d_{+}^2)_4$	4 ^e	1486749.21
Ca	77	8	$(d_{+}^2)_2$	2 ^e	1556132.20
Ca	77	9	$(d_{+}^2)_0$	0 ^e	1757556.69
Ca	78	1	$(d_{-}^2)_2$	2 ^e	0.00
Ca	78	2	$(d_{-}^2)_0$	0 ^e	201981.66
Ca	78	3	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_3$	3 ^e	754720.91
Ca	78	4	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_2$	2 ^e	843542.57
Ca	78	5	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	874397.11
Ca	78	6	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	886707.30
Ca	78	7	$(d_{+}^2)_4$	4 ^e	1578828.83
Ca	78	8	$(d_{+}^2)_2$	2 ^e	1649914.89
Ca	78	9	$(d_{+}^2)_0$	0 ^e	1854465.98
Ca	79	1	$(d_{-}^2)_2$	2 ^e	0.00
Ca	79	2	$(d_{-}^2)_0$	0 ^e	206041.19

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ca	79	3	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_3$	3 ^e	802489.05
Ca	79	4	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_2$	2 ^e	892762.43
Ca	79	5	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	924159.12
Ca	79	6	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	937024.49
Ca	79	7	$(d_{+}^2)_4$	4 ^e	1675248.83
Ca	79	8	$(d_{+}^2)_2$	2 ^e	1748039.57
Ca	79	9	$(d_{+}^2)_0$	0 ^e	1955744.71
Ca	80	1	$(d_{-}^2)_2$	2 ^e	0.00
Ca	80	2	$(d_{-}^2)_0$	0 ^e	210115.21
Ca	80	3	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_3$	3 ^e	852492.22
Ca	80	4	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_2$	2 ^e	944223.46
Ca	80	5	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	976136.22
Ca	80	6	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	989596.46
Ca	80	7	$(d_{+}^2)_4$	4 ^e	1776148.33
Ca	80	8	$(d_{+}^2)_2$	2 ^e	1850646.33
Ca	80	9	$(d_{+}^2)_0$	0 ^e	2061532.68
Ca	81	1	$(d_{-}^2)_2$	2 ^e	0.00
Ca	81	2	$(d_{-}^2)_0$	0 ^e	214204.34

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ca	81	3	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_3$	3 ^e	904800.99
Ca	81	4	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_2$	2 ^e	997996.21
Ca	81	5	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	1030399.61
Ca	81	6	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	1044494.06
Ca	81	7	$(d_{+}^2)_4$	4 ^e	1881667.90
Ca	81	8	$(d_{+}^2)_2$	2 ^e	1957876.64
Ca	81	9	$(d_{+}^2)_0$	0 ^e	2171971.32
Ca	82	1	$(d_{-}^2)_2$	2 ^e	0.00
Ca	82	2	$(d_{-}^2)_0$	0 ^e	218309.18
Ca	82	3	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_3$	3 ^e	959487.93
Ca	82	4	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_2$	2 ^e	1054153.21
Ca	82	5	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	1087022.44
Ca	82	6	$\left((d_{-}^1)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	1101790.06
Ca	82	7	$(d_{+}^2)_4$	4 ^e	1991952.21
Ca	82	8	$(d_{+}^2)_2$	2 ^e	2069875.98
Ca	82	9	$(d_{+}^2)_0$	0 ^e	2287205.98
Ca	83	1	$(d_{-}^2)_2$	2 ^e	0.00
Ca	83	2	$(d_{-}^2)_0$	0 ^e	222430.33

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Ca	83	3	$\left((d_{-}^{1})_{3/2}, (d_{+}^{1})_{5/2}\right)_3$	3 ^e	1016626.50
Ca	83	4	$\left((d_{-}^{1})_{3/2}, (d_{+}^{1})_{5/2}\right)_2$	2 ^e	1112767.88
Ca	83	5	$\left((d_{-}^{1})_{3/2}, (d_{+}^{1})_{5/2}\right)_4$	4 ^e	1146078.65
Ca	83	6	$\left((d_{-}^{1})_{3/2}, (d_{+}^{1})_{5/2}\right)_1$	1 ^e	1161558.15
Ca	83	7	$(d_{+}^{2})_4$	4 ^e	2107147.73
Ca	83	8	$(d_{+}^{2})_2$	2 ^e	2186791.59
Ca	83	9	$(d_{+}^{2})_0$	0 ^e	2407383.68
Sc	72	1	$(d_{-}^3)_{3/2}$	3/2 ^e	0.00
Sc	72	2	$\left((d_{-}^{2})_2, (d_{+}^{1})_{5/2}\right)_{5/2}$	5/2 ^e	458657.12
Sc	72	3	$\left((d_{-}^{2})_2, (d_{+}^{1})_{5/2}\right)_{3/2}$	3/2 ^e	508409.27
Sc	72	4	$\left((d_{-}^{2})_2, (d_{+}^{1})_{5/2}\right)_{7/2}$	7/2 ^e	537429.07
Sc	72	5	$\left((d_{-}^{2})_2, (d_{+}^{1})_{5/2}\right)_{9/2}$	9/2 ^e	538443.59
Sc	72	6	$\left((d_{-}^{2})_2, (d_{+}^{1})_{5/2}\right)_{1/2}$	1/2 ^e	549846.70
Sc	72	7	$\left((d_{-}^{2})_0, (d_{+}^{1})_{5/2}\right)_{5/2}$	5/2 ^e	729280.79
Sc	72	8	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_4\right)_{7/2}$	7/2 ^e	985965.06
Sc	72	9	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_4\right)_{9/2}$	9/2 ^e	1021737.60
Sc	72	10	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_2\right)_{3/2}$	3/2 ^e	1061143.39
Sc	72	11	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_2\right)_{1/2}$	1/2 ^e	1084104.13

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Sc	72	12	$((d_{-}^1)_{3/2}, (d_{+}^2)_{4/11/2})$	$11/2^e$	1097401.20
Sc	72	13	$((d_{-}^1)_{3/2}, (d_{+}^2)_{4/5/2})$	$5/2^e$	1098838.24
Sc	72	14	$((d_{-}^1)_{3/2}, (d_{+}^2)_{2/5/2})$	$5/2^e$	1164445.26
Sc	72	15	$((d_{-}^1)_{3/2}, (d_{+}^2)_{2/7/2})$	$7/2^e$	1170572.47
Sc	72	16	$((d_{-}^1)_{3/2}, (d_{+}^2)_{0/3/2})$	$3/2^e$	1322251.88
Sc	72	17	$(d_{+}^3)_{9/2}$	$9/2^e$	1547371.53
Sc	72	18	$(d_{+}^3)_{3/2}$	$3/2^e$	1657244.63
Sc	72	19	$(d_{+}^3)_{5/2}$	$5/2^e$	1735496.40
Sc	73	1	$(d_{-}^3)_{3/2}$	$3/2^e$	0.00
Sc	73	2	$((d_{-}^2)_{2}, (d_{+}^1)_{5/2/5/2})$	$5/2^e$	493005.71
Sc	73	3	$((d_{-}^2)_{2}, (d_{+}^1)_{5/2/3/2})$	$3/2^e$	543303.77
Sc	73	4	$((d_{-}^2)_{2}, (d_{+}^1)_{5/2/7/2})$	$7/2^e$	573376.48
Sc	73	5	$((d_{-}^2)_{2}, (d_{+}^1)_{5/2/9/2})$	$9/2^e$	573693.02
Sc	73	6	$((d_{-}^2)_{2}, (d_{+}^1)_{5/2/1/2})$	$1/2^e$	585624.40
Sc	73	7	$((d_{-}^2)_{0}, (d_{+}^1)_{5/2/5/2})$	$5/2^e$	769708.13
Sc	73	8	$((d_{-}^1)_{3/2}, (d_{+}^2)_{4/7/2})$	$7/2^e$	1055439.26
Sc	73	9	$((d_{-}^1)_{3/2}, (d_{+}^2)_{4/9/2})$	$9/2^e$	1092121.92
Sc	73	10	$((d_{-}^1)_{3/2}, (d_{+}^2)_{2/3/2})$	$3/2^e$	1132396.89

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Sc	73	11	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{21/2}\right)$	1/2 ^e	1155822.52
Sc	73	12	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{411/2}\right)$	11/ 2 ^e	1168744.06
Sc	73	13	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{45/2}\right)$	5/2 ^e	1169846.79
Sc	73	14	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{25/2}\right)$	5/2 ^e	1238090.91
Sc	73	15	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{27/2}\right)$	7/2 ^e	1243240.06
Sc	73	16	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{03/2}\right)$	3/2 ^e	1399364.30
Sc	73	17	$(d_{+}^3)_{9/2}$	9/2 ^e	1653230.90
Sc	73	18	$(d_{+}^3)_{3/2}$	3/2 ^e	1764627.82
Sc	73	19	$(d_{+}^3)_{5/2}$	5/2 ^e	1844345.23
Sc	74	1	$(d_{-}^3)_{3/2}$	3/2 ^e	0.00
Sc	74	2	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/25/2}\right)$	5/2 ^e	529176.81
Sc	74	3	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/23/2}\right)$	3/2 ^e	580037.83
Sc	74	4	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/29/2}\right)$	9/2 ^e	610739.76
Sc	74	5	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/27/2}\right)$	7/2 ^e	611117.74
Sc	74	6	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/21/2}\right)$	1/2 ^e	623230.04
Sc	74	7	$\left((d_{-}^2)_{0}, (d_{+}^1)_{5/25/2}\right)$	5/2 ^e	811912.90
Sc	74	8	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{47/2}\right)$	7/2 ^e	1128567.32
Sc	74	9	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{49/2}\right)$	9/2 ^e	1166133.71

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Sc	74	10	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{2}\right)_{3/2}$	3/2 ^e	1207306.03
Sc	74	11	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{2}\right)_{1/2}$	1/2 ^e	1231190.66
Sc	74	12	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{4}\right)_{11/2}$	11/ 2 ^e	1243704.70
Sc	74	13	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{4}\right)_{5/2}$	5/2 ^e	1244550.44
Sc	74	14	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{2}\right)_{5/2}$	5/2 ^e	1315376.59
Sc	74	15	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{2}\right)_{7/2}$	7/2 ^e	1319550.30
Sc	74	16	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{0}\right)_{3/2}$	3/2 ^e	1480061.72
Sc	74	17	$(d_{+}^3)_{9/2}$	9/2 ^e	1764552.87
Sc	74	18	$(d_{+}^3)_{3/2}$	3/2 ^e	1877559.59
Sc	74	19	$(d_{+}^3)_{5/2}$	5/2 ^e	1958694.16
Sc	75	1	$(d_{-}^3)_{3/2}$	3/2 ^e	0.00
Sc	75	2	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2}\right)_{5/2}$	5/2 ^e	567232.38
Sc	75	3	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2}\right)_{3/2}$	3/2 ^e	618672.84
Sc	75	4	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2}\right)_{9/2}$	9/2 ^e	649646.14
Sc	75	5	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2}\right)_{7/2}$	7/2 ^e	650715.63
Sc	75	6	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2}\right)_{1/2}$	1/2 ^e	662725.59
Sc	75	7	$\left((d_{-}^2)_{0}, (d_{+}^1)_{5/2}\right)_{5/2}$	5/2 ^e	855962.48
Sc	75	8	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{4}\right)_{7/2}$	7/2 ^e	1205472.82

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Sc	75	9	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{4/9/2}\right)$	9/2 ^e	1243897.19
Sc	75	10	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{2/3/2}\right)$	3/2 ^e	1285995.50
Sc	75	11	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{2/1/2}\right)$	1/2 ^e	1310333.20
Sc	75	12	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{4/11/2}\right)$	11/ 2 ^e	1322407.44
Sc	75	13	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{4/5/2}\right)$	5/2 ^e	1323070.07
Sc	75	14	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{2/5/2}\right)$	5/2 ^e	1396426.49
Sc	75	15	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{2/7/2}\right)$	7/2 ^e	1399627.75
Sc	75	16	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{0/3/2}\right)$	3/2 ^e	1564478.78
Sc	75	17	$(d_{+}^3)_{9/2}$	9/2 ^e	1881524.42
Sc	75	18	$(d_{+}^3)_{3/2}$	3/2 ^e	1996217.95
Sc	75	19	$(d_{+}^3)_{5/2}$	5/2 ^e	2078729.94
Sc	76	1	$(d_{-}^3)_{3/2}$	3/2 ^e	0.00
Sc	76	2	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2/5/2}\right)$	5/2 ^e	607235.93
Sc	76	3	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2/3/2}\right)$	3/2 ^e	659271.71
Sc	76	4	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2/9/2}\right)$	9/2 ^e	690475.93
Sc	76	5	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2/7/2}\right)$	7/2 ^e	692234.36
Sc	76	6	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2/1/2}\right)$	1/2 ^e	704174.54
Sc	76	7	$\left((d_{-}^2)_{0}, (d_{+}^1)_{5/2/5/2}\right)$	5/2 ^e	901925.24

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Sc	76	8	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{4/7/2}\right)$	7/2 ^e	1286282.42
Sc	76	9	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{4/9/2}\right)$	9/2 ^e	1325539.63
Sc	76	10	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{2/3/2}\right)$	3/2 ^e	1368592.95
Sc	76	11	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{2/1/2}\right)$	1/2 ^e	1393377.81
Sc	76	12	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{4/11/2}\right)$	11/ 2 ^e	1404979.60
Sc	76	13	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{4/5/2}\right)$	5/2 ^e	1405529.83
Sc	76	14	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{2/5/2}\right)$	5/2 ^e	1481367.98
Sc	76	15	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{2/7/2}\right)$	7/2 ^e	1483599.91
Sc	76	16	$\left((d_{-}^1)_{3/2}, (d_{+}^2)_{0/3/2}\right)$	3/2 ^e	1652751.68
Sc	76	17	$(d_{+}^3)_{9/2}$	9/2 ^e	2004337.03
Sc	76	18	$(d_{+}^3)_{3/2}$	3/2 ^e	2120786.76
Sc	76	19	$(d_{+}^3)_{5/2}$	5/2 ^e	2204643.77
Sc	77	1	$(d_{-}^3)_{3/2}$	3/2 ^e	0.00
Sc	77	2	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2/5/2}\right)$	5/2 ^e	649251.68
Sc	77	3	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2/3/2}\right)$	3/2 ^e	701898.18
Sc	77	4	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2/9/2}\right)$	9/2 ^e	733293.51
Sc	77	5	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2/7/2}\right)$	7/2 ^e	735738.79
Sc	77	6	$\left((d_{-}^2)_{2}, (d_{+}^1)_{5/2/1/2}\right)$	1/2 ^e	747641.08

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Sc	77	7	$\left((d_{-}^{2})_0, (d_{+}^{1})_{5/2}\right)_{5/2}$	5/2 ^e	949869.83
Sc	77	8	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{7/2}$	7/2 ^e	1371124.29
Sc	77	9	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{9/2}$	9/2 ^e	1411189.75
Sc	77	10	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{3/2}$	3/2 ^e	1455227.49
Sc	77	11	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{1/2}$	1/2 ^e	1480453.58
Sc	77	12	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{11/2}$	11/ 2 ^e	1491549.86
Sc	77	13	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{5/2}$	5/2 ^e	1492055.63
Sc	77	14	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{5/2}$	5/2 ^e	1570330.00
Sc	77	15	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{7/2}$	7/2 ^e	1571595.71
Sc	77	16	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{0}\right)_{3/2}$	3/2 ^e	1745016.82
Sc	77	17	$(d_{+}^{3})_{9/2}$	9/2 ^e	2133184.30
Sc	77	18	$(d_{+}^{3})_{3/2}$	3/2 ^e	2251453.26
Sc	77	19	$(d_{+}^{3})_{5/2}$	5/2 ^e	2336629.02
Sc	78	1	$(d_{-}^{3})_{3/2}$	3/2 ^e	0.00
Sc	78	2	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{5/2}$	5/2 ^e	693346.17
Sc	78	3	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{3/2}$	3/2 ^e	746618.25
Sc	78	4	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{9/2}$	9/2 ^e	778165.55
Sc	78	5	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{7/2}$	7/2 ^e	781296.04

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Sc	78	6	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{1/2}$	1/2 ^e	793191.71
Sc	78	7	$\left((d_{-}^{2})_{0}, (d_{+}^{1})_{5/2}\right)_{5/2}$	5/2 ^e	999866.71
Sc	78	8	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{7/2}$	7/2 ^e	1460131.19
Sc	78	9	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{9/2}$	9/2 ^e	1500980.85
Sc	78	10	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{3/2}$	3/2 ^e	1546032.70
Sc	78	11	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{1/2}$	1/2 ^e	1571694.09
Sc	78	12	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{11/2}$	11/ 2 ^e	1582251.51
Sc	78	13	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{5/2}$	5/2 ^e	1582778.13
Sc	78	14	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{5/2}$	5/2 ^e	1663446.10
Sc	78	15	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{7/2}$	7/2 ^e	1663748.53
Sc	78	16	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{0}\right)_{3/2}$	3/2 ^e	1841414.06
Sc	78	17	$(d_{+}^{3})_{9/2}$	9/2 ^e	2268266.61
Sc	78	18	$(d_{+}^{3})_{3/2}$	3/2 ^e	2388412.36
Sc	78	19	$(d_{+}^{3})_{5/2}$	5/2 ^e	2474885.73
Sc	79	1	$(d_{-}^{3})_{3/2}$	3/2 ^e	0.00
Sc	79	2	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{5/2}$	5/2 ^e	739586.59
Sc	79	3	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{3/2}$	3/2 ^e	793498.68
Sc	79	4	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{9/2}$	9/2 ^e	825159.33

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Sc	79	5	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{7/2}$	7/2 ^e	828973.82
Sc	79	6	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{1/2}$	1/2 ^e	840893.56
Sc	79	7	$\left((d_{-}^{2})_{0}, (d_{+}^{1})_{5/2}\right)_{5/2}$	5/2 ^e	1051986.71
Sc	79	8	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{7/2}$	7/2 ^e	1553437.31
Sc	79	9	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{9/2}$	9/2 ^e	1595047.60
Sc	79	10	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{3/2}$	3/2 ^e	1641143.56
Sc	79	11	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{1/2}$	1/2 ^e	1667234.30
Sc	79	12	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{11/2}$	11/ 2 ^e	1677219.17
Sc	79	13	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{5/2}$	5/2 ^e	1677829.65
Sc	79	14	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{5/2}$	7/2 ^e	1760193.14
Sc	79	15	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{7/2}$	5/2 ^e	1760851.26
Sc	79	16	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{0}\right)_{3/2}$	3/2 ^e	1942083.81
Sc	79	17	$(d_{+}^{3})_{9/2}$	9/2 ^e	2409786.44
Sc	79	18	$(d_{+}^{3})_{3/2}$	3/2 ^e	2531861.94
Sc	79	19	$(d_{+}^{3})_{5/2}$	5/2 ^e	2619616.13
Sc	80	1	$(d_{-}^{3})_{3/2}$	3/2 ^e	0.00
Sc	80	2	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{5/2}$	5/2 ^e	788042.11
Sc	80	3	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{3/2}$	3/2 ^e	842608.17

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Sc	80	4	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{9/2}$	9/2 ^e	874344.02
Sc	80	5	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{7/2}$	7/2 ^e	878841.75
Sc	80	6	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{1/2}$	1/2 ^e	890815.69
Sc	80	7	$\left((d_{-}^{2})_{0}, (d_{+}^{1})_{5/2}\right)_{5/2}$	5/2 ^e	1106302.19
Sc	80	8	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{7/2}$	7/2 ^e	1651180.71
Sc	80	9	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{9/2}$	9/2 ^e	1693528.52
Sc	80	10	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{3/2}$	3/2 ^e	1740698.82
Sc	80	11	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{1/2}$	1/2 ^e	1767212.97
Sc	80	12	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{11/2}$	11/ 2 ^e	1776591.26
Sc	80	13	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{5/2}$	5/2 ^e	1777346.53
Sc	80	14	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{7/2}$	7/2 ^e	1861068.08
Sc	80	15	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{5/2}$	5/2 ^e	1862684.36
Sc	80	16	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{0}\right)_{3/2}$	3/2 ^e	2047169.54
Sc	80	17	$(d_{+}^{3})_{9/2}$	9/2 ^e	2557951.96
Sc	80	18	$(d_{+}^{3})_{3/2}$	3/2 ^e	2682006.23
Sc	80	19	$(d_{+}^{3})_{5/2}$	5/2 ^e	2771028.11
Sc	81	1	$(d_{-}^{3})_{3/2}$	3/2 ^e	0.00
Sc	81	2	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{5/2}$	5/2 ^e	838782.40

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Sc	81	3	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{3/2}$	3/2 ^e	894016.01
Sc	81	4	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{9/2}$	9/2 ^e	925789.26
Sc	81	5	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{7/2}$	7/2 ^e	930969.89
Sc	81	6	$\left((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2}\right)_{1/2}$	1/2 ^e	943027.74
Sc	81	7	$\left((d_{-}^{2})_{0}, (d_{+}^{1})_{5/2}\right)_{5/2}$	5/2 ^e	1162885.78
Sc	81	8	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{7/2}$	7/2 ^e	1753500.58
Sc	81	9	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{9/2}$	9/2 ^e	1796563.20
Sc	81	10	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{3/2}$	3/2 ^e	1844838.37
Sc	81	11	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{1/2}$	1/2 ^e	1871769.97
Sc	81	12	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{11/2}$	11/ 2 ^e	1880507.25
Sc	81	13	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{4}\right)_{5/2}$	5/2 ^e	1881466.48
Sc	81	14	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{7/2}$	7/2 ^e	1966512.97
Sc	81	15	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{2}\right)_{5/2}$	5/2 ^e	1969085.41
Sc	81	16	$\left((d_{-}^{1})_{3/2}, (d_{+}^{2})_{0}\right)_{3/2}$	3/2 ^e	2156815.17
Sc	81	17	$(d_{+}^{3})_{9/2}$	9/2 ^e	2712972.97
Sc	81	18	$(d_{+}^{3})_{3/2}$	3/2 ^e	2839051.75
Sc	81	19	$(d_{+}^{3})_{5/2}$	5/2 ^e	2929331.20
Sc	82	1	$(d_{-}^{3})_{3/2}$	3/2 ^e	0.00

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Sc	82	2	$\left((d_{-}^{+})_{2}, (d_{+}^{+})_{5/2}\right)_{5/2}$	5/2 ^e	891879.22
Sc	82	3	$\left((d_{-}^{+})_{2}, (d_{+}^{+})_{5/2}\right)_{3/2}$	3/2 ^e	947793.60
Sc	82	4	$\left((d_{-}^{+})_{2}, (d_{+}^{+})_{5/2}\right)_{9/2}$	9/2 ^e	979566.75
Sc	82	5	$\left((d_{-}^{+})_{2}, (d_{+}^{+})_{5/2}\right)_{7/2}$	7/2 ^e	985430.37
Sc	82	6	$\left((d_{-}^{+})_{2}, (d_{+}^{+})_{5/2}\right)_{1/2}$	1/2 ^e	997601.40
Sc	82	7	$\left((d_{-}^{+})_{0}, (d_{+}^{+})_{5/2}\right)_{5/2}$	5/2 ^e	1221811.86
Sc	82	8	$\left((d_{-}^{+})_{3/2}, (d_{+}^{+})_{4}\right)_{7/2}$	7/2 ^e	1860540.29
Sc	82	9	$\left((d_{-}^{+})_{3/2}, (d_{+}^{+})_{4}\right)_{9/2}$	9/2 ^e	1904295.37
Sc	82	10	$\left((d_{-}^{+})_{3/2}, (d_{+}^{+})_{2}\right)_{3/2}$	3/2 ^e	1953706.16
Sc	82	11	$\left((d_{-}^{+})_{3/2}, (d_{+}^{+})_{2}\right)_{1/2}$	1/2 ^e	1981049.25
Sc	82	12	$\left((d_{-}^{+})_{3/2}, (d_{+}^{+})_{4}\right)_{11/2}$	11/ 2 ^e	1989110.75
Sc	82	13	$\left((d_{-}^{+})_{3/2}, (d_{+}^{+})_{4}\right)_{5/2}$	5/2 ^e	1990331.45
Sc	82	14	$\left((d_{-}^{+})_{3/2}, (d_{+}^{+})_{2}\right)_{7/2}$	7/2 ^e	2076671.53
Sc	82	15	$\left((d_{-}^{+})_{3/2}, (d_{+}^{+})_{2}\right)_{5/2}$	5/2 ^e	2080198.53
Sc	82	16	$\left((d_{-}^{+})_{3/2}, (d_{+}^{+})_{0}\right)_{3/2}$	3/2 ^e	2271168.21
Sc	82	17	$(d_{+}^{3})_{9/2}$	9/2 ^e	2875065.46
Sc	82	18	$(d_{+}^{3})_{3/2}$	3/2 ^e	3003211.63
Sc	82	19	$(d_{+}^{3})_{5/2}$	5/2 ^e	3094741.13

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Sc	83	1	$(d^-)^3_{3/2}$	3/2 ^e	0.00
Sc	83	2	$((d^-)^2_2, (d^+)^1_{5/2})_{5/2}$	5/2 ^e	947405.28
Sc	83	3	$((d^-)^2_2, (d^+)^1_{5/2})_{3/2}$	3/2 ^e	1004013.27
Sc	83	4	$((d^-)^2_2, (d^+)^1_{5/2})_{9/2}$	9/2 ^e	1035749.08
Sc	83	5	$((d^-)^2_2, (d^+)^1_{5/2})_{7/2}$	7/2 ^e	1042296.19
Sc	83	6	$((d^-)^2_2, (d^+)^1_{5/2})_{1/2}$	1/2 ^e	1054609.27
Sc	83	7	$((d^-)^2_0, (d^+)^1_{5/2})_{5/2}$	5/2 ^e	1283155.54
Sc	83	8	$((d^-)^1_{3/2}, (d^2_+)^1_{4/7})_{7/2}$	7/2 ^e	1972445.08
Sc	83	9	$((d^-)^1_{3/2}, (d^2_+)^1_{4/9})_{9/2}$	9/2 ^e	2016870.61
Sc	83	10	$((d^-)^1_{3/2}, (d^2_+)^1_{2/3})_{3/2}$	3/2 ^e	2067448.00
Sc	83	11	$((d^-)^1_{3/2}, (d^2_+)^1_{2/1})_{1/2}$	1/2 ^e	2095196.63
Sc	83	12	$((d^-)^1_{3/2}, (d^2_+)^1_{4/11})_{11/2}$	11/ 2 ^e	2102547.18
Sc	83	13	$((d^-)^1_{3/2}, (d^2_+)^1_{4/5})_{5/2}$	5/2 ^e	2104085.49
Sc	83	14	$((d^-)^1_{3/2}, (d^2_+)^1_{2/7})_{7/2}$	7/2 ^e	2191689.30
Sc	83	15	$((d^-)^1_{3/2}, (d^2_+)^1_{2/5})_{5/2}$	5/2 ^e	2196169.74
Sc	83	16	$((d^-)^1_{3/2}, (d^2_+)^1_{0/3})_{3/2}$	3/2 ^e	2390377.57
Sc	83	17	$(d^3_+)^1_{9/2}$	9/2 ^e	3044448.19
Sc	83	18	$(d^3_+)^1_{3/2}$	3/2 ^e	3174702.22

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Sc	83	19	$(d^3_{+})_{5/2}$	5/2 ^e	3267476.42
Ti	72	1	$(d^4_{+})_0$	0 ^e	0.00
Ti	72	2	$((d^3_{-})_{3/2}, (d^1_{+})_{5/2})_1$	1 ^e	447000.25
Ti	72	3	$((d^3_{-})_{3/2}, (d^1_{+})_{5/2})_4$	4 ^e	541836.86
Ti	72	4	$((d^3_{-})_{3/2}, (d^1_{+})_{5/2})_2$	2 ^e	562774.97
Ti	72	5	$((d^3_{-})_{3/2}, (d^1_{+})_{5/2})_3$	3 ^e	590422.02
Ti	72	6	$((d^2_{-})_2, (d^2_{+})_2)_0$	0 ^e	961652.28
Ti	72	7	$((d^2_{-})_2, (d^2_{+})_4)_2$	2 ^e	968557.12
Ti	72	8	$((d^2_{-})_2, (d^2_{+})_4)_4$	4 ^e	985084.90
Ti	72	9	$((d^2_{-})_2, (d^2_{+})_4)_3$	3 ^e	1000704.64
Ti	72	10	$((d^2_{-})_2, (d^2_{+})_4)_5$	5 ^e	1031339.09
Ti	72	11	$((d^2_{-})_2, (d^2_{+})_4)_6$	6 ^e	1054386.84
Ti	72	12	$((d^2_{-})_2, (d^2_{+})_2)_1$	1 ^e	1068383.33
Ti	72	13	$((d^2_{-})_2, (d^2_{+})_2)_3$	3 ^e	1095424.75
Ti	72	14	$((d^2_{-})_2, (d^2_{+})_2)_4$	4 ^e	1097849.99
Ti	72	15	$((d^2_{-})_2, (d^2_{+})_2)_2$	2 ^e	1111933.47
Ti	72	16	$((d^2_{-})_2, (d^2_{+})_0)_2$	2 ^e	1208958.60
Ti	72	17	$((d^2_{-})_0, (d^2_{+})_4)_4$	4 ^e	1251872.80

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Ti	72	18	$((d_{-}^{-})_0, (d_{+}^{2})_2)_2$	2 ^e	1348035.24
Ti	72	19	$((d_{-}^{-})_0, (d_{+}^{2})_0)_0$	0 ^e	1464910.41
Ti	72	20	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_4$	4 ^e	1503446.06
Ti	72	21	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_3$	3 ^e	1513479.99
Ti	72	22	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_1$	1 ^e	1553097.42
Ti	72	23	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_5$	5 ^e	1560218.69
Ti	72	24	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_6$	6 ^e	1565965.72
Ti	72	25	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_2$	2 ^e	1624700.19
Ti	72	26	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_3$	3 ^e	1640930.00
Ti	72	27	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_0$	0 ^e	1706349.39
Ti	72	28	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{5/2})_3$	3 ^e	1757736.82
Ti	72	29	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{5/2})_1$	1 ^e	1761401.39
Ti	72	30	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{5/2})_4$	4 ^e	1763746.48
Ti	72	31	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{5/2})_2$	2 ^e	1796346.02
Ti	72	32	$(d_{+}^{4})_4$	4 ^e	2090190.98
Ti	72	33	$(d_{+}^{4})_2$	2 ^e	2172777.98
Ti	72	34	$(d_{+}^{4})_0$	0 ^e	2368636.13
Ti	73	1	$(d_{-}^{4})_0$	0 ^e	0.00

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Ti	73	2	$((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2})_1$	1 ^e	480935.44
Ti	73	3	$((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2})_4$	4 ^e	577027.45
Ti	73	4	$((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2})_2$	2 ^e	599829.65
Ti	73	5	$((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2})_3$	3 ^e	627576.96
Ti	73	6	$((d_{-}^2)_{2^+}, (d_{+}^2)_{2^0})$	0 ^e	1030569.70
Ti	73	7	$((d_{-}^2)_{2^+}, (d_{+}^2)_{4^2})$	2 ^e	1036488.17
Ti	73	8	$((d_{-}^2)_{2^+}, (d_{+}^2)_{4^4})$	4 ^e	1054255.05
Ti	73	9	$((d_{-}^2)_{2^+}, (d_{+}^2)_{4^3})$	3 ^e	1070249.76
Ti	73	10	$((d_{-}^2)_{2^+}, (d_{+}^2)_{4^5})$	5 ^e	1100782.92
Ti	73	11	$((d_{-}^2)_{2^+}, (d_{+}^2)_{4^6})$	6 ^e	1124034.83
Ti	73	12	$((d_{-}^2)_{2^+}, (d_{+}^2)_{2^1})$	1 ^e	1139716.09
Ti	73	13	$((d_{-}^2)_{2^+}, (d_{+}^2)_{2^3})$	3 ^e	1166038.09
Ti	73	14	$((d_{-}^2)_{2^+}, (d_{+}^2)_{2^4})$	4 ^e	1168952.14
Ti	73	15	$((d_{-}^2)_{2^+}, (d_{+}^2)_{2^2})$	2 ^e	1183566.39
Ti	73	16	$((d_{-}^2)_{2^+}, (d_{+}^2)_{0^2})$	2 ^e	1282612.48
Ti	73	17	$((d_{-}^2)_{0^+}, (d_{+}^2)_{4^4})$	4 ^e	1326430.22
Ti	73	18	$((d_{-}^2)_{0^+}, (d_{+}^2)_{2^2})$	2 ^e	1425310.86
Ti	73	19	$((d_{-}^2)_{0^+}, (d_{+}^2)_{0^0})$	0 ^e	1547413.31

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ti	73	20	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_4$	4 ^e	1607011.46
Ti	73	21	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_3$	3 ^e	1617484.97
Ti	73	22	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_1$	1 ^e	1657913.90
Ti	73	23	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_5$	5 ^e	1665243.03
Ti	73	24	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_6$	6 ^e	1670703.42
Ti	73	25	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_2$	2 ^e	1730912.30
Ti	73	26	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_3$	3 ^e	1747318.68
Ti	73	27	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_0$	0 ^e	1812347.27
Ti	73	28	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_3$	3 ^e	1866727.99
Ti	73	29	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_1$	1 ^e	1870453.96
Ti	73	30	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_4$	4 ^e	1872246.62
Ti	73	31	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_2$	2 ^e	1905285.49
Ti	73	32	$(d_{+}^4)_4$	4 ^e	2230529.73
Ti	73	33	$(d_{+}^4)_2$	2 ^e	2313760.14
Ti	73	34	$(d_{+}^4)_0$	0 ^e	2512384.49
Ti	74	1	$(d_{-}^4)_0$	0 ^e	0.00
Ti	74	2	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	516667.61
Ti	74	3	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	613991.73

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Ti	74	4	$((d_{-}^{2})_{3/2}, (d_{+}^{1})_{5/2})_{2}$	2 ^e	638623.05
Ti	74	5	$((d_{-}^{3})_{3/2}, (d_{+}^{1})_{5/2})_{3}$	3 ^e	666482.78
Ti	74	6	$((d_{-}^{2})_{2}, (d_{+}^{2})_{2})_{0}$	0 ^e	1103101.77
Ti	74	7	$((d_{-}^{2})_{2}, (d_{+}^{2})_{4})_{2}$	2 ^e	1108069.49
Ti	74	8	$((d_{-}^{2})_{2}, (d_{+}^{2})_{4})_{4}$	4 ^e	1127004.37
Ti	74	9	$((d_{-}^{2})_{2}, (d_{+}^{2})_{4})_{3}$	3 ^e	1143407.39
Ti	74	10	$((d_{-}^{2})_{2}, (d_{+}^{2})_{4})_{5}$	5 ^e	1173800.82
Ti	74	11	$((d_{-}^{2})_{2}, (d_{+}^{2})_{4})_{6}$	6 ^e	1197237.99
Ti	74	12	$((d_{-}^{2})_{2}, (d_{+}^{2})_{2})_{1}$	1 ^e	1214642.38
Ti	74	13	$((d_{-}^{2})_{2}, (d_{+}^{2})_{2})_{3}$	3 ^e	1240249.68
Ti	74	14	$((d_{-}^{2})_{2}, (d_{+}^{2})_{2})_{4}$	4 ^e	1243629.29
Ti	74	15	$((d_{-}^{2})_{2}, (d_{+}^{2})_{2})_{2}$	2 ^e	1258785.49
Ti	74	16	$((d_{-}^{2})_{2}, (d_{+}^{2})_{0})_{2}$	2 ^e	1359850.74
Ti	74	17	$((d_{-}^{2})_{0}, (d_{+}^{2})_{4})_{4}$	4 ^e	1404515.64
Ti	74	18	$((d_{-}^{2})_{0}, (d_{+}^{2})_{2})_{2}$	2 ^e	1506160.47
Ti	74	19	$((d_{-}^{2})_{0}, (d_{+}^{2})_{0})_{0}$	0 ^e	1633255.72
Ti	74	20	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_{4}$	4 ^e	1716039.79
Ti	74	21	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_{3}$	3 ^e	1726901.78

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Ti	74	22	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_1$	1 ^e	1768152.70
Ti	74	23	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_5$	5 ^e	1775644.77
Ti	74	24	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_6$	6 ^e	1780809.30
Ti	74	25	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_2$	2 ^e	1842542.79
Ti	74	26	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_3$	3 ^e	1859108.90
Ti	74	27	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_0$	0 ^e	1923957.94
Ti	74	28	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_3$	3 ^e	1981124.02
Ti	74	29	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_1$	1 ^e	1984926.37
Ti	74	30	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_4$	4 ^e	1986138.91
Ti	74	31	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_2$	2 ^e	2019600.23
Ti	74	32	$(d_{+}^4)_4$	4 ^e	2378085.38
Ti	74	33	$(d_{+}^4)_2$	2 ^e	2462036.81
Ti	74	34	$(d_{+}^4)_0$	0 ^e	2663436.90
Ti	75	1	$(d_{-}^4)_0$	0 ^e	0.00
Ti	75	2	$\left((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	554258.88
Ti	75	3	$\left((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	652791.74
Ti	75	4	$\left((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2}\right)_2$	2 ^e	679220.87
Ti	75	5	$\left((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2}\right)_3$	3 ^e	707204.81

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Ti	75	6	$((d^-)_2, (d^+)_2)_{00}$	0 ^e	1179371.84
Ti	75	7	$((d^-)_2, (d^+)_4)_{22}$	2 ^e	1183421.36
Ti	75	8	$((d^-)_2, (d^+)_4)_{44}$	4 ^e	1203456.70
Ti	75	9	$((d^-)_2, (d^+)_4)_{33}$	3 ^e	1220298.68
Ti	75	10	$((d^-)_2, (d^+)_4)_{55}$	5 ^e	1250516.36
Ti	75	11	$((d^-)_2, (d^+)_4)_{66}$	6 ^e	1274119.88
Ti	75	12	$((d^-)_2, (d^+)_2)_{11}$	1 ^e	1293285.92
Ti	75	13	$((d^-)_2, (d^+)_2)_{33}$	3 ^e	1318183.03
Ti	75	14	$((d^-)_2, (d^+)_2)_{44}$	4 ^e	1322004.95
Ti	75	15	$((d^-)_2, (d^+)_2)_{22}$	2 ^e	1337714.55
Ti	75	16	$((d^-)_2, (d^+)_0)_{22}$	2 ^e	1440799.28
Ti	75	17	$((d^-)_{10}, (d^+)_4)_{44}$	4 ^e	1486264.61
Ti	75	18	$((d^-)_{10}, (d^+)_2)_{22}$	2 ^e	1590709.70
Ti	75	19	$((d^-)_{10}, (d^+)_0)_{00}$	0 ^e	1722591.48
Ti	75	20	$((d^-)_{3/2}, (d^+)_9)_{24}$	4 ^e	1830705.71
Ti	75	21	$((d^-)_{3/2}, (d^+)_9)_{23}$	3 ^e	1841916.55
Ti	75	22	$((d^-)_{3/2}, (d^+)_3)_{21}$	1 ^e	1883999.90
Ti	75	23	$((d^-)_{3/2}, (d^+)_9)_{25}$	5 ^e	1891609.95

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ti	75	24	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_6$	6 ^e	1896468.99
Ti	75	25	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_2$	2 ^e	1959775.69
Ti	75	26	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_3$	3 ^e	1976486.42
Ti	75	27	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_0$	0 ^e	2041343.07
Ti	75	28	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_3$	3 ^e	2101111.29
Ti	75	29	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_1$	1 ^e	2105005.41
Ti	75	30	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_4$	4 ^e	2105610.80
Ti	75	31	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_2$	2 ^e	2139484.57
Ti	75	32	$(d_{+}^4)_4$	4 ^e	2533104.89
Ti	75	33	$(d_{+}^4)_2$	2 ^e	2617847.65
Ti	75	34	$(d_{+}^4)_0$	0 ^e	2822038.07
Ti	76	1	$(d_{-}^4)_0$	0 ^e	0.00
Ti	76	2	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	593772.84
Ti	76	3	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	693491.00
Ti	76	4	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_2$	2 ^e	721690.09
Ti	76	5	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_3$	3 ^e	749809.54
Ti	76	6	$\left((d_{-}^2)_{2}, (d_{+}^2)_{2}\right)_0$	0 ^e	1259506.28
Ti	76	7	$\left((d_{-}^2)_{2}, (d_{+}^2)_{4}\right)_2$	2 ^e	1262667.29

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ti	76	8	$((d^-)_2, (d^+)_4)_4$	4 ^e	1283738.93
Ti	76	9	$((d^-)_2, (d^+)_4)_3$	3 ^e	1301048.12
Ti	76	10	$((d^-)_2, (d^+)_4)_5$	5 ^e	1331056.14
Ti	76	11	$((d^-)_2, (d^+)_4)_6$	6 ^e	1354807.08
Ti	76	12	$((d^-)_2, (d^+)_2)_1$	1 ^e	1375773.49
Ti	76	13	$((d^-)_2, (d^+)_2)_3$	3 ^e	1399964.60
Ti	76	14	$((d^-)_2, (d^+)_2)_4$	4 ^e	1404205.67
Ti	76	15	$((d^-)_2, (d^+)_2)_2$	2 ^e	1420480.31
Ti	76	16	$((d^-)_2, (d^+)_0)_2$	2 ^e	1525586.75
Ti	76	17	$((d^-)_{10}, (d^+)_4)_4$	4 ^e	1571813.28
Ti	76	18	$((d^-)_{10}, (d^+)_2)_2$	2 ^e	1679087.15
Ti	76	19	$((d^-)_{10}, (d^+)_0)_0$	0 ^e	1815575.44
Ti	76	20	$((d^-)_{3/2}, (d^+)_9)_{2/4}$	4 ^e	1951190.68
Ti	76	21	$((d^-)_{3/2}, (d^+)_9)_{2/3}$	3 ^e	1962719.83
Ti	76	22	$((d^-)_{3/2}, (d^+)_3)_{2/1}$	1 ^e	2005646.00
Ti	76	23	$((d^-)_{3/2}, (d^+)_9)_{2/5}$	5 ^e	2013329.04
Ti	76	24	$((d^-)_{3/2}, (d^+)_9)_{2/6}$	6 ^e	2017872.63
Ti	76	25	$((d^-)_{3/2}, (d^+)_3)_{2/2}$	2 ^e	2082799.78

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ti	76	26	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_3$	3 ^e	2099641.48
Ti	76	27	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_0$	0 ^e	2164670.41
Ti	76	28	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_3$	3 ^e	2226880.62
Ti	76	29	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_1$	4 ^e	2230853.97
Ti	76	30	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_4$	1 ^e	2230882.31
Ti	76	31	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_2$	2 ^e	2265135.85
Ti	76	32	$(d_{+}^4)_4$	4 ^e	2695841.39
Ti	76	33	$(d_{+}^4)_2$	2 ^e	2781439.49
Ti	76	34	$(d_{+}^4)_0$	0 ^e	2988438.80
Ti	77	1	$(d_{-}^4)_0$	0 ^e	0.00
Ti	77	2	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	635273.83
Ti	77	3	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	736153.64
Ti	77	4	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_2$	2 ^e	766098.17
Ti	77	5	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_3$	3 ^e	794363.87
Ti	77	6	$\left((d_{-}^2)_{2}, (d_{+}^2)_{2}\right)_0$	0 ^e	1343633.10
Ti	77	7	$\left((d_{-}^2)_{2}, (d_{+}^2)_{4}\right)_2$	2 ^e	1345932.54
Ti	77	8	$\left((d_{-}^2)_{2}, (d_{+}^2)_{4}\right)_4$	4 ^e	1367979.43
Ti	77	9	$\left((d_{-}^2)_{2}, (d_{+}^2)_{4}\right)_3$	3 ^e	1385782.02

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Ti	77	10	$((d_{-}^{2})_{2}, (d_{+}^{2})_{4})_{5}$	5 ^e	1415548.16
Ti	77	11	$((d_{-}^{2})_{2}, (d_{+}^{2})_{4})_{6}$	6 ^e	1439427.54
Ti	77	12	$((d_{-}^{2})_{2}, (d_{+}^{2})_{2})_{1}$	1 ^e	1462233.45
Ti	77	13	$((d_{-}^{2})_{2}, (d_{+}^{2})_{2})_{3}$	3 ^e	1485722.36
Ti	77	14	$((d_{-}^{2})_{2}, (d_{+}^{2})_{2})_{4}$	4 ^e	1490359.45
Ti	77	15	$((d_{-}^{2})_{2}, (d_{+}^{2})_{2})_{2}$	2 ^e	1507211.07
Ti	77	16	$((d_{-}^{2})_{2}, (d_{+}^{2})_{0})_{2}$	2 ^e	1614343.07
Ti	77	17	$((d_{-}^{2})_{0}, (d_{+}^{2})_{4})_{4}$	4 ^e	1661297.43
Ti	77	18	$((d_{-}^{2})_{0}, (d_{+}^{2})_{2})_{2}$	2 ^e	1771422.86
Ti	77	19	$((d_{-}^{2})_{0}, (d_{+}^{2})_{0})_{0}$	0 ^e	1912361.37
Ti	77	20	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_{4}$	4 ^e	2077680.22
Ti	77	21	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_{3}$	3 ^e	2089504.38
Ti	77	22	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_{1}$	1 ^e	2133283.75
Ti	77	23	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_{5}$	5 ^e	2140994.73
Ti	77	24	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_{6}$	6 ^e	2145212.54
Ti	77	25	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_{2}$	2 ^e	2211806.41
Ti	77	26	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_{3}$	3 ^e	2228766.58
Ti	77	27	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_{0}$	0 ^e	2294112.33

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ti	77	28	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_3$	3 ^e	2358625.07
Ti	77	29	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_1$	4 ^e	2362062.08
Ti	77	30	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_4$	1 ^e	2362750.49
Ti	77	31	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_2$	2 ^e	2396752.55
Ti	77	32	$(d_{+}^4)_4$	4 ^e	2866551.25
Ti	77	33	$(d_{+}^4)_2$	2 ^e	2953063.27
Ti	77	34	$(d_{+}^4)_0$	0 ^e	3162893.16
Ti	78	1	$(d_{-}^4)_0$	0 ^e	0.00
Ti	78	2	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	678828.28
Ti	78	3	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	780845.91
Ti	78	4	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_2$	2 ^e	812514.39
Ti	78	5	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_3$	3 ^e	840936.53
Ti	78	6	$\left((d_{-}^2)_{2'}, (d_{+}^2)_{20}\right)$	0 ^e	1431884.42
Ti	78	7	$\left((d_{-}^2)_{2'}, (d_{+}^2)_{42}\right)$	2 ^e	1433346.73
Ti	78	8	$\left((d_{-}^2)_{2'}, (d_{+}^2)_{44}\right)$	4 ^e	1456310.79
Ti	78	9	$\left((d_{-}^2)_{2'}, (d_{+}^2)_{43}\right)$	3 ^e	1474631.13
Ti	78	10	$\left((d_{-}^2)_{2'}, (d_{+}^2)_{45}\right)$	5 ^e	1504124.67
Ti	78	11	$\left((d_{-}^2)_{2'}, (d_{+}^2)_{46}\right)$	6 ^e	1528113.49

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ti	78	12	$((d^-)_2, (d^+)_2)_1$	1 ^e	1552798.34
Ti	78	13	$((d^-)_2, (d^+)_2)_3$	3 ^e	1575588.40
Ti	78	14	$((d^-)_2, (d^+)_2)_4$	4 ^e	1580598.51
Ti	78	15	$((d^-)_2, (d^+)_2)_2$	2 ^e	1598039.27
Ti	78	16	$((d^-)_2, (d^+)_0)_2$	2 ^e	1707202.21
Ti	78	17	$((d^-)_0, (d^+)_4)_4$	4 ^e	1754855.60
Ti	78	18	$((d^-)_0, (d^+)_2)_2$	2 ^e	1867851.05
Ti	78	19	$((d^-)_0, (d^+)_0)_0$	0 ^e	2013104.67
Ti	78	20	$((d^-)_{3/2}, (d^+_{-3})_{9/2})_4$	4 ^e	2210367.43
Ti	78	21	$((d^-)_{3/2}, (d^+_{-3})_{9/2})_3$	3 ^e	2222469.14
Ti	78	22	$((d^-)_{3/2}, (d^+_{-3})_{3/2})_1$	1 ^e	2267112.06
Ti	78	23	$((d^-)_{3/2}, (d^+_{-3})_{9/2})_5$	5 ^e	2274805.95
Ti	78	24	$((d^-)_{3/2}, (d^+_{-3})_{9/2})_6$	6 ^e	2278687.34
Ti	78	25	$((d^-)_{3/2}, (d^+_{-3})_{3/2})_2$	2 ^e	2346993.30
Ti	78	26	$((d^-)_{3/2}, (d^+_{-3})_{3/2})_3$	3 ^e	2364060.42
Ti	78	27	$((d^-)_{3/2}, (d^+_{-3})_{3/2})_0$	0 ^e	2429849.55
Ti	78	28	$((d^-)_{3/2}, (d^+_{-3})_{5/2})_3$	3 ^e	2496543.91
Ti	78	29	$((d^-)_{3/2}, (d^+_{-3})_{5/2})_4$	4 ^e	2499434.92

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ti	78	30	$((d^-)_{3/2}, (d^3_+)_{5/2})_1$	1 ^e	2500809.52
Ti	78	31	$((d^-)_{3/2}, (d^3_+)_{5/2})_2$	2 ^e	2534538.29
Ti	78	32	$(d^4_+)_4$	4 ^e	3045499.26
Ti	78	33	$(d^4_+)_2$	2 ^e	3132979.02
Ti	78	34	$(d^4_+)_0$	0 ^e	3345663.65
Ti	79	1	$(d^4_+)_0$	0 ^e	0.00
Ti	79	2	$((d^-)_{3/2}, (d^1_+)_{5/2})_1$	1 ^e	724503.49
Ti	79	3	$((d^-)_{3/2}, (d^1_+)_{5/2})_4$	4 ^e	827634.86
Ti	79	4	$((d^-)_{3/2}, (d^1_+)_{5/2})_2$	2 ^e	861008.69
Ti	79	5	$((d^-)_{3/2}, (d^1_+)_{5/2})_3$	3 ^e	889596.84
Ti	79	6	$((d^-)_{2'}, (d^2_+)_{2/0})$	0 ^e	1524394.32
Ti	79	7	$((d^-)_{2'}, (d^2_+)_{4/2})$	2 ^e	1525041.57
Ti	79	8	$((d^-)_{2'}, (d^2_+)_{4/4})$	4 ^e	1548867.38
Ti	79	9	$((d^-)_{2'}, (d^2_+)_{4/3})$	3 ^e	1567728.24
Ti	79	10	$((d^-)_{2'}, (d^2_+)_{4/5})$	5 ^e	1596919.66
Ti	79	11	$((d^-)_{2'}, (d^2_+)_{4/6})$	6 ^e	1620998.83
Ti	79	12	$((d^-)_{2'}, (d^2_+)_{2/1})$	1 ^e	1647602.52
Ti	79	13	$((d^-)_{2'}, (d^2_+)_{2/3})$	3 ^e	1669696.61

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ti	79	14	$((d^-)_2, (d^2_+)_2)_{2/4}$	4 ^e	1675056.85
Ti	79	15	$((d^-)_2, (d^2_+)_2)_{2/2}$	2 ^e	1693099.14
Ti	79	16	$((d^-)_2, (d^2_+)_0)_{2/2}$	2 ^e	1804299.75
Ti	79	17	$((d^-)_0, (d^2_+)_4)_{4/4}$	4 ^e	1852626.98
Ti	79	18	$((d^-)_0, (d^2_+)_2)_{2/2}$	2 ^e	1968507.59
Ti	79	19	$((d^-)_0, (d^2_+)_0)_{0/0}$	0 ^e	2117959.81
Ti	79	20	$((d^-)_{3/2}, (d^3_+)_{9/2})_{4/4}$	4 ^e	2349449.24
Ti	79	21	$((d^-)_{3/2}, (d^3_+)_{9/2})_{3/3}$	3 ^e	2361815.76
Ti	79	22	$((d^-)_{3/2}, (d^3_+)_{3/2})_{1/1}$	1 ^e	2407332.57
Ti	79	23	$((d^-)_{3/2}, (d^3_+)_{9/2})_{5/5}$	5 ^e	2414964.34
Ti	79	24	$((d^-)_{3/2}, (d^3_+)_{9/2})_{6/6}$	6 ^e	2418498.36
Ti	79	25	$((d^-)_{3/2}, (d^3_+)_{3/2})_{2/2}$	2 ^e	2488561.09
Ti	79	26	$((d^-)_{3/2}, (d^3_+)_{3/2})_{3/3}$	3 ^e	2505724.43
Ti	79	27	$((d^-)_{3/2}, (d^3_+)_{3/2})_{0/0}$	0 ^e	2572067.92
Ti	79	28	$((d^-)_{3/2}, (d^3_+)_{5/2})_{3/3}$	3 ^e	2640839.09
Ti	79	29	$((d^-)_{3/2}, (d^3_+)_{5/2})_{4/4}$	4 ^e	2643174.80
Ti	79	30	$((d^-)_{3/2}, (d^3_+)_{5/2})_{1/1}$	1 ^e	2645261.64
Ti	79	31	$((d^-)_{3/2}, (d^3_+)_{5/2})_{2/2}$	2 ^e	2678698.60

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ti	79	32	$(d^4_+)_4$	4 ^e	3232954.10
Ti	79	33	$(d^4_+)_2$	2 ^e	3321451.27
Ti	79	34	$(d^4_+)_0$	0 ^e	3537016.72
Ti	80	1	$(d^2_-)_0$	0 ^e	0.00
Ti	80	2	$((d^3_-)_{3/2}, (d^1_+)_{5/2})_1$	1 ^e	772368.58
Ti	80	3	$((d^3_-)_{3/2}, (d^1_+)_{5/2})_4$	4 ^e	876589.40
Ti	80	4	$((d^3_-)_{3/2}, (d^1_+)_{5/2})_2$	2 ^e	911652.69
Ti	80	5	$((d^3_-)_{3/2}, (d^1_+)_{5/2})_3$	3 ^e	940415.88
Ti	80	6	$((d^2_-)_{2^+}, (d^2_+)_{4/2})$	2 ^e	1621152.58
Ti	80	7	$((d^2_-)_{2^+}, (d^2_+)_{2/0})$	0 ^e	1621300.39
Ti	80	8	$((d^2_-)_{0^+}, (d^2_+)_{4/4})$	4 ^e	1645787.21
Ti	80	9	$((d^2_-)_{2^+}, (d^2_+)_{4/3})$	3 ^e	1665210.02
Ti	80	10	$((d^2_-)_{2^+}, (d^2_+)_{4/5})$	5 ^e	1694070.80
Ti	80	11	$((d^2_-)_{2^+}, (d^2_+)_{4/6})$	6 ^e	1718221.21
Ti	80	12	$((d^2_-)_{2^+}, (d^2_+)_{2/1})$	1 ^e	1746784.09
Ti	80	13	$((d^2_-)_{2^+}, (d^2_+)_{2/3})$	3 ^e	1768184.61
Ti	80	14	$((d^2_-)_{2^+}, (d^2_+)_{2/4})$	4 ^e	1773872.18
Ti	80	15	$((d^2_-)_{2^+}, (d^2_+)_{2/2})$	2 ^e	1792528.69

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ti	80	16	$((d^-)_{-2}, (d^2_+)_{0})_{-2}$	2 ^e	1905774.83
Ti	80	17	$((d^-)_{-2}, (d^2_+)_{0}, (d^2_+)_{4})_{-4}$	4 ^e	1954753.84
Ti	80	18	$((d^-)_{-2}, (d^2_+)_{0}, (d^2_+)_{2})_{-2}$	2 ^e	2073532.28
Ti	80	19	$((d^-)_{-2}, (d^2_+)_{0})_{-0}$	0 ^e	2227082.91
Ti	80	20	$((d^1_-)_{-3/2}, (d^3_+)_{9/2})_{-4}$	4 ^e	2495128.70
Ti	80	21	$((d^1_-)_{-3/2}, (d^3_+)_{9/2})_{-3}$	3 ^e	2507751.20
Ti	80	22	$((d^1_-)_{-3/2}, (d^3_+)_{3/2})_{-1}$	1 ^e	2554152.21
Ti	80	23	$((d^1_-)_{-3/2}, (d^3_+)_{9/2})_{-5}$	5 ^e	2561676.93
Ti	80	24	$((d^1_-)_{-3/2}, (d^3_+)_{9/2})_{-6}$	6 ^e	2564852.33
Ti	80	25	$((d^1_-)_{-3/2}, (d^3_+)_{3/2})_{-2}$	2 ^e	2636716.00
Ti	80	26	$((d^1_-)_{-3/2}, (d^3_+)_{3/2})_{-3}$	3 ^e	2653965.47
Ti	80	27	$((d^1_-)_{-3/2}, (d^3_+)_{3/2})_{-0}$	0 ^e	2720960.69
Ti	80	28	$((d^1_-)_{-3/2}, (d^3_+)_{5/2})_{-3}$	3 ^e	2791718.07
Ti	80	29	$((d^1_-)_{-3/2}, (d^3_+)_{5/2})_{-4}$	4 ^e	2793489.45
Ti	80	30	$((d^1_-)_{-3/2}, (d^3_+)_{5/2})_{-1}$	1 ^e	2796314.63
Ti	80	31	$((d^1_-)_{-3/2}, (d^3_+)_{5/2})_{-2}$	2 ^e	2829443.88
Ti	80	32	$(d^4_+)_{-4}$	4 ^e	3429191.46
Ti	80	33	$(d^4_+)_{-2}$	2 ^e	3518752.22

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Ti	80	34	$(d^4_+)_0$	0 ^e	3737226.04
Ti	81	1	$(d^4_-)_0$	0 ^e	0.00
Ti	81	2	$((d^3_-)_{3/2}, (d^1_+)_{5/2})_1$	1 ^e	822493.92
Ti	81	3	$((d^3_-)_{3/2}, (d^1_+)_{5/2})_4$	4 ^e	927780.54
Ti	81	4	$((d^3_-)_{3/2}, (d^1_+)_{5/2})_2$	2 ^e	964520.87
Ti	81	5	$((d^3_-)_{3/2}, (d^1_+)_{5/2})_3$	3 ^e	993467.87
Ti	81	6	$((d^2_-)_2, (d^2_+)_{4/2})$	2 ^e	1721819.10
Ti	81	7	$((d^2_-)_2, (d^2_+)_{2/0})$	0 ^e	1722743.60
Ti	81	8	$((d^2_-)_{0^*}, (d^2_+)_{4/4})$	4 ^e	1747211.60
Ti	81	9	$((d^2_-)_2, (d^2_+)_{4/3})$	3 ^e	1767217.45
Ti	81	10	$((d^2_-)_2, (d^2_+)_{4/5})$	5 ^e	1795719.55
Ti	81	11	$((d^2_-)_2, (d^2_+)_{4/6})$	6 ^e	1819921.76
Ti	81	12	$((d^2_-)_2, (d^2_+)_{2/1})$	1 ^e	1850486.50
Ti	81	13	$((d^2_-)_2, (d^2_+)_{2/3})$	3 ^e	1871195.60
Ti	81	14	$((d^2_-)_2, (d^2_+)_{2/4})$	4 ^e	1877187.42
Ti	81	15	$((d^2_-)_2, (d^2_+)_{2/2})$	2 ^e	1896471.92
Ti	81	16	$((d^2_-)_2, (d^2_+)_{0/2})$	2 ^e	2011772.50
Ti	81	17	$((d^2_-)_{0^*}, (d^2_+)_{4/4})$	4 ^e	2061384.96

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Ti	81	18	$((d_{-}^{-})_0, (d_{+}^{2})_2)_2$	2 ^e	2183073.61
Ti	81	19	$((d_{-}^{-})_0, (d_{+}^{2})_0)_0$	0 ^e	2340637.37
Ti	81	20	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_4$	4 ^e	2647614.90
Ti	81	21	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_3$	3 ^e	2660488.15
Ti	81	22	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_1$	1 ^e	2707784.23
Ti	81	23	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_5$	5 ^e	2715156.76
Ti	81	24	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{9/2})_6$	6 ^e	2717961.31
Ti	81	25	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_2$	2 ^e	2791671.55
Ti	81	26	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_3$	3 ^e	2808998.20
Ti	81	27	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{3/2})_0$	0 ^e	2876733.08
Ti	81	28	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{5/2})_3$	3 ^e	2949397.14
Ti	81	29	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{5/2})_4$	4 ^e	2950594.77
Ti	81	30	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{5/2})_1$	1 ^e	2954185.46
Ti	81	31	$((d_{-}^{1})_{3/2}, (d_{+}^{3})_{5/2})_2$	2 ^e	2986994.07
Ti	81	32	$(d_{+}^{4})_4$	4 ^e	3634494.85
Ti	81	33	$(d_{+}^{4})_2$	2 ^e	3725163.89
Ti	81	34	$(d_{+}^{4})_0$	0 ^e	3946576.35
Ti	82	1	$(d_{-}^{4})_0$	0 ^e	0.00

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Ti	82	2	$((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2})_1$	1 ^e	874948.74
Ti	82	3	$((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2})_4$	4 ^e	981274.23
Ti	82	4	$((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2})_2$	2 ^e	1019678.42
Ti	82	5	$((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2})_3$	3 ^e	1048816.50
Ti	82	6	$((d_{-}^2)_{2}, (d_{+}^2)_{4})_2$	2 ^e	1827174.10
Ti	82	7	$((d_{-}^2)_{2}, (d_{+}^2)_{2})_0$	0 ^e	1828860.09
Ti	82	8	$((d_{-}^2)_{0}, (d_{+}^2)_{4})_4$	4 ^e	1853276.36
Ti	82	9	$((d_{-}^2)_{2}, (d_{+}^2)_{4})_3$	3 ^e	1873882.65
Ti	82	10	$((d_{-}^2)_{2}, (d_{+}^2)_{4})_5$	5 ^e	1901999.62
Ti	82	11	$((d_{-}^2)_{2}, (d_{+}^2)_{4})_6$	6 ^e	1926234.74
Ti	82	12	$((d_{-}^2)_{2}, (d_{+}^2)_{2})_1$	1 ^e	1958839.36
Ti	82	13	$((d_{-}^2)_{2}, (d_{+}^2)_{2})_3$	3 ^e	1978857.71
Ti	82	14	$((d_{-}^2)_{2}, (d_{+}^2)_{2})_4$	4 ^e	1985132.05
Ti	82	15	$((d_{-}^2)_{2}, (d_{+}^2)_{2})_2$	2 ^e	2005055.94
Ti	82	16	$((d_{-}^2)_{2}, (d_{+}^2)_{0})_2$	2 ^e	2122421.10
Ti	82	17	$((d_{-}^2)_{0}, (d_{+}^2)_{4})_4$	4 ^e	2172645.99
Ti	82	18	$((d_{-}^2)_{0}, (d_{+}^2)_{2})_2$	2 ^e	2297251.16
Ti	82	19	$((d_{-}^2)_{0}, (d_{+}^2)_{0})_0$	0 ^e	2458752.88

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Ti	82	20	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_4$	4 ^e	2807108.33
Ti	82	21	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_3$	3 ^e	2820228.56
Ti	82	22	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_1$	1 ^e	2868429.05
Ti	82	23	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_5$	5 ^e	2875604.54
Ti	82	24	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_6$	6 ^e	2878027.76
Ti	82	25	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_2$	2 ^e	2953624.33
Ti	82	26	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_3$	3 ^e	2971017.95
Ti	82	27	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_0$	0 ^e	3039563.89
Ti	82	28	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_3$	3 ^e	3114068.42
Ti	82	29	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_4$	4 ^e	3114684.68
Ti	82	30	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_1$	1 ^e	3119065.08
Ti	82	31	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_2$	2 ^e	3151539.27
Ti	82	32	$(d_{+}^4)_4$	4 ^e	3849134.17
Ti	82	33	$(d_{+}^4)_2$	2 ^e	3940948.31
Ti	82	34	$(d_{+}^4)_0$	0 ^e	4165325.87
Ti	83	1	$(d_{-}^4)_0$	0 ^e	0.00
Ti	83	2	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_1$	1 ^e	929808.01
Ti	83	3	$\left((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2}\right)_4$	4 ^e	1037148.13

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ti	83	4	$((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2})_2$	2 ^e	1077208.22
Ti	83	5	$((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2})_3$	3 ^e	1106545.11
Ti	83	6	$((d_{-}^2)_{2'}, (d_{+}^2)_{4'})_2$	2 ^e	1937368.70
Ti	83	7	$((d_{-}^2)_{2'}, (d_{+}^2)_{2'})_0$	0 ^e	1939801.31
Ti	83	8	$((d_{-}^2)_{0'}, (d_{+}^2)_{4'})_4$	4 ^e	1964133.71
Ti	83	9	$((d_{-}^2)_{2'}, (d_{+}^2)_{4'})_3$	3 ^e	1985359.61
Ti	83	10	$((d_{-}^2)_{2'}, (d_{+}^2)_{4'})_5$	5 ^e	2013064.58
Ti	83	11	$((d_{-}^2)_{2'}, (d_{+}^2)_{4'})_6$	6 ^e	2037312.97
Ti	83	12	$((d_{-}^2)_{2'}, (d_{+}^2)_{2'})_1$	1 ^e	2072001.30
Ti	83	13	$((d_{-}^2)_{2'}, (d_{+}^2)_{2'})_3$	3 ^e	2091329.97
Ti	83	14	$((d_{-}^2)_{2'}, (d_{+}^2)_{2'})_4$	4 ^e	2097863.99
Ti	83	15	$((d_{-}^2)_{2'}, (d_{+}^2)_{2'})_2$	2 ^e	2118441.55
Ti	83	16	$((d_{-}^2)_{2'}, (d_{+}^2)_{0'})_2$	2 ^e	2237882.00
Ti	83	17	$((d_{-}^2)_{0'}, (d_{+}^2)_{4'})_4$	4 ^e	2288704.58
Ti	83	18	$((d_{-}^2)_{0'}, (d_{+}^2)_{2'})_2$	2 ^e	2416236.32
Ti	83	19	$((d_{-}^2)_{0'}, (d_{+}^2)_{0'})_0$	0 ^e	2581613.81
Ti	83	20	$((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2})_4$	4 ^e	2973835.68
Ti	83	21	$((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2})_3$	3 ^e	2987202.58

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Ti	83	22	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_1$	1 ^e	3036318.35
Ti	83	23	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_5$	5 ^e	3043251.70
Ti	83	24	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{9/2}\right)_6$	6 ^e	3045280.78
Ti	83	25	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_2$	2 ^e	3122808.82
Ti	83	26	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_3$	3 ^e	3140261.25
Ti	83	27	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{3/2}\right)_0$	0 ^e	3209687.54
Ti	83	28	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_3$	3 ^e	3285972.62
Ti	83	29	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_4$	4 ^e	3285998.25
Ti	83	30	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_1$	1 ^e	3291195.84
Ti	83	31	$\left((d_{-}^1)_{3/2}, (d_{+}^3)_{5/2}\right)_2$	2 ^e	3323325.65
Ti	83	32	$(d_{+}^4)_4$	4 ^e	4073415.86
Ti	83	33	$(d_{+}^4)_2$	2 ^e	4166414.69
Ti	83	34	$(d_{+}^4)_0$	0 ^e	4393789.12
V	72	1	$(d_{+}^1)_{5/2}$	5/2 ^e	0.00
V	72	2	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4/2}\right)_{5/2}$	5/2 ^e	403709.92
V	72	3	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4/2}\right)_{7/2}$	7/2 ^e	496730.46
V	72	4	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4/2}\right)_{11/2}$	11/ 2 ^e	508358.08
V	72	5	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2/2}\right)_{3/2}$	3/2 ^e	509867.54

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	72	6	$\left((d_{-}^{2})_{3/2}, (d_{+}^{2})_{4/2}\right)$	9/2 ^e	550312.27
V	72	7	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2/2}\right)$	5/2 ^e	577649.03
V	72	8	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2/2}\right)$	1/2 ^e	603000.42
V	72	9	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2/2}\right)$	7/2 ^e	614377.19
V	72	10	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{0/2}\right)$	3/2 ^e	740862.07
V	72	11	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)$	5/2 ^e	892377.18
V	72	12	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)$	7/2 ^e	959898.67
V	72	13	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)$	11/2 ^e	964901.42
V	72	14	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)$	9/2 ^e	980201.84
V	72	15	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)$	13/2 ^e	1005477.60
V	72	16	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)$	1/2 ^e	1015234.42
V	72	17	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)$	3/2 ^e	1024015.71
V	72	18	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)$	5/2 ^e	1034891.37
V	72	19	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)$	9/2 ^e	1076043.79
V	72	20	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)$	7/2 ^e	1096050.93
V	72	21	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)$	5/2 ^e	1111034.19
V	72	22	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)$	3/2 ^e	1117715.80
V	72	23	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)$	7/2 ^e	1162586.83

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	72	24	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{1/2}$	1/2 ^e	1162777.17
V	72	25	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	1231638.63
V	72	26	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1352456.95
V	72	27	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1376017.19
V	72	28	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/5/2}\right)$	5/2 ^e	1454891.71
V	72	29	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/7/2}\right)$	7/2 ^e	1523590.48
V	72	30	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/11/2}\right)$	11/ 2 ^e	1537039.07
V	72	31	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/3/2}\right)$	3/2 ^e	1548373.83
V	72	32	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/9/2}\right)$	9/2 ^e	1594941.08
V	72	33	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/5/2}\right)$	5/2 ^e	1630645.35
V	72	34	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/7/2}\right)$	7/2 ^e	1657445.81
V	72	35	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/1/2}\right)$	1/2 ^e	1719697.45
V	72	36	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{0/3/2}\right)$	3/2 ^e	1842063.13
V	72	37	$(d_{+}^{5})_{5/2}$	5/2 ^e	2080888.47
V	73	1	$(d_{+}^{1})_{5/2}$	5/2 ^e	0.00
V	73	2	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{4/5/2}\right)$	5/2 ^e	436195.74
V	73	3	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{4/7/2}\right)$	7/2 ^e	530292.11
V	73	4	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{4/11/2}\right)$	11/ 2 ^e	541767.42

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	73	5	$((d_{-}^2)_{3/2}, (d_{+}^2)_{2/3/2})$	3/2 ^e	544071.43
V	73	6	$((d_{-}^3)_{3/2}, (d_{+}^2)_{4/9/2})$	9/2 ^e	585101.05
V	73	7	$((d_{-}^3)_{3/2}, (d_{+}^2)_{2/5/2})$	5/2 ^e	613536.79
V	73	8	$((d_{-}^2)_{3/2}, (d_{+}^2)_{2/1/2})$	1/2 ^e	640604.83
V	73	9	$((d_{-}^3)_{3/2}, (d_{+}^2)_{2/7/2})$	7/2 ^e	650397.81
V	73	10	$((d_{-}^3)_{3/2}, (d_{+}^2)_{0/3/2})$	3/2 ^e	781544.86
V	73	11	$((d_{-}^2)_{2}, (d_{+}^3)_{9/2/5/2})$	5/2 ^e	957944.67
V	73	12	$((d_{-}^2)_{2}, (d_{+}^3)_{9/2/7/2})$	7/2 ^e	1027203.55
V	73	13	$((d_{-}^2)_{2}, (d_{+}^3)_{9/2/11/2})$	11/ 2 ^e	1031831.15
V	73	14	$((d_{-}^2)_{2}, (d_{+}^3)_{9/2/9/2})$	9/2 ^e	1047462.07
V	73	15	$((d_{-}^2)_{2}, (d_{+}^3)_{9/2/13/2})$	13/ 2 ^e	1072866.61
V	73	16	$((d_{-}^2)_{2}, (d_{+}^3)_{3/2/1/2})$	1/2 ^e	1084186.43
V	73	17	$((d_{-}^2)_{2}, (d_{+}^3)_{5/2/3/2})$	3/2 ^e	1092971.00
V	73	18	$((d_{-}^2)_{2}, (d_{+}^3)_{3/2/5/2})$	5/2 ^e	1103598.10
V	73	19	$((d_{-}^2)_{2}, (d_{+}^3)_{5/2/9/2})$	9/2 ^e	1145373.00
V	73	20	$((d_{-}^2)_{2}, (d_{+}^3)_{3/2/7/2})$	7/2 ^e	1165689.85
V	73	21	$((d_{-}^2)_{2}, (d_{+}^3)_{5/2/5/2})$	5/2 ^e	1181380.05
V	73	22	$((d_{-}^2)_{2}, (d_{+}^3)_{3/2/3/2})$	3/2 ^e	1187188.82

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	73	23	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{7/2}$	7/2 ^e	1233777.93
V	73	24	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{1/2}$	1/2 ^e	1233975.13
V	73	25	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	1304247.53
V	73	26	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1427056.40
V	73	27	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1453045.56
V	73	28	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/5/2}\right)$	5/2 ^e	1555761.88
V	73	29	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/7/2}\right)$	7/2 ^e	1626625.60
V	73	30	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/11/2}\right)$	11/ 2 ^e	1639879.35
V	73	31	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/3/2}\right)$	3/2 ^e	1651681.71
V	73	32	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/9/2}\right)$	9/2 ^e	1698567.18
V	73	33	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/5/2}\right)$	5/2 ^e	1735046.05
V	73	34	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/7/2}\right)$	7/2 ^e	1762481.83
V	73	35	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/1/2}\right)$	1/2 ^e	1824544.12
V	73	36	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{0/3/2}\right)$	3/2 ^e	1950078.47
V	73	37	$(d_{+}^{5})_{5/2}$	5/2 ^e	2218693.13
V	74	1	$(d_{+}^{1})_{5/2}$	5/2 ^e	0.00
V	74	2	$\left((d_{-}^{2})_{3/2}, (d_{+}^{2})_{4/5/2}\right)$	5/2 ^e	470509.86
V	74	3	$\left((d_{-}^{2})_{3/2}, (d_{+}^{2})_{4/7/2}\right)$	7/2 ^e	565664.98

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	74	4	$\left((d_{-}^{-})_{3/2}, (d_{+}^{2})_{4/11/2}\right)$	11/ 2 ^e	576960.85
V	74	5	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2/3/2}\right)$	3/2 ^e	580099.62
V	74	6	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{4/9/2}\right)$	9/2 ^e	621678.79
V	74	7	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2/5/2}\right)$	5/2 ^e	651201.93
V	74	8	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2/1/2}\right)$	1/2 ^e	680013.84
V	74	9	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2/7/2}\right)$	7/2 ^e	688224.96
V	74	10	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{0/3/2}\right)$	3/2 ^e	823988.88
V	74	11	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2/5/2}\right)$	5/2 ^e	1027176.24
V	74	12	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2/7/2}\right)$	7/2 ^e	1098115.89
V	74	13	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2/11/2}\right)$	11/ 2 ^e	1102347.34
V	74	14	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2/9/2}\right)$	9/2 ^e	1118327.88
V	74	15	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2/13/2}\right)$	13/ 2 ^e	1143816.00
V	74	16	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2/1/2}\right)$	1/2 ^e	1156740.78
V	74	17	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2/3/2}\right)$	3/2 ^e	1165530.05
V	74	18	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2/5/2}\right)$	5/2 ^e	1175911.47
V	74	19	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2/9/2}\right)$	9/2 ^e	1218296.00
V	74	20	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2/7/2}\right)$	7/2 ^e	1238917.95
V	74	21	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2/5/2}\right)$	5/2 ^e	1255336.64

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	74	22	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1260299.78
V	74	23	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{7/2}$	7/2 ^e	1308552.50
V	74	24	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{1/2}$	1/2 ^e	1308791.09
V	74	25	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	1380426.81
V	74	26	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1505292.62
V	74	27	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1533394.23
V	74	28	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/5/2}\right)$	5/2 ^e	1662253.41
V	74	29	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/7/2}\right)$	7/2 ^e	1735053.08
V	74	30	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/11/2}\right)$	11/ 2 ^e	1748086.48
V	74	31	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/3/2}\right)$	3/2 ^e	1760418.48
V	74	32	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/9/2}\right)$	9/2 ^e	1807603.80
V	74	33	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/5/2}\right)$	5/2 ^e	1844867.21
V	74	34	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/7/2}\right)$	7/2 ^e	1872924.73
V	74	35	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/1/2}\right)$	1/2 ^e	1934825.76
V	74	36	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{0/3/2}\right)$	3/2 ^e	2063511.88
V	74	37	$(d_{+}^{5})_{5/2}$	5/2 ^e	2363752.49
V	75	1	$(d_{+}^{1})_{5/2}$	5/2 ^e	0.00
V	75	2	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{4/5/2}\right)$	5/2 ^e	506706.91

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
V	75	3	$\left((d_{-}^{2})_{3/2}, (d_{+}^{2})_{4/2}\right)_{7/2}$	7/2 ^e	602906.49
V	75	4	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{4/2}\right)_{11/2}$	11/ 2 ^e	613996.02
V	75	5	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2/2}\right)_{3/2}$	3/2 ^e	618009.56
V	75	6	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{4/2}\right)_{9/2}$	9/2 ^e	660104.07
V	75	7	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2/2}\right)_{5/2}$	5/2 ^e	690705.20
V	75	8	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2/2}\right)_{1/2}$	1/2 ^e	721283.67
V	75	9	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2/2}\right)_{7/2}$	7/2 ^e	727916.59
V	75	10	$\left((d_{-}^{3})_{3/2}, (d_{+}^{2})_{0/2}\right)_{3/2}$	3/2 ^e	868254.41
V	75	11	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)_{5/2}$	5/2 ^e	1100186.20
V	75	12	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)_{7/2}$	7/2 ^e	1172753.91
V	75	13	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)_{11/2}$	11/ 2 ^e	1176568.04
V	75	14	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	1192916.46
V	75	15	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)_{13/2}$	13/ 2 ^e	1218444.32
V	75	16	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{1/2}$	1/2 ^e	1233017.60
V	75	17	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{3/2}$	3/2 ^e	1241812.82
V	75	18	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{5/2}$	5/2 ^e	1251950.25
V	75	19	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{9/2}$	9/2 ^e	1294931.81
V	75	20	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{7/2}$	7/2 ^e	1315854.28

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
V	75	21	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1333023.63
V	75	22	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1337166.96
V	75	23	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{7/2}$	7/2 ^e	1387031.14
V	75	24	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{1/2}$	1/2 ^e	1387344.39
V	75	25	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	1460299.06
V	75	26	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1587285.02
V	75	27	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1617286.23
V	75	28	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/5/2}\right)$	5/2 ^e	1774455.51
V	75	29	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/7/2}\right)$	7/2 ^e	1849053.62
V	75	30	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/11/2}\right)$	11/ 2 ^e	1861841.32
V	75	31	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/3/2}\right)$	3/2 ^e	1874762.06
V	75	32	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/9/2}\right)$	9/2 ^e	1922228.81
V	75	33	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/5/2}\right)$	5/2 ^e	1960286.42
V	75	34	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/7/2}\right)$	7/2 ^e	1988954.62
V	75	35	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/1/2}\right)$	1/2 ^e	2050724.12
V	75	36	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{0/3/2}\right)$	3/2 ^e	2182545.76
V	75	37	$(d_{+}^{5})_{5/2}$	5/2 ^e	2516301.92
V	76	1	$(d_{+}^{1})_{5/2}$	5/2 ^e	0.00

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	76	2	$\left((d_{-}^2)_{3/2}, (d_{+}^2)_{4/5/2}\right)$	5/2 ^e	544844.18
V	76	3	$\left((d_{-}^2)_{3/2}, (d_{+}^2)_{4/7/2}\right)$	7/2 ^e	642076.11
V	76	4	$\left((d_{-}^2)_{3/2}, (d_{+}^2)_{4/11/2}\right)$	11/ 2 ^e	652932.61
V	76	5	$\left((d_{-}^2)_{3/2}, (d_{+}^2)_{2/3/2}\right)$	3/2 ^e	657860.79
V	76	6	$\left((d_{-}^2)_{3/2}, (d_{+}^2)_{4/9/2}\right)$	9/2 ^e	700437.39
V	76	7	$\left((d_{-}^2)_{3/2}, (d_{+}^2)_{2/5/2}\right)$	5/2 ^e	732109.03
V	76	8	$\left((d_{-}^2)_{3/2}, (d_{+}^2)_{2/1/2}\right)$	1/2 ^e	764472.94
V	76	9	$\left((d_{-}^2)_{3/2}, (d_{+}^2)_{2/7/2}\right)$	7/2 ^e	769532.63
V	76	10	$\left((d_{-}^2)_{3/2}, (d_{+}^2)_{0/3/2}\right)$	3/2 ^e	914404.11
V	76	11	$\left((d_{-}^2)_{2}, (d_{+}^2)_{9/2/5/2}\right)$	5/2 ^e	1177092.88
V	76	12	$\left((d_{-}^2)_{2}, (d_{+}^2)_{9/2/7/2}\right)$	7/2 ^e	1251239.48
V	76	13	$\left((d_{-}^2)_{2}, (d_{+}^2)_{9/2/11/2}\right)$	11/ 2 ^e	1254614.94
V	76	14	$\left((d_{-}^2)_{2}, (d_{+}^2)_{9/2/9/2}\right)$	9/2 ^e	1271348.77
V	76	15	$\left((d_{-}^2)_{2}, (d_{+}^2)_{9/2/13/2}\right)$	13/ 2 ^e	1296873.69
V	76	16	$\left((d_{-}^2)_{2}, (d_{+}^2)_{3/2/1/2}\right)$	1/2 ^e	1313140.54
V	76	17	$\left((d_{-}^2)_{2}, (d_{+}^2)_{5/2/3/2}\right)$	3/2 ^e	1321942.78
V	76	18	$\left((d_{-}^2)_{2}, (d_{+}^2)_{3/2/5/2}\right)$	5/2 ^e	1331836.80
V	76	19	$\left((d_{-}^2)_{2}, (d_{+}^2)_{5/2/9/2}\right)$	9/2 ^e	1375402.99

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
V	76	20	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{7/2}$	7/2 ^e	1396621.38
V	76	21	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1414564.19
V	76	22	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1417911.76
V	76	23	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{7/2}$	7/2 ^e	1469337.83
V	76	24	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{1/2}$	1/2 ^e	1469757.84
V	76	25	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	1543989.98
V	76	26	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1673156.27
V	76	27	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1704900.73
V	76	28	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/5/2}\right)$	5/2 ^e	1892507.97
V	76	29	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/7/2}\right)$	7/2 ^e	1968812.99
V	76	30	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/11/2}\right)$	11/ 2 ^e	1981329.77
V	76	31	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/3/2}\right)$	3/2 ^e	1994896.01
V	76	32	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4/9/2}\right)$	9/2 ^e	2042625.56
V	76	33	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/5/2}\right)$	5/2 ^e	2081486.87
V	76	34	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/7/2}\right)$	7/2 ^e	2110756.68
V	76	35	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2/1/2}\right)$	1/2 ^e	2172425.64
V	76	36	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{0/3/2}\right)$	3/2 ^e	2307367.37
V	76	37	$(d_{+}^{5})_{5/2}$	5/2 ^e	2676584.49

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	77	1	$(d^1_+)^{1/2}$	5/2 ^e	0.00
V	77	2	$((d^3_-)^{3/2}, (d^2_+)^{4/2})^{5/2}$	5/2 ^e	584980.74
V	77	3	$((d^3_-)^{3/2}, (d^2_+)^{4/2})^{7/2}$	7/2 ^e	683234.58
V	77	4	$((d^3_-)^{3/2}, (d^2_+)^{4/2})^{11/2}$	11/2 ^e	693831.43
V	77	5	$((d^3_-)^{3/2}, (d^2_+)^{2/2})^{3/2}$	3/2 ^e	699714.14
V	77	6	$((d^3_-)^{3/2}, (d^2_+)^{4/2})^{9/2}$	9/2 ^e	742740.37
V	77	7	$((d^3_-)^{3/2}, (d^2_+)^{2/2})^{5/2}$	5/2 ^e	775476.77
V	77	8	$((d^3_-)^{3/2}, (d^2_+)^{2/2})^{1/2}$	1/2 ^e	809641.84
V	77	9	$((d^3_-)^{3/2}, (d^2_+)^{2/2})^{7/2}$	7/2 ^e	813134.23
V	77	10	$((d^3_-)^{3/2}, (d^2_+)^{0/2})^{3/2}$	3/2 ^e	962501.94
V	77	11	$((d^2_-)^{2/2}, (d^3_+)^{9/2})^{5/2}$	5/2 ^e	1258017.05
V	77	12	$((d^2_-)^{2/2}, (d^3_+)^{9/2})^{7/2}$	7/2 ^e	1333696.62
V	77	13	$((d^2_-)^{2/2}, (d^3_+)^{9/2})^{11/2}$	11/2 ^e	1336611.80
V	77	14	$((d^2_-)^{2/2}, (d^3_+)^{9/2})^{9/2}$	9/2 ^e	1353747.90
V	77	15	$((d^2_-)^{2/2}, (d^3_+)^{9/2})^{13/2}$	13/2 ^e	1379228.14
V	77	16	$((d^2_-)^{2/2}, (d^3_+)^{3/2})^{1/2}$	1/2 ^e	1397235.25
V	77	17	$((d^2_-)^{2/2}, (d^3_+)^{5/2})^{3/2}$	3/2 ^e	1406045.40
V	77	18	$((d^2_-)^{2/2}, (d^3_+)^{3/2})^{5/2}$	5/2 ^e	1415695.50

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	77	19	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{9/2}$	9/2 ^e	1459834.10
V	77	20	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{7/2}$	7/2 ^e	1481343.83
V	77	21	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1500083.42
V	77	22	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1502657.35
V	77	23	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{7/2}$	7/2 ^e	1555598.42
V	77	24	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{1/2}$	1/2 ^e	1556156.26
V	77	25	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	1631626.82
V	77	26	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1763030.87
V	77	27	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1796396.79
V	77	28	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	2016574.01
V	77	29	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	2094519.78
V	77	30	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/ 2 ^e	2106740.41
V	77	31	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{3/2}$	3/2 ^e	2121007.17
V	77	32	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{9/2}$	9/2 ^e	2168980.49
V	77	33	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{5/2}$	5/2 ^e	2208655.03
V	77	34	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{7/2}$	7/2 ^e	2238518.94
V	77	35	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{1/2}$	1/2 ^e	2300119.39
V	77	36	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{0}\right)_{3/2}$	3/2 ^e	2438166.58

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	77	37	$(d^5_+)^{5/2}$	5/2 ^e	284847.81
V	78	1	$(d^1_+)^{5/2}$	5/2 ^e	0.00
V	78	2	$((d^3_-)^{3/2}, (d^2_+)^4)^{5/2}$	5/2 ^e	627178.52
V	78	3	$((d^2_-)^{3/2}, (d^2_+)^4)^{7/2}$	7/2 ^e	726445.08
V	78	4	$((d^3_-)^{3/2}, (d^2_+)^4)^{11/2}$	11/ 2 ^e	736755.82
V	78	5	$((d^3_-)^{3/2}, (d^2_+)^2)^{3/2}$	3/2 ^e	743632.92
V	78	6	$((d^3_-)^{3/2}, (d^2_+)^4)^{9/2}$	9/2 ^e	787077.04
V	78	7	$((d^3_-)^{3/2}, (d^2_+)^2)^{5/2}$	5/2 ^e	820873.95
V	78	8	$((d^3_-)^{3/2}, (d^2_+)^2)^{1/2}$	1/2 ^e	856853.25
V	78	9	$((d^3_-)^{3/2}, (d^2_+)^2)^{7/2}$	7/2 ^e	858784.96
V	78	10	$((d^3_-)^{3/2}, (d^2_+)^0)^{3/2}$	3/2 ^e	1012614.51
V	78	11	$((d^2_-)^2, (d^3_+)^{9/2})^{5/2}$	5/2 ^e	1343084.42
V	78	12	$((d^2_-)^2, (d^3_+)^{9/2})^{7/2}$	7/2 ^e	1420253.96
V	78	13	$((d^2_-)^2, (d^3_+)^{9/2})^{11/2}$	11/ 2 ^e	1422687.03
V	78	14	$((d^2_-)^2, (d^3_+)^{9/2})^{9/2}$	9/2 ^e	1440241.68
V	78	15	$((d^2_-)^2, (d^3_+)^{9/2})^{13/2}$	13/ 2 ^e	1465636.39
V	78	16	$((d^2_-)^2, (d^3_+)^{3/2})^{1/2}$	1/2 ^e	1485431.89
V	78	17	$((d^2_-)^2, (d^3_+)^{5/2})^{3/2}$	3/2 ^e	1494250.64

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
V	78	18	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{5/2}$	5/2 ^e	1503655.28
V	78	19	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{9/2}$	9/2 ^e	1548354.27
V	78	20	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{7/2}$	7/2 ^e	1570150.73
V	78	21	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1589710.94
V	78	22	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1591531.20
V	78	23	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{7/2}$	7/2 ^e	1645943.16
V	78	24	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{1/2}$	1/2 ^e	1646668.94
V	78	25	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	1723341.08
V	78	26	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1857037.72
V	78	27	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1891926.46
V	78	28	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	2146833.73
V	78	29	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	2226369.18
V	78	30	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/2 ^e	2238268.48
V	78	31	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{3/2}$	3/2 ^e	2253289.27
V	78	32	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{9/2}$	9/2 ^e	2301486.95
V	78	33	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{5/2}$	5/2 ^e	2341984.31
V	78	34	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{7/2}$	7/2 ^e	2372436.08
V	78	35	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{1/2}$	1/2 ^e	2434000.73

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	78	36	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{0,3/2}\right)$	3/2 ^e	2575139.73
V	78	37	$(d_{+}^5)_{5/2}$	5/2 ^e	3021348.90
V	79	1	$(d_{+}^1)_{5/2}$	5/2 ^e	0.00
V	79	2	$\left((d_{-}^2)_{3/2}, (d_{+}^2)_{4,5/2}\right)$	5/2 ^e	671501.04
V	79	3	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4,7/2}\right)$	7/2 ^e	771772.10
V	79	4	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4,11/2}\right)$	11/ 2 ^e	781770.29
V	79	5	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2,3/2}\right)$	3/2 ^e	789681.73
V	79	6	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4,9/2}\right)$	9/2 ^e	833512.57
V	79	7	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2,5/2}\right)$	5/2 ^e	868367.11
V	79	8	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2,1/2}\right)$	1/2 ^e	906171.56
V	79	9	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2,7/2}\right)$	7/2 ^e	906549.63
V	79	10	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{0,3/2}\right)$	3/2 ^e	1064809.64
V	79	11	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2,5/2}\right)$	5/2 ^e	1432423.26
V	79	12	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2,7/2}\right)$	7/2 ^e	1511042.42
V	79	13	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2,11/2}\right)$	11/ 2 ^e	1512971.25
V	79	14	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2,9/2}\right)$	9/2 ^e	1530960.22
V	79	15	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2,13/2}\right)$	13/ 2 ^e	1556229.27
V	79	16	$\left((d_{-}^2)_{2}, (d_{+}^3)_{3/2,1/2}\right)$	1/2 ^e	1577862.80

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	79	17	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{3/2}$	3/2 ^e	1586690.62
V	79	18	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{5/2}$	5/2 ^e	1595847.31
V	79	19	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{9/2}$	9/2 ^e	1641094.83
V	79	20	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{7/2}$	7/2 ^e	1663173.37
V	79	21	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1683578.53
V	79	22	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1684662.95
V	79	23	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{7/2}$	7/2 ^e	1740504.43
V	79	24	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{1/2}$	1/2 ^e	1741427.35
V	79	25	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	1819266.19
V	79	26	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1955307.92
V	79	27	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1991637.33
V	79	28	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	2283476.01
V	79	29	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	2364559.59
V	79	30	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/2 ^e	2376112.33
V	79	31	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{3/2}$	3/2 ^e	2391939.50
V	79	32	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{9/2}$	9/2 ^e	2440341.68
V	79	33	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{5/2}$	5/2 ^e	2481671.57
V	79	34	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{7/2}$	7/2 ^e	2512705.97

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	79	35	$((d_{-}^1)_{3/2}, (d_{+}^4)_{21/2})$	1/2 ^e	2574268.04
V	79	36	$((d_{-}^1)_{3/2}, (d_{+}^4)_{03/2})$	3/2 ^e	2718486.15
V	79	37	$(d_{+}^5)_{5/2}$	5/2 ^e	3206349.59
V	80	1	$(d_{+}^1)_{5/2}$	5/2 ^e	0.00
V	80	2	$((d_{-}^3)_{3/2}, (d_{+}^2)_{45/2})$	5/2 ^e	718014.10
V	80	3	$((d_{-}^3)_{3/2}, (d_{+}^2)_{47/2})$	7/2 ^e	819282.11
V	80	4	$((d_{-}^3)_{3/2}, (d_{+}^2)_{411/2})$	11/ 2 ^e	828941.37
V	80	5	$((d_{-}^3)_{3/2}, (d_{+}^2)_{23/2})$	3/2 ^e	837927.19
V	80	6	$((d_{-}^3)_{3/2}, (d_{+}^2)_{49/2})$	9/2 ^e	882114.12
V	80	7	$((d_{-}^3)_{3/2}, (d_{+}^2)_{25/2})$	5/2 ^e	918024.61
V	80	8	$((d_{-}^3)_{3/2}, (d_{+}^2)_{27/2})$	7/2 ^e	956495.04
V	80	9	$((d_{-}^3)_{3/2}, (d_{+}^2)_{21/2})$	1/2 ^e	957663.33
V	80	10	$((d_{-}^3)_{3/2}, (d_{+}^2)_{03/2})$	3/2 ^e	1119157.13
V	80	11	$((d_{-}^2)_{2}, (d_{+}^3)_{9/25/2})$	5/2 ^e	1526165.88
V	80	12	$((d_{-}^2)_{2}, (d_{+}^3)_{9/27/2})$	7/2 ^e	1606196.71
V	80	13	$((d_{-}^2)_{2}, (d_{+}^3)_{9/211/2})$	11/ 2 ^e	1607598.94
V	80	14	$((d_{-}^2)_{2}, (d_{+}^3)_{9/29/2})$	9/2 ^e	1626037.53
V	80	15	$((d_{-}^2)_{2}, (d_{+}^3)_{9/213/2})$	13/ 2 ^e	1651141.40

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	80	16	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{1/2}$	1/2 ^e	1674664.01
V	80	17	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{3/2}$	3/2 ^e	1683501.18
V	80	18	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{5/2}$	5/2 ^e	1692406.53
V	80	19	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{9/2}$	9/2 ^e	1738190.86
V	80	20	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{7/2}$	7/2 ^e	1760546.77
V	80	21	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1781821.66
V	80	22	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1782185.90
V	80	23	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{7/2}$	7/2 ^e	1839418.21
V	80	24	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{1/2}$	1/2 ^e	1840566.70
V	80	25	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	1919539.04
V	80	26	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	2057976.26
V	80	27	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	2095676.64
V	80	28	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	2426698.42
V	80	29	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	2509294.85
V	80	30	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/2 ^e	2520475.78
V	80	31	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{3/2}$	3/2 ^e	2537160.71
V	80	32	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{9/2}$	9/2 ^e	2585747.11
V	80	33	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2}\right)_{5/2}$	5/2 ^e	2627919.37

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	80	34	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{2,7/2}\right)$	7/2 ^e	2659532.03
V	80	35	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{2,1/2}\right)$	1/2 ^e	2721125.01
V	80	36	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{0,3/2}\right)$	3/2 ^e	2868410.55
V	80	37	$(d_{+}^5)_{5/2}$	5/2 ^e	3400119.47
V	81	1	$(d_{+}^1)_{5/2}$	5/2 ^e	0.00
V	81	2	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4,5/2}\right)$	5/2 ^e	766784.52
V	81	3	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4,7/2}\right)$	7/2 ^e	869042.41
V	81	4	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4,11/2}\right)$	11/ 2 ^e	878336.31
V	81	5	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2,3/2}\right)$	3/2 ^e	888436.78
V	81	6	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4,9/2}\right)$	9/2 ^e	932949.52
V	81	7	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2,5/2}\right)$	5/2 ^e	969915.39
V	81	8	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2,7/2}\right)$	7/2 ^e	1008688.77
V	81	9	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2,1/2}\right)$	1/2 ^e	1011396.10
V	81	10	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{0,3/2}\right)$	3/2 ^e	1175727.46
V	81	11	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2,5/2}\right)$	5/2 ^e	1624446.32
V	81	12	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2,7/2}\right)$	7/2 ^e	1705853.01
V	81	13	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2,11/2}\right)$	11/ 2 ^e	1706705.92
V	81	14	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2,9/2}\right)$	9/2 ^e	1725609.09

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	81	15	$((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2})_{13/2}$	$13/2^e$	1750508.72
V	81	16	$((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2})_{1/2}$	$1/2^e$	1775972.93
V	81	17	$((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2})_{3/2}$	$3/2^e$	1784819.53
V	81	18	$((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2})_{5/2}$	$5/2^e$	1793469.28
V	81	19	$((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2})_{9/2}$	$9/2^e$	1839778.79
V	81	20	$((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2})_{7/2}$	$7/2^e$	1862407.35
V	81	21	$((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2})_{3/2}$	$3/2^e$	1884234.80
V	81	22	$((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2})_{5/2}$	$5/2^e$	1884577.18
V	81	23	$((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2})_{7/2}$	$7/2^e$	1942821.80
V	81	24	$((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2})_{1/2}$	$1/2^e$	1944223.59
V	81	25	$((d_{-}^{2})_{0}, (d_{+}^{3})_{9/2})_{9/2}$	$9/2^e$	2024297.70
V	81	26	$((d_{-}^{2})_{0}, (d_{+}^{3})_{3/2})_{3/2}$	$3/2^e$	2165178.94
V	81	27	$((d_{-}^{2})_{0}, (d_{+}^{3})_{5/2})_{5/2}$	$5/2^e$	2204190.27
V	81	28	$((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4})_{5/2}$	$5/2^e$	2576702.52
V	81	29	$((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4})_{7/2}$	$7/2^e$	2660780.83
V	81	30	$((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4})_{11/2}$	$11/2^e$	2671564.56
V	81	31	$((d_{-}^{1})_{3/2}, (d_{+}^{4})_{2})_{3/2}$	$3/2^e$	2689157.91
V	81	32	$((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4})_{9/2}$	$9/2^e$	2737907.82

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	81	33	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{2/5/2}\right)$	5/2 ^e	2780932.52
V	81	34	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{2/7/2}\right)$	7/2 ^e	2813119.66
V	81	35	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{2/1/2}\right)$	1/2 ^e	2874777.28
V	81	36	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{0/3/2}\right)$	3/2 ^e	3025119.51
V	81	37	$(d_{+}^5)_{5/2}$	5/2 ^e	3602931.18
V	82	1	$(d_{+}^1)_{5/2}$	5/2 ^e	0.00
V	82	2	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4/5/2}\right)$	5/2 ^e	817881.52
V	82	3	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4/7/2}\right)$	7/2 ^e	921122.53
V	82	4	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4/11/2}\right)$	11/ 2 ^e	930024.63
V	82	5	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2/3/2}\right)$	3/2 ^e	941280.20
V	82	6	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4/9/2}\right)$	9/2 ^e	986088.82
V	82	7	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2/5/2}\right)$	5/2 ^e	1024110.50
V	82	8	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2/7/2}\right)$	7/2 ^e	1063200.63
V	82	9	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2/1/2}\right)$	1/2 ^e	1067439.76
V	82	10	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{0/3/2}\right)$	3/2 ^e	1234593.30
V	82	11	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2/5/2}\right)$	5/2 ^e	1727403.11
V	82	12	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2/7/2}\right)$	7/2 ^e	1810151.81
V	82	13	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2/11/2}\right)$	11/ 2 ^e	1810432.40

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	82	14	$\left((d_{-}^{-})_2, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	1829814.73
V	82	15	$\left((d_{-}^{-})_2, (d_{+}^{3})_{9/2}\right)_{13/2}$	13/ 2 ^e	1854471.51
V	82	16	$\left((d_{-}^{-})_2, (d_{+}^{3})_{3/2}\right)_{1/2}$	1/2 ^e	1881931.20
V	82	17	$\left((d_{-}^{-})_2, (d_{+}^{3})_{5/2}\right)_{3/2}$	3/2 ^e	1890787.08
V	82	18	$\left((d_{-}^{-})_2, (d_{+}^{3})_{3/2}\right)_{5/2}$	5/2 ^e	1899176.19
V	82	19	$\left((d_{-}^{-})_2, (d_{+}^{3})_{5/2}\right)_{9/2}$	9/2 ^e	1945999.36
V	82	20	$\left((d_{-}^{-})_2, (d_{+}^{3})_{3/2}\right)_{7/2}$	7/2 ^e	1968895.78
V	82	21	$\left((d_{-}^{-})_2, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	1990948.69
V	82	22	$\left((d_{-}^{-})_2, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	1991986.19
V	82	23	$\left((d_{-}^{-})_2, (d_{+}^{3})_{5/2}\right)_{7/2}$	7/2 ^e	2050856.67
V	82	24	$\left((d_{-}^{-})_2, (d_{+}^{3})_{5/2}\right)_{1/2}$	1/2 ^e	2052538.84
V	82	25	$\left((d_{-}^{-})_0, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	2133684.34
V	82	26	$\left((d_{-}^{-})_0, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	2277056.44
V	82	27	$\left((d_{-}^{-})_0, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	2317326.53
V	82	28	$\left((d_{-}^{-})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	2733697.44
V	82	29	$\left((d_{-}^{-})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	2819229.70
V	82	30	$\left((d_{-}^{-})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/ 2 ^e	2829590.75
V	82	31	$\left((d_{-}^{-})_{3/2}, (d_{+}^{4})_{2}\right)_{3/2}$	3/2 ^e	2848142.59

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	82	32	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{4/9/2}\right)$	9/2 ^e	2897034.83
V	82	33	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{2/5/2}\right)$	5/2 ^e	2940922.22
V	82	34	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{2/7/2}\right)$	7/2 ^e	2973680.64
V	82	35	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{2/1/2}\right)$	1/2 ^e	3035436.62
V	82	36	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{0/3/2}\right)$	3/2 ^e	3188825.85
V	82	37	$(d_{+}^5)_{5/2}$	5/2 ^e	3815066.09
V	83	1	$(d_{+}^1)_{5/2}$	5/2 ^e	0.00
V	83	2	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4/5/2}\right)$	5/2 ^e	871375.57
V	83	3	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4/7/2}\right)$	7/2 ^e	975593.09
V	83	4	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4/11/2}\right)$	11/ 2 ^e	984076.87
V	83	5	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2/3/2}\right)$	3/2 ^e	996528.26
V	83	6	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{4/9/2}\right)$	9/2 ^e	1041603.09
V	83	7	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2/5/2}\right)$	5/2 ^e	1080681.90
V	83	8	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2/7/2}\right)$	7/2 ^e	1120101.48
V	83	9	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{2/1/2}\right)$	1/2 ^e	1125865.40
V	83	10	$\left((d_{-}^3)_{3/2}, (d_{+}^2)_{0/3/2}\right)$	3/2 ^e	1295828.23
V	83	11	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2/5/2}\right)$	5/2 ^e	1835177.05
V	83	12	$\left((d_{-}^2)_{2}, (d_{+}^3)_{9/2/11/2}\right)$	11/ 2 ^e	1918920.60

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
V	83	13	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)_{7/2}$	7/2 ^e	1919235.64
V	83	14	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	1938796.41
V	83	15	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2}\right)_{13/2}$	13/2 ^e	1963172.01
V	83	16	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{1/2}$	1/2 ^e	1992682.43
V	83	17	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{3/2}$	3/2 ^e	2001547.27
V	83	18	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{5/2}$	5/2 ^e	2009669.94
V	83	19	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{9/2}$	9/2 ^e	2056995.31
V	83	20	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{7/2}$	7/2 ^e	2080154.74
V	83	21	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	2102468.69
V	83	22	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	2104191.79
V	83	23	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{7/2}$	7/2 ^e	2163666.24
V	83	24	$\left((d_{-}^{2})_{2}, (d_{+}^{3})_{5/2}\right)_{1/2}$	1/2 ^e	2165655.30
V	83	25	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{9/2}\right)_{9/2}$	9/2 ^e	2247842.99
V	83	26	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{3/2}\right)_{3/2}$	3/2 ^e	2393751.30
V	83	27	$\left((d_{-}^{2})_{0}, (d_{+}^{3})_{5/2}\right)_{5/2}$	5/2 ^e	2435234.38
V	83	28	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	2897896.10
V	83	29	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	2984856.60
V	83	30	$\left((d_{-}^{1})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/2 ^e	2994769.34

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
V	83	31	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{2/3/2}\right)$	3/2 ^e	3014329.28
V	83	32	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{4/9/2}\right)$	9/2 ^e	3063342.27
V	83	33	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{2/5/2}\right)$	5/2 ^e	3108102.81
V	83	34	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{2/7/2}\right)$	7/2 ^e	3141429.70
V	83	35	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{2/1/2}\right)$	1/2 ^e	3203317.76
V	83	36	$\left((d_{-}^1)_{3/2}, (d_{+}^4)_{0/3/2}\right)$	3/2 ^e	3359745.21
V	83	37	$(d_{+}^5)_{5/2}$	5/2 ^e	4036809.83
Cr	72	1	$(d_{+}^2)_{4}$	4 ^e	0.00
Cr	72	2	$(d_{+}^2)_{2}$	2 ^e	59545.35
Cr	72	3	$(d_{+}^2)_{0}$	0 ^e	194996.21
Cr	72	4	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2/3}\right)$	3 ^e	438324.91
Cr	72	5	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2/4}\right)$	4 ^e	452029.63
Cr	72	6	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2/1}\right)$	1 ^e	475694.65
Cr	72	7	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2/5}\right)$	5 ^e	514347.26
Cr	72	8	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2/6}\right)$	6 ^e	514481.01
Cr	72	9	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2/2}\right)$	2 ^e	566126.59
Cr	72	10	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2/3}\right)$	3 ^e	577337.41
Cr	72	11	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2/0}\right)$	0 ^e	651557.94

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Cr	72	12	$((d_{-}^2)_{3/2}, (d_{+}^3)_{5/2})_4$	4 ^e	683039.13
Cr	72	13	$((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2})_2$	2 ^e	686627.93
Cr	72	14	$((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2})_1$	1 ^e	688681.55
Cr	72	15	$((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2})_3$	3 ^e	705082.17
Cr	72	16	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_2$	2 ^e	922282.24
Cr	72	17	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_0$	0 ^e	946360.31
Cr	72	18	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_4$	4 ^e	971313.75
Cr	72	19	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_3$	3 ^e	997834.45
Cr	72	20	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_5$	5 ^e	1004142.84
Cr	72	21	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_6$	6 ^e	1031150.28
Cr	72	22	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_3$	3 ^e	1055537.41
Cr	72	23	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_1$	1 ^e	1077162.33
Cr	72	24	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_4$	4 ^e	1092442.71
Cr	72	25	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_2$	2 ^e	1101811.08
Cr	72	26	$((d_{-}^2)_{2}, (d_{+}^4)_{0})_2$	2 ^e	1190633.95
Cr	72	27	$((d_{-}^2)_{0}, (d_{+}^4)_{4})_4$	4 ^e	1226634.38
Cr	72	28	$((d_{-}^2)_{0}, (d_{+}^4)_{2})_2$	2 ^e	1367079.41
Cr	72	29	$((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2})_1$	1 ^e	1455964.19

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	72	30	$((d_{-}^2)_0, (d_{+}^4)_0)_0$	0 ^e	1500546.69
Cr	72	31	$((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2})_4$	4 ^e	1555105.54
Cr	72	32	$((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2})_2$	2 ^e	1602150.27
Cr	72	33	$((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2})_3$	3 ^e	1618771.64
Cr	72	34	$(d_{+}^6)_0$	0 ^e	2042937.59
Cr	73	1	$(d_{+}^2)_4$	4 ^e	0.00
Cr	73	2	$(d_{+}^2)_2$	2 ^e	60992.40
Cr	73	3	$(d_{+}^2)_0$	0 ^e	200793.30
Cr	73	4	$((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2})_3$	3 ^e	471717.45
Cr	73	5	$((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2})_4$	4 ^e	484608.68
Cr	73	6	$((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2})_1$	1 ^e	509970.70
Cr	73	7	$((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2})_6$	6 ^e	547961.77
Cr	73	8	$((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2})_5$	5 ^e	547973.66
Cr	73	9	$((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2})_2$	2 ^e	601273.47
Cr	73	10	$((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2})_3$	3 ^e	612809.78
Cr	73	11	$((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2})_0$	0 ^e	687456.71
Cr	73	12	$((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2})_4$	4 ^e	721039.55
Cr	73	13	$((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2})_2$	2 ^e	725585.00

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	73	14	$((d^-)^2_{3/2}, (d^3_+)^{5/2}_1)$	1 ^e	727022.87
Cr	73	15	$((d^-)^3_{3/2}, (d^3_+)^{5/2}_3)$	3 ^e	742752.74
Cr	73	16	$((d^-)^2_{2^+}, (d^4_+)^{4/2}_2)$	2 ^e	989081.07
Cr	73	17	$((d^-)^2_{2^+}, (d^4_+)^{2/0}_0)$	0 ^e	1013305.46
Cr	73	18	$((d^-)^2_{2^+}, (d^4_+)^{4/4}_4)$	4 ^e	1038449.62
Cr	73	19	$((d^-)^2_{2^+}, (d^4_+)^{4/3}_3)$	3 ^e	1065171.60
Cr	73	20	$((d^-)^2_{2^+}, (d^4_+)^{4/5}_5)$	5 ^e	1071918.50
Cr	73	21	$((d^-)^2_{2^+}, (d^4_+)^{4/6}_6)$	6 ^e	1099008.08
Cr	73	22	$((d^-)^2_{2^+}, (d^4_+)^{2/3}_3)$	3 ^e	1124810.71
Cr	73	23	$((d^-)^2_{2^+}, (d^4_+)^{2/1}_1)$	1 ^e	1145749.09
Cr	73	24	$((d^-)^2_{2^+}, (d^4_+)^{2/4}_4)$	4 ^e	1161237.43
Cr	73	25	$((d^-)^2_{2^+}, (d^4_+)^{2/2}_2)$	2 ^e	1171244.39
Cr	73	26	$((d^-)^2_{2^+}, (d^4_+)^{0/2}_0)$	2 ^e	1262150.11
Cr	73	27	$((d^-)^2_{10^+}, (d^4_+)^{4/4}_{4/4})$	4 ^e	1299167.83
Cr	73	28	$((d^-)^2_{10^+}, (d^4_+)^{2/2}_{2/2})$	2 ^e	1441256.29
Cr	73	29	$((d^-)^1_{3/2}, (d^5_+)^{5/2}_1)$	1 ^e	1557438.58
Cr	73	30	$((d^-)^2_{10^+}, (d^4_+)^{0/0}_{0/0})$	0 ^e	1578668.46
Cr	73	31	$((d^-)^1_{3/2}, (d^5_+)^{5/2}_{4/4})$	4 ^e	1657565.18

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Cr	73	32	$\left((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2}\right)_2$	2 ^e	1705688.83
Cr	73	33	$\left((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2}\right)_3$	3 ^e	1722799.83
Cr	73	34	$(d_{+}^6)_{10}$	0 ^e	2179214.19
Cr	74	1	$(d_{+}^2)_{4}$	4 ^e	0.00
Cr	74	2	$(d_{+}^2)_{2}$	2 ^e	62458.22
Cr	74	3	$(d_{+}^2)_{10}$	0 ^e	206576.22
Cr	74	4	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2}\right)_3$	3 ^e	506890.15
Cr	74	5	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2}\right)_4$	4 ^e	518991.78
Cr	74	6	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2}\right)_1$	1 ^e	546032.75
Cr	74	7	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2}\right)_6$	6 ^e	583200.98
Cr	74	8	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2}\right)_5$	5 ^e	583372.89
Cr	74	9	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2}\right)_2$	2 ^e	638210.95
Cr	74	10	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2}\right)_3$	3 ^e	650058.19
Cr	74	11	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2}\right)_0$	0 ^e	725179.95
Cr	74	12	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2}\right)_4$	4 ^e	760789.00
Cr	74	13	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2}\right)_2$	2 ^e	766290.23
Cr	74	14	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2}\right)_1$	1 ^e	767143.39
Cr	74	15	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2}\right)_3$	3 ^e	782216.88

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	74	16	$((d^-)_2, (d^+)_4)_2$	2 ^e	1059479.50
Cr	74	17	$((d^-)_2, (d^+)_2)_0$	0 ^e	1083845.13
Cr	74	18	$((d^-)_2, (d^+)_4)_4$	4 ^e	1109142.69
Cr	74	19	$((d^-)_2, (d^+)_4)_3$	3 ^e	1136091.42
Cr	74	20	$((d^-)_2, (d^+)_4)_5$	5 ^e	1143233.13
Cr	74	21	$((d^-)_2, (d^+)_4)_6$	6 ^e	1170392.03
Cr	74	22	$((d^-)_2, (d^+)_2)_3$	3 ^e	1197635.08
Cr	74	23	$((d^-)_2, (d^+)_2)_1$	1 ^e	1217932.59
Cr	74	24	$((d^-)_2, (d^+)_2)_4$	4 ^e	1233596.11
Cr	74	25	$((d^-)_2, (d^+)_2)_2$	2 ^e	1244243.88
Cr	74	26	$((d^-)_2, (d^+)_0)_2$	2 ^e	1337239.41
Cr	74	27	$((d^-)_0, (d^+)_4)_4$	4 ^e	1375236.82
Cr	74	28	$((d^-)_0, (d^+)_2)_2$	2 ^e	1519016.00
Cr	74	29	$((d^-)_0, (d^+)_0)_0$	0 ^e	1660251.15
Cr	74	30	$((d^-)_{3/2}, (d^+)_5)_{5/2,1}$	1 ^e	1664268.61
Cr	74	31	$((d^-)_{3/2}, (d^+)_5)_{5/2,4}$	4 ^e	1765384.75
Cr	74	32	$((d^-)_{3/2}, (d^+)_5)_{5/2,2}$	2 ^e	1814574.75
Cr	74	33	$((d^-)_{3/2}, (d^+)_5)_{5/2,3}$	3 ^e	1832168.56

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	74	34	$(d^6_+)_0$	0 ^e	2322740.47
Cr	75	1	$(d^2_+)_4$	4 ^e	0.00
Cr	75	2	$(d^2_+)_2$	2 ^e	63942.01
Cr	75	3	$(d^2_+)_0$	0 ^e	212346.86
Cr	75	4	$((d^3_{-})_{3/2}, (d^3_+)_{9/2})_3$	3 ^e	543903.39
Cr	75	5	$((d^3_{-})_{3/2}, (d^3_+)_{9/2})_4$	4 ^e	555237.17
Cr	75	6	$((d^3_{-})_{3/2}, (d^3_+)_{3/2})_1$	1 ^e	583941.52
Cr	75	7	$((d^3_{-})_{3/2}, (d^3_+)_{9/2})_6$	6 ^e	620258.25
Cr	75	8	$((d^3_{-})_{3/2}, (d^3_+)_{9/2})_5$	5 ^e	620604.66
Cr	75	9	$((d^3_{-})_{3/2}, (d^3_+)_{3/2})_2$	2 ^e	676999.22
Cr	75	10	$((d^3_{-})_{3/2}, (d^3_+)_{3/2})_3$	3 ^e	689143.09
Cr	75	11	$((d^3_{-})_{3/2}, (d^3_+)_{3/2})_0$	0 ^e	764786.22
Cr	75	12	$((d^3_{-})_{3/2}, (d^3_+)_{5/2})_4$	4 ^e	802350.24
Cr	75	13	$((d^3_{-})_{3/2}, (d^3_+)_{5/2})_2$	2 ^e	808808.35
Cr	75	14	$((d^3_{-})_{3/2}, (d^3_+)_{5/2})_1$	1 ^e	809105.84
Cr	75	15	$((d^3_{-})_{3/2}, (d^3_+)_{5/2})_3$	3 ^e	823535.26
Cr	75	16	$((d^2_{-})_2, (d^4_+)_{4/2})$	2 ^e	1133593.93
Cr	75	17	$((d^2_{-})_2, (d^4_+)_{2/0})$	0 ^e	1158099.05

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	75	18	$((d^-)_2, (d^+)_4)_4$	4 ^e	1183514.13
Cr	75	19	$((d^-)_2, (d^+)_4)_3$	3 ^e	1210714.37
Cr	75	20	$((d^-)_2, (d^+)_4)_5$	5 ^e	1218208.09
Cr	75	21	$((d^-)_2, (d^+)_4)_6$	6 ^e	1245423.17
Cr	75	22	$((d^-)_2, (d^+)_2)_3$	3 ^e	1274132.05
Cr	75	23	$((d^-)_2, (d^+)_2)_1$	1 ^e	1293833.25
Cr	75	24	$((d^-)_2, (d^+)_2)_4$	4 ^e	1309639.29
Cr	75	25	$((d^-)_2, (d^+)_2)_2$	2 ^e	1320931.14
Cr	75	26	$((d^-)_2, (d^+)_0)_2$	2 ^e	1416023.52
Cr	75	27	$((d^-)_{10}, (d^+)_4)_4$	4 ^e	1454966.43
Cr	75	28	$((d^-)_{10}, (d^+)_2)_2$	2 ^e	1600481.16
Cr	75	29	$((d^-)_{10}, (d^+)_0)_0$	0 ^e	1745439.87
Cr	75	30	$((d^-)_{3/2}, (d^+)_5)_{1/2}$	1 ^e	1776636.34
Cr	75	31	$((d^-)_{3/2}, (d^+)_5)_{1/4}$	4 ^e	1878742.77
Cr	75	32	$((d^-)_{3/2}, (d^+)_5)_{1/2}$	2 ^e	1928991.02
Cr	75	33	$((d^-)_{3/2}, (d^+)_5)_{1/3}$	3 ^e	1947061.28
Cr	75	34	$(d^+_6)_0$	0 ^e	2473739.75
Cr	76	1	$(d^+_2)_4$	4 ^e	0.00

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	76	2	$(d^2_+)_2$	2 ^e	65443.09
Cr	76	3	$(d^2_+)_0$	0 ^e	218107.14
Cr	76	4	$((d^3_{-})_{3/2}, (d^3_{+})_{9/2})_3$	3 ^e	582819.18
Cr	76	5	$((d^3_{-})_{3/2}, (d^3_{+})_{9/2})_4$	4 ^e	593404.88
Cr	76	6	$((d^3_{-})_{3/2}, (d^3_{+})_{3/2})_1$	1 ^e	623759.27
Cr	76	7	$((d^3_{-})_{3/2}, (d^3_{+})_{9/2})_6$	6 ^e	659194.83
Cr	76	8	$((d^3_{-})_{3/2}, (d^3_{+})_{9/2})_5$	5 ^e	659730.25
Cr	76	9	$((d^3_{-})_{3/2}, (d^3_{+})_{3/2})_2$	2 ^e	717699.99
Cr	76	10	$((d^3_{-})_{3/2}, (d^3_{+})_{3/2})_3$	3 ^e	730126.45
Cr	76	11	$((d^3_{-})_{3/2}, (d^3_{+})_{3/2})_0$	0 ^e	806335.63
Cr	76	12	$((d^3_{-})_{3/2}, (d^3_{+})_{5/2})_4$	4 ^e	845787.41
Cr	76	13	$((d^3_{-})_{3/2}, (d^3_{+})_{5/2})_1$	1 ^e	852974.32
Cr	76	14	$((d^3_{-})_{3/2}, (d^3_{+})_{5/2})_2$	2 ^e	853204.92
Cr	76	15	$((d^3_{-})_{3/2}, (d^3_{+})_{5/2})_3$	3 ^e	866770.02
Cr	76	16	$((d^2_{-})_2, (d^4_{+})_{4/2})$	2 ^e	1211544.82
Cr	76	17	$((d^2_{-})_2, (d^4_{+})_{2/0})$	0 ^e	1236190.20
Cr	76	18	$((d^2_{-})_2, (d^4_{+})_{4/4})$	4 ^e	1261688.19
Cr	76	19	$((d^2_{-})_2, (d^4_{+})_{4/3})$	3 ^e	1289164.00

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	76	20	$((d^-)_2, (d^+)_4)_5$	5 ^e	1296967.79
Cr	76	21	$((d^-)_2, (d^+)_4)_6$	6 ^e	1324225.62
Cr	76	22	$((d^-)_2, (d^+)_2)_3$	3 ^e	1354426.23
Cr	76	23	$((d^-)_2, (d^+)_2)_1$	1 ^e	1373574.45
Cr	76	24	$((d^-)_2, (d^+)_2)_4$	4 ^e	1389490.46
Cr	76	25	$((d^-)_2, (d^+)_2)_2$	2 ^e	1401430.70
Cr	76	26	$((d^-)_2, (d^+)_0)_2$	2 ^e	1498627.15
Cr	76	27	$((d^-)_0, (d^+)_4)_4$	4 ^e	1538484.32
Cr	76	28	$((d^-)_0, (d^+)_2)_2$	2 ^e	1685777.25
Cr	76	29	$((d^-)_0, (d^+)_0)_0$	0 ^e	1834378.20
Cr	76	30	$((d^-)_{3/2}, (d^+)_5)_{5/2}_1$	1 ^e	1894728.56
Cr	76	31	$((d^-)_{3/2}, (d^+)_5)_{5/2}_4$	4 ^e	1997822.89
Cr	76	32	$((d^-)_{3/2}, (d^+)_5)_{5/2}_2$	2 ^e	2049125.14
Cr	76	33	$((d^-)_{3/2}, (d^+)_5)_{5/2}_3$	3 ^e	2067665.90
Cr	76	34	$(d^+)_0$	0 ^e	2632445.76
Cr	77	1	$(d^+)_4$	4 ^e	0.00
Cr	77	2	$(d^+)_2$	2 ^e	66960.85
Cr	77	3	$(d^+)_0$	0 ^e	223858.93

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Cr	77	4	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{9/2})_3$	3 ^e	623700.43
Cr	77	5	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{9/2})_4$	4 ^e	633555.90
Cr	77	6	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{3/2})_1$	1 ^e	665549.19
Cr	77	7	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{9/2})_6$	6 ^e	700072.76
Cr	77	8	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{9/2})_5$	5 ^e	700811.81
Cr	77	9	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{3/2})_2$	2 ^e	760375.83
Cr	77	10	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{3/2})_3$	3 ^e	773071.14
Cr	77	11	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{3/2})_0$	0 ^e	849889.15
Cr	77	12	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{5/2})_4$	4 ^e	891165.27
Cr	77	13	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{5/2})_1$	1 ^e	898813.66
Cr	77	14	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{5/2})_2$	2 ^e	899545.73
Cr	77	15	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{5/2})_3$	3 ^e	911984.11
Cr	77	16	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4/2})$	2 ^e	1293455.10
Cr	77	17	$((d_{-}^{2})_{2}, (d_{+}^{4})_{2/0})$	0 ^e	1318243.39
Cr	77	18	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4/4})$	4 ^e	1343790.74
Cr	77	19	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4/3})$	3 ^e	1371565.56
Cr	77	20	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4/5})$	5 ^e	1379638.23
Cr	77	21	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4/6})$	6 ^e	1406925.02

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	77	22	$((d^-)_2, (d^+)_2)_{3/2}^3$	3 ^e	1438643.85
Cr	77	23	$((d^-)_2, (d^+)_2)_{1/2}^1$	1 ^e	1457281.23
Cr	77	24	$((d^-)_2, (d^+)_2)_{3/2}^4$	4 ^e	1473274.75
Cr	77	25	$((d^-)_2, (d^+)_2)_{1/2}^2$	2 ^e	1485868.68
Cr	77	26	$((d^-)_2, (d^+)_2)_{5/2}^2$	2 ^e	1585176.64
Cr	77	27	$((d^-)_0, (d^+)_4)_{4/2}^4$	4 ^e	1625919.33
Cr	77	28	$((d^-)_0, (d^+)_2)_{1/2}^2$	2 ^e	1775031.30
Cr	77	29	$((d^-)_0, (d^+)_0)_{0/0}^0$	0 ^e	1927207.82
Cr	77	30	$((d^-)_{3/2}, (d^+)_{5/2})_{1/2}^1$	1 ^e	2018734.63
Cr	77	31	$((d^-)_{3/2}, (d^+)_{5/2})_{3/4}^4$	4 ^e	2122811.71
Cr	77	32	$((d^-)_{3/2}, (d^+)_{5/2})_{1/2}^2$	2 ^e	2175167.03
Cr	77	33	$((d^-)_{3/2}, (d^+)_{5/2})_{3/3}^3$	3 ^e	2194172.67
Cr	77	34	$(d^+)_0^0$	0 ^e	2799098.79
Cr	78	1	$(d^+)_4^4$	4 ^e	0.00
Cr	78	2	$(d^+)_2^2$	2 ^e	68494.75
Cr	78	3	$(d^+)_0^0$	0 ^e	229604.15
Cr	78	4	$((d^-)_{3/2}, (d^+)_{9/2})_{3/3}^3$	3 ^e	666612.16
Cr	78	5	$((d^-)_{3/2}, (d^+)_{9/2})_{4/4}^4$	4 ^e	675753.52

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Cr	78	6	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{3/2})_1$	1 ^e	709376.55
Cr	78	7	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{9/2})_6$	6 ^e	742956.28
Cr	78	8	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{9/2})_5$	5 ^e	743913.64
Cr	78	9	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{3/2})_2$	2 ^e	805091.41
Cr	78	10	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{3/2})_3$	3 ^e	818042.09
Cr	78	11	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{3/2})_0$	0 ^e	895509.84
Cr	78	12	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{5/2})_4$	4 ^e	938550.61
Cr	78	13	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{5/2})_1$	1 ^e	946690.61
Cr	78	14	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{5/2})_2$	2 ^e	947898.30
Cr	78	15	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{5/2})_3$	3 ^e	959242.55
Cr	78	16	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4/2})$	2 ^e	1379452.41
Cr	78	17	$((d_{-}^{2})_{2}, (d_{+}^{4})_{2/0})$	0 ^e	1404387.78
Cr	78	18	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4/4})$	4 ^e	1429951.86
Cr	78	19	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4/3})$	3 ^e	1458048.46
Cr	78	20	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4/5})$	5 ^e	1466349.60
Cr	78	21	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4/6})$	6 ^e	1493651.29
Cr	78	22	$((d_{-}^{2})_{2}, (d_{+}^{4})_{2/3})$	3 ^e	1526915.36
Cr	78	23	$((d_{-}^{2})_{2}, (d_{+}^{4})_{2/1})$	1 ^e	1545082.74

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Cr	78	24	$((d^-)_2, (d^+)_2)_4$	4 ^e	1561121.42
Cr	78	25	$((d^-)_2, (d^+)_2)_2$	2 ^e	1574375.21
Cr	78	26	$((d^-)_2, (d^+)_0)_2$	2 ^e	1675802.49
Cr	78	27	$((d^-)_0, (d^+)_4)_4$	4 ^e	1717404.16
Cr	78	28	$((d^-)_0, (d^+)_2)_2$	2 ^e	1868374.36
Cr	78	29	$((d^-)_0, (d^+)_0)_0$	0 ^e	2024071.85
Cr	78	30	$((d^+)_3/2, (d^+)_5/2)_1$	1 ^e	2148850.20
Cr	78	31	$((d^+)_3/2, (d^+)_5/2)_4$	4 ^e	2253902.51
Cr	78	32	$((d^+)_3/2, (d^+)_5/2)_2$	2 ^e	2307312.76
Cr	78	33	$((d^+)_3/2, (d^+)_5/2)_3$	3 ^e	2326778.02
Cr	78	34	$(d^+)_0$	0 ^e	2973949.99
Cr	79	1	$(d^+)_4$	4 ^e	0.00
Cr	79	2	$(d^+)_2$	2 ^e	70044.31
Cr	79	3	$(d^+)_0$	0 ^e	235344.66
Cr	79	4	$((d^+)_3/2, (d^+)_9/2)_3$	3 ^e	711620.47
Cr	79	5	$((d^+)_3/2, (d^+)_9/2)_4$	4 ^e	720062.17
Cr	79	6	$((d^+)_3/2, (d^+)_3/2)_1$	1 ^e	755307.65
Cr	79	7	$((d^+)_3/2, (d^+)_9/2)_6$	6 ^e	787910.61

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	79	8	$((d_{-}^2)_{3/2}, (d_{+}^2)_{9/2})_5$	5 ^e	789101.05
Cr	79	9	$((d_{-}^2)_{3/2}, (d_{+}^2)_{3/2})_2$	2 ^e	851912.40
Cr	79	10	$((d_{-}^2)_{3/2}, (d_{+}^2)_{3/2})_3$	3 ^e	865105.25
Cr	79	11	$((d_{-}^2)_{3/2}, (d_{+}^2)_{3/2})_0$	0 ^e	943261.83
Cr	79	12	$((d_{-}^2)_{3/2}, (d_{+}^2)_{5/2})_4$	4 ^e	988011.01
Cr	79	13	$((d_{-}^2)_{3/2}, (d_{+}^2)_{5/2})_1$	1 ^e	996672.80
Cr	79	14	$((d_{-}^2)_{3/2}, (d_{+}^2)_{5/2})_2$	2 ^e	998330.79
Cr	79	15	$((d_{-}^2)_{3/2}, (d_{+}^2)_{5/2})_3$	3 ^e	1008611.32
Cr	79	16	$((d_{-}^2)_{2'}, (d_{+}^4)_{4/2})$	2 ^e	1469666.88
Cr	79	17	$((d_{-}^2)_{2'}, (d_{+}^4)_{2/0})$	0 ^e	1494754.65
Cr	79	18	$((d_{-}^2)_{2'}, (d_{+}^4)_{4/4})$	4 ^e	1520303.58
Cr	79	19	$((d_{-}^2)_{2'}, (d_{+}^4)_{4/3})$	3 ^e	1548744.17
Cr	79	20	$((d_{-}^2)_{2'}, (d_{+}^4)_{4/5})$	5 ^e	1557234.02
Cr	79	21	$((d_{-}^2)_{2'}, (d_{+}^4)_{4/6})$	6 ^e	1584536.23
Cr	79	22	$((d_{-}^2)_{2'}, (d_{+}^4)_{2/3})$	3 ^e	1619373.12
Cr	79	23	$((d_{-}^2)_{2'}, (d_{+}^4)_{2/1})$	1 ^e	1637110.16
Cr	79	24	$((d_{-}^2)_{2'}, (d_{+}^4)_{2/4})$	4 ^e	1653161.69
Cr	79	25	$((d_{-}^2)_{2'}, (d_{+}^4)_{2/2})$	2 ^e	1667082.38

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	79	26	$((d^-)_2, (d^+)_0)_2$	2 ^e	1770637.14
Cr	79	27	$((d^-)_0, (d^+)_4)_4$	4 ^e	1813073.15
Cr	79	28	$((d^-)_0, (d^+)_2)_2$	2 ^e	1965939.34
Cr	79	29	$((d^-)_0, (d^+)_0)_0$	0 ^e	2125113.18
Cr	79	30	$((d^+)_3/2, (d^+)_5/2)_1$	1 ^e	2285273.94
Cr	79	31	$((d^+)_3/2, (d^+)_5/2)_4$	4 ^e	2391291.82
Cr	79	32	$((d^+)_3/2, (d^+)_5/2)_2$	2 ^e	2445761.33
Cr	79	33	$((d^+)_3/2, (d^+)_5/2)_3$	3 ^e	2465681.21
Cr	79	34	$(d^+)_0$	0 ^e	3157256.43
Cr	80	1	$(d^+)_4$	4 ^e	0.00
Cr	80	2	$(d^+)_2$	2 ^e	71609.11
Cr	80	3	$(d^+)_0$	0 ^e	241082.27
Cr	80	4	$((d^+)_3/2, (d^+)_9/2)_3$	3 ^e	758793.21
Cr	80	5	$((d^+)_3/2, (d^+)_9/2)_4$	4 ^e	766548.17
Cr	80	6	$((d^+)_3/2, (d^+)_3/2)_1$	1 ^e	803410.57
Cr	80	7	$((d^+)_3/2, (d^+)_9/2)_6$	6 ^e	835002.77
Cr	80	8	$((d^+)_3/2, (d^+)_9/2)_5$	5 ^e	836441.13
Cr	80	9	$((d^+)_3/2, (d^+)_3/2)_2$	2 ^e	900906.24

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Cr	80	10	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{3/2})_{3}$	3 ^e	914328.32
Cr	80	11	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{3/2})_{0}$	0 ^e	993211.07
Cr	80	12	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{5/2})_{4}$	4 ^e	1039615.68
Cr	80	13	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{5/2})_{1}$	1 ^e	1048829.49
Cr	80	14	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{5/2})_{2}$	2 ^e	1050912.86
Cr	80	15	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{5/2})_{3}$	3 ^e	1060158.15
Cr	80	16	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4})_{2}$	2 ^e	1564232.46
Cr	80	17	$((d_{-}^{2})_{2}, (d_{+}^{4})_{2})_{0}$	0 ^e	1589478.86
Cr	80	18	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4})_{4}$	4 ^e	1614981.44
Cr	80	19	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4})_{3}$	3 ^e	1643787.63
Cr	80	20	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4})_{5}$	5 ^e	1652427.10
Cr	80	21	$((d_{-}^{2})_{2}, (d_{+}^{4})_{4})_{6}$	6 ^e	1679715.18
Cr	80	22	$((d_{-}^{2})_{2}, (d_{+}^{4})_{2})_{3}$	3 ^e	1716153.04
Cr	80	23	$((d_{-}^{2})_{2}, (d_{+}^{4})_{2})_{1}$	1 ^e	1733498.15
Cr	80	24	$((d_{-}^{2})_{2}, (d_{+}^{4})_{2})_{4}$	4 ^e	1749530.31
Cr	80	25	$((d_{-}^{2})_{2}, (d_{+}^{4})_{2})_{2}$	2 ^e	1764125.70
Cr	80	26	$((d_{-}^{2})_{2}, (d_{+}^{4})_{0})_{2}$	2 ^e	1869816.53
Cr	80	27	$((d_{-}^{2})_{0}, (d_{+}^{4})_{4})_{4}$	4 ^e	1913063.88

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	80	28	$((d_{-}^{2})_0, (d_{+}^{4})_2)_2$	2 ^e	2067862.56
Cr	80	29	$((d_{-}^{2})_0, (d_{+}^{4})_0)_0$	0 ^e	2230476.44
Cr	80	30	$((d_{-}^{1})_{3/2}, (d_{+}^{5})_{5/2})_1$	1 ^e	2428209.79
Cr	80	31	$((d_{-}^{1})_{3/2}, (d_{+}^{5})_{5/2})_4$	4 ^e	2535181.70
Cr	80	32	$((d_{-}^{1})_{3/2}, (d_{+}^{5})_{5/2})_2$	2 ^e	2590716.90
Cr	80	33	$((d_{-}^{1})_{3/2}, (d_{+}^{5})_{5/2})_3$	3 ^e	2611086.71
Cr	80	34	$(d_{+}^{6})_0$	0 ^e	3349283.70
Cr	81	1	$(d_{+}^{2})_4$	4 ^e	0.00
Cr	81	2	$(d_{+}^{2})_2$	2 ^e	73188.82
Cr	81	3	$(d_{+}^{2})_0$	0 ^e	246818.73
Cr	81	4	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{9/2})_3$	3 ^e	808198.92
Cr	81	5	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{9/2})_4$	4 ^e	815278.60
Cr	81	6	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{3/2})_1$	1 ^e	853754.04
Cr	81	7	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{9/2})_6$	6 ^e	884300.40
Cr	81	8	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{9/2})_5$	5 ^e	886001.62
Cr	81	9	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{3/2})_2$	2 ^e	952141.05
Cr	81	10	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{3/2})_3$	3 ^e	965779.63
Cr	81	11	$((d_{-}^{2})_{3/2}, (d_{+}^{3})_{3/2})_0$	0 ^e	1045424.25

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	81	12	$((d_{-}^2)_{3/2}, (d_{+}^3)_{5/2})_4$	4 ^e	1093434.33
Cr	81	13	$((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2})_1$	1 ^e	1103230.46
Cr	81	14	$((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2})_2$	2 ^e	1105714.60
Cr	81	15	$((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2})_3$	3 ^e	1113951.40
Cr	81	16	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_2$	2 ^e	1663284.74
Cr	81	17	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_0$	0 ^e	1688696.71
Cr	81	18	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_4$	4 ^e	1714122.22
Cr	81	19	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_3$	3 ^e	1743315.12
Cr	81	20	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_5$	5 ^e	1752065.66
Cr	81	21	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_6$	6 ^e	1779324.64
Cr	81	22	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_3$	3 ^e	1817392.24
Cr	81	23	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_1$	1 ^e	1834382.73
Cr	81	24	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_4$	4 ^e	1850363.28
Cr	81	25	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_2$	2 ^e	1865641.97
Cr	81	26	$((d_{-}^2)_{2}, (d_{+}^4)_{0})_2$	2 ^e	1973477.83
Cr	81	27	$((d_{-}^2)_{0}, (d_{+}^4)_{4})_4$	4 ^e	2017514.96
Cr	81	28	$((d_{-}^2)_{0}, (d_{+}^4)_{2})_2$	2 ^e	2174281.52
Cr	81	29	$((d_{-}^2)_{0}, (d_{+}^4)_{0})_0$	0 ^e	2340306.14

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	81	30	$\left((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2}\right)_1$	1 ^e	2577863.64
Cr	81	31	$\left((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2}\right)_4$	4 ^e	2685776.33
Cr	81	32	$\left((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2}\right)_2$	2 ^e	2742385.52
Cr	81	33	$\left((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2}\right)_3$	3 ^e	2763200.77
Cr	81	34	$(d_{+}^6)_{10}$	0 ^e	3550301.18
Cr	82	1	$(d_{+}^2)_{44}$	4 ^e	0.00
Cr	82	2	$(d_{+}^2)_{22}$	2 ^e	74783.13
Cr	82	3	$(d_{+}^2)_{10}$	0 ^e	252555.77
Cr	82	4	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2}\right)_3$	3 ^e	859908.19
Cr	82	5	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2}\right)_4$	4 ^e	866322.70
Cr	82	6	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2}\right)_1$	1 ^e	906408.85
Cr	82	7	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2}\right)_6$	6 ^e	935873.26
Cr	82	8	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2}\right)_5$	5 ^e	937852.36
Cr	82	9	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2}\right)_2$	2 ^e	1005687.00
Cr	82	10	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2}\right)_3$	3 ^e	1019529.56
Cr	82	11	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2}\right)_0$	0 ^e	1099970.17
Cr	82	12	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2}\right)_4$	4 ^e	1149538.60
Cr	82	13	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2}\right)_1$	1 ^e	1159947.45

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	82	14	$((d_{-}^2)_{3/2}, (d_{+}^3)_{5/2})_2$	2 ^e	1162808.01
Cr	82	15	$((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2})_3$	3 ^e	1170061.47
Cr	82	16	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_2$	2 ^e	1766963.58
Cr	82	17	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_0$	0 ^e	1792548.62
Cr	82	18	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_4$	4 ^e	1817866.79
Cr	82	19	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_3$	3 ^e	1847467.04
Cr	82	20	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_5$	5 ^e	1856290.64
Cr	82	21	$((d_{-}^2)_{2}, (d_{+}^4)_{4})_6$	6 ^e	1883505.25
Cr	82	22	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_3$	3 ^e	1923231.93
Cr	82	23	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_1$	1 ^e	1939904.02
Cr	82	24	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_4$	4 ^e	1955800.74
Cr	82	25	$((d_{-}^2)_{2}, (d_{+}^4)_{2})_2$	2 ^e	1971771.96
Cr	82	26	$((d_{-}^2)_{2}, (d_{+}^4)_{0})_2$	2 ^e	2081762.29
Cr	82	27	$((d_{-}^2)_{0}, (d_{+}^4)_{4})_4$	4 ^e	2126568.89
Cr	82	28	$((d_{-}^2)_{0}, (d_{+}^4)_{2})_2$	2 ^e	2285337.74
Cr	82	29	$((d_{-}^2)_{0}, (d_{+}^4)_{0})_0$	0 ^e	2454749.74
Cr	82	30	$((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2})_1$	1 ^e	2734447.51
Cr	82	31	$((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2})_4$	4 ^e	2843286.22

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Cr	82	32	$\left((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2}\right)_2$	2 ^e	2900979.31
Cr	82	33	$\left((d_{-}^1)_{3/2}, (d_{+}^5)_{5/2}\right)_3$	3 ^e	2922235.74
Cr	82	34	$(d_{+}^6)_{10}$	0 ^e	3760587.37
Cr	83	1	$(d_{+}^2)_{4}$	4 ^e	0.00
Cr	83	2	$(d_{+}^2)_{2}$	2 ^e	76391.80
Cr	83	3	$(d_{+}^2)_{10}$	0 ^e	258295.01
Cr	83	4	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2}\right)_3$	3 ^e	913992.58
Cr	83	5	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2}\right)_4$	4 ^e	919750.78
Cr	83	6	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2}\right)_1$	1 ^e	961446.74
Cr	83	7	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2}\right)_6$	6 ^e	989792.03
Cr	83	8	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2}\right)_5$	5 ^e	992064.15
Cr	83	9	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2}\right)_2$	2 ^e	1061615.21
Cr	83	10	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2}\right)_3$	3 ^e	1075649.47
Cr	83	11	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2}\right)_0$	0 ^e	1156918.70
Cr	83	12	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2}\right)_4$	4 ^e	1208000.97
Cr	83	13	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2}\right)_4$	1 ^e	1219053.04
Cr	83	14	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2}\right)_2$	2 ^e	1222265.88
Cr	83	15	$\left((d_{-}^3)_{3/2}, (d_{+}^3)_{5/2}\right)_3$	3 ^e	1228559.69

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Cr	83	16	$((d^-)_2, (d^+)_4)_2$	2 ^e	1875410.97
Cr	83	17	$((d^-)_2, (d^+)_2)_0$	0 ^e	1901177.04
Cr	83	18	$((d^-)_2, (d^+)_4)_4$	4 ^e	1926357.96
Cr	83	19	$((d^-)_2, (d^+)_4)_3$	3 ^e	1956385.71
Cr	83	20	$((d^-)_2, (d^+)_4)_5$	5 ^e	1965244.84
Cr	83	21	$((d^-)_2, (d^+)_4)_6$	6 ^e	1992399.50
Cr	83	22	$((d^-)_2, (d^+)_2)_3$	3 ^e	2033815.23
Cr	83	23	$((d^-)_2, (d^+)_2)_1$	1 ^e	2050204.09
Cr	83	24	$((d^-)_2, (d^+)_2)_4$	4 ^e	2065984.74
Cr	83	25	$((d^-)_2, (d^+)_2)_2$	2 ^e	2082658.40
Cr	83	26	$((d^-)_2, (d^+)_0)_2$	2 ^e	2194813.04
Cr	83	27	$((d^-)_{10}, (d^+)_4)_4$	4 ^e	2240369.94
Cr	83	28	$((d^-)_{10}, (d^+)_2)_2$	2 ^e	2401174.56
Cr	83	29	$((d^-)_{10}, (d^+)_0)_0$	0 ^e	2573955.68
Cr	83	30	$((d^-)_{3/2}, (d^+)_5)_{5/2}1$	1 ^e	2898176.32
Cr	83	31	$((d^-)_{3/2}, (d^+)_5)_{5/2}4$	4 ^e	3007924.91
Cr	83	32	$((d^-)_{3/2}, (d^+)_5)_{5/2}2$	2 ^e	3066713.22
Cr	83	33	$((d^-)_{3/2}, (d^+)_5)_{5/2}3$	3 ^e	3088406.76

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Cr	83	34	$(d_+^6)_0$	0 [±]	3980425.40
Mn	72	1	$(d_+^3)_{9/2}$	9/2 [±]	0.00
Mn	72	2	$(d_+^3)_{3/2}$	3/2 [±]	97169.08
Mn	72	3	$(d_+^3)_{5/2}$	5/2 [±]	150699.67
Mn	72	4	$((d_-^3)_{3/2}, (d_+^4)_{4/7/2})$	7/2 [±]	459970.19
Mn	72	5	$((d_-^3)_{3/2}, (d_+^4)_{4/9/2})$	9/2 [±]	514758.52
Mn	72	6	$((d_-^3)_{3/2}, (d_+^4)_{2/3/2})$	3/2 [±]	536348.27
Mn	72	7	$((d_-^3)_{3/2}, (d_+^4)_{4/5/2})$	5/2 [±]	552432.47
Mn	72	8	$((d_-^3)_{3/2}, (d_+^4)_{2/1/2})$	1/2 [±]	563728.21
Mn	72	9	$((d_-^3)_{3/2}, (d_+^4)_{4/11/2})$	11/ 2 [±]	579107.60
Mn	72	10	$((d_-^3)_{3/2}, (d_+^4)_{2/7/2})$	7/2 [±]	630068.15
Mn	72	11	$((d_-^3)_{3/2}, (d_+^4)_{2/7/2})$	5/2 [±]	667999.03
Mn	72	12	$((d_-^3)_{3/2}, (d_+^4)_{0/3/2})$	3/2 [±]	805935.03
Mn	72	13	$((d_-^2)_{2}, (d_+^5)_{5/2/5/2})$	5/2 [±]	978180.89
Mn	72	14	$((d_-^2)_{2}, (d_+^5)_{5/2/3/2})$	3/2 [±]	1008503.07
Mn	72	15	$((d_-^2)_{2}, (d_+^5)_{5/2/9/2})$	9/2 [±]	1046244.83
Mn	72	16	$((d_-^2)_{2}, (d_+^5)_{5/2/1/2})$	1/2 [±]	1051068.72
Mn	72	17	$((d_-^2)_{2}, (d_+^5)_{5/2/7/2})$	7/2 [±]	1071270.45

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Mn	72	18	$\left((d_{+}^{2})_{0}^{+}, (d_{+}^{5})_{5/2}^{+}\right)_{5/2}^{+}$	5/2 ⁺	1261614.65
Mn	72	19	$(d_{-}^{1})_{3/2}^{-}$	3/2 ⁺	1542503.65
Mn	73	1	$(d_{+}^{3})_{9/2}^{+}$	9/2 ⁺	0.00
Mn	73	2	$(d_{+}^{3})_{3/2}^{+}$	3/2 ⁺	99223.76
Mn	73	3	$(d_{+}^{3})_{5/2}^{+}$	5/2 ⁺	154524.09
Mn	73	4	$\left((d_{+}^{3})_{3/2}^{+}, (d_{+}^{4})_{4}^{+}\right)_{7/2}^{+}$	7/2 ⁺	493321.06
Mn	73	5	$\left((d_{+}^{3})_{3/2}^{+}, (d_{+}^{4})_{4}^{+}\right)_{9/2}^{+}$	9/2 ⁺	548451.83
Mn	73	6	$\left((d_{+}^{3})_{3/2}^{+}, (d_{+}^{4})_{4}^{+}\right)_{3/2}^{+}$	3/2 ⁺	571353.56
Mn	73	7	$\left((d_{+}^{3})_{3/2}^{+}, (d_{+}^{4})_{4}^{+}\right)_{5/2}^{+}$	5/2 ⁺	587942.19
Mn	73	8	$\left((d_{+}^{3})_{3/2}^{+}, (d_{+}^{4})_{4}^{+}\right)_{2}^{+}$	1/2 ⁺	598976.91
Mn	73	9	$\left((d_{+}^{3})_{3/2}^{+}, (d_{+}^{4})_{4}^{+}\right)_{11/2}^{+}$	11/2 ⁺	613986.61
Mn	73	10	$\left((d_{+}^{3})_{3/2}^{+}, (d_{+}^{4})_{4}^{+}\right)_{7/2}^{+}$	7/2 ⁺	666834.73
Mn	73	11	$\left((d_{+}^{3})_{3/2}^{+}, (d_{+}^{4})_{4}^{+}\right)_{5/2}^{+}$	5/2 ⁺	704540.79
Mn	73	12	$\left((d_{+}^{3})_{3/2}^{+}, (d_{+}^{4})_{4}^{+}\right)_{3/2}^{+}$	3/2 ⁺	846076.44
Mn	73	13	$\left((d_{+}^{2})_{2}^{+}, (d_{+}^{5})_{5/2}^{+}\right)_{5/2}^{+}$	5/2 ⁺	1045370.95
Mn	73	14	$\left((d_{+}^{2})_{2}^{+}, (d_{+}^{5})_{5/2}^{+}\right)_{3/2}^{+}$	3/2 ⁺	1076594.78
Mn	73	15	$\left((d_{+}^{2})_{2}^{+}, (d_{+}^{5})_{5/2}^{+}\right)_{9/2}^{+}$	9/2 ⁺	1114603.97
Mn	73	16	$\left((d_{+}^{2})_{2}^{+}, (d_{+}^{5})_{5/2}^{+}\right)_{1/2}^{+}$	1/2 ⁺	1120089.41

Sequence	Z	Key	Level	J^π	Energy (cm ⁻¹)
Mn	73	17	$((d_{-}^{2})_{2}, (d_{+}^{5})_{5/2})_{7/2}$	7/2 ^e	1139559.65
Mn	73	18	$((d_{-}^{2})_{0}, (d_{+}^{5})_{5/2})_{5/2}$	5/2 ^e	1334061.19
Mn	73	19	$(d_{-}^{1})_{3/2}$	3/2 ^e	1644860.29
Mn	74	1	$(d_{+}^{3})_{9/2}$	9/2 ^e	0.00
Mn	74	2	$(d_{+}^{3})_{3/2}$	3/2 ^e	101301.12
Mn	74	3	$(d_{+}^{3})_{5/2}$	5/2 ^e	158353.82
Mn	74	4	$((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4})_{7/2}$	7/2 ^e	528430.73
Mn	74	5	$((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4})_{9/2}$	9/2 ^e	583901.23
Mn	74	6	$((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2})_{3/2}$	3/2 ^e	608123.54
Mn	74	7	$((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4})_{5/2}$	5/2 ^e	625213.24
Mn	74	8	$((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2})_{1/2}$	1/2 ^e	635995.15
Mn	74	9	$((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4})_{11/2}$	11/2 ^e	650605.98
Mn	74	10	$((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2})_{7/2}$	7/2 ^e	705341.66
Mn	74	11	$((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2})_{5/2}$	5/2 ^e	742857.08
Mn	74	12	$((d_{-}^{3})_{3/2}, (d_{+}^{4})_{0})_{3/2}$	3/2 ^e	887952.67
Mn	74	13	$((d_{-}^{2})_{2}, (d_{+}^{5})_{5/2})_{5/2}$	5/2 ^e	1116092.29
Mn	74	14	$((d_{-}^{2})_{2}, (d_{+}^{5})_{5/2})_{3/2}$	3/2 ^e	1148239.63
Mn	74	15	$((d_{-}^{2})_{2}, (d_{+}^{5})_{5/2})_{9/2}$	9/2 ^e	1186460.58
Mn	74	16	$((d_{-}^{2})_{2}, (d_{+}^{5})_{5/2})_{1/2}$	1/2 ^e	1192628.85

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Mn	74	17	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{7/2}$	7/2 ^e	1211372.36
Mn	74	18	$\left((d_{-}^{2})_{0}, (d_{+}^{2})_{5/2}\right)_{5/2}$	5/2 ^e	1410041.39
Mn	74	19	$(d_{-}^{1})_{3/2}$	3/2 ^e	1752509.90
Mn	75	1	$(d_{+}^{3})_{9/2}$	9/2 ^e	0.00
Mn	75	2	$(d_{+}^{3})_{3/2}$	3/2 ^e	103401.04
Mn	75	3	$(d_{+}^{3})_{5/2}$	5/2 ^e	162189.63
Mn	75	4	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	565360.27
Mn	75	5	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{9/2}$	9/2 ^e	621167.39
Mn	75	6	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{3/2}$	3/2 ^e	646720.04
Mn	75	7	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	664306.97
Mn	75	8	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{1/2}$	1/2 ^e	674844.17
Mn	75	9	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/ 2 ^e	689026.49
Mn	75	10	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{7/2}$	7/2 ^e	745651.01
Mn	75	11	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{5/2}$	5/2 ^e	783009.28
Mn	75	12	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{0}\right)_{3/2}$	3/2 ^e	931633.45
Mn	75	13	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{5/2}$	5/2 ^e	1190466.43
Mn	75	14	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{3/2}$	3/2 ^e	1223553.64
Mn	75	15	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{9/2}$	9/2 ^e	1261936.93
Mn	75	16	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{1/2}$	1/2 ^e	1268809.64

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Mn	75	17	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{7/2}$	7/2 ^e	1286830.01
Mn	75	18	$\left((d_{-}^{2})_{0}, (d_{+}^{2})_{5/2}\right)_{5/2}$	5/2 ^e	1489678.12
Mn	75	19	$(d_{-}^{1})_{3/2}$	3/2 ^e	1865634.61
Mn	76	1	$(d_{+}^{3})_{9/2}$	9/2 ^e	0.00
Mn	76	2	$(d_{+}^{3})_{3/2}$	3/2 ^e	105523.36
Mn	76	3	$(d_{+}^{3})_{5/2}$	5/2 ^e	166032.25
Mn	76	4	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	604172.21
Mn	76	5	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{9/2}$	9/2 ^e	660312.43
Mn	76	6	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{3/2}$	3/2 ^e	687206.29
Mn	76	7	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	705286.20
Mn	76	8	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{1/2}$	1/2 ^e	715586.65
Mn	76	9	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/ 2 ^e	729310.39
Mn	76	10	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{7/2}$	7/2 ^e	787826.27
Mn	76	11	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{5/2}$	5/2 ^e	825060.13
Mn	76	12	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{0}\right)_{3/2}$	3/2 ^e	977188.01
Mn	76	13	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{5/2}$	5/2 ^e	1268617.86
Mn	76	14	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{3/2}$	3/2 ^e	1302657.42
Mn	76	15	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{9/2}$	9/2 ^e	1341158.18
Mn	76	16	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{1/2}$	1/2 ^e	1348757.22

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Mn	76	17	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{7/2}$	7/2 ^e	1366056.94
Mn	76	18	$\left((d_{-}^{2})_{0}, (d_{+}^{2})_{5/2}\right)_{5/2}$	5/2 ^e	1573097.07
Mn	76	19	$(d_{-}^{1})_{3/2}$	3/2 ^e	1984421.15
Mn	77	1	$(d_{+}^{3})_{9/2}$	9/2 ^e	0.00
Mn	77	2	$(d_{+}^{3})_{3/2}$	3/2 ^e	107668.00
Mn	77	3	$(d_{+}^{3})_{5/2}$	5/2 ^e	169882.44
Mn	77	4	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	644929.85
Mn	77	5	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{9/2}$	9/2 ^e	701399.22
Mn	77	6	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{3/2}$	3/2 ^e	729646.23
Mn	77	7	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	748214.50
Mn	77	8	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{1/2}$	1/2 ^e	758286.04
Mn	77	9	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/ 2 ^e	771520.63
Mn	77	10	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{7/2}$	7/2 ^e	831931.58
Mn	77	11	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{5/2}$	5/2 ^e	869073.07
Mn	77	12	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{0}\right)_{3/2}$	3/2 ^e	1024684.90
Mn	77	13	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{5/2}$	5/2 ^e	1350672.66
Mn	77	14	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{3/2}$	3/2 ^e	1385674.32
Mn	77	15	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{9/2}$	9/2 ^e	1424250.94
Mn	77	16	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{1/2}$	1/2 ^e	1432598.61

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Mn	77	17	$\left((d_{-}^{2})_{2}, (d_{+}^{5})_{5/2}\right)_{7/2}$	7/2 ^e	1449179.04
Mn	77	18	$\left((d_{-}^{2})_{0}, (d_{+}^{5})_{5/2}\right)_{5/2}$	5/2 ^e	1660425.43
Mn	77	19	$(d_{-}^{1})_{3/2}$	3/2 ^e	2109058.73
Mn	78	1	$(d_{+}^{3})_{9/2}$	9/2 ^e	0.00
Mn	78	2	$(d_{+}^{3})_{3/2}$	3/2 ^e	109834.81
Mn	78	3	$(d_{+}^{3})_{5/2}$	5/2 ^e	173740.92
Mn	78	4	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	687698.51
Mn	78	5	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{9/2}$	9/2 ^e	744492.66
Mn	78	6	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{3/2}$	3/2 ^e	774105.77
Mn	78	7	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	793157.45
Mn	78	8	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{1/2}$	1/2 ^e	803007.73
Mn	78	9	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/2 ^e	815722.23
Mn	78	10	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{7/2}$	7/2 ^e	878033.09
Mn	78	11	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{5/2}$	5/2 ^e	915113.50
Mn	78	12	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{0}\right)_{3/2}$	3/2 ^e	1074193.71
Mn	78	13	$\left((d_{-}^{2})_{2}, (d_{+}^{5})_{5/2}\right)_{5/2}$	5/2 ^e	1436761.01
Mn	78	14	$\left((d_{-}^{2})_{2}, (d_{+}^{5})_{5/2}\right)_{3/2}$	3/2 ^e	1472732.49
Mn	78	15	$\left((d_{-}^{2})_{2}, (d_{+}^{5})_{5/2}\right)_{9/2}$	9/2 ^e	1511345.91

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Mn	78	16	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{1/2}$	1/2 ^e	1520464.75
Mn	78	17	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{7/2}$	7/2 ^e	1536326.22
Mn	78	18	$\left((d_{-}^{2})_{0}, (d_{+}^{2})_{5/2}\right)_{5/2}$	5/2 ^e	1751794.36
Mn	78	19	$(d_{-}^{1})_{3/2}$	3/2 ^e	2239742.79
Mn	79	1	$(d_{+}^{3})_{9/2}$	9/2 ^e	0.00
Mn	79	2	$(d_{+}^{3})_{3/2}$	3/2 ^e	112023.70
Mn	79	3	$(d_{+}^{3})_{5/2}$	5/2 ^e	177608.43
Mn	79	4	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	732544.46
Mn	79	5	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{9/2}$	9/2 ^e	789658.60
Mn	79	6	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{3/2}$	3/2 ^e	820651.72
Mn	79	7	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	840181.59
Mn	79	8	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{1/2}$	1/2 ^e	849818.11
Mn	79	9	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/2 ^e	861981.11
Mn	79	10	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{7/2}$	7/2 ^e	926197.79
Mn	79	11	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{5/2}$	5/2 ^e	963247.69
Mn	79	12	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{0}\right)_{3/2}$	3/2 ^e	1125784.18
Mn	79	13	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{5/2}$	5/2 ^e	1527014.98
Mn	79	14	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{3/2}$	3/2 ^e	1563962.60

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Mn	79	15	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{9/2}$	9/2 ^e	1602575.60
Mn	79	16	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{1/2}$	1/2 ^e	1612488.49
Mn	79	17	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{7/2}$	7/2 ^e	1627630.32
Mn	79	18	$\left((d_{-}^{2})_{0}, (d_{+}^{2})_{5/2}\right)_{5/2}$	5/2 ^e	1847336.88
Mn	79	19	$(d_{-}^{1})_{3/2}$	3/2 ^e	2376671.68
Mn	80	1	$(d_{+}^{3})_{9/2}$	9/2 ^e	0.00
Mn	80	2	$(d_{+}^{3})_{3/2}$	3/2 ^e	114234.56
Mn	80	3	$(d_{+}^{3})_{5/2}$	5/2 ^e	181485.69
Mn	80	4	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	779535.65
Mn	80	5	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{9/2}$	9/2 ^e	836964.56
Mn	80	6	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{3/2}$	3/2 ^e	869352.54
Mn	80	7	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	889355.10
Mn	80	8	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{1/2}$	1/2 ^e	898785.18
Mn	80	9	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/2 ^e	910364.89
Mn	80	10	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{7/2}$	7/2 ^e	976494.33
Mn	80	11	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{5/2}$	5/2 ^e	1013543.60
Mn	80	12	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{0}\right)_{3/2}$	3/2 ^e	1179527.17
Mn	80	13	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{5/2}$	5/2 ^e	1621570.11

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Mn	80	14	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{3/2}$	3/2 ^e	1659499.11
Mn	80	15	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{9/2}$	9/2 ^e	1698075.90
Mn	80	16	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{1/2}$	1/2 ^e	1708806.04
Mn	80	17	$\left((d_{-}^{2})_{2}, (d_{+}^{2})_{5/2}\right)_{7/2}$	7/2 ^e	1723226.55
Mn	80	18	$\left((d_{-}^{2})_{0}, (d_{+}^{2})_{5/2}\right)_{5/2}$	5/2 ^e	1947189.36
Mn	80	19	$(d_{-}^{1})_{3/2}$	3/2 ^e	2520048.99
Mn	81	1	$(d_{+}^{3})_{9/2}$	9/2 ^e	0.00
Mn	81	2	$(d_{+}^{3})_{3/2}$	3/2 ^e	116467.36
Mn	81	3	$(d_{+}^{3})_{5/2}$	5/2 ^e	185373.40
Mn	81	4	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{7/2}$	7/2 ^e	828740.63
Mn	81	5	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{9/2}$	9/2 ^e	886478.68
Mn	81	6	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{3/2}$	3/2 ^e	920277.26
Mn	81	7	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{5/2}$	5/2 ^e	940746.79
Mn	81	8	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{1/2}$	1/2 ^e	949977.60
Mn	81	9	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{4}\right)_{11/2}$	11/2 ^e	960941.76
Mn	81	10	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{7/2}$	7/2 ^e	1028991.89
Mn	81	11	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{2}\right)_{5/2}$	5/2 ^e	1066069.71
Mn	81	12	$\left((d_{-}^{3})_{3/2}, (d_{+}^{4})_{0}\right)_{3/2}$	3/2 ^e	1235493.64

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Mn	81	13	$\left(\left(d_{-}^{2}\right)_{2},\left(d_{+}^{2}\right)_{5/2}\right)_{5/2}$	5/2 ^e	1720563.16
Mn	81	14	$\left(\left(d_{-}^{2}\right)_{2},\left(d_{+}^{2}\right)_{5/2}\right)_{3/2}$	3/2 ^e	1759478.06
Mn	81	15	$\left(\left(d_{-}^{2}\right)_{2},\left(d_{+}^{2}\right)_{5/2}\right)_{9/2}$	9/2 ^e	1797983.86
Mn	81	16	$\left(\left(d_{-}^{2}\right)_{2},\left(d_{+}^{2}\right)_{5/2}\right)_{1/2}$	1/2 ^e	1809554.79
Mn	81	17	$\left(\left(d_{-}^{2}\right)_{2},\left(d_{+}^{2}\right)_{5/2}\right)_{7/2}$	7/2 ^e	1823251.37
Mn	81	18	$\left(\left(d_{-}^{2}\right)_{0},\left(d_{+}^{2}\right)_{5/2}\right)_{5/2}$	5/2 ^e	2051489.31
Mn	81	19	$\left(d_{-}^{1}\right)_{3/2}$	3/2 ^e	2670080.17
Mn	82	1	$\left(d_{+}^{3}\right)_{9/2}$	9/2 ^e	0.00
Mn	82	2	$\left(d_{+}^{3}\right)_{3/2}$	3/2 ^e	118722.02
Mn	82	3	$\left(d_{+}^{3}\right)_{5/2}$	5/2 ^e	189272.25
Mn	82	4	$\left(\left(d_{-}^{3}\right)_{3/2},\left(d_{+}^{4}\right)_{4}\right)_{7/2}$	7/2 ^e	880229.95
Mn	82	5	$\left(\left(d_{-}^{3}\right)_{3/2},\left(d_{+}^{4}\right)_{4}\right)_{9/2}$	9/2 ^e	938271.10
Mn	82	6	$\left(\left(d_{-}^{3}\right)_{3/2},\left(d_{+}^{4}\right)_{2}\right)_{3/2}$	3/2 ^e	973496.86
Mn	82	7	$\left(\left(d_{-}^{3}\right)_{3/2},\left(d_{+}^{4}\right)_{4}\right)_{5/2}$	5/2 ^e	994427.43
Mn	82	8	$\left(\left(d_{-}^{3}\right)_{3/2},\left(d_{+}^{4}\right)_{2}\right)_{1/2}$	1/2 ^e	1003465.98
Mn	82	9	$\left(\left(d_{-}^{3}\right)_{3/2},\left(d_{+}^{4}\right)_{4}\right)_{11/2}$	11/ 2 ^e	1013781.89
Mn	82	10	$\left(\left(d_{-}^{3}\right)_{3/2},\left(d_{+}^{4}\right)_{2}\right)_{7/2}$	7/2 ^e	1083761.57
Mn	82	11	$\left(\left(d_{-}^{3}\right)_{3/2},\left(d_{+}^{4}\right)_{2}\right)_{5/2}$	5/2 ^e	1120896.50

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Mn	82	12	$\left((d_{-}^{-})_{3/2}, (d_{+}^{+})_0\right)_{3/2}$	3/2 ^e	1293756.21
Mn	82	13	$\left((d_{-}^{-})_2, (d_{+}^{+})_{5/2}\right)_{5/2}$	5/2 ^e	1824134.92
Mn	82	14	$\left((d_{-}^{-})_2, (d_{+}^{+})_{5/2}\right)_{3/2}$	3/2 ^e	1864039.67
Mn	82	15	$\left((d_{-}^{-})_2, (d_{+}^{+})_{5/2}\right)_{9/2}$	9/2 ^e	1902440.51
Mn	82	16	$\left((d_{-}^{-})_2, (d_{+}^{+})_{5/2}\right)_{1/2}$	1/2 ^e	1914876.11
Mn	82	17	$\left((d_{-}^{-})_2, (d_{+}^{+})_{5/2}\right)_{7/2}$	7/2 ^e	1927845.23
Mn	82	18	$\left((d_{-}^{-})_0, (d_{+}^{+})_{5/2}\right)_{5/2}$	5/2 ^e	2160378.21
Mn	82	19	$(d_{-}^{-})_{3/2}$	3/2 ^e	2826976.75
Mn	83	1	$(d_{+}^{+})_{9/2}$	9/2 ^e	0.00
Mn	83	2	$(d_{+}^{+})_{3/2}$	3/2 ^e	120998.51
Mn	83	3	$(d_{+}^{+})_{5/2}$	5/2 ^e	193182.92
Mn	83	4	$\left((d_{-}^{-})_{3/2}, (d_{+}^{+})_4\right)_{7/2}$	7/2 ^e	934075.10
Mn	83	5	$\left((d_{-}^{-})_{3/2}, (d_{+}^{+})_4\right)_{9/2}$	9/2 ^e	992412.87
Mn	83	6	$\left((d_{-}^{-})_{3/2}, (d_{+}^{+})_2\right)_{3/2}$	3/2 ^e	1029083.22
Mn	83	7	$\left((d_{-}^{-})_{3/2}, (d_{+}^{+})_4\right)_{5/2}$	5/2 ^e	1050468.71
Mn	83	8	$\left((d_{-}^{-})_{3/2}, (d_{+}^{+})_2\right)_{1/2}$	1/2 ^e	1059321.84
Mn	83	9	$\left((d_{-}^{-})_{3/2}, (d_{+}^{+})_4\right)_{11/2}$	11/ 2 ^e	1068956.39
Mn	83	10	$\left((d_{-}^{-})_{3/2}, (d_{+}^{+})_2\right)_{7/2}$	7/2 ^e	1140875.38

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Mn	83	11	$\left(\left(d_{-}^{-3}\right)_{3/2},\left(d_{+}^{4}\right)_{2}\right)_{5/2}$	5/2 ^e	1178095.33
Mn	83	12	$\left(\left(d_{-}^{-3}\right)_{3/2},\left(d_{+}^{4}\right)_{0}\right)_{3/2}$	3/2 ^e	1354388.13
Mn	83	13	$\left(\left(d_{-}^{-2}\right)_{2},\left(d_{+}^{5}\right)_{5/2}\right)_{5/2}$	5/2 ^e	1932428.06
Mn	83	14	$\left(\left(d_{-}^{-2}\right)_{2},\left(d_{+}^{5}\right)_{5/2}\right)_{3/2}$	3/2 ^e	1973326.23
Mn	83	15	$\left(\left(d_{-}^{-2}\right)_{2},\left(d_{+}^{5}\right)_{5/2}\right)_{9/2}$	9/2 ^e	2011588.71
Mn	83	16	$\left(\left(d_{-}^{-2}\right)_{2},\left(d_{+}^{5}\right)_{5/2}\right)_{1/2}$	1/2 ^e	2024913.21
Mn	83	17	$\left(\left(d_{-}^{-2}\right)_{2},\left(d_{+}^{5}\right)_{5/2}\right)_{7/2}$	7/2 ^e	2037150.46
Mn	83	18	$\left(\left(d_{-}^{-2}\right)_{0},\left(d_{+}^{5}\right)_{5/2}\right)_{5/2}$	5/2 ^e	2273999.39
Mn	83	19	$\left(d_{-}^{-1}\right)_{3/2}$	3/2 ^e	2990953.09
Fe	72	1	$\left(d_{+}^{4}\right)_{4}$	4 ^e	0.00
Fe	72	2	$\left(d_{+}^{4}\right)_{2}$	2 ^e	69215.00
Fe	72	3	$\left(d_{+}^{4}\right)_{0}$	0 ^e	219175.65
Fe	72	4	$\left(\left(d_{-}^{-3}\right)_{3/2},\left(d_{+}^{5}\right)_{5/2}\right)_{3}$	3 ^e	458235.36
Fe	72	5	$\left(\left(d_{-}^{-3}\right)_{3/2},\left(d_{+}^{5}\right)_{5/2}\right)_{2}$	2 ^e	530173.94
Fe	72	6	$\left(\left(d_{-}^{-3}\right)_{3/2},\left(d_{+}^{5}\right)_{5/2}\right)_{1}$	1 ^e	570041.47
Fe	72	7	$\left(\left(d_{-}^{-3}\right)_{3/2},\left(d_{+}^{5}\right)_{5/2}\right)_{4}$	4 ^e	573383.75
Fe	72	8	$\left(d_{-}^{-2}\right)_{2}$	2 ^e	970769.22
Fe	72	9	$\left(d_{-}^{-2}\right)_{0}$	0 ^e	1160598.23

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Fe	73	1	$(d^4_+)_4$	4 ^e	0.00
Fe	73	2	$(d^4_+)_2$	2 ^e	70540.23
Fe	73	3	$(d^4_+)_0$	0 ^e	224190.81
Fe	73	4	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_3$	3 ^e	491051.17
Fe	73	5	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_2$	2 ^e	564524.61
Fe	73	6	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_1$	1 ^e	605246.47
Fe	73	7	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_4$	4 ^e	607926.02
Fe	73	8	$(d^2_{-})_2$	2 ^e	1037437.28
Fe	73	9	$(d^2_{-})_0$	0 ^e	1230616.47
Fe	74	1	$(d^4_+)_4$	4 ^e	0.00
Fe	74	2	$(d^4_+)_2$	2 ^e	71876.62
Fe	74	3	$(d^4_+)_0$	0 ^e	229214.79
Fe	74	4	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_3$	3 ^e	525603.10
Fe	74	5	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_2$	2 ^e	600611.55
Fe	74	6	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_1$	1 ^e	642204.11
Fe	74	7	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_4$	4 ^e	644198.72
Fe	74	8	$(d^2_{-})_2$	2 ^e	1107580.76
Fe	74	9	$(d^2_{-})_0$	0 ^e	1304142.88

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Fe	75	1	$(d^4_+)_4$	4 ^e	0.00
Fe	75	2	$(d^4_+)_2$	2 ^e	73224.56
Fe	75	3	$(d^4_+)_0$	0 ^e	234249.10
Fe	75	4	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_3$	3 ^e	561952.25
Fe	75	5	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_2$	2 ^e	638496.15
Fe	75	6	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_1$	1 ^e	680975.77
Fe	75	7	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_4$	4 ^e	682262.90
Fe	75	8	$(d^2_-)_2$	2 ^e	1181321.51
Fe	75	9	$(d^2_-)_0$	0 ^e	1381299.02
Fe	76	1	$(d^4_+)_4$	4 ^e	0.00
Fe	76	2	$(d^4_+)_2$	2 ^e	74584.42
Fe	76	3	$(d^4_+)_0$	0 ^e	239295.18
Fe	76	4	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_3$	3 ^e	600161.13
Fe	76	5	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_2$	2 ^e	678241.16
Fe	76	6	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_1$	1 ^e	721624.23
Fe	76	7	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_4$	4 ^e	722181.00
Fe	76	8	$(d^2_-)_2$	2 ^e	1258784.24
Fe	76	9	$(d^2_-)_0$	0 ^e	1462209.34

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Fe	77	1	$(d^4_+)_4$	4 ^e	0.00
Fe	77	2	$(d^4_+)_2$	2 ^e	75956.53
Fe	77	3	$(d^4_+)_0$	0 ^e	244354.41
Fe	77	4	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_3$	3 ^e	640292.98
Fe	77	5	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_2$	2 ^e	719910.08
Fe	77	6	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_4$	4 ^e	764016.16
Fe	77	7	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_1$	1 ^e	764213.02
Fe	77	8	$(d^2_{-})_2$	2 ^e	1340095.22
Fe	77	9	$(d^2_{-})_0$	0 ^e	1546999.83
Fe	78	1	$(d^4_+)_4$	4 ^e	0.00
Fe	78	2	$(d^4_+)_2$	2 ^e	77341.18
Fe	78	3	$(d^4_+)_0$	0 ^e	249428.08
Fe	78	4	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_3$	3 ^e	682413.04
Fe	78	5	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_2$	2 ^e	763568.36
Fe	78	6	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_4$	4 ^e	807833.52
Fe	78	7	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_1$	1 ^e	808807.63
Fe	78	8	$(d^2_{-})_2$	2 ^e	1425384.67
Fe	78	9	$(d^2_{-})_0$	0 ^e	1635800.52

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Fe	79	1	$(d^4_+)_4$	4 ^e	0.00
Fe	79	2	$(d^4_+)_2$	2 ^e	78738.64
Fe	79	3	$(d^4_-)_0$	0 ^e	254517.43
Fe	79	4	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_3$	3 ^e	726587.45
Fe	79	5	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_2$	2 ^e	809282.35
Fe	79	6	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_4$	4 ^e	853699.07
Fe	79	7	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_1$	1 ^e	855474.46
Fe	79	8	$(d^2_-)_2$	2 ^e	1514784.73
Fe	79	9	$(d^2_-)_0$	0 ^e	1728743.29
Fe	80	1	$(d^4_+)_4$	4 ^e	0.00
Fe	80	2	$(d^4_+)_2$	2 ^e	80149.16
Fe	80	3	$(d^4_+)_0$	0 ^e	259623.62
Fe	80	4	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_3$	3 ^e	772883.99
Fe	80	5	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_2$	2 ^e	857120.02
Fe	80	6	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_4$	4 ^e	901680.51
Fe	80	7	$((d^3_-)_{3/2}, (d^5_+)_{5/2})_1$	1 ^e	904281.57
Fe	80	8	$(d^2_-)_2$	2 ^e	1608430.85
Fe	80	9	$(d^2_-)_0$	0 ^e	1825963.45

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Fe	81	1	$(d^4_+)_4$	4 ^e	0.00
Fe	81	2	$(d^4_+)_2$	2 ^e	81572.98
Fe	81	3	$(d^4_+)_0$	0 ^e	264747.77
Fe	81	4	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_3$	3 ^e	821371.06
Fe	81	5	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_2$	2 ^e	907149.96
Fe	81	6	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_4$	4 ^e	951846.03
Fe	81	7	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_1$	1 ^e	955297.59
Fe	81	8	$(d^2_{-})_2$	2 ^e	1706459.70
Fe	81	9	$(d^2_{-})_0$	0 ^e	1927597.50
Fe	82	1	$(d^4_+)_4$	4 ^e	0.00
Fe	82	2	$(d^4_+)_2$	2 ^e	83010.29
Fe	82	3	$(d^4_+)_0$	0 ^e	269890.91
Fe	82	4	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_3$	3 ^e	872118.97
Fe	82	5	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_2$	2 ^e	959442.66
Fe	82	6	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_4$	4 ^e	1004265.83
Fe	82	7	$((d^3_{-})_{3/2}, (d^5_{+})_{5/2})_1$	1 ^e	1008593.13
Fe	82	8	$(d^2_{-})_2$	2 ^e	1809011.88
Fe	82	9	$(d^2_{-})_0$	0 ^e	2033785.91

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Fe	83	1	$(d^4_+)_4$	4 ^e	0.00
Fe	83	2	$(d^4_+)_2$	2 ^e	84461.31
Fe	83	3	$(d^4_+)_0$	0 ^e	275054.04
Fe	83	4	$((d^3_{-})_{3/2}, (d^5_+)_{5/2})_3$	3 ^e	925198.99
Fe	83	5	$((d^3_{-})_{3/2}, (d^5_+)_{5/2})_2$	2 ^e	1014069.53
Fe	83	6	$((d^3_{-})_{3/2}, (d^5_+)_{5/2})_4$	4 ^e	1059010.97
Fe	83	7	$((d^3_{-})_{3/2}, (d^5_+)_{5/2})_1$	1 ^e	1064239.67
Fe	83	8	$(d^2_{-})_2$	2 ^e	1916229.85
Fe	83	9	$(d^2_{-})_0$	0 ^e	2144671.04
Co	72	1	$(d^5_+)_{5/2}$	5/2 ^e	0.00
Co	72	2	$(d^3_{-})_{3/2}$	3/2 ^e	470087.33
Co	73	1	$(d^5_+)_{5/2}$	5/2 ^e	0.00
Co	73	2	$(d^3_{-})_{3/2}$	3/2 ^e	502993.80
Co	74	1	$(d^5_+)_{5/2}$	5/2 ^e	0.00
Co	74	2	$(d^3_{-})_{3/2}$	3/2 ^e	537613.74
Co	75	1	$(d^5_+)_{5/2}$	5/2 ^e	0.00
Co	75	2	$(d^3_{-})_{3/2}$	3/2 ^e	574008.77
Co	76	1	$(d^5_+)_{5/2}$	5/2 ^e	0.00

Sequence	Z	Key	Level	J^{π}	Energy (cm ⁻¹)
Co	76	2	$(d^-)_{3/2}$	3/2 ^e	612240.71
Co	77	1	$(d^+)_{5/2}$	5/2 ^e	0.00
Co	77	2	$(d^-)_{3/2}$	3/2 ^e	652372.43
Co	78	1	$(d^+)_{5/2}$	5/2 ^e	0.00
Co	78	2	$(d^-)_{3/2}$	3/2 ^e	694468.76
Co	79	1	$(d^+)_{5/2}$	5/2 ^e	0.00
Co	79	2	$(d^-)_{3/2}$	3/2 ^e	738595.53
Co	80	1	$(d^+)_{5/2}$	5/2 ^e	0.00
Co	80	2	$(d^-)_{3/2}$	3/2 ^e	784820.14
Co	81	1	$(d^+)_{5/2}$	5/2 ^e	0.00
Co	81	2	$(d^-)_{3/2}$	3/2 ^e	833210.65
Co	82	1	$(d^+)_{5/2}$	5/2 ^e	0.00
Co	82	2	$(d^-)_{3/2}$	3/2 ^e	883837.03
Co	83	1	$(d^+)_{5/2}$	5/2 ^e	0.00
Co	83	2	$(d^-)_{3/2}$	3/2 ^e	936770.21

Table 3

Comparisons of wavelengths (nm) and transition rates (s^{-1}) for some forbidden transitions of Hf ($Z = 72$), Ta ($Z = 73$), W ($Z = 74$) and Au ($Z = 79$) ions. These transitions have been observed by Ralchenko et al. [1,2]. See page 16 for Explanation of Tables.

Z	Sequence	i	Lower level	j	Upper Level	Wavelengths (nm)		Transition rates (s ⁻¹)				
						Exp.	MCDHF/RCI	MBPT	RCI	MCDHF/RCI	MBPT	RCI
72	K	1	(d ¹ ₋) _{3/2}	2	(d ¹ ₊) _{5/2}	18.158	18.1899	18.1561	18.2132	1.77E+06	1.73E+06	1.76E+06
72	Ca	1	(d ² ₋) ₂	3	((d ¹ ₋) _{3/2} , (d ¹ ₊) _{5/2}) ₃	19.525	19.5605	19.5151	19.6012	2.49E+06	2.45E+06	2.48E+06
72	Ca	1	(d ² ₋) ₂	4	((d ¹ ₋) _{3/2} , (d ¹ ₊) _{5/2}) ₂	16.884	16.9068	16.8988	16.9070	1.24E+06	1.21E+06	1.23E+06
72	Ca	2	(d ² ₋) ₀	6	((d ¹ ₋) _{3/2} , (d ¹ ₊) _{5/2}) ₁	22.158	22.2007	22.1428	22.2673	1.14E+06	1.12E+06	1.13E+06
72	Sc	1	(d ³ ₋) _{3/2}	2	((d ² ₋) ₂ , (d ¹ ₊) _{5/2}) _{5/2}	21.762	21.8028	21.7386	21.8713	2.28E+06	2.25E+06	2.26E+06
72	Sc	1	(d ³ ₋) _{3/2}	3	((d ² ₋) ₂ , (d ¹ ₊) _{5/2}) _{3/2}	19.639	19.6692	19.6381	19.6876	1.84E+06	1.81E+06	1.83E+06
72	Sc	1	(d ³ ₋) _{3/2}	6	((d ² ₋) ₂ , (d ¹ ₊) _{5/2}) _{1/2}	18.15	18.1869	18.1778	18.1838	6.88E+05	6.76E+05	6.84E+05
72	Sc	1	(d ³ ₋) _{3/2}	7	((d ² ₋) ₀ , (d ¹ ₊) _{5/2}) _{5/2}	13.706	13.7121	13.7146	13.6749	1.93E+05	1.89E+05	1.92E+05
72	Sc	2	((d ² ₋) ₂ , (d ¹ ₊) _{5/2}) _{5/2}	8	((d ¹ ₋) _{3/2} , (d ² ₊) ₄) _{7/2}	18.942	18.9643	18.9404	18.9797	3.31E+06	3.27E+06	3.29E+06
72	Sc	5	((d ² ₋) ₂ , (d ¹ ₊) _{5/2}) _{9/2}	12	((d ¹ ₋) _{3/2} , (d ² ₊) ₄) _{11/2}	17.873	17.8904	17.8629	17.8904	9.64E+05	9.51E+05	9.60E+05
72	Ti	1	(d ⁴ ₋) ₀	2	((d ³ ₋) _{3/2} , (d ¹ ₊) _{5/2}) ₁	22.325	22.3714	22.2998	22.4327	2.19E+06	2.17E+06	2.17E+06
72	Ti	2	((d ³ ₋) _{3/2} , (d ¹ ₊) _{5/2}) ₁	7	((d ² ₋) ₂ , (d ² ₊) ₄) ₂	19.148	19.1734	19.1555	19.1681	3.15E+06	3.12E+06	3.13E+06
72	Ti	3	((d ³ ₋) _{3/2} , (d ¹ ₊) _{5/2}) ₄	8	((d ² ₋) ₂ , (d ² ₊) ₄) ₄	22.502	22.5607	22.4933	22.6346	2.00E+06	1.98E+06	1.98E+06
72	Ti	3	((d ³ ₋) _{3/2} , (d ¹ ₊) _{5/2}) ₄	10	((d ² ₋) ₂ , (d ² ₊) ₄) ₅	20.41	20.4289	20.3862	20.4503	1.10E+06	1.09E+06	1.10E+06
72	Ti	3	((d ³ ₋) _{3/2} , (d ¹ ₊) _{5/2}) ₄	13	((d ² ₋) ₂ , (d ² ₊) ₂) ₃	18.043	18.0640	18.0669	18.0451	1.19E+06	1.17E+06	1.19E+06

Z	Sequence	i	Lower level	j	Upper Level	Wavelengths (nm) Exp.	MCDHF/RCI	MBPT	RCI	MCDHF/RCI	MBPT	RCI
Transition rates (s ⁻¹)												
72	Ti	5	$((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2})_{3/3}$	17	$((d_{-}^2)_{0}, (d_{+}^2)_{4/4})$	15.105	15.1183	15.1177	15.0733	7.51E + 05	7.44E + 05	7.48E + 05
72	V	1	$(d_{+}^1)_{5/2}$	2	$((d_{-}^3)_{3/2}, (d_{+}^2)_{4/5/2})$	24.711	24.7703	24.6778	24.8671	2.22E + 06	2.21E + 06	2.19E + 06
72	V	1	$(d_{+}^1)_{5/2}$	3	$((d_{-}^3)_{3/2}, (d_{+}^2)_{4/7/2})$	20.114	20.1316	20.1022	20.1278	1.06E + 06	1.05E + 06	1.05E + 06
72	V	1	$(d_{+}^1)_{5/2}$	5	$((d_{-}^3)_{3/2}, (d_{+}^2)_{2/3/2})$	19.583	19.6129	19.6010	19.6141	2.55E + 06	2.52E + 06	2.54E + 06
72	V	1	$(d_{+}^1)_{5/2}$	9	$((d_{-}^3)_{3/2}, (d_{+}^2)_{2/7/2})$	16.275	16.2766	16.2857	16.2253	8.17E + 04	8.23E + 04	8.31E + 04
72	V	1	$(d_{+}^1)_{5/2}$	10	$((d_{-}^3)_{3/2}, (d_{+}^2)_{0/3/2})$	13.487	13.4978	13.5045	13.4510	1.83E + 05	1.81E + 05	1.82E + 05
72	Cr	1	$(d_{+}^2)_{4/4}$	4	$((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2/3})$	22.754	22.8141	22.7666	22.8747	1.69E + 06	1.69E + 06	1.69E + 06
72	Cr	1	$(d_{+}^2)_{4/4}$	5	$((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2/4})$	22.091	22.1224	22.0820	22.1559	2.01E + 06	2.00E + 06	2.00E + 06
72	Cr	1	$(d_{+}^2)_{4/4}$	7	$((d_{-}^3)_{3/2}, (d_{+}^3)_{9/2/5})$	19.437	19.4421	19.4284	19.4248	4.38E + 05	4.35E + 05	4.35E + 05
72	Cr	1	$(d_{+}^2)_{4/4}$	10	$((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2/3})$	17.3	17.3209	17.3281	17.2838	7.08E + 05	6.96E + 05	7.07E + 05
72	Cr	2	$(d_{+}^2)_{2/2}$	9	$((d_{-}^3)_{3/2}, (d_{+}^3)_{3/2/2})$	19.721	19.7402	19.7302	19.7351	1.36E + 06	1.35E + 06	1.35E + 06
72	Mn	1	$(d_{+}^3)_{9/2}$	4	$((d_{-}^3)_{3/2}, (d_{+}^4)_{4/7/2})$	21.687	21.7405	21.7103	21.7903	2.39E + 06	2.38E + 06	2.38E + 06
72	Mn	1	$(d_{+}^3)_{9/2}$	5	$((d_{-}^3)_{3/2}, (d_{+}^4)_{4/9/2})$	19.403	19.4266	19.4164	19.4231	1.52E + 06	1.51E + 06	1.51E + 06
72	Mn	1	$(d_{+}^3)_{9/2}$	9	$((d_{-}^3)_{3/2}, (d_{+}^4)_{4/11/2})$	17.263	17.2679	17.2693	17.2267	1.28E + 05	1.27E + 05	1.28E + 05
72	Mn	2	$(d_{+}^3)_{3/2}$	7	$((d_{-}^3)_{3/2}, (d_{+}^4)_{4/5/2})$	21.916	21.9653	21.8980	21.9934	6.83E + 05	6.82E + 05	6.80E + 05
72	Mn	2	$(d_{+}^3)_{3/2}$	8	$((d_{-}^3)_{3/2}, (d_{+}^4)_{2/1/2})$	21.39	21.4335	21.4048	21.4662	1.73E + 06	1.71E + 06	1.72E + 06
72	Mn	3	$(d_{+}^3)_{5/2}$	10	$((d_{-}^3)_{3/2}, (d_{+}^4)_{2/7/2})$	20.851	20.8608	20.8495	20.8488	1.85E + 05	1.84E + 05	1.84E + 05
72	Fe	1	$(d_{+}^4)_{4/4}$	4	$((d_{-}^3)_{3/2}, (d_{+}^5)_{5/2/3})$	21.775	21.8228	21.7979	21.8812	2.16E + 06	2.15E + 06	2.15E + 06

Z	Sequence	i	Lower level	j	Upper Level	Wavelengths (nm)			Transition rates (s ⁻¹)			
						Exp.	MCDHF/RCI	MBPT	RCI	MCDHF/RCI	MBPT	RCI
72	Fe	1	(d ⁴) ₄	7	((d ⁻ _{3/2} , (d ⁵) _{5/2}) ₄	17.424	17.4403	17.4455	17.3934	6.91E + 05	6.86E + 05	6.90E + 05
72	Fe	2	(d ⁴) ₂	5	((d ⁻ _{3/2} , (d ⁵) _{5/2}) ₂	21.652	21.6939	21.6608	21.7390	1.30E + 06	1.29E + 06	1.29E + 06
72	Fe	2	(d ⁴) ₂	6	((d ⁻ _{3/2} , (d ⁵) _{5/2}) ₁	19.929	19.9670	19.9452	19.9516	1.15E + 06	1.15E + 06	1.15E + 06
72	Co	1	(d ⁵) _{5/2}	2	(d ⁻ _{3/2})	21.229	21.2726	21.2529	21.3176	1.66E + 06	1.65E + 06	1.65E + 06
73	K	1	(d ⁻ _{3/2})	2	(d ⁺ _{5/2})	17.015	17.0438	17.0142	17.0662	2.15E + 06	2.10E + 06	2.14E + 06
73	Ca	1	(d ⁻ ₂)	3	((d ⁻ _{3/2} , (d ⁺ _{5/2}) ₃)	18.25	18.2812	18.2417	18.3192	3.04E + 06	2.99E + 06	3.02E + 06
73	Ca	1	(d ⁻ ₂)	4	((d ⁻ _{3/2} , (d ⁺ _{5/2}) ₂)	15.885	15.9067	15.8993	15.9086	1.50E + 06	1.46E + 06	1.49E + 06
73	Ca	2	(d ⁻ ₀)	6	((d ⁻ _{3/2} , (d ⁺ _{5/2}) ₁)	20.598	20.6330	20.5828	20.6941	1.41E + 06	1.39E + 06	1.40E + 06
73	Sc	1	(d ⁻ _{3/2})	2	((d ⁻ ₂ , (d ⁺ _{5/2}) _{5/2})	20.247	20.2837	20.2285	20.3630	2.80E + 06	2.77E + 06	2.78E + 06
73	Sc	1	(d ⁻ _{3/2})	3	((d ⁻ ₂ , (d ⁺ _{5/2}) _{3/2})	18.377	18.4059	18.3783	18.4346	2.26E + 06	2.22E + 06	2.24E + 06
73	Sc	1	(d ⁻ _{3/2})	6	((d ⁻ ₂ , (d ⁺ _{5/2}) _{1/2})	17.053	17.0758	17.0674	17.0818	8.43E + 05	8.29E + 05	8.37E + 05
73	Sc	1	(d ⁻ _{3/2})	7	((d ⁻ ₀ , (d ⁺ _{5/2}) _{5/2})	12.987	12.9919	12.9942	12.9603	2.31E + 05	2.27E + 05	2.31E + 05
73	Sc	2	((d ⁻ ₂ , (d ⁺ _{5/2}) _{5/2})	8	((d ⁻ _{3/2} , (d ²) _{4/7/2})	17.758	17.7799	17.7588	17.8065	4.04E + 06	3.99E + 06	4.01E + 06
73	Ti	1	(d ⁺ ₀)	2	((d ⁻ _{3/2} , (d ⁺ _{5/2}) ₁)	20.75	20.7928	20.7313	20.8492	2.71E + 06	2.68E + 06	2.69E + 06
73	Ti	3	((d ⁻ _{3/2} , (d ⁺ _{5/2}) ₄)	10	((d ⁻ ₂ , (d ⁺ _{4/5})	19.073	19.0929	19.0558	19.1147	1.36E + 06	1.34E + 06	1.35E + 06
73	Ti	5	((d ⁻ _{3/2} , (d ⁺ _{5/2}) ₃)	17	((d ⁻ ₀ , (d ⁺ _{4/4})	14.303	14.3092	14.3086	14.2704	9.08E + 05	8.98E + 05	9.03E + 05
73	V	1	(d ⁺ _{5/2})	2	((d ⁻ _{3/2} , (d ²) _{4/5/2})	22.869	22.9255	22.8460	23.0137	2.76E + 06	2.75E + 06	2.73E + 06
73	V	1	(d ⁺ _{5/2})	3	((d ⁻ _{3/2} , (d ⁺ _{4/7/2})	18.841	18.8575	18.8314	18.8579	1.31E + 06	1.30E + 06	1.30E + 06

Z	Sequence	i	Lower level	j	Upper Level	Wavelengths (nm)		MBPT	RCI	Transition rates (s ⁻¹)		RCI
						Exp.	MCDHF/RCI			MCDHF/RCI	MBPT	
73	V	1	$(d^1_{+})_{5/2}$	5	$((d^3_{-})_{3/2}, (d^2_{+})_{2/3/2})$	18.352	18.3799	18.3689	18.3840	3.10E+06	3.07E+06	3.09E+06
73	V	1	$(d^1_{+})_{5/2}$	9	$((d^3_{-})_{3/2}, (d^2_{+})_{2/7/2})$	15.374	15.3752	15.3831	15.3315	9.86E+04	9.94E+04	1.00E+05
73	V	1	$(d^1_{+})_{5/2}$	10	$((d^3_{-})_{3/2}, (d^2_{+})_{0/3/2})$	12.787	12.7952	12.8014	12.7531	2.17E+05	2.14E+05	2.16E+05
73	V	4	$((d^3_{-})_{3/2}, (d^2_{+})_{4/11/2})$	13	$((d^2_{-})_{2}, (d^3_{+})_{9/2/11/2})$	20.368	20.4055	20.3697	20.4465	1.90E+06	1.88E+06	1.88E+06
73	V	4	$((d^3_{-})_{3/2}, (d^2_{+})_{4/11/2})$	15	$((d^2_{-})_{2}, (d^3_{+})_{9/2/13/2})$	18.841	18.8289	18.8069	18.8432	4.25E+05	4.23E+05	4.23E+05
73	Cr	1	$(d^2_{+})_{4}$	4	$((d^3_{-})_{3/2}, (d^2_{+})_{9/2/3})$	21.144	21.1991	21.1583	21.2545	2.09E+06	2.08E+06	2.08E+06
73	Cr	1	$(d^2_{+})_{4}$	5	$((d^3_{-})_{3/2}, (d^2_{+})_{9/2/4})$	20.602	20.6352	20.5997	20.6685	2.47E+06	2.46E+06	2.46E+06
73	Cr	1	$(d^2_{+})_{4}$	8	$((d^3_{-})_{3/2}, (d^2_{+})_{9/2/5})$	18.242	18.2491	18.2370	18.2370	5.38E+05	5.35E+05	5.35E+05
73	Cr	1	$(d^2_{+})_{4}$	10	$((d^3_{-})_{3/2}, (d^2_{+})_{3/2/3})$	16.286	16.3183	16.3246	16.2870	8.48E+05	8.35E+05	8.47E+05
73	Cr	1	$(d^2_{+})_{4}$	12	$((d^3_{-})_{3/2}, (d^2_{+})_{5/2/4})$	13.861	13.8689	13.8786	13.8207	3.17E+04	3.11E+04	3.13E+04
73	Cr	1	$(d^2_{+})_{4}$	15	$((d^3_{-})_{3/2}, (d^2_{+})_{5/2/3})$	13.462	13.4634	13.4812	13.3992	3.43E+05	3.40E+05	3.39E+05
73	Cr	2	$(d^2_{+})_{2}$	6	$((d^3_{-})_{3/2}, (d^3_{+})_{3/2/1})$	22.214	22.2728	22.2039	22.3583	2.69E+06	2.68E+06	2.66E+06
73	Cr	2	$(d^2_{+})_{2}$	9	$((d^3_{-})_{3/2}, (d^2_{+})_{3/2/2})$	18.486	18.5089	18.4999	18.5076	1.66E+06	1.65E+06	1.66E+06
73	Cr	2	$(d^2_{+})_{2}$	15	$((d^3_{-})_{3/2}, (d^2_{+})_{5/2/3})$	14.665	14.6679	14.6696	14.6071	4.07E+05	4.05E+05	4.07E+05
73	Mn	1	$(d^3_{+})_{9/2}$	4	$((d^3_{-})_{3/2}, (d^4_{+})_{4/7/2})$	20.215	20.2708	20.2444	20.3167	2.93E+06	2.92E+06	2.92E+06
73	Mn	1	$(d^3_{+})_{9/2}$	5	$((d^3_{-})_{3/2}, (d^4_{+})_{4/9/2})$	18.21	18.2331	18.2240	18.2328	1.85E+06	1.84E+06	1.85E+06
73	Mn	1	$(d^3_{+})_{9/2}$	9	$((d^3_{-})_{3/2}, (d^4_{+})_{4/11/2})$	16.281	16.2870	16.2883	16.2525	1.56E+05	1.55E+05	1.56E+05
73	Mn	2	$(d^3_{+})_{3/2}$	7	$((d^3_{-})_{3/2}, (d^4_{+})_{4/5/2})$	20.417	20.4617	20.4038	20.4889	8.43E+05	8.41E+05	8.38E+05

Z	Sequence	i	Lower level	j	Upper Level	Wavelengths (nm)		MBPT	RCI	Transition rates (s ⁻¹)		RCI
						Exp.	MCDHF/RCI			MCDHF/RCI	MBPT	
73	Mn	2	$(d^3_+)^{3/2}$	8	$((d^3_-)^{3/2}, (d^4_+)^{1/2})_{1/2}$	19.968	20.0099	19.9848	20.0415	2.12E+06	2.10E+06	2.11E+06
73	Mn	3	$(d^3_+)^{5/2}$	6	$((d^3_-)^{3/2}, (d^4_+)^{3/2})_{3/2}$	23.938	23.9906	23.9391	24.0887	1.39E+06	1.38E+06	1.38E+06
73	Mn	3	$(d^3_+)^{5/2}$	7	$((d^3_-)^{3/2}, (d^4_+)^{5/2})_{5/2}$	23.031	23.0724	23.0231	23.1203	7.07E+05	7.04E+05	7.00E+05
73	Mn	3	$(d^3_+)^{5/2}$	10	$((d^3_-)^{3/2}, (d^4_+)^{7/2})_{7/2}$	19.508	19.5194	19.5097	19.5120	2.29E+05	2.28E+05	2.28E+05
73	Mn	3	$(d^3_+)^{5/2}$	11	$((d^3_-)^{3/2}, (d^4_+)^{5/2})_{5/2}$	18.169	18.1813	18.1837	18.1220	7.03E+05	7.00E+05	7.02E+05
73	Mn	5	$((d^2_-)^{3/2}, (d^4_+)^{9/2})_{9/2}$	15	$((d^2_-)^{3/2}, (d^5_+)^{5/2})_{5/2}$	17.64	17.6631	17.6584	17.6608	1.81E+06	1.79E+06	1.81E+06
73	Fe	1	$(d^4_+)^4$	4	$((d^3_-)^{3/2}, (d^5_+)^{5/2})_{3/2}$	20.322	20.3645	20.3426	20.4182	2.65E+06	2.64E+06	2.64E+06
73	Fe	1	$(d^4_+)^4$	7	$((d^3_-)^{3/2}, (d^5_+)^{5/2})_{5/2}$	16.436	16.4494	16.4539	16.4099	8.38E+05	8.32E+05	8.37E+05
73	Fe	2	$(d^4_+)^2$	5	$((d^3_-)^{3/2}, (d^5_+)^{5/2})_{5/2}$	20.204	20.2436	20.2149	20.2858	1.60E+06	1.59E+06	1.59E+06
73	Fe	2	$(d^4_+)^2$	6	$((d^3_-)^{3/2}, (d^5_+)^{5/2})_{5/2}$	18.667	18.7019	18.6827	18.6907	1.41E+06	1.40E+06	1.40E+06
73	Co	1	$(d^5_+)^{5/2}$	2	$(d^3_-)^{3/2}$	19.843	19.8810	19.8638	19.9229	2.04E+06	2.02E+06	2.02E+06
74	K	1	$(d^1_-)^{3/2}$	2	$(d^1_+)^{5/2}$	15.962	15.9860	15.9602	16.0030	2.61E+06	2.55E+06	2.59E+06
74	Ca	1	$(d^2_-)^2$	3	$((d^1_-)^{3/2}, (d^1_+)^{5/2})_{5/2}$	17.08	17.1050	17.0707	17.1470	3.70E+06	3.64E+06	3.68E+06
74	Ca	1	$(d^2_-)^2$	4	$((d^1_-)^{3/2}, (d^1_+)^{5/2})_{5/2}$	14.959	14.9768	14.9701	14.9840	1.82E+06	1.77E+06	1.81E+06
74	Ca	2	$(d^2_-)^0$	6	$((d^1_-)^{3/2}, (d^1_+)^{5/2})_{5/2}$	19.177	19.2038	19.1605	19.2810	1.74E+06	1.71E+06	1.72E+06
74	Sc	1	$(d^3_-)^{3/2}$	2	$((d^2_-)^2, (d^1_+)^{5/2})_{5/2}$	18.867	18.8973	18.8498	18.9710	3.44E+06	3.39E+06	3.41E+06
74	Sc	1	$(d^3_-)^{3/2}$	3	$((d^2_-)^2, (d^1_+)^{5/2})_{5/2}$	17.216	17.2403	17.2158	17.2710	2.76E+06	2.72E+06	2.74E+06
74	Sc	1	$(d^3_-)^{3/2}$	6	$((d^2_-)^2, (d^1_+)^{5/2})_{5/2}$	16.027	16.0454	16.0378	16.0560	1.03E+06	1.01E+06	1.02E+06

Z	Sequence	i	Lower level	j	Upper Level	Wavelengths (nm)		MBPT	RCI	Transition rates (s ⁻¹)		RCI
						Exp.	MCDHF/RCI			MCDHF/RCI	MBPT	
74	Sc	1	$(d_{-}^3)_{3/2}$	7	$((d_{-}^2)_{0'}, (d_{+}^1)_{5/2, 5/2})$	12.312	12.3166	12.3188	12.2910	2.76E+05	2.71E+05	2.75E+05
74	Sc	4	$((d_{-}^2)_{2'}, (d_{+}^1)_{5/2, 9/2})$	12	$((d_{-}^1)_{3/2}, (d_{+}^2)_{4, 11/2})$	15.785	15.7987	15.7778	15.8120	1.42E+06	1.40E+06	1.42E+06
74	Ti	1	$(d_{+}^4)_{0}$	2	$((d_{-}^3)_{3/2}, (d_{+}^1)_{5/2, 1})$	19.319	19.3548	19.3020	19.4270	3.34E+06	3.31E+06	3.31E+06
74	Ti	2	$((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2, 1})$	7	$((d_{-}^2)_{1/2}, (d_{+}^2)_{4, 2})$	16.89	16.9090	16.8940	16.9220	4.73E+06	4.68E+06	4.70E+06
74	Ti	3	$((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2, 4})$	8	$((d_{-}^2)_{1/2}, (d_{+}^2)_{4, 4})$	19.445	19.4927	19.4430	19.5680	3.04E+06	3.01E+06	3.02E+06
74	Ti	3	$((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2, 4})$	10	$((d_{-}^2)_{1/2}, (d_{+}^2)_{4, 5})$	17.846	17.8632	17.8312	17.9050	1.66E+06	1.64E+06	1.65E+06
74	Ti	5	$((d_{-}^2)_{3/2}, (d_{+}^1)_{5/2, 3})$	17	$((d_{-}^2)_{0'}, (d_{+}^2)_{4, 4})$	13.543	13.5495	13.5490	13.5210	1.09E+06	1.08E+06	1.09E+06
74	V	1	$(d_{+}^1)_{5/2}$	2	$((d_{-}^3)_{3/2}, (d_{+}^2)_{4, 5/2})$	21.203	21.2535	21.1852	21.3700	3.43E+06	3.41E+06	3.40E+06
74	V	1	$(d_{+}^1)_{5/2}$	3	$((d_{-}^3)_{3/2}, (d_{+}^2)_{4, 7/2})$	17.66	17.6783	17.6552	17.7090	1.61E+06	1.59E+06	1.59E+06
74	V	1	$(d_{+}^1)_{5/2}$	5	$((d_{-}^3)_{3/2}, (d_{+}^2)_{2, 3/2})$	17.215	17.2384	17.2284	17.2600	3.77E+06	3.72E+06	3.75E+06
74	V	1	$(d_{+}^1)_{5/2}$	9	$((d_{-}^3)_{3/2}, (d_{+}^2)_{2, 7/2})$	14.531	14.5301	14.5370	14.5110	1.19E+05	1.20E+05	1.21E+05
74	V	4	$((d_{-}^3)_{3/2}, (d_{+}^2)_{4, 11/2})$	13	$((d_{-}^2)_{1/2}, (d_{+}^3)_{9/2, 11/2})$	18.996	19.0336	19.0026	19.0980	2.33E+06	2.31E+06	2.31E+06
74	Cr	1	$(d_{+}^2)_{4}$	4	$((d_{-}^3)_{3/2}, (d_{+}^2)_{9/2, 3})$	19.684	19.7281	19.6930	19.7910	2.58E+06	2.56E+06	2.56E+06
74	Cr	1	$(d_{+}^2)_{4}$	5	$((d_{-}^3)_{3/2}, (d_{+}^2)_{9/2, 4})$	19.239	19.2681	19.2371	19.3170	3.04E+06	3.02E+06	3.02E+06
74	Cr	1	$(d_{+}^2)_{4}$	8	$((d_{-}^3)_{3/2}, (d_{+}^2)_{9/2, 5})$	17.133	17.1417	17.1312	17.1530	6.60E+05	6.56E+05	6.57E+05
74	Cr	1	$(d_{+}^2)_{4}$	10	$((d_{-}^3)_{3/2}, (d_{+}^2)_{3/2, 3})$	15.363	15.3832	15.3889	15.3630	1.01E+06	9.98E+05	1.01E+06
74	Cr	1	$(d_{+}^2)_{4}$	12	$((d_{-}^3)_{3/2}, (d_{+}^2)_{5/2, 4})$	13.137	13.1442	13.1531	13.1050	3.81E+04	3.73E+04	3.68E+04
74	Cr	1	$(d_{+}^2)_{4}$	15	$((d_{-}^3)_{3/2}, (d_{+}^2)_{5/2, 3})$	12.779	12.7842	12.8000	12.6850	4.09E+05	4.07E+05	4.05E+05

Z	Sequence	i	Lower level	j	Upper Level	Wavelengths (nm)		MBPT	RCI	Transition rates (s ⁻¹)		RCI
						Exp.	MCDHF/RCI			MCDHF/RCI	MBPT	
74	Cr	2	(d ² ₊) ₂	13	((d ³ ₋) _{3/2} , (d ³ ₊) _{5/2,2})	14.193	14.2079	14.2023	14.1760	3.21E+05	3.21E+05	3.20E+05
74	Cr	2	(d ² ₊) ₂	15	((d ³ ₋) _{3/2} , (d ³ ₊) _{5/2,3})	13.886	13.8935	13.8950	13.8480	4.92E+05	4.89E+05	4.92E+05
74	Cr	3	(d ² ₊) ₀	14	((d ³ ₋) _{3/2} , (d ³ ₊) _{5/2,1})	17.826	17.8391	17.8371	17.8230	1.33E+06	1.32E+06	1.32E+06
74	Mn	1	(d ³ ₊) _{9/2}	4	((d ³ ₋) _{3/2} , (d ⁴ ₊) _{4,7/2})	18.88	18.9240	18.9011	18.9720	3.59E+06	3.57E+06	3.57E+06
74	Mn	1	(d ³ ₊) _{9/2}	5	((d ³ ₋) _{3/2} , (d ⁴ ₊) _{4,9/2})	17.106	17.1262	17.1181	17.1370	2.25E+06	2.24E+06	2.23E+06
74	Mn	1	(d ³ ₊) _{9/2}	9	((d ³ ₋) _{3/2} , (d ⁴ ₊) _{4,11/2})	15.368	15.3703	15.3716	15.3540	1.90E+05	1.89E+05	1.89E+05
74	Mn	1	(d ³ ₊) _{9/2}	10	((d ³ ₋) _{3/2} , (d ⁴ ₊) _{2,7/2})	14.166	14.1775	14.1873	14.1390	1.74E+05	1.71E+05	1.76E+05
74	Mn	2	(d ³ ₊) _{3/2}	7	((d ³ ₋) _{3/2} , (d ⁴ ₊) _{4,5/2})	19.047	19.0872	19.0374	19.1270	1.04E+06	1.03E+06	1.03E+06
74	Mn	2	(d ³ ₊) _{3/2}	8	((d ³ ₋) _{3/2} , (d ⁴ ₊) _{2,1/2})	18.67	18.7023	18.6805	18.7410	2.59E+06	2.57E+06	2.56E+06
74	Mn	3	(d ³ ₊) _{5/2}	10	((d ³ ₋) _{3/2} , (d ⁴ ₊) _{2,7/2})	18.276	18.2819	18.2738	18.3030	2.83E+05	2.81E+05	2.72E+05
74	Fe	1	(d ⁴ ₊) ₄	4	((d ³ ₋) _{3/2} , (d ⁵ ₊) _{5/2,3})	18.988	19.0258	19.0067	19.0750	3.24E+06	3.23E+06	3.22E+06
74	Fe	1	(d ⁴ ₊) ₄	7	((d ³ ₋) _{3/2} , (d ⁵ ₊) _{5/2,4})	15.511	15.5232	15.5272	15.5250	1.01E+06	1.01E+06	1.01E+06
74	Fe	2	(d ⁴ ₊) ₂	5	((d ³ ₋) _{3/2} , (d ⁵ ₊) _{5/2,2})	18.878	18.9131	18.8884	18.9560	1.95E+06	1.94E+06	1.93E+06
74	Fe	2	(d ⁴ ₊) ₂	6	((d ³ ₋) _{3/2} , (d ⁵ ₊) _{5/2,1})	17.502	17.5338	17.5170	17.4890	1.72E+06	1.71E+06	1.71E+06
74	Co	1	(d ⁵ ₊) _{5/2}	2	(d ³ ₋) _{3/2}	18.567	18.6007	18.5858	18.6400	2.48E+06	2.47E+06	2.47E+06
79	K	1	(d ¹ ₋) _{3/2}	2	(d ¹ ₊) _{5/2}	11.75	11.7682	11.7555	11.7861	6.52E+06	6.38E+06	6.49E+06
79	Ca	1	(d ² ₋) ₂	3	((d ¹ ₋) _{3/2} , (d ¹ ₊) _{5/2,3})	12.444	12.4612	12.4445	12.4874	9.41E+06	9.26E+06	9.35E+06
79	Ca	1	(d ² ₋) ₂	4	((d ¹ ₋) _{3/2} , (d ¹ ₊) _{5/2,2})	11.189	11.2012	11.1976	11.2089	4.51E+06	4.41E+06	4.49E+06

Z	Sequence	i	Lower level	j	Upper Level	Wavelengths (nm) Exp.	MCDHF/RCI	MBPT	RCI	MCDHF/RCI	Transition rates (s ⁻¹) MBPT	RCI
79	Ca	2	$(d_{-}^{2})_{0}$	6	$((d_{-}^{1})_{3/2}, (d_{+}^{1})_{5/2})_{1}$	13.656	13.6802	13.6594	13.7184	4.68E+06	4.60E+06	4.65E+06
79	Sc	1	$(d_{-}^{3})_{3/2}$	2	$((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2})_{5/2}$	13.501	13.5211	13.4987	13.5597	9.06E+06	8.94E+06	8.98E+06
79	Sc	1	$(d_{-}^{3})_{3/2}$	3	$((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2})_{3/2}$	12.59	12.6024	12.5897	12.6212	7.19E+06	7.08E+06	7.14E+06
79	Sc	1	$(d_{-}^{3})_{3/2}$	6	$((d_{-}^{2})_{2}, (d_{+}^{1})_{5/2})_{1/2}$	11.887	11.8921	11.8880	11.9000	2.66E+06	2.62E+06	2.65E+06
79	Sc	1	$(d_{-}^{3})_{3/2}$	7	$((d_{-}^{2})_{0}, (d_{+}^{1})_{5/2})_{5/2}$	9.502	9.5058	9.5078	9.4918	6.44E+05	6.34E+05	6.44E+05
79	Ti	1	$(d_{-}^{4})_{0}$	2	$((d_{-}^{2})_{3/2}, (d_{+}^{1})_{5/2})_{1}$	13.781	13.8026	13.7777	13.8384	8.96E+06	8.87E+06	8.89E+06
79	Ti	3	$((d_{-}^{2})_{3/2}, (d_{+}^{1})_{5/2})_{4}$	10	$((d_{-}^{2})_{2}, (d_{+}^{2})_{4})_{5}$	12.991	12.9991	12.9839	13.0196	4.33E+06	4.29E+06	4.30E+06
79	Ti	3	$((d_{-}^{2})_{3/2}, (d_{+}^{1})_{5/2})_{4}$	13	$((d_{-}^{2})_{2}, (d_{+}^{2})_{2})_{3}$	11.87	11.8756	11.8761	11.8770	4.41E+06	4.36E+06	4.39E+06
79	V	1	$(d_{+}^{1})_{5/2}$	2	$((d_{-}^{3})_{3/2}, (d_{+}^{2})_{4})_{5/2}$	14.862	14.8920	14.8598	14.9435	9.46E+06	9.41E+06	9.34E+06
79	V	1	$(d_{+}^{1})_{5/2}$	3	$((d_{-}^{3})_{3/2}, (d_{+}^{2})_{4})_{7/2}$	12.947	12.9572	12.9455	12.9689	4.25E+06	4.21E+06	4.22E+06
79	V	1	$(d_{+}^{1})_{5/2}$	5	$((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2})_{3/2}$	12.647	12.6633	12.6578	12.6749	9.57E+06	9.47E+06	9.52E+06
79	V	1	$(d_{+}^{1})_{5/2}$	7	$((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2})_{5/2}$	11.509	11.5159	11.5158	11.5065	8.90E+04	8.55E+04	9.17E+04
79	V	1	$(d_{+}^{1})_{5/2}$	9	$((d_{-}^{3})_{3/2}, (d_{+}^{2})_{2})_{7/2}$	11.028	11.0308	11.0350	11.0158	2.93E+05	2.95E+05	2.96E+05
79	V	1	$(d_{+}^{1})_{5/2}$	10	$((d_{-}^{3})_{3/2}, (d_{+}^{2})_{0})_{3/2}$	9.387	9.3913	9.3957	9.3698	5.76E+05	5.70E+05	5.75E+05
79	V	4	$((d_{-}^{3})_{3/2}, (d_{+}^{2})_{4})_{11/2}$	13	$((d_{-}^{2})_{2}, (d_{+}^{3})_{9/2})_{11/2}$	13.652	13.6761	13.6612	13.7051	6.16E+06	6.10E+06	6.11E+06
79	Cr	1	$(d_{+}^{2})_{4}$	4	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{9/2})_{3}$	14.025	14.0524	14.0358	14.0868	6.89E+06	6.85E+06	6.85E+06
79	Cr	1	$(d_{+}^{2})_{4}$	5	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{9/2})_{4}$	13.869	13.8877	13.8723	13.9155	8.04E+06	8.00E+06	7.98E+06
79	Cr	1	$(d_{+}^{2})_{4}$	8	$((d_{-}^{3})_{3/2}, (d_{+}^{3})_{9/2})_{5}$	12.667	12.6726	12.6680	12.6774	1.74E+06	1.73E+06	1.73E+06

Z	Sequence	i	Lower level	j	Upper Level	Wavelengths (nm)		Transition rates (s ⁻¹)				
						Exp.	MCDHF/RCI	MBPT	RCI	MCDHF/RCI	MBPT	RCI
79	Cr	1	(d ² ₊) ₄	10	((d ³ ₋) _{3/2} , (d ³ ₊) _{3/2}) ₃	11.553	11.5593	11.5629	11.5501	2.40E+06	2.36E+06	2.39E+06
79	Cr	1	(d ² ₊) ₄	12	((d ³ ₋) _{3/2} , (d ³ ₊) _{5/2}) ₄	10.117	10.1213	10.1273	10.0994	9.00E+04	8.82E+04	8.98E+05
79	Cr	1	(d ² ₊) ₄	15	((d ³ ₋) _{3/2} , (d ³ ₊) _{5/2}) ₃	9.91	9.9146	9.9238	9.8848	9.66E+05	9.61E+05	9.56E+05
79	Cr	2	(d ² ₊) ₂	6	((d ³ ₋) _{3/2} , (d ³ ₊) _{3/2}) ₁	14.562	14.5929	14.5654	14.6410	9.07E+06	9.02E+06	8.98E+06
79	Cr	2	(d ² ₊) ₂	9	((d ³ ₋) _{3/2} , (d ³ ₊) _{3/2}) ₂	12.773	12.7899	12.7858	12.7997	5.23E+06	5.18E+06	5.20E+06
79	Cr	2	(d ² ₊) ₂	14	((d ³ ₋) _{3/2} , (d ³ ₊) _{5/2}) ₂	10.764	10.7725	10.7707	10.7550	7.45E+05	7.44E+05	7.40E+05
79	Cr	2	(d ² ₊) ₂	15	((d ³ ₋) _{3/2} , (d ³ ₊) _{5/2}) ₃	10.652	10.6545	10.6557	10.6295	1.22E+06	1.21E+06	1.22E+06
79	Mn	1	(d ³ ₊) _{9/2}	4	((d ³ ₋) _{3/2} , (d ⁴ ₊) _{4/2}) _{7/2}	13.627	13.6510	13.6399	13.6811	9.36E+06	9.31E+06	9.29E+06
79	Mn	1	(d ³ ₊) _{9/2}	5	((d ³ ₋) _{3/2} , (d ⁴ ₊) _{4/2}) _{9/2}	12.65	12.6637	12.6599	12.6728	5.73E+06	5.70E+06	5.70E+06
79	Mn	1	(d ³ ₊) _{9/2}	9	((d ³ ₋) _{3/2} , (d ⁴ ₊) _{4/2}) _{11/2}	11.598	11.6012	11.6029	11.5917	4.83E+05	4.80E+05	4.80E+05
79	Mn	1	(d ³ ₊) _{9/2}	10	((d ³ ₋) _{3/2} , (d ⁴ ₊) _{2/2}) _{7/2}	10.783	10.7968	10.8030	10.7761	3.90E+05	3.86E+05	3.89E+05
79	Mn	3	(d ³ ₊) _{5/2}	12	((d ³ ₋) _{3/2} , (d ⁴ ₊) _{0/2}) _{3/2}	10.541	10.5466	10.5526	10.5155	2.51E+06	2.49E+06	2.49E+06
79	Fe	1	(d ⁴ ₊) ₄	4	((d ³ ₋) _{3/2} , (d ⁵ ₊) _{5/2}) ₃	13.739	13.7630	13.7537	13.7943	8.44E+06	8.39E+06	8.38E+06
79	Fe	1	(d ⁴ ₊) ₄	6	((d ³ ₋) _{3/2} , (d ⁵ ₊) _{5/2}) ₄	11.707	11.7137	11.7165	11.6996	2.52E+06	2.51E+06	2.52E+06
79	Fe	2	(d ⁴ ₊) ₂	7	((d ³ ₋) _{3/2} , (d ⁵ ₊) _{5/2}) ₁	12.854	12.8744	12.8660	12.8748	4.40E+06	4.38E+06	4.38E+06
79	Fe	3	(d ⁴ ₊) ₀	7	((d ³ ₋) _{3/2} , (d ⁵ ₊) _{5/2}) ₁	16.61	16.6401	16.6155	16.6990	1.89E+06	1.88E+06	1.86E+06
79	Co	1	(d ⁵ ₊) _{5/2}	2	(d ³ ₋) _{3/2}	13.517	13.5392	13.5321	13.5678	6.43E+06	6.39E+06	6.38E+06

Table 4

Wavelengths (λ , in nm), transition rates (A , in s^{-1}), weighted oscillator strengths (gf , dimensionless) and line strengths (S , in atomic unit) with the uncertainties (in %), for 11 988 M1 transitions among all levels of the $3s^23p^63d^k$ ($k = 1-9$) ground configurations of highly charged ions ($Z = 72-83$). Table 4 is published in its entirety in the machine-readable format. The values for the K-like sequence are shown here for guidance regarding its form and content. See Explanation of Tables.

Sequence	Z	i	Lower level	j	Upper level	λ	A	gf	S	Unc.
K	72	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.8190E+00	1.77E+06	5.27E-05	2.37E+00	1.4
K	73	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.7044E+00	2.15E+06	5.62E-05	2.37E+00	1.5
K	74	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.5986E+00	2.61E+06	5.99E-05	2.37E+00	1.4
K	75	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.5009E+00	3.15E+06	6.38E-05	2.37E+00	1.4
K	76	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.4104E+00	3.79E+06	6.78E-05	2.37E+00	1.4
K	77	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.3266E+00	4.55E+06	7.21E-05	2.36E+00	1.2
K	78	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.2490E+00	5.45E+06	7.65E-05	2.36E+00	1.2
K	79	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.1768E+00	6.52E+06	8.12E-05	2.36E+00	1.2
K	80	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.1098E+00	7.77E+06	8.60E-05	2.36E+00	1.1
K	81	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.0474E+00	9.23E+06	9.11E-05	2.36E+00	1.1
K	82	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	9.8933E-01	1.10E+07	9.64E-05	2.36E+00	1.3
K	83	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	9.3517E-01	1.30E+07	1.02E-04	2.36E+00	1.2

Table 5

Wavelengths (λ , in nm), transition rates (A , in s^{-1}), weighted oscillator strengths (gf , dimensionless) and line strengths (S , in atomic unit) with the uncertainties (in %), for 18 192 E2 transitions among all levels of the $3s^23p^63d^k$ ($k = 1-9$) ground configurations of highly charged ions ($Z = 72-83$). Table 5 is published in its entirety in the machine-readable format. The values for the K-like sequence are shown here for guidance regarding its form and content. See Explanation of Tables.

Sequence	Z	i	Lower level	j	Upper level	λ	A	gf	S	Unc.
K	72	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.8190E+01	3.20E+02	9.52E-09	3.41E-04	1.7
K	73	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.7044E+01	4.14E+02	1.08E-08	3.19E-04	1.5
K	74	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.5986E+01	5.35E+02	1.23E-08	2.99E-04	1.5
K	75	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.5009E+01	6.88E+02	1.39E-08	2.81E-04	1.5
K	76	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.4104E+01	8.81E+02	1.58E-08	2.63E-04	1.4
K	77	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.3266E+01	1.12E+03	1.78E-08	2.47E-04	1.3
K	78	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.2490E+01	1.43E+03	2.01E-08	2.33E-04	1.4
K	79	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.1768E+01	1.81E+03	2.26E-08	2.19E-04	1.1
K	80	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.1098E+01	2.29E+03	2.53E-08	2.06E-04	1.2
K	81	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	1.0474E+01	2.88E+03	2.84E-08	1.95E-04	1.2
K	82	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	9.8933E+00	3.61E+03	3.18E-08	1.84E-04	1.2
K	83	1	$(d^-)_{3/2}^1$	2	$(d^+)_{5/2}^1$	9.3517E+00	4.52E+03	3.56E-08	1.73E-04	1.0