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Energy levels and transition probabilities for boron-like Fe XXII⋆,⋆⋆

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ABSTRACT

The Multiconfiguration Dirac-Fock method is used to calculate the energies of the 407 lowest levels in Fe XXII. These results are cross-checked using a suite of codes which employ the configuration interaction method on the basis set of transformed radial orbitals with variable parameters, and takes into account relativistic corrections in the Breit-Pauli approximation. Transition probabilities, oscillator and line strengths are presented for electric dipole (E1), electric quadrupole (E2) and magnetic dipole (M1) transitions among these levels. The total radiative transition probabilities, as well as the five largest values from each level be it of E1, M1, E2, M2, or E3 type, are also provided. Finally, the results are compared with data compiled by NIST.

Key words. atomic data

1. Introduction

Physical processes and conditions in astrophysical sources can be understood through the use of theoretical models to analyse high resolution spectral observations. In particular, X-ray spectra from iron L-shell ions are prominent candidates for astrophysics plasma diagnostics, as their emission lines are observed in the wavelength range from 6–18 Å, covered with large effective areas by X-ray telescopes on board the space observatories *Chandra* and *XMM-Newton*. Behar et al. (2001) identified Fe XXII lines in a spectrum of the Capella binary system obtained by the High Energy Transmission Grating Spectrometer on board *Chandra*, while Kinkhabwala et al. (2002) observed Fe XXII in the Seyfert 2 galaxy NGC 1068. To reliably analyse such spectra requires an accurate knowledge of wavelengths and radiative transition rates, obtained from calculations or experiment.

Numerous observations of boron-like iron have been previously reported in the X-ray spectra of the Sun (Doschek et al. 1973, 1981; Phillips et al. 1982; Fawcett et al. 1987; Phillips et al. 1996; McKenzie et al. 1985). Wargelin et al. (1998) have presented an analysis of the density sensitivity of Fe XXII L-shell lines in plasma obtained in the Princeton Large Torus tokamak. They analysed the intensity ratios of $4d_{5/2} - 2p_{3/2}$ and $4d_{3/2} - 2p_{1/2}$ lines using the HULLAC atomic physics package (Bar-Shalom et al. 2001). Recently, Chen et al. (2004) used a radiative-collisional model to predict the density of a plasma produced using the Electron Beam Ion Trap at Lawrence Livermore National Laboratory. They showed that the line ratios of the 2p−3d transitions in boron-like iron are sensitive to the electron density in the range $n_e = 10^{13}-10^{15}$ cm^{-3}. Earlier, electron-excitation rate calculations for 45 fine-structure levels, using the Breit-Pauli formulation of the R-matrix method, were performed by Zhang & Pradhan (1997). Badnell et al. (2001) used the AUTOSTRUCTURE code (Badnell 1986, 1997) to generate radial orbitals and atomic structure for 204-level close-coupling calculations in Fe XXII. A large set of energy levels is presented in the CHIANTI database at http://wwwsolar.nrl.navy.mil/chianti.html.

The aim of the present paper is extend our series of calculations for iron ions (Jonauskas et al. 2004a,b, 2005), by providing highly reliable energy levels and radiative transition rates for Fe XXII up to the $n = 5$ complex. We note that in photoionized plasmas these high-lying levels will not in general be populated via electron impact (although collisional redistribution among the levels may play a role), but rather by a range of processes including recombination and charge transfer (Savin 2001). Transitions in Fe XXII from high-lying levels having 5d electrons were observed by Fawcett et al. (1987) in a solar flare spectrum. Wargelin et al. (1998) identified transitions from $2s^24d^1$, $2s^12p^14p^1$, $2s^12p^15p^1$, $2s^25d^1$, $2s^12p^15d^1$ and $2s^26d^1$ configurations which are populated in a radiative-collisional model by electron collisions from metastable state.

In the present paper calculations are performed using the multiconfiguration Dirac-Fock (MCDF) approach. Energies of the lowest 407 levels, plus E1, E2 and M1 type radiative transition probabilities, as well as line and oscillator strengths among

⋆ Tables 1 to 5 are only available in electronic form at http://www.edpsciences.org
⋆⋆ Tables 6 to 8 are only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/455/1157

the levels of Fe XXII, are provided. The calculated results are compared with data compiled by NIST, as well as results obtained from other codes. The agreement between the length and velocity forms of electric transition operators is checked for the strongest transitions as an additional measure of the accuracy for the data obtained. The total radiative probabilities and five strongest probabilities required for calculating branching ratios of levels are presented as well.

2. Method of calculation

Results were obtained using the multiconfiguration Dirac-Fock (MCDF) method employed in the GRASP code of Grant et al. (1980) and Parpia et al. (1996) (http://www.am.qub.ac.uk/DARC). To cross-check our MCDF data, we used a code developed by Bogdanovich & Karpuškienė (1999), which adopts the configuration interaction (CI) method on the basis of transformed radial orbitals (TROs) with variable parameters, including relativistic effects in the Breit-Pauli approximation (CITRO).

2.1. MCDF approach

In the MCDF approach, intermediate coupling wavefunctions $\Psi_\gamma(J)$ are constructed by using an expansion of the form:

$$\Psi_\gamma(J) = \sum_\alpha c_\gamma(\alpha J)\,\Phi(\alpha J), \quad (1)$$

where configuration state functions (CSFs) $\Phi(\alpha J)$ are expressed as antisymmetrized products of two-component orbitals

$$\phi(r) = \frac{1}{r}\begin{pmatrix} P_{nlj}(r) & \chi_{ljm}(\hat{r}) \\ \mathrm{i}\,Q_{n\bar{l}j}(r) & \chi_{\bar{l}jm}(\hat{r}) \end{pmatrix}. \quad (2)$$

Here $P_{nlj}(r)$ and $Q_{n\bar{l}j}(r)$ are the large and small radial components of one-electron wavefunctions and $\chi_{ljm}(\hat{r})$ are the two component Pauli spherical spinors. Two-component orbitals are obtained as the self-consistent solutions of the Dirac-Fock equations systematically increasing CI basis. Direct and indirect relativistic effects, when the contraction of inner orbitals leads to more effective screening of the nucleus for valence orbitals, are included in the relativistic wavefunctions by solving MCDF equations.

The configuration mixing coefficients c_γ are obtained through diagonalization of the Dirac-Coulomb-Breit Hamiltonian:

$$H^{\mathrm{DF}} = \sum_i h_i^{\mathrm{D}} + \sum_{i<j} h_{ij}^{\mathrm{e}} + \sum_{i<j} h_{ij}^{\mathrm{trans}}, \quad (3)$$

where h_i^{D} is one-electron Dirac Hamiltonian, h_{ij}^{e} is the instantaneous Coulomb repulsion. The effects of the transverse interaction h_{ij}^{trans} that corresponds to the Breit interaction:

$$h_{ij}^{\mathrm{Breit}} = -\frac{\alpha_i\cdot\alpha_j}{2r_{ij}} - \frac{(\alpha_i\cdot r_{ij})(\alpha_j\cdot r_{ij})}{2r_{ij}^3} \quad (4)$$

in the low-frequency limit were evaluated in the first order of perturbation expansion. QED corrections, which include vacuum polarization and self-energy (known as the Lamb shift), are considered in the first order of perturbation theory.

One-electron excitations from the 2s and 2p orbitals of the $1s^22s^22p^1$, $1s^22s^12p^2$ and $1s^22p^3$ configurations up to the 8k orbital, as well as two- and three-electron excitations from orbitals with $n = 2$ to all possible combinations of two or three electrons in the shells up to $n = 3$, were employed to generate one-electron wavefunctions as a basis set for CSFs in the MCDF method. Additionally, to extend the CI basis and obtain higher accuracy, an additional 14 configurations with electrons in $n = 4$ are included, namely: $1s^22s^14s^2$, $1s^22s^14p^2$, $1s^22s^14d^2$, $1s^22s^14f^2$, $1s^22p^14s^2$, $1s^22p^14p^2$, $1s^22p^14d^2$, $1s^22p^14f^2$, $1s^22s^13p^14p^1$, $1s^22s^13p^14f^1$, $1s^23s^13p^14p^1$, $1s^23s^13p^14f^1$, $1s^22p^13p^14s^1$, $1s^22p^13p^14d^1$. The total number of CSFs in our MCDF calculations is 2253.

2.2. CITRO method

In the nonrelativistic, multiconfiguration Hartree-Fock approach, intermediate coupling wavefunctions $\Psi_\gamma(J)$ being eigenfunctions of Coulomb-Breit-Pauli Hamiltonian are expanded in terms of CSFs $\Phi(\alpha LS\,J)$ obtained in the $LS\,J$-coupling scheme:

$$\Psi_\gamma(J) = \sum_{\alpha LS} c_\gamma(\alpha LS\,J)\,\Phi(\alpha LS\,J) \quad (5)$$

CSFs are formed from a basis of one-electron spin orbitals:

$$\phi(r) = \frac{1}{r}P_{nl}(r)Y_{lm_l}(\vartheta,\phi)\chi_{m_s}. \quad (6)$$

The number of CSFs in the intermediate coupling wavefunction expansion (5) is limited. Hence transformed radial orbitals with variable parameters were proposed by Bogdanovich & Karpuškienė (1999) to mimic the correlation effects from omitted CSFs:

$$P_{nl}^{\mathrm{T}}(r) = N\left\{f(r)P_{nl}(r) - \sum_{n''<n} c_{n'',n}P_{n''l}(r)\right\}. \quad (7)$$

Here N is a normalization factor, $c_{n'',n}$ denotes the corresponding overlap integral, and $f(r)$ is a transforming function:

$$f(r) = r^k\exp(-Ar^m) \quad (8)$$

with variable parameters k, m and A ($k \geq 0$, $k \geq l - l'$, $m > 0$, $A > 0$). The variation of all parameters ensure the largest corrections of correlation energies obtained in the second order of perturbation theory using admixed configurations with excited electrons. A Schmidt orthogonalization procedure is employed for TROs in (7).

The Coulomb-Breit-Pauli Hamiltonian is used for our configuration interaction calculations which lead to the expansion coefficients $c_\gamma(\alpha LS\,J)$ and the corresponding energies for levels. This Hamiltonian includes spin-orbit h_i^{so}, spin-other-orbit h_{ij}^{soo} and spin-spin h_{ij}^{ss} corrections as well as orbit-orbit corrections h_{ij}^{oo} within a shell of equivalent electrons:

$$H^{\mathrm{BP}} = \sum_i\left(-\frac{1}{2}\nabla_i^2 - Z/r_i\right) + \sum_{i<j}\frac{1}{r_{ij}} + \sum_i h_i^{\mathrm{so}} + \sum_{i<j} h_{ij}^{\mathrm{soo}} + \sum_{i<j} h_{ij}^{\mathrm{ss}} + \sum_{i<j} h_{ij}^{\mathrm{oo}}, \quad (9)$$

where H^{BP} is expressed in atomic units. Orbit-orbit interactions between shells omitted in our CITRO calculations are usually smaller than within shells.

The frozen core approximation is used to obtain Hartree-Fock radial orbitals with $n \leq 7$. To include correlation effects from higher CSFs, the obtained basis is supplemented by TROs with principal quantum numbers $8 \leq n \leq 10$ and orbital quantum numbers $l \leq 7$. The large number of admixed configurations is reduced, leaving only configurations with significant influence on the energies of the adjusted configurations. For this, the method presented by Bogdanovich et al. (2002) and Bogdanovich & Momkauskaitė (2004) is adopted. The total number of CSFs with odd parity is 2115, and the number with even parity is 1987 in our CITRO calculations.

3. Results and discussion

In Table 1 we list energies of the 407 lowest levels of Fe XXII obtained with the GRASP code. These levels correspond to $1s^22s^22p^1$, $1s^22s^12p^2$, $1s^22p^3$, $1s^22s^23l$, $1s^22s^12p^13l$, $1s^22p^23l$, $1s^22s^24l'$, $1s^22s^12p^14l'$, $1s^22p^24l'$, $1s^22s^25l''$, $1s^22s^12p^15l''$, $1s^22s^26l'''$ ($l = 0, 1, 2$, $l' = 0, 1, 2, 3$, $l'' = 0, 1, 2, 3, 4$ and $l''' = 0, 1, 2, 3, 4, 5$) configurations. Energy levels are given in cm^{-1} relative to the ground state $1s^22s^22p^1\ ^2P_{0.5}$, along with the leading percentage compositions $c_\gamma(\alpha J)^2$ (where these exceed 10%) from the expansion relation Eq. (1) for intermediate coupling wavefunctions. The expansion coefficients for the intermediate coupling wavefunctions with CSFs presented in the LSJ-coupling scheme (5) are obtained from the expansion terms of intermediate coupling wavefunctions with CSFs presented in jj-coupling scheme (1). Diagonalization of Dirac-Coulomb-Breit matrix gives the expansion coefficients for intermediate coupling wavefunctions with CSFs constructed from two-component orbitals. The indices for the levels provided in the first column of Table 1 are used in all subsequent tables.

Some excited levels due to strong intermediate coupling are assigned to the same CSFs. In Table 2 new LSJ-coupling spectroscopic notations are proposed for the levels which have the same CSFs with primary contributions to the intermediate coupling wavefunctions. For this, the technique presented in our earlier paper for Fe XIX (Jonauskas et al. 2004b) is used.

In Table 3 we compare our calculated energy levels with values compiled by NIST (National Institute for Standards and Technology: `www.physics.nist.gov`) whose data are commonly used as a reference set. Fairly good agreement is obtained for the MCDF calculations, with the many energy levels agreeing to better than within 1% with the NIST recommended values. However, some excited energy levels (indices 29, 55, 59, 69, 74, 174 and 195) differ by up to 2% from NIST data. As well, our absolute values of energies for two levels (55 and 174) show the largest deviations from the NIST recommended values, while another five levels (29, 59, 69, 74 and 195) have MCDF absolute energies lower than those from NIST. To cross-check our results for these levels, we present data from CITRO calculations. For both our calculations, the highly excited levels show the similar discrepancies from NIST values. On the other hand, the MCDF energies of levels 174 ($1s^22s^12p^1$ (^3P) $4d^1\ ^2F_{3.5}$) and 195 ($1s^22s^12p^1$ (^1P) $4d^1\ ^2F_{3.5}$) show good agreement with NIST data after their values are interchanged. This suggests that there are some typographical errors in the NIST data for these levels. The calculated energies of level 29 ($1s^2\ 2s^1\ 2p^1(^3P)3p^1\ ^2P_{0.5}$) has similar discrepancies (~1.5%) for both calculations presented in Table 3, but our MCDF result is closer to the NIST recommended value. As well, our CITRO and MCDF calculations show the same percentage composition for the intermediate coupling wavefunction of the level. The energy of the $1s^2\ 2s^1\ 2p^1$ (^3P) $3p^1\ ^2P_{0.5}$ level (29) is lower than that of $1s^2\ 2s^1\ 2p^1$ (^3P) $3p^1\ ^2P_{1.5}$ (28) in the NIST data, while the ordering of both levels in our calculations is opposite to the NIST order. It suggests that a bigger CI basis may be required for the MCDF calculations to obtain better agreement with the NIST values for the level. However, the energy for the level obtained by Zhang & Pradhan (1997) with SUPERSTRUCTURE (Eissner et al. 1974), and the value provided by Badnell et al. (2001) from their AUTOSTRUCTURE (Badnell 1986, 1997) calculations show similar differences from NIST, and the same order as in our data.

For another five levels (55, 59, 69 and 74) with the largest discrepancies from NIST values, our MCDF and CITRO energies are in close agreement with the AUTOSTRUCTURE values of Badnell et al. (2001) and, in general, are slightly closer to the NIST data. Furthermore, as will be seen later, some transitions from those levels have largest discrepancies for line strengths compared with the NIST values. Additionally, our calculated lifetimes for the levels are presented in Table 3, to have an additional way to estimate the accuracy of our calculations. Differences between the calculated lifetimes for those levels is less than 10%, which confirm the accuracy of our results.

Energy levels and intermediate coupling wavefunctions calculated with the configuration interaction method have been employed to compute matrix elements of transition operators, which subsequently are adopted for the calculation of transition probabilities, line and oscillator strengths. The wavelengths and line strengths are presented in Table 4, where our transition data are compared with NIST results. All line strengths belong to E1 type transitions except one from the first excited level which corresponds to M1 type transition. E2 type transition from the level is much weaker (MCDF and NIST line strengths equal to 2.10×10^{-3} and 2.15×10^{-3} correspondingly). The length form is used for electric transitions, as they are less sensitive to the accuracy of wavefunction compared with results obtained in the velocity form of the transition operator. The wavelengths for many transitions agree to better than within 1% with the NIST data. The largest differences for the wavelengths are obtained for transitions between energy levels which showed largest discrepancies from NIST energies. The largest discrepancy for line strengths is observed for the weak transition ($f = 3 \times 10^{-5}$) from the $2s^12p^2\ ^2P_{0.5}$ level (8) to $2s^22p^1\ ^2P_{1.5}$ (2). The length and velocity forms differ by a factor of 3.5, while our calculated MCDF and CITRO line strengths coincide within 20% for the transition. Furthermore, the contribution of the transition to the lifetime of the level is very small. The line strengths for the transitions from $2s^24s^1\ ^2S_{0.5}$ (126) to the first and second levels of the ground configuration differ by 80% and 29%, respectively, from the NIST values, but are in the limits of uncertainties provided by NIST.

Additionally, large discrepancies are observed for some transitions from the above mentioned levels which showed the largest deviations for energy levels compared with the NIST values. The line strengths for transitions $55 \rightarrow 9$, $55 \rightarrow 10$, $59 \rightarrow 8$, $69 \rightarrow 8$, $74 \rightarrow 8$, $174 \rightarrow 7$ and $195 \rightarrow 7$ differ by 29% to up to a factor of 4. The contributions to the lifetimes of those dipole allowed transitions vary from 7% ($74 \rightarrow 8$) to 84% ($195 \rightarrow 7$) (Table 5). The large discrepancies observed for transitions from levels 174 and 195 can be explained by a typographical error in the NIST data. As in a case of energy levels, our line strengths and wavelengths for those transitions are in good agreement with the NIST line strengths, after the NIST values are interchanged. Finally, our MCDF results for all those transitions with large discrepancies with NIST line strengths are in close agreement with the CITRO ones. It is possible that the determination of all those energy levels is uncertain in the NIST database. Additionally, the fairly good agreement between length and velocity forms for all those transitions indicate that our transition characteristics are quite accurate and reliable.

Transition probabilities, line and oscillator strengths are calculated for radiative E1, E2, E3, M1 and M2 type transitions among the presented 407 energy levels of Fe XXII. We provide the transition wavelengths, probabilities, oscillator strengths and line strengths of E1, E2 and M1 type for Fe XXII in Tables 6-8. Only the strongest transitions are presented here for every type of transition: electric dipole transitions with $f \geq 0.001$, electric quadrupole with $f \geq 10^{-8}$ and magnetic dipole with $f \geq 10^{-8}$. The relation between length (Babushkin gauge in the relativistic approach) and velocity (Coulomb gauge) forms are provided for both electric transitions to have an additional indicator of accuracy of our MCDF results. The difference between both forms for many strong E1 type transitions ($f \geq 0.1$) does not exceed 20%. Only 4 transitions from highly excited levels have differences larger than 20% but less than 40%. On the other hand, the contribution of these transitions to the lifetimes of the levels is much smaller than 1%. Finally, the length and velocity forms of the strongest electric dipole transitions ($f \geq 0.1$) agree to better than within 10%, with an average deviation of only 1.8% for 457 transitions. For many E2 transitions, the two forms agree to better than within 10%.

In Table 5 we provide the five largest spontaneous radiative transition probabilities from each level, and the sum of all E1, E2, E3, M1 and M2 radiative transition probabilities from the corresponding level to all lower levels. The sums of radiative transition probabilities are important for branching ratios, while their inverse values are equal to the lifetimes of the levels. The contribution to the lifetimes of levels for many forbidden electric quadrupole and magnetic dipole transitions is negligible and does not exceed 1%. However, the highly excited $2s^1 2p^1$ (^{3}P) $3p^1$ $^4D_{0.5}$ (33) and $2p^2$ (^{1}D) $3d^1$ $^2G_{0.5}$ (114) levels decay primarily through E2 type transitions. For another two levels, i.e. $2p^2$ (^{3}P) $3d^1$ $^4D_{0.5}$ (97) and $2p^2$ (^{3}P) $3d^1$ $^4F_{0.5}$ (96), E2 type transitions contribute 48% and 46%, respectively. As well, the first excited level decays mainly due to magnetic dipole transition.

The forbidden transitions have been taken into account to obtain total radiative transition probabilities from levels. The total radiative probabilities allow estimates of the lifetimes of the presented states, and are also important for the calculation of branching ratios. It was found that the highly excited $2s^1 2p^1$ (^{3}P) $3p^1$ $^4D_{0.5}$ and $2p^2$ (^{1}D) $3d^1$ $^2G_{0.5}$ levels mainly decay due to forbidden E2 type transitions. Their contributions to the lifetimes of the $2p^2$ (^{3}P) $3d^1$ $^4D_{0.5}$ and $2p^2$ (^{3}P) $3d^1$ $^4F_{0.5}$ levels is 48% and 46%, respectively. The first excited level decays mainly through M1 type transition. For each level, the five strongest transition probabilities are presented.

To conclude, the comparison with the NIST recommended wavelengths and radiative transition data shows that all the presented theoretical results are reliable, and may be successfully used for the interpretation of astronomical and other spectral observations.

4. Conclusions

In this paper, energy levels, electric dipole, electric quadrupole and magnetic dipole radiative transition rates, oscillator and line strengths have been reported for the lowest 407 levels in Fe XXII in the MCDF approximation. The characteristics of the levels in the *LS J*-coupling scheme have been provided and checked for their completeness. Calculated values have been compared with NIST recommended values. Breit-Pauli energy levels and electric dipole transition characteristics in the basis set of transformed radial orbitals with variable parameters were used to cross-check the accuracy of our results. Likely typographical errors for Fe XXII have been found in both the NIST energy levels and transition characteristics for the highly excited $2s^1 2p^1$ (^{3}P) $4d^1$ $^2F_{3.5}$ and $2s^1 2p^1$ (^{1}P) $4d^1$ $^2F_{3.5}$ levels.

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Table 1. MCDF results for energy levels of Fe XXII. The energies of levels are presented relative to the ground energy. The leading percentage compositions (>10%) of levels are provided in the last column.

Index	Configuration	*LS*	*J*	*E* (cm^{-1})	Composition
1	$1s^2\ 2s^2\ 2p^1$	^2P	0.5	−192757192	98%
2	$1s^2\ 2s^2\ 2p^1$	^2P	1.5	117953	97%
3	$1s^2\ 2s^1\ 2p^2$	^4P	0.5	402902	96%
4	$1s^2\ 2s^1\ 2p^2$	^4P	1.5	458031	99%
5	$1s^2\ 2s^1\ 2p^2$	^4P	2.5	511295	94%
6	$1s^2\ 2s^1\ 2p^2$	^2D	1.5	741538	95%
7	$1s^2\ 2s^1\ 2p^2$	^2D	2.5	763743	94%
8	$1s^2\ 2s^1\ 2p^2$	^2P	0.5	861921	60% + 37% $1s^2\ 2s^1\ 2p^2\ ^2S$
9	$1s^2\ 2s^1\ 2p^2$	^2S	0.5	986277	59% + 39% $1s^2\ 2s^1\ 2p^2\ ^2P$
10	$1s^2\ 2s^1\ 2p^2$	^2P	1.5	1000692	95%
11	$1s^2\ 2p^3$	^4S	1.5	1260179	90%
12	$1s^2\ 2p^3$	^2D	1.5	1405688	82% + 12% $1s^2\ 2p^3\ ^2P$
13	$1s^2\ 2p^3$	^2D	2.5	1435674	100%
14	$1s^2\ 2p^3$	^2P	0.5	1582452	98%
15	$1s^2\ 2p^3$	^2P	1.5	1639226	78% + 16% $1s^2\ 2p^3\ ^2D$
16	$1s^2\ 2s^2\ 3s^1$	^2S	0.5	8111550	95%
17	$1s^2\ 2s^2\ 3p^1$	^2P	0.5	8292834	91%
18	$1s^2\ 2s^2\ 3p^1$	^2P	1.5	8326008	91%
19	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3s^1$	^4P	0.5	8471848	96%
20	$1s^2\ 2s^2\ 3d^1$	^2D	1.5	8491152	95%
21	$1s^2\ 2s^2\ 3d^1$	^2D	2.5	8501013	95%
22	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3s^1$	^4P	1.5	8502156	91%
23	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3s^1$	^2P	0.5	8577184	92%
24	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3s^1$	^4P	2.5	8584529	98%
25	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^4D	0.5	8630313	76% + 21% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^2P$
26	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^4D	1.5	8657024	75% + 18% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^2P$
27	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3s^1$	^2P	1.5	8663895	90%
28	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^2P	1.5	8695560	30% + 25% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^4S$ + 17% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^4P$
29	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^2P	0.5	8704356	66% + 22% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^4D$
30	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^4D	2.5	8707420	90%
31	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^4P	0.5	8734123	90%
32	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^2D	1.5	8748534	36% + 31% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^4S$ + 15% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^4P$
33	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^4D	3.5	8781923	99%
34	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^4P	1.5	8791861	44% + 25% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^2D$ + 19% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^2P$
35	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^4F	1.5	8808079	89%
36	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^4S	1.5	8809920	37% + 22% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^4P$ + 19% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^2D$
37	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^4P	2.5	8809932	68% + 23% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^2D$
38	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^4F	2.5	8827013	85% + 11% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^4D$
39	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^2D	2.5	8857624	73% + 24% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1\ ^4P$
40	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^4F	3.5	8857700	79% + 17% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^4D$
41	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^4P	2.5	8868503	46% + 23% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^4D$ + 23% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^2D$
42	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^4D	1.5	8878309	59% + 25% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^4P$
43	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^4D	0.5	8881447	84%
44	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3p^1$	^2S	0.5	8888579	79%
45	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 3s^1$	^2P	0.5	8891445	91%
46	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 3s^1$	^2P	1.5	8892983	82%
47	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^2D	1.5	8916505	67% + 11% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^2P$
48	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^4F	4.5	8925683	100%
49	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^2D	2.5	8930222	43% + 28% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^2F$ + 13% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^4D$
50	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^4D	3.5	8955370	79% + 19% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^4F$
51	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^4D	2.5	8966348	50% + 35% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^4P$
52	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^4P	1.5	8972247	68% + 29% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^4D$
53	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^4P	0.5	8975643	91%
54	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^2F	2.5	9004790	55% + 28% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^2D$
55	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^2P	1.5	9043521	78% + 10% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1\ ^2D$
56	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^2F	3.5	9060831	97%
57	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 3p^1$	^2P	0.5	9067791	79% + 10% $1s^2\ 2p^2\ (^3P)\ 3s^1\ ^2P$
58	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 3p^1$	^2D	1.5	9074412	64% + 26% $1s^2\ 2s^1\ 2p^1\ (^1P)\ 3p^1\ ^2P$
59	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 3d^1$	^2P	0.5	9078984	94%
60	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 3p^1$	^2D	2.5	9093833	91%

Table 1. continued.

Index	Configuration	*LS*	*J*	*E* (cm^{-1})	Composition
61	$1s^2 2s^1 2p^1 (^1P) 3p^1$	^2P	1.5	9103377	59% + 25% $1s^2 2s^1 2p^1 (^1P) 3p^1\ ^2D$
62	$1s^2 2p^2 (^3P) 3s^1$	^4P	0.5	9121949	55% + 27% $1s^2 2s^1 2p^1 (^1P) 3p^1\ ^2S$
63	$1s^2 2s^1 2p^1 (^1P) 3p^1$	^2S	0.5	9153543	54% + 33% $1s^2 2p^2 (^3P) 3s^1\ ^4P$
64	$1s^2 2p^2 (^3P) 3s^1$	^4P	1.5	9193266	95%
65	$1s^2 2p^2 (^3P) 3s^1$	^4P	2.5	9238570	80% + 16% $1s^2 2p^2 (^1D) 3s^1\ ^2D$
66	$1s^2 2s^1 2p^1 (^1P) 3d^1$	^2F	3.5	9250872	93%
67	$1s^2 2s^1 2p^1 (^1P) 3d^1$	^2F	2.5	9253139	85%
68	$1s^2 2p^2 (^3P) 3s^1$	^2P	0.5	9262279	77%
69	$1s^2 2s^1 2p^1 (^1P) 3d^1$	^2D	1.5	9263777	93%
70	$1s^2 2p^2 (^3P) 3p^1$	^4D	0.5	9265730	50% + 16% $1s^2 2p^2 (^3P) 3p^1\ ^2S$
71	$1s^2 2s^1 2p^1 (^1P) 3d^1$	^2D	2.5	9276912	90%
72	$1s^2 2p^2 (^3P) 3s^1$	^2P	1.5	9298666	47% + 41% $1s^2 2p^2 (^1D) 3s^1\ ^2D$
73	$1s^2 2s^1 2p^1 (^1P) 3d^1$	^2P	0.5	9298930	89%
74	$1s^2 2s^1 2p^1 (^1P) 3d^1$	^2P	1.5	9300838	62% + 18% $1s^2 2p^2 (^3P) 3p^1\ ^4D$
75	$1s^2 2p^2 (^3P) 3p^1$	^4D	1.5	9318728	53% + 32% $1s^2 2s^1 2p^1 (^1P) 3d^1\ ^2P$
76	$1s^2 2p^2 (^3P) 3p^1$	^2S	0.5	9326572	44% + 33% $1s^2 2p^2 (^3P) 3p^1\ ^4D$ + 21% $1s^2 2p^2 (^3P) 3p^1\ ^4P$
77	$1s^2 2p^2 (^3P) 3p^1$	^4P	1.5	9360271	32% + 25% $1s^2 2p^2 (^3P) 3p^1\ ^2D$ + 20% $1s^2 2p^2 (^3P) 3p^1\ ^4D$
78	$1s^2 2p^2 (^3P) 3p^1$	^4D	2.5	9369611	86%
79	$1s^2 2p^2 (^3P) 3p^1$	^4P	0.5	9385693	64% + 21% $1s^2 2p^2 (^3P) 3p^1\ ^2S$
80	$1s^2 2p^2 (^1D) 3s^1$	^2D	2.5	9386490	77% + 18% $1s^2 2p^2 (^3P) 3s^1\ ^4P$
81	$1s^2 2p^2 (^3P) 3p^1$	^4P	2.5	9390309	43% + 23% $1s^2 2p^2 (^3P) 3p^1\ ^2D$ + 20% $1s^2 2p^2 (^1D) 3p^1\ ^2D$
82	$1s^2 2p^2 (^3P) 3p^1$	^2D	1.5	9405884	43% + 32% $1s^2 2p^2 (^3P) 3p^1\ ^4P$ + 14% $1s^2 2p^2 (^1D) 3p^1\ ^2D$
83	$1s^2 2p^2 (^1D) 3s^1$	^2D	1.5	9406759	53% + 37% $1s^2 2p^2 (^3P) 3s^1\ ^2P$
84	$1s^2 2p^2 (^3P) 3p^1$	^4D	3.5	9414721	80% + 17% $1s^2 2p^2 (^1D) 3p^1\ ^2F$
85	$1s^2 2p^2 (^3P) 3d^1$	^4F	1.5	9442168	70% + 11% $1s^2 2p^2 (^3P) 3d^1\ ^4D$
86	$1s^2 2p^2 (^3P) 3p^1$	^4S	1.5	9460642	53% + 30% $1s^2 2p^2 (^1D) 3p^1\ ^2P$ + 13% $1s^2 2p^2 (^3P) 3p^1\ ^2P$
87	$1s^2 2p^2 (^3P) 3d^1$	^4F	2.5	9466629	58% + 24% $1s^2 2p^2 (^3P) 3d^1\ ^4D$
88	$1s^2 2p^2 (^3P) 3p^1$	^4P	2.5	9472291	34% + 29% $1s^2 2p^2 (^3P) 3p^1\ ^2D$ + 29% $1s^2 2p^2 (^1D) 3p^1\ ^2F$
89	$1s^2 2p^2 (^3P) 3p^1$	^2P	1.5	9472381	47% + 23% $1s^2 2p^2 (^3P) 3p^1\ ^4S$ + 11% $1s^2 2p^2 (^3P) 3p^1\ ^4P$
90	$1s^2 2p^2 (^3P) 3p^1$	^2P	0.5	9504310	69% + 15% $1s^2 2p^2 (^3P) 3p^1\ ^2S$
91	$1s^2 2p^2 (^3P) 3d^1$	^4F	3.5	9514316	75% + 21% $1s^2 2p^2 (^3P) 3d^1\ ^4D$
92	$1s^2 2p^2 (^3P) 3d^1$	^2P	1.5	9516554	42% + 25% $1s^2 2p^2 (^3P) 3d^1\ ^4D$ + 23% $1s^2 2p^2 (^3P) 3d^1\ ^4F$
93	$1s^2 2p^2 (^3P) 3d^1$	^4F	2.5	9522857	32% + 26% $1s^2 2p^2 (^3P) 3d^1\ ^2F$ + 20% $1s^2 2p^2 (^1D) 3d^1\ ^2F$
94	$1s^2 2p^2 (^3P) 3d^1$	^4D	0.5	9525480	83% + 13% $1s^2 2p^2 (^3P) 3d^1\ ^2P$
95	$1s^2 2p^2 (^1D) 3p^1$	^2F	2.5	9549139	49% + 24% $1s^2 2p^2 (^1D) 3p^1\ ^2D$ + 15% $1s^2 2p^2 (^3P) 3p^1\ ^2D$
96	$1s^2 2p^2 (^3P) 3d^1$	^4D	3.5	9551033	38% + 24% $1s^2 2p^2 (^1D) 3d^1\ ^2F$ + 16% $1s^2 2p^2 (^3P) 3d^1\ ^2F$
97	$1s^2 2p^2 (^3P) 3d^1$	^4F	4.5	9552660	82% + 18% $1s^2 2p^2 (^1D) 3d^1\ ^2G$
98	$1s^2 2p^2 (^3P) 3d^1$	^4D	1.5	9555613	47% + 33% $1s^2 2p^2 (^3P) 3d^1\ ^2P$
99	$1s^2 2p^2 (^3P) 3d^1$	^2F	2.5	9557712	32% + 26% $1s^2 2p^2 (^3P) 3d^1\ ^4P$ + 22% $1s^2 2p^2 (^3P) 3d^1\ ^4D$
100	$1s^2 2p^2 (^1D) 3p^1$	^2F	3.5	9563994	78% + 19% $1s^2 2p^2 (^3P) 3p^1\ ^4D$
101	$1s^2 2p^2 (^1D) 3p^1$	^2D	1.5	9583303	48% + 22% $1s^2 2p^2 (^1D) 3p^1\ ^2P$ + 14% $1s^2 2p^2 (^3P) 3p^1\ ^2D$
102	$1s^2 2p^2 (^1D) 3p^1$	^2D	2.5	9597713	55% + 31% $1s^2 2p^2 (^3P) 3p^1\ ^2D$
103	$1s^2 2p^2 (^3P) 3d^1$	^4P	2.5	9599924	48% + 31% $1s^2 2p^2 (^3P) 3d^1\ ^4D$ + 16% $1s^2 2p^2 (^1D) 3d^1\ ^2D$
104	$1s^2 2p^2 (^1S) 3s^1$	^2S	0.5	9602844	59% + 13% $1s^2 2p^2 (^3P) 3d^1\ ^2P$ + 11% $1s^2 2p^2 (^1D) 3d^1\ ^2S$
105	$1s^2 2p^2 (^1D) 3p^1$	^2P	0.5	9611964	89%
106	$1s^2 2p^2 (^3P) 3d^1$	^4P	1.5	9613678	74%
107	$1s^2 2p^2 (^3P) 3d^1$	^2P	0.5	9621528	49% + 24% $1s^2 2p^2 (^1S) 3s^1\ ^2S$ + 16% $1s^2 2p^2 (^3P) 3d^1\ ^4P$
108	$1s^2 2p^2 (^3P) 3d^1$	^4P	0.5	9624060	63% + 21% $1s^2 2p^2 (^3P) 3d^1\ ^2P$
109	$1s^2 2p^2 (^3P) 3d^1$	^2F	3.5	9629317	36% + 29% $1s^2 2p^2 (^1D) 3d^1\ ^2G$ + 28% $1s^2 2p^2 (^3P) 3d^1\ ^4D$
110	$1s^2 2p^2 (^3P) 3d^1$	^2D	2.5	9667354	60% + 16% $1s^2 2p^2 (^1D) 3d^1\ ^2F$ + 12% $1s^2 2p^2 (^1D) 3d^1\ ^2D$
111	$1s^2 2p^2 (^3P) 3d^1$	^2D	1.5	9670700	71% + 12% $1s^2 2p^2 (^1D) 3d^1\ ^2D$
112	$1s^2 2p^2 (^1D) 3p^1$	^2P	1.5	9683971	39% + 32% $1s^2 2p^2 (^3P) 3p^1\ ^2P$ + 14% $1s^2 2p^2 (^1D) 3p^1\ ^2D$
113	$1s^2 2p^2 (^1D) 3d^1$	^2G	3.5	9691641	45% + 39% $1s^2 2p^2 (^1D) 3d^1\ ^2F$ + 11% $1s^2 2p^2 (^3P) 3d^1\ ^4D$
114	$1s^2 2p^2 (^1D) 3d^1$	^2G	4.5	9708418	82% + 18% $1s^2 2p^2 (^3P) 3d^1\ ^4F$
115	$1s^2 2p^2 (^1D) 3d^1$	^2D	1.5	9736179	73%
116	$1s^2 2p^2 (^1D) 3d^1$	^2D	2.5	9740434	52% + 23% $1s^2 2p^2 (^1D) 3d^1\ ^2F$
117	$1s^2 2p^2 (^3P) 3d^1$	^2F	3.5	9762003	40% + 36% $1s^2 2p^2 (^1D) 3d^1\ ^2F$ + 17% $1s^2 2p^2 (^1D) 3d^1\ ^2G$
118	$1s^2 2p^2 (^1D) 3d^1$	^2P	0.5	9763792	89%
119	$1s^2 2p^2 (^1S) 3p^1$	^2P	0.5	9792303	84%

Table 1. continued.

Index	Configuration	*LS*	*J*	*E* (cm^{-1})	Composition
120	$1s^2 2p^2 (^3P) 3d^1$	^2D	2.5	9801608	36% + 27% $1s^2 2p^2 (^1D) 3d^1$ ^2F + 18% $1s^2 2p^2 (^1D) 3d^1$ ^2D
121	$1s^2 2p^2 (^1D) 3d^1$	^2S	0.5	9804009	80%
122	$1s^2 2p^2 (^1D) 3d^1$	^2P	1.5	9806502	69% + 12% $1s^2 2p^2 (^3P) 3d^1$ ^2P
123	$1s^2 2p^2 (^1S) 3p^1$	^2P	1.5	9810603	86%
124	$1s^2 2p^2 (^1S) 3d^1$	^2D	2.5	9960890	87%
125	$1s^2 2p^2 (^1S) 3d^1$	^2D	1.5	9969426	83%
126	$1s^2 2s^2 4s^1$	^2S	0.5	10986106	95%
127	$1s^2 2s^2 4p^1$	^2P	0.5	11061237	95%
128	$1s^2 2s^2 4p^1$	^2P	1.5	11075121	95%
129	$1s^2 2s^2 4d^1$	^2D	1.5	11135585	95%
130	$1s^2 2s^2 4d^1$	^2D	2.5	11139649	95%
131	$1s^2 2s^2 4f^1$	^2F	2.5	11173539	95%
132	$1s^2 2s^2 4f^1$	^2F	3.5	11175356	95%
133	$1s^2 2s^1 2p^1 (^3P) 4s^1$	^4P	0.5	11340530	88% + 11% $1s^2 2s^1 2p^1 (^3P) 4s^1$ ^2P
134	$1s^2 2s^1 2p^1 (^3P) 4s^1$	^4P	1.5	11369374	86% + 11% $1s^2 2s^1 2p^1 (^3P) 4s^1$ ^2P
135	$1s^2 2s^1 2p^1 (^3P) 4s^1$	^2P	0.5	11389750	87% + 10% $1s^2 2s^1 2p^1 (^3P) 4s^1$ ^4P
136	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^4D	0.5	11407650	74% + 19% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^2P
137	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^4D	1.5	11428039	69% + 20% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^4P
138	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^2P	1.5	11439838	33% + 22% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^4S + 17% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^4D
139	$1s^2 2s^1 2p^1 (^3P) 4s^1$	^4P	2.5	11457080	97%
140	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^4P	0.5	11457418	81% + 13% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^2P
141	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^4D	2.5	11457419	70% + 19% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^4P
142	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^2P	0.5	11460571	49% + 23% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^4D + 21% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^2S
143	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^2D	1.5	11470801	57% + 19% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^4S + 16% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^4P
144	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^4F	1.5	11478339	76% + 10% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4D
145	$1s^2 2s^1 2p^1 (^3P) 4s^1$	^2P	1.5	11481674	88% + 11% $1s^2 2s^1 2p^1 (^3P) 4s^1$ ^4P
146	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^4F	2.5	11489897	51% + 28% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4D + 12% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4P
147	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^4P	2.5	11511057	33% + 31% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4F + 26% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^2D
148	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^4F	3.5	11516474	62% + 29% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4D
149	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^4D	1.5	11518812	50% + 29% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4P
150	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^4D	0.5	11521977	81%
151	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^4G	2.5	11522349	48% + 21% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^4F + 14% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^2F
152	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^4F	3.5	11524662	30% + 22% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^4D + 20% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^4G
153	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^2D	1.5	11534686	50% + 34% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^2P + 13% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4F
154	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^4P	1.5	11538763	43% + 23% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^2P + 16% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^4S
155	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^4D	3.5	11539955	99%
156	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^2F	2.5	11541402	59% + 15% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4P + 15% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^2D
157	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^4P	2.5	11542484	52% + 28% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^4D + 19% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^2D
158	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^2P	1.5	11549509	35% + 33% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^4S + 12% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^2D
159	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^4F	1.5	11551577	63% + 12% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^4D + 11% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^2D
160	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^4G	3.5	11552614	44% + 33% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^2F + 11% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^2G
161	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^4F	2.5	11553334	34% + 29% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^4D + 27% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^2F
162	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^4G	4.5	11553358	43% + 41% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^4F + 14% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^2G
163	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^2D	2.5	11558617	41% + 34% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^4G + 17% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^2F
164	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^2G	3.5	11559897	44% + 38% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^4D
165	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^2D	2.5	11566890	71% + 26% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^4P
166	$1s^2 2s^1 2p^1 (^3P) 4p^1$	^2S	0.5	11577839	71% + 16% $1s^2 2s^1 2p^1 (^3P) 4p^1$ ^2P
167	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^4F	4.5	11596554	100%
168	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^4D	3.5	11604622	63% + 35% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4F
169	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^4D	2.5	11607936	56% + 20% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4P + 14% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4F
170	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^4P	1.5	11611137	61% + 36% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4D
171	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^4P	0.5	11612623	90%
172	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^2D	2.5	11620801	50% + 25% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^2F + 17% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^4P
173	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^2P	1.5	11632223	57% + 29% $1s^2 2s^1 2p^1 (^3P) 4d^1$ ^2D
174	$1s^2 2s^1 2p^1 (^3P) 4d^1$	^2F	3.5	11641117	91%
175	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^4F	3.5	11642518	46% + 26% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^4G + 12% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^2F
176	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^4F	4.5	11642764	54% + 46% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^4G
177	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^4F	2.5	11644818	43% + 30% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^4D + 10% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^2D
178	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^2F	3.5	11646915	46% + 23% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^4D + 18% $1s^2 2s^1 2p^1 (^3P) 4f^1$ ^2G
179	$1s^2 2s^1 2p^1 (^3P) 4f^1$	^4G	5.5	11646958	100%

Table 1. continued.

Index	Configuration	*LS*	*J*	*E* (cm^{-1})	Composition
180	$1s^2\,2s^1\,2p^1\,(^3P)\,4d^1$	^2P	0.5	11647548	90%
181	$1s^2\,2s^1\,2p^1\,(^3P)\,4f^1$	^4D	1.5	11648980	69% + 23% $1s^2\,2s^1\,2p^1\,(^3P)\,4f^1\,^4F$
182	$1s^2\,2s^1\,2p^1\,(^3P)\,4f^1$	^2G	4.5	11650991	85% + 10% $1s^2\,2s^1\,2p^1\,(^3P)\,4f^1\,^4G$
183	$1s^2\,2s^1\,2p^1\,(^3P)\,4f^1$	^4D	2.5	11651834	34% + 33% $1s^2\,2s^1\,2p^1\,(^3P)\,4f^1\,^2D$ + 31% $1s^2\,2s^1\,2p^1\,(^3P)\,4f^1\,^2F$
184	$1s^2\,2s^1\,2p^1\,(^3P)\,4f^1$	^4D	0.5	11652069	100%
185	$1s^2\,2s^1\,2p^1\,(^3P)\,4f^1$	^2D	1.5	11657791	79% + 17% $1s^2\,2s^1\,2p^1\,(^3P)\,4f^1\,^4D$
186	$1s^2\,2s^1\,2p^1\,(^1P)\,4s^1$	^2P	0.5	11758032	96%
187	$1s^2\,2s^1\,2p^1\,(^1P)\,4s^1$	^2P	1.5	11759674	96%
188	$1s^2\,2s^1\,2p^1\,(^1P)\,4p^1$	^2D	1.5	11832259	82% + 14% $1s^2\,2s^1\,2p^1\,(^1P)\,4p^1\,^2P$
189	$1s^2\,2s^1\,2p^1\,(^1P)\,4p^1$	^2P	0.5	11833806	85% + 11% $1s^2\,2s^1\,2p^1\,(^1P)\,4p^1\,^2S$
190	$1s^2\,2s^1\,2p^1\,(^1P)\,4p^1$	^2D	2.5	11841574	96%
191	$1s^2\,2s^1\,2p^1\,(^1P)\,4p^1$	^2P	1.5	11847478	82% + 13% $1s^2\,2s^1\,2p^1\,(^1P)\,4p^1\,^2D$
192	$1s^2\,2s^1\,2p^1\,(^1P)\,4p^1$	^2S	0.5	11855186	83% + 11% $1s^2\,2s^1\,2p^1\,(^1P)\,4p^1\,^2P$
193	$1s^2\,2s^1\,2p^1\,(^1P)\,4d^1$	^2D	1.5	11902998	97%
194	$1s^2\,2s^1\,2p^1\,(^1P)\,4d^1$	^2F	2.5	11903215	91%
195	$1s^2\,2s^1\,2p^1\,(^1P)\,4d^1$	^2F	3.5	11903365	97%
196	$1s^2\,2s^1\,2p^1\,(^1P)\,4d^1$	^2D	2.5	11908277	91%
197	$1s^2\,2s^1\,2p^1\,(^1P)\,4d^1$	^2P	0.5	11916727	97%
198	$1s^2\,2s^1\,2p^1\,(^1P)\,4d^1$	^2P	1.5	11920666	96%
199	$1s^2\,2s^1\,2p^1\,(^1P)\,4f^1$	^2F	2.5	11932709	97%
200	$1s^2\,2s^1\,2p^1\,(^1P)\,4f^1$	^2F	3.5	11934584	97%
201	$1s^2\,2s^1\,2p^1\,(^1P)\,4f^1$	^2G	3.5	11941218	97%
202	$1s^2\,2s^1\,2p^1\,(^1P)\,4f^1$	^2G	4.5	11942845	97%
203	$1s^2\,2s^1\,2p^1\,(^1P)\,4f^1$	^2D	1.5	11948864	97%
204	$1s^2\,2s^1\,2p^1\,(^1P)\,4f^1$	^2D	2.5	11950454	97%
205	$1s^2\,2p^2\,(^3P)\,4s^1$	^4P	0.5	11966282	72% + 20% $1s^2\,2p^2\,(^3P)\,4s^1\,^2P$
206	$1s^2\,2p^2\,(^3P)\,4p^1$	^4D	0.5	12026218	57% + 13% $1s^2\,2p^2\,(^3P)\,4p^1\,^2S$ + 13% $1s^2\,2p^2\,(^3P)\,4p^1\,^2P$
207	$1s^2\,2p^2\,(^3P)\,4s^1$	^4P	1.5	12032154	90%
208	$1s^2\,2p^2\,(^3P)\,4s^1$	^2P	0.5	12044766	75% + 23% $1s^2\,2p^2\,(^3P)\,4s^1\,^4P$
209	$1s^2\,2p^2\,(^3P)\,4p^1$	^4D	1.5	12048491	41% + 28% $1s^2\,2p^2\,(^3P)\,4p^1\,^4P$ + 16% $1s^2\,2p^2\,(^3P)\,4p^1\,^2D$
210	$1s^2\,2p^2\,(^3P)\,4s^1$	^4P	2.5	12077037	74% + 22% $1s^2\,2p^2\,(^1D)\,4s^1\,^2D$
211	$1s^2\,2p^2\,(^3P)\,4p^1$	^2S	0.5	12090712	36% + 32% $1s^2\,2p^2\,(^3P)\,4p^1\,^4D$ + 32% $1s^2\,2p^2\,(^3P)\,4p^1\,^4P$
212	$1s^2\,2p^2\,(^3P)\,4d^1$	^4F	1.5	12091037	31% + 27% $1s^2\,2p^2\,(^3P)\,4s^1\,^2P$ + 12% $1s^2\,2p^2\,(^1D)\,4s^1\,^2D$
213	$1s^2\,2p^2\,(^3P)\,4s^1$	^2P	1.5	12096944	38% + 24% $1s^2\,2p^2\,(^3P)\,4d^1\,^4F$ + 16% $1s^2\,2p^2\,(^1D)\,4s^1\,^2D$
214	$1s^2\,2p^2\,(^3P)\,4p^1$	^4D	1.5	12104155	51% + 14% $1s^2\,2p^2\,(^3P)\,4p^1\,^2D$ + 12% $1s^2\,2p^2\,(^3P)\,4p^1\,^2P$
215	$1s^2\,2p^2\,(^3P)\,4d^1$	^4F	2.5	12109479	33% + 28% $1s^2\,2p^2\,(^3P)\,4d^1\,^4D$ + 15% $1s^2\,2p^2\,(^3P)\,4d^1\,^2F$
216	$1s^2\,2p^2\,(^3P)\,4p^1$	^4D	2.5	12109603	68% + 24% $1s^2\,2p^2\,(^3P)\,4p^1\,^4P$
217	$1s^2\,2p^2\,(^3P)\,4p^1$	^4P	0.5	12119410	50% + 23% $1s^2\,2p^2\,(^3P)\,4p^1\,^2P$ + 20% $1s^2\,2p^2\,(^3P)\,4p^1\,^2S$
218	$1s^2\,2p^2\,(^3P)\,4p^1$	^2D	1.5	12125947	58% + 23% $1s^2\,2p^2\,(^3P)\,4p^1\,^4P$ + 15% $1s^2\,2p^2\,(^3P)\,4p^1\,^4S$
219	$1s^2\,2p^2\,(^3P)\,4f^1$	^4G	2.5	12133488	43% + 17% $1s^2\,2p^2\,(^3P)\,4f^1\,^2D$ + 15% $1s^2\,2p^2\,(^3P)\,4f^1\,^4F$
220	$1s^2\,2p^2\,(^3P)\,4f^1$	^4D	3.5	12136390	24% + 23% $1s^2\,2p^2\,(^3P)\,4f^1\,^2G$ + 21% $1s^2\,2p^2\,(^3P)\,4f^1\,^4F$
221	$1s^2\,2p^2\,(^3P)\,4p^1$	^4P	2.5	12142023	31% + 22% $1s^2\,2p^2\,(^3P)\,4p^1\,^4D$ + 19% $1s^2\,2p^2\,(^3P)\,4p^1\,^2D$
222	$1s^2\,2p^2\,(^3P)\,4p^1$	^4D	3.5	12153226	77% + 23% $1s^2\,2p^2\,(^1D)\,4p^1\,^2F$
223	$1s^2\,2p^2\,(^3P)\,4p^1$	^4S	1.5	12163250	50% + 26% $1s^2\,2p^2\,(^3P)\,4p^1\,^4P$ + 16% $1s^2\,2p^2\,(^1D)\,4p^1\,^2P$
224	$1s^2\,2p^2\,(^3P)\,4d^1$	^4F	1.5	12165218	36% + 35% $1s^2\,2p^2\,(^3P)\,4d^1\,^2P$ + 18% $1s^2\,2p^2\,(^3P)\,4d^1\,^4D$
225	$1s^2\,2p^2\,(^3P)\,4d^1$	^4F	3.5	12167484	59% + 33% $1s^2\,2p^2\,(^3P)\,4d^1\,^4D$
226	$1s^2\,2p^2\,(^3P)\,4d^1$	^4D	0.5	12168370	80% + 14% $1s^2\,2p^2\,(^3P)\,4d^1\,^2P$
227	$1s^2\,2p^2\,(^3P)\,4p^1$	^2P	1.5	12170620	58% + 22% $1s^2\,2p^2\,(^1D)\,4p^1\,^2D$
228	$1s^2\,2p^2\,(^3P)\,4d^1$	^4F	2.5	12172277	56% + 23% $1s^2\,2p^2\,(^3P)\,4d^1\,^4P$
229	$1s^2\,2p^2\,(^3P)\,4p^1$	^2D	2.5	12179277	45% + 27% $1s^2\,2p^2\,(^3P)\,4p^1\,^4P$ + 18% $1s^2\,2p^2\,(^1D)\,4p^1\,^2F$
230	$1s^2\,2p^2\,(^3P)\,4p^1$	^2P	0.5	12185339	57% + 22% $1s^2\,2p^2\,(^3P)\,4p^1\,^2S$ + 11% $1s^2\,2p^2\,(^1D)\,4p^1\,^2P$
231	$1s^2\,2p^2\,(^3P)\,4d^1$	^4D	1.5	12186252	37% + 28% $1s^2\,2p^2\,(^3P)\,4d^1\,^2P$ + 17% $1s^2\,2p^2\,(^3P)\,4d^1\,^2D$
232	$1s^2\,2p^2\,(^3P)\,4d^1$	^2F	2.5	12187456	64% + 21% $1s^2\,2p^2\,(^3P)\,4d^1\,^4P$
233	$1s^2\,2p^2\,(^3P)\,4f^1$	^4G	2.5	12200490	44% + 35% $1s^2\,2p^2\,(^3P)\,4f^1\,^2D$ + 15% $1s^2\,2p^2\,(^3P)\,4f^1\,^4D$
234	$1s^2\,2p^2\,(^3P)\,4f^1$	^4D	3.5	12202351	44% + 42% $1s^2\,2p^2\,(^3P)\,4f^1\,^4G$
235	$1s^2\,2p^2\,(^3P)\,4f^1$	^4G	4.5	12205379	53% + 31% $1s^2\,2p^2\,(^3P)\,4f^1\,^4F$ + 16% $1s^2\,2p^2\,(^3P)\,4f^1\,^2G$
236	$1s^2\,2p^2\,(^3P)\,4f^1$	^2G	3.5	12205809	52% + 18% $1s^2\,2p^2\,(^3P)\,4f^1\,^4G$ + 15% $1s^2\,2p^2\,(^3P)\,4f^1\,^2F$
237	$1s^2\,2p^2\,(^3P)\,4f^1$	^4F	1.5	12206952	59% + 21% $1s^2\,2p^2\,(^3P)\,4f^1\,^4D$ + 20% $1s^2\,2p^2\,(^3P)\,4f^1\,^2D$
238	$1s^2\,2p^2\,(^3P)\,4d^1$	^4D	3.5	12207587	32% + 29% $1s^2\,2p^2\,(^3P)\,4d^1\,^4F$ + 17% $1s^2\,2p^2\,(^1D)\,4d^1\,^2F$

Table 1. continued.

Index	Configuration	*LS*	*J*	*E* (cm^{-1})	Composition
239	$1s^2\ 2p^2\ (^3P)\ 4d^1$	^4F	4.5	12209498	78% + 22% $1s^2\ 2p^2\ (^1D)\ 4d^1\ ^2G$
240	$1s^2\ 2p^2\ (^3P)\ 4f^1$	^2F	2.5	12210388	30% + 29% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4D$ + 24% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4F$
241	$1s^2\ 2p^2\ (^1D)\ 4s^1$	^2D	2.5	12213901	56% + 17% $1s^2\ 2p^2\ (^3P)\ 4s^1\ ^4P$
242	$1s^2\ 2p^2\ (^1D)\ 4s^1$	^2D	1.5	12221564	68% + 24% $1s^2\ 2p^2\ (^3P)\ 4s^1\ ^2P$
243	$1s^2\ 2p^2\ (^3P)\ 4d^1$	^4D	2.5	12222169	37% + 18% $1s^2\ 2p^2\ (^3P)\ 4d^1\ ^4P$
244	$1s^2\ 2p^2\ (^3P)\ 4d^1$	^4P	1.5	12227306	57% + 19% $1s^2\ 2p^2\ (^3P)\ 4d^1\ ^4D$ + 13% $1s^2\ 2p^2\ (^1D)\ 4d^1\ ^2P$
245	$1s^2\ 2p^2\ (^3P)\ 4d^1$	^4P	0.5	12230405	72% + 17% $1s^2\ 2p^2\ (^1D)\ 4d^1\ ^2S$
246	$1s^2\ 2p^2\ (^3P)\ 4d^1$	^2P	0.5	12236303	68% + 14% $1s^2\ 2p^2\ (^3P)\ 4d^1\ ^4D$ + 11% $1s^2\ 2p^2\ (^1D)\ 4d^1\ ^2P$
247	$1s^2\ 2p^2\ (^3P)\ 4d^1$	^2F	3.5	12243343	54% + 21% $1s^2\ 2p^2\ (^1D)\ 4d^1\ ^2G$ + 18% $1s^2\ 2p^2\ (^3P)\ 4d^1\ ^4D$
248	$1s^2\ 2p^2\ (^3P)\ 4d^1$	^2D	1.5	12244386	58% + 15% $1s^2\ 2p^2\ (^1D)\ 4d^1\ ^2D$ + 10% $1s^2\ 2p^2\ (^3P)\ 4d^1\ ^2P$
249	$1s^2\ 2p^2\ (^3P)\ 4d^1$	^2D	2.5	12244441	53% + 19% $1s^2\ 2p^2\ (^1D)\ 4d^1\ ^2F$
250	$1s^2\ 2p^2\ (^3P)\ 4f^1$	^4G	4.5	12248830	32% + 31% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^2G$ + 18% $1s^2\ 2p^2\ (^1D)\ 4f^1\ ^2H$
251	$1s^2\ 2p^2\ (^3P)\ 4f^1$	^4G	5.5	12249213	77% + 23% $1s^2\ 2p^2\ (^1D)\ 4f^1\ ^2H$
252	$1s^2\ 2p^2\ (^3P)\ 4f^1$	^4D	0.5	12251273	79% + 20% $1s^2\ 2p^2\ (^1D)\ 4f^1\ ^2P$
253	$1s^2\ 2p^2\ (^3P)\ 4f^1$	^4F	3.5	12251580	42% + 19% $1s^2\ 2p^2\ (^1D)\ 4f^1\ ^2G$ + 13% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4G$
254	$1s^2\ 2p^2\ (^3P)\ 4f^1$	^4D	1.5	12251859	61% + 15% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4F$ + 11% $1s^2\ 2p^2\ (^1D)\ 4f^1\ ^2P$
255	$1s^2\ 2p^2\ (^3P)\ 4f^1$	^4F	2.5	12252205	42% + 26% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4D$ + 18% $1s^2\ 2p^2\ (^1D)\ 4f^1\ ^2F$
256	$1s^2\ 2p^2\ (^3P)\ 4f^1$	^4F	4.5	12254349	38% + 32% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^2G$ + 21% $1s^2\ 2p^2\ (^1D)\ 4f^1\ ^2G$
257	$1s^2\ 2p^2\ (^3P)\ 4f^1$	^2D	1.5	12254654	60% + 17% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4F$ + 12% $1s^2\ 2p^2\ (^1D)\ 4f^1\ ^2D$
258	$1s^2\ 2p^2\ (^3P)\ 4f^1$	^2F	3.5	12255378	43% + 19% $1s^2\ 2p^2\ (^1D)\ 4f^1\ ^2F$ + 11% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4D$
259	$1s^2\ 2p^2\ (^3P)\ 4f^1$	^2F	2.5	12255749	42% + 19% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^2D$ + 16% $1s^2\ 2p^2\ (^1D)\ 4f^1\ ^2D$
260	$1s^2\ 2s^2\ 5s^1$	^2S	0.5	12279291	95%
261	$1s^2\ 2p^2\ (^1D)\ 4p^1$	^2F	2.5	12289009	53% + 20% $1s^2\ 2p^2\ (^1D)\ 4p^1\ ^2D$ + 19% $1s^2\ 2p^2\ (^3P)\ 4p^1\ ^2D$
262	$1s^2\ 2p^2\ (^1D)\ 4p^1$	^2D	1.5	12293068	45% + 30% $1s^2\ 2p^2\ (^1D)\ 4p^1\ ^2P$
263	$1s^2\ 2p^2\ (^1D)\ 4p^1$	^2F	3.5	12294467	76% + 23% $1s^2\ 2p^2\ (^3P)\ 4p^1\ ^4D$
264	$1s^2\ 2p^2\ (^1D)\ 4p^1$	^2D	2.5	12295436	58% + 15% $1s^2\ 2p^2\ (^1D)\ 4p^1\ ^2F$ + 11% $1s^2\ 2p^2\ (^3P)\ 4p^1\ ^4P$
265	$1s^2\ 2p^2\ (^1D)\ 4p^1$	^2P	0.5	12303528	84%
266	$1s^2\ 2s^2\ 5p^1$	^2P	0.5	12315762	95%
267	$1s^2\ 2s^2\ 5p^1$	^2P	1.5	12322749	95%
268	$1s^2\ 2p^2\ (^1D)\ 4p^1$	^2P	1.5	12331975	42% + 23% $1s^2\ 2p^2\ (^1D)\ 4p^1\ ^2D$ + 21% $1s^2\ 2p^2\ (^3P)\ 4p^1\ ^2P$
269	$1s^2\ 2p^2\ (^1D)\ 4d^1$	^2F	3.5	12345098	53% + 24% $1s^2\ 2p^2\ (^1D)\ 4d^1\ ^2G$ + 13% $1s^2\ 2p^2\ (^3P)\ 4d^1\ ^4D$
270	$1s^2\ 2s^2\ 5d^1$	^2D	1.5	12351697	95%
271	$1s^2\ 2p^2\ (^1D)\ 4d^1$	^2G	4.5	12352563	77% + 22% $1s^2\ 2p^2\ (^3P)\ 4d^1\ ^4F$
272	$1s^2\ 2s^2\ 5d^1$	^2D	2.5	12353856	95%
273	$1s^2\ 2p^2\ (^1D)\ 4d^1$	^2D	2.5	12359613	47% + 27% $1s^2\ 2p^2\ (^1D)\ 4d^1\ ^2F$ + 12% $1s^2\ 2p^2\ (^3P)\ 4d^1\ ^4D$
274	$1s^2\ 2p^2\ (^1D)\ 4d^1$	^2D	1.5	12360467	69%
275	$1s^2\ 2p^2\ (^1D)\ 4d^1$	^2G	3.5	12362665	44% + 25% $1s^2\ 2p^2\ (^1D)\ 4d^1\ ^2F$ + 18% $1s^2\ 2p^2\ (^3P)\ 4d^1\ ^2F$
276	$1s^2\ 2p^2\ (^1D)\ 4d^1$	^2P	0.5	12364441	79%
277	$1s^2\ 2s^2\ 5f^1$	^2F	2.5	12370344	95%
278	$1s^2\ 2s^2\ 5f^1$	^2F	3.5	12371272	95%
279	$1s^2\ 2s^2\ 5g^1$	^2G	3.5	12374527	95%
280	$1s^2\ 2s^2\ 5g^1$	^2G	4.5	12375073	95%
281	$1s^2\ 2p^2\ (^1D)\ 4d^1$	^2S	0.5	12379477	72% + 16% $1s^2\ 2p^2\ (^3P)\ 4d^1\ ^4P$
282	$1s^2\ 2p^2\ (^1D)\ 4d^1$	^2F	2.5	12380298	36% + 26% $1s^2\ 2p^2\ (^1D)\ 4d^1\ ^2D$ + 24% $1s^2\ 2p^2\ (^3P)\ 4d^1\ ^2D$
283	$1s^2\ 2p^2\ (^1D)\ 4f^1$	^2G	4.5	12383167	72% + 19% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4F$
284	$1s^2\ 2p^2\ (^1D)\ 4f^1$	^2G	3.5	12383475	56% + 15% $1s^2\ 2p^2\ (^1D)\ 4f^1\ ^2F$ + 12% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4F$
285	$1s^2\ 2p^2\ (^1D)\ 4f^1$	^2F	2.5	12385035	70% + 11% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4F$
286	$1s^2\ 2p^2\ (^1D)\ 4d^1$	^2P	1.5	12385131	68%
287	$1s^2\ 2p^2\ (^1D)\ 4f^1$	^2F	3.5	12387472	57% + 14% $1s^2\ 2p^2\ (^1D)\ 4f^1\ ^2G$ + 13% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^2F$
288	$1s^2\ 2p^2\ (^1D)\ 4f^1$	^2H	4.5	12389246	76% + 17% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^2G$
289	$1s^2\ 2p^2\ (^1D)\ 4f^1$	^2H	5.5	12390193	77% + 23% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4G$
290	$1s^2\ 2p^2\ (^1D)\ 4f^1$	^2D	1.5	12391428	76%
291	$1s^2\ 2p^2\ (^1D)\ 4f^1$	^2D	2.5	12394627	74% + 10% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4D$
292	$1s^2\ 2p^2\ (^1D)\ 4f^1$	^2P	0.5	12399188	79% + 20% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^4D$
293	$1s^2\ 2p^2\ (^1D)\ 4f^1$	^2P	1.5	12400743	79% + 11% $1s^2\ 2p^2\ (^3P)\ 4f^1\ ^2D$
294	$1s^2\ 2p^2\ (^1S)\ 4s^1$	^2S	0.5	12444475	86%
295	$1s^2\ 2p^2\ (^1S)\ 4p^1$	^2P	0.5	12515791	88%
296	$1s^2\ 2p^2\ (^1S)\ 4p^1$	^2P	1.5	12525285	89%
297	$1s^2\ 2p^2\ (^1S)\ 4d^1$	^2D	2.5	12584193	89%
298	$1s^2\ 2p^2\ (^1S)\ 4d^1$	^2D	1.5	12585234	88%

Table 1. continued.

Index	Configuration	*LS*	*J*	*E* (cm^{-1})	Composition
299	$1s^2\ 2p^2\ (^1S)\ 4f^1$	^2F	2.5	12612343	89%
300	$1s^2\ 2p^2\ (^1S)\ 4f^1$	^2F	3.5	12613762	89%
301	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5s^1$	^4P	0.5	12630518	80% + 20% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5s^1\ ^2P$
302	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5s^1$	^4P	1.5	12659932	84% + 13% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5s^1\ ^2P$
303	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^4D	0.5	12664345	68% + 20% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^2P$
304	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5s^1$	^2P	0.5	12668513	78% + 19% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5s^1\ ^4P$
305	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^4D	1.5	12674610	39% + 29% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^4P$ + 18% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^2D$
306	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^4D	1.5	12694215	46% + 27% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^2P$ + 13% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^4S$
307	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^4F	1.5	12699708	65% + 14% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4D$ + 12% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^2D$
308	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^4P	0.5	12702390	79%
309	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^4D	2.5	12704007	63% + 23% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^4P$ + 12% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^2D$
310	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^4F	2.5	12705133	31% + 30% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4D$ + 21% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4P$
311	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^2P	0.5	12706122	52% + 24% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^4D$ + 21% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^2S$
312	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^2D	1.5	12709631	56% + 20% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^4S$ + 19% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^4P$
313	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^4G	2.5	12719581	47% + 20% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4F$ + 15% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^2D$
314	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^4F	3.5	12720793	28% + 24% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4D$ + 22% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^2G$
315	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4H	3.5	12723256	41% + 20% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4G$ + 18% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2F$
316	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4G	4.5	12723812	25% + 25% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4F$ + 25% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2H$
317	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^4F	2.5	12729171	49% + 24% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^2D$ + 23% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4P$
318	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^4D	1.5	12733531	44% + 29% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4P$ + 11% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4F$
319	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^4F	3.5	12733667	55% + 32% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4D$ + 11% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^2F$
320	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^4D	0.5	12735488	77% + 12% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^2P$
321	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^2D	1.5	12740788	40% + 38% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^2P$ + 18% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4F$
322	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^2F	2.5	12743266	59% + 18% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4P$
323	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^4F	1.5	12749823	68% + 15% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4D$ + 14% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^2D$
324	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^4G	3.5	12750182	49% + 29% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^2F$
325	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^4G	4.5	12750617	44% + 38% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4F$ + 15% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^2G$
326	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^4D	2.5	12750624	33% + 32% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4F$ + 23% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^2F$
327	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5s^1$	^4P	2.5	12750970	96%
328	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^2D	2.5	12753515	44% + 33% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4G$ + 19% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^2F$
329	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4H	4.5	12753912	38% + 30% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2G$ + 20% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2H$
330	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^2G	3.5	12753933	47% + 37% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4D$
331	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4G	2.5	12753995	62% + 19% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4F$ + 15% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2F$
332	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4H	5.5	12754416	42% + 40% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4G$ + 16% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2H$
333	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^2G	3.5	12754525	33% + 31% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4F$ + 27% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4G$
334	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4H	3.5	12755347	46% + 41% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2F$
335	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4F	4.5	12755830	47% + 32% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2H$ + 15% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4H$
336	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5s^1$	^2P	1.5	12761021	86% + 14% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5s^1\ ^4P$
337	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^4P	1.5	12789953	43% + 22% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^4S$ + 19% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^2P$
338	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^4P	2.5	12791181	46% + 36% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^4D$ + 18% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^2D$
339	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^4D	3.5	12791466	100%
340	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^2P	1.5	12796141	48% + 33% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^4S$ + 12% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^2D$
341	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^2D	2.5	12803110	69% + 30% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^4P$
342	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1$	^2S	0.5	12808123	64% + 22% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^2P$ + 11% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5p^1\ ^4P$
343	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^4F	4.5	12819666	100%
344	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^4D	3.5	12822836	58% + 40% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4F$
345	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^4D	2.5	12824275	55% + 17% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4P$ + 17% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4F$
346	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^4P	1.5	12825800	58% + 38% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4D$
347	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^4P	0.5	12826522	89% + 10% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4D$
348	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^2D	2.5	12830199	54% + 20% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^2F$ + 19% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4P$
349	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^2P	1.5	12835076	48% + 36% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^2D$ + 10% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4P$
350	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^2F	3.5	12838918	87%
351	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^4F	3.5	12841180	52% + 24% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4G$ + 12% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4D$
352	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^4F	4.5	12841237	55% + 45% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4G$
353	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^4F	2.5	12842245	46% + 32% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4D$
354	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1$	^2P	0.5	12842361	87% + 10% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5d^1\ ^4D$
355	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^4G	5.5	12843058	100%
356	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^2F	3.5	12843675	52% + 19% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^2G$ + 19% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4D$
357	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^4D	1.5	12844088	70% + 25% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4F$
358	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^4D	0.5	12845515	100%
359	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^2G	4.5	12845612	30% + 29% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4G$ + 28% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4H$

Table 1. continued.

Index	Configuration	*LS*	*J*	*E* (cm^{-1})	Composition
360	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^2G	4.5	12845829	85%
361	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^2F	2.5	12845954	36% + 33% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^2D$ + 28% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4D$
362	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4G	3.5	12845979	42% + 20% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2G$ + 15% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2F$
363	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4G	5.5	12846054	57% + 40% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4H$
364	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4G	4.5	12846473	32% + 30% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2G$ + 25% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4F$
365	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^2H	5.5	12846865	81% + 17% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4H$
366	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4F	2.5	12847101	45% + 35% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4G$ + 20% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2F$
367	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4H	6.5	12847235	100%
368	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4F	3.5	12847598	43% + 27% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2G$ + 21% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^2F$
369	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^4F	1.5	12848351	100%
370	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1$	^2F	2.5	12848953	64% + 35% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5g^1\ ^4F$
371	$1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1$	^2D	1.5	12849038	80% + 15% $1s^2\ 2s^1\ 2p^1\ (^3P)\ 5f^1\ ^4D$
372	$1s^2\ 2s^2\ 6s^1$	^2S	0.5	12966803	94%
373	$1s^2\ 2s^2\ 6p^1$	^2P	0.5	12988610	94%
374	$1s^2\ 2s^2\ 6p^1$	^2P	1.5	12992885	94%
375	$1s^2\ 2s^2\ 6d^1$	^2D	1.5	13010344	95%
376	$1s^2\ 2s^2\ 6d^1$	^2D	2.5	13011577	95%
377	$1s^2\ 2s^2\ 6f^1$	^2F	2.5	13020767	95%
378	$1s^2\ 2s^2\ 6f^1$	^2F	3.5	13021353	96%
379	$1s^2\ 2s^2\ 6h^1$	^2H	4.5	13022298	95%
380	$1s^2\ 2s^2\ 6g^1$	^2G	3.5	13022462	95%
381	$1s^2\ 2s^2\ 6h^1$	^2H	5.5	13022514	95%
382	$1s^2\ 2s^2\ 6g^1$	^2G	4.5	13022792	95%
383	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5s^1$	^2P	0.5	13048296	96%
384	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5s^1$	^2P	1.5	13048997	96%
385	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5p^1$	^2D	1.5	13084306	82% + 14% $1s^2\ 2s^1\ 2p^1\ (^1P)\ 5p^1\ ^2P$
386	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5p^1$	^2P	0.5	13085077	89%
387	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5p^1$	^2D	2.5	13089534	97%
388	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5p^1$	^2P	1.5	13091712	83% + 14% $1s^2\ 2s^1\ 2p^1\ (^1P)\ 5p^1\ ^2D$
389	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5p^1$	^2S	0.5	13097616	87%
390	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5d^1$	^2D	1.5	13119131	97%
391	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5d^1$	^2F	2.5	13119873	88%
392	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5d^1$	^2F	3.5	13120241	97%
393	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5d^1$	^2D	2.5	13121768	88%
394	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5d^1$	^2P	0.5	13126394	97%
395	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5d^1$	^2P	1.5	13128371	97%
396	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5f^1$	^2F	2.5	13133808	97%
397	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5f^1$	^2F	3.5	13134781	97%
398	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5g^1$	^2G	3.5	13138485	97%
399	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5f^1$	^2G	3.5	13138756	97%
400	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5g^1$	^2G	4.5	13139009	97%
401	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5f^1$	^2G	4.5	13139549	97%
402	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5f^1$	^2D	1.5	13141514	97%
403	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5f^1$	^2D	2.5	13142299	97%
404	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5g^1$	^2H	4.5	13142538	96%
405	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5g^1$	^2H	5.5	13143067	97%
406	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5g^1$	^2F	2.5	13143102	97%
407	$1s^2\ 2s^1\ 2p^1\ (^1P)\ 5g^1$	^2F	3.5	13143620	97%

Table 2. Suggested change of spectroscopic identifications of levels to ensure the completeness of spectroscopic dataset. The indices of levels for which spectroscopic identifications are changed are presented in the first column. The second column contains index of level with the same highest contribution of configuration state function (Table 1) as level from the first column before change. Indices of levels in the first two columns are taken from Table 1.

Index	Index	Changed CSF
88	81	$2p^2$ (^3P) $3p^1$ $^2D_{2.5}$
87	93	$2p^2$ (^3P) $3d^1$ $^4D_{2.5}$
117	109	$2p^2$ (^1D) $3d^1$ $^2F_{3.5}$
120	110	$2p^2$ (^1D) $3d^1$ $^2F_{2.5}$
152	175	$2s^1$ $2p^1$ (^3P) $4f^1$ $^4D_{3.5}$
161	177	$2s^1$ $2p^1$ (^3P) $4f^1$ $^2F_{2.5}$
209	214	$2p^2$ (^3P) $4p^1$ $^4P_{1.5}$
224	213	$2p^2$ (^3P) $4d^1$ $^2P_{1.5}$
228	215	$2p^2$ (^3P) $4d^1$ $^4P_{2.5}$
219	233	$2p^2$ (^3P) $4f^1$ $^2D_{2.5}$
234	220	$2p^2$ (^3P) $4f^1$ $^4G_{3.5}$
306	305	$2s^1$ $2p^1$ (^3P) $5p^1$ $^4S_{1.5}$
310	317	$2s^1$ $2p^1$ (^3P) $5d^1$ $^4P_{2.5}$
314	351	$2s^1$ $2p^1$ (^3P) $5f^1$ $^4D_{3.5}$
315	334	$2s^1$ $2p^1$ (^3P) $5g^1$ $^2F_{3.5}$
316	364	$2s^1$ $2p^1$ (^3P) $5g^1$ $^2H_{4.5}$

Table 3. Comparison of calculated energies E^{GRASP} and E^{CITRO} for Fe XXII levels with data compiled by NIST (E^{NIST}). Indices of levels in the first column and CSFs in the second column are taken from Table 1. Energies are in cm^{-1}. The lifetimes of levels are presented in the last two columns.

Index	CSF	E^{NIST}	E^{CITRO}	E^{GRASP}	τ^{CITRO} (s)	τ^{GRASP} (s)
2	$1s^2\ 2s^2\ 2p^1\ {}^2P_{1.5}$	118266	115650	117953	7.19E−05	6.81E−05
3	$1s^2\ 2s^1\ 2p^2\ {}^4P_{0.5}$	404550	399846	402902	1.06E−08	1.09E−08
4	$1s^2\ 2s^1\ 2p^2\ {}^4P_{1.5}$	460190	454430	458031	9.81E−08	1.02E−07
5	$1s^2\ 2s^1\ 2p^2\ {}^4P_{2.5}$	513260	506869	511295	1.41E−08	1.48E−08
6	$1s^2\ 2s^1\ 2p^2\ {}^2D_{1.5}$	736310	728951	741538	9.49E−11	9.13E−11
7	$1s^2\ 2s^1\ 2p^2\ {}^2D_{2.5}$	759210	751725	763743	1.71E−10	1.65E−10
8	$1s^2\ 2s^1\ 2p^2\ {}^2P_{0.5}$	853650	847120	861921	2.64E−11	2.55E−11
9	$1s^2\ 2s^1\ 2p^2\ {}^2S_{0.5}$	978350	969456	986277	2.82E−11	2.71E−11
10	$1s^2\ 2s^1\ 2p^2\ {}^2P_{1.5}$	992320	983323	1000692	2.01E−11	1.94E−11
11	$1s^2\ 2p^3\ {}^4S_{1.5}$	1255700	1245542	1260179	2.29E−11	2.22E−11
12	$1s^2\ 2p^3\ {}^2D_{1.5}$	1396110	1384720	1405688	4.69E−11	4.61E−11
13	$1s^2\ 2p^3\ {}^2D_{2.5}$	1426570	1414255	1435674	4.89E−11	4.77E−11
14	$1s^2\ 2p^3\ {}^2P_{0.5}$	1569630	1556753	1582452	2.33E−11	2.24E−11
15	$1s^2\ 2p^3\ {}^2P_{1.5}$	1627720	1613294	1639226	2.38E−11	2.30E−11
20	$1s^2\ 2s^2\ 3d^1\ {}^2D_{1.5}$	8498000	8508732	8491152	5.10E−14	5.12E−14
21	$1s^2\ 2s^2\ 3d^1\ {}^2D_{2.5}$	8507000	8518565	8501013	5.26E−14	5.31E−14
28	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3p^1\ {}^2P_{1.5}$	8688000	8707856	8695560	2.85E−13	2.96E−13
29	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3p^1\ {}^2P_{0.5}$	8584000	8716292	8704356	1.35E−13	1.38E−13
32	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3p^1\ {}^2D_{1.5}$	8740000	8758943	8748534	1.94E−13	1.99E−13
39	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3p^1\ {}^2D_{2.5}$	8845000	8862704	8857624	1.30E−13	1.35E−13
40	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^4F_{3.5}$	8864000	8870786	8857700	1.68E−13	1.64E−13
41	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^4P_{2.5}$	8874000	8882016	8868503	5.84E−14	5.93E−14
42	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^4D_{1.5}$	8882000	8890791	8878309	5.97E−14	4.23E−14
43	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^4D_{0.5}$	8888000	8895387	8881447	3.73E−14	3.52E−14
49	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^2D_{2.5}$	8938000	8940836	8930222	6.80E−14	6.84E−14
50	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^4D_{3.5}$	8962000	8965402	8955370	4.06E−14	4.13E−14
51	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^4D_{2.5}$	8973000	8976048	8966348	4.40E−14	4.44E−14
52	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^4P_{1.5}$	8972000	8981681	8972247	4.90E−14	4.94E−14
53	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^4P_{0.5}$	8973000	8985011	8975643	5.65E−14	5.70E−14
54	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^2F_{2.5}$	9030000	9012908	9004790	6.49E−14	6.53E−14
55	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^2P_{1.5}$	9180000	9049954	9043521	6.53E−14	6.56E−14
56	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^2F_{3.5}$	9062000	9066838	9060831	4.45E−14	4.42E−14
59	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 3d^1\ {}^2P_{0.5}$	8967000	9084039	9078984	5.74E−14	5.74E−14
66	$1s^2\ 2s^1\ 2p^1\ ({}^1P)\ 3d^1\ {}^2F_{3.5}$	9242000	9249517	9250872	7.00E−14	7.18E−14
67	$1s^2\ 2s^1\ 2p^1\ ({}^1P)\ 3d^1\ {}^2F_{2.5}$	9249000	9251362	9253139	4.85E−14	4.91E−14
69	$1s^2\ 2s^1\ 2p^1\ ({}^1P)\ 3d^1\ {}^2D_{1.5}$	9134000	9262676	9263777	4.20E−14	4.17E−14
71	$1s^2\ 2s^1\ 2p^1\ ({}^1P)\ 3d^1\ {}^2D_{2.5}$	9272000	9275516	9276912	4.15E−14	4.14E−14
74	$1s^2\ 2s^1\ 2p^1\ ({}^1P)\ 3d^1\ {}^2P_{1.5}$	9168000	9299040	9300838	6.00E−14	6.26E−14
126	$1s^2\ 2s^2\ 4s^1\ {}^2S_{0.5}$	11050000	11012901	10986106	6.37E−13	5.83E−13
129	$1s^2\ 2s^2\ 4d^1\ {}^2D_{1.5}$	11140000	11159006	11135585	1.28E−13	1.24E−13
130	$1s^2\ 2s^2\ 4d^1\ {}^2D_{2.5}$	11140000	11162502	11139649	1.28E−13	1.26E−13
142	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 4p^1\ {}^2P_{0.5}$	11465000	11478060	11460571	2.70E−13	2.47E−13
143	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 4p^1\ {}^2D_{1.5}$	11474000	11487446	11470801	2.70E−13	2.64E−13
146	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 4d^1\ {}^4F_{2.5}$	11492000	11509097	11489897	1.78E−13	1.77E−13
149	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 4d^1\ {}^4D_{1.5}$	11526000	11536933	11518812	1.15E−13	1.11E−13
156	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 4d^1\ {}^2F_{2.5}$	11558000	11557332	11541402	1.23E−13	1.18E−13
168	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 4d^1\ {}^4D_{3.5}$	11618000	11618692	11604622	1.26E−13	1.22E−13
169	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 4d^1\ {}^4D_{2.5}$	11618000	11621954	11607936	1.16E−13	1.12E−13
172	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 4d^1\ {}^2D_{2.5}$	11611000	11633161	11620801	1.43E−13	1.38E−13
174	$1s^2\ 2s^1\ 2p^1\ ({}^3P)\ 4d^1\ {}^2F_{3.5}$	11900000	11652015	11641117	9.77E−14	9.30E−14
194	$1s^2\ 2s^1\ 2p^1\ ({}^1P)\ 4d^1\ {}^2F_{2.5}$	11897000	11903101	11903215	1.52E−13	1.45E−13
195	$1s^2\ 2s^1\ 2p^1\ ({}^1P)\ 4d^1\ {}^2F_{3.5}$	11649000	11902966	11903365	2.06E−13	2.01E−13
196	$1s^2\ 2s^1\ 2p^1\ ({}^1P)\ 4d^1\ {}^2D_{2.5}$	11906000	11908125	11908277	1.06E−13	1.02E−13
270	$1s^2\ 2s^2\ 5d^1\ {}^2D_{1.5}$	12359000	12377319	12351697	2.32E−13	2.44E−13

Table 4. Comparison of calculated wavelengths ($\lambda^{\rm GRASP}$, $\lambda^{\rm CITRO}$) and line strengths ($S^{\rm GRASP}$, $S^{\rm CITRO}$) for Fe XXII with values presented by NIST ($\lambda^{\rm NIST}$, $S^{\rm NIST}$). Indices of levels in the first two columns are taken from Table 1.

k	i	$\lambda^{\rm NIST}$ (Å)	$\lambda^{\rm CITRO}$ (Å)	$\lambda^{\rm GRASP}$ (Å)	$S^{\rm NIST}$	$S^{\rm CITRO}$	$S^{\rm GRASP}$
1	2	845.52	864.68	847.80	1.33E+00	1.33E+00	1.33E+00
1	3	247.19	250.10	248.20	1.30E−03	1.18E−03	1.24E−03
1	6	135.81	137.18	134.85	5.40E−02	5.29E−02	5.36E−02
1	8	117.14	118.05	116.02	6.20E−02	6.05E−02	6.13E−02
1	9	102.22	103.15	101.39	2.80E−03	2.28E−03	2.32E−03
1	10	100.77	101.70	99.93	1.25E−02	1.25E−02	1.27E−02
1	20	11.77	11.75	11.78	5.10E−02	5.28E−02	5.27E−02
1	126	9.06	9.08	9.10	1.40E−04	2.52E−04	2.10E−004
1	129	8.98	8.96	8.98	6.60E−03	7.61E−03	7.26E−003
2	3	349.30	351.87	350.94	5.90E−04	5.55E−04	5.78E−04
2	4	292.46	295.18	294.05	4.20E−04	3.98E−04	4.16E−04
2	5	253.17	255.61	254.23	3.40E−03	3.30E−03	3.50E−03
2	6	161.74	163.05	160.36	3.20E−04	2.64E−04	2.46E−04
2	7	156.02	157.21	154.85	7.00E−02	6.67E−02	6.75E−02
2	8	136.01	136.71	134.41	3.00E−05	1.65E−04	1.97E−04
2	9	116.26	117.12	115.16	5.48E−02	5.23E−02	5.28E−02
2	10	114.41	115.25	113.28	1.30E−01	1.30E−01	1.32E−01
2	20	11.94	11.91	11.94	1.00E−02	1.06E−02	1.06E−02
2	21	11.92	11.91	11.93	9.00E−02	9.46E−02	9.48E−02
2	126	9.14	9.18	9.20	4.20E−04	5.42E−04	5.02E−04
2	129	9.07	9.06	9.08	1.40E−03	1.54E−03	1.47E−03
2	130	9.07	9.05	9.07	1.20E−02	1.38E−02	1.33E−02
3	11	117.52	118.25	116.65	3.30E−02	3.20E−02	3.24E−02
3	12	100.82	101.54	99.72	6.70E−05	7.28E−05	1.03E−04
3	14	85.83	86.44	84.78	1.40E−04	1.30E−04	1.32E−04
3	42	11.80	11.78	11.80	5.50E−02	5.38E−02	3.32E−02
3	43	11.79	11.78	11.79	4.20E−02	4.31E−02	4.11E−02
3	149	8.99	8.98	9.00	7.00E−03	7.67E−03	7.25E−03
4	11	125.71	126.40	124.67	5.96E−02	5.76E−02	5.81E−02
4	12	106.81	107.49	105.52	5.50E−03	5.10E−03	5.52E−03
4	13	103.45	104.19	102.29	1.60E−04	1.37E−04	1.32E−04
4	15	85.65	86.29	84.66	3.60E−04	3.70E−04	3.97E−04
4	41	11.89	11.87	11.89	6.50E−02	6.87E−02	6.92E−02
4	51	11.75	11.73	11.75	2.30E−02	1.92E−02	1.89E−02
4	52	11.75	11.73	11.75	3.80E−02	3.68E−02	3.68E−02
4	53	11.75	11.72	11.74	2.90E−02	2.78E−02	2.79E−02
4	146	9.07	9.05	9.06	7.70E−03	7.39E−03	7.23E−03
5	11	134.65	135.38	133.53	9.46E−02	9.11E−02	9.27E−02
5	12	113.23	113.91	111.81	6.30E−04	5.83E−04	7.01E−04
5	13	109.53	110.21	108.18	7.40E−03	7.15E−03	7.42E−03
5	15	89.73	90.38	88.66	2.10E−04	1.94E−04	2.04E−04
5	40	11.98	11.96	11.98	4.00E−02	3.97E−02	3.87E−02
5	50	11.84	11.82	11.84	1.50E−01	1.57E−01	1.59E−01
5	51	11.84	11.81	11.83	8.30E−02	8.35E−02	8.37E−02
5	52	11.82	11.80	11.82	2.60E−02	2.64E−02	2.65E−02
5	168	9.01	9.00	9.01	1.60E−02	1.87E−02	1.79E−02
5	169	9.01	9.00	9.01	1.10E−02	1.08E−02	1.01E−02
6	11	192.61	193.58	192.81	1.80E−03	1.81E−03	2.03E−03
6	12	151.54	152.49	150.57	5.20E−02	4.99E−02	5.04E−02
6	13	144.85	145.92	144.06	3.19E−02	2.99E−02	3.03E−02
6	14	120.03	120.80	118.92	5.05E−02	4.73E−02	4.77E−02
6	15	112.21	113.08	111.40	1.40E−02	1.33E−02	1.35E−02
6	49	12.19	12.18	12.21	5.30E−02	4.18E−02	4.02E−02
6	54	12.05	12.07	12.10	3.20E−02	3.55E−02	3.59E−02
6	67	11.75	11.73	11.75	7.70E−02	9.04E−02	9.12E−02
6	156	9.24	9.24	9.26	1.20E−02	1.32E−02	1.23E−02
6	194	8.96	8.95	8.96	8.10E−03	9.98E−03	9.50E−03

Table 4. continued.

k	i	$\lambda^{\rm NIST}$ (Å)	$\lambda^{\rm CITRO}$ (Å)	$\lambda^{\rm GRASP}$ (Å)	$S^{\rm NIST}$	$S^{\rm CITRO}$	$S^{\rm GRASP}$
7	12	157.03	157.98	155.78	3.80E−02	3.56E−02	3.64E−02
7	13	149.87	150.94	148.82	1.28E−01	1.22E−01	1.23E−01
7	15	115.19	116.07	114.22	4.31E−02	4.09E−02	4.11E−02
7	54	12.10	12.10	12.13	4.10E−02	3.68E−02	3.64E−02
7	56	12.05	12.03	12.05	1.70E−01	1.55E−01	1.53E−01
7	66	11.79	11.77	11.78	7.80E−02	8.88E−02	9.07E−02
7	172	9.22	9.19	9.21	6.30E−03	6.65E−03	6.32E−03
7	174	8.98	9.17	9.19	7.10E−03	2.80E−02	2.62E−02
7	195	9.18	8.97	8.98	2.50E−02	9.27E−03	8.88E−03
8	11	248.62	250.99	251.09	3.60E−03	3.56E−03	3.97E−03
8	12	184.18	186.01	183.90	8.20E−02	7.74E−02	7.83E−02
8	14	139.64	140.92	138.79	7.00E−03	6.93E−03	6.93E−03
8	15	129.17	130.52	128.65	1.59E−02	1.52E−02	1.52E−02
8	55	12.01	12.19	12.22	2.50E−02	2.54E−02	2.53E−02
8	59	12.33	12.14	12.17	2.80E−02	4.60E−03	4.59E−03
8	69	12.08	11.88	11.90	3.50E−02	2.65E−02	2.63E−02
8	74	12.03	11.83	11.85	2.40E−02	3.77E−03	3.80E−03
9	11	360.39	362.21	365.09	1.10E−03	9.46E−04	1.02E−03
9	12	239.12	240.81	238.43	2.30E−02	1.94E−02	1.93E−02
9	14	169.08	170.27	167.74	5.70E−02	5.18E−02	5.25E−02
9	15	153.96	155.32	153.15	1.25E−02	1.26E−02	1.30E−02
9	55	12.19	12.38	12.41	2.60E−02	1.68E−02	1.67E−02
9	59	12.52	12.32	12.36	2.90E−02	2.51E−02	2.49E−02
9	69	12.26	12.06	12.08	3.60E−02	3.34E−02	3.28E−02
10	11	379.64	381.36	385.38	3.30E−03	3.05E−03	3.24E−03
10	12	247.45	249.13	246.92	1.30E−03	1.53E−03	1.56E−03
10	13	230.10	232.06	229.89	1.22E−01	1.15E−01	1.16E−01
10	14	173.21	174.39	171.89	1.10E−02	1.07E−02	1.07E−02
10	15	157.37	158.74	156.61	1.50E−01	1.43E−01	1.45E−01
10	55	12.21	12.40	12.43	3.50E−02	8.48E−03	8.45E−03
10	71	12.08	12.06	12.08	1.30E−01	1.20E−01	1.19E−01
10	196	9.16	9.15	9.17	1.60E−02	1.72E−02	1.64E−02

Table 5. The five major spontaneous radiative transition probabilities A^r from each level of Fe XXII and the sum of all radiative probabilities $\sum A^r$ from the corresponding level. Electric dipole, quadrupole and octupole as well as magnetic dipole and quadrupole transitions are included. Arrow marks the final level to which radiative transition happens from the level.

Level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	$\sum A^r$ (s^{-1})
2	1.47E+04	→ 1									1.47E+04
3	7.84E+07	→ 1	1.30E+07	→ 2							9.14E+07
4	7.93E+06	→ 2	1.89E+06	→ 1	3.60E+03	→ 3					9.82E+06
5	6.78E+07	→ 2	2.36E+03	→ 4	6.81E+00	→ 1	6.27E-01	→ 3			6.78E+07
6	1.09E+10	→ 1	3.25E+07	→ 2	7.86E+03	→ 4	4.95E+03	→ 5	3.50E+03	→ 3	1.10E+10
7	6.06E+09	→ 2	3.10E+04	→ 5	1.42E+04	→ 4	1.10E+02	→ 6	3.93E+01	→ 1	6.06E+09
8	3.92E+10	→ 1	6.88E+07	→ 2	5.52E+04	→ 4	5.48E+04	→ 3	7.23E+02	→ 6	3.93E+10
9	3.47E+10	→ 2	2.22E+09	→ 1	1.01E+05	→ 4	1.69E+04	→ 8	5.53E+03	→ 6	3.69E+10
10	4.52E+10	→ 2	6.36E+09	→ 1	2.01E+04	→ 6	1.67E+04	→ 4	1.43E+04	→ 8	5.16E+10
11	1.94E+10	→ 5	1.51E+10	→ 4	1.02E+10	→ 3	1.28E+08	→ 6	1.14E+08	→ 8	4.49E+10
12	7.41E+09	→ 6	6.30E+09	→ 8	4.77E+09	→ 7	2.20E+09	→ 4	7.26E+08	→ 9	2.17E+10
13	1.25E+10	→ 7	3.38E+09	→ 6	3.18E+09	→ 10	1.91E+09	→ 5	4.34E+07	→ 4	2.10E+10
14	2.85E+10	→ 6	1.11E+10	→ 9	2.62E+09	→ 8	2.13E+09	→ 10	2.17E+08	→ 3	4.46E+10
15	1.89E+10	→ 10	1.39E+10	→ 7	4.87E+09	→ 6	3.62E+09	→ 8	1.78E+09	→ 9	4.35E+10
16	1.90E+12	→ 2	8.94E+11	→ 1	1.18E+08	→ 15	9.19E+07	→ 11	5.64E+07	→ 12	2.79E+12
17	1.92E+11	→ 6	3.71E+10	→ 9	3.90E+09	→ 2	3.74E+09	→ 4	1.00E+09	→ 16	2.38E+11
18	1.56E+11	→ 7	2.70E+10	→ 8	2.56E+10	→ 10	2.30E+10	→ 5	1.06E+10	→ 6	2.52E+11
19	2.48E+12	→ 4	5.38E+11	→ 3	2.84E+10	→ 6	3.85E+09	→ 9	6.30E+08	→ 8	3.05E+12
20	1.64E+13	→ 1	3.15E+12	→ 2	1.21E+09	→ 12	8.63E+08	→ 17	1.13E+08	→ 8	1.95E+13
21	1.88E+13	→ 2	1.10E+09	→ 13	7.29E+08	→ 18	2.19E+08	→ 15	1.38E+08	→ 11	1.88E+13
22	1.45E+12	→ 5	1.33E+12	→ 3	3.47E+11	→ 4	3.52E+10	→ 6	2.41E+10	→ 7	3.19E+12
23	1.54E+12	→ 6	6.16E+11	→ 8	5.13E+10	→ 9	2.54E+10	→ 4	4.83E+09	→ 10	2.24E+12
24	2.20E+12	→ 5	1.12E+12	→ 4	1.06E+11	→ 7	3.01E+09	→ 6	2.66E+09	→ 10	3.42E+12
25	1.53E+12	→ 1	2.18E+11	→ 2	1.46E+10	→ 12	2.95E+09	→ 4	2.25E+09	→ 14	1.77E+12
26	7.38E+11	→ 2	7.17E+11	→ 1	1.01E+10	→ 13	2.06E+09	→ 14	1.22E+09	→ 4	1.47E+12
27	1.89E+12	→ 7	5.21E+11	→ 9	2.05E+11	→ 8	1.47E+11	→ 6	1.23E+11	→ 10	2.94E+12
28	2.35E+12	→ 1	9.90E+11	→ 2	3.09E+10	→ 13	3.44E+09	→ 11	3.26E+09	→ 14	3.38E+12
29	6.49E+12	→ 1	6.12E+11	→ 2	1.16E+11	→ 12	5.06E+09	→ 11	5.03E+09	→ 14	7.23E+12
30	4.15E+10	→ 2	2.93E+09	→ 11	2.02E+09	→ 3	1.64E+09	→ 5	1.48E+09	→ 22	5.09E+10
31	2.52E+11	→ 1	1.52E+11	→ 2	2.53E+10	→ 11	3.31E+09	→ 14	2.91E+09	→ 15	4.42E+11
32	4.91E+12	→ 1	5.06E+10	→ 2	3.85E+10	→ 13	1.21E+10	→ 12	8.63E+09	→ 14	5.03E+12
33	2.27E+09	→ 5	1.62E+09	→ 4	1.43E+09	→ 24	1.18E+08	→ 7	1.73E+07	→ 13	5.47E+09
34	3.26E+12	→ 2	1.04E+12	→ 1	4.01E+10	→ 12	7.58E+09	→ 13	7.20E+09	→ 14	4.36E+12
35	6.48E+11	→ 4	6.38E+11	→ 3	4.97E+11	→ 6	4.72E+10	→ 5	2.27E+10	→ 7	1.87E+12
36	2.56E+12	→ 2	7.38E+11	→ 1	2.19E+10	→ 12	1.23E+10	→ 11	6.51E+09	→ 13	3.35E+12
37	2.13E+12	→ 2	1.43E+10	→ 13	1.22E+10	→ 11	9.91E+09	→ 15	1.61E+09	→ 24	2.17E+12
38	2.78E+12	→ 4	7.49E+11	→ 5	1.76E+11	→ 7	1.03E+11	→ 6	1.46E+09	→ 10	3.81E+12
39	7.32E+12	→ 2	6.68E+10	→ 13	2.08E+10	→ 15	1.32E+10	→ 11	1.09E+09	→ 18	7.43E+12
40	5.84E+12	→ 5	2.49E+11	→ 7	4.96E+08	→ 30	2.91E+07	→ 2	7.05E+06	→ 21	6.09E+12
41	1.38E+13	→ 4	1.23E+12	→ 7	1.13E+12	→ 5	5.26E+11	→ 6	1.68E+11	→ 10	1.69E+13
42	1.66E+13	→ 3	5.23E+12	→ 4	1.11E+12	→ 6	2.93E+11	→ 8	2.27E+11	→ 5	2.36E+13
43	2.66E+13	→ 3	1.27E+12	→ 4	2.62E+11	→ 6	2.12E+11	→ 9	5.16E+10	→ 10	2.84E+13
44	7.66E+12	→ 2	1.53E+12	→ 1	1.82E+11	→ 15	9.42E+10	→ 14	2.07E+10	→ 11	9.51E+12
45	1.71E+12	→ 9	1.23E+12	→ 6	9.69E+11	→ 10	9.34E+11	→ 3	4.22E+10	→ 8	4.92E+12
46	2.25E+12	→ 8	1.15E+12	→ 10	9.86E+11	→ 6	7.98E+11	→ 7	5.62E+11	→ 3	6.08E+12
47	3.74E+12	→ 6	3.21E+12	→ 8	1.28E+12	→ 3	5.75E+11	→ 10	5.64E+11	→ 7	1.02E+13
48	4.56E+08	→ 33	1.24E+07	→ 7	1.67E+06	→ 5	9.33E+05	→ 4	7.28E+03	→ 24	4.70E+08
49	7.75E+12	→ 6	4.71E+12	→ 4	1.23E+12	→ 7	6.54E+11	→ 10	2.64E+11	→ 5	1.46E+13
50	2.40E+13	→ 5	2.21E+11	→ 7	2.59E+08	→ 37	2.34E+08	→ 33	7.73E+07	→ 2	2.42E+13
51	1.70E+13	→ 5	4.00E+12	→ 4	1.17E+12	→ 6	3.20E+11	→ 7	1.44E+10	→ 10	2.25E+13
52	1.15E+13	→ 4	8.10E+12	→ 5	3.09E+11	→ 7	1.49E+11	→ 8	1.11E+11	→ 3	2.03E+13
53	1.74E+13	→ 4	5.08E+10	→ 3	3.72E+10	→ 10	3.19E+10	→ 6	1.57E+10	→ 9	1.75E+13
54	6.96E+12	→ 7	6.76E+12	→ 6	1.02E+12	→ 10	4.20E+11	→ 5	1.32E+11	→ 4	1.53E+13
55	7.05E+12	→ 8	4.44E+12	→ 9	2.24E+12	→ 10	9.64E+11	→ 7	3.20E+11	→ 6	1.53E+13
56	2.25E+13	→ 7	1.23E+11	→ 5	1.50E+10	→ 2	1.10E+09	→ 39	4.12E+08	→ 37	2.26E+13
57	1.99E+12	→ 2	7.91E+11	→ 1	5.31E+11	→ 12	1.46E+11	→ 14	7.69E+10	→ 11	3.56E+12
58	1.74E+12	→ 2	1.44E+11	→ 13	2.13E+10	→ 14	1.82E+10	→ 15	1.78E+10	→ 17	1.97E+12
59	1.35E+13	→ 9	2.59E+12	→ 8	9.03E+11	→ 10	2.79E+11	→ 6	1.56E+11	→ 3	1.74E+13
60	1.08E+12	→ 2	1.63E+10	→ 18	7.82E+09	→ 15	6.10E+09	→ 12	1.91E+09	→ 11	1.12E+12

Table 5. continued.

Level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	$\sum A^r$ (s^{-1})
61	1.53E+12	→ 2	4.55E+11	→ 1	3.78E+11	→ 13	1.20E+11	→ 15	3.04E+10	→ 14	2.57E+12
62	9.67E+11	→ 11	2.75E+11	→ 2	5.93E+10	→ 12	1.40E+10	→ 14	1.22E+10	→ 1	1.35E+12
63	6.34E+11	→ 11	4.71E+11	→ 1	1.26E+11	→ 2	1.97E+10	→ 14	1.86E+10	→ 12	1.30E+12
64	1.53E+12	→ 11	1.34E+11	→ 12	9.37E+10	→ 2	1.10E+10	→ 13	8.82E+09	→ 19	1.79E+12
65	1.74E+12	→ 11	3.24E+11	→ 13	8.22E+10	→ 2	9.14E+09	→ 24	6.66E+09	→ 22	2.17E+12
66	1.38E+13	→ 7	1.55E+11	→ 5	1.20E+10	→ 21	4.43E+09	→ 2	5.04E+08	→ 60	1.39E+13
67	1.88E+13	→ 6	1.47E+12	→ 7	2.42E+10	→ 5	2.39E+10	→ 10	2.08E+10	→ 4	2.04E+13
68	2.41E+12	→ 12	7.73E+11	→ 14	4.86E+11	→ 1	2.86E+11	→ 2	1.01E+11	→ 15	4.09E+12
69	9.60E+12	→ 9	7.97E+12	→ 8	3.18E+12	→ 6	3.08E+12	→ 10	1.12E+11	→ 7	2.40E+13
70	4.32E+12	→ 8	2.10E+12	→ 3	3.33E+11	→ 9	5.44E+10	→ 10	8.75E+09	→ 26	6.84E+12
71	2.30E+13	→ 10	7.97E+11	→ 7	3.75E+11	→ 6	2.21E+10	→ 21	9.27E+09	→ 4	2.42E+13
72	1.64E+12	→ 13	8.41E+11	→ 14	5.95E+11	→ 12	3.29E+11	→ 2	2.06E+11	→ 1	3.81E+12
73	1.02E+13	→ 8	3.36E+12	→ 10	1.05E+12	→ 6	3.94E+11	→ 3	4.88E+10	→ 9	1.51E+13
74	8.15E+12	→ 10	5.78E+12	→ 9	1.15E+12	→ 8	4.84E+11	→ 3	2.59E+11	→ 7	1.60E+13
75	2.45E+12	→ 3	1.75E+12	→ 9	8.69E+11	→ 10	4.60E+11	→ 4	7.62E+10	→ 7	5.65E+12
76	1.66E+12	→ 4	1.48E+12	→ 10	5.64E+11	→ 8	4.36E+11	→ 9	2.76E+11	→ 3	4.70E+12
77	1.59E+12	→ 4	9.11E+11	→ 8	7.68E+11	→ 9	6.06E+11	→ 5	2.51E+11	→ 3	4.46E+12
78	3.15E+12	→ 4	2.36E+11	→ 5	3.43E+10	→ 10	4.35E+09	→ 30	3.63E+09	→ 33	3.45E+12
79	2.13E+12	→ 4	1.11E+12	→ 8	5.37E+11	→ 9	4.87E+11	→ 3	2.99E+11	→ 6	4.81E+12
80	1.92E+12	→ 13	7.00E+11	→ 12	4.97E+11	→ 15	1.31E+11	→ 11	1.24E+11	→ 2	3.38E+12
81	2.30E+12	→ 5	1.13E+12	→ 10	3.82E+11	→ 7	3.67E+11	→ 4	9.47E+10	→ 6	4.29E+12
82	1.32E+12	→ 8	1.01E+12	→ 6	7.22E+11	→ 4	6.55E+11	→ 10	5.18E+11	→ 9	5.00E+12
83	2.19E+12	→ 15	8.41E+11	→ 12	2.99E+11	→ 13	2.67E+11	→ 2	8.05E+10	→ 14	3.73E+12
84	3.27E+12	→ 5	4.48E+10	→ 7	8.68E+09	→ 33	4.83E+09	→ 30	1.95E+09	→ 11	3.33E+12
85	6.02E+11	→ 11	6.00E+11	→ 12	7.46E+10	→ 15	6.46E+10	→ 1	3.67E+10	→ 14	1.41E+12
86	2.18E+12	→ 5	1.16E+12	→ 4	7.37E+11	→ 7	6.08E+11	→ 10	4.56E+11	→ 6	5.66E+12
87	2.14E+12	→ 11	5.77E+11	→ 12	1.20E+11	→ 13	8.94E+09	→ 2	8.16E+09	→ 3	2.87E+12
88	1.77E+12	→ 10	1.37E+12	→ 5	1.09E+12	→ 6	2.41E+11	→ 7	7.56E+10	→ 4	4.56E+12
89	1.74E+12	→ 5	1.28E+12	→ 8	1.27E+12	→ 10	1.12E+12	→ 6	4.85E+11	→ 9	6.35E+12
90	3.97E+12	→ 10	8.66E+11	→ 8	3.20E+11	→ 9	9.86E+10	→ 4	3.87E+10	→ 3	5.33E+12
91	3.35E+11	→ 13	9.88E+09	→ 4	3.95E+09	→ 48	3.37E+09	→ 40	2.47E+09	→ 38	3.59E+11
92	2.16E+12	→ 11	8.39E+11	→ 13	7.54E+11	→ 15	5.22E+11	→ 14	4.76E+11	→ 12	4.83E+12
93	2.63E+12	→ 11	3.58E+11	→ 12	1.93E+10	→ 13	8.96E+09	→ 15	4.34E+09	→ 4	3.03E+12
94	6.83E+11	→ 11	5.84E+11	→ 14	3.25E+11	→ 12	1.88E+11	→ 15	1.46E+10	→ 35	1.82E+12
95	1.61E+12	→ 6	1.43E+12	→ 10	5.52E+11	→ 7	1.06E+11	→ 5	5.27E+10	→ 4	3.76E+12
96	6.88E+09	→ 5	2.61E+09	→ 41	2.23E+09	→ 48	1.72E+09	→ 50	1.59E+09	→ 40	2.14E+10
97	1.03E+10	→ 5	7.30E+09	→ 48	3.01E+09	→ 40	6.60E+08	→ 50	4.63E+08	→ 84	2.21E+10
98	4.31E+12	→ 12	7.46E+11	→ 11	6.24E+11	→ 15	5.02E+11	→ 14	2.17E+11	→ 13	6.46E+12
99	6.31E+12	→ 11	2.31E+12	→ 12	7.81E+11	→ 13	4.82E+10	→ 15	4.12E+09	→ 40	9.47E+12
100	3.19E+12	→ 7	1.52E+11	→ 5	4.76E+09	→ 60	3.58E+09	→ 33	1.48E+09	→ 13	3.36E+12
101	2.96E+12	→ 7	1.18E+12	→ 8	1.18E+12	→ 6	6.26E+11	→ 10	2.79E+11	→ 9	6.43E+12
102	3.76E+12	→ 7	3.12E+12	→ 10	1.12E+11	→ 6	3.23E+09	→ 37	2.90E+09	→ 58	7.01E+12
103	1.69E+13	→ 11	2.37E+12	→ 13	1.12E+11	→ 15	2.53E+10	→ 12	1.81E+10	→ 2	1.94E+13
104	5.87E+12	→ 14	2.21E+12	→ 11	2.71E+11	→ 15	8.64E+10	→ 12	7.14E+10	→ 1	8.60E+12
105	4.31E+12	→ 6	2.38E+11	→ 10	1.49E+11	→ 8	1.39E+11	→ 9	4.08E+09	→ 4	4.86E+12
106	2.42E+13	→ 11	9.87E+11	→ 13	4.01E+10	→ 14	3.69E+10	→ 2	8.46E+09	→ 5	2.53E+13
107	3.81E+12	→ 15	2.27E+12	→ 14	1.64E+12	→ 11	6.20E+10	→ 2	3.76E+10	→ 1	7.85E+12
108	2.32E+13	→ 11	1.79E+12	→ 14	1.35E+11	→ 15	4.52E+10	→ 2	4.22E+10	→ 12	2.53E+13
109	7.20E+12	→ 13	3.15E+09	→ 6	2.48E+09	→ 5	2.47E+09	→ 49	2.43E+09	→ 56	7.22E+12
110	2.00E+13	→ 12	5.56E+12	→ 13	9.88E+11	→ 11	5.10E+11	→ 15	1.58E+11	→ 2	2.73E+13
111	1.32E+13	→ 14	1.26E+12	→ 15	1.09E+12	→ 13	3.44E+11	→ 1	7.78E+10	→ 11	1.60E+13
112	2.99E+12	→ 10	1.25E+12	→ 7	9.25E+11	→ 6	3.01E+10	→ 5	2.34E+10	→ 4	5.24E+12
113	2.18E+12	→ 13	6.25E+09	→ 6	1.76E+09	→ 7	1.54E+09	→ 10	1.45E+09	→ 48	2.19E+12
114	9.69E+09	→ 7	2.95E+09	→ 48	2.02E+09	→ 66	5.73E+08	→ 100	4.20E+08	→ 5	1.60E+10
115	1.39E+13	→ 12	3.52E+12	→ 13	1.91E+12	→ 14	3.48E+11	→ 11	1.84E+11	→ 15	1.99E+13
116	1.25E+13	→ 13	1.08E+13	→ 12	1.57E+12	→ 15	3.63E+11	→ 11	2.72E+10	→ 2	2.53E+13
117	3.29E+13	→ 13	5.22E+09	→ 7	4.33E+09	→ 56	3.62E+09	→ 10	1.63E+09	→ 67	3.29E+13
118	8.35E+12	→ 12	8.03E+12	→ 14	1.57E+11	→ 15	1.04E+11	→ 1	7.73E+10	→ 11	1.68E+13
119	4.76E+12	→ 9	3.47E+11	→ 8	2.25E+11	→ 10	2.88E+10	→ 6	2.41E+10	→ 58	5.40E+12
120	1.98E+13	→ 15	5.67E+12	→ 12	7.54E+11	→ 13	2.12E+11	→ 2	1.11E+11	→ 11	2.66E+13

Table 5. continued.

Level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	$\sum A^r$ (s^{-1})
121	9.83E+12	→ 15	2.75E+12	→ 12	1.11E+12	→ 14	4.71E+11	→ 11	1.35E+11	→ 2	1.43E+13
122	1.83E+13	→ 15	1.89E+12	→ 13	1.19E+12	→ 14	3.21E+11	→ 11	2.27E+11	→ 2	2.20E+13
123	2.92E+12	→ 9	1.22E+12	→ 8	4.84E+11	→ 10	1.89E+10	→ 60	1.02E+10	→ 61	4.67E+12
124	1.34E+13	→ 15	4.98E+11	→ 13	1.44E+11	→ 12	4.88E+10	→ 2	2.93E+10	→ 11	1.41E+13
125	1.55E+13	→ 14	3.48E+12	→ 15	1.15E+11	→ 12	6.98E+10	→ 13	1.96E+10	→ 67	1.92E+13
126	7.05E+11	→ 2	4.39E+11	→ 18	3.39E+11	→ 1	2.09E+11	→ 17	1.09E+10	→ 27	1.71E+12
127	7.15E+11	→ 16	1.32E+11	→ 20	4.43E+10	→ 9	3.89E+10	→ 8	1.25E+10	→ 6	9.58E+11
128	6.85E+11	→ 16	1.13E+11	→ 21	4.62E+10	→ 9	3.85E+10	→ 8	1.24E+10	→ 20	9.22E+11
129	5.32E+12	→ 1	1.36E+12	→ 17	1.04E+12	→ 2	2.73E+11	→ 18	4.26E+10	→ 23	8.06E+12
130	6.25E+12	→ 2	1.63E+12	→ 18	4.47E+10	→ 27	1.48E+10	→ 22	4.59E+09	→ 74	7.95E+12
131	3.17E+12	→ 20	2.26E+11	→ 21	1.07E+10	→ 58	5.51E+09	→ 1	3.89E+09	→ 61	3.43E+12
132	3.39E+12	→ 21	1.44E+10	→ 60	7.13E+09	→ 2	2.70E+09	→ 7	2.26E+09	→ 30	3.42E+12
133	6.96E+11	→ 4	3.23E+11	→ 28	1.72E+11	→ 25	1.70E+11	→ 3	8.33E+10	→ 6	1.65E+12
134	4.57E+11	→ 5	4.13E+11	→ 3	2.93E+11	→ 30	1.28E+11	→ 31	1.16E+11	→ 26	1.74E+12
135	6.99E+11	→ 6	2.96E+11	→ 8	2.65E+11	→ 32	1.88E+11	→ 29	7.54E+10	→ 26	1.74E+12
136	7.83E+11	→ 1	6.08E+11	→ 19	1.06E+11	→ 35	7.13E+10	→ 23	4.50E+10	→ 2	1.71E+12
137	5.90E+11	→ 19	1.19E+11	→ 1	1.07E+11	→ 22	8.46E+10	→ 38	2.90E+10	→ 2	9.85E+11
138	1.52E+12	→ 1	3.94E+11	→ 22	3.68E+11	→ 2	2.15E+11	→ 23	7.39E+10	→ 41	2.78E+12
139	7.44E+11	→ 5	6.41E+11	→ 4	2.76E+11	→ 33	2.06E+11	→ 37	8.14E+10	→ 36	2.13E+12
140	5.06E+11	→ 22	4.38E+11	→ 1	2.74E+11	→ 2	8.66E+10	→ 23	8.25E+10	→ 19	1.54E+12
141	6.80E+11	→ 22	1.83E+11	→ 2	8.84E+10	→ 40	1.33E+10	→ 41	7.75E+09	→ 38	1.01E+12
142	3.15E+12	→ 1	4.88E+11	→ 23	1.48E+11	→ 22	9.43E+10	→ 47	4.66E+10	→ 14	4.05E+12
143	2.88E+12	→ 1	4.55E+11	→ 23	1.61E+11	→ 22	7.92E+10	→ 49	4.99E+10	→ 14	3.79E+12
144	1.30E+12	→ 25	7.17E+11	→ 3	4.57E+11	→ 4	2.25E+11	→ 6	1.62E+11	→ 26	3.26E+12
145	7.70E+11	→ 7	2.66E+11	→ 39	2.14E+11	→ 9	1.11E+11	→ 10	1.10E+11	→ 44	1.93E+12
146	3.35E+12	→ 4	9.28E+11	→ 28	6.56E+11	→ 26	5.05E+11	→ 6	1.05E+11	→ 5	5.66E+12
147	1.64E+12	→ 4	7.42E+11	→ 5	6.54E+11	→ 26	4.98E+11	→ 28	3.75E+11	→ 30	4.85E+12
148	3.52E+12	→ 5	1.57E+12	→ 30	4.14E+11	→ 7	1.26E+11	→ 37	4.51E+09	→ 33	5.65E+12
149	5.34E+12	→ 3	1.31E+12	→ 4	6.73E+11	→ 31	3.89E+11	→ 26	3.47E+11	→ 32	8.99E+12
150	8.88E+12	→ 3	1.23E+12	→ 31	2.93E+11	→ 4	1.72E+11	→ 25	1.69E+11	→ 26	1.11E+13
151	2.50E+12	→ 35	3.25E+11	→ 47	2.20E+11	→ 42	9.67E+10	→ 41	9.38E+10	→ 38	3.42E+12
152	1.54E+12	→ 41	1.46E+12	→ 38	1.55E+11	→ 54	1.24E+11	→ 49	6.50E+10	→ 51	3.37E+12
153	3.54E+12	→ 8	1.16E+12	→ 29	1.13E+12	→ 6	1.72E+11	→ 3	1.10E+11	→ 26	6.52E+12
154	1.24E+12	→ 2	4.29E+11	→ 24	2.58E+11	→ 27	3.64E+10	→ 51	2.82E+10	→ 52	2.14E+12
155	6.96E+11	→ 24	8.42E+10	→ 48	2.30E+10	→ 50	1.93E+10	→ 51	4.38E+09	→ 41	8.38E+11
156	5.59E+12	→ 6	1.34E+12	→ 32	1.04E+12	→ 4	8.66E+10	→ 5	8.21E+10	→ 10	8.46E+12
157	7.57E+11	→ 2	5.69E+11	→ 24	1.32E+11	→ 27	5.47E+10	→ 50	2.16E+10	→ 51	1.63E+12
158	1.86E+12	→ 2	3.73E+11	→ 27	2.49E+11	→ 24	8.54E+10	→ 43	5.81E+10	→ 54	2.87E+12
159	2.13E+12	→ 43	7.13E+11	→ 42	1.56E+11	→ 35	1.12E+11	→ 2	6.20E+10	→ 45	3.43E+12
160	1.66E+12	→ 38	8.21E+11	→ 41	5.57E+11	→ 49	2.22E+11	→ 40	7.26E+10	→ 54	3.41E+12
161	2.37E+12	→ 42	3.53E+11	→ 41	1.95E+11	→ 38	1.74E+11	→ 47	1.12E+11	→ 49	3.43E+12
162	2.95E+12	→ 40	2.61E+11	→ 50	1.49E+11	→ 56	6.22E+09	→ 84	5.24E+09	→ 5	3.38E+12
163	1.67E+12	→ 47	4.94E+11	→ 35	3.92E+11	→ 55	2.49E+11	→ 46	1.80E+11	→ 38	3.35E+12
164	1.69E+12	→ 49	7.50E+11	→ 41	3.63E+11	→ 54	2.07E+11	→ 51	2.05E+11	→ 40	3.32E+12
165	2.90E+12	→ 2	5.24E+11	→ 27	1.07E+11	→ 24	8.99E+10	→ 56	8.15E+10	→ 47	3.90E+12
166	3.37E+12	→ 2	5.78E+11	→ 27	1.50E+11	→ 1	7.78E+10	→ 15	7.47E+10	→ 59	4.40E+12
167	1.72E+12	→ 33	2.26E+09	→ 96	1.31E+09	→ 109	1.00E+09	→ 91	5.86E+08	→ 24	1.73E+12
168	6.47E+12	→ 5	9.41E+11	→ 37	6.01E+11	→ 33	1.07E+11	→ 39	5.74E+10	→ 30	8.21E+12
169	4.97E+12	→ 5	2.12E+12	→ 4	8.18E+11	→ 37	4.71E+11	→ 34	1.28E+11	→ 33	8.97E+12
170	4.23E+12	→ 4	2.62E+12	→ 5	5.76E+11	→ 36	5.43E+11	→ 34	3.77E+11	→ 37	8.68E+12
171	5.93E+12	→ 4	9.38E+11	→ 36	6.72E+11	→ 34	5.40E+10	→ 28	1.82E+10	→ 32	7.66E+12
172	2.88E+12	→ 7	1.20E+12	→ 10	9.05E+11	→ 6	6.66E+11	→ 36	5.59E+11	→ 5	7.23E+12
173	2.28E+12	→ 9	1.36E+12	→ 10	1.05E+12	→ 8	6.36E+11	→ 44	5.45E+11	→ 7	7.36E+12
174	9.12E+12	→ 7	1.38E+12	→ 39	1.69E+11	→ 37	2.65E+10	→ 30	2.58E+10	→ 60	1.08E+13
175	1.66E+12	→ 51	8.69E+11	→ 50	3.85E+11	→ 49	1.75E+11	→ 54	1.07E+11	→ 40	3.42E+12
176	2.51E+12	→ 50	6.57E+11	→ 48	1.99E+11	→ 40	4.13E+10	→ 56	9.08E+09	→ 84	3.42E+12
177	1.28E+12	→ 52	1.15E+12	→ 51	3.57E+11	→ 55	2.18E+11	→ 49	1.46E+11	→ 50	3.43E+12
178	2.01E+12	→ 54	3.83E+11	→ 56	3.20E+11	→ 49	3.09E+11	→ 51	2.33E+11	→ 50	3.38E+12
179	3.42E+12	→ 48	9.11E+08	→ 33	5.85E+07	→ 167	5.45E+05	→ 96	2.79E+05	→ 109	3.42E+12
180	5.39E+12	→ 9	1.10E+12	→ 44	7.28E+11	→ 8	4.82E+11	→ 10	2.75E+11	→ 3	8.71E+12

Table 5. continued.

Level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	$\sum A^r$ (s^{-1})
181	1.77E+12	→ 52	9.83E+11	→ 53	3.46E+11	→ 51	1.67E+11	→ 59	5.10E+10	→ 47	3.44E+12
182	2.92E+12	→ 56	2.26E+11	→ 40	3.84E+10	→ 66	1.00E+10	→ 7	8.05E+09	→ 50	3.21E+12
183	1.66E+12	→ 55	6.17E+11	→ 54	3.15E+11	→ 52	2.84E+11	→ 51	2.48E+11	→ 47	3.39E+12
184	2.64E+12	→ 53	7.46E+11	→ 52	9.98E+09	→ 19	8.79E+09	→ 43	7.77E+09	→ 76	3.45E+12
185	2.02E+12	→ 59	7.06E+11	→ 55	1.63E+11	→ 47	1.39E+11	→ 52	7.18E+10	→ 53	3.35E+12
186	3.87E+11	→ 6	3.07E+11	→ 61	2.59E+11	→ 10	2.28E+11	→ 9	1.18E+11	→ 58	1.68E+12
187	3.80E+11	→ 10	3.14E+11	→ 60	2.59E+11	→ 7	1.59E+11	→ 58	9.69E+10	→ 6	1.56E+12
188	7.60E+11	→ 2	3.31E+11	→ 45	3.30E+11	→ 46	2.27E+11	→ 1	1.02E+11	→ 67	1.89E+12
189	1.18E+12	→ 2	4.15E+11	→ 46	2.87E+11	→ 1	2.23E+11	→ 45	9.18E+10	→ 69	2.37E+12
190	1.20E+12	→ 2	6.04E+11	→ 46	1.03E+11	→ 66	6.68E+10	→ 47	1.94E+10	→ 128	2.09E+12
191	8.99E+11	→ 2	3.48E+11	→ 1	3.40E+11	→ 45	2.91E+11	→ 46	9.40E+10	→ 71	2.12E+12
192	5.31E+11	→ 1	4.50E+11	→ 2	4.13E+11	→ 45	1.76E+11	→ 46	1.02E+11	→ 74	1.85E+12
193	2.87E+12	→ 8	2.76E+12	→ 9	1.26E+12	→ 6	9.63E+11	→ 10	8.72E+11	→ 57	9.64E+12
194	4.69E+12	→ 6	1.24E+12	→ 58	3.99E+11	→ 7	2.08E+11	→ 60	1.85E+11	→ 61	6.88E+12
195	3.25E+12	→ 7	1.62E+12	→ 60	2.32E+10	→ 39	2.21E+10	→ 80	2.18E+10	→ 5	4.98E+12
196	7.52E+12	→ 10	1.22E+12	→ 61	3.73E+11	→ 7	2.70E+11	→ 60	1.62E+11	→ 6	9.78E+12
197	4.61E+12	→ 8	1.14E+12	→ 10	7.05E+11	→ 57	3.55E+11	→ 62	3.05E+11	→ 6	7.76E+12
198	3.19E+12	→ 10	2.51E+12	→ 9	5.71E+11	→ 63	4.01E+11	→ 61	3.69E+11	→ 62	7.73E+12
199	2.70E+12	→ 69	4.36E+11	→ 67	1.22E+11	→ 71	4.26E+10	→ 47	4.03E+10	→ 55	3.45E+12
200	2.85E+12	→ 71	3.80E+11	→ 66	4.97E+10	→ 54	4.48E+10	→ 67	2.71E+10	→ 49	3.44E+12
201	2.91E+12	→ 67	1.00E+11	→ 71	1.00E+11	→ 66	5.76E+10	→ 54	5.03E+10	→ 95	3.35E+12
202	3.17E+12	→ 66	7.29E+10	→ 100	5.78E+10	→ 56	4.15E+10	→ 84	1.32E+10	→ 132	3.36E+12
203	2.07E+12	→ 73	4.77E+11	→ 69	4.03E+11	→ 74	2.56E+11	→ 70	6.27E+10	→ 75	3.46E+12
204	2.29E+12	→ 74	4.88E+11	→ 71	4.65E+11	→ 75	4.61E+10	→ 69	2.50E+10	→ 77	3.45E+12
205	5.26E+11	→ 11	2.73E+11	→ 75	1.81E+11	→ 70	1.60E+11	→ 12	6.46E+10	→ 77	1.44E+12
206	1.75E+12	→ 3	3.72E+11	→ 62	3.39E+11	→ 8	2.37E+11	→ 63	1.50E+11	→ 9	3.19E+12
207	5.28E+11	→ 11	2.76E+11	→ 78	8.63E+10	→ 77	7.54E+10	→ 13	6.10E+10	→ 82	1.37E+12
208	9.97E+11	→ 12	3.65E+11	→ 14	1.81E+11	→ 82	8.39E+10	→ 101	7.40E+10	→ 79	2.12E+12
209	1.98E+12	→ 3	3.67E+11	→ 62	3.00E+11	→ 8	2.48E+11	→ 63	1.22E+11	→ 9	3.28E+12
210	8.41E+11	→ 11	2.88E+11	→ 84	1.44E+11	→ 13	1.27E+11	→ 81	1.01E+11	→ 86	1.75E+12
211	1.36E+12	→ 4	4.46E+11	→ 10	4.25E+11	→ 64	3.54E+11	→ 8	1.56E+11	→ 9	3.45E+12
212	7.59E+11	→ 13	4.05E+11	→ 14	2.28E+11	→ 12	2.07E+11	→ 15	1.72E+11	→ 88	2.37E+12
213	1.18E+12	→ 70	4.15E+11	→ 11	2.32E+11	→ 12	1.79E+11	→ 75	1.55E+11	→ 73	2.53E+12
214	1.59E+12	→ 4	5.08E+11	→ 8	4.88E+11	→ 64	1.98E+11	→ 9	1.61E+11	→ 68	3.36E+12
215	2.05E+12	→ 11	1.14E+12	→ 75	8.97E+11	→ 12	2.75E+11	→ 74	1.71E+11	→ 77	4.66E+12
216	2.16E+12	→ 4	6.68E+11	→ 64	1.52E+11	→ 10	9.15E+10	→ 91	1.07E+10	→ 61	3.17E+12
217	8.94E+11	→ 4	8.84E+11	→ 8	3.81E+11	→ 9	3.34E+11	→ 3	3.23E+11	→ 68	3.47E+12
218	1.11E+12	→ 8	4.87E+11	→ 4	4.43E+11	→ 9	3.83E+11	→ 68	3.53E+11	→ 3	3.58E+12
219	2.83E+12	→ 85	1.61E+11	→ 87	1.32E+11	→ 92	8.57E+10	→ 111	3.26E+10	→ 110	3.39E+12
220	2.52E+12	→ 87	3.72E+11	→ 93	2.12E+11	→ 110	1.22E+11	→ 103	3.03E+10	→ 99	3.32E+12
221	1.57E+12	→ 5	5.10E+11	→ 65	4.16E+11	→ 10	2.08E+11	→ 6	1.75E+11	→ 7	3.32E+12
222	2.07E+12	→ 5	7.01E+11	→ 65	1.31E+11	→ 7	8.64E+10	→ 97	2.17E+10	→ 96	3.05E+12
223	2.31E+12	→ 5	6.29E+11	→ 65	1.26E+11	→ 7	1.01E+11	→ 4	5.04E+10	→ 106	3.45E+12
224	1.31E+12	→ 11	8.28E+11	→ 76	3.60E+11	→ 77	2.65E+11	→ 14	2.39E+11	→ 15	3.80E+12
225	1.48E+12	→ 78	4.62E+11	→ 13	1.98E+11	→ 81	8.97E+09	→ 102	4.58E+09	→ 146	2.18E+12
226	8.74E+11	→ 76	5.55E+11	→ 11	4.87E+11	→ 79	2.74E+11	→ 14	1.25E+11	→ 77	2.71E+12
227	1.20E+12	→ 6	1.09E+12	→ 10	5.32E+11	→ 72	1.64E+11	→ 8	1.63E+11	→ 4	3.60E+12
228	2.99E+12	→ 11	9.03E+11	→ 77	4.49E+11	→ 78	1.41E+11	→ 75	1.28E+11	→ 13	5.01E+12
229	1.14E+12	→ 10	8.27E+11	→ 6	6.58E+11	→ 5	4.51E+11	→ 72	1.67E+11	→ 65	3.58E+12
230	1.56E+12	→ 10	4.70E+11	→ 6	3.97E+11	→ 72	2.24E+11	→ 8	1.34E+11	→ 4	3.32E+12
231	1.93E+12	→ 12	1.18E+12	→ 14	9.48E+11	→ 79	7.57E+11	→ 11	1.65E+11	→ 82	5.64E+12
232	4.59E+12	→ 12	1.27E+12	→ 11	1.18E+12	→ 82	1.03E+11	→ 86	1.02E+11	→ 77	7.66E+12
233	2.35E+12	→ 92	2.10E+11	→ 93	1.53E+11	→ 85	1.48E+11	→ 106	1.42E+11	→ 87	3.42E+12
234	1.43E+12	→ 99	7.05E+11	→ 93	4.36E+11	→ 91	3.32E+11	→ 87	3.01E+11	→ 103	3.37E+12
235	3.00E+12	→ 91	1.47E+11	→ 96	1.00E+11	→ 117	6.89E+10	→ 109	1.37E+10	→ 113	3.35E+12
236	1.04E+12	→ 99	8.11E+11	→ 93	8.03E+11	→ 110	3.94E+11	→ 87	1.41E+11	→ 116	3.27E+12
237	2.23E+12	→ 94	5.70E+11	→ 92	1.46E+11	→ 98	1.38E+11	→ 106	1.20E+11	→ 108	3.42E+12
238	1.03E+12	→ 81	5.08E+11	→ 84	1.30E+11	→ 78	1.12E+10	→ 67	7.85E+09	→ 66	1.72E+12
239	1.68E+12	→ 84	2.08E+10	→ 66	6.64E+09	→ 167	5.29E+09	→ 50	4.17E+09	→ 148	1.72E+12
240	2.03E+12	→ 98	5.88E+11	→ 111	2.91E+11	→ 99	1.46E+11	→ 106	6.08E+10	→ 103	3.35E+12

Table 5. continued.

Level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	$\sum A^r$ (s^{-1})
241	1.95E+12	→ 13	5.57E+11	→ 11	3.00E+11	→ 15	2.55E+11	→ 102	2.12E+11	→ 100	3.95E+12
242	1.01E+12	→ 15	2.40E+11	→ 95	2.38E+11	→ 112	1.50E+11	→ 11	1.47E+11	→ 12	2.15E+12
243	3.18E+12	→ 11	9.23E+11	→ 12	6.45E+11	→ 81	3.36E+11	→ 15	3.17E+11	→ 89	6.18E+12
244	7.13E+12	→ 11	5.68E+11	→ 86	4.60E+11	→ 13	3.71E+11	→ 89	3.40E+11	→ 81	9.41E+12
245	8.40E+12	→ 11	8.92E+11	→ 86	3.29E+11	→ 14	3.17E+11	→ 89	2.08E+11	→ 77	1.04E+13
246	4.31E+12	→ 14	7.14E+11	→ 11	6.35E+11	→ 90	5.52E+11	→ 15	3.16E+11	→ 79	7.48E+12
247	7.90E+12	→ 13	1.26E+12	→ 88	1.91E+11	→ 102	8.65E+10	→ 84	3.87E+10	→ 81	9.56E+12
248	4.79E+12	→ 14	8.59E+11	→ 15	4.97E+11	→ 90	4.83E+11	→ 13	2.75E+11	→ 82	8.05E+12
249	3.70E+12	→ 12	1.82E+12	→ 13	7.88E+11	→ 15	4.88E+11	→ 89	4.54E+11	→ 86	7.90E+12
250	2.30E+12	→ 96	3.38E+11	→ 97	2.59E+11	→ 109	2.45E+11	→ 91	1.24E+11	→ 117	3.34E+12
251	3.34E+12	→ 97	1.24E+10	→ 114	5.59E+09	→ 179	3.76E+09	→ 162	8.49E+08	→ 84	3.36E+12
252	2.14E+12	→ 108	6.74E+11	→ 106	2.33E+11	→ 104	1.27E+11	→ 107	8.01E+10	→ 94	3.41E+12
253	1.15E+12	→ 103	9.61E+11	→ 96	7.24E+11	→ 93	3.10E+11	→ 110	6.40E+10	→ 91	3.39E+12
254	1.64E+12	→ 106	6.34E+11	→ 108	3.28E+11	→ 103	1.91E+11	→ 104	1.82E+11	→ 92	3.42E+12
255	1.22E+12	→ 106	1.06E+12	→ 103	4.29E+11	→ 93	2.33E+11	→ 98	1.62E+11	→ 96	3.41E+12
256	1.92E+12	→ 109	5.12E+11	→ 117	3.68E+11	→ 96	2.96E+11	→ 97	8.04E+10	→ 91	3.25E+12
257	1.06E+12	→ 107	5.23E+11	→ 111	5.04E+11	→ 104	3.88E+11	→ 108	3.84E+11	→ 98	3.38E+12
258	1.36E+12	→ 110	6.31E+11	→ 103	4.29E+11	→ 109	2.64E+11	→ 99	2.30E+11	→ 93	3.29E+12
259	1.69E+12	→ 111	4.24E+11	→ 98	3.37E+11	→ 110	1.85E+11	→ 103	1.38E+11	→ 93	3.32E+12
260	3.03E+11	→ 2	2.07E+11	→ 18	1.50E+11	→ 1	1.44E+11	→ 128	9.96E+10	→ 17	9.93E+11
261	1.16E+12	→ 6	9.44E+11	→ 10	6.04E+11	→ 83	1.96E+11	→ 7	8.00E+10	→ 113	3.25E+12
262	1.78E+12	→ 7	4.66E+11	→ 80	4.31E+11	→ 6	3.63E+11	→ 10	1.93E+11	→ 83	3.61E+12
263	2.10E+12	→ 7	6.90E+11	→ 80	1.38E+11	→ 5	8.80E+10	→ 114	1.54E+10	→ 117	3.09E+12
264	2.21E+12	→ 7	6.18E+11	→ 80	3.37E+11	→ 10	1.06E+11	→ 5	7.47E+10	→ 83	3.53E+12
265	1.80E+12	→ 6	8.07E+11	→ 10	5.48E+11	→ 83	6.46E+10	→ 72	5.39E+10	→ 122	3.47E+12
266	3.92E+11	→ 16	1.56E+11	→ 126	6.32E+10	→ 129	6.03E+10	→ 20	5.22E+10	→ 8	7.71E+11
267	3.79E+11	→ 16	1.49E+11	→ 126	5.43E+10	→ 130	5.20E+10	→ 21	4.90E+10	→ 9	7.54E+11
268	1.03E+12	→ 10	7.81E+11	→ 6	6.20E+11	→ 7	4.34E+11	→ 83	1.56E+11	→ 80	3.27E+12
269	1.39E+12	→ 95	8.68E+11	→ 13	2.34E+11	→ 100	5.80E+10	→ 102	1.09E+10	→ 67	2.59E+12
270	2.39E+12	→ 1	6.84E+11	→ 17	4.61E+11	→ 2	2.71E+11	→ 127	1.36E+11	→ 18	4.09E+12
271	1.66E+12	→ 100	2.94E+10	→ 66	5.24E+09	→ 84	3.40E+09	→ 167	2.89E+09	→ 195	1.70E+12
272	2.82E+12	→ 2	8.16E+11	→ 18	3.30E+11	→ 128	2.13E+10	→ 12	2.08E+10	→ 27	4.06E+12
273	4.61E+12	→ 13	2.39E+12	→ 12	7.21E+11	→ 102	4.65E+11	→ 101	1.89E+11	→ 88	8.97E+12
274	4.59E+12	→ 12	1.41E+12	→ 13	8.77E+11	→ 101	3.06E+11	→ 14	2.45E+11	→ 102	8.20E+12
275	6.58E+12	→ 13	9.55E+11	→ 102	3.43E+11	→ 100	2.07E+11	→ 95	1.19E+11	→ 88	8.25E+12
276	2.64E+12	→ 12	1.74E+12	→ 14	8.74E+11	→ 105	4.67E+11	→ 101	2.08E+11	→ 90	6.19E+12
277	1.09E+12	→ 20	5.72E+11	→ 129	7.71E+10	→ 21	4.09E+10	→ 130	6.82E+09	→ 6	1.80E+12
278	1.16E+12	→ 21	6.12E+11	→ 130	6.46E+09	→ 7	4.88E+09	→ 2	1.67E+09	→ 116	1.79E+12
279	9.86E+11	→ 131	3.64E+10	→ 132	2.97E+09	→ 67	1.17E+09	→ 20	3.04E+08	→ 54	1.03E+12
280	1.02E+12	→ 132	3.55E+09	→ 66	1.29E+09	→ 21	3.66E+08	→ 56	1.53E+08	→ 100	1.03E+12
281	4.37E+12	→ 15	1.45E+12	→ 12	5.80E+11	→ 112	5.18E+11	→ 101	4.36E+11	→ 11	8.32E+12
282	7.78E+12	→ 15	2.09E+12	→ 12	8.97E+11	→ 112	4.91E+11	→ 95	1.72E+11	→ 101	1.18E+13
283	1.69E+12	→ 113	5.73E+11	→ 117	5.55E+11	→ 114	5.24E+11	→ 109	3.66E+10	→ 96	3.41E+12
284	1.60E+12	→ 116	6.97E+11	→ 117	4.25E+11	→ 120	2.42E+11	→ 109	2.08E+11	→ 99	3.34E+12
285	1.92E+12	→ 115	9.20E+11	→ 116	1.70E+11	→ 120	1.11E+11	→ 99	8.93E+10	→ 117	3.39E+12
286	6.77E+12	→ 15	8.49E+11	→ 112	6.28E+11	→ 13	3.42E+11	→ 14	2.70E+11	→ 105	9.78E+12
287	1.99E+12	→ 120	6.21E+11	→ 113	3.48E+11	→ 116	1.14E+11	→ 110	7.37E+10	→ 109	3.34E+12
288	1.50E+12	→ 117	1.41E+12	→ 113	2.52E+11	→ 109	8.75E+10	→ 114	9.43E+09	→ 91	3.27E+12
289	3.27E+12	→ 114	1.82E+10	→ 97	3.43E+09	→ 202	3.00E+09	→ 179	8.35E+08	→ 100	3.29E+12
290	1.45E+12	→ 115	1.29E+12	→ 118	2.53E+11	→ 116	1.39E+11	→ 107	7.92E+10	→ 122	3.44E+12
291	1.93E+12	→ 122	5.78E+11	→ 120	5.22E+11	→ 116	6.78E+10	→ 113	6.76E+10	→ 110	3.37E+12
292	1.76E+12	→ 121	7.04E+11	→ 118	4.08E+11	→ 115	3.33E+11	→ 122	6.47E+10	→ 104	3.41E+12
293	1.29E+12	→ 121	1.24E+12	→ 122	3.75E+11	→ 118	1.63E+11	→ 107	1.25E+11	→ 116	3.40E+12
294	4.38E+11	→ 123	2.16E+11	→ 119	1.20E+11	→ 14	7.60E+10	→ 15	3.51E+10	→ 112	9.63E+11
295	2.04E+12	→ 9	4.61E+11	→ 8	4.58E+11	→ 104	2.23E+11	→ 107	1.36E+11	→ 125	3.41E+12
296	1.66E+12	→ 9	6.41E+11	→ 8	4.30E+11	→ 104	2.27E+11	→ 107	1.15E+11	→ 124	3.20E+12
297	3.73E+12	→ 15	1.64E+12	→ 123	9.80E+10	→ 12	3.35E+10	→ 2	1.76E+10	→ 13	5.60E+12
298	4.92E+12	→ 14	1.35E+12	→ 119	7.44E+11	→ 15	2.76E+11	→ 123	2.02E+10	→ 90	7.39E+12
299	2.92E+12	→ 125	2.15E+11	→ 124	8.06E+10	→ 111	3.87E+10	→ 115	2.54E+10	→ 122	3.35E+12
300	3.18E+12	→ 124	7.59E+10	→ 120	3.01E+10	→ 110	2.08E+10	→ 116	1.38E+10	→ 202	3.36E+12

Table 5. continued.

Level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	$\sum A^r$ (s^{-1})
301	2.49E+11	→ 4	1.70E+11	→ 28	1.22E+11	→ 137	8.74E+10	→ 6	8.72E+10	→ 25	9.85E+11
302	1.83E+11	→ 5	1.71E+11	→ 3	1.41E+11	→ 30	1.12E+11	→ 141	6.11E+10	→ 31	1.02E+12
303	4.89E+11	→ 1	3.36E+11	→ 19	1.52E+11	→ 133	6.03E+10	→ 144	5.01E+10	→ 23	1.21E+12
304	3.68E+11	→ 6	1.61E+11	→ 8	1.38E+11	→ 32	1.10E+11	→ 143	9.62E+10	→ 29	1.14E+12
305	4.04E+11	→ 1	3.40E+11	→ 19	1.47E+11	→ 133	5.05E+10	→ 146	3.97E+10	→ 23	1.09E+12
306	5.33E+11	→ 1	2.75E+11	→ 22	1.78E+11	→ 2	1.16E+11	→ 134	9.53E+10	→ 23	1.44E+12
307	6.52E+11	→ 25	5.23E+11	→ 3	2.68E+11	→ 136	2.63E+11	→ 4	1.77E+11	→ 8	2.30E+12
308	3.70E+11	→ 22	1.50E+11	→ 134	1.44E+11	→ 2	3.09E+10	→ 150	2.85E+10	→ 43	8.29E+11
309	3.76E+11	→ 22	1.52E+11	→ 134	1.46E+11	→ 2	4.81E+10	→ 148	3.83E+10	→ 40	8.18E+11
310	2.00E+12	→ 4	6.21E+11	→ 28	5.85E+11	→ 6	2.84E+11	→ 137	1.52E+11	→ 26	3.79E+12
311	1.80E+12	→ 1	3.16E+11	→ 23	1.43E+11	→ 135	6.20E+10	→ 153	5.02E+10	→ 19	2.54E+12
312	1.35E+12	→ 1	2.45E+11	→ 23	1.11E+11	→ 135	8.98E+10	→ 22	5.39E+10	→ 14	2.12E+12
313	8.51E+11	→ 35	5.13E+11	→ 144	1.18E+11	→ 47	7.13E+10	→ 42	3.58E+10	→ 153	1.79E+12
314	5.31E+11	→ 41	5.03E+11	→ 146	4.74E+11	→ 38	6.68E+10	→ 147	5.92E+10	→ 54	1.75E+12
315	9.65E+11	→ 151	3.56E+10	→ 152	4.73E+09	→ 163	1.19E+09	→ 165	8.72E+08	→ 35	1.01E+12
316	1.00E+12	→ 152	3.68E+09	→ 160	1.66E+09	→ 164	1.14E+09	→ 91	7.80E+08	→ 155	1.01E+12
317	5.23E+11	→ 5	4.96E+11	→ 26	2.72E+11	→ 4	2.06E+11	→ 138	1.78E+11	→ 30	2.28E+12
318	2.22E+12	→ 3	4.68E+11	→ 4	3.26E+11	→ 31	2.34E+11	→ 26	1.61E+11	→ 32	4.22E+12
319	1.81E+12	→ 5	7.44E+11	→ 30	3.47E+11	→ 7	3.33E+11	→ 141	9.66E+10	→ 37	3.36E+12
320	3.88E+12	→ 3	6.09E+11	→ 31	2.08E+11	→ 140	1.34E+11	→ 9	1.10E+11	→ 4	5.37E+12
321	1.85E+12	→ 8	6.08E+11	→ 29	4.33E+11	→ 6	2.29E+11	→ 142	6.20E+10	→ 26	3.51E+12
322	2.60E+12	→ 6	6.78E+11	→ 4	6.29E+11	→ 32	2.81E+11	→ 143	1.34E+11	→ 5	4.58E+12
323	7.41E+11	→ 43	4.24E+11	→ 150	2.54E+11	→ 42	1.56E+11	→ 149	5.86E+10	→ 35	1.78E+12
324	6.14E+11	→ 38	4.05E+11	→ 147	3.05E+11	→ 41	1.24E+11	→ 49	9.00E+10	→ 40	1.79E+12
325	1.01E+12	→ 40	5.91E+11	→ 148	7.23E+10	→ 50	5.33E+10	→ 56	8.25E+09	→ 174	1.75E+12
326	8.10E+11	→ 42	4.42E+11	→ 149	1.31E+11	→ 41	9.48E+10	→ 147	8.13E+10	→ 38	1.79E+12
327	1.33E+11	→ 5	1.26E+11	→ 33	1.04E+11	→ 6	8.73E+10	→ 155	6.91E+10	→ 37	8.65E+11
328	5.93E+11	→ 47	4.97E+11	→ 153	1.84E+11	→ 35	1.46E+11	→ 55	8.97E+10	→ 46	1.77E+12
329	9.16E+11	→ 160	5.69E+10	→ 164	2.76E+10	→ 162	4.76E+09	→ 152	6.34E+08	→ 38	1.01E+12
330	6.02E+11	→ 49	4.98E+11	→ 156	2.26E+11	→ 41	1.21E+11	→ 54	8.07E+10	→ 51	1.72E+12
331	8.30E+11	→ 159	1.13E+11	→ 161	3.64E+10	→ 158	2.63E+10	→ 163	3.24E+09	→ 160	1.02E+12
332	1.00E+12	→ 162	1.27E+09	→ 97	1.14E+09	→ 40	8.24E+08	→ 182	5.63E+08	→ 176	1.01E+12
333	8.49E+11	→ 161	8.00E+10	→ 164	6.19E+10	→ 163	1.67E+10	→ 160	2.20E+09	→ 165	1.02E+12
334	8.36E+11	→ 163	7.54E+10	→ 160	4.09E+10	→ 161	3.78E+10	→ 165	3.90E+09	→ 151	1.01E+12
335	9.03E+11	→ 164	5.66E+10	→ 162	3.98E+10	→ 160	1.34E+09	→ 152	1.12E+09	→ 155	1.01E+12
336	4.00E+11	→ 7	1.35E+11	→ 39	1.09E+11	→ 9	8.94E+10	→ 165	8.83E+10	→ 10	1.21E+12
337	4.97E+11	→ 2	2.78E+11	→ 24	1.10E+11	→ 27	1.07E+11	→ 139	4.63E+10	→ 145	1.21E+12
338	3.58E+11	→ 2	3.21E+11	→ 24	1.24E+11	→ 139	7.53E+10	→ 27	3.16E+10	→ 145	1.06E+12
339	3.88E+11	→ 24	1.52E+11	→ 139	4.47E+10	→ 167	3.65E+10	→ 48	1.27E+10	→ 168	6.66E+11
340	1.21E+12	→ 2	2.59E+11	→ 27	1.07E+11	→ 145	1.07E+11	→ 24	4.06E+10	→ 139	1.93E+12
341	1.40E+12	→ 2	3.00E+11	→ 27	1.24E+11	→ 145	7.28E+10	→ 24	5.15E+10	→ 15	2.14E+12
342	1.65E+12	→ 2	3.37E+11	→ 27	1.42E+11	→ 145	4.50E+10	→ 15	3.86E+10	→ 59	2.36E+12
343	8.48E+11	→ 33	3.38E+11	→ 155	1.46E+10	→ 179	1.88E+09	→ 176	1.45E+09	→ 96	1.21E+12
344	2.63E+12	→ 5	4.58E+11	→ 37	3.04E+11	→ 33	2.00E+11	→ 157	1.17E+11	→ 155	3.84E+12
345	2.09E+12	→ 5	9.77E+11	→ 4	4.06E+11	→ 37	2.41E+11	→ 34	1.77E+11	→ 157	4.37E+12
346	1.94E+12	→ 4	1.16E+12	→ 5	2.92E+11	→ 34	2.75E+11	→ 36	1.91E+11	→ 37	4.36E+12
347	2.69E+12	→ 4	4.74E+11	→ 36	3.46E+11	→ 34	2.05E+11	→ 154	1.20E+11	→ 158	3.91E+12
348	1.28E+12	→ 7	7.06E+11	→ 10	3.27E+11	→ 36	3.17E+11	→ 5	2.84E+11	→ 6	3.79E+12
349	1.14E+12	→ 9	6.56E+11	→ 10	2.97E+11	→ 44	2.78E+11	→ 8	2.50E+11	→ 7	3.80E+12
350	4.27E+12	→ 7	7.11E+11	→ 39	2.77E+11	→ 165	6.78E+10	→ 37	3.26E+10	→ 157	5.48E+12
351	5.94E+11	→ 51	4.00E+11	→ 169	3.23E+11	→ 50	1.85E+11	→ 168	1.22E+11	→ 49	1.78E+12
352	8.63E+11	→ 50	4.82E+11	→ 168	2.31E+11	→ 48	1.14E+11	→ 167	6.42E+10	→ 40	1.78E+12
353	4.63E+11	→ 52	4.21E+11	→ 51	2.71E+11	→ 170	2.61E+11	→ 169	7.82E+10	→ 55	1.79E+12
354	2.48E+12	→ 9	5.70E+11	→ 44	3.30E+11	→ 8	2.58E+11	→ 166	2.23E+11	→ 10	4.51E+12
355	1.19E+12	→ 48	6.03E+11	→ 167	1.33E+08	→ 155	3.56E+07	→ 33	2.09E+07	→ 343	1.79E+12
356	6.91E+11	→ 54	4.95E+11	→ 172	1.40E+11	→ 49	1.36E+11	→ 56	8.49E+10	→ 174	1.76E+12
357	6.22E+11	→ 52	3.44E+11	→ 53	3.35E+11	→ 170	1.82E+11	→ 171	1.23E+11	→ 51	1.80E+12
358	9.14E+11	→ 53	4.72E+11	→ 171	2.59E+11	→ 52	1.33E+11	→ 170	4.14E+09	→ 19	1.81E+12
359	7.54E+11	→ 175	1.01E+11	→ 178	1.00E+11	→ 176	5.03E+10	→ 182	3.29E+09	→ 179	1.01E+12
360	9.46E+11	→ 56	5.83E+11	→ 174	8.66E+10	→ 40	1.08E+10	→ 148	9.57E+09	→ 66	1.65E+12

Table 5. continued.

Level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	A^r (s^{-1})	final level	$\sum A^r$ (s^{-1})
361	5.74E+11	→ 55	3.96E+11	→ 173	2.23E+11	→ 54	1.61E+11	→ 172	1.13E+11	→ 47	1.78E+12
362	7.22E+11	→ 177	2.26E+11	→ 175	5.15E+10	→ 183	1.01E+10	→ 176	1.40E+09	→ 182	1.02E+12
363	8.78E+11	→ 176	1.15E+11	→ 179	1.54E+10	→ 182	1.27E+09	→ 162	8.57E+08	→ 50	1.01E+12
364	7.95E+11	→ 178	1.14E+11	→ 176	6.33E+10	→ 175	3.67E+10	→ 182	3.01E+09	→ 179	1.02E+12
365	9.76E+11	→ 182	1.22E+10	→ 176	2.96E+09	→ 179	1.14E+09	→ 56	9.68E+08	→ 162	9.94E+11
366	6.46E+11	→ 181	2.83E+11	→ 177	5.12E+10	→ 185	2.30E+10	→ 175	6.37E+09	→ 183	1.02E+12
367	9.95E+11	→ 179	1.33E+09	→ 48	1.34E+08	→ 167	9.22E+05	→ 33	6.89E+04	→ 355	9.97E+11
368	7.78E+11	→ 183	1.69E+11	→ 178	3.25E+10	→ 175	2.07E+10	→ 177	7.52E+09	→ 176	1.02E+12
369	6.49E+11	→ 184	2.99E+11	→ 181	2.76E+10	→ 177	2.59E+10	→ 185	8.26E+09	→ 183	1.01E+12
370	7.92E+11	→ 185	1.75E+11	→ 183	1.96E+10	→ 181	8.70E+09	→ 178	7.84E+09	→ 177	1.01E+12
371	6.82E+11	→ 59	3.99E+11	→ 180	2.44E+11	→ 55	1.67E+11	→ 173	6.36E+10	→ 47	1.75E+12
372	3.27E+11	→ 2	1.36E+11	→ 1	1.30E+11	→ 18	8.31E+10	→ 128	6.59E+10	→ 267	8.97E+11
373	2.44E+11	→ 16	9.94E+10	→ 126	5.51E+10	→ 260	4.22E+10	→ 20	3.56E+10	→ 129	5.61E+11
374	2.38E+11	→ 16	9.60E+10	→ 126	5.19E+10	→ 260	3.64E+10	→ 21	3.08E+10	→ 130	5.35E+11
375	1.38E+12	→ 1	4.00E+11	→ 17	2.77E+11	→ 2	1.70E+11	→ 127	8.21E+10	→ 266	2.48E+12
376	1.66E+12	→ 2	4.73E+11	→ 18	2.04E+11	→ 128	9.97E+10	→ 267	1.18E+10	→ 27	2.47E+12
377	5.23E+11	→ 20	2.96E+11	→ 129	1.50E+11	→ 270	3.71E+10	→ 21	2.11E+10	→ 130	1.05E+12
378	5.58E+11	→ 21	3.16E+11	→ 130	1.62E+11	→ 272	4.31E+09	→ 60	3.15E+09	→ 2	1.05E+12
379	3.56E+11	→ 279	1.57E+10	→ 201	8.08E+09	→ 280	3.56E+08	→ 202	3.22E+08	→ 131	3.81E+11
380	3.17E+11	→ 131	2.39E+11	→ 277	1.17E+10	→ 132	8.84E+09	→ 278	5.60E+09	→ 67	5.89E+11
381	3.64E+11	→ 280	1.60E+10	→ 202	3.42E+08	→ 132	2.65E+07	→ 278	1.46E+07	→ 114	3.80E+11
382	3.28E+11	→ 132	2.48E+11	→ 278	5.69E+09	→ 66	5.33E+09	→ 195	9.55E+08	→ 21	5.88E+11
383	1.53E+11	→ 9	1.48E+11	→ 61	1.48E+11	→ 6	1.38E+11	→ 10	8.07E+10	→ 191	1.06E+12
384	2.29E+11	→ 10	1.49E+11	→ 60	1.05E+11	→ 190	9.73E+10	→ 7	7.71E+10	→ 58	1.01E+12
385	3.68E+11	→ 2	1.84E+11	→ 46	1.80E+11	→ 45	1.15E+11	→ 1	8.40E+10	→ 187	1.21E+12
386	4.92E+11	→ 2	2.10E+11	→ 46	1.46E+11	→ 45	1.41E+11	→ 1	9.51E+10	→ 187	1.36E+12
387	6.02E+11	→ 2	3.36E+11	→ 46	1.54E+11	→ 187	4.97E+10	→ 195	4.57E+10	→ 66	1.31E+12
388	3.92E+11	→ 2	1.94E+11	→ 45	1.67E+11	→ 1	1.60E+11	→ 46	7.97E+10	→ 186	1.26E+12
389	2.89E+11	→ 2	2.36E+11	→ 1	2.13E+11	→ 45	1.17E+11	→ 46	8.63E+10	→ 186	1.23E+12
390	1.31E+12	→ 8	1.18E+12	→ 9	5.84E+11	→ 6	4.41E+11	→ 57	4.33E+11	→ 10	4.77E+12
391	1.85E+12	→ 6	6.28E+11	→ 58	2.76E+11	→ 188	1.91E+11	→ 7	1.22E+11	→ 60	3.38E+12
392	1.30E+12	→ 7	7.90E+11	→ 60	3.32E+11	→ 190	2.13E+10	→ 272	1.51E+10	→ 80	2.53E+12
393	3.28E+12	→ 10	6.44E+11	→ 61	2.80E+11	→ 191	1.58E+11	→ 7	1.26E+11	→ 6	4.80E+12
394	2.08E+12	→ 8	5.26E+11	→ 10	3.68E+11	→ 57	1.76E+11	→ 189	1.75E+11	→ 62	3.98E+12
395	1.47E+12	→ 10	1.14E+12	→ 9	2.99E+11	→ 63	2.05E+11	→ 192	2.04E+11	→ 61	3.97E+12
396	9.01E+11	→ 69	5.07E+11	→ 193	1.50E+11	→ 67	8.69E+10	→ 194	3.96E+10	→ 71	1.79E+12
397	9.51E+11	→ 71	5.26E+11	→ 196	1.31E+11	→ 66	6.95E+10	→ 195	1.95E+10	→ 54	1.79E+12
398	9.14E+11	→ 199	6.29E+10	→ 201	3.88E+10	→ 200	1.74E+10	→ 279	1.91E+09	→ 202	1.04E+12
399	9.85E+11	→ 67	5.37E+11	→ 194	3.50E+10	→ 66	3.41E+10	→ 277	3.35E+10	→ 196	1.76E+12
400	9.46E+11	→ 200	6.80E+10	→ 202	1.72E+10	→ 280	2.35E+09	→ 201	1.07E+09	→ 71	1.04E+12
401	1.08E+12	→ 66	5.91E+11	→ 195	3.51E+10	→ 278	2.29E+10	→ 56	1.94E+10	→ 100	1.77E+12
402	7.11E+11	→ 73	4.24E+11	→ 197	1.68E+11	→ 69	1.37E+11	→ 74	8.93E+10	→ 193	1.82E+12
403	7.85E+11	→ 74	5.08E+11	→ 198	1.72E+11	→ 71	1.58E+11	→ 75	8.79E+10	→ 196	1.81E+12
404	9.48E+11	→ 201	5.29E+10	→ 279	1.98E+10	→ 202	1.42E+09	→ 280	1.10E+09	→ 67	1.02E+12
405	9.67E+11	→ 202	5.42E+10	→ 280	1.22E+09	→ 66	6.71E+08	→ 114	1.85E+08	→ 271	1.02E+12
406	8.66E+11	→ 203	8.34E+10	→ 199	6.06E+10	→ 204	2.07E+10	→ 279	4.23E+09	→ 200	1.04E+12
407	9.28E+11	→ 204	8.11E+10	→ 200	2.02E+10	→ 280	3.93E+09	→ 199	2.07E+09	→ 124	1.04E+12