

Dirac-Fock energy levels and transition probabilities for oxygen-like Fe XIX^{*,**}

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Abstract. Multiconfigurational Dirac-Fock calculations are reported for 656 energy levels and the 214 840 electric dipole (E1), electric quadrupole (E2) and magnetic dipole (M1) transition probabilities in oxygen-like Fe XIX. The spectroscopic notations as well as the total transition probabilities from each energy level are provided. Good agreement is found with data compiled by NIST.

Key words. atomic data

1. Introduction

Atomic data for O-like Fe XIX have been extensively studied under the framework of the IRON Project (Hummer et al. 1993). Galavis et al. (1997) present radiative rates for forbidden transitions in O-like ions with $Z \leq 28$, for the $n = 2$ complex. Butler & Zeppen (2001) provide energy levels, electron impact collision strengths and rates for transitions among the 92 lowest levels of the $n = 2$ and $n = 3$ complexes of Fe XIX. The atomic structure code SUPERSTRUCTURE (SS) (Eissner et al. 1974) was employed by both sets of authors. On the other hand, McLaughlin et al. (2001) present the 25 lowest energy levels and effective collision strengths, calculated with the atomic structure code CIV3 (Hibbert 1975), and the Breit-Pauli version of the R-matrix codes (Berrington et al. 1995), respectively. Zhang & Sampson (2002) obtain relativistic distorted-wave collision strengths and oscillator strengths for transitions among 10 lowest levels of the $n = 2$ complex.

High resolution spectra of astrophysical sources require accurate atomic data for reliable plasma modelling. In particular,

the *Chandra* and *XMM-Newton* satellites provide spectra with particularly large effective areas in the 6 to 18 Å wavelength range, covering Fe XIX lines arising from the $n \geq 3$ complex (Behar et al. 2001; Heyden et al. 2003; McKernan et al. 2003). To allow the reliable interpretation of these lines, we have studied Fe XIX transitions among the levels of the 25 lowest configurations originating from the $n = 3, 4$ and 5 complexes. Previous calculations cover a smaller range of transitions.

In the present paper we report calculations for energy levels, transition probabilities and oscillator strengths for electric dipole (E1), electric quadrupole (E2), and magnetic dipole (M1) transitions among 656 levels of oxygen-like Fe XIX. A comparison between NIST data and our calculations, as well as the energy levels of McLaughlin et al. (2001) and Butler & Zeppen (2001), is made. The five strongest and the sum of all the radiative transition probabilities (useful to obtain decay branching ratios) from the levels are also presented.

2. Calculations

The GRASP code of Dyall et al. (1989); Norrington (2003); Parpia et al. (1996) is used for the calculation of wave functions as well as the matrix elements of the Dirac-Coulomb-Breit Hamiltonian and transition operators. As a result, direct and indirect relativistic effects are included in the calculations. One-electron wave functions, obtained by solving multiconfigurational Dirac-Fock (MCDF) equations, were used to build

* Tables 1 and 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/424/363>

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configuration state wave functions. The intermediate coupling wave functions:

$$\Psi_{\gamma}(J) = \sum_{\alpha} c_{\gamma}(\alpha J) \phi(\alpha J) \quad (1)$$

are generated in the basis $\phi(\alpha J)$ of configuration state functions (CSF) by diagonalizing the Dirac-Coulomb-Breit Hamiltonian matrix. The frequency-dependent transverse Breit interaction operator is used for the calculation of Breit matrix elements. QED corrections are considered in the first order of perturbation theory, and the correlation corrections taken into account by the configuration interaction (CI) method. The relativistic line strengths are obtained from matrix elements of frequency-dependent transition operators. Coulomb and Babushkin gauges of the electric transition operators allow us to estimate the accuracy of wave function expansion in the intermediate coupling.

Results are presented for total number of 656 lowest energy levels in Fe XIX. We consider 565 energy levels arising from the $1s^2 2s^2 2p^4$, $1s^2 2s^1 2p^5$, $1s^2 2p^6$, $1s^2 2s^2 2p^3 nl$, $1s^2 2s^1 2p^4 3l'$, $1s^2 2s^1 2p^4 4s^1$, $1s^2 2s^1 2p^4 4p^1$, and $1s^2 2p^5 3l'$ ($n = 3, 4, 5$, $l = 0, \dots, n-1$, $l' = 0, 1, 2$) configurations. Due to the high density of levels between highly excited configurations, and strong configuration interaction between these, there are also included some energy levels of other configurations (38 levels of $1s^2 2s^1 2p^4 4d^1$ and 41 levels of $1s^2 2s^1 2p^4 4f^1$) with calculated binding energies larger than our chosen cut-off value, which corresponds to the highest level of the $1s^2 2s^2 2p^3 5g^1$ configuration.

A large CI basis is used to generate one-electron wave functions solving MCDF equations as well to obtain accurate intermediate coupling wave functions diagonalizing the Dirac-Coulomb-Breit Hamiltonian matrix. We include one-electron excitations from 2s and 2p orbitals of the $1s^2 2s^2 2p^4$ configuration up to the $7l$ orbital, and two-electron excitations from 2s or/and 2p orbitals to all possible combinations of two electrons in the shells with $n = 3$. The level energies and intermediate coupling wave functions obtained after the diagonalization of the Dirac-Coulomb-Breit Hamiltonian matrix are then used to evaluate the transition probabilities, oscillator and line strengths for electric dipole, electric quadrupole and magnetic dipole transitions among the 656 lowest levels in our calculations.

3. Results and discussion

The 656 fine-structure levels which give rise from the above mentioned configurations are listed in Table 1. The indexes for levels presented in the first column of Table 1 are used in all tables. Energy levels are given in cm^{-1} relative to the ground state $1s^2 2s^2 2p^4 \ ^3P_2$. Configuration as well as term notations presented in the second and third columns have the primary contribution to the wavefunction of Eq. (1) obtained after Dirac-Coulomb-Breit matrix diagonalization. For brevity, filled $1s^2$ shells are omitted in the notations of configurations, and intermediate many-electron quantum numbers are shown in the parentheses. Leading percentage compositions

are equal to squared expansion coefficients $c_{\gamma}(\alpha J)$ for the intermediate coupling function of Eq. (1), and are limited to values larger than 10%. As was mentioned above, diagonalization of the Dirac-Coulomb-Breit matrix, which is obtained in the *jj*-coupling scheme, provides expansion coefficients for the intermediate coupling functions in the basis of CSF. We present the CSF in the *LS*-coupling scheme. Therefore, the corresponding percentage compositions are obtained from coefficients calculated in the *jj*-coupling scheme using term-coupling coefficients. The expansion of the intermediate coupling function in the CSF basis depends on the model used in calculations. Leading percentage compositions obtained after Dirac-Coulomb matrix diagonalization differ from our presented values. The discrepancies between the two sets of coefficients are not large, but in some cases the order of levels identified by the largest contribution of CSF can be different. Calculated energies of levels can also change after inclusion of Breit and QED corrections.

Some levels identified by the CSF obtained in *LS*-coupling scheme with the largest contribution to an intermediate coupling function have the same spectroscopic notations. To ensure the completeness of the spectroscopic dataset, we suggest new spectroscopic notations for levels with the same spectroscopic identities. In some cases, the mixing of CSF defined in *LS*-coupling scheme is so strong that it is difficult to make definite identifications of levels. The mixing of CSF especially increases for highly excited levels where the separation between level energies decreases. Leading percentages of levels show that the *LS*-coupling scheme is not satisfactory for highly excited states. Proposed spectroscopic notations for levels with the same largest contribution of *LS*-coupling CSF are presented in Table 2. If two levels have the same many-electron quantum numbers for a given configuration in the second and third columns of Table 1, the identification of the level with the smaller contribution to the intermediate coupling wave function is changed to that of the secondary CSF. If this secondary function is employed for the identification of some other level, then the third CSF is checked. The spectroscopic notation of level 492 has had its *LS*-configuration state function re-assigned to level 482. However, no other level in the second and third columns of Table 1 has the new spectroscopic notation proposed for level 492. Therefore, no spectroscopic notation has been assigned to level 492 in the second column of Table 2.

In Table 3 we compare our calculated energy levels as well as the data obtained by McLaughlin et al. (2001) and Butler & Zeippen (2001) with values compiled by NIST (National Institute for Standards and Technology: www.physics.nist.gov). Fairly good agreement is obtained for the MCDF calculations, with the energy levels agreeing to better than 2% with the NIST values. Levels 10 ($2p^6 \ ^1S_0$) and 9 ($2s^1 2p^5 \ ^1P_1$) show the largest differences of 1.9% and 1.6%, respectively. All highly excited levels agree to better than 1%. Only level 493 has a large deviation from the NIST energy, but even this is only 1.3%. The percentage composition of the *LS*-coupling CSF for the level shows that there is strong mixing between CSF and no single CSF has a contribution exceeding 50%. Our energy of ground state

Table 2. Suggested change of spectroscopic identifications of levels to ensure the completeness of spectroscopic dataset. The indexes 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. Identification of level with index 492 was changed due to use for identification its *LS*-configuration state function for level with index 482. Indexes of levels in the first two columns are taken from Table 1.

Index	Index	Changed <i>LS</i> -configuration
47	36	2s ² 2p ³ (² P) 3p ¹ (¹ P)
55	39	2s ² 2p ³ (² P) 3p ¹ (¹ D)
86	81	2s ² 2p ³ (² P) 3d ¹ (³ P)
90	80	2s ² 2p ³ (² P) 3d ¹ (¹ D)
195	193	2s ¹ 2p ⁴ (² P) 3d ¹ (³ D)
215	206	2p ⁵ (² P) 3p ¹ (¹ D)
233	263	2p ⁵ (² P) 3d ¹ (¹ D)
258	249	2s ² 2p ³ (² D) 4p ¹ ¹ F
293	305	2s ² 2p ³ (² D) 4f ¹ ³ F
309	294	2s ² 2p ³ (² D) 4f ¹ ³ D
325	320	2s ² 2p ³ (² P) 4d ¹ ¹ D
339	330	2s ² 2p ³ (² P) 4f ¹ ³ F
364	354	2s ¹ 2p ⁴ (⁴ P) 4p ¹ ³ P
379	411	2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ D
400	402	2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ D
406	374	2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ P
414	386	2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ F
420	413	2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ D
433	454	2s ² 2p ³ (² D) 5s ¹ ³ D
469	472	2s ² 2p ³ (² D) 5p ¹ ¹ P
471	466	2s ² 2p ³ (² D) 5p ¹ ¹ F
482	486	2s ¹ 2p ⁴ (² D) 4d ¹ ³ S
492		2s ¹ 2p ⁴ (² P) 4s ¹ ¹ P
495	529	2s ² 2p ³ (² D) 5d ¹ ³ P
501	536	2s ¹ 2p ⁴ (² S) 4p ¹ ³ P
502	550	2s ² 2p ³ (² D) 5g ¹ ¹ G
506	544	2s ² 2p ³ (² D) 5g ¹ ³ G
515	560	2s ² 2p ³ (² D) 5f ¹ ¹ G
520	559	2s ² 2p ³ (² D) 5f ¹ ³ P
533	554	2s ¹ 2p ⁴ (² D) 4f ¹ ³ P
542	528	2s ² 2p ³ (² P) 5s ¹ ³ P
545	573	2s ² 2p ³ (² D) 5g ¹ ¹ F
548	571	2s ¹ 2p ⁴ (² D) 4f ¹ ³ D
551	581	2s ² 2p ³ (² D) 5g ¹ ³ G
574	546	2s ¹ 2p ⁴ (² D) 4f ¹ ³ D
583	582	2s ¹ 2p ⁴ (² P) 4s ¹ ³ P
592	579	2s ² 2p ³ (² P) 5s ¹ ³ P
608	647	2s ² 2p ³ (² P) 5g ¹ ¹ F
633	594	2s ¹ 2p ⁴ (² S) 4p ¹ ³ P
648	609	2s ² 2p ³ (² P) 5g ¹ ³ G
649	616	2s ² 2p ³ (² P) 5f ¹ ³ F

–230 793 799 cm⁻¹ is slightly higher than NIST value of –231 017 600 ± 142 300 cm⁻¹. Due to this some calculated energies of levels relative to the calculated ground energy are lower than NIST values presented in Table 3.

The average deviation between our energy levels and the NIST values is only 0.35%. On the other hand, the average deviation for energies obtained by McLaughlin et al. (2001) is 0.8%. For the energies in common, the average deviation of the Butler & Zeippen (2001) values is 0.8%, while for our data this is only 0.6%. The largest deviation for energies obtained by McLaughlin et al. (2001) is 3.2% for the first excited level (2s²2p⁴ ³P₀) and 2.7% for the second (2s²2p⁴ ³P₁). Butler & Zeippen (2001) energies show an average deviation of 0.6% with NIST data, while the average for our values is 0.45% for the same range of levels. The largest deviations for energies obtained by Butler & Zeippen (2001) is 3.3% for level 4 (2s²2p⁴ ¹D₂) and 1.6% for levels 10 (2p⁶ ¹S₀) and 9 (2s¹2p⁵ ¹P₁). Therefore, our energy levels agree better with the NIST values than those calculated by previous authors. The main reason for this is that we use a larger base of CSF, and a fully relativistic approach. Level ordering differs from NIST in both large-scale calculations.

The total number of dipole allowed and intercombination E1-type transitions is 58 390, while the complete set of forbidden transitions totals 136 866. Table 6 includes only E1-type transitions for which oscillator strengths exceed 0.001. All forbidden E2-type transitions with $f \geq 10^{-11}$ are reported in Table 7. Table 8 provides data for M1-type transitions with f -values exceeding 10⁻⁷. Differences between Babushkin and Coulomb gauges (velocity and length forms of the electric transition operators in the nonrelativistic limit), which are an additional indicator of accuracy for the wavefunctions, do not exceed 20% for most strong E1-type transitions ($f \geq 0.1$). The average deviation between the two forms is 5.3% for 812 lines with $f \geq 0.1$ and 9.6% for 4524 lines with $f \geq 0.01$. The electric quadrupole transition has the largest contribution to the lifetime of the first excited level, the difference between the two forms is large, and the oscillator strength is very small. E2-type transition from level 5 (79% 2s²2p⁴ ¹S₀ + 19% 2s²2p⁴ ³P₀) also shows a large deviation of 80% between the two forms, and a small f -value ($f = 2.5 \times 10^{-11}$). On the other hand, our obtained leading compositions of wavefunctions reports similar values for these three levels as NIST ones; 1: 90% (2s² 2p⁴ ³P₂) + 10% (2s² 2p⁴ ¹D₂); 2: 80% (2s² 2p⁴ ³P₀) + 20% (2s² 2p⁴ ¹S₀); 5: 78% (2s² 2p⁴ ¹S₀) + 20% (2s² 2p⁴ ³P₀). The deviation between calculated (Babushkin gauge) and NIST characteristics of the transition from the first excited level does not exceed 4%.

Our calculated wavelengths, transition probabilities, oscillator and line strengths as well as the NIST values are presented in Table 4. The accuracy of the transition wavelengths is well above 1% for short wavelengths ($\lambda < 16$ Å). The largest deviations of wavelengths (up to 4%) are obtained for transitions which involve levels 4, 9 and 10, as these show the largest differences in energies from NIST data. Our probabilities for most transitions are slightly smaller than the corresponding NIST values, with intercombination E1-type transitions showing the largest deviations. The difference for their radiative

Table 3. Comparison of some calculated energies of Fe XIX levels with data presented by NIST (E^{NIST}), $E^{\text{McLaughlin}}$ – values obtained by McLaughlin et al. (2001), E^{Butler} – energies calculated by Butler & Zeippen (2001), E^{GRASP} – our values. Indexes of levels in the first column are taken from Table 1. Energies are in cm^{-1} .

Index	Configuration	LSJ	E^{NIST}	$E^{\text{McLaughlin}}$	E^{Butler}	E^{GRASP}
2	$2s^2 2p^4$	3P_0	75 250.	72 817.	74 766.	75 446.
3	$2s^2 2p^4$	3P_1	89 441.	87 003.	90 160.	88 791.
4	$2s^2 2p^4$	1D_2	168 852.	171 145.	174 400.	170 847.
5	$2s^2 2p^4$	1S_0	325 140.	322 490.	328 726.	326 536.
6	$2s^1 2p^5$	3P_2	922 890.	926 563.	932 013.	933 081.
7	$2s^1 2p^5$	3P_1	984 740.	988 359.	995 686.	995 006.
8	$2s^1 2p^5$	3P_0	1 030 020.	1 032 521.	1 041 743.	1 039 692.
9	$2s^1 2p^5$	1P_1	1 267 600.	1 279 832.	1 287 358.	1 287 773.
10	$2p^6$	1S_0	2 134 180.	2 157 557.	2 168 921.	2 175 645.
12	$2s^2 2p^3 (^4S) 3s^1$	3S_1	6 680 000.	6 717 208.	6 695 619.	6 668 591.
13	$2s^2 2p^3 (^2D) 3s^1$	3D_2	6 787 000.	6 818 206.	6 799 977.	6 774 890.
14	$2s^2 2p^3 (^2D) 3s^1$	3D_1	6 788 000.	6 820 650.	6 801 973.	6 776 938.
15	$2s^2 2p^3 (^2D) 3s^1$	3D_3	6 818 000.	6 853 053.	6 835 715.	6 807 447.
16	$2s^2 2p^3 (^2D) 3s^1$	1D_2	6 834 000.	6 873 424.	6 855 497.	6 827 890.
20	$2s^2 2p^3 (^2P) 3s^1$	3P_0	6 907 000.	6 929 307.	6 913 096.	6 891 588.
21	$2s^2 2p^3 (^2P) 3s^1$	3P_1	6 923 000.	6 937 398.	6 921 107.	6 899 384.
25	$2s^2 2p^3 (^2P) 3s^1$	3P_2	6 970 000.	6 991 802.	6 978 533.	6 956 007.
26	$2s^2 2p^3 (^2P) 3s^1$	1P_1	6 985 000.	7 008 231.	6 994 093.	6 972 035.
53	$2s^2 2p^3 (^2P) 3d^1$	3D_3	7 249 000.		7 266 108.	7 242 650.
65	$2s^2 2p^3 (^2D) 3d^1$	3P_2	7 370 000.		7 394 243.	7 370 636.
68	$2s^2 2p^3 (^2D) 3d^1$	3D_3	7 396 000.		7 417 913.	7 390 818.
71	$2s^2 2p^3 (^2D) 3d^1$	3D_2	7 405 000.		7 423 125.	7 398 130.
76	$2s^2 2p^3 (^2D) 3d^1$	1F_3	7 449 000.		7 469 769.	7 442 848.
78	$2s^2 2p^3 (^2P) 3d^1$	3F_3	7 450 000.		7 483 374.	7 462 620.
85	$2s^2 2p^3 (^2P) 3d^1$	3P_2	7 468 000.		7 537 621.	7 515 849.
86	$2s^2 2p^3 (^2P) 3d^1$	3D_1	7 567 000.		7 500 485.	7 522 780.
89	$2s^2 2p^3 (^2P) 3d^1$	1F_3	7 565 000.		7 543 025.	7 560 086.
90	$2s^2 2p^3 (^2P) 3d^1$	3D_2	7 554 000.		7 583 729.	7 563 304.
92	$2s^2 2p^3 (^2P) 3d^1$	1P_1	7 606 000.		7 644 484.	7 623 053.
239	$2s^2 2p^3 (^4S) 4d^1$	3D_2	9 242 000.			9 229 319.
241	$2s^2 2p^3 (^4S) 4d^1$	3D_1	9 244 000.			9 236 651.
242	$2s^2 2p^3 (^4S) 4d^1$	3D_3	9 248 000.			9 238 888.
275	$2s^2 2p^3 (^2D) 4d^1$	3F_3	9 359 000.			9 358 081.
276	$2s^2 2p^3 (^2D) 4d^1$	3D_2	9 374 000.			9 372 252.
282	$2s^2 2p^3 (^2D) 4d^1$	3D_3	9 383 000.			9 391 730.
286	$2s^2 2p^3 (^2D) 4d^1$	3P_2	9 395 000.			9 399 299.
290	$2s^2 2p^3 (^2D) 4d^1$	3S_1	9 403 000.			9 409 036.
292	$2s^2 2p^3 (^2D) 4d^1$	1D_2	9 417 000.			9 413 571.
298	$2s^2 2p^3 (^2D) 4d^1$	1F_3	9 417 000.			9 418 361.
321	$2s^2 2p^3 (^2P) 4d^1$	3F_3	9 483 000.			9 504 377.

probabilities varies from 4% to 20%. Transitions $2s^1 2p^5 ^3P_1 \rightarrow 2s^2 2p^4 ^1S_0$ and $2s^1 2p^5 ^1P_1 \rightarrow 2s^2 2p^4 ^3P_0$ have the largest deviation of 20% and 16%, respectively. On the other hand, their

contributions to the radiative lifetimes of the levels do not exceed 1%. The deviation for other intercombination E1-type transitions does not exceed 12%, while transition probabilities

Table 3. continued.

Index	Configuration	<i>LSJ</i>	E^{NIST}	$E^{\text{McLaughlin}}$	E^{Butler}	E^{GRASP}
322	2s ² 2p ³ (² P) 4d ¹	³ D ₁	9 494 000.			9 514 678.
325	2s ² 2p ³ (² P) 4d ¹	³ P ₂	9 492 000.			9 556 216.
326	2s ² 2p ³ (² P) 4d ¹	³ P ₁	9 556 000.			9 557 202.
332	2s ² 2p ³ (² P) 4d ¹	¹ F ₃	9 552 000.			9 566 948.
334	2s ² 2p ³ (² P) 4d ¹	¹ P ₁	9 573 000.			9 593 317.
430	2s ² 2p ³ (⁴ S) 5d ¹	³ D ₃	10 190 000.			10 148 967.
493	2s ² 2p ³ (² D) 5d ¹	³ F ₃	10 420 000.			10 282 236.
526	2s ² 2p ³ (² D) 5d ¹	³ D ₃	10 330 000.			10 313 519.
529	2s ² 2p ³ (² D) 5d ¹	³ D ₂	10 330 000.			10 316 701.
535	2s ² 2p ³ (² D) 5d ¹	¹ D ₂	10 360 000.			10 324 287.
537	2s ² 2p ³ (² D) 5d ¹	¹ F ₃	10 390 000.			10 325 950.
600	2s ² 2p ³ (² P) 5d ¹	³ F ₃	10 500 000.			10 425 386.
605	2s ² 2p ³ (² P) 5d ¹	³ D ₁	10 450 000.			10 429 724.
621	2s ² 2p ³ (² P) 5d ¹	³ P ₁	10 500 000.			10 476 007.
630	2s ² 2p ³ (² P) 5d ¹	¹ F ₃	10 500 000.			10 483 130.
631	2s ² 2p ³ (² P) 5d ¹	³ D ₃	10 500 000.			10 484 213.
633	2s ² 2p ³ (² P) 5d ¹	¹ P ₁	10 510 000.			10 485 769.

for other lines agree to better than 10%. This is highly satisfactory for such a large-scale calculation. The average deviation between our radiative transition probabilities and NIST values presented in Table 4 is 5.8%.

The five largest spontaneous radiative transition probabilities from each level are given in Table 5, and the sum of all E1, E2, and M1 radiative transition probabilities from the corresponding level are provided in the last column. Forbidden E2 and M1 transitions have the largest weight for transitions between fine-structure levels of the ground configuration, where E1-type transitions are forbidden. Levels 3, 4, and 5 (2s²2p⁴ ³P₁, ¹D₂, and ¹S₀) decay mainly due to magnetic dipole transitions. The contribution of electric quadrupole transitions from these levels is negligible. For highly excited levels, the contribution of magnetic dipole transitions is small. On the other hand, the first excited level decays only through E2-type transition. Contribution of E2-type forbidden transitions to the lifetimes of highly excited levels is noticeable for levels of the 2s²2p³3p¹ and 2s¹2p⁴3d¹ configurations. For example, E2-type transitions amount to 40% of the lifetime for level 24 (2s²2p³ (⁴S) 3p¹ ³P₀), 28% for level 138 (2s¹2p⁴ (⁴P) 3d¹ ³F₄), and 27% for level 33 (2s²2p³ (²D) 3p¹ ¹F₃). Finally, electric quadrupole transitions have contributions exceeding 10% of the total transition probability for 12 levels (24, 138, 33, 30, 34, 23, 28, 22, 176, 126, 18 and 172).

4. Conclusion

In the present paper we have reported large-scale calculations in the multiconfigurational Dirac-Fock approach of 656 lowest energy levels as well as corresponding transition

wavelengths, absorption oscillator strengths and radiative transition probabilities for electric dipole, electric quadrupole as well as magnetic dipole type transitions in oxygen-like Fe XIX. To our knowledge, our work represents the largest calculation to date for Fe XIX. Fairly good agreement is obtained between our calculated and NIST data.

Spectroscopic notations of levels in the *LS*-coupling scheme have been presented, and checked for their completeness. Contributions of CSF to intermediate coupling wave functions indicate that *LS*-coupling scheme is not satisfactory for highly excited states.

The five major radiative probabilities from each level and the total transition probability have been provided, taking into account forbidden transitions. The largest contributions of forbidden E2 and M1 transitions have been obtained for the lifetimes of fine-structure levels of the ground configuration.

Agreement between our presented theoretical values and available NIST data as well as large basis of configuration state functions and relativistic Dirac-Fock approach, allows us to conclude that our calculations of energy levels and radiative transition data for Fe XIX are reliable. They may successfully be used in various plasma codes for the interpretation of astronomical and other spectral observations, especially for high resolution spectra provided by the *Chandra* and *XMM-Newton* satellites.

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Table 4. Comparison of some calculated (GRASP) Fe XIX wavelengths λ , radiative transition probabilities A_{ki}^r , oscillator f_{ik} and line S strengths with values presented by NIST. Indexes of levels in the first two columns are taken from Table 1.

k	i	Type	NIST				GRASP			
			λ (Å)	A_{ki}^r (s ⁻¹)	f_{ik}	S	λ (Å)	A_{ki}^r (s ⁻¹)	f_{ik}	S
1	16	E1	14.63	1.40E+11	4.49E-03	1.08E-03	14.65	1.27E+11	4.08E-03	9.85E-04
1	15	E1	14.67	1.10E+12	5.00E-02	1.20E-02	14.69	1.11E+12	5.02E-02	1.21E-02
1	13	E1	14.73	9.80E+11	3.19E-02	7.74E-03	14.76	9.53E+11	3.11E-02	7.56E-03
1	12	E1	14.97	2.50E+12	5.00E-02	1.20E-02	15.00	2.34E+12	4.74E-02	1.17E-02
1	9	E1	78.89	1.30E+10	7.28E-03	9.45E-03	77.65	1.15E+10	6.24E-03	7.98E-03
1	7	E1	101.55	3.17E+10	2.94E-02	4.92E-02	100.50	2.91E+10	2.64E-02	4.37E-02
1	6	E1	108.37	3.90E+10	6.87E-02	1.22E-01	107.17	3.57E+10	6.15E-02	1.08E-01
2	21	E1	14.60	7.50E+11	7.19E-02	3.46E-03	14.65	7.21E+11	6.96E-02	3.36E-03
2	12	E1	15.14	5.10E+11	5.26E-02	2.62E-03	15.17	4.95E+11	5.13E-02	2.56E-03
2	9	E1	83.87	1.60E+09	5.10E-03	1.40E-03	82.49	1.34E+09	4.11E-03	1.12E-03
2	7	E1	109.95	1.60E+10	8.70E-02	3.15E-02	108.75	1.49E+10	7.90E-02	2.83E-02
3	25	E1	14.53	6.80E+11	3.59E-02	5.15E-03	14.56	6.58E+11	3.49E-02	5.02E-03
3	20	E1	14.67	1.10E+12	1.20E-02	1.70E-03	14.70	1.11E+12	1.20E-02	1.74E-03
3	14	E1	14.93	1.20E+12	4.00E-02	5.90E-03	14.95	1.21E+12	4.06E-02	5.99E-03
3	13	E1	14.93	2.50E+11	1.39E-02	2.05E-03	14.96	2.65E+11	1.48E-02	2.18E-03
3	12	E1	15.17	6.70E+11	2.31E-02	3.46E-03	15.20	6.03E+11	2.09E-02	3.14E-03
3	9	E1	84.88	9.30E+08	1.00E-03	8.40E-04	83.40	8.41E+08	8.77E-04	7.22E-04
3	8	E1	106.32	6.10E+10	3.45E-02	3.62E-02	105.16	5.57E+10	3.08E-02	3.20E-02
3	7	E1	111.70	1.26E+10	2.36E-02	2.60E-02	110.35	1.16E+10	2.12E-02	2.31E-02
3	6	E1	120.00	1.04E+10	3.74E-02	4.44E-02	118.44	9.60E+09	3.36E-02	3.94E-02
4	26	E1	14.67	1.10E+12	2.10E-02	5.10E-03	14.70	9.96E+11	1.94E-02	4.69E-03
4	21	E1	14.81	5.60E+11	1.10E-02	2.69E-03	14.86	5.05E+11	1.00E-02	2.45E-03
4	16	E1	15.00	2.20E+12	7.40E-02	1.80E-02	15.02	2.16E+12	7.32E-02	1.81E-02
4	15	E1	15.04	1.10E+11	5.22E-03	1.29E-03	15.07	1.05E+11	5.01E-03	1.24E-03
4	9	E1	91.01	1.49E+11	1.11E-01	1.66E-01	89.53	1.42E+11	1.02E-01	1.51E-01
4	6	E1	132.64	2.20E+09	5.80E-03	1.30E-02	131.19	1.94E+09	5.02E-03	1.08E-02
5	26	E1	15.02	1.40E+12	1.40E-01	7.00E-03	15.05	1.37E+12	1.39E-01	6.91E-03
5	9	E1	106.11	1.10E+10	5.57E-02	1.95E-02	104.03	1.03E+10	5.01E-02	1.72E-02
5	7	E1	151.61	7.90E+08	8.20E-03	4.10E-03	149.60	6.35E+08	6.39E-03	3.15E-03
7	10	E1	87.00	1.20E+10	4.54E-03	3.90E-03	84.70	1.06E+10	3.79E-03	3.17E-03
9	10	E1	115.40	1.61E+11	1.07E-01	1.22E-01	112.63	1.50E+11	9.48E-02	1.05E-01
1	4	E2	592.23	6.00E+00	3.20E-10	2.00E-03	585.32	6.18E+00	3.17E-10	1.90E-03
1	3	E2	1118.06	6.10E-01	6.90E-11	2.90E-03	1126.20	6.14E-01	7.01E-11	2.98E-03
1	2	E2	1328.90	4.90E-01	2.60E-11	1.80E-03	1325.50	5.09E-01	2.68E-11	1.86E-03
4	5	E2	639.67	4.90E+01	6.00E-10	4.70E-03	642.31	4.83E+01	5.97E-10	4.71E-03
1	4	M1	592.23	1.70E+04	8.90E-07	6.50E-01	585.32	1.69E+04	8.69E-07	6.29E-01
1	3	M1	1118.06	1.45E+04	1.63E-06	2.25E+00	1126.20	1.42E+04	1.62E-06	2.26E+00
3	5	M1	424.27	1.50E+05	1.30E-06	4.20E-01	420.62	1.39E+05	1.23E-06	3.84E-01
3	4	M1	1259.27	6.70E+02	2.65E-07	2.48E-01	1218.70	6.99E+02	2.59E-07	2.34E-01
6	9	M1	289.99	2.90E+04	2.20E-07	7.90E-02	281.93	2.91E+04	2.08E-07	7.24E-02
6	7	M1	1613.40	5.20E+03	1.22E-06	2.43E+00	1614.90	5.16E+03	1.21E-06	2.42E+00
7	9	M1	353.53	9.40E+03	1.76E-07	4.62E-02	341.57	9.42E+03	1.65E-07	4.17E-02
8	9	M1	420.91	7.70E+03	6.14E-07	6.39E-02	403.10	8.06E+03	5.89E-07	5.87E-02

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Online Material

Table 1. Calculated energy levels of Fe XIX with spectroscopic identification (in cm^{-1}) relative to the ground energy. The leading percentage compositions of levels which contributions exceed 10% are presented in the last column.

Index	Configuration	<i>LS</i>	<i>J</i>	<i>E</i> (cm^{-1})	Composition
1	$2s^2 2p^4$	3P	2	-230 793 799.	90%
2	$2s^2 2p^4$	3P	0	75 445.	80% + 19% $2s^2 2p^4 \ ^1S$
3	$2s^2 2p^4$	3P	1	88 791.	100%
4	$2s^2 2p^4$	1D	2	170 847.	90%
5	$2s^2 2p^4$	1S	0	326 535.	79% + 19% $2s^2 2p^4 \ ^3P$
6	$2s^1 2p^5$	3P	2	933 080.	99%
7	$2s^1 2p^5$	3P	1	995 005.	97%
8	$2s^1 2p^5$	3P	0	1 039 692.	99%
9	$2s^1 2p^5$	1P	1	1 287 772.	96%
10	$2p^6$	1S	0	2 175 645.	97%
11	$2s^2 2p^3 \ (^4S) 3s^1$	5S	2	6 615 412.	90%
12	$2s^2 2p^3 \ (^4S) 3s^1$	3S	1	6 668 591.	83%
13	$2s^2 2p^3 \ (^2D) 3s^1$	3D	2	6 774 890.	63% + 19% $2s^2 2p^3 \ (^2P) 3s^1 \ ^3P$ + 12% $2s^2 2p^3 \ (^2D) 3s^1 \ ^1D$
14	$2s^2 2p^3 \ (^2D) 3s^1$	3D	1	6 776 938.	75% + 11% $2s^2 2p^3 \ (^4S) 3s^1 \ ^3S$
15	$2s^2 2p^3 \ (^2D) 3s^1$	3D	3	6 807 447.	99%
16	$2s^2 2p^3 \ (^2D) 3s^1$	1D	2	6 827 890.	74% + 23% $2s^2 2p^3 \ (^2D) 3s^1 \ ^3D$
17	$2s^2 2p^3 \ (^4S) 3p^1$	5P	1	6 852 162.	84%
18	$2s^2 2p^3 \ (^4S) 3p^1$	5P	2	6 855 911.	77%
19	$2s^2 2p^3 \ (^4S) 3p^1$	5P	3	6 875 984.	89%
20	$2s^2 2p^3 \ (^2P) 3s^1$	3P	0	6 891 587.	98%
21	$2s^2 2p^3 \ (^2P) 3s^1$	3P	1	6 899 384.	75% + 21% $2s^2 2p^3 \ (^2P) 3s^1 \ ^1P$
22	$2s^2 2p^3 \ (^4S) 3p^1$	3P	1	6 907 373.	59% + 11% $2s^2 2p^3 \ (^2D) 3p^1 \ ^3P$
23	$2s^2 2p^3 \ (^4S) 3p^1$	3P	2	6 928 881.	63% + 15% $2s^2 2p^3 \ (^4S) 3p^1 \ ^5P$
24	$2s^2 2p^3 \ (^4S) 3p^1$	3P	0	6 938 016.	84%
25	$2s^2 2p^3 \ (^2P) 3s^1$	3P	2	6 956 006.	68% + 13% $2s^2 2p^3 \ (^2D) 3s^1 \ ^1D$ + 13% $2s^2 2p^3 \ (^2D) 3s^1 \ ^3D$
26	$2s^2 2p^3 \ (^2P) 3s^1$	1P	1	6 972 034.	62% + 18% $2s^2 2p^3 \ (^2D) 3s^1 \ ^3D$ + 12% $2s^2 2p^3 \ (^2P) 3s^1 \ ^3P$
27	$2s^2 2p^3 \ (^2D) 3p^1$	3D	1	6 987 114.	37% + 27% $2s^2 2p^3 \ (^2D) 3p^1 \ ^1P$
28	$2s^2 2p^3 \ (^2D) 3p^1$	3F	2	7 009 674.	46% + 29% $2s^2 2p^3 \ (^2D) 3p^1 \ ^3D$ + 11% $2s^2 2p^3 \ (^2P) 3p^1 \ ^3D$
29	$2s^2 2p^3 \ (^2D) 3p^1$	3D	2	7 028 528.	55% + 27% $2s^2 2p^3 \ (^2D) 3p^1 \ ^3F$
30	$2s^2 2p^3 \ (^2D) 3p^1$	3F	3	7 031 765.	67% + 13% $2s^2 2p^3 \ (^2D) 3p^1 \ ^3D$ + 13% $2s^2 2p^3 \ (^2P) 3p^1 \ ^3D$
31	$2s^2 2p^3 \ (^2D) 3p^1$	1P	1	7 043 265.	45% + 36% $2s^2 2p^3 \ (^2D) 3p^1 \ ^3D$
32	$2s^2 2p^3 \ (^2D) 3p^1$	3D	3	7 045 196.	54% + 37% $2s^2 2p^3 \ (^2D) 3p^1 \ ^1F$
33	$2s^2 2p^3 \ (^2D) 3p^1$	1F	3	7 065 394.	48% + 32% $2s^2 2p^3 \ (^2D) 3p^1 \ ^3D$ + 19% $2s^2 2p^3 \ (^2D) 3p^1 \ ^3F$
34	$2s^2 2p^3 \ (^2D) 3p^1$	3F	4	7 070 421.	100%
35	$2s^2 2p^3 \ (^2D) 3p^1$	3P	0	7 090 786.	70% + 24% $2s^2 2p^3 \ (^2P) 3p^1 \ ^3P$
36	$2s^2 2p^3 \ (^2D) 3p^1$	3P	1	7 111 290.	36% + 16% $2s^2 2p^3 \ (^2P) 3p^1 \ ^3S$ + 15% $2s^2 2p^3 \ (^4S) 3p^1 \ ^3P$
37	$2s^2 2p^3 \ (^2D) 3p^1$	3P	2	7 129 866.	67% + 13% $2s^2 2p^3 \ (^4S) 3p^1 \ ^3P$
38	$2s^2 2p^3 \ (^2P) 3p^1$	3D	1	7 134 136.	64% + 17% $2s^2 2p^3 \ (^2P) 3p^1 \ ^1P$
39	$2s^2 2p^3 \ (^2D) 3p^1$	1D	2	7 157 955.	46% + 20% $2s^2 2p^3 \ (^2P) 3p^1 \ ^3P$ + 13% $2s^2 2p^3 \ (^2P) 3p^1 \ ^1D$
40	$2s^2 2p^3 \ (^4S) 3d^1$	5D	3	7 163 487.	85%
41	$2s^2 2p^3 \ (^4S) 3d^1$	5D	2	7 163 998.	87%
42	$2s^2 2p^3 \ (^4S) 3d^1$	5D	0	7 164 394.	91%
43	$2s^2 2p^3 \ (^2P) 3p^1$	3S	1	7 164 476.	41% + 27% $2s^2 2p^3 \ (^2P) 3p^1 \ ^3P$ + 12% $2s^2 2p^3 \ (^2P) 3p^1 \ ^1P$
44	$2s^2 2p^3 \ (^4S) 3d^1$	5D	1	7 164 686.	91%
45	$2s^2 2p^3 \ (^2P) 3p^1$	3D	2	7 164 943.	76%
46	$2s^2 2p^3 \ (^4S) 3d^1$	5D	4	7 166 775.	90%
47	$2s^2 2p^3 \ (^2D) 3p^1$	3P	1	7 210 375.	35% + 26% $2s^2 2p^3 \ (^2P) 3p^1 \ ^1P$ + 17% $2s^2 2p^3 \ (^2P) 3p^1 \ ^3S$

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
48	2s ² 2p ³ (² P) 3p ¹	³ D	3	7 210 737.	69% + 13% 2s ² 2p ³ (² D) 3p ¹ ³ F + 12% 2s ² 2p ³ (² D) 3p ¹ ¹ F
49	2s ² 2p ³ (² P) 3p ¹	³ P	0	7 211 270.	61% + 15% 2s ² 2p ³ (² P) 3p ¹ ¹ S + 11% 2s ² 2p ³ (² D) 3p ¹ ³ P
50	2s ² 2p ³ (⁴ S) 3d ¹	³ D	2	7 212 426.	57% + 13% 2s ² 2p ³ (² D) 3d ¹ ³ D + 10% 2s ² 2p ³ (² P) 3d ¹ ¹ D
51	2s ² 2p ³ (² P) 3p ¹	³ P	1	7 237 209.	42% + 19% 2s ² 2p ³ (² P) 3p ¹ ¹ P + 11% 2s ² 2p ³ (⁴ S) 3p ¹ ³ P
52	2s ² 2p ³ (⁴ S) 3d ¹	³ D	1	7 237 895.	81%
53	2s ² 2p ³ (⁴ S) 3d ¹	³ D	3	7 238 873.	69% + 11% 2s ² 2p ³ (² D) 3d ¹ ³ D
54	2s ² 2p ³ (² P) 3p ¹	³ P	2	7 242 650.	38% + 32% 2s ² 2p ³ (² P) 3p ¹ ¹ D
55	2s ² 2p ³ (² D) 3p ¹	¹ D	2	7 272 169.	43% + 31% 2s ² 2p ³ (² P) 3p ¹ ¹ D + 12% 2s ² 2p ³ (² P) 3p ¹ ³ P
56	2s ² 2p ³ (² D) 3d ¹	³ F	2	7 308 270.	65%
57	2s ² 2p ³ (² D) 3d ¹	³ F	3	7 319 965.	70%
58	2s ² 2p ³ (² D) 3d ¹	¹ S	0	7 321 082.	79% + 12% 2s ² 2p ³ (² P) 3d ¹ ³ P
59	2s ² 2p ³ (² D) 3d ¹	³ G	3	7 326 971.	64% + 10% 2s ² 2p ³ (² D) 3d ¹ ³ F
60	2s ² 2p ³ (² D) 3d ¹	³ G	4	7 327 447.	51% + 22% 2s ² 2p ³ (² D) 3d ¹ ¹ G + 19% 2s ² 2p ³ (² P) 3d ¹ ³ F
61	2s ² 2p ³ (² D) 3d ¹	³ D	1	7 331 284.	46% + 26% 2s ² 2p ³ (² D) 3d ¹ ¹ P
62	2s ² 2p ³ (² D) 3d ¹	³ F	4	7 349 806.	97%
63	2s ² 2p ³ (² D) 3d ¹	³ G	5	7 362 279.	100%
64	2s ² 2p ³ (² D) 3d ¹	¹ G	4	7 363 111.	63% + 35% 2s ² 2p ³ (² D) 3d ¹ ³ G
65	2s ² 2p ³ (² D) 3d ¹	³ P	2	7 370 636.	28% + 24% 2s ² 2p ³ (² D) 3d ¹ ³ D + 15% 2s ² 2p ³ (² P) 3d ¹ ³ P
66	2s ² 2p ³ (² P) 3p ¹	¹ S	0	7 376 410.	76% + 10% 2s ² 2p ³ (² D) 3p ¹ ³ P
67	2s ² 2p ³ (² D) 3d ¹	¹ P	1	7 378 172.	37% + 23% 2s ² 2p ³ (² D) 3d ¹ ³ D + 15% 2s ² 2p ³ (² P) 3d ¹ ³ P
68	2s ² 2p ³ (² D) 3d ¹	³ D	3	7 390 818.	72% + 14% 2s ² 2p ³ (⁴ S) 3d ¹ ³ D
69	2s ¹ 2p ⁴ (⁴ P) 3s ¹	⁵ P	3	7 392 833.	96%
70	2s ² 2p ³ (² D) 3d ¹	³ P	0	7 393 753.	73% + 13% 2s ² 2p ³ (² D) 3d ¹ ¹ S + 12% 2s ² 2p ³ (² P) 3d ¹ ³ P
71	2s ² 2p ³ (² D) 3d ¹	³ D	2	7 398 129.	42% + 24% 2s ² 2p ³ (² D) 3d ¹ ³ P + 10% 2s ² 2p ³ (² D) 3d ¹ ¹ D
72	2s ² 2p ³ (² D) 3d ¹	³ P	1	7 399 267.	53% + 14% 2s ² 2p ³ (² D) 3d ¹ ¹ P + 11% 2s ² 2p ³ (² D) 3d ¹ ³ D
73	2s ² 2p ³ (² D) 3d ¹	¹ D	2	7 409 151.	32% + 26% 2s ² 2p ³ (² D) 3d ¹ ³ P + 24% 2s ² 2p ³ (² P) 3d ¹ ¹ D
74	2s ² 2p ³ (² D) 3d ¹	³ S	1	7 422 532.	60% + 26% 2s ² 2p ³ (² D) 3d ¹ ³ P
75	2s ¹ 2p ⁴ (⁴ P) 3s ¹	⁵ P	2	7 442 806.	80% + 16% 2s ¹ 2p ⁴ (⁴ P) 3s ¹ ³ P
76	2s ² 2p ³ (² D) 3d ¹	¹ F	3	7 442 847.	66% + 18% 2s ² 2p ³ (² P) 3d ¹ ³ D
77	2s ² 2p ³ (² P) 3d ¹	³ F	2	7 456 495.	63% + 10% 2s ² 2p ³ (² D) 3d ¹ ³ F
78	2s ² 2p ³ (² P) 3d ¹	³ F	3	7 462 619.	66% + 17% 2s ² 2p ³ (² P) 3d ¹ ³ D
79	2s ¹ 2p ⁴ (⁴ P) 3s ¹	⁵ P	1	7 476 726.	94%
80	2s ² 2p ³ (² P) 3d ¹	³ D	2	7 478 825.	32% + 28% 2s ² 2p ³ (² P) 3d ¹ ³ P + 18% 2s ² 2p ³ (² D) 3d ¹ ¹ D
81	2s ² 2p ³ (² P) 3d ¹	³ D	1	7 497 246.	34% + 34% 2s ² 2p ³ (² P) 3d ¹ ³ P
82	2s ¹ 2p ⁴ (⁴ P) 3s ¹	³ P	2	7 499 065.	76% + 17% 2s ¹ 2p ⁴ (⁴ P) 3s ¹ ⁵ P
83	2s ² 2p ³ (² P) 3d ¹	³ F	4	7 500 367.	70% + 13% 2s ² 2p ³ (² D) 3d ¹ ³ G + 12% 2s ² 2p ³ (² D) 3d ¹ ¹ G
84	2s ² 2p ³ (² P) 3d ¹	³ P	0	7 505 642.	66% + 21% 2s ² 2p ³ (² D) 3d ¹ ³ P
85	2s ² 2p ³ (² P) 3d ¹	³ P	2	7 515 848.	30% + 24% 2s ² 2p ³ (² P) 3d ¹ ¹ D + 17% 2s ² 2p ³ (² D) 3d ¹ ³ P
86	2s ² 2p ³ (² P) 3d ¹	³ D	1	7 522 780.	35% + 27% 2s ² 2p ³ (² P) 3d ¹ ³ P + 13% 2s ² 2p ³ (² D) 3d ¹ ³ S
87	2s ² 2p ³ (² P) 3d ¹	³ D	3	7 538 090.	39% + 29% 2s ² 2p ³ (² P) 3d ¹ ¹ F
88	2s ¹ 2p ⁴ (⁴ P) 3s ¹	³ P	1	7 551 265.	90%
89	2s ² 2p ³ (² P) 3d ¹	¹ F	3	7 560 085.	44% + 22% 2s ² 2p ³ (² D) 3d ¹ ¹ F + 11% 2s ² 2p ³ (² P) 3d ¹ ³ D
90	2s ² 2p ³ (² P) 3d ¹	³ D	2	7 563 303.	29% + 26% 2s ² 2p ³ (² D) 3d ¹ ¹ D + 21% 2s ² 2p ³ (² P) 3d ¹ ¹ D
91	2s ¹ 2p ⁴ (⁴ P) 3s ¹	³ P	0	7 571 511.	90%
92	2s ² 2p ³ (² P) 3d ¹	¹ P	1	7 623 053.	69%
93	2s ¹ 2p ⁴ (⁴ P) 3p ¹	⁵ P	3	7 626 093.	70% + 25% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ⁵ D
94	2s ¹ 2p ⁴ (⁴ P) 3p ¹	⁵ P	2	7 627 441.	68% + 13% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ⁵ S
95	2s ¹ 2p ⁴ (⁴ P) 3p ¹	⁵ D	4	7 659 203.	96%

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
96	2s ¹ 2p ⁴ (⁴ P) 3p ¹	⁵ P	1	7 669 444.	79%
97	2s ¹ 2p ⁴ (⁴ P) 3p ¹	³ D	3	7 672 638.	62% + 18% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ⁵ D + 16% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ⁵ P
98	2s ¹ 2p ⁴ (⁴ P) 3p ¹	⁵ D	2	7 704 931.	58% + 24% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ³ D
99	2s ¹ 2p ⁴ (² D) 3s ¹	³ D	1	7 706 424.	92%
100	2s ¹ 2p ⁴ (² D) 3s ¹	³ D	2	7 709 743.	91%
101	2s ¹ 2p ⁴ (² D) 3s ¹	³ D	3	7 718 580.	95%
102	2s ¹ 2p ⁴ (⁴ P) 3p ¹	⁵ D	1	7 719 659.	68% + 14% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ³ S
103	2s ¹ 2p ⁴ (⁴ P) 3p ¹	⁵ D	0	7 722 890.	94%
104	2s ¹ 2p ⁴ (⁴ P) 3p ¹	³ S	1	7 724 278.	46% + 16% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ⁵ P + 16% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ⁵ D
105	2s ¹ 2p ⁴ (⁴ P) 3p ¹	⁵ D	3	7 727 671.	54% + 32% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ³ D + 12% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ⁵ P
106	2s ¹ 2p ⁴ (⁴ P) 3p ¹	³ P	2	7 733 587.	40% + 29% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ³ D + 21% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ⁵ D
107	2s ¹ 2p ⁴ (⁴ P) 3p ¹	⁵ S	2	7 754 782.	74% + 19% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ⁵ P
108	2s ¹ 2p ⁴ (⁴ P) 3p ¹	³ P	0	7 772 950.	74% + 21% 2s ¹ 2p ⁴ (² D) 3p ¹ ³ P
109	2s ¹ 2p ⁴ (² D) 3s ¹	¹ D	2	7 773 374.	91%
110	2s ¹ 2p ⁴ (⁴ P) 3p ¹	³ D	1	7 775 125.	77% + 11% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ³ S
111	2s ¹ 2p ⁴ (⁴ P) 3p ¹	³ D	2	7 778 423.	40% + 39% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ³ P
112	2s ¹ 2p ⁴ (⁴ P) 3p ¹	³ P	1	7 794 438.	45% + 22% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ³ S + 13% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ³ D
113	2s ¹ 2p ⁴ (² S) 3s ¹	³ S	1	7 862 062.	74% + 15% 2s ¹ 2p ⁴ (² P) 3s ¹ ³ P
114	2s ¹ 2p ⁴ (² S) 3s ¹	¹ S	0	7 897 457.	57% + 39% 2s ¹ 2p ⁴ (² P) 3s ¹ ³ P
115	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ D	4	7 911 807.	78% + 19% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ⁵ F
116	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ D	3	7 912 363.	78% + 10% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ⁵ F
117	2s ¹ 2p ⁴ (² P) 3s ¹	³ P	2	7 914 328.	91%
118	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ D	2	7 919 866.	74% + 17% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ⁵ P
119	2s ¹ 2p ⁴ (² P) 3s ¹	¹ P	1	7 926 989.	55% + 38% 2s ¹ 2p ⁴ (² P) 3s ¹ ³ P
120	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ D	1	7 932 071.	67% + 25% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ⁵ P
121	2s ¹ 2p ⁴ (² D) 3p ¹	³ F	2	7 933 725.	90%
122	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ F	5	7 937 912.	97%
123	2s ¹ 2p ⁴ (² D) 3p ¹	¹ P	1	7 940 286.	50% + 25% 2s ¹ 2p ⁴ (² D) 3p ¹ ³ D
124	2s ¹ 2p ⁴ (² D) 3p ¹	³ F	3	7 948 416.	90%
125	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ D	0	7 950 967.	90%
126	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ F	4	7 968 993.	51% + 36% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ³ F + 10% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ⁵ D
127	2s ¹ 2p ⁴ (² D) 3p ¹	³ F	4	7 969 257.	96%
128	2s ¹ 2p ⁴ (² D) 3p ¹	¹ F	3	7 972 616.	75% + 15% 2s ¹ 2p ⁴ (² D) 3p ¹ ³ D
129	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ P	1	7 981 629.	71% + 21% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ⁵ D
130	2s ¹ 2p ⁴ (² D) 3p ¹	³ D	2	7 983 085.	83%
131	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ F	3	7 993 060.	64% + 16% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ³ F
132	2s ¹ 2p ⁴ (² D) 3p ¹	³ D	1	7 994 491.	69% + 19% 2s ¹ 2p ⁴ (² D) 3p ¹ ¹ P
133	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ P	2	7 998 742.	61% + 25% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ⁵ F
134	2s ¹ 2p ⁴ (² D) 3p ¹	³ D	3	8 002 343.	79% + 17% 2s ¹ 2p ⁴ (² D) 3p ¹ ¹ F
135	2s ¹ 2p ⁴ (² D) 3p ¹	¹ D	2	8 007 594.	64% + 22% 2s ¹ 2p ⁴ (² D) 3p ¹ ³ P
136	2s ¹ 2p ⁴ (² P) 3s ¹	³ P	1	8 013 073.	44% + 35% 2s ¹ 2p ⁴ (² P) 3s ¹ ¹ P + 18% 2s ¹ 2p ⁴ (² S) 3s ¹ ³ S
137	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ F	2	8 015 343.	64% + 16% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ⁵ P + 15% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ⁵ D
138	2s ¹ 2p ⁴ (⁴ P) 3d ¹	³ F	4	8 015 448.	60% + 27% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ⁵ F
139	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ F	1	8 019 137.	93%
140	2s ¹ 2p ⁴ (² D) 3p ¹	³ P	1	8 021 480.	55% + 14% 2s ¹ 2p ⁴ (² D) 3p ¹ ¹ P + 12% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ³ P
141	2s ¹ 2p ⁴ (² D) 3p ¹	³ P	2	8 024 170.	58% + 26% 2s ¹ 2p ⁴ (² D) 3p ¹ ¹ D + 10% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ³ P
142	2s ¹ 2p ⁴ (⁴ P) 3d ¹	⁵ P	3	8 025 361.	48% + 16% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ⁵ F + 12% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ³ D

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
143	2s ¹ 2p ⁴ (² D) 3p ¹	³ P	0	8 025 904.	59% + 19% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ P + 18% 2s ¹ 2p ⁴ (⁴ P) 3p ¹ ³ P
144	2s ¹ 2p ⁴ (² P) 3s ¹	³ P	0	8 027 729.	57% + 36% 2s ¹ 2p ⁴ (² S) 3s ¹ ¹ S
145	2s ¹ 2p ⁴ (⁴ P) 3d ¹	³ F	3	8 036 088.	48% + 31% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ⁵ P
146	2s ¹ 2p ⁴ (⁴ P) 3d ¹	³ P	0	8 038 796.	77%
147	2s ¹ 2p ⁴ (⁴ P) 3d ¹	³ P	1	8 043 511.	65% + 15% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ³ D
148	2s ¹ 2p ⁴ (⁴ P) 3d ¹	³ D	2	8 047 025.	39% + 24% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ³ F + 20% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ³ P
149	2s ¹ 2p ⁴ (⁴ P) 3d ¹	³ F	2	8 080 045.	66% + 21% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ³ P
150	2s ¹ 2p ⁴ (⁴ P) 3d ¹	³ D	1	8 088 509.	64% + 15% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ³ P + 10% 2s ¹ 2p ⁴ (² D) 3d ¹ ³ D
151	2s ¹ 2p ⁴ (² S) 3p ¹	³ P	0	8 093 150.	65% + 20% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ P
152	2s ¹ 2p ⁴ (⁴ P) 3d ¹	³ D	3	8 094 748.	66% + 23% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ³ F
153	2s ¹ 2p ⁴ (² S) 3p ¹	³ P	1	8 102 842.	54% + 19% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ D + 12% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ P
154	2s ¹ 2p ⁴ (⁴ P) 3d ¹	³ P	2	8 113 545.	47% + 34% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ³ D
155	2s ¹ 2p ⁴ (² S) 3p ¹	³ P	2	8 128 418.	62% + 30% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ D
156	2s ¹ 2p ⁴ (² S) 3p ¹	¹ P	1	8 138 461.	55% + 10% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ P
157	2s ¹ 2p ⁴ (² P) 3p ¹	³ P	2	8 148 713.	40% + 19% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ D + 19% 2s ¹ 2p ⁴ (² P) 3p ¹ ¹ D
158	2s ¹ 2p ⁴ (² P) 3p ¹	¹ D	2	8 169 057.	41% + 38% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ P + 11% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ D
159	2s ¹ 2p ⁴ (² P) 3p ¹	³ D	3	8 171 239.	93%
160	2s ¹ 2p ⁴ (² P) 3p ¹	³ P	1	8 185 333.	36% + 30% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ S + 12% 2s ¹ 2p ⁴ (² S) 3p ¹ ³ P
161	2s ¹ 2p ⁴ (² P) 3p ¹	¹ S	0	8 201 751.	61% + 22% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ P + 12% 2s ¹ 2p ⁴ (² D) 3p ¹ ³ P
162	2s ¹ 2p ⁴ (² P) 3p ¹	³ D	1	8 223 121.	52% + 21% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ S + 10% 2s ¹ 2p ⁴ (² S) 3p ¹ ³ P
163	2s ¹ 2p ⁴ (² D) 3d ¹	³ G	3	8 225 367.	94%
164	2s ¹ 2p ⁴ (² D) 3d ¹	³ G	4	8 231 612.	94%
165	2s ¹ 2p ⁴ (² D) 3d ¹	³ G	5	8 240 957.	97%
166	2s ¹ 2p ⁴ (² D) 3d ¹	³ F	2	8 262 760.	85%
167	2s ¹ 2p ⁴ (² P) 3p ¹	³ P	0	8 264 410.	36% + 30% 2s ¹ 2p ⁴ (² P) 3p ¹ ¹ S + 26% 2s ¹ 2p ⁴ (² S) 3p ¹ ³ P
168	2s ¹ 2p ⁴ (² P) 3p ¹	³ D	2	8 268 400.	36% + 34% 2s ¹ 2p ⁴ (² P) 3p ¹ ¹ D + 21% 2s ¹ 2p ⁴ (² S) 3p ¹ ³ P
169	2s ¹ 2p ⁴ (² D) 3d ¹	³ S	1	8 270 258.	68% + 13% 2s ¹ 2p ⁴ (² D) 3d ¹ ³ D
170	2s ¹ 2p ⁴ (² D) 3d ¹	³ F	3	8 270 468.	88%
171	2s ¹ 2p ⁴ (² P) 3p ¹	³ S	1	8 271 581.	34% + 24% 2s ¹ 2p ⁴ (² S) 3p ¹ ¹ P + 21% 2s ¹ 2p ⁴ (² P) 3p ¹ ³ P
172	2s ¹ 2p ⁴ (² D) 3d ¹	³ F	4	8 274 216.	60% + 34% 2s ¹ 2p ⁴ (² D) 3d ¹ ¹ G
173	2s ¹ 2p ⁴ (² D) 3d ¹	³ D	1	8 275 567.	30% + 26% 2s ¹ 2p ⁴ (² D) 3d ¹ ³ S + 20% 2s ¹ 2p ⁴ (² D) 3d ¹ ¹ P
174	2s ¹ 2p ⁴ (² D) 3d ¹	³ P	0	8 278 378.	64% + 19% 2s ¹ 2p ⁴ (² D) 3d ¹ ¹ S
175	2s ¹ 2p ⁴ (² D) 3d ¹	³ D	2	8 283 769.	75%
176	2s ¹ 2p ⁴ (² D) 3d ¹	¹ G	4	8 288 800.	60% + 36% 2s ¹ 2p ⁴ (² D) 3d ¹ ³ F
177	2s ¹ 2p ⁴ (² D) 3d ¹	³ D	3	8 290 292.	85%
178	2s ¹ 2p ⁴ (² D) 3d ¹	³ P	2	8 291 566.	84%
179	2s ¹ 2p ⁴ (² D) 3d ¹	³ P	1	8 296 912.	70% + 11% 2s ¹ 2p ⁴ (⁴ P) 3d ¹ ³ P
180	2s ¹ 2p ⁴ (² D) 3d ¹	¹ P	1	8 317 743.	57% + 26% 2s ¹ 2p ⁴ (² D) 3d ¹ ³ D
181	2s ¹ 2p ⁴ (² D) 3d ¹	¹ D	2	8 317 945.	69%
182	2s ¹ 2p ⁴ (² D) 3d ¹	¹ F	3	8 322 491.	88%
183	2s ¹ 2p ⁴ (² D) 3d ¹	¹ S	0	8 339 870.	75% + 16% 2s ¹ 2p ⁴ (² D) 3d ¹ ³ P
184	2s ¹ 2p ⁴ (² P) 3p ¹	¹ P	1	8 346 455.	75%
185	2s ¹ 2p ⁴ (² S) 3d ¹	³ D	1	8 401 771.	58% + 30% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ D
186	2s ¹ 2p ⁴ (² S) 3d ¹	³ D	2	8 408 479.	63% + 14% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ D + 11% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ F

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
187	2s ¹ 2p ⁴ (² S) 3d ¹	³ D	3	8 411 526.	72%
188	2s ¹ 2p ⁴ (² P) 3d ¹	³ D	3	8 436 181.	74% + 12% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ F
189	2s ¹ 2p ⁴ (² S) 3d ¹	¹ D	2	8 438 486.	49% + 18% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ D + 14% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ F
190	2s ¹ 2p ⁴ (² P) 3d ¹	³ D	2	8 451 365.	42% + 31% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ P
191	2s ¹ 2p ⁴ (² P) 3d ¹	¹ F	3	8 461 874.	56% + 38% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ F
192	2s ¹ 2p ⁴ (² P) 3d ¹	³ F	4	8 463 253.	94%
193	2s ¹ 2p ⁴ (² P) 3d ¹	³ P	1	8 469 720.	46% + 31% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ D + 11% 2s ¹ 2p ⁴ (² S) 3d ¹ ³ D
194	2s ¹ 2p ⁴ (² P) 3d ¹	³ P	0	8 485 157.	88%
195	2s ¹ 2p ⁴ (² P) 3d ¹	³ P	1	8 503 809.	37% + 23% 2s ¹ 2p ⁴ (² P) 3d ¹ ¹ P + 19% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ D
196	2s ¹ 2p ⁴ (² P) 3d ¹	³ F	2	8 508 027.	43% + 23% 2s ¹ 2p ⁴ (² P) 3d ¹ ¹ D + 17% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ P
197	2s ¹ 2p ⁴ (² P) 3d ¹	³ F	3	8 553 132.	37% + 33% 2s ¹ 2p ⁴ (² P) 3d ¹ ¹ F + 20% 2s ¹ 2p ⁴ (² S) 3d ¹ ³ D
198	2s ¹ 2p ⁴ (² P) 3d ¹	³ P	2	8 566 696.	37% + 26% 2s ¹ 2p ⁴ (² S) 3d ¹ ¹ D + 14% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ D
199	2s ¹ 2p ⁴ (² P) 3d ¹	¹ P	1	8 591 981.	63% + 12% 2s ¹ 2p ⁴ (² S) 3d ¹ ³ D
200	2s ¹ 2p ⁴ (² P) 3d ¹	¹ D	2	8 606 433.	57% + 15% 2s ¹ 2p ⁴ (² P) 3d ¹ ³ F + 11% 2s ¹ 2p ⁴ (² S) 3d ¹ ¹ D
201	2p ⁵ 3s ¹	³ P	2	8 671 622.	95%
202	2p ⁵ 3s ¹	³ P	1	8 692 816.	49% + 46% 2p ⁵ 3s ¹ ¹ P
203	2p ⁵ 3s ¹	³ P	0	8 776 738.	96%
204	2p ⁵ 3s ¹	¹ P	1	8 792 690.	48% + 47% 2p ⁵ 3s ¹ ³ P
205	2p ⁵ 3p ¹	³ S	1	8 864 540.	80% + 16% 2p ⁵ 3p ¹ ³ P
206	2p ⁵ 3p ¹	³ D	2	8 895 588.	58% + 27% 2p ⁵ 3p ¹ ¹ D + 11% 2p ⁵ 3p ¹ ³ P
207	2p ⁵ 3p ¹	³ D	3	8 909 009.	96%
208	2p ⁵ 3p ¹	¹ P	1	8 920 712.	47% + 27% 2p ⁵ 3p ¹ ³ D + 18% 2p ⁵ 3p ¹ ³ P
209	2p ⁵ 3p ¹	³ P	2	8 938 448.	64% + 31% 2p ⁵ 3p ¹ ¹ D
210	2p ⁵ 3p ¹	³ P	0	8 985 996.	92%
211	2s ² 2p ³ (⁴ S) 4s ¹	⁵ S	2	8 991 312.	90%
212	2p ⁵ 3p ¹	³ D	1	8 996 265.	63% + 32% 2p ⁵ 3p ¹ ¹ P
213	2s ² 2p ³ (⁴ S) 4s ¹	³ S	1	9 009 157.	89%
214	2p ⁵ 3p ¹	³ P	1	9 027 898.	61% + 17% 2p ⁵ 3p ¹ ¹ P + 12% 2p ⁵ 3p ¹ ³ S
215	2p ⁵ 3p ¹	³ D	2	9 030 110.	38% + 37% 2p ⁵ 3p ¹ ¹ D + 21% 2p ⁵ 3p ¹ ³ P
216	2s ² 2p ³ (⁴ S) 4p ¹	⁵ P	1	9 088 194.	88%
217	2s ² 2p ³ (⁴ S) 4p ¹	⁵ P	2	9 089 818.	81%
218	2s ² 2p ³ (⁴ S) 4p ¹	⁵ P	3	9 097 647.	91%
219	2s ² 2p ³ (⁴ S) 4p ¹	³ P	1	9 115 464.	80%
220	2s ² 2p ³ (⁴ S) 4p ¹	³ P	2	9 123 469.	79%
221	2s ² 2p ³ (⁴ S) 4p ¹	³ P	0	9 127 683.	92%
222	2s ² 2p ³ (² D) 4s ¹	³ D	1	9 141 821.	79%
223	2s ² 2p ³ (² D) 4s ¹	³ D	2	9 142 211.	56% + 22% 2s ² 2p ³ (² D) 4s ¹ ¹ D + 16% 2s ² 2p ³ (² P) 4s ¹ ³ P
224	2p ⁵ 3d ¹	³ P	0	9 154 400.	97%
225	2p ⁵ 3d ¹	³ P	1	9 163 141.	90%
226	2s ² 2p ³ (² D) 4s ¹	³ D	3	9 173 229.	99%
227	2p ⁵ 3d ¹	³ F	4	9 177 518.	97%
228	2s ² 2p ³ (² D) 4s ¹	¹ D	2	9 179 643.	68% + 31% 2s ² 2p ³ (² D) 4s ¹ ³ D
229	2p ⁵ 3d ¹	³ P	2	9 180 218.	72% + 17% 2p ⁵ 3d ¹ ³ D
230	2p ⁵ 3d ¹	³ F	3	9 184 859.	66% + 26% 2p ⁵ 3d ¹ ¹ F
231	2p ⁵ 3p ¹	¹ S	0	9 188 407.	92%
232	2s ² 2p ³ (⁴ S) 4d ¹	⁵ D	2	9 202 980.	88%
233	2p ⁵ 3d ¹	³ F	2	9 203 382.	38% + 37% 2p ⁵ 3d ¹ ¹ D + 21% 2p ⁵ 3d ¹ ³ D

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
234	2s ² 2p ³ (⁴ S) 4d ¹	⁵ D	0	9 203 794.	91%
235	2s ² 2p ³ (⁴ S) 4d ¹	⁵ D	3	9 203 813.	87%
236	2s ² 2p ³ (⁴ S) 4d ¹	⁵ D	1	9 203 899.	91%
237	2s ² 2p ³ (⁴ S) 4d ¹	⁵ D	4	9 205 171.	91%
238	2p ⁵ 3d ¹	³ D	3	9 214 490.	59% + 33% 2p ⁵ 3d ¹ ¹ F
239	2s ² 2p ³ (⁴ S) 4d ¹	³ D	2	9 229 318.	80%
240	2s ² 2p ³ (² D) 4p ¹	³ D	1	9 230 606.	50% + 24% 2s ² 2p ³ (² D) 4p ¹ ¹ P
241	2s ² 2p ³ (⁴ S) 4d ¹	³ D	1	9 236 651.	89%
242	2s ² 2p ³ (⁴ S) 4d ¹	³ D	3	9 238 888.	82%
243	2s ² 2p ³ (² D) 4p ¹	³ F	2	9 239 740.	73%
244	2s ² 2p ³ (² D) 4p ¹	³ F	3	9 248 145.	51% + 26% 2s ² 2p ³ (² D) 4p ¹ ¹ F + 16% 2s ² 2p ³ (² P) 4p ¹ ³ D
245	2s ² 2p ³ (² D) 4p ¹	³ D	2	9 248 932.	75%
246	2p ⁵ 3d ¹	³ D	1	9 260 898.	80% + 11% 2p ⁵ 3d ¹ ¹ P
247	2s ² 2p ³ (² D) 4p ¹	¹ P	1	9 261 508.	36% + 29% 2s ² 2p ³ (² D) 4p ¹ ³ D + 16% 2s ² 2p ³ (² D) 4p ¹ ³ P
248	2s ² 2p ³ (² D) 4p ¹	³ P	0	9 265 613.	82%
249	2s ² 2p ³ (² D) 4p ¹	³ D	3	9 268 630.	51% + 25% 2s ² 2p ³ (² D) 4p ¹ ³ F + 22% 2s ² 2p ³ (² D) 4p ¹ ¹ F
250	2s ² 2p ³ (⁴ S) 4f ¹	⁵ F	3	9 271 251.	82%
251	2s ² 2p ³ (⁴ S) 4f ¹	⁵ F	4	9 271 282.	85%
252	2s ² 2p ³ (⁴ S) 4f ¹	⁵ F	2	9 271 482.	87%
253	2s ² 2p ³ (⁴ S) 4f ¹	⁵ F	1	9 271 849.	91%
254	2s ² 2p ³ (⁴ S) 4f ¹	⁵ F	5	9 271 973.	90%
255	2s ² 2p ³ (⁴ S) 4f ¹	³ F	3	9 273 855.	81%
256	2s ² 2p ³ (⁴ S) 4f ¹	³ F	4	9 273 866.	84%
257	2s ² 2p ³ (⁴ S) 4f ¹	³ F	2	9 274 963.	87%
258	2s ² 2p ³ (² D) 4p ¹	³ D	3	9 278 913.	44% + 43% 2s ² 2p ³ (² D) 4p ¹ ¹ F + 12% 2s ² 2p ³ (² D) 4p ¹ ³ F
259	2s ² 2p ³ (² D) 4p ¹	³ F	4	9 279 919.	99%
260	2s ² 2p ³ (² P) 4s ¹	³ P	0	9 281 924.	99%
261	2s ² 2p ³ (² P) 4s ¹	³ P	1	9 284 736.	70% + 28% 2s ² 2p ³ (² P) 4s ¹ ¹ P
262	2s ² 2p ³ (² D) 4p ¹	³ P	1	9 289 554.	58% + 30% 2s ² 2p ³ (² D) 4p ¹ ¹ P
263	2p ⁵ 3d ¹	³ F	2	9 291 760.	58% + 29% 2p ⁵ 3d ¹ ¹ D + 11% 2p ⁵ 3d ¹ ³ D
264	2s ² 2p ³ (² D) 4p ¹	³ P	2	9 292 210.	78%
265	2p ⁵ 3d ¹	³ D	2	9 303 353.	48% + 25% 2p ⁵ 3d ¹ ³ P + 24% 2p ⁵ 3d ¹ ¹ D
266	2p ⁵ 3d ¹	¹ F	3	9 306 188.	37% + 31% 2p ⁵ 3d ¹ ³ D + 30% 2p ⁵ 3d ¹ ³ F
267	2s ² 2p ³ (² D) 4p ¹	¹ D	2	9 317 200.	71% + 14% 2s ² 2p ³ (² D) 4p ¹ ³ P
268	2s ² 2p ³ (² P) 4s ¹	³ P	2	9 339 579.	73% + 11% 2s ² 2p ³ (² D) 4s ¹ ³ D
269	2s ² 2p ³ (² P) 4s ¹	¹ P	1	9 344 672.	53% + 19% 2s ² 2p ³ (² P) 4s ¹ ³ P + 17% 2s ² 2p ³ (² D) 4s ¹ ³ D
270	2s ² 2p ³ (² D) 4d ¹	³ F	2	9 350 980.	71%
271	2s ² 2p ³ (² D) 4d ¹	³ G	3	9 355 292.	54% + 21% 2s ² 2p ³ (² D) 4d ¹ ³ F
272	2s ² 2p ³ (² D) 4d ¹	³ G	4	9 356 568.	46% + 29% 2s ² 2p ³ (² D) 4d ¹ ¹ G + 16% 2s ² 2p ³ (² P) 4d ¹ ³ F
273	2s ² 2p ³ (² D) 4d ¹	³ D	1	9 356 728.	56% + 17% 2s ² 2p ³ (² D) 4d ¹ ¹ P
274	2s ² 2p ³ (² D) 4d ¹	¹ S	0	9 357 756.	61% + 20% 2s ² 2p ³ (² D) 4d ¹ ³ P + 14% 2s ² 2p ³ (² P) 4d ¹ ³ P
275	2s ² 2p ³ (² D) 4d ¹	³ F	3	9 358 080.	44% + 23% 2s ² 2p ³ (² D) 4d ¹ ³ G
276	2s ² 2p ³ (² D) 4d ¹	³ D	2	9 372 251.	47% + 21% 2s ² 2p ³ (² D) 4d ¹ ³ P
277	2s ² 2p ³ (² D) 4d ¹	³ P	1	9 377 227.	33% + 26% 2s ² 2p ³ (² D) 4d ¹ ³ S + 17% 2s ² 2p ³ (² D) 4d ¹ ¹ P
278	2s ² 2p ³ (² P) 4p ¹	³ D	1	9 377 502.	72% + 24% 2s ² 2p ³ (² P) 4p ¹ ¹ P
279	2s ² 2p ³ (² D) 4d ¹	³ F	4	9 383 888.	88% + 11% 2s ² 2p ³ (² D) 4d ¹ ³ G
280	2s ² 2p ³ (² D) 4d ¹	³ G	5	9 387 834.	100%
281	2s ² 2p ³ (² D) 4d ¹	¹ G	4	9 388 039.	61% + 32% 2s ² 2p ³ (² D) 4d ¹ ³ G

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
282	2s ² 2p ³ (² D) 4d ¹	³ D	3	9 391 730.	74% + 21% 2s ² 2p ³ (² D) 4d ¹ ³ F
283	2s ² 2p ³ (² P) 4p ¹	³ P	1	9 393 312.	42% + 34% 2s ² 2p ³ (² P) 4p ¹ ³ S + 13% 2s ² 2p ³ (² P) 4p ¹ ¹ P
284	2s ² 2p ³ (² P) 4p ¹	³ D	2	9 394 935.	66% + 19% 2s ² 2p ³ (² P) 4p ¹ ¹ D + 13% 2s ² 2p ³ (² P) 4p ¹ ³ P
285	2s ² 2p ³ (² D) 4d ¹	³ P	0	9 39 6437.	66% + 31% 2s ² 2p ³ (² D) 4d ¹ ¹ S
286	2s ² 2p ³ (² D) 4d ¹	³ P	2	9 399 298.	45% + 40% 2s ² 2p ³ (² D) 4d ¹ ³ D
287	2s ² 2p ³ (² D) 4d ¹	¹ P	1	9 399 609.	43% + 27% 2s ² 2p ³ (² D) 4d ¹ ³ P + 26% 2s ² 2p ³ (² D) 4d ¹ ³ D
288	2p ⁵ 3d ¹	¹ P	1	9403676.	77%
289	2s ² 2p ³ (² P) 4p ¹	³ P	0	9 405 849.	78% + 18% 2s ² 2p ³ (² P) 4p ¹ ¹ S
290	2s ² 2p ³ (² D) 4d ¹	³ S	1	9 409 036.	55% + 27% 2s ² 2p ³ (² D) 4d ¹ ³ P
291	2s ² 2p ³ (² D) 4f ¹	³ G	3	9 412 969.	59% + 11% 2s ² 2p ³ (² D) 4f ¹ ¹ F
292	2s ² 2p ³ (² D) 4d ¹	¹ D	2	9 413 570.	67% + 22% 2s ² 2p ³ (² D) 4d ¹ ³ P
293	2s ² 2p ³ (² D) 4f ¹	³ G	4	9 414 125.	33% + 24% 2s ² 2p ³ (² D) 4f ¹ ¹ G + 20% 2s ² 2p ³ (² D) 4f ¹ ³ F
294	2s ² 2p ³ (² D) 4f ¹	³ F	2	9 416 210.	43% + 22% 2s ² 2p ³ (² D) 4f ¹ ¹ D + 13% 2s ² 2p ³ (² D) 4f ¹ ³ D
295	2s ² 2p ³ (² D) 4f ¹	³ H	4	9 416 321.	74%
296	2s ² 2p ³ (² D) 4f ¹	³ H	5	9 417 075.	41% + 33% 2s ² 2p ³ (² D) 4f ¹ ¹ H + 15% 2s ² 2p ³ (² P) 4f ¹ ³ G
297	2s ² 2p ³ (² D) 4f ¹	³ D	3	9 417 559.	37% + 25% 2s ² 2p ³ (² D) 4f ¹ ³ F + 15% 2s ² 2p ³ (² D) 4f ¹ ¹ F
298	2s ² 2p ³ (² D) 4d ¹	¹ F	3	9 418 360.	79%
299	2s ² 2p ³ (² D) 4f ¹	¹ P	1	9 422 031.	37% + 26% 2s ² 2p ³ (² D) 4f ¹ ³ D + 17% 2s ² 2p ³ (² D) 4f ¹ ³ P
300	2s ² 2p ³ (² D) 4f ¹	³ P	2	9 423 555.	54% + 17% 2s ² 2p ³ (² D) 4f ¹ ³ D
301	2s ² 2p ³ (² P) 4p ¹	³ S	1	9 439 881.	45% + 19% 2s ² 2p ³ (² P) 4p ¹ ³ P + 17% 2s ² 2p ³ (² D) 4p ¹ ³ P
302	2s ² 2p ³ (² P) 4p ¹	³ D	3	9 444 216.	75% + 10% 2s ² 2p ³ (² D) 4p ¹ ³ F
303	2s ² 2p ³ (² D) 4f ¹	¹ H	5	9 448 108.	49% + 48% 2s ² 2p ³ (² D) 4f ¹ ³ H
304	2s ² 2p ³ (² D) 4f ¹	³ H	6	9 448 931.	100%
305	2s ² 2p ³ (² D) 4f ¹	³ G	4	9 449 669.	53% + 26% 2s ² 2p ³ (² D) 4f ¹ ³ F + 16% 2s ² 2p ³ (² D) 4f ¹ ¹ G
306	2s ² 2p ³ (² D) 4f ¹	³ G	5	9 449 826.	90%
307	2s ² 2p ³ (² P) 4p ¹	¹ P	1	9 450 324.	30% + 23% 2s ² 2p ³ (² P) 4p ¹ ³ P + 13% 2s ² 2p ³ (² D) 4p ¹ ³ D
308	2s ² 2p ³ (² D) 4f ¹	³ F	3	9 450 595.	54% + 19% 2s ² 2p ³ (² D) 4f ¹ ³ G + 15% 2s ² 2p ³ (² D) 4f ¹ ¹ F
309	2s ² 2p ³ (² D) 4f ¹	³ F	2	9 451 023.	31% + 25% 2s ² 2p ³ (² D) 4f ¹ ³ D + 15% 2s ² 2p ³ (² P) 4p ¹ ¹ D
310	2s ² 2p ³ (² D) 4f ¹	¹ G	4	9 451 772.	49% + 48% 2s ² 2p ³ (² D) 4f ¹ ³ F
311	2s ² 2p ³ (² P) 4p ¹	¹ D	2	9 452 986.	34% + 28% 2s ² 2p ³ (² D) 4f ¹ ³ D + 11% 2s ² 2p ³ (² D) 4f ¹ ³ P
312	2s ² 2p ³ (² D) 4f ¹	³ D	1	9 453 065.	56% + 16% 2s ² 2p ³ (² D) 4f ¹ ¹ P + 11% 2s ² 2p ³ (² D) 4f ¹ ³ P
313	2s ² 2p ³ (² D) 4f ¹	¹ F	3	9 453 134.	50% + 40% 2s ² 2p ³ (² D) 4f ¹ ³ D
314	2s ² 2p ³ (² D) 4f ¹	³ P	0	9 453 411.	100%
315	2s ² 2p ³ (² D) 4f ¹	¹ D	2	9 453 744.	44% + 18% 2s ² 2p ³ (² D) 4f ¹ ³ P
316	2s ² 2p ³ (² D) 4f ¹	³ P	1	9 453 907.	62% + 37% 2s ² 2p ³ (² D) 4f ¹ ¹ P
317	2s ² 2p ³ (² P) 4p ¹	³ P	2	9 456 194.	56% + 11% 2s ² 2p ³ (² P) 4p ¹ ¹ D
318	2s ² 2p ³ (² P) 4d ¹	³ F	2	9 495 736.	76% + 18% 2s ² 2p ³ (² P) 4d ¹ ¹ D
319	2s ² 2p ³ (² P) 4p ¹	¹ S	0	9 501 661.	69% + 15% 2s ² 2p ³ (² D) 4p ¹ ³ P
320	2s ² 2p ³ (² P) 4d ¹	³ P	2	9 503 492.	45% + 35% 2s ² 2p ³ (² P) 4d ¹ ³ D + 16% 2s ² 2p ³ (² P) 4d ¹ ¹ D
321	2s ² 2p ³ (² P) 4d ¹	³ F	3	9 504 376.	58% + 22% 2s ² 2p ³ (² P) 4d ¹ ³ D + 19% 2s ² 2p ³ (² P) 4d ¹ ¹ F
322	2s ² 2p ³ (² P) 4d ¹	³ D	1	9 514 677.	57% + 20% 2s ² 2p ³ (² P) 4d ¹ ³ P + 20% 2s ² 2p ³ (² P) 4d ¹ ¹ P
323	2s ² 2p ³ (² P) 4d ¹	³ F	4	9 551 253.	77% + 10% 2s ² 2p ³ (² D) 4d ¹ ³ G
324	2s ² 2p ³ (² P) 4d ¹	³ P	0	9 553 626.	76% + 13% 2s ² 2p ³ (² D) 4d ¹ ³ P
325	2s ² 2p ³ (² P) 4d ¹	³ P	2	9 556 215.	35% + 31% 2s ² 2p ³ (² P) 4d ¹ ¹ D
326	2s ² 2p ³ (² P) 4d ¹	³ P	1	9 557 201.	57% + 16% 2s ² 2p ³ (² P) 4d ¹ ³ D
327	2s ² 2p ³ (² P) 4f ¹	³ G	3	9 558 072.	72% + 18% 2s ² 2p ³ (² P) 4f ¹ ¹ F
328	2s ² 2p ³ (² P) 4f ¹	³ G	4	9 5595 73.	41% + 31% 2s ² 2p ³ (² P) 4f ¹ ¹ G + 28% 2s ² 2p ³ (² P) 4f ¹ ³ F
329	2s ² 2p ³ (² P) 4f ¹	³ F	2	9 560 171.	51% + 29% 2s ² 2p ³ (² P) 4f ¹ ¹ D + 20% 2s ² 2p ³ (² P) 4f ¹ ³ D

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
330	2s ² 2p ³ (2P) 4f ¹	³ D	3	9 560 383.	49% + 31% 2s ² 2p ³ (2P) 4f ¹ ³ F + 19% 2s ² 2p ³ (2P) 4f ¹ ¹ F
331	2s ² 2p ³ (2P) 4d ¹	³ D	3	9 565 122.	57% + 13% 2s ² 2p ³ (2P) 4d ¹ ¹ F
332	2s ² 2p ³ (2P) 4d ¹	¹ F	3	9 566 948.	54% + 21% 2s ² 2p ³ (2P) 4d ¹ ³ F + 14% 2s ² 2p ³ (2D) 4d ¹ ³ G
333	2s ² 2p ³ (2P) 4d ¹	³ D	2	9 569 160.	39% + 19% 2s ² 2p ³ (2P) 4d ¹ ¹ D + 12% 2s ² 2p ³ (2P) 4d ¹ ³ F
334	2s ² 2p ³ (2P) 4d ¹	¹ P	1	9 593 316.	63% + 14% 2s ² 2p ³ (2P) 4d ¹ ³ D
335	2s ² 2p ³ (2P) 4f ¹	³ D	1	9 614 101.	77%
336	2s ² 2p ³ (2P) 4f ¹	¹ G	4	9 614 622.	41% + 36% 2s ² 2p ³ (2P) 4f ¹ ³ G + 17% 2s ² 2p ³ (2D) 4f ¹ ³ H
337	2s ² 2p ³ (2P) 4f ¹	³ G	5	9 614 681.	77%
338	2s ² 2p ³ (2P) 4f ¹	³ D	2	9 615 576.	56% + 19% 2s ² 2p ³ (2P) 4f ¹ ¹ D + 12% 2s ² 2p ³ (2D) 4f ¹ ³ P
339	2s ² 2p ³ (2P) 4f ¹	³ D	3	9 619 775.	37% + 27% 2s ² 2p ³ (2P) 4f ¹ ³ F + 11% 2s ² 2p ³ (2P) 4f ¹ ¹ F
340	2s ² 2p ³ (2P) 4f ¹	¹ D	2	9 620 200.	36% + 35% 2s ² 2p ³ (2P) 4f ¹ ³ F
341	2s ² 2p ³ (2P) 4f ¹	¹ F	3	9 620 622.	37% + 20% 2s ² 2p ³ (2P) 4f ¹ ³ G + 18% 2s ² 2p ³ (2P) 4f ¹ ³ F
342	2s ² 2p ³ (2P) 4f ¹	³ F	4	9 621 467.	55% + 12% 2s ² 2p ³ (2P) 4f ¹ ¹ G
343	2s ¹ 2p ⁴ (4P) 4s ¹	⁵ P	3	9 747 903.	97%
344	2s ¹ 2p ⁴ (4P) 4s ¹	³ P	2	9 772 064.	73% + 24% 2s ¹ 2p ⁴ (4P) 4s ¹ ⁵ P
345	2s ¹ 2p ⁴ (4P) 4s ¹	⁵ P	2	9 820 267.	74% + 24% 2s ¹ 2p ⁴ (4P) 4s ¹ ³ P
346	2s ¹ 2p ⁴ (4P) 4s ¹	⁵ P	1	9 829 742.	78% + 19% 2s ¹ 2p ⁴ (4P) 4s ¹ ³ P
347	2s ¹ 2p ⁴ (4P) 4p ¹	⁵ P	3	9 845 022.	61% + 33% 2s ¹ 2p ⁴ (4P) 4p ¹ ⁵ D
348	2s ¹ 2p ⁴ (4P) 4p ¹	⁵ P	2	9 846 715.	56% + 25% 2s ¹ 2p ⁴ (4P) 4p ¹ ⁵ S + 10% 2s ¹ 2p ⁴ (4P) 4p ¹ ⁵ D
349	2s ¹ 2p ⁴ (4P) 4s ¹	³ P	1	9 850 941.	78% + 17% 2s ¹ 2p ⁴ (4P) 4s ¹ ⁵ P
350	2s ¹ 2p ⁴ (4P) 4p ¹	⁵ D	4	9 857 121.	97%
351	2s ¹ 2p ⁴ (4P) 4p ¹	³ D	3	9 862 799.	78% + 14% 2s ¹ 2p ⁴ (4P) 4p ¹ ⁵ P
352	2s ¹ 2p ⁴ (4P) 4s ¹	³ P	0	9 866 261.	94%
353	2s ¹ 2p ⁴ (4P) 4p ¹	³ S	1	9 874 451.	40% + 25% 2s ¹ 2p ⁴ (4P) 4p ¹ ⁵ P + 22% 2s ¹ 2p ⁴ (4P) 4p ¹ ³ P
354	2s ¹ 2p ⁴ (4P) 4p ¹	³ D	2	9 886 157.	35% + 34% 2s ¹ 2p ⁴ (4P) 4p ¹ ³ P + 16% 2s ¹ 2p ⁴ (4P) 4p ¹ ⁵ S
355	2s ¹ 2p ⁴ (4P) 4p ¹	⁵ P	1	9 913 612.	51% + 27% 2s ¹ 2p ⁴ (4P) 4p ¹ ³ S + 15% 2s ¹ 2p ⁴ (4P) 4p ¹ ⁵ D
356	2s ¹ 2p ⁴ (4P) 4p ¹	⁵ D	3	9 923 679.	60% + 23% 2s ¹ 2p ⁴ (4P) 4p ¹ ⁵ P + 15% 2s ¹ 2p ⁴ (4P) 4p ¹ ³ D
357	2s ¹ 2p ⁴ (4P) 4p ¹	⁵ D	2	9 924 784.	62% + 24% 2s ¹ 2p ⁴ (4P) 4p ¹ ³ P
358	2s ¹ 2p ⁴ (4P) 4p ¹	⁵ D	1	9 931 461.	61% + 19% 2s ¹ 2p ⁴ (4P) 4p ¹ ⁵ P + 16% 2s ¹ 2p ⁴ (4P) 4p ¹ ³ D
359	2s ¹ 2p ⁴ (4P) 4p ¹	⁵ D	0	9 934 178.	95%
360	2s ¹ 2p ⁴ (4P) 4p ¹	⁵ S	2	9 934 457.	37% + 24% 2s ¹ 2p ⁴ (4P) 4p ¹ ³ D + 24% 2s ¹ 2p ⁴ (4P) 4p ¹ ⁵ P
361	2s ¹ 2p ⁴ (4P) 4p ¹	³ D	1	9 949 583.	56% + 15% 2s ¹ 2p ⁴ (4P) 4p ¹ ⁵ D + 13% 2s ¹ 2p ⁴ (4P) 4p ¹ ³ P
362	2s ¹ 2p ⁴ (4P) 4d ¹	⁵ D	4	9 954 334.	64% + 33% 2s ¹ 2p ⁴ (4P) 4d ¹ ⁵ F
363	2s ¹ 2p ⁴ (4P) 4d ¹	⁵ D	3	9 954 577.	66% + 15% 2s ¹ 2p ⁴ (4P) 4d ¹ ⁵ P + 15% 2s ¹ 2p ⁴ (4P) 4d ¹ ⁵ F
364	2s ¹ 2p ⁴ (4P) 4p ¹	³ D	2	9 955 403.	34% + 27% 2s ¹ 2p ⁴ (4P) 4p ¹ ³ P + 15% 2s ¹ 2p ⁴ (4P) 4p ¹ ⁵ P
365	2s ¹ 2p ⁴ (4P) 4p ¹	³ P	0	9 957 053.	90%
366	2s ¹ 2p ⁴ (4P) 4d ¹	⁵ D	2	9 957 910.	53% + 36% 2s ¹ 2p ⁴ (4P) 4d ¹ ⁵ P
367	2s ¹ 2p ⁴ (4P) 4d ¹	⁵ F	5	9 961 877.	97%
368	2s ¹ 2p ⁴ (4P) 4d ¹	⁵ P	1	9 962 803.	63% + 30% 2s ¹ 2p ⁴ (4P) 4d ¹ ⁵ D
369	2s ¹ 2p ⁴ (4P) 4p ¹	³ P	1	9 968 765.	53% + 23% 2s ¹ 2p ⁴ (4P) 4p ¹ ³ D + 15% 2s ¹ 2p ⁴ (4P) 4p ¹ ³ S
370	2s ¹ 2p ⁴ (4P) 4d ¹	³ F	4	9 976 846.	76% + 15% 2s ¹ 2p ⁴ (4P) 4d ¹ ⁵ F
371	2s ¹ 2p ⁴ (4P) 4d ¹	³ P	0	9 984 870.	52% + 43% 2s ¹ 2p ⁴ (4P) 4d ¹ ⁵ D
372	2s ¹ 2p ⁴ (4P) 4d ¹	³ P	1	9 990 544.	40% + 21% 2s ¹ 2p ⁴ (4P) 4d ¹ ⁵ P + 17% 2s ¹ 2p ⁴ (4P) 4d ¹ ⁵ D
373	2s ¹ 2p ⁴ (4P) 4d ¹	³ F	3	9 991 366.	37% + 35% 2s ¹ 2p ⁴ (4P) 4d ¹ ³ D + 13% 2s ¹ 2p ⁴ (4P) 4d ¹ ⁵ F
374	2s ¹ 2p ⁴ (4P) 4d ¹	³ D	2	9 995 072.	36% + 23% 2s ¹ 2p ⁴ (4P) 4d ¹ ⁵ P + 19% 2s ¹ 2p ⁴ (4P) 4d ¹ ³ P
375	2s ¹ 2p ⁴ (4P) 4f ¹	⁵ F	4	10 019 609.	59% + 23% 2s ¹ 2p ⁴ (4P) 4f ¹ ⁵ G + 10% 2s ¹ 2p ⁴ (4P) 4f ¹ ⁵ D
376	2s ¹ 2p ⁴ (4P) 4f ¹	⁵ F	5	10 019 679.	56% + 40% 2s ¹ 2p ⁴ (4P) 4f ¹ ⁵ G

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
377	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ F	3	10 020 791.	52% + 21% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ D + 11% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ G
378	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ G	6	10 022 791.	96%
379	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ F	2	10 023 034.	41% + 38% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ D
380	2s ¹ 2p ⁴ (⁴ P) 4f ¹	³ F	4	10 023 358.	54% + 30% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ G
381	2s ¹ 2p ⁴ (⁴ P) 4f ¹	³ G	5	10 023 912.	84%
382	2s ¹ 2p ⁴ (⁴ P) 4f ¹	³ F	3	10 025 549.	50% + 18% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ D + 18% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ D
383	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ D	1	10 025 679.	64% + 23% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ F + 10% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ D
384	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ D	0	10 027 697.	97%
385	2s ¹ 2p ⁴ (⁴ P) 4d ¹	⁵ D	0	10 028 257.	56% + 41% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ P
386	2s ¹ 2p ⁴ (⁴ P) 4f ¹	³ D	2	10 028 323.	43% + 28% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ F + 25% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ D
387	2s ¹ 2p ⁴ (⁴ P) 4d ¹	⁵ F	4	10 028 769.	49% + 29% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ⁵ D + 21% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ F
388	2s ² 2p ³ (⁴ S) 5s ¹	⁵ S	2	10 029 917.	87%
389	2s ¹ 2p ⁴ (⁴ P) 4f ¹	³ D	1	10 030 448.	73% + 21% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ D
390	2s ¹ 2p ⁴ (⁴ P) 4d ¹	⁵ D	1	10 030 621.	42% + 30% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ P + 11% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ⁵ P
391	2s ¹ 2p ⁴ (⁴ P) 4d ¹	⁵ P	2	10 034 178.	28% + 18% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ⁵ F + 18% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ⁵ D
392	2s ¹ 2p ⁴ (⁴ P) 4d ¹	⁵ F	3	10 034 685.	56% + 15% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ⁵ P + 13% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ D
393	2s ² 2p ³ (⁴ S) 5s ¹	³ S	1	10 036 271.	87%
394	2s ¹ 2p ⁴ (⁴ P) 4d ¹	⁵ F	2	10 041 077.	57% + 20% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ⁵ D
395	2s ¹ 2p ⁴ (⁴ P) 4d ¹	⁵ P	3	10 041 395.	43% + 22% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ⁵ D + 12% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ F
396	2s ¹ 2p ⁴ (⁴ P) 4d ¹	⁵ F	1	10 043 508.	79%
397	2s ¹ 2p ⁴ (² D) 4s ¹	³ D	1	10 054 379.	80%
398	2s ¹ 2p ⁴ (² D) 4s ¹	³ D	2	10 058 837.	81%
399	2s ¹ 2p ⁴ (⁴ P) 4d ¹	³ F	2	10 062 792.	59% + 20% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ P
400	2s ¹ 2p ⁴ (² D) 4s ¹	³ D	3	10 063 969.	30% + 27% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ F + 25% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ D
401	2s ¹ 2p ⁴ (⁴ P) 4d ¹	³ D	1	10 070 264.	61% + 14% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ P + 10% 2s ¹ 2p ⁴ (² D) 4s ¹ ³ D
402	2s ¹ 2p ⁴ (² D) 4s ¹	³ D	3	10 073 278.	65% + 15% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ D
403	2s ² 2p ³ (⁴ S) 5p ¹	⁵ P	1	10 076 909.	86%
404	2s ² 2p ³ (⁴ S) 5p ¹	⁵ P	2	10 078 238.	72%
405	2s ² 2p ³ (⁴ S) 5p ¹	⁵ P	3	10 082 863.	78%
406	2s ¹ 2p ⁴ (⁴ P) 4d ¹	³ D	2	10 083 045.	29% + 21% 2s ² 2p ³ (⁴ S) 5p ¹ ³ P + 18% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ P
407	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ F	1	10 087 007.	72% + 14% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ D + 13% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ D
408	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ G	5	10 087 520.	45% + 40% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ F + 11% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ G
409	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ G	4	10 088 414.	37% + 31% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ F + 18% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ G
410	2s ¹ 2p ⁴ (² D) 4s ¹	¹ D	2	10 088 640.	81%
411	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ F	2	10 088 837.	43% + 30% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ D + 20% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ F
412	2s ² 2p ³ (⁴ S) 5p ¹	³ P	1	10 090 505.	78%
413	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ G	3	10 091 288.	46% + 35% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ D
414	2s ¹ 2p ⁴ (⁴ P) 4f ¹	³ D	2	10 092 496.	36% + 30% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ F + 29% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ G
415	2s ¹ 2p ⁴ (⁴ P) 4f ¹	³ G	4	10 092 728.	38% + 32% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ D + 23% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ G
416	2s ¹ 2p ⁴ (⁴ P) 4f ¹	³ G	3	10 093 449.	41% + 27% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ D + 11% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ F
417	2s ² 2p ³ (⁴ S) 5p ¹	³ P	0	10 095 133.	90%
418	2s ² 2p ³ (⁴ S) 5p ¹	³ P	2	10 096 671.	50% + 19% 2s ¹ 2p ⁴ (⁴ P) 4d ¹ ³ P
419	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ G	2	10 110 105.	53% + 13% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ F + 13% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ F
420	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ G	3	10 111 137.	27% + 23% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ F + 23% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ G
421	2s ¹ 2p ⁴ (⁴ P) 4f ¹	⁵ D	4	10 113 102.	47% + 24% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ⁵ F
422	2s ¹ 2p ⁴ (⁴ P) 4f ¹	³ D	3	10 114 678.	41% + 29% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ F + 20% 2s ¹ 2p ⁴ (⁴ P) 4f ¹ ³ G

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
423	2s ² 2p ³ (4S) 5d ¹	⁵ D	0	10 131 741.	91%
424	2s ² 2p ³ (4S) 5d ¹	⁵ D	2	10 131 778.	89%
425	2s ² 2p ³ (4S) 5d ¹	⁵ D	1	10 131 778.	90%
426	2s ² 2p ³ (4S) 5d ¹	⁵ D	3	10 131 820.	88%
427	2s ² 2p ³ (4S) 5d ¹	⁵ D	4	10 132 479.	90%
428	2s ² 2p ³ (4S) 5d ¹	³ D	2	10 144 800.	84%
429	2s ² 2p ³ (4S) 5d ¹	³ D	1	10 148 213.	89%
430	2s ² 2p ³ (4S) 5d ¹	³ D	3	10 148 966.	87%
431	2s ¹ 2p ⁴ (2D) 4p ¹	³ F	2	10 151 165.	83%
432	2s ¹ 2p ⁴ (2D) 4p ¹	³ D	1	10 151 752.	48% + 26% 2s ² 2p ³ (2D) 5s ¹ ³ D + 12% 2s ¹ 2p ⁴ (2D) 4p ¹ ¹ P
433	2s ¹ 2p ⁴ (2D) 4p ¹	³ D	2	10 159 634.	32% + 29% 2s ² 2p ³ (2D) 5s ¹ ³ D + 11% 2s ² 2p ³ (2D) 5s ¹ ¹ D
434	2s ¹ 2p ⁴ (2D) 4p ¹	³ F	3	10 160 953.	89%
435	2s ² 2p ³ (4S) 5f ¹	⁵ F	3	10 164 794.	82%
436	2s ² 2p ³ (4S) 5f ¹	⁵ F	4	10 164 800.	85%
437	2s ² 2p ³ (4S) 5f ¹	⁵ F	2	10 165 020.	87%
438	2s ² 2p ³ (4S) 5f ¹	⁵ F	5	10 165 091.	90%
439	2s ² 2p ³ (4S) 5f ¹	⁵ F	1	10 1652 58.	90%
440	2s ² 2p ³ (4S) 5f ¹	³ F	3	10 166 383.	82%
441	2s ² 2p ³ (4S) 5f ¹	³ F	4	10 166 496.	85%
442	2s ² 2p ³ (4S) 5f ¹	³ F	2	10 167 030.	87%
443	2s ¹ 2p ⁴ (2D) 4p ¹	¹ F	3	10 169 519.	58% + 30% 2s ¹ 2p ⁴ (2D) 4p ¹ ³ D
444	2s ² 2p ³ (4S) 5g ¹	³ G	5	10 169 934.	67% + 22% 2s ² 2p ³ (4S) 5g ¹ ⁵ G
445	2s ² 2p ³ (4S) 5g ¹	⁵ G	6	10 170 208.	89%
446	2s ¹ 2p ⁴ (2D) 4p ¹	³ P	1	10 170 216.	52% + 21% 2s ¹ 2p ⁴ (2D) 4p ¹ ¹ P + 16% 2s ² 2p ³ (2D) 5s ¹ ³ D
447	2s ² 2p ³ (4S) 5g ¹	³ G	4	10 170 540.	45% + 42% 2s ² 2p ³ (4S) 5g ¹ ⁵ G
448	2s ² 2p ³ (4S) 5g ¹	⁵ G	5	10 170 816.	65% + 22% 2s ² 2p ³ (4S) 5g ¹ ³ G
449	2s ² 2p ³ (4S) 5g ¹	⁵ G	3	10 171 325.	63% + 23% 2s ² 2p ³ (4S) 5g ¹ ³ G
450	2s ² 2p ³ (4S) 5g ¹	⁵ G	4	10 171 630.	44% + 42% 2s ² 2p ³ (4S) 5g ¹ ³ G
451	2s ² 2p ³ (4S) 5g ¹	⁵ G	2	10 172 086.	85%
452	2s ² 2p ³ (4S) 5g ¹	³ G	3	10 172 454.	62% + 22% 2s ² 2p ³ (4S) 5g ¹ ⁵ G
453	2s ¹ 2p ⁴ (2D) 4p ¹	³ F	4	10 174 246.	97%
454	2s ¹ 2p ⁴ (2D) 4p ¹	³ D	2	10 179 727.	41% + 30% 2s ¹ 2p ⁴ (2D) 4p ¹ ³ P + 16% 2s ² 2p ³ (2D) 5s ¹ ¹ D
455	2s ¹ 2p ⁴ (2D) 4p ¹	³ D	3	10 179 940.	46% + 30% 2s ¹ 2p ⁴ (2D) 4p ¹ ¹ F + 19% 2s ² 2p ³ (2D) 5s ¹ ³ D
456	2s ¹ 2p ⁴ (2D) 4p ¹	³ P	0	10 180 266.	86%
457	2s ¹ 2p ⁴ (2D) 4p ¹	¹ D	2	10 184 747.	50% + 33% 2s ¹ 2p ⁴ (2D) 4p ¹ ³ P
458	2s ² 2p ³ (2D) 5s ¹	³ D	1	10 185 432.	36% + 32% 2s ¹ 2p ⁴ (2D) 4p ¹ ³ D + 20% 2s ¹ 2p ⁴ (2D) 4p ¹ ³ P
459	2s ¹ 2p ⁴ (2D) 4p ¹	³ P	2	10 188 698.	31% + 26% 2s ¹ 2p ⁴ (2D) 4p ¹ ¹ D + 19% 2s ² 2p ³ (2D) 5s ¹ ³ D
460	2s ¹ 2p ⁴ (2D) 4p ¹	¹ P	1	10 195 743.	59% + 19% 2s ¹ 2p ⁴ (2D) 4p ¹ ³ P + 15% 2s ¹ 2p ⁴ (2D) 4p ¹ ³ D
461	2s ¹ 2p ⁴ (2S) 4s ¹	³ S	1	10 206 315.	53% + 11% 2s ² 2p ³ (2D) 5p ¹ ¹ P
462	2s ² 2p ³ (2D) 5s ¹	¹ D	2	10 211 635.	51% + 32% 2s ² 2p ³ (2D) 5s ¹ ³ D
463	2s ² 2p ³ (2D) 5s ¹	³ D	3	10 212 017.	76% + 20% 2s ¹ 2p ⁴ (2D) 4p ¹ ³ D
464	2s ² 2p ³ (2D) 5p ¹	³ D	1	10 220 024.	47% + 17% 2s ¹ 2p ⁴ (2S) 4s ¹ ³ S + 12% 2s ² 2p ³ (2D) 5p ¹ ¹ P
465	2s ² 2p ³ (2D) 5p ¹	³ F	2	10 220 805.	73%
466	2s ² 2p ³ (2D) 5p ¹	³ F	3	10 224 866.	44% + 28% 2s ² 2p ³ (2D) 5p ¹ ¹ F + 15% 2s ² 2p ³ (2P) 5p ¹ ³ D

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
467	2s ¹ 2p ⁴ (² S) 4s ¹	¹ S	0	10 225 279.	53% + 22% 2s ¹ 2p ⁴ (² P) 4s ¹ ³ P + 20% 2s ² 2p ³ (² D) 5p ¹ ³ P
468	2s ² 2p ³ (² D) 5p ¹	³ D	2	10 227 881.	60% + 12% 2s ² 2p ³ (² P) 5p ¹ ³ P
469	2s ² 2p ³ (² D) 5p ¹	³ P	1	10 234 327.	33% + 22% 2s ² 2p ³ (² D) 5p ¹ ¹ P + 17% 2s ² 2p ³ (² D) 5p ¹ ³ D
470	2s ² 2p ³ (² D) 5p ¹	³ P	0	10 234 489.	61% + 16% 2s ¹ 2p ⁴ (² S) 4s ¹ ¹ S
471	2s ² 2p ³ (² D) 5p ¹	³ F	3	10 252 186.	35% + 34% 2s ² 2p ³ (² D) 5p ¹ ³ D + 26% 2s ² 2p ³ (² D) 5p ¹ ¹ F
472	2s ² 2p ³ (² D) 5p ¹	³ P	1	10 253 092.	35% + 28% 2s ² 2p ³ (² D) 5p ¹ ¹ P + 17% 2s ¹ 2p ⁴ (² P) 4s ¹ ¹ P
473	2s ² 2p ³ (² D) 5p ¹	³ P	2	10 255 657.	50% + 23% 2s ¹ 2p ⁴ (² P) 4s ¹ ³ P + 18% 2s ² 2p ³ (² D) 5p ¹ ³ D
474	2s ² 2p ³ (² D) 5p ¹	³ F	4	10 256 907.	95%
475	2s ² 2p ³ (² D) 5p ¹	³ D	3	10 257 163.	56% + 33% 2s ² 2p ³ (² D) 5p ¹ ¹ F
476	2s ¹ 2p ⁴ (² D) 4d ¹	³ G	3	10 260 304.	87%
477	2s ¹ 2p ⁴ (² D) 4d ¹	³ G	4	10 264 464.	80%
478	2s ² 2p ³ (² D) 5p ¹	¹ D	2	10 271 678.	62% + 13% 2s ¹ 2p ⁴ (² P) 4s ¹ ³ P
479	2s ¹ 2p ⁴ (² D) 4d ¹	³ F	2	10 274 524.	72%
480	2s ¹ 2p ⁴ (² D) 4d ¹	³ G	5	10 275 448.	96%
481	2s ¹ 2p ⁴ (² D) 4d ¹	³ P	0	10 276 855.	72% + 19% 2s ¹ 2p ⁴ (² D) 4d ¹ ¹ S
482	2s ¹ 2p ⁴ (² D) 4d ¹	³ D	1	10 276 874.	21% + 21% 2s ¹ 2p ⁴ (² D) 4d ¹ ³ S + 20% 2s ¹ 2p ⁴ (² D) 4d ¹ ¹ P
483	2s ¹ 2p ⁴ (² P) 4s ¹	³ P	2	10 276 965.	51% + 35% 2s ² 2p ³ (² D) 5p ¹ ³ P
484	2s ² 2p ³ (² D) 5d ¹	³ F	2	10 277 827.	68%
485	2s ¹ 2p ⁴ (² D) 4d ¹	³ F	3	10 278 678.	66% + 13% 2s ¹ 2p ⁴ (² D) 4d ¹ ³ D
486	2s ¹ 2p ⁴ (² D) 4d ¹	³ D	1	10 279 350.	46% + 16% 2s ¹ 2p ⁴ (² P) 4s ¹ ¹ P + 10% 2s ¹ 2p ⁴ (² P) 4s ¹ ³ P
487	2s ² 2p ³ (² D) 5d ¹	³ G	3	10 279 431.	62% + 14% 2s ² 2p ³ (² D) 5d ¹ ³ F
488	2s ² 2p ³ (² D) 5d ¹	³ D	1	10 279 494.	55% + 21% 2s ² 2p ³ (² D) 5d ¹ ¹ P
489	2s ² 2p ³ (² D) 5d ¹	³ G	4	10 279 933.	42% + 31% 2s ² 2p ³ (² D) 5d ¹ ¹ G + 15% 2s ² 2p ³ (² P) 5d ¹ ³ F
490	2s ² 2p ³ (² D) 5d ¹	¹ S	0	10 280 208.	43% + 33% 2s ² 2p ³ (² D) 5d ¹ ³ P + 15% 2s ² 2p ³ (² P) 5d ¹ ³ P
491	2s ¹ 2p ⁴ (² D) 4d ¹	³ D	2	10 281 638.	46% + 31% 2s ¹ 2p ⁴ (² D) 4d ¹ ³ P
492	2s ¹ 2p ⁴ (² D) 4d ¹	³ S	1	10 281 984.	37% + 20% 2s ¹ 2p ⁴ (² D) 4d ¹ ³ P + 18% 2s ¹ 2p ⁴ (² P) 4s ¹ ¹ P
493	2s ² 2p ³ (² D) 5d ¹	³ F	3	10 282 235.	39% + 14% 2s ² 2p ³ (² D) 5d ¹ ¹ F + 13% 2s ² 2p ³ (² D) 5d ¹ ³ D
494	2s ¹ 2p ⁴ (² D) 4d ¹	¹ G	4	10 284 931.	46% + 34% 2s ¹ 2p ⁴ (² D) 4d ¹ ³ F + 12% 2s ¹ 2p ⁴ (² D) 4d ¹ ³ G
495	2s ² 2p ³ (² D) 5d ¹	³ D	2	10 287 333.	42% + 25% 2s ² 2p ³ (² D) 5d ¹ ³ P + 10% 2s ² 2p ³ (² D) 5d ¹ ¹ D
496	2s ¹ 2p ⁴ (² D) 4d ¹	³ P	1	10 288 596.	60% + 33% 2s ¹ 2p ⁴ (² D) 4d ¹ ³ S
497	2s ² 2p ³ (² D) 5d ¹	³ P	1	10 288 811.	36% + 25% 2s ² 2p ³ (² D) 5d ¹ ³ S + 12% 2s ² 2p ³ (² D) 5d ¹ ¹ P
498	2s ¹ 2p ⁴ (² D) 4d ¹	³ P	2	10 291 387.	60% + 30% 2s ¹ 2p ⁴ (² D) 4d ¹ ³ D
499	2s ¹ 2p ⁴ (² D) 4d ¹	³ D	3	10 292 261.	73% + 16% 2s ¹ 2p ⁴ (² D) 4d ¹ ³ F
500	2s ¹ 2p ⁴ (² D) 4d ¹	³ F	4	10 292 768.	51% + 41% 2s ¹ 2p ⁴ (² D) 4d ¹ ¹ G
501	2s ² 2p ³ (² P) 5s ¹	³ P	0	10 297 256.	41% + 35% 2s ¹ 2p ⁴ (² S) 4p ¹ ³ P + 13% 2s ¹ 2p ⁴ (² P) 4p ¹ ³ P
502	2s ² 2p ³ (² D) 5g ¹	³ H	4	10 300 819.	40% + 26% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ H
503	2s ² 2p ³ (² D) 5g ¹	³ H	5	10 301 602.	23% + 18% 2s ² 2p ³ (² D) 5g ¹ ¹ H + 15% 2s ² 2p ³ (² D) 5g ¹ ³ G
504	2s ² 2p ³ (² D) 5g ¹	³ G	3	10 303 198.	33% + 17% 2s ² 2p ³ (² D) 5g ¹ ¹ F + 14% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ G
505	2s ¹ 2p ⁴ (² D) 4d ¹	¹ F	3	10 303 244.	77%
506	2s ² 2p ³ (² D) 5g ¹	³ F	4	10 303 714.	30% + 18% 2s ² 2p ³ (² D) 5g ¹ ³ G + 14% 2s ² 2p ³ (² D) 5g ¹ ¹ G
507	2s ² 2p ³ (² P) 5s ¹	³ P	1	10 304 003.	35% + 29% 2s ¹ 2p ⁴ (² S) 4p ¹ ³ P + 14% 2s ² 2p ³ (² P) 5s ¹ ¹ P
508	2s ¹ 2p ⁴ (² D) 4d ¹	¹ P	1	10 306 975.	67% + 17% 2s ¹ 2p ⁴ (² D) 4d ¹ ³ D
509	2s ² 2p ³ (² D) 5g ¹	¹ D	2	10 307 078.	27% + 20% 2s ² 2p ³ (² D) 5g ¹ ³ F + 18% 2s ² 2p ³ (² D) 5g ¹ ³ D

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
510	2s ² 2p ³ (² D) 5g ¹	³ D	3	10 307 504.	46% + 11% 2s ² 2p ³ (² D) 5g ¹ ³ F
511	2s ¹ 2p ⁴ (² D) 4d ¹	¹ D	2	10 307 796.	65% + 11% 2s ¹ 2p ⁴ (² D) 4d ¹ ³ F
512	2s ² 2p ³ (² D) 5f ¹	³ G	3	10 308 915.	55%
513	2s ² 2p ³ (² D) 5f ¹	³ F	2	10 309 335.	40% + 18% 2s ² 2p ³ (² D) 5f ¹ ¹ D
514	2s ² 2p ³ (² D) 5f ¹	³ H	4	10 309 411.	70%
515	2s ² 2p ³ (² D) 5f ¹	³ G	4	10 309 604.	27% + 27% 2s ² 2p ³ (² D) 5f ¹ ¹ G + 18% 2s ² 2p ³ (² D) 5f ¹ ³ F
516	2s ² 2p ³ (² D) 5f ¹	³ H	5	10 309 765.	39% + 32% 2s ² 2p ³ (² D) 5f ¹ ¹ H + 15% 2s ² 2p ³ (² P) 5f ¹ ³ G
517	2s ¹ 2p ⁴ (² D) 4d ¹	¹ S	0	10 309 886.	74% + 19% 2s ¹ 2p ⁴ (² D) 4d ¹ ³ P
518	2s ² 2p ³ (² D) 5d ¹	³ F	4	10 310 728.	78% + 20% 2s ² 2p ³ (² D) 5d ¹ ³ G
519	2s ² 2p ³ (² D) 5f ¹	³ D	3	10 311 647.	30% + 25% 2s ² 2p ³ (² D) 5f ¹ ³ F + 15% 2s ² 2p ³ (² D) 5f ¹ ¹ F
520	2s ² 2p ³ (² D) 5f ¹	¹ P	1	10 311 867.	35% + 25% 2s ² 2p ³ (² D) 5f ¹ ³ D + 15% 2s ² 2p ³ (² D) 5f ¹ ³ P
521	2s ² 2p ³ (² D) 5d ¹	¹ G	4	10 312 417.	58% + 27% 2s ² 2p ³ (² D) 5d ¹ ³ G + 14% 2s ² 2p ³ (² D) 5d ¹ ³ F
522	2s ² 2p ³ (² D) 5d ¹	³ G	5	10 312 436.	100%
523	2s ² 2p ³ (² D) 5f ¹	³ P	2	10 313 074.	47% + 20% 2s ² 2p ³ (² D) 5f ¹ ³ D
524	2s ² 2p ³ (² D) 5g ¹	³ I	5	10 313 144.	70%
525	2s ² 2p ³ (² D) 5g ¹	³ I	6	10 313 433.	38% + 32% 2s ² 2p ³ (² D) 5g ¹ ¹ I + 15% 2s ² 2p ³ (² P) 5g ¹ ³ H
526	2s ² 2p ³ (² D) 5d ¹	³ D	3	10 313 518.	66% + 30% 2s ² 2p ³ (² D) 5d ¹ ³ F
527	2s ² 2p ³ (² D) 5d ¹	³ P	0	10 314 908.	53% + 40% 2s ² 2p ³ (² D) 5d ¹ ¹ S
528	2s ¹ 2p ⁴ (² S) 4p ¹	¹ P	1	10 316 162.	32% + 20% 2s ¹ 2p ⁴ (² S) 4p ¹ ³ P + 15% 2s ¹ 2p ⁴ (² P) 4p ¹ ³ D
529	2s ² 2p ³ (² D) 5d ¹	³ D	2	10 316 700.	45% + 41% 2s ² 2p ³ (² D) 5d ¹ ³ P
530	2s ² 2p ³ (² D) 5d ¹	¹ P	1	10 317 146.	46% + 29% 2s ² 2p ³ (² D) 5d ¹ ³ D + 20% 2s ² 2p ³ (² D) 5d ¹ ³ P
531	2s ¹ 2p ⁴ (² S) 4p ¹	³ P	2	10 318 799.	49% + 12% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ P + 10% 2s ² 2p ³ (² D) 5d ¹ ¹ D
532	2s ² 2p ³ (² D) 5d ¹	³ S	1	10 321 417.	52% + 31% 2s ² 2p ³ (² D) 5d ¹ ³ P
533	2s ¹ 2p ⁴ (² D) 4f ¹	¹ P	1	10 323 772.	33% + 29% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ D + 27% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ P
534	2s ¹ 2p ⁴ (² D) 4f ¹	³ P	2	10 324 035.	56% + 15% 2s ¹ 2p ⁴ (² S) 4p ¹ ³ P + 12% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ D
535	2s ² 2p ³ (² D) 5d ¹	¹ D	2	10 324 286.	53% + 19% 2s ² 2p ³ (² D) 5d ¹ ³ P + 10% 2s ¹ 2p ⁴ (² S) 4p ¹ ³ P
536	2s ² 2p ³ (² P) 5s ¹	³ P	0	10 325 233.	55% + 30% 2s ¹ 2p ⁴ (² S) 4p ¹ ³ P
537	2s ² 2p ³ (² D) 5d ¹	¹ F	3	10 325 949.	72% + 12% 2s ² 2p ³ (² D) 5d ¹ ³ D
538	2s ¹ 2p ⁴ (² D) 4f ¹	³ H	5	10 328 023.	41% + 19% 2s ¹ 2p ⁴ (² D) 4f ¹ ¹ H + 17% 2s ² 2p ³ (² D) 5g ¹ ¹ H
539	2s ¹ 2p ⁴ (² D) 4f ¹	³ H	6	10 328 024.	62% + 34% 2s ² 2p ³ (² D) 5g ¹ ³ H
540	2s ¹ 2p ⁴ (² D) 4f ¹	³ H	4	10 329 881.	39% + 22% 2s ² 2p ³ (² D) 5g ¹ ³ G + 20% 2s ² 2p ³ (² D) 5g ¹ ¹ G
541	2s ² 2p ³ (² D) 5g ¹	³ G	5	10 330 843.	42% + 26% 2s ¹ 2p ⁴ (² D) 4f ¹ ¹ H + 18% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ G
542	2s ¹ 2p ⁴ (² S) 4p ¹	¹ P	1	10 331 878.	30% + 20% 2s ¹ 2p ⁴ (² S) 4p ¹ ³ P + 15% 2s ² 2p ³ (² P) 5s ¹ ³ P
543	2s ² 2p ³ (² D) 5g ¹	³ F	3	10 332 947.	26% + 20% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ F + 20% 2s ² 2p ³ (² D) 5g ¹ ³ G
544	2s ² 2p ³ (² D) 5g ¹	³ F	4	10 333 176.	29% + 25% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ F + 13% 2s ² 2p ³ (² D) 5g ¹ ¹ G
545	2s ¹ 2p ⁴ (² D) 4f ¹	³ D	3	10 333 255.	47% + 28% 2s ² 2p ³ (² D) 5g ¹ ¹ F + 11% 2s ² 2p ³ (² D) 5g ¹ ³ F
546	2s ² 2p ³ (² D) 5g ¹	³ F	2	10 333 847.	33% + 25% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ D + 16% 2s ² 2p ³ (² D) 5g ¹ ³ D
547	2s ¹ 2p ⁴ (² D) 4f ¹	³ F	2	10 334 135.	42% + 25% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ D + 21% 2s ² 2p ³ (² D) 5g ¹ ¹ D
548	2s ² 2p ³ (² D) 5g ¹	³ D	1	10 334 506.	38% + 36% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ D + 21% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ P
549	2s ¹ 2p ⁴ (² D) 4f ¹	³ P	0	10 3349 75.	96%
550	2s ² 2p ³ (² D) 5g ¹	³ H	4	10 335 117.	30% + 22% 2s ¹ 2p ⁴ (² D) 4f ¹ ³ H + 20% 2s ¹ 2p ⁴ (² D) 4f ¹ ¹ G
551	2s ¹ 2p ⁴ (² D) 4f ¹	³ G	5	10 335 134.	27% + 18% 2s ¹ 2p ⁴ (² D) 4f ¹ ¹ H + 18% 2s ² 2p ³ (² D) 5g ¹ ³ H
552	2s ¹ 2p ⁴ (² D) 4f ¹	¹ D	2	10 336 255.	43% + 20% 2s ² 2p ³ (² D) 5g ¹ ³ D + 13% 2s ² 2p ³ (² D) 5g ¹ ¹ D
553	2s ¹ 2p ⁴ (² D) 4f ¹	³ F	3	10 336 325.	27% + 25% 2s ¹ 2p ⁴ (² D) 4f ¹ ¹ F + 20% 2s ² 2p ³ (² D) 5g ¹ ³ D

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
554	2s ¹ 2p ⁴ (2D) 4f ¹	¹ P	1	10 337 672.	43% + 43% 2s ¹ 2p ⁴ (2D) 4f ¹ ³ P
555	2s ¹ 2p ⁴ (2D) 4f ¹	³ G	3	10 339 833.	47% + 18% 2s ¹ 2p ⁴ (2D) 4f ¹ ¹ F + 13% 2s ² 2p ³ (2D) 5g ¹ ³ G
556	2s ¹ 2p ⁴ (2D) 4f ¹	³ G	4	10 340 509.	27% + 25% 2s ¹ 2p ⁴ (2D) 4f ¹ ³ F + 24% 2s ¹ 2p ⁴ (2D) 4f ¹ ¹ G
557	2s ² 2p ³ (2D) 5f ¹	¹ H	5	10 342 085.	51% + 48% 2s ² 2p ³ (2D) 5f ¹ ³ H
558	2s ² 2p ³ (2D) 5f ¹	³ H	6	10 342 468.	100%
559	2s ² 2p ³ (2D) 5f ¹	¹ P	1	10 343 155.	52% + 33% 2s ² 2p ³ (2D) 5f ¹ ³ P + 13% 2s ² 2p ³ (2D) 5f ¹ ³ D
560	2s ² 2p ³ (2D) 5f ¹	³ G	4	10 343 456.	53% + 21% 2s ² 2p ³ (2D) 5f ¹ ¹ G + 18% 2s ² 2p ³ (2D) 5f ¹ ³ F
561	2s ² 2p ³ (2D) 5f ¹	³ P	0	10 343 465.	98%
562	2s ² 2p ³ (2D) 5f ¹	³ G	5	10 343 558.	88%
563	2s ² 2p ³ (2D) 5f ¹	³ D	1	10 343 569.	50% + 45% 2s ² 2p ³ (2D) 5f ¹ ³ P
564	2s ² 2p ³ (2D) 5f ¹	³ D	2	10 343 788.	59% + 20% 2s ² 2p ³ (2D) 5f ¹ ³ P + 17% 2s ² 2p ³ (2D) 5f ¹ ³ F
565	2s ² 2p ³ (2D) 5f ¹	³ F	3	10 343 793.	54% + 18% 2s ² 2p ³ (2D) 5f ¹ ³ G + 14% 2s ² 2p ³ (2D) 5f ¹ ³ D
566	2s ² 2p ³ (2D) 5f ¹	¹ D	2	10 344 015.	58% + 26% 2s ² 2p ³ (2D) 5f ¹ ³ F + 15% 2s ² 2p ³ (2D) 5f ¹ ³ P
567	2s ² 2p ³ (2D) 5f ¹	¹ F	3	10 344 587.	50% + 40% 2s ² 2p ³ (2D) 5f ¹ ³ D
568	2s ² 2p ³ (2D) 5f ¹	³ F	4	10 344 621.	54% + 41% 2s ² 2p ³ (2D) 5f ¹ ¹ G
569	2s ² 2p ³ (2D) 5g ¹	¹ I	6	10 346 236.	54% + 46% 2s ² 2p ³ (2D) 5g ¹ ³ I
570	2s ² 2p ³ (2D) 5g ¹	³ I	7	10 346 531.	100%
571	2s ² 2p ³ (2D) 5g ¹	³ D	1	10 348 797.	53% + 29% 2s ¹ 2p ⁴ (2D) 4f ¹ ³ D + 14% 2s ¹ 2p ⁴ (2D) 4f ¹ ¹ P
572	2s ² 2p ³ (2D) 5g ¹	³ D	2	10 348 904.	36% + 20% 2s ¹ 2p ⁴ (2D) 4f ¹ ³ D + 18% 2s ² 2p ³ (2D) 5g ¹ ¹ D
573	2s ¹ 2p ⁴ (2D) 4f ¹	³ D	3	10 354 200.	24% + 23% 2s ² 2p ³ (2D) 5g ¹ ³ F + 20% 2s ¹ 2p ⁴ (2D) 4f ¹ ³ F
574	2s ² 2p ³ (2D) 5g ¹	³ F	2	10 354 400.	31% + 25% 2s ¹ 2p ⁴ (2D) 4f ¹ ³ F + 23% 2s ¹ 2p ⁴ (2D) 4f ¹ ¹ D
575	2s ² 2p ³ (2D) 5g ¹	¹ H	5	10 354 480.	29% + 26% 2s ² 2p ³ (2D) 5g ¹ ³ H + 20% 2s ¹ 2p ⁴ (2D) 4f ¹ ¹ H
576	2s ² 2p ³ (2D) 5g ¹	³ H	6	10 354 694.	55% + 34% 2s ¹ 2p ⁴ (2D) 4f ¹ ³ H
577	2s ¹ 2p ⁴ (2D) 4f ¹	³ F	4	10 358 277.	35% + 21% 2s ² 2p ³ (2D) 5g ¹ ³ G + 19% 2s ¹ 2p ⁴ (2D) 4f ¹ ³ G
578	2s ¹ 2p ⁴ (2D) 4f ¹	¹ F	3	10 358 576.	31% + 20% 2s ² 2p ³ (2D) 5g ¹ ³ G + 15% 2s ² 2p ³ (2D) 5g ¹ ¹ F
579	2s ¹ 2p ⁴ (2P) 4p ¹	³ P	2	10 359 199.	46% + 22% 2s ² 2p ³ (2P) 5s ¹ ³ P + 15% 2s ¹ 2p ⁴ (2P) 4p ¹ ³ D
580	2s ¹ 2p ⁴ (2D) 4f ¹	¹ G	4	10 359 518.	37% + 24% 2s ² 2p ³ (2D) 5g ¹ ¹ G + 11% 2s ² 2p ³ (2D) 5g ¹ ³ H
581	2s ¹ 2p ⁴ (2D) 4f ¹	³ G	5	10 359 534.	49% + 32% 2s ² 2p ³ (2D) 5g ¹ ³ G
582	2s ² 2p ³ (2P) 5p ¹	³ D	1	10 359 975.	45% + 21% 2s ² 2p ³ (2P) 5p ¹ ¹ P + 17% 2s ¹ 2p ⁴ (2P) 4s ¹ ³ P
583	2s ² 2p ³ (2P) 5p ¹	³ D	1	10 362 948.	33% + 26% 2s ¹ 2p ⁴ (2P) 4s ¹ ³ P + 18% 2s ¹ 2p ⁴ (2P) 4s ¹ ¹ P
584	2s ¹ 2p ⁴ (2P) 4s ¹	³ P	0	10 366 419.	42% + 31% 2s ² 2p ³ (2P) 5p ¹ ³ P + 15% 2s ¹ 2p ⁴ (2S) 4s ¹ ¹ S
585	2s ² 2p ³ (2P) 5s ¹	¹ P	1	10 368 739.	35% + 17% 2s ¹ 2p ⁴ (2P) 4p ¹ ³ P + 12% 2s ² 2p ³ (2D) 5s ¹ ³ D
586	2s ¹ 2p ⁴ (2P) 4p ¹	¹ D	2	10 370 110.	35% + 31% 2s ¹ 2p ⁴ (2P) 4p ¹ ³ D + 21% 2s ² 2p ³ (2P) 5s ¹ ³ P
587	2s ² 2p ³ (2P) 5p ¹	³ D	2	10 370 257.	56% + 27% 2s ² 2p ³ (2P) 5p ¹ ¹ D + 15% 2s ² 2p ³ (2P) 5p ¹ ³ P
588	2s ² 2p ³ (2P) 5p ¹	³ P	1	10 371 431.	37% + 37% 2s ² 2p ³ (2P) 5p ¹ ³ S + 13% 2s ² 2p ³ (2P) 5p ¹ ¹ P
589	2s ¹ 2p ⁴ (2P) 4p ¹	³ D	3	10 373 917.	93%
590	2s ¹ 2p ⁴ (2P) 4p ¹	³ S	1	10 379 297.	28% + 27% 2s ¹ 2p ⁴ (2P) 4p ¹ ³ P + 14% 2s ² 2p ³ (2P) 5s ¹ ¹ P
591	2s ² 2p ³ (2P) 5p ¹	³ P	0	10 379 724.	43% + 30% 2s ¹ 2p ⁴ (2P) 4s ¹ ³ P + 15% 2s ² 2p ³ (2P) 5p ¹ ¹ S
592	2s ¹ 2p ⁴ (2P) 4p ¹	³ P	2	10 380 073.	34% + 31% 2s ² 2p ³ (2P) 5s ¹ ³ P + 23% 2s ¹ 2p ⁴ (2P) 4p ¹ ¹ D
593	2s ¹ 2p ⁴ (2P) 4p ¹	¹ S	0	10 382 688.	60% + 31% 2s ¹ 2p ⁴ (2P) 4p ¹ ³ P
594	2s ¹ 2p ⁴ (2P) 4p ¹	¹ P	1	10 400 286.	40% + 25% 2s ¹ 2p ⁴ (2P) 4p ¹ ³ D + 22% 2s ¹ 2p ⁴ (2P) 4p ¹ ³ S
595	2s ² 2p ³ (2P) 5d ¹	³ F	2	10 420 442.	75% + 20% 2s ² 2p ³ (2P) 5d ¹ ¹ D
596	2s ² 2p ³ (2P) 5p ¹	³ D	3	10 420 563.	54% + 21% 2s ¹ 2p ⁴ (2S) 4d ¹ ³ D
597	2s ² 2p ³ (2P) 5p ¹	¹ D	2	10 422 521.	31% + 21% 2s ¹ 2p ⁴ (2S) 4d ¹ ³ D + 17% 2s ² 2p ³ (2P) 5p ¹ ³ D

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
598	2s ¹ 2p ⁴ (² S) 4d ¹	³ D	1	10 422 969.	27% + 27% 2s ² 2p ³ (² P) 5p ¹ ³ P + 12% 2s ² 2p ³ (² P) 5p ¹ ¹ P
599	2s ² 2p ³ (² P) 5d ¹	³ P	2	10 424 370.	47% + 35% 2s ² 2p ³ (² P) 5d ¹ ³ D + 15% 2s ² 2p ³ (² P) 5d ¹ ¹ D
600	2s ² 2p ³ (² P) 5d ¹	³ F	3	10 425 385.	51% + 26% 2s ² 2p ³ (² P) 5d ¹ ¹ F + 22% 2s ² 2p ³ (² P) 5d ¹ ³ D
601	2s ² 2p ³ (² P) 5p ¹	³ S	1	10 426 717.	33% + 20% 2s ¹ 2p ⁴ (² S) 4d ¹ ³ D + 11% 2s ² 2p ³ (² P) 5p ¹ ³ P
602	2s ¹ 2p ⁴ (² S) 4d ¹	³ D	3	10 426 905.	46% + 21% 2s ² 2p ³ (² P) 5p ¹ ³ D
603	2s ¹ 2p ⁴ (² S) 4d ¹	³ D	2	10 428 613.	43% + 13% 2s ² 2p ³ (² P) 5p ¹ ¹ D + 11% 2s ² 2p ³ (² P) 5p ¹ ³ D
604	2s ² 2p ³ (² P) 5p ¹	¹ P	1	10 429 637.	29% + 24% 2s ¹ 2p ⁴ (² S) 4d ¹ ³ D + 11% 2s ² 2p ³ (² P) 5p ¹ ³ D
605	2s ² 2p ³ (² P) 5d ¹	³ D	1	10 429 724.	55% + 26% 2s ² 2p ³ (² P) 5d ¹ ¹ P + 18% 2s ² 2p ³ (² P) 5d ¹ ³ P
606	2s ² 2p ³ (² P) 5p ¹	³ P	2	10 430 477.	59% + 13% 2s ² 2p ³ (² P) 5p ¹ ¹ D + 10% 2s ² 2p ³ (² D) 5p ¹ ³ D
607	2s ¹ 2p ⁴ (² S) 4d ¹	¹ D	2	10 436 717.	57% + 11% 2s ¹ 2p ⁴ (² P) 4d ¹ ³ D
608	2s ² 2p ³ (² P) 5g ¹	³ G	3	10 447 756.	36% + 27% 2s ² 2p ³ (² P) 5g ¹ ¹ F + 21% 2s ² 2p ³ (² P) 5g ¹ ³ F
609	2s ² 2p ³ (² P) 5g ¹	³ F	4	10 447 947.	48% + 20% 2s ² 2p ³ (² P) 5g ¹ ³ G + 16% 2s ² 2p ³ (² P) 5g ¹ ¹ G
610	2s ² 2p ³ (² P) 5p ¹	¹ S	0	10 450 062.	61% + 17% 2s ² 2p ³ (² D) 5p ¹ ³ P + 16% 2s ² 2p ³ (² P) 5p ¹ ³ P
611	2s ² 2p ³ (² P) 5f ¹	³ G	3	10 450 314.	71% + 16% 2s ² 2p ³ (² P) 5f ¹ ¹ F + 10% 2s ² 2p ³ (² P) 5f ¹ ³ F
612	2s ² 2p ³ (² P) 5f ¹	³ G	4	10 451 425.	40% + 31% 2s ² 2p ³ (² P) 5f ¹ ¹ G + 26% 2s ² 2p ³ (² P) 5f ¹ ³ F
613	2s ² 2p ³ (² P) 5g ¹	³ H	4	10 454 443.	70% + 15% 2s ² 2p ³ (² P) 5g ¹ ¹ G + 13% 2s ² 2p ³ (² P) 5g ¹ ³ G
614	2s ² 2p ³ (² P) 5f ¹	³ F	2	10 454 534.	41% + 27% 2s ² 2p ³ (² P) 5f ¹ ¹ D + 18% 2s ² 2p ³ (² P) 5f ¹ ³ D
615	2s ² 2p ³ (² P) 5g ¹	³ H	5	10 454 770.	38% + 32% 2s ² 2p ³ (² P) 5g ¹ ¹ H + 28% 2s ² 2p ³ (² P) 5g ¹ ³ G
616	2s ² 2p ³ (² P) 5f ¹	³ D	3	10 454 778.	46% + 25% 2s ² 2p ³ (² P) 5f ¹ ³ F + 17% 2s ² 2p ³ (² P) 5f ¹ ¹ F
617	2s ¹ 2p ⁴ (² P) 4p ¹	³ P	0	10 460 637.	41% + 26% 2s ¹ 2p ⁴ (² P) 4p ¹ ¹ S + 19% 2s ¹ 2p ⁴ (² S) 4p ¹ ³ P
618	2s ¹ 2p ⁴ (² P) 4p ¹	³ D	1	10 467 129.	39% + 22% 2s ¹ 2p ⁴ (² P) 4p ¹ ³ P + 22% 2s ¹ 2p ⁴ (² S) 4p ¹ ¹ P
619	2s ¹ 2p ⁴ (² P) 4p ¹	³ D	2	10 468 314.	31% + 23% 2s ¹ 2p ⁴ (² P) 4p ¹ ¹ D + 16% 2s ¹ 2p ⁴ (² S) 4p ¹ ³ P
620	2s ¹ 2p ⁴ (² P) 4d ¹	³ D	3	10 474 187.	70% + 19% 2s ¹ 2p ⁴ (² P) 4d ¹ ³ F
621	2s ² 2p ³ (² P) 5d ¹	³ P	1	10 476 006.	43% + 15% 2s ¹ 2p ⁴ (² P) 4p ¹ ¹ P
622	2s ² 2p ³ (² P) 5d ¹	³ F	4	10 477 716.	77%
623	2s ¹ 2p ⁴ (² P) 4d ¹	³ D	2	10 478 516.	56% + 25% 2s ¹ 2p ⁴ (² P) 4d ¹ ³ P
624	2s ¹ 2p ⁴ (² S) 4f ¹	³ F	2	10 480 616.	74%
625	2s ² 2p ³ (² P) 5d ¹	³ P	0	10 480 749.	67% + 11% 2s ² 2p ³ (² D) 5d ¹ ³ P
626	2s ¹ 2p ⁴ (² P) 4d ¹	¹ F	3	10 480 822.	56% + 30% 2s ¹ 2p ⁴ (² P) 4d ¹ ³ F
627	2s ¹ 2p ⁴ (² P) 4d ¹	³ F	4	10 480 874.	89%
628	2s ² 2p ³ (² P) 5d ¹	¹ D	2	10 481 403.	34% + 24% 2s ² 2p ³ (² P) 5d ¹ ³ P
629	2s ¹ 2p ⁴ (² S) 4f ¹	³ F	3	10 482 445.	51% + 15% 2s ¹ 2p ⁴ (² S) 4f ¹ ¹ F
630	2s ² 2p ³ (² P) 5d ¹	¹ F	3	10 483 129.	50% + 14% 2s ² 2p ³ (² P) 5d ¹ ³ F + 13% 2s ² 2p ³ (² D) 5d ¹ ³ G
631	2s ² 2p ³ (² P) 5d ¹	³ D	3	10 484 212.	56% + 20% 2s ² 2p ³ (² P) 5d ¹ ³ F
632	2s ¹ 2p ⁴ (² P) 4d ¹	³ P	1	10 485 268.	47% + 37% 2s ¹ 2p ⁴ (² P) 4d ¹ ³ D
633	2s ¹ 2p ⁴ (² P) 4p ¹	¹ P	1	10 485 769.	29% + 17% 2s ² 2p ³ (² P) 5d ¹ ³ P + 11% 2s ¹ 2p ⁴ (² S) 4p ¹ ³ P
634	2s ² 2p ³ (² P) 5d ¹	³ D	2	10 485 890.	42% + 12% 2s ² 2p ³ (² P) 5d ¹ ¹ D + 12% 2s ² 2p ³ (² P) 5d ¹ ³ F
635	2s ¹ 2p ⁴ (² S) 4f ¹	³ F	4	10 488 084.	64%
636	2s ¹ 2p ⁴ (² S) 4f ¹	¹ F	3	10 489 009.	46% + 16% 2s ¹ 2p ⁴ (² S) 4f ¹ ³ F + 12% 2s ¹ 2p ⁴ (² P) 4f ¹ ³ G
637	2s ¹ 2p ⁴ (² P) 4d ¹	³ P	0	10 491 547.	92%
638	2s ² 2p ³ (² P) 5d ¹	¹ P	1	10 497 559.	56% + 17% 2s ² 2p ³ (² P) 5d ¹ ³ D
639	2s ¹ 2p ⁴ (² P) 4d ¹	¹ P	1	10 497 742.	39% + 31% 2s ¹ 2p ⁴ (² P) 4d ¹ ³ P + 11% 2s ¹ 2p ⁴ (² P) 4d ¹ ³ D
640	2s ¹ 2p ⁴ (² P) 4d ¹	¹ D	2	10 499 657.	38% + 19% 2s ¹ 2p ⁴ (² P) 4d ¹ ³ F + 12% 2s ¹ 2p ⁴ (² P) 4d ¹ ³ P
641	2s ² 2p ³ (² P) 5g ¹	³ F	2	10 507 602.	70%

Table 1. continued.

Index	Configuration	LS	J	E (cm ⁻¹)	Composition
642	2s ² 2p ³ (² P) 5f ¹	³ D	1	10 507 743.	64% + 14% 2s ¹ 2p ⁴ (² P) 4d ¹ ¹ P
643	2s ² 2p ³ (² P) 5f ¹	³ D	2	10 507 905.	55% + 15% 2s ² 2p ³ (² P) 5f ¹ ¹ D
644	2s ² 2p ³ (² P) 5g ¹	³ F	3	10 508 008.	44% + 26% 2s ² 2p ³ (² P) 5g ¹ ¹ F + 12% 2s ² 2p ³ (² D) 5g ¹ ³ D
645	2s ² 2p ³ (² P) 5f ¹	³ G	5	10 508 859.	77%
646	2s ² 2p ³ (² P) 5f ¹	¹ G	4	10 508 984.	39% + 37% 2s ² 2p ³ (² P) 5f ¹ ³ G + 17% 2s ² 2p ³ (² D) 5f ¹ ³ H
647	2s ² 2p ³ (² P) 5g ¹	³ G	3	10 509 630.	36% + 22% 2s ² 2p ³ (² P) 5g ¹ ¹ F
648	2s ² 2p ³ (² P) 5g ¹	³ F	4	10 509 853.	30% + 22% 2s ² 2p ³ (² P) 5g ¹ ³ G + 15% 2s ² 2p ³ (² P) 5g ¹ ¹ G
649	2s ² 2p ³ (² P) 5f ¹	³ D	3	10 510 502.	36% + 24% 2s ² 2p ³ (² P) 5f ¹ ³ F + 14% 2s ² 2p ³ (² P) 5f ¹ ¹ F
650	2s ² 2p ³ (² P) 5g ¹	¹ G	4	10 511 681.	27% + 23% 2s ² 2p ³ (² P) 5g ¹ ³ H + 19% 2s ² 2p ³ (² P) 5g ¹ ³ G
651	2s ² 2p ³ (² P) 5g ¹	³ G	5	10 512 008.	46% + 14% 2s ² 2p ³ (² P) 5g ¹ ³ H
652	2s ² 2p ³ (² P) 5f ¹	¹ F	3	10 512 443.	34% + 22% 2s ² 2p ³ (² P) 5f ¹ ³ F + 18% 2s ² 2p ³ (² P) 5f ¹ ³ G
653	2s ² 2p ³ (² P) 5f ¹	³ F	4	10 512 897.	55% + 12% 2s ² 2p ³ (² P) 5f ¹ ¹ G
654	2s ² 2p ³ (² P) 5g ¹	¹ H	5	10 513 496.	43% + 33% 2s ² 2p ³ (² P) 5g ¹ ³ H + 17% 2s ² 2p ³ (² D) 5g ¹ ³ I
655	2s ² 2p ³ (² P) 5f ¹	¹ D	2	10 513 649.	28% + 27% 2s ² 2p ³ (² P) 5f ¹ ³ F + 13% 2s ¹ 2p ⁴ (² P) 4d ¹ ¹ D
656	2s ² 2p ³ (² P) 5g ¹	³ H	6	10 513 782.	76%

Table 5. Calculated energy levels of Fe XIX (in cm^{-1}) relative to the ground energy with spectroscopic notations. The five major spontaneous radiative transition probabilities A^r (in s^{-1}) from each level are given. Arrow marks the final level to which radiative transition happens from the level. The sum of all radiative probabilities from the corresponding level is given in the last column.

Index	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	5.09E-01	→ 1									5.09E-01
3	1.42E+04	→ 1	3.44E+01	→ 2							1.43E+04
4	1.69E+04	→ 1	6.99E+02	→ 3	7.70E-02	→ 2					1.76E+04
5	1.39E+05	→ 3	4.83E+01	→ 4	9.05E+00	→ 1					1.39E+05
6	3.57E+10	→ 1	9.60E+09	→ 3	1.95E+09	→ 4	7.14E+01	→ 2	5.91E+00	→ 5	4.73E+10
7	2.91E+10	→ 1	1.49E+10	→ 2	1.16E+10	→ 3	6.35E+08	→ 5	7.58E+06	→ 4	5.62E+10
8	5.57E+10	→ 3	4.67E+03	→ 7	3.71E+02	→ 4	9.62E+01	→ 1	2.19E+00	→ 6	5.57E+10
9	1.42E+11	→ 4	1.15E+10	→ 1	1.03E+10	→ 5	1.35E+09	→ 2	8.41E+08	→ 3	1.66E+11
10	1.50E+11	→ 9	1.06E+10	→ 7	6.50E+05	→ 4	9.27E+04	→ 1	2.17E+04	→ 3	1.60E+11
11	1.07E+11	→ 1	3.64E+09	→ 3	3.10E+08	→ 4	3.16E+05	→ 6	1.28E+05	→ 7	1.11E+11
12	2.34E+12	→ 1	6.03E+11	→ 3	4.96E+11	→ 2	2.18E+10	→ 4	1.93E+08	→ 5	3.46E+12
13	9.53E+11	→ 1	2.65E+11	→ 3	1.05E+11	→ 4	5.43E+06	→ 6	6.10E+05	→ 8	1.32E+12
14	1.21E+12	→ 3	1.99E+11	→ 2	1.38E+11	→ 4	1.98E+10	→ 5	2.72E+09	→ 1	1.57E+12
15	1.11E+12	→ 1	1.05E+11	→ 4	5.41E+06	→ 6	2.32E+06	→ 7	8.25E+04	→ 3	1.21E+12
16	2.16E+12	→ 4	2.76E+11	→ 3	1.27E+11	→ 1	3.44E+06	→ 9	1.03E+06	→ 7	2.57E+12
17	2.67E+09	→ 11	1.97E+09	→ 6	7.24E+08	→ 7	2.79E+08	→ 8	2.67E+08	→ 1	6.00E+09
18	2.63E+09	→ 11	8.43E+08	→ 7	3.99E+08	→ 1	1.44E+08	→ 12	1.43E+08	→ 9	4.40E+09
19	3.76E+09	→ 11	1.15E+09	→ 6	1.00E+08	→ 1	6.54E+06	→ 3	3.56E+05	→ 4	5.02E+09
20	1.11E+12	→ 3	6.73E+06	→ 6	5.22E+05	→ 4	8.35E+04	→ 1	2.81E+04	→ 12	1.11E+12
21	7.21E+11	→ 2	5.05E+11	→ 4	1.84E+11	→ 3	9.60E+10	→ 1	4.96E+10	→ 5	1.56E+12
22	4.19E+09	→ 6	2.52E+09	→ 12	2.03E+09	→ 1	2.79E+08	→ 11	2.76E+08	→ 7	9.70E+09
23	2.83E+09	→ 12	1.63E+09	→ 7	9.63E+08	→ 1	7.38E+08	→ 11	6.64E+08	→ 9	8.02E+09
24	3.44E+09	→ 12	2.90E+09	→ 1	9.94E+08	→ 9	1.62E+08	→ 4	1.42E+08	→ 14	7.66E+09
25	6.58E+11	→ 3	6.49E+11	→ 4	1.25E+11	→ 1	2.26E+06	→ 7	2.20E+06	→ 8	1.43E+12
26	1.37E+12	→ 5	9.96E+11	→ 4	5.13E+10	→ 2	2.37E+10	→ 3	2.17E+10	→ 1	2.46E+12
27	6.54E+09	→ 6	2.37E+09	→ 7	2.34E+09	→ 9	1.21E+09	→ 13	6.04E+08	→ 4	1.47E+10
28	1.40E+09	→ 13	9.57E+08	→ 9	8.47E+08	→ 3	8.31E+08	→ 14	4.35E+08	→ 6	5.23E+09
29	6.01E+09	→ 6	2.39E+09	→ 14	2.33E+09	→ 7	6.95E+08	→ 13	5.62E+08	→ 9	1.33E+10
30	2.31E+09	→ 13	1.13E+09	→ 1	9.15E+08	→ 15	6.17E+08	→ 6	1.98E+08	→ 3	5.20E+09
31	7.15E+09	→ 9	5.32E+09	→ 6	1.58E+09	→ 7	1.27E+09	→ 14	1.13E+09	→ 16	1.82E+10
32	1.32E+10	→ 6	1.58E+09	→ 13	1.26E+09	→ 15	9.57E+08	→ 4	4.14E+08	→ 16	1.75E+10
33	2.40E+09	→ 16	1.59E+09	→ 6	1.13E+09	→ 4	5.25E+08	→ 15	4.36E+08	→ 3	6.45E+09
34	4.12E+09	→ 15	1.27E+09	→ 1	1.25E+08	→ 4	1.17E+03	→ 19	7.78E+02	→ 30	5.52E+09
35	6.78E+10	→ 7	5.70E+09	→ 14	3.36E+09	→ 12	1.08E+09	→ 9	4.89E+08	→ 1	7.85E+10
36	6.56E+10	→ 6	4.71E+09	→ 7	3.68E+09	→ 8	3.00E+09	→ 13	2.55E+09	→ 14	8.31E+10
37	1.08E+11	→ 6	3.33E+10	→ 7	5.06E+09	→ 15	5.01E+09	→ 12	1.71E+09	→ 13	1.54E+11
38	1.41E+10	→ 8	1.13E+10	→ 9	6.46E+09	→ 7	2.32E+09	→ 6	1.43E+09	→ 21	3.84E+10
39	2.36E+10	→ 9	6.01E+09	→ 16	4.67E+09	→ 6	1.65E+09	→ 4	7.95E+08	→ 7	3.91E+10
40	4.23E+10	→ 1	4.52E+09	→ 4	3.70E+09	→ 18	1.46E+09	→ 19	2.88E+07	→ 23	5.20E+10
41	2.50E+11	→ 1	2.88E+10	→ 3	3.00E+09	→ 18	2.10E+09	→ 17	1.22E+09	→ 4	2.85E+11
42	1.67E+11	→ 3	5.54E+09	→ 17	1.62E+08	→ 22	4.96E+06	→ 6	1.58E+05	→ 1	1.72E+11
43	2.42E+10	→ 6	1.44E+10	→ 8	7.06E+09	→ 7	6.87E+09	→ 9	2.40E+09	→ 20	5.73E+10
44	2.62E+11	→ 1	4.89E+10	→ 2	4.66E+10	→ 3	4.20E+09	→ 17	2.25E+09	→ 4	3.66E+11
45	1.85E+10	→ 7	5.29E+09	→ 6	3.46E+09	→ 21	9.50E+08	→ 9	7.94E+08	→ 2	3.00E+10
46	4.72E+09	→ 19	6.92E+06	→ 1	1.89E+06	→ 6	1.36E+05	→ 11	5.55E+04	→ 34	4.72E+09
47	7.02E+10	→ 7	2.30E+10	→ 8	6.88E+09	→ 6	1.58E+09	→ 12	1.31E+09	→ 26	1.08E+11
48	2.05E+10	→ 6	3.58E+09	→ 25	7.18E+08	→ 3	4.75E+08	→ 4	2.86E+08	→ 15	2.56E+10
49	6.60E+10	→ 7	1.19E+10	→ 9	6.40E+09	→ 21	4.42E+09	→ 12	3.26E+08	→ 4	8.94E+10
50	1.85E+12	→ 1	1.34E+12	→ 3	8.03E+10	→ 4	3.83E+09	→ 22	1.02E+09	→ 23	3.28E+12

Table 5. continued.

Index	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})
51	2.45E+10	→ 8	8.57E+09	→ 9	8.21E+09	→ 6	2.01E+09	→ 25	1.96E+09	→ 26	4.89E+10
52	3.81E+12	→ 2	1.73E+12	→ 3	2.48E+11	→ 1	5.41E+10	→ 4	2.64E+09	→ 24	5.85E+12
53	5.80E+12	→ 1	6.58E+10	→ 4	4.96E+09	→ 23	3.59E+08	→ 18	1.21E+08	→ 19	5.87E+12
54	1.01E+10	→ 9	4.31E+09	→ 6	2.52E+09	→ 25	2.32E+09	→ 26	8.63E+08	→ 5	2.19E+10
55	5.12E+09	→ 16	5.10E+09	→ 6	4.75E+09	→ 7	3.98E+09	→ 9	3.10E+09	→ 25	2.68E+10
56	1.09E+12	→ 1	3.99E+11	→ 3	1.28E+10	→ 4	2.39E+09	→ 27	2.09E+09	→ 28	1.51E+12
57	2.26E+12	→ 1	6.73E+10	→ 4	2.17E+09	→ 28	1.63E+09	→ 30	9.91E+08	→ 29	2.33E+12
58	3.91E+09	→ 27	1.60E+09	→ 31	1.39E+09	→ 3	1.48E+08	→ 22	3.34E+07	→ 38	7.14E+09
59	5.77E+11	→ 1	2.79E+11	→ 4	3.60E+09	→ 29	1.87E+09	→ 28	6.91E+07	→ 23	8.61E+11
60	3.90E+09	→ 30	7.20E+08	→ 32	1.98E+08	→ 34	7.09E+07	→ 33	5.67E+06	→ 6	4.90E+09
61	3.40E+12	→ 2	1.45E+12	→ 4	1.27E+12	→ 1	3.94E+11	→ 5	5.62E+10	→ 3	6.57E+12
62	2.88E+09	→ 32	1.19E+09	→ 34	8.38E+08	→ 33	4.78E+07	→ 30	1.61E+07	→ 19	4.99E+09
63	4.98E+09	→ 34	7.62E+05	→ 1	1.40E+05	→ 15	7.20E+04	→ 4	1.15E+03	→ 46	4.98E+09
64	3.87E+09	→ 33	1.08E+09	→ 32	6.57E+08	→ 30	5.01E+07	→ 34	3.28E+06	→ 4	5.66E+09
65	9.64E+12	→ 3	4.07E+12	→ 1	2.47E+11	→ 4	1.77E+09	→ 29	1.35E+09	→ 31	1.40E+13
66	1.35E+11	→ 9	3.78E+10	→ 7	1.64E+10	→ 26	1.88E+09	→ 4	1.26E+09	→ 21	1.93E+11
67	2.49E+12	→ 4	2.37E+12	→ 1	1.54E+12	→ 2	2.13E+11	→ 3	9.07E+10	→ 5	6.70E+12
68	1.91E+13	→ 1	3.82E+11	→ 4	2.43E+09	→ 32	1.31E+09	→ 37	9.02E+08	→ 33	1.95E+13
69	2.92E+10	→ 6	1.86E+10	→ 11	7.10E+08	→ 13	3.31E+08	→ 15	6.02E+07	→ 25	4.88E+10
70	7.05E+12	→ 3	2.28E+09	→ 36	2.04E+09	→ 27	1.37E+09	→ 31	6.30E+08	→ 22	7.05E+12
71	1.54E+13	→ 1	1.35E+12	→ 3	1.39E+09	→ 37	1.24E+09	→ 27	1.15E+09	→ 32	1.68E+13
72	8.66E+12	→ 3	1.62E+12	→ 1	1.28E+12	→ 2	5.90E+11	→ 4	3.87E+11	→ 5	1.25E+13
73	4.85E+12	→ 4	8.93E+11	→ 1	6.58E+11	→ 3	1.93E+09	→ 31	1.06E+09	→ 39	6.41E+12
74	1.52E+13	→ 1	4.45E+12	→ 4	5.32E+11	→ 3	2.56E+11	→ 5	2.58E+09	→ 37	2.04E+13
75	4.17E+11	→ 6	4.23E+10	→ 7	1.98E+10	→ 11	1.15E+09	→ 12	3.41E+08	→ 14	4.81E+11
76	8.03E+12	→ 4	4.99E+12	→ 1	3.07E+09	→ 39	2.15E+09	→ 33	1.20E+09	→ 32	1.30E+13
77	1.84E+12	→ 4	1.22E+12	→ 3	2.97E+10	→ 1	4.02E+09	→ 38	1.25E+09	→ 43	3.09E+12
78	2.06E+12	→ 4	2.93E+11	→ 1	4.99E+09	→ 45	2.24E+08	→ 30	8.40E+07	→ 32	2.36E+12
79	6.06E+10	→ 7	2.58E+10	→ 11	1.69E+10	→ 8	3.37E+08	→ 13	1.33E+08	→ 21	1.04E+11
80	8.40E+12	→ 3	5.51E+12	→ 4	1.20E+12	→ 1	3.10E+09	→ 43	1.12E+09	→ 45	1.51E+13
81	1.66E+13	→ 2	7.19E+11	→ 4	2.09E+11	→ 1	3.80E+10	→ 5	3.37E+10	→ 3	1.76E+13
82	1.47E+12	→ 6	4.04E+11	→ 7	7.91E+09	→ 12	3.54E+09	→ 11	1.06E+09	→ 13	1.89E+12
83	4.75E+09	→ 48	2.44E+08	→ 34	3.23E+07	→ 6	1.03E+07	→ 33	9.35E+06	→ 32	5.06E+09
84	1.52E+13	→ 3	1.69E+09	→ 47	1.25E+09	→ 51	1.19E+09	→ 36	1.10E+09	→ 43	1.52E+13
85	2.51E+12	→ 3	4.34E+11	→ 1	3.41E+11	→ 4	2.79E+09	→ 47	1.57E+09	→ 54	3.29E+12
86	1.48E+13	→ 3	1.75E+12	→ 2	8.55E+11	→ 5	3.92E+11	→ 4	5.48E+10	→ 1	1.78E+13
87	9.25E+11	→ 1	3.30E+10	→ 4	4.17E+09	→ 54	1.37E+09	→ 48	9.20E+07	→ 39	9.64E+11
88	1.30E+12	→ 6	6.65E+11	→ 7	5.33E+11	→ 8	1.78E+10	→ 12	9.31E+08	→ 16	2.52E+12
89	2.65E+13	→ 4	1.58E+11	→ 1	3.50E+09	→ 55	1.09E+09	→ 48	6.79E+08	→ 39	2.66E+13
90	1.24E+13	→ 4	5.11E+12	→ 3	1.04E+11	→ 1	3.00E+09	→ 51	1.79E+09	→ 55	1.76E+13
91	2.40E+12	→ 7	1.51E+10	→ 12	3.04E+09	→ 14	1.93E+09	→ 9	1.59E+09	→ 26	2.42E+12
92	2.63E+13	→ 5	1.26E+12	→ 4	6.81E+11	→ 3	9.70E+10	→ 2	3.35E+09	→ 51	2.83E+13
93	5.34E+10	→ 1	1.20E+10	→ 18	3.94E+09	→ 19	2.88E+09	→ 69	7.02E+08	→ 4	7.46E+10
94	1.39E+11	→ 1	1.46E+10	→ 17	8.63E+09	→ 3	2.60E+09	→ 69	1.78E+09	→ 19	1.71E+11
95	1.13E+10	→ 19	4.88E+09	→ 69	2.71E+08	→ 34	2.27E+08	→ 30	8.67E+07	→ 32	1.68E+10
96	3.29E+11	→ 1	9.94E+09	→ 18	9.26E+09	→ 4	8.09E+09	→ 17	2.50E+09	→ 75	3.68E+11

Table 5. continued.

Index	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})
97	2.16E+12	→ 1	3.71E+10	→ 4	6.22E+09	→ 23	6.01E+09	→ 19	2.70E+09	→ 37	2.22E+12
98	3.76E+11	→ 3	3.48E+11	→ 1	1.18E+10	→ 18	2.76E+09	→ 75	2.22E+09	→ 22	7.48E+11
99	9.12E+11	→ 8	5.06E+11	→ 7	3.98E+10	→ 14	2.90E+10	→ 9	9.37E+09	→ 13	1.51E+12
100	1.03E+12	→ 7	3.66E+11	→ 6	3.95E+10	→ 13	4.23E+09	→ 21	3.37E+09	→ 16	1.46E+12
101	1.53E+12	→ 6	3.87E+10	→ 15	7.82E+09	→ 25	2.48E+09	→ 16	2.52E+07	→ 13	1.58E+12
102	1.20E+12	→ 1	6.03E+10	→ 3	5.51E+10	→ 2	1.58E+10	→ 4	1.04E+10	→ 17	1.36E+12
103	3.72E+10	→ 3	1.84E+10	→ 17	3.61E+09	→ 79	2.53E+08	→ 38	1.82E+08	→ 27	6.00E+10
104	3.03E+12	→ 1	1.22E+11	→ 2	9.56E+10	→ 3	6.63E+10	→ 4	2.04E+10	→ 5	3.36E+12
105	1.47E+12	→ 1	2.69E+10	→ 4	1.01E+10	→ 19	6.33E+09	→ 23	2.04E+09	→ 82	1.52E+12
106	3.28E+12	→ 1	5.73E+10	→ 4	3.97E+10	→ 3	1.16E+10	→ 22	4.44E+09	→ 18	3.40E+12
107	7.33E+10	→ 3	2.10E+10	→ 19	1.98E+10	→ 1	3.22E+09	→ 79	1.93E+09	→ 75	1.24E+11
108	3.00E+12	→ 3	2.71E+10	→ 22	2.23E+09	→ 47	2.00E+09	→ 88	1.43E+09	→ 6	3.03E+12
109	8.41E+11	→ 9	7.23E+10	→ 6	3.64E+10	→ 7	2.00E+10	→ 16	4.20E+09	→ 15	9.84E+11
110	3.00E+12	→ 3	5.04E+11	→ 2	9.25E+09	→ 24	7.76E+09	→ 5	6.91E+09	→ 22	3.55E+12
111	3.09E+12	→ 3	3.89E+11	→ 1	1.89E+10	→ 23	1.22E+10	→ 4	2.13E+09	→ 88	3.51E+12
112	3.12E+12	→ 2	7.74E+11	→ 3	1.88E+11	→ 5	1.95E+10	→ 23	3.82E+09	→ 4	4.12E+12
113	7.76E+11	→ 6	3.75E+11	→ 7	1.14E+11	→ 9	6.48E+10	→ 8	3.82E+10	→ 13	1.43E+12
114	7.59E+11	→ 9	4.07E+11	→ 7	5.40E+10	→ 14	4.24E+10	→ 21	1.85E+09	→ 12	1.27E+12
115	6.85E+09	→ 46	5.25E+09	→ 40	2.90E+09	→ 93	1.09E+09	→ 95	4.62E+08	→ 53	1.72E+10
116	7.00E+09	→ 41	6.10E+09	→ 40	2.70E+09	→ 93	1.51E+09	→ 94	8.13E+08	→ 6	1.96E+10
117	3.91E+11	→ 7	3.83E+11	→ 6	9.96E+10	→ 15	1.89E+10	→ 13	1.05E+10	→ 9	9.32E+11
118	8.49E+09	→ 44	5.52E+09	→ 41	5.23E+09	→ 7	3.21E+09	→ 94	1.43E+09	→ 93	2.59E+10
119	2.04E+12	→ 9	2.12E+11	→ 8	1.51E+11	→ 7	1.17E+11	→ 16	2.90E+10	→ 6	2.58E+12
120	4.14E+10	→ 7	1.50E+10	→ 6	9.32E+09	→ 42	4.59E+09	→ 44	4.18E+09	→ 94	8.13E+10
121	1.27E+11	→ 3	7.53E+10	→ 1	4.83E+10	→ 4	2.94E+10	→ 28	6.69E+09	→ 29	3.01E+11
122	7.01E+09	→ 46	4.78E+09	→ 95	1.91E+08	→ 63	1.41E+08	→ 60	7.52E+06	→ 62	1.21E+10
123	2.98E+12	→ 4	5.20E+11	→ 1	1.58E+11	→ 3	4.41E+10	→ 27	3.60E+10	→ 2	3.82E+12
124	2.24E+11	→ 4	4.69E+10	→ 1	2.69E+10	→ 30	5.83E+09	→ 33	2.76E+09	→ 29	3.17E+11
125	1.40E+11	→ 7	1.58E+10	→ 44	4.34E+09	→ 96	2.15E+09	→ 9	1.61E+09	→ 52	1.65E+11
126	4.83E+09	→ 97	4.61E+09	→ 46	2.77E+09	→ 1	2.58E+09	→ 40	1.02E+09	→ 53	1.74E+10
127	3.07E+10	→ 34	4.23E+09	→ 48	3.89E+09	→ 101	2.67E+09	→ 33	1.41E+09	→ 6	4.33E+10
128	3.60E+12	→ 4	3.90E+11	→ 1	3.03E+10	→ 32	8.33E+09	→ 55	3.98E+09	→ 33	4.04E+12
129	7.63E+11	→ 6	5.13E+10	→ 7	1.29E+10	→ 41	1.00E+10	→ 8	4.66E+09	→ 44	8.50E+11
130	3.09E+11	→ 1	7.04E+10	→ 3	3.05E+10	→ 4	1.58E+10	→ 29	1.18E+10	→ 30	4.68E+11
131	1.12E+12	→ 6	6.46E+09	→ 40	3.57E+09	→ 98	2.24E+09	→ 41	1.55E+09	→ 97	1.13E+12
132	1.20E+12	→ 4	1.22E+11	→ 1	5.33E+10	→ 2	3.13E+10	→ 3	1.87E+10	→ 29	1.48E+12
133	1.15E+12	→ 6	2.02E+11	→ 7	8.91E+09	→ 40	5.92E+09	→ 41	2.23E+09	→ 96	1.38E+12
134	8.58E+11	→ 4	2.48E+10	→ 1	1.51E+10	→ 33	5.94E+09	→ 34	5.69E+09	→ 54	9.32E+11
135	3.20E+12	→ 4	5.45E+11	→ 1	3.71E+10	→ 3	1.28E+10	→ 33	1.14E+10	→ 39	3.84E+12
136	1.66E+12	→ 9	3.52E+11	→ 8	2.23E+11	→ 7	9.03E+10	→ 25	2.45E+10	→ 13	2.39E+12
137	6.92E+10	→ 7	1.27E+10	→ 6	9.84E+09	→ 40	2.73E+09	→ 102	2.37E+09	→ 41	1.03E+11
138	5.85E+09	→ 1	4.72E+09	→ 105	4.50E+09	→ 53	4.10E+09	→ 46	8.30E+08	→ 97	2.12E+10
139	1.09E+11	→ 7	7.72E+10	→ 8	5.15E+09	→ 44	3.31E+09	→ 42	3.15E+09	→ 6	2.07E+11
140	1.47E+12	→ 4	4.42E+11	→ 1	4.08E+11	→ 2	1.56E+11	→ 3	1.80E+10	→ 29	2.56E+12
141	2.07E+12	→ 4	2.13E+11	→ 3	1.03E+11	→ 1	1.95E+10	→ 32	1.06E+10	→ 37	2.44E+12
142	1.39E+12	→ 6	1.56E+10	→ 46	2.20E+09	→ 107	1.89E+09	→ 1	1.74E+09	→ 50	1.42E+12

Table 5. continued.

Index	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})
143	2.29E+12	→ 3	4.26E+10	→ 31	1.22E+10	→ 27	1.10E+10	→ 36	6.44E+09	→ 99	2.37E+12
144	6.67E+11	→ 7	4.04E+11	→ 9	7.76E+10	→ 26	2.41E+10	→ 14	8.45E+09	→ 21	1.18E+12
145	1.12E+12	→ 6	6.90E+09	→ 46	5.14E+09	→ 50	4.36E+09	→ 1	2.26E+09	→ 106	1.14E+12
146	3.37E+12	→ 7	1.67E+10	→ 52	1.64E+10	→ 9	6.48E+09	→ 1	4.44E+09	→ 104	3.43E+12
147	2.96E+12	→ 7	2.46E+12	→ 6	1.20E+10	→ 9	1.11E+10	→ 52	7.24E+09	→ 1	5.47E+12
148	4.51E+12	→ 6	2.02E+12	→ 7	7.35E+09	→ 1	6.69E+09	→ 52	5.10E+09	→ 50	6.56E+12
149	2.31E+12	→ 6	5.67E+10	→ 7	7.78E+09	→ 50	4.85E+09	→ 3	4.29E+09	→ 110	2.40E+12
150	4.90E+12	→ 8	2.53E+12	→ 7	1.77E+10	→ 50	1.26E+10	→ 6	6.67E+09	→ 52	7.49E+12
151	5.92E+11	→ 3	3.80E+10	→ 27	3.16E+10	→ 38	1.75E+10	→ 36	4.63E+09	→ 31	6.92E+11
152	1.12E+13	→ 6	1.77E+10	→ 53	6.21E+09	→ 3	5.84E+09	→ 111	1.77E+09	→ 1	1.13E+13
153	7.69E+11	→ 3	3.27E+11	→ 5	1.56E+11	→ 1	5.59E+10	→ 2	5.23E+10	→ 28	1.42E+12
154	6.54E+12	→ 7	5.58E+10	→ 6	2.10E+10	→ 53	1.08E+10	→ 9	5.99E+09	→ 112	6.65E+12
155	4.01E+11	→ 3	2.91E+11	→ 1	1.90E+11	→ 4	4.88E+10	→ 30	2.03E+10	→ 45	9.89E+11
156	2.09E+12	→ 5	9.65E+11	→ 2	4.93E+10	→ 4	3.10E+10	→ 1	2.55E+10	→ 10	3.28E+12
157	3.09E+11	→ 1	2.59E+11	→ 4	7.88E+10	→ 3	5.06E+10	→ 32	2.06E+10	→ 30	7.81E+11
158	6.13E+11	→ 3	8.61E+10	→ 33	7.09E+10	→ 1	3.74E+10	→ 4	1.48E+10	→ 29	8.74E+11
159	1.25E+12	→ 1	5.18E+11	→ 4	1.02E+11	→ 34	1.08E+10	→ 48	1.02E+10	→ 32	1.92E+12
160	3.45E+11	→ 4	3.13E+11	→ 1	4.78E+10	→ 37	3.02E+10	→ 2	2.53E+10	→ 3	8.39E+11
161	9.63E+10	→ 3	5.39E+10	→ 31	3.43E+10	→ 47	1.68E+10	→ 38	1.27E+10	→ 43	2.30E+11
162	8.32E+11	→ 3	4.56E+11	→ 5	1.77E+11	→ 2	8.88E+10	→ 1	5.19E+10	→ 39	1.76E+12
163	2.03E+10	→ 59	1.64E+10	→ 6	4.63E+09	→ 121	3.69E+09	→ 57	3.68E+09	→ 56	5.52E+10
164	1.92E+10	→ 60	5.71E+09	→ 64	4.03E+09	→ 124	2.71E+09	→ 57	1.44E+09	→ 78	3.71E+10
165	2.35E+10	→ 63	4.22E+09	→ 127	2.35E+09	→ 83	1.49E+09	→ 62	7.34E+08	→ 64	3.26E+10
166	8.92E+10	→ 7	1.28E+10	→ 59	1.02E+10	→ 56	7.52E+09	→ 61	5.61E+09	→ 9	1.45E+11
167	9.59E+10	→ 3	7.25E+10	→ 51	2.09E+10	→ 27	1.22E+10	→ 43	4.18E+09	→ 88	2.18E+11
168	6.17E+11	→ 3	7.51E+10	→ 48	2.55E+10	→ 54	1.38E+10	→ 32	1.30E+10	→ 30	7.77E+11
169	1.09E+13	→ 7	6.25E+12	→ 6	3.74E+11	→ 8	1.21E+11	→ 9	1.22E+10	→ 56	1.77E+13
170	7.98E+11	→ 6	9.90E+09	→ 60	9.32E+09	→ 57	5.53E+09	→ 65	4.34E+09	→ 78	8.42E+11
171	2.39E+12	→ 5	2.42E+11	→ 2	8.98E+10	→ 3	6.97E+10	→ 1	4.56E+10	→ 54	2.94E+12
172	1.56E+10	→ 62	8.02E+09	→ 64	3.99E+09	→ 4	3.76E+09	→ 128	2.25E+09	→ 60	4.44E+10
173	7.99E+12	→ 6	2.85E+12	→ 8	6.91E+11	→ 9	3.14E+11	→ 7	1.81E+10	→ 56	1.19E+13
174	1.53E+13	→ 7	1.63E+12	→ 9	4.85E+10	→ 61	4.17E+09	→ 123	3.23E+09	→ 1	1.70E+13
175	1.05E+13	→ 7	3.38E+11	→ 6	2.00E+11	→ 9	2.72E+10	→ 57	6.48E+09	→ 59	1.11E+13
176	1.12E+10	→ 64	8.45E+09	→ 4	5.96E+09	→ 63	4.58E+09	→ 60	3.79E+09	→ 83	4.73E+10
177	1.23E+13	→ 6	1.62E+10	→ 62	8.06E+09	→ 68	3.69E+09	→ 85	2.75E+09	→ 134	1.23E+13
178	1.76E+13	→ 6	3.41E+12	→ 7	9.04E+10	→ 9	1.92E+10	→ 68	6.04E+09	→ 71	2.12E+13
179	1.26E+13	→ 8	6.23E+12	→ 6	2.09E+12	→ 7	1.71E+10	→ 65	9.28E+09	→ 67	2.10E+13
180	4.54E+12	→ 9	3.12E+12	→ 7	1.85E+12	→ 8	1.12E+12	→ 6	1.18E+10	→ 73	1.07E+13
181	2.77E+12	→ 6	1.52E+12	→ 7	1.47E+12	→ 9	9.83E+09	→ 4	9.79E+09	→ 71	5.82E+12
182	2.12E+12	→ 6	1.12E+10	→ 4	1.00E+10	→ 76	7.95E+09	→ 64	7.74E+09	→ 60	2.18E+12
183	1.71E+13	→ 9	3.67E+12	→ 7	1.52E+10	→ 72	1.51E+10	→ 67	1.13E+10	→ 74	2.08E+13
184	4.81E+11	→ 4	2.35E+11	→ 5	9.32E+10	→ 55	3.94E+10	→ 3	3.34E+10	→ 10	9.62E+11
185	2.72E+11	→ 9	4.82E+10	→ 7	3.75E+10	→ 8	3.33E+10	→ 56	2.26E+10	→ 77	4.53E+11
186	6.41E+11	→ 7	1.21E+11	→ 9	1.14E+11	→ 6	2.89E+10	→ 57	1.28E+10	→ 77	9.69E+11
187	4.81E+12	→ 6	2.30E+10	→ 60	1.11E+10	→ 78	8.22E+09	→ 62	6.33E+09	→ 80	4.89E+12

Table 5. continued.

Index	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)
188	2.87E+12	→ 6	4.40E+10	→ 62	2.53E+10	→ 60	1.51E+10	→ 68	4.85E+09	→ 78	3.00E+12
189	3.93E+12	→ 7	2.35E+10	→ 9	2.28E+10	→ 59	1.08E+10	→ 78	8.43E+09	→ 76	4.06E+12
190	4.56E+12	→ 7	3.48E+12	→ 6	5.50E+10	→ 9	2.37E+10	→ 57	2.08E+10	→ 68	8.20E+12
191	9.42E+10	→ 64	1.30E+10	→ 76	8.96E+09	→ 59	5.45E+09	→ 6	3.22E+09	→ 158	1.47E+11
192	9.59E+10	→ 63	1.23E+10	→ 62	9.60E+09	→ 83	5.26E+09	→ 159	5.14E+09	→ 78	1.46E+11
193	8.25E+12	→ 7	1.58E+12	→ 8	1.22E+12	→ 6	2.75E+11	→ 9	2.84E+10	→ 71	1.14E+13
194	7.46E+12	→ 7	4.97E+10	→ 9	3.41E+10	→ 72	2.25E+10	→ 74	1.89E+10	→ 86	7.62E+12
195	7.15E+12	→ 8	5.63E+12	→ 9	2.53E+11	→ 6	2.36E+11	→ 7	2.24E+10	→ 80	1.34E+13
196	8.35E+12	→ 9	1.19E+12	→ 7	8.93E+10	→ 6	4.22E+10	→ 76	1.69E+10	→ 59	9.76E+12
197	6.38E+10	→ 83	2.26E+10	→ 87	2.11E+10	→ 60	5.42E+09	→ 6	4.80E+09	→ 168	1.37E+11
198	1.24E+12	→ 7	1.43E+11	→ 9	6.70E+10	→ 6	3.22E+10	→ 87	2.34E+10	→ 85	1.56E+12
199	1.71E+13	→ 9	2.13E+12	→ 8	6.20E+10	→ 7	5.09E+10	→ 90	1.47E+10	→ 92	1.94E+13
200	2.79E+13	→ 9	1.25E+11	→ 7	8.21E+10	→ 89	1.26E+10	→ 90	6.53E+09	→ 76	2.81E+13
201	4.27E+10	→ 101	3.56E+10	→ 117	1.98E+10	→ 100	1.96E+10	→ 1	1.16E+10	→ 3	1.60E+11
202	1.24E+12	→ 10	5.05E+10	→ 109	2.35E+10	→ 119	2.07E+10	→ 4	1.71E+10	→ 99	1.42E+12
203	4.77E+10	→ 119	4.63E+10	→ 99	3.18E+10	→ 136	2.69E+10	→ 3	4.14E+09	→ 113	1.62E+11
204	1.41E+12	→ 10	3.34E+10	→ 117	2.83E+10	→ 4	2.74E+10	→ 136	2.55E+10	→ 109	1.60E+12
205	2.32E+12	→ 6	2.37E+11	→ 7	6.90E+10	→ 8	2.04E+10	→ 141	2.03E+10	→ 140	2.75E+12
206	1.07E+12	→ 6	8.02E+11	→ 7	3.05E+11	→ 9	3.64E+10	→ 124	2.54E+10	→ 157	2.30E+12
207	2.39E+12	→ 6	4.35E+10	→ 127	2.74E+10	→ 159	8.76E+09	→ 128	6.66E+09	→ 134	2.51E+12
208	1.57E+12	→ 7	1.41E+12	→ 9	8.80E+10	→ 6	2.95E+10	→ 135	1.66E+10	→ 121	3.20E+12
209	1.19E+12	→ 6	4.93E+11	→ 9	4.89E+11	→ 7	3.47E+10	→ 134	1.16E+10	→ 158	2.30E+12
210	2.27E+12	→ 7	3.81E+10	→ 162	3.61E+10	→ 132	2.08E+10	→ 160	1.22E+10	→ 9	2.41E+12
211	2.29E+11	→ 19	1.44E+11	→ 18	9.11E+10	→ 17	3.28E+10	→ 1	1.89E+10	→ 23	5.25E+11
212	1.60E+12	→ 9	9.30E+11	→ 8	3.67E+11	→ 7	3.38E+10	→ 121	1.98E+10	→ 157	3.03E+12
213	8.05E+11	→ 1	2.72E+11	→ 3	1.89E+11	→ 23	1.65E+11	→ 2	1.28E+11	→ 22	1.77E+12
214	1.36E+12	→ 8	9.41E+11	→ 9	3.06E+11	→ 7	7.71E+10	→ 6	2.73E+10	→ 168	2.82E+12
215	1.21E+12	→ 9	1.03E+12	→ 7	3.13E+10	→ 159	3.03E+10	→ 128	2.15E+10	→ 168	2.39E+12
216	3.96E+11	→ 11	4.60E+10	→ 44	3.80E+10	→ 41	2.04E+10	→ 42	1.41E+10	→ 12	5.19E+11
217	3.69E+11	→ 11	5.79E+10	→ 40	3.94E+10	→ 12	3.37E+10	→ 41	8.80E+09	→ 44	5.17E+11
218	3.95E+11	→ 11	7.63E+10	→ 46	1.91E+10	→ 40	2.95E+09	→ 41	1.00E+09	→ 211	4.97E+11
219	3.78E+11	→ 12	7.00E+10	→ 50	2.55E+10	→ 52	1.20E+10	→ 11	5.79E+09	→ 71	5.16E+11
220	3.43E+11	→ 12	7.63E+10	→ 53	3.34E+10	→ 11	1.42E+10	→ 50	1.02E+10	→ 68	5.12E+11
221	3.55E+11	→ 12	9.70E+10	→ 52	2.66E+10	→ 14	1.18E+10	→ 9	6.02E+09	→ 72	5.10E+11
222	3.74E+11	→ 3	1.82E+11	→ 29	1.05E+11	→ 2	6.70E+10	→ 28	5.78E+10	→ 36	1.04E+12
223	3.69E+11	→ 1	1.21E+11	→ 30	1.10E+11	→ 4	9.87E+10	→ 3	8.78E+10	→ 32	1.08E+12
224	7.37E+10	→ 3	4.01E+10	→ 173	1.87E+10	→ 193	1.80E+10	→ 185	8.38E+09	→ 180	1.90E+11
225	7.67E+10	→ 10	3.05E+10	→ 3	2.01E+10	→ 175	1.93E+10	→ 1	1.44E+10	→ 190	2.57E+11
226	5.42E+11	→ 1	1.97E+11	→ 34	1.11E+11	→ 37	6.92E+10	→ 32	6.02E+10	→ 30	1.08E+12
227	4.35E+10	→ 165	1.97E+10	→ 192	8.71E+09	→ 172	7.51E+09	→ 6	7.28E+09	→ 164	1.11E+11
228	7.52E+11	→ 4	1.68E+11	→ 33	1.25E+11	→ 39	1.07E+11	→ 3	5.49E+10	→ 55	1.38E+12
229	3.22E+10	→ 1	2.32E+10	→ 188	2.10E+10	→ 177	8.48E+09	→ 186	7.82E+09	→ 178	1.52E+11
230	4.84E+10	→ 4	2.51E+10	→ 164	1.79E+10	→ 191	1.60E+10	→ 172	7.06E+09	→ 163	1.62E+11
231	4.22E+12	→ 9	7.20E+10	→ 184	1.30E+10	→ 204	1.12E+10	→ 202	1.07E+10	→ 160	4.35E+12
232	4.91E+11	→ 18	3.25E+11	→ 17	1.02E+11	→ 1	6.00E+10	→ 19	3.40E+10	→ 23	1.05E+12

Table 5. continued.

Index	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})
233	2.64E+10	→ 163	1.37E+10	→ 182	1.13E+10	→ 4	1.02E+10	→ 3	8.81E+09	→ 191	1.46E+11
234	8.78E+11	→ 17	4.89E+10	→ 22	3.56E+10	→ 3	4.17E+09	→ 79	1.39E+09	→ 129	9.72E+11
235	6.07E+11	→ 18	3.01E+11	→ 19	1.61E+10	→ 23	1.10E+10	→ 1	5.81E+09	→ 4	9.53E+11
236	6.67E+11	→ 17	2.07E+11	→ 18	9.92E+10	→ 1	2.69E+10	→ 22	2.41E+10	→ 23	1.06E+12
237	9.30E+11	→ 19	6.12E+09	→ 69	1.13E+09	→ 218	7.13E+08	→ 142	6.44E+08	→ 122	9.41E+11
238	3.39E+10	→ 176	2.57E+10	→ 4	2.41E+10	→ 1	2.37E+10	→ 23	1.21E+10	→ 192	1.88E+11
239	2.00E+12	→ 3	1.45E+12	→ 1	6.16E+11	→ 22	2.06E+11	→ 23	2.89E+10	→ 4	4.39E+12
240	2.40E+11	→ 13	1.44E+11	→ 14	4.06E+10	→ 61	3.87E+10	→ 56	2.17E+10	→ 16	5.36E+11
241	3.09E+12	→ 2	1.35E+12	→ 3	4.36E+11	→ 24	3.16E+11	→ 22	1.66E+11	→ 1	5.54E+12
242	5.54E+12	→ 1	7.30E+11	→ 23	7.42E+10	→ 37	5.82E+10	→ 4	3.28E+10	→ 18	6.47E+12
243	2.85E+11	→ 14	1.20E+11	→ 13	5.40E+10	→ 59	1.98E+10	→ 56	1.43E+10	→ 15	5.26E+11
244	3.87E+11	→ 13	6.06E+10	→ 60	1.32E+10	→ 57	1.20E+10	→ 16	1.02E+10	→ 62	5.09E+11
245	2.43E+11	→ 13	1.19E+11	→ 14	3.38E+10	→ 57	2.42E+10	→ 59	2.11E+10	→ 65	5.05E+11
246	4.74E+12	→ 10	1.03E+11	→ 2	2.61E+10	→ 166	2.53E+10	→ 196	1.88E+10	→ 3	4.99E+12
247	2.04E+11	→ 14	1.11E+11	→ 16	5.65E+10	→ 13	4.61E+10	→ 65	3.61E+10	→ 67	5.02E+11
248	3.32E+11	→ 14	5.21E+10	→ 67	3.13E+10	→ 72	2.91E+10	→ 61	1.94E+10	→ 9	4.89E+11
249	2.88E+11	→ 15	1.17E+11	→ 16	2.69E+10	→ 64	2.19E+10	→ 62	1.93E+10	→ 41	5.63E+11
250	1.35E+12	→ 41	5.62E+11	→ 40	2.57E+10	→ 46	1.63E+10	→ 50	7.57E+09	→ 15	1.99E+12
251	1.67E+12	→ 40	3.15E+11	→ 46	5.06E+09	→ 53	3.83E+09	→ 68	2.85E+09	→ 97	2.01E+12
252	1.11E+12	→ 44	7.82E+11	→ 41	7.66E+10	→ 40	2.58E+10	→ 52	3.73E+09	→ 61	2.01E+12
253	9.35E+11	→ 42	9.33E+11	→ 44	1.29E+11	→ 41	4.11E+09	→ 50	3.49E+09	→ 103	2.01E+12
254	1.99E+12	→ 46	8.72E+09	→ 95	2.81E+09	→ 62	5.34E+08	→ 19	1.85E+08	→ 237	2.00E+12
255	1.41E+12	→ 50	1.76E+11	→ 53	8.46E+10	→ 71	4.80E+10	→ 56	4.56E+10	→ 65	1.90E+12
256	1.49E+12	→ 53	2.49E+11	→ 68	6.28E+10	→ 57	1.86E+10	→ 46	1.11E+10	→ 15	1.87E+12
257	1.39E+12	→ 52	2.66E+11	→ 50	5.01E+10	→ 61	3.91E+10	→ 81	3.01E+10	→ 67	1.91E+12
258	2.90E+11	→ 16	9.83E+10	→ 15	4.26E+10	→ 64	1.86E+10	→ 62	1.40E+10	→ 76	5.25E+11
259	3.96E+11	→ 15	6.48E+10	→ 63	2.29E+10	→ 53	1.81E+10	→ 62	5.14E+09	→ 57	5.19E+11
260	4.48E+11	→ 3	2.61E+11	→ 43	1.51E+11	→ 38	2.61E+10	→ 51	2.47E+10	→ 47	9.55E+11
261	2.81E+11	→ 4	2.07E+11	→ 45	2.01E+11	→ 2	1.16E+11	→ 3	7.03E+10	→ 38	1.20E+12
262	2.38E+11	→ 16	8.01E+10	→ 13	3.40E+10	→ 72	3.17E+10	→ 14	1.85E+10	→ 70	4.80E+11
263	3.15E+10	→ 191	2.64E+10	→ 163	8.79E+09	→ 166	8.16E+09	→ 196	7.19E+09	→ 182	1.29E+11
264	3.10E+11	→ 15	3.11E+10	→ 71	2.90E+10	→ 74	2.56E+10	→ 13	2.26E+10	→ 16	4.76E+11
265	5.95E+10	→ 3	2.88E+10	→ 197	1.47E+10	→ 170	9.07E+09	→ 175	8.71E+09	→ 188	1.80E+11
266	4.90E+10	→ 4	3.16E+10	→ 192	1.62E+10	→ 164	1.51E+10	→ 197	1.35E+10	→ 172	1.79E+11
267	3.19E+11	→ 16	4.98E+10	→ 76	2.44E+10	→ 73	2.18E+10	→ 15	5.75E+09	→ 74	4.60E+11
268	5.16E+11	→ 3	2.25E+11	→ 4	2.07E+11	→ 48	1.87E+11	→ 1	7.58E+10	→ 54	1.45E+12
269	6.03E+11	→ 4	3.38E+11	→ 5	1.33E+11	→ 54	1.16E+11	→ 1	1.01E+11	→ 2	1.74E+12
270	7.31E+11	→ 1	4.82E+11	→ 3	3.87E+11	→ 27	3.48E+11	→ 28	9.42E+10	→ 31	2.20E+12
271	7.28E+11	→ 29	2.64E+11	→ 4	1.85E+11	→ 28	1.54E+11	→ 1	3.89E+09	→ 33	1.35E+12
272	5.61E+11	→ 30	3.63E+11	→ 32	3.70E+09	→ 34	2.90E+09	→ 48	1.16E+09	→ 244	9.35E+11
273	8.00E+11	→ 2	4.93E+11	→ 27	3.78E+11	→ 1	1.85E+11	→ 4	1.82E+11	→ 5	2.48E+12
274	5.79E+11	→ 27	2.87E+11	→ 3	2.26E+11	→ 31	5.72E+10	→ 36	4.07E+10	→ 43	1.22E+12
275	1.95E+12	→ 1	4.44E+11	→ 28	2.73E+11	→ 30	1.24E+11	→ 4	8.67E+10	→ 29	3.01E+12
276	3.71E+12	→ 3	6.94E+11	→ 1	4.79E+11	→ 4	3.04E+11	→ 36	2.60E+11	→ 29	5.79E+12
277	1.96E+12	→ 3	1.18E+12	→ 2	4.78E+11	→ 1	3.93E+11	→ 4	2.86E+11	→ 35	5.12E+12

Table 5. continued.

Index	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})
278	2.66E+11	→ 21	1.44E+11	→ 20	5.43E+10	→ 77	2.01E+10	→ 81	1.90E+10	→ 73	5.45E+11
279	3.49E+11	→ 34	3.32E+11	→ 32	1.68E+11	→ 30	8.24E+10	→ 33	3.08E+09	→ 101	9.40E+11
280	9.32E+11	→ 34	1.14E+09	→ 259	7.36E+08	→ 192	3.81E+08	→ 176	3.24E+08	→ 172	9.35E+11
281	7.90E+11	→ 33	7.21E+10	→ 32	6.40E+10	→ 30	1.18E+09	→ 48	8.87E+08	→ 258	9.31E+11
282	3.77E+12	→ 1	3.26E+11	→ 32	2.57E+11	→ 37	1.38E+11	→ 30	7.69E+10	→ 33	4.72E+12
283	2.52E+11	→ 20	1.20E+11	→ 21	5.89E+10	→ 80	3.28E+10	→ 77	9.54E+09	→ 81	5.10E+11
284	3.90E+11	→ 21	7.70E+10	→ 78	1.28E+10	→ 80	5.16E+09	→ 25	3.64E+09	→ 89	5.14E+11
285	3.02E+12	→ 3	3.57E+11	→ 36	2.97E+11	→ 31	1.28E+11	→ 38	6.23E+10	→ 47	3.94E+12
286	5.63E+12	→ 1	4.24E+11	→ 37	1.54E+11	→ 32	1.03E+11	→ 3	8.74E+10	→ 30	6.66E+12
287	2.04E+12	→ 3	1.30E+12	→ 1	7.43E+11	→ 4	2.24E+11	→ 31	1.88E+11	→ 36	5.09E+12
288	3.27E+13	→ 10	4.81E+11	→ 1	2.04E+11	→ 5	1.12E+11	→ 4	8.45E+10	→ 3	3.38E+13
289	3.81E+11	→ 21	8.43E+10	→ 81	1.27E+10	→ 86	5.41E+09	→ 67	3.42E+09	→ 9	5.00E+11
290	4.67E+12	→ 1	2.95E+12	→ 10	1.50E+12	→ 4	4.47E+11	→ 37	3.34E+11	→ 3	1.04E+13
291	1.17E+12	→ 56	1.68E+11	→ 50	1.49E+11	→ 59	1.39E+11	→ 71	1.14E+11	→ 57	2.01E+12
292	5.53E+12	→ 4	5.03E+11	→ 3	3.96E+11	→ 39	1.87E+11	→ 31	8.35E+10	→ 55	6.94E+12
293	8.19E+11	→ 57	2.53E+11	→ 59	2.50E+11	→ 60	2.28E+11	→ 76	1.90E+11	→ 53	1.98E+12
294	1.22E+12	→ 61	4.26E+11	→ 56	6.87E+10	→ 71	5.43E+10	→ 52	5.31E+10	→ 65	2.06E+12
295	1.62E+12	→ 59	1.24E+11	→ 68	1.03E+11	→ 57	4.25E+10	→ 60	1.92E+10	→ 53	1.93E+12
296	1.67E+12	→ 60	2.35E+11	→ 62	1.50E+10	→ 64	4.48E+09	→ 83	2.17E+09	→ 63	1.93E+12
297	1.33E+12	→ 65	1.98E+11	→ 57	9.03E+10	→ 59	5.88E+10	→ 53	5.64E+10	→ 76	2.01E+12
298	6.59E+12	→ 4	4.76E+11	→ 1	4.67E+11	→ 39	2.38E+11	→ 33	1.09E+11	→ 55	7.95E+12
299	7.07E+11	→ 58	6.57E+11	→ 61	2.28E+11	→ 70	1.70E+11	→ 67	5.55E+10	→ 65	2.07E+12
300	8.26E+11	→ 67	5.09E+11	→ 72	4.36E+11	→ 65	3.68E+10	→ 74	3.26E+10	→ 81	2.00E+12
301	3.03E+11	→ 25	8.26E+10	→ 26	3.78E+10	→ 86	3.59E+10	→ 85	1.66E+10	→ 84	5.20E+11
302	3.96E+11	→ 25	7.41E+10	→ 83	1.50E+10	→ 87	9.58E+09	→ 71	7.10E+09	→ 89	5.31E+11
303	1.69E+12	→ 64	9.41E+10	→ 62	8.37E+10	→ 63	5.33E+10	→ 60	2.50E+08	→ 33	1.93E+12
304	1.92E+12	→ 63	5.29E+08	→ 34	1.42E+08	→ 280	8.41E+04	→ 15	5.60E+04	→ 64	1.92E+12
305	4.90E+11	→ 57	4.48E+11	→ 68	4.00E+11	→ 62	2.50E+11	→ 76	1.60E+11	→ 64	1.98E+12
306	1.29E+12	→ 62	3.27E+11	→ 63	2.03E+11	→ 64	1.28E+11	→ 60	2.62E+10	→ 83	1.98E+12
307	2.35E+11	→ 26	1.15E+11	→ 72	8.30E+10	→ 74	7.08E+10	→ 71	6.49E+10	→ 25	7.96E+11
308	6.57E+11	→ 71	3.67E+11	→ 68	3.63E+11	→ 57	1.53E+11	→ 56	1.03E+11	→ 76	2.00E+12
309	5.11E+11	→ 71	3.07E+11	→ 72	1.47E+11	→ 56	1.30E+11	→ 67	7.22E+10	→ 26	1.61E+12
310	7.97E+11	→ 76	3.85E+11	→ 68	2.06E+11	→ 62	1.93E+11	→ 64	1.32E+11	→ 89	1.94E+12
311	2.95E+11	→ 71	2.03E+11	→ 26	1.94E+11	→ 74	1.48E+11	→ 73	1.01E+11	→ 68	1.20E+12
312	4.97E+11	→ 72	2.72E+11	→ 71	2.57E+11	→ 74	2.29E+11	→ 70	1.46E+11	→ 67	1.80E+12
313	7.46E+11	→ 73	3.16E+11	→ 76	2.77E+11	→ 68	1.56E+11	→ 80	1.15E+11	→ 77	1.97E+12
314	1.57E+12	→ 74	3.33E+11	→ 72	3.11E+10	→ 67	2.36E+10	→ 81	2.11E+10	→ 86	2.04E+12
315	4.20E+11	→ 73	2.62E+11	→ 74	2.52E+11	→ 67	2.39E+11	→ 72	8.77E+10	→ 77	1.69E+12
316	8.44E+11	→ 74	4.17E+11	→ 70	1.83E+11	→ 58	1.81E+11	→ 73	1.15E+11	→ 67	2.06E+12
317	2.81E+11	→ 25	8.63E+10	→ 26	5.79E+10	→ 87	4.28E+10	→ 73	3.18E+10	→ 74	5.99E+11
318	7.06E+11	→ 38	5.63E+11	→ 4	1.08E+11	→ 45	5.35E+10	→ 3	4.74E+10	→ 31	1.56E+12
319	3.35E+11	→ 26	8.74E+10	→ 92	3.18E+09	→ 269	2.71E+09	→ 184	2.34E+09	→ 74	4.45E+11
320	2.31E+12	→ 3	7.17E+11	→ 43	4.82E+11	→ 4	7.81E+10	→ 45	4.49E+10	→ 47	3.73E+12
321	1.44E+12	→ 4	8.16E+11	→ 45	2.17E+11	→ 1	5.24E+10	→ 39	4.53E+10	→ 55	2.60E+12
322	5.17E+12	→ 2	4.44E+11	→ 49	4.03E+11	→ 3	3.33E+11	→ 10	2.28E+11	→ 5	7.15E+12

Table 5. continued.

Index	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})
323	9.36E+11	→ 48	6.36E+09	→ 30	4.62E+09	→ 33	2.36E+09	→ 101	1.11E+09	→ 302	9.54E+11
324	4.49E+12	→ 3	3.61E+11	→ 51	3.14E+11	→ 47	1.42E+11	→ 36	9.67E+10	→ 43	5.44E+12
325	4.34E+11	→ 47	3.35E+11	→ 54	2.93E+11	→ 1	2.25E+11	→ 3	7.25E+10	→ 51	1.47E+12
326	3.43E+12	→ 3	3.50E+11	→ 4	3.26E+11	→ 5	3.08E+11	→ 47	1.96E+11	→ 51	5.21E+12
327	1.26E+12	→ 77	4.02E+11	→ 73	8.42E+10	→ 78	6.37E+10	→ 80	5.07E+10	→ 56	2.01E+12
328	1.53E+12	→ 78	2.10E+11	→ 89	1.55E+11	→ 76	4.07E+10	→ 57	2.52E+10	→ 87	1.98E+12
329	1.17E+12	→ 81	2.35E+11	→ 86	1.79E+11	→ 80	9.49E+10	→ 67	9.37E+10	→ 92	2.01E+12
330	1.24E+12	→ 80	3.41E+11	→ 77	1.72E+11	→ 71	1.23E+11	→ 73	9.23E+10	→ 78	2.04E+12
331	6.73E+11	→ 1	6.37E+11	→ 54	2.29E+11	→ 48	1.01E+11	→ 4	3.13E+10	→ 55	1.71E+12
332	5.67E+12	→ 4	5.16E+11	→ 55	1.29E+11	→ 39	1.22E+11	→ 54	7.08E+10	→ 45	6.60E+12
333	2.38E+12	→ 4	1.77E+12	→ 3	4.05E+11	→ 51	2.65E+11	→ 55	1.50E+11	→ 1	5.22E+12
334	9.52E+12	→ 5	4.61E+11	→ 66	4.50E+11	→ 10	2.87E+11	→ 4	2.86E+11	→ 3	1.17E+13
335	9.31E+11	→ 84	7.81E+11	→ 86	9.36E+10	→ 81	8.11E+10	→ 90	5.22E+10	→ 85	2.09E+12
336	1.27E+12	→ 89	3.34E+11	→ 78	1.31E+11	→ 87	9.81E+10	→ 76	6.89E+10	→ 83	1.95E+12
337	1.94E+12	→ 83	2.96E+10	→ 62	2.20E+10	→ 60	3.57E+09	→ 127	3.16E+09	→ 64	2.00E+12
338	6.66E+11	→ 86	5.08E+11	→ 85	3.12E+11	→ 92	3.02E+11	→ 81	1.09E+11	→ 90	2.07E+12
339	1.26E+12	→ 85	4.36E+11	→ 87	1.33E+11	→ 90	6.08E+10	→ 89	3.80E+10	→ 65	2.04E+12
340	1.12E+12	→ 92	4.34E+11	→ 90	2.23E+11	→ 86	2.47E+10	→ 52	2.43E+10	→ 89	1.95E+12
341	1.14E+12	→ 90	2.56E+11	→ 85	2.34E+11	→ 89	8.47E+10	→ 73	7.21E+10	→ 77	1.97E+12
342	1.61E+12	→ 87	2.60E+11	→ 83	5.65E+10	→ 89	3.89E+10	→ 76	7.83E+09	→ 62	1.99E+12
343	2.11E+11	→ 95	1.64E+11	→ 93	1.02E+11	→ 94	1.63E+10	→ 211	1.48E+10	→ 107	5.35E+11
344	5.98E+11	→ 6	2.13E+11	→ 97	1.27E+11	→ 7	7.05E+10	→ 98	5.69E+10	→ 106	1.25E+12
345	2.21E+11	→ 105	1.55E+11	→ 6	9.03E+10	→ 106	6.60E+10	→ 7	4.39E+10	→ 96	7.49E+11
346	1.67E+11	→ 107	9.59E+10	→ 7	9.10E+10	→ 98	8.68E+10	→ 102	5.85E+10	→ 8	7.46E+11
347	3.94E+11	→ 69	8.14E+10	→ 1	4.25E+10	→ 115	3.34E+10	→ 116	1.35E+10	→ 118	6.18E+11
348	3.60E+11	→ 69	1.16E+11	→ 1	3.73E+10	→ 118	2.96E+10	→ 75	2.84E+10	→ 120	6.56E+11
349	4.61E+11	→ 6	2.33E+11	→ 111	1.98E+11	→ 7	1.98E+11	→ 8	1.14E+11	→ 110	1.39E+12
350	3.99E+11	→ 69	7.26E+10	→ 122	1.92E+10	→ 115	1.31E+10	→ 218	4.95E+09	→ 116	5.18E+11
351	1.80E+12	→ 1	2.19E+11	→ 75	1.67E+11	→ 82	5.49E+10	→ 126	4.19E+10	→ 4	2.38E+12
352	1.05E+12	→ 7	3.55E+11	→ 112	7.76E+10	→ 110	3.43E+10	→ 140	1.80E+10	→ 213	1.58E+12
353	1.65E+12	→ 1	2.82E+11	→ 75	9.30E+10	→ 82	3.99E+10	→ 4	2.16E+10	→ 147	2.24E+12
354	1.53E+12	→ 1	2.05E+11	→ 75	1.12E+11	→ 82	9.34E+10	→ 3	3.71E+10	→ 131	2.17E+12
355	9.18E+11	→ 1	2.69E+11	→ 82	1.17E+11	→ 75	1.03E+11	→ 3	2.95E+10	→ 147	1.61E+12
356	4.68E+11	→ 1	2.16E+11	→ 82	1.79E+11	→ 75	5.96E+10	→ 138	1.53E+10	→ 126	1.00E+12
357	7.54E+11	→ 1	2.33E+11	→ 82	1.08E+11	→ 75	4.89E+10	→ 79	4.26E+10	→ 3	1.35E+12
358	3.63E+11	→ 79	2.19E+11	→ 3	1.26E+11	→ 2	7.00E+10	→ 137	2.48E+10	→ 91	9.00E+11
359	4.12E+11	→ 79	9.92E+10	→ 139	2.66E+10	→ 3	1.87E+10	→ 216	6.30E+09	→ 129	5.71E+11
360	6.77E+11	→ 3	2.29E+11	→ 79	8.88E+10	→ 88	3.52E+10	→ 142	3.41E+10	→ 75	1.21E+12
361	1.79E+12	→ 3	3.12E+11	→ 88	1.02E+11	→ 2	6.10E+10	→ 149	3.41E+10	→ 79	2.45E+12
362	5.63E+11	→ 93	3.51E+11	→ 95	2.72E+10	→ 97	6.67E+09	→ 235	4.87E+09	→ 237	9.60E+11
363	5.65E+11	→ 93	2.64E+11	→ 94	8.29E+10	→ 95	1.26E+10	→ 105	7.93E+09	→ 232	9.59E+11
364	1.41E+12	→ 3	2.69E+11	→ 88	9.70E+10	→ 79	8.76E+10	→ 1	6.89E+10	→ 152	2.03E+12
365	2.10E+12	→ 3	3.68E+11	→ 88	1.06E+11	→ 150	1.94E+10	→ 219	5.73E+09	→ 47	2.63E+12
366	5.82E+11	→ 94	2.86E+11	→ 93	2.41E+10	→ 107	1.59E+10	→ 96	1.26E+10	→ 7	9.67E+11
367	9.29E+11	→ 95	6.85E+09	→ 237	1.07E+09	→ 350	9.75E+08	→ 46	6.73E+08	→ 83	9.40E+11
368	7.86E+11	→ 94	6.11E+10	→ 107	5.15E+10	→ 7	4.13E+10	→ 96	1.94E+10	→ 6	1.02E+12

Table 5. continued.

Index	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})
369	2.13E+12	→ 2	3.25E+11	→ 91	2.35E+11	→ 3	9.49E+10	→ 154	8.42E+10	→ 5	3.01E+12
370	8.61E+11	→ 97	2.63E+10	→ 93	1.30E+10	→ 105	5.12E+09	→ 242	2.61E+09	→ 95	9.18E+11
371	1.58E+12	→ 7	6.69E+11	→ 96	2.15E+11	→ 104	1.38E+10	→ 102	1.22E+10	→ 241	2.52E+12
372	1.48E+12	→ 6	1.29E+12	→ 7	4.38E+11	→ 96	1.54E+11	→ 104	1.30E+11	→ 98	3.70E+12
373	3.59E+12	→ 6	3.31E+11	→ 98	2.80E+11	→ 97	1.83E+11	→ 106	3.55E+10	→ 94	4.51E+12
374	3.52E+12	→ 6	8.94E+11	→ 7	2.53E+11	→ 98	1.86E+11	→ 96	1.33E+11	→ 106	5.33E+12
375	1.15E+12	→ 116	6.19E+11	→ 115	9.57E+10	→ 126	4.20E+10	→ 122	3.15E+10	→ 145	1.99E+12
376	1.52E+12	→ 115	3.95E+11	→ 122	3.25E+10	→ 138	1.36E+10	→ 126	4.54E+09	→ 254	1.97E+12
377	8.43E+11	→ 116	7.94E+11	→ 118	1.05E+11	→ 115	9.40E+10	→ 148	5.11E+10	→ 131	1.99E+12
378	1.90E+12	→ 122	3.45E+09	→ 254	5.03E+08	→ 95	2.21E+08	→ 296	1.67E+08	→ 304	1.90E+12
379	1.00E+12	→ 118	4.71E+11	→ 120	2.57E+11	→ 116	8.89E+10	→ 147	5.95E+10	→ 148	2.00E+12
380	5.86E+11	→ 131	3.68E+11	→ 142	2.68E+11	→ 145	2.10E+11	→ 152	1.61E+11	→ 126	1.87E+12
381	1.35E+12	→ 126	5.02E+11	→ 138	4.98E+09	→ 122	2.41E+09	→ 115	2.15E+09	→ 256	1.86E+12
382	5.93E+11	→ 148	4.58E+11	→ 133	1.86E+11	→ 131	1.73E+11	→ 142	1.15E+11	→ 116	1.88E+12
383	1.03E+12	→ 120	5.33E+11	→ 118	1.72E+11	→ 129	6.31E+10	→ 125	5.14E+10	→ 146	2.00E+12
384	1.31E+12	→ 120	6.57E+11	→ 129	1.41E+10	→ 253	3.73E+09	→ 17	2.89E+09	→ 139	1.99E+12
385	1.83E+12	→ 7	3.44E+11	→ 104	2.95E+11	→ 102	2.28E+11	→ 96	1.70E+10	→ 110	2.77E+12
386	5.23E+11	→ 147	3.46E+11	→ 133	3.43E+11	→ 148	3.39E+11	→ 129	6.85E+10	→ 118	1.90E+12
387	9.01E+11	→ 105	2.14E+10	→ 97	9.27E+09	→ 237	5.77E+09	→ 93	2.21E+09	→ 242	9.45E+11
388	9.86E+10	→ 19	6.19E+10	→ 18	5.96E+10	→ 218	4.11E+10	→ 217	3.87E+10	→ 17	3.83E+11
389	4.47E+11	→ 147	4.37E+11	→ 129	4.21E+11	→ 146	2.89E+11	→ 125	8.81E+10	→ 133	1.91E+12
390	1.29E+12	→ 7	6.45E+11	→ 6	2.70E+11	→ 104	1.97E+11	→ 96	1.75E+11	→ 102	2.88E+12
391	1.21E+12	→ 6	5.49E+11	→ 7	2.85E+11	→ 106	1.44E+11	→ 107	1.24E+11	→ 104	2.69E+12
392	8.59E+11	→ 6	3.79E+11	→ 106	2.77E+11	→ 105	1.64E+11	→ 98	4.94E+10	→ 107	1.79E+12
393	2.54E+11	→ 1	9.17E+10	→ 23	6.83E+10	→ 220	6.02E+10	→ 22	4.56E+10	→ 219	7.14E+11
394	4.66E+11	→ 102	1.99E+11	→ 7	1.53E+11	→ 104	1.10E+11	→ 107	9.34E+10	→ 6	1.23E+12
395	5.94E+11	→ 107	4.83E+11	→ 6	2.06E+11	→ 98	3.05E+10	→ 94	2.61E+10	→ 237	1.42E+12
396	5.81E+11	→ 8	4.31E+11	→ 103	2.75E+11	→ 7	2.56E+11	→ 102	8.52E+10	→ 104	1.79E+12
397	8.68E+11	→ 8	3.24E+11	→ 7	1.58E+11	→ 121	1.25E+11	→ 132	6.87E+10	→ 143	1.84E+12
398	6.03E+11	→ 7	1.27E+11	→ 124	7.79E+10	→ 130	6.39E+10	→ 128	5.80E+10	→ 140	1.20E+12
399	7.69E+11	→ 6	5.98E+11	→ 110	2.20E+11	→ 7	1.67E+11	→ 111	2.71E+10	→ 104	1.88E+12
400	3.81E+12	→ 6	4.49E+11	→ 111	7.48E+10	→ 141	5.83E+10	→ 127	5.02E+10	→ 134	4.63E+12
401	2.96E+12	→ 8	9.37E+11	→ 7	3.71E+11	→ 108	2.55E+11	→ 110	4.24E+10	→ 103	4.79E+12
402	5.74E+11	→ 6	2.78E+11	→ 111	1.46E+11	→ 127	6.26E+10	→ 134	2.56E+10	→ 226	1.20E+12
403	2.11E+11	→ 11	7.71E+10	→ 211	4.48E+10	→ 8	1.90E+10	→ 236	1.85E+10	→ 44	4.57E+11
404	1.73E+11	→ 11	6.31E+10	→ 211	5.70E+10	→ 7	5.50E+10	→ 6	2.39E+10	→ 107	5.55E+11
405	1.92E+11	→ 6	1.80E+11	→ 11	7.07E+10	→ 107	6.94E+10	→ 211	4.66E+10	→ 111	6.34E+11
406	2.95E+12	→ 7	4.85E+11	→ 112	5.96E+10	→ 12	3.86E+10	→ 242	2.49E+10	→ 110	3.72E+12
407	5.83E+11	→ 125	4.17E+11	→ 129	3.16E+11	→ 146	3.14E+11	→ 147	1.42E+11	→ 120	2.01E+12
408	1.31E+12	→ 138	5.12E+11	→ 126	8.42E+10	→ 115	6.69E+09	→ 254	9.88E+08	→ 172	1.92E+12
409	8.18E+11	→ 131	7.10E+11	→ 152	1.62E+11	→ 142	7.99E+10	→ 138	3.20E+10	→ 126	1.87E+12
410	3.55E+11	→ 9	2.28E+11	→ 7	1.23E+11	→ 135	1.15E+11	→ 128	5.18E+10	→ 134	1.14E+12
411	4.79E+11	→ 129	3.90E+11	→ 133	2.64E+11	→ 148	2.49E+11	→ 147	2.05E+11	→ 150	1.98E+12
412	3.09E+11	→ 8	1.98E+11	→ 12	7.09E+10	→ 213	6.04E+10	→ 6	2.87E+10	→ 50	8.25E+11
413	7.77E+11	→ 133	3.71E+11	→ 148	2.81E+11	→ 145	2.57E+11	→ 131	5.57E+10	→ 118	1.92E+12

Table 5. continued.

Index	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})
414	8.33E+11	→ 150	4.11E+11	→ 139	1.34E+11	→ 149	9.45E+10	→ 147	8.43E+10	→ 137	1.87E+12
415	1.24E+12	→ 145	2.55E+11	→ 152	1.41E+11	→ 131	1.25E+11	→ 138	5.29E+10	→ 126	1.87E+12
416	6.96E+11	→ 149	5.30E+11	→ 137	2.06E+11	→ 154	1.10E+11	→ 148	8.26E+10	→ 145	1.86E+12
417	2.08E+11	→ 12	7.40E+10	→ 213	6.26E+10	→ 7	4.64E+10	→ 52	4.09E+10	→ 241	4.72E+11
418	1.54E+12	→ 7	2.37E+11	→ 112	1.32E+11	→ 6	1.15E+11	→ 12	4.50E+10	→ 213	2.23E+12
419	1.10E+12	→ 139	3.44E+11	→ 150	1.87E+11	→ 137	7.59E+10	→ 149	3.12E+10	→ 129	1.86E+12
420	9.35E+11	→ 137	6.40E+11	→ 149	1.12E+11	→ 142	6.57E+10	→ 152	5.38E+10	→ 118	1.87E+12
421	1.24E+12	→ 142	4.70E+11	→ 152	7.64E+10	→ 145	6.70E+10	→ 116	4.43E+10	→ 131	1.95E+12
422	1.37E+12	→ 154	1.30E+11	→ 149	1.03E+11	→ 137	6.28E+10	→ 175	5.63E+10	→ 178	1.85E+12
423	4.70E+11	→ 17	1.60E+11	→ 216	2.60E+10	→ 22	1.24E+10	→ 3	1.11E+10	→ 253	6.91E+11
424	2.67E+11	→ 18	1.76E+11	→ 17	9.15E+10	→ 217	6.58E+10	→ 1	5.93E+10	→ 216	7.59E+11
425	3.57E+11	→ 17	1.22E+11	→ 216	1.11E+11	→ 18	5.42E+10	→ 1	3.77E+10	→ 217	7.44E+11
426	3.24E+11	→ 18	1.60E+11	→ 19	1.11E+11	→ 217	5.52E+10	→ 218	1.23E+10	→ 1	7.03E+11
427	4.92E+11	→ 19	1.69E+11	→ 218	8.82E+09	→ 254	4.47E+09	→ 69	2.53E+09	→ 142	6.82E+11
428	1.28E+12	→ 3	9.17E+11	→ 1	3.18E+11	→ 22	1.19E+11	→ 219	9.90E+10	→ 23	2.88E+12
429	1.78E+12	→ 2	8.85E+11	→ 3	2.24E+11	→ 24	1.64E+11	→ 22	1.09E+11	→ 1	3.46E+12
430	3.39E+12	→ 1	3.88E+11	→ 23	1.53E+11	→ 220	7.28E+10	→ 37	4.63E+10	→ 4	4.11E+12
431	2.69E+11	→ 99	1.24E+11	→ 100	1.21E+11	→ 3	1.20E+11	→ 1	1.14E+11	→ 4	9.46E+11
432	5.06E+11	→ 4	1.34E+11	→ 3	1.28E+11	→ 99	9.10E+10	→ 100	9.05E+10	→ 1	1.31E+12
433	2.14E+11	→ 4	1.44E+11	→ 1	9.82E+10	→ 99	7.55E+10	→ 244	7.33E+10	→ 100	9.06E+11
434	3.64E+11	→ 100	1.29E+11	→ 1	1.16E+11	→ 4	6.54E+10	→ 164	4.07E+10	→ 101	8.18E+11
435	4.98E+11	→ 41	2.26E+11	→ 232	2.08E+11	→ 40	9.67E+10	→ 235	9.53E+09	→ 46	1.07E+12
436	6.10E+11	→ 40	2.81E+11	→ 235	1.16E+11	→ 46	5.42E+10	→ 237	1.78E+09	→ 242	1.07E+12
437	4.04E+11	→ 44	2.86E+11	→ 41	1.88E+11	→ 236	1.32E+11	→ 232	2.81E+10	→ 40	1.08E+12
438	7.26E+11	→ 46	3.38E+11	→ 237	1.26E+09	→ 62	8.43E+08	→ 227	1.84E+08	→ 350	1.07E+12
439	3.42E+11	→ 42	3.42E+11	→ 44	1.60E+11	→ 236	1.60E+11	→ 234	4.75E+10	→ 41	1.08E+12
440	5.03E+11	→ 50	2.85E+11	→ 239	6.40E+10	→ 53	3.85E+10	→ 242	2.92E+10	→ 71	1.02E+12
441	5.31E+11	→ 53	3.17E+11	→ 242	7.76E+10	→ 68	2.21E+10	→ 57	1.08E+10	→ 238	9.90E+11
442	4.88E+11	→ 52	2.78E+11	→ 241	9.53E+10	→ 50	5.42E+10	→ 239	1.68E+10	→ 61	1.01E+12
443	1.90E+12	→ 4	2.50E+11	→ 109	1.39E+11	→ 101	1.05E+11	→ 1	5.21E+10	→ 172	2.59E+12
444	3.01E+11	→ 256	2.53E+11	→ 251	1.46E+10	→ 254	1.14E+10	→ 126	5.81E+09	→ 259	5.90E+11
445	5.76E+11	→ 254	1.33E+10	→ 122	5.31E+08	→ 46	6.15E+07	→ 237	2.17E+07	→ 306	5.89E+11
446	5.18E+11	→ 4	2.46E+11	→ 1	1.95E+11	→ 100	5.50E+10	→ 109	4.01E+10	→ 99	1.36E+12
447	3.59E+11	→ 250	1.34E+11	→ 255	6.37E+10	→ 251	2.27E+10	→ 131	1.14E+10	→ 249	6.21E+11
448	2.68E+11	→ 251	2.65E+11	→ 256	4.61E+10	→ 254	3.14E+10	→ 138	6.26E+09	→ 126	6.20E+11
449	3.96E+11	→ 252	1.09E+11	→ 250	6.90E+10	→ 257	3.65E+10	→ 137	8.93E+09	→ 133	6.54E+11
450	3.94E+11	→ 255	1.10E+11	→ 250	3.91E+10	→ 251	3.52E+10	→ 256	2.10E+10	→ 145	6.52E+11
451	4.48E+11	→ 253	1.24E+11	→ 252	7.24E+10	→ 139	1.31E+10	→ 137	8.28E+09	→ 250	6.79E+11
452	4.55E+11	→ 257	5.52E+10	→ 149	5.52E+10	→ 255	4.83E+10	→ 252	1.57E+10	→ 250	6.96E+11
453	4.08E+11	→ 101	6.60E+10	→ 165	3.20E+10	→ 259	1.73E+10	→ 172	9.01E+09	→ 176	5.57E+11
454	3.44E+11	→ 4	2.21E+11	→ 101	3.56E+10	→ 100	2.99E+10	→ 264	1.98E+10	→ 3	8.95E+11
455	9.08E+11	→ 4	1.47E+11	→ 109	1.26E+11	→ 101	9.44E+10	→ 1	4.96E+10	→ 176	1.56E+12
456	3.52E+11	→ 99	2.65E+11	→ 3	7.59E+10	→ 179	4.01E+10	→ 247	1.47E+10	→ 173	7.96E+11
457	2.19E+12	→ 4	2.35E+11	→ 109	1.25E+11	→ 1	7.60E+10	→ 101	4.05E+10	→ 267	2.89E+12
458	1.98E+11	→ 99	3.55E+10	→ 29	3.17E+10	→ 248	2.29E+10	→ 175	1.87E+10	→ 166	4.51E+11

Table 5. continued.

Index	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})
459	6.77E+11	→ 4	9.54E+10	→ 100	7.70E+10	→ 109	6.08E+10	→ 101	2.22E+10	→ 99	1.15E+12
460	2.36E+12	→ 4	2.68E+11	→ 109	8.19E+10	→ 100	4.91E+10	→ 180	3.24E+10	→ 1	2.94E+12
461	2.08E+11	→ 6	1.62E+11	→ 155	1.05E+11	→ 7	8.63E+10	→ 153	8.24E+10	→ 223	1.05E+12
462	8.22E+10	→ 3	6.62E+10	→ 33	4.58E+10	→ 39	3.73E+10	→ 258	3.35E+10	→ 109	4.84E+11
463	1.34E+11	→ 4	1.07E+11	→ 1	7.91E+10	→ 101	7.10E+10	→ 34	4.67E+10	→ 259	6.38E+11
464	1.18E+11	→ 7	9.96E+10	→ 6	9.84E+10	→ 14	7.32E+10	→ 13	5.15E+10	→ 155	6.89E+11
465	1.92E+11	→ 14	6.82E+10	→ 222	3.84E+10	→ 13	3.83E+10	→ 271	3.12E+10	→ 59	4.51E+11
466	2.17E+11	→ 13	7.81E+10	→ 223	4.60E+10	→ 272	2.78E+10	→ 60	1.22E+10	→ 6	4.50E+11
467	4.09E+11	→ 9	3.27E+11	→ 156	1.15E+11	→ 7	9.18E+10	→ 222	4.83E+10	→ 14	1.11E+12
468	1.83E+11	→ 13	1.01E+11	→ 7	6.29E+10	→ 223	3.47E+10	→ 14	2.43E+10	→ 275	5.53E+11
469	1.14E+11	→ 14	8.60E+10	→ 8	5.64E+10	→ 13	3.95E+10	→ 6	3.27E+10	→ 7	5.67E+11
470	2.68E+11	→ 9	1.54E+11	→ 14	8.16E+10	→ 156	2.49E+10	→ 277	2.29E+10	→ 222	6.72E+11
471	1.33E+11	→ 15	9.63E+10	→ 16	4.31E+10	→ 226	3.91E+10	→ 6	3.54E+10	→ 228	5.01E+11
472	2.63E+11	→ 9	1.49E+11	→ 228	1.30E+11	→ 16	9.63E+10	→ 7	5.64E+10	→ 158	1.00E+12
473	2.35E+11	→ 6	1.54E+11	→ 15	1.40E+11	→ 226	5.48E+10	→ 159	3.38E+10	→ 7	8.37E+11
474	2.25E+11	→ 15	7.58E+10	→ 226	4.41E+10	→ 280	3.12E+10	→ 63	1.89E+10	→ 134	4.49E+11
475	1.26E+11	→ 16	8.96E+10	→ 15	5.70E+10	→ 6	4.43E+10	→ 228	2.75E+10	→ 226	5.08E+11
476	8.02E+11	→ 121	4.81E+10	→ 130	3.62E+10	→ 124	1.40E+10	→ 271	8.53E+09	→ 6	9.51E+11
477	6.35E+11	→ 124	2.55E+11	→ 128	1.61E+10	→ 272	1.55E+10	→ 127	7.95E+09	→ 134	9.54E+11
478	1.71E+11	→ 16	1.14E+11	→ 7	6.81E+10	→ 228	4.26E+10	→ 9	3.04E+10	→ 159	6.53E+11
479	3.01E+11	→ 132	2.53E+11	→ 121	2.20E+11	→ 123	2.20E+11	→ 7	3.14E+10	→ 6	1.14E+12
480	9.34E+11	→ 127	1.85E+10	→ 280	4.03E+09	→ 323	2.05E+09	→ 63	9.38E+08	→ 453	9.64E+11
481	4.91E+12	→ 7	6.99E+11	→ 9	5.17E+11	→ 123	2.45E+11	→ 140	4.74E+10	→ 156	6.59E+12
482	2.59E+12	→ 7	1.08E+12	→ 9	2.84E+11	→ 123	2.73E+11	→ 6	1.03E+11	→ 140	4.83E+12
483	1.65E+11	→ 7	1.28E+11	→ 159	5.74E+10	→ 157	5.40E+10	→ 9	5.37E+10	→ 15	7.12E+11
484	4.03E+11	→ 1	3.62E+11	→ 3	2.12E+11	→ 27	1.62E+11	→ 28	7.77E+10	→ 240	1.50E+12
485	5.10E+11	→ 6	4.76E+11	→ 130	1.84E+11	→ 124	9.87E+10	→ 141	5.53E+10	→ 128	1.41E+12
486	2.50E+12	→ 8	1.96E+11	→ 9	1.72E+11	→ 123	1.50E+11	→ 143	9.37E+10	→ 132	3.54E+12
487	3.46E+11	→ 29	1.46E+11	→ 28	1.32E+11	→ 4	1.16E+11	→ 243	5.13E+10	→ 245	8.17E+11
488	4.01E+11	→ 2	2.98E+11	→ 27	2.52E+11	→ 1	1.29E+11	→ 4	9.96E+10	→ 240	1.53E+12
489	2.76E+11	→ 30	2.19E+11	→ 32	1.68E+11	→ 244	1.03E+10	→ 296	1.44E+09	→ 48	6.81E+11
490	5.84E+11	→ 3	3.37E+11	→ 27	1.26E+11	→ 240	6.55E+10	→ 36	6.29E+10	→ 31	1.29E+12
491	3.10E+12	→ 7	4.27E+11	→ 6	2.84E+11	→ 130	1.89E+11	→ 140	1.21E+11	→ 132	4.54E+12
492	2.28E+12	→ 8	1.68E+12	→ 7	4.45E+11	→ 9	2.56E+11	→ 6	2.13E+11	→ 143	5.49E+12
493	1.26E+12	→ 1	2.57E+11	→ 4	1.69E+11	→ 28	1.17E+11	→ 30	7.68E+10	→ 29	2.20E+12
494	5.29E+11	→ 128	1.79E+11	→ 124	1.64E+11	→ 127	1.77E+10	→ 134	1.07E+10	→ 281	9.29E+11
495	1.77E+12	→ 3	5.82E+11	→ 1	3.19E+11	→ 4	1.39E+11	→ 29	1.38E+11	→ 36	3.35E+12
496	6.07E+12	→ 6	3.56E+11	→ 141	2.95E+11	→ 8	2.33E+11	→ 130	1.28E+11	→ 135	7.45E+12
497	1.45E+12	→ 3	8.07E+11	→ 2	1.92E+11	→ 4	1.45E+11	→ 35	1.21E+11	→ 1	3.37E+12
498	4.78E+12	→ 6	2.45E+11	→ 141	2.17E+11	→ 134	1.35E+11	→ 135	1.13E+11	→ 130	5.79E+12
499	2.61E+12	→ 6	4.05E+11	→ 134	1.40E+11	→ 141	7.13E+10	→ 124	6.90E+10	→ 127	3.52E+12
500	6.29E+11	→ 134	1.40E+11	→ 127	8.72E+10	→ 128	2.53E+10	→ 124	7.58E+09	→ 281	9.18E+11
501	6.95E+11	→ 3	2.05E+11	→ 113	8.65E+10	→ 43	7.48E+10	→ 278	5.14E+10	→ 185	1.27E+12
502	5.70E+11	→ 163	2.66E+11	→ 291	1.49E+10	→ 164	1.41E+10	→ 182	8.45E+09	→ 293	9.02E+11
503	3.80E+11	→ 164	2.84E+11	→ 293	1.42E+11	→ 172	5.21E+10	→ 176	7.28E+09	→ 296	8.72E+11
504	3.17E+11	→ 166	2.76E+11	→ 294	5.54E+10	→ 163	3.72E+10	→ 291	1.60E+10	→ 182	7.75E+11

Table 5. continued.

Index	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)
505	4.48E+11	→ 135	1.50E+11	→ 128	8.64E+10	→ 141	6.46E+10	→ 134	4.91E+10	→ 124	9.45E+11
506	2.94E+11	→ 297	2.40E+11	→ 170	8.95E+10	→ 182	3.64E+10	→ 164	3.58E+10	→ 293	7.59E+11
507	4.42E+11	→ 1	1.54E+11	→ 113	7.69E+10	→ 284	4.85E+10	→ 4	4.76E+10	→ 45	1.09E+12
508	3.36E+12	→ 9	6.76E+11	→ 7	2.30E+11	→ 6	2.27E+11	→ 140	2.00E+11	→ 132	5.27E+12
509	2.77E+11	→ 299	8.88E+10	→ 173	8.17E+10	→ 166	7.75E+10	→ 179	5.54E+10	→ 294	7.51E+11
510	3.11E+11	→ 300	1.68E+11	→ 175	5.50E+10	→ 170	5.39E+10	→ 297	3.20E+10	→ 178	7.43E+11
511	1.53E+12	→ 9	3.18E+11	→ 135	2.45E+11	→ 7	1.83E+11	→ 6	1.08E+11	→ 132	2.86E+12
512	3.88E+11	→ 56	2.44E+11	→ 270	6.38E+10	→ 50	5.24E+10	→ 59	4.42E+10	→ 71	1.10E+12
513	3.83E+11	→ 61	1.98E+11	→ 273	1.71E+11	→ 9	1.49E+11	→ 56	1.13E+11	→ 6	1.42E+12
514	6.33E+11	→ 59	2.89E+11	→ 271	3.62E+10	→ 275	3.31E+10	→ 68	9.66E+09	→ 57	1.02E+12
515	2.97E+11	→ 57	2.06E+11	→ 275	9.42E+10	→ 60	8.68E+10	→ 76	7.37E+10	→ 53	1.06E+12
516	5.79E+11	→ 60	3.30E+11	→ 272	1.04E+11	→ 62	4.55E+09	→ 64	1.50E+09	→ 279	1.02E+12
517	6.72E+12	→ 9	1.10E+12	→ 7	4.00E+11	→ 140	1.86E+11	→ 132	1.52E+11	→ 123	8.76E+12
518	1.85E+11	→ 34	1.72E+11	→ 32	1.21E+11	→ 30	8.91E+10	→ 249	5.96E+10	→ 259	6.80E+11
519	4.18E+11	→ 65	2.49E+11	→ 276	1.84E+11	→ 6	6.99E+10	→ 57	4.84E+10	→ 275	1.26E+12
520	2.48E+11	→ 58	2.36E+11	→ 61	2.24E+11	→ 8	1.46E+11	→ 274	8.88E+10	→ 273	1.35E+12
521	4.45E+11	→ 33	1.37E+11	→ 258	2.86E+10	→ 249	2.38E+10	→ 30	2.09E+10	→ 32	6.83E+11
522	4.95E+11	→ 34	1.68E+11	→ 259	9.52E+09	→ 304	1.68E+09	→ 256	1.24E+09	→ 306	6.79E+11
523	2.93E+11	→ 67	2.46E+11	→ 277	1.73E+11	→ 72	1.40E+11	→ 65	1.39E+11	→ 7	1.35E+12
524	5.41E+11	→ 295	9.94E+09	→ 296	1.21E+09	→ 305	1.16E+09	→ 176	9.76E+08	→ 172	5.58E+11
525	5.52E+11	→ 296	3.49E+09	→ 165	1.23E+09	→ 306	4.65E+08	→ 60	1.30E+08	→ 122	5.58E+11
526	1.35E+12	→ 1	1.69E+11	→ 32	1.08E+11	→ 37	1.04E+11	→ 30	7.73E+10	→ 249	2.04E+12
527	1.08E+12	→ 3	1.97E+11	→ 31	1.54E+11	→ 36	1.39E+11	→ 262	5.95E+10	→ 38	1.77E+12
528	8.64E+11	→ 5	3.97E+11	→ 2	2.72E+11	→ 3	2.20E+11	→ 4	1.74E+11	→ 114	2.50E+12
529	2.53E+12	→ 1	2.13E+11	→ 37	1.06E+11	→ 264	8.21E+10	→ 32	5.95E+10	→ 30	3.28E+12
530	7.74E+11	→ 3	5.51E+11	→ 1	3.82E+11	→ 4	1.47E+11	→ 31	8.84E+10	→ 36	2.48E+12
531	5.63E+11	→ 4	2.19E+11	→ 113	1.38E+11	→ 169	8.70E+10	→ 179	5.72E+10	→ 187	1.44E+12
532	2.46E+12	→ 1	6.91E+11	→ 4	2.48E+11	→ 37	1.68E+11	→ 3	1.16E+11	→ 5	4.22E+12
533	7.56E+11	→ 174	6.68E+11	→ 169	1.25E+11	→ 173	5.28E+10	→ 146	5.07E+10	→ 5	2.09E+12
534	4.89E+11	→ 169	4.72E+11	→ 179	2.49E+11	→ 175	1.17E+11	→ 113	9.75E+10	→ 178	1.78E+12
535	2.44E+12	→ 4	4.98E+11	→ 3	1.54E+11	→ 39	7.57E+10	→ 31	7.26E+10	→ 267	3.70E+12
536	1.56E+11	→ 113	6.17E+10	→ 38	6.05E+10	→ 283	5.30E+10	→ 43	4.18E+10	→ 185	4.87E+11
537	3.29E+12	→ 4	2.26E+11	→ 39	1.49E+11	→ 33	1.02E+11	→ 267	7.16E+10	→ 55	4.04E+12
538	6.51E+11	→ 164	3.21E+11	→ 172	2.06E+11	→ 176	9.86E+10	→ 305	5.90E+10	→ 165	1.37E+12
539	1.27E+12	→ 165	1.15E+11	→ 306	3.50E+09	→ 303	2.53E+09	→ 337	3.50E+08	→ 296	1.39E+12
540	6.52E+11	→ 163	1.18E+11	→ 182	1.14E+11	→ 164	1.08E+11	→ 170	9.41E+10	→ 291	1.30E+12
541	7.86E+11	→ 176	1.18E+11	→ 310	1.12E+11	→ 164	1.02E+11	→ 165	5.43E+10	→ 293	1.22E+12
542	5.33E+11	→ 5	1.50E+11	→ 2	1.45E+11	→ 114	8.66E+10	→ 113	3.96E+10	→ 189	1.28E+12
543	2.18E+11	→ 181	1.33E+11	→ 170	1.20E+11	→ 177	9.55E+10	→ 166	8.41E+10	→ 309	1.12E+12
544	4.42E+11	→ 177	1.41E+11	→ 176	1.22E+11	→ 172	1.17E+11	→ 313	7.08E+10	→ 163	1.12E+12
545	4.51E+11	→ 178	2.97E+11	→ 177	8.36E+10	→ 315	6.94E+10	→ 175	6.44E+10	→ 154	1.33E+12
546	1.89E+11	→ 178	1.70E+11	→ 181	1.18E+11	→ 180	9.87E+10	→ 175	8.61E+10	→ 177	1.22E+12
547	3.54E+11	→ 179	2.76E+11	→ 166	2.26E+11	→ 169	1.67E+11	→ 173	1.60E+11	→ 178	1.69E+12
548	3.33E+11	→ 173	1.83E+11	→ 179	1.76E+11	→ 178	1.39E+11	→ 180	7.20E+10	→ 175	1.43E+12
549	1.04E+12	→ 173	4.61E+11	→ 179	3.05E+11	→ 169	9.05E+10	→ 180	7.53E+10	→ 147	2.07E+12
550	5.12E+11	→ 163	3.14E+11	→ 182	1.74E+11	→ 170	1.36E+11	→ 291	4.54E+10	→ 295	1.38E+12

Table 5. continued.

Index	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)
551	6.81E+11	→ 172	5.10E+11	→ 164	1.76E+11	→ 293	5.92E+10	→ 296	3.37E+10	→ 165	1.52E+12
552	3.05E+11	→ 173	2.25E+11	→ 180	1.87E+11	→ 181	1.23E+11	→ 178	8.79E+10	→ 166	1.40E+12
553	7.52E+11	→ 175	1.75E+11	→ 181	1.67E+11	→ 170	1.32E+11	→ 300	1.31E+11	→ 182	1.65E+12
554	5.58E+11	→ 183	3.50E+11	→ 173	3.38E+11	→ 180	1.88E+11	→ 178	1.42E+11	→ 169	1.94E+12
555	9.88E+11	→ 166	1.87E+11	→ 294	1.67E+11	→ 163	1.05E+11	→ 182	8.47E+10	→ 181	1.76E+12
556	7.93E+11	→ 170	3.74E+11	→ 182	1.97E+11	→ 297	1.21E+11	→ 164	9.75E+10	→ 172	1.76E+12
557	6.27E+11	→ 64	2.75E+11	→ 281	4.57E+10	→ 279	2.24E+10	→ 63	1.85E+10	→ 62	1.02E+12
558	6.85E+11	→ 63	3.32E+11	→ 280	6.69E+07	→ 259	5.96E+07	→ 522	5.14E+07	→ 34	1.02E+12
559	2.21E+11	→ 70	1.41E+11	→ 74	1.30E+11	→ 285	9.88E+10	→ 72	9.20E+10	→ 58	1.13E+12
560	1.95E+11	→ 57	1.35E+11	→ 282	1.19E+11	→ 62	1.17E+11	→ 68	1.17E+11	→ 76	1.06E+12
561	5.43E+11	→ 74	2.43E+11	→ 290	1.17E+11	→ 72	7.43E+10	→ 9	4.62E+10	→ 287	1.13E+12
562	4.61E+11	→ 62	2.21E+11	→ 279	1.26E+11	→ 63	6.63E+10	→ 280	6.43E+10	→ 60	1.07E+12
563	2.69E+11	→ 74	1.51E+11	→ 71	1.37E+11	→ 72	1.21E+11	→ 290	8.33E+10	→ 287	1.17E+12
564	2.64E+11	→ 71	1.79E+11	→ 286	1.23E+11	→ 74	9.55E+10	→ 73	7.43E+10	→ 68	1.15E+12
565	2.26E+11	→ 71	1.45E+11	→ 68	1.41E+11	→ 286	1.38E+11	→ 57	1.30E+11	→ 282	1.10E+12
566	1.71E+11	→ 72	1.47E+11	→ 287	1.26E+11	→ 67	1.17E+11	→ 73	1.12E+11	→ 292	1.14E+12
567	2.53E+11	→ 73	2.04E+11	→ 292	1.16E+11	→ 76	8.87E+10	→ 68	7.86E+10	→ 298	1.07E+12
568	2.42E+11	→ 76	1.88E+11	→ 298	1.72E+11	→ 68	1.00E+11	→ 62	6.01E+10	→ 282	1.04E+12
569	5.32E+11	→ 303	1.55E+10	→ 306	7.40E+09	→ 304	5.23E+08	→ 64	5.39E+07	→ 281	5.56E+11
570	5.55E+11	→ 304	5.52E+08	→ 63	6.10E+07	→ 280	3.40E+05	→ 34	8.51E+04	→ 558	5.55E+11
571	2.85E+11	→ 180	2.13E+11	→ 183	1.61E+11	→ 314	8.19E+10	→ 173	8.09E+10	→ 179	1.29E+12
572	3.21E+11	→ 178	2.45E+11	→ 316	1.22E+11	→ 173	9.76E+10	→ 177	7.07E+10	→ 175	1.25E+12
573	4.11E+11	→ 177	3.24E+11	→ 178	1.25E+11	→ 315	9.65E+10	→ 175	7.55E+10	→ 311	1.41E+12
574	4.06E+11	→ 180	3.29E+11	→ 181	1.70E+11	→ 312	7.34E+10	→ 309	5.44E+10	→ 175	1.43E+12
575	2.57E+11	→ 305	2.36E+11	→ 176	2.12E+11	→ 164	2.02E+11	→ 172	1.06E+11	→ 310	1.14E+12
576	6.52E+11	→ 165	3.77E+11	→ 306	9.14E+10	→ 304	4.56E+09	→ 303	2.47E+09	→ 296	1.13E+12
577	5.41E+11	→ 177	2.01E+11	→ 172	1.39E+11	→ 176	1.25E+11	→ 313	1.07E+11	→ 308	1.44E+12
578	5.41E+11	→ 181	2.20E+11	→ 182	1.44E+11	→ 309	1.06E+11	→ 170	9.70E+10	→ 308	1.46E+12
579	2.91E+11	→ 1	2.65E+11	→ 4	2.64E+11	→ 117	4.58E+10	→ 249	3.57E+10	→ 302	1.18E+12
580	5.86E+11	→ 182	1.76E+11	→ 170	1.38E+11	→ 313	1.35E+11	→ 308	1.02E+11	→ 176	1.42E+12
581	4.97E+11	→ 176	3.15E+11	→ 172	2.19E+11	→ 310	1.82E+11	→ 165	1.02E+11	→ 306	1.40E+12
582	1.09E+11	→ 21	1.08E+11	→ 9	7.81E+10	→ 168	5.67E+10	→ 261	4.47E+10	→ 20	6.86E+11
583	1.52E+11	→ 168	1.22E+11	→ 9	7.93E+10	→ 20	6.91E+10	→ 184	5.80E+10	→ 268	7.26E+11
584	2.32E+11	→ 171	8.97E+10	→ 21	6.92E+10	→ 261	5.60E+10	→ 162	5.33E+10	→ 269	6.10E+11
585	3.05E+11	→ 5	1.20E+11	→ 117	1.07E+11	→ 1	5.03E+10	→ 54	3.71E+10	→ 311	9.67E+11
586	4.60E+11	→ 3	2.70E+11	→ 119	6.14E+10	→ 191	3.66E+10	→ 302	3.51E+10	→ 4	1.10E+12
587	2.24E+11	→ 21	7.50E+10	→ 261	4.88E+10	→ 321	3.27E+10	→ 78	3.05E+10	→ 9	4.75E+11
588	1.01E+11	→ 20	9.41E+10	→ 21	3.87E+10	→ 320	3.02E+10	→ 8	2.69E+10	→ 260	4.71E+11
589	5.87E+11	→ 1	3.86E+11	→ 117	3.05E+11	→ 4	7.95E+10	→ 192	7.77E+10	→ 259	1.54E+12
590	2.46E+11	→ 4	2.43E+11	→ 117	1.75E+11	→ 1	1.13E+11	→ 5	3.42E+10	→ 264	1.09E+12
591	1.66E+11	→ 171	1.33E+11	→ 21	3.36E+10	→ 162	2.96E+10	→ 7	2.83E+10	→ 322	4.90E+11
592	1.17E+11	→ 119	1.08E+11	→ 117	1.04E+11	→ 1	3.89E+10	→ 48	3.66E+10	→ 258	6.38E+11
593	3.73E+11	→ 119	2.22E+11	→ 3	8.58E+10	→ 195	4.47E+10	→ 247	3.87E+10	→ 262	8.59E+11
594	4.27E+11	→ 3	3.34E+11	→ 119	7.51E+10	→ 196	6.94E+10	→ 267	4.61E+10	→ 4	1.15E+12
595	3.70E+11	→ 38	1.85E+11	→ 4	1.34E+11	→ 278	5.56E+10	→ 45	3.61E+10	→ 31	8.88E+11

Table 5. continued.

Index	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)
596	3.37E+11	→ 6	2.08E+11	→ 155	1.72E+11	→ 25	5.40E+10	→ 268	3.91E+10	→ 323	9.14E+11
597	2.61E+11	→ 7	1.82E+11	→ 153	1.16E+11	→ 26	7.98E+10	→ 6	6.23E+10	→ 155	9.45E+11
598	1.73E+11	→ 151	1.24E+11	→ 153	1.17E+11	→ 7	1.05E+11	→ 8	8.94E+10	→ 25	9.08E+11
599	1.01E+12	→ 3	3.86E+11	→ 43	1.44E+11	→ 283	1.42E+11	→ 4	3.96E+10	→ 45	1.83E+12
600	8.46E+11	→ 4	4.00E+11	→ 45	1.60E+11	→ 284	7.96E+10	→ 1	4.28E+10	→ 39	1.60E+12
601	1.45E+11	→ 7	1.35E+11	→ 151	1.22E+11	→ 25	8.07E+10	→ 8	8.05E+10	→ 153	8.40E+11
602	9.15E+11	→ 6	4.92E+11	→ 155	1.10E+11	→ 157	5.37E+10	→ 25	3.48E+10	→ 80	1.72E+12
603	6.94E+11	→ 7	4.00E+11	→ 153	1.54E+11	→ 6	1.20E+11	→ 9	1.19E+11	→ 155	1.76E+12
604	1.64E+11	→ 151	1.35E+11	→ 26	1.17E+11	→ 9	1.13E+11	→ 153	9.78E+10	→ 7	9.23E+11
605	2.24E+12	→ 2	2.29E+11	→ 49	2.20E+11	→ 5	1.88E+11	→ 3	1.10E+11	→ 38	3.38E+12
606	1.53E+11	→ 25	5.51E+10	→ 26	5.27E+10	→ 268	3.25E+10	→ 331	2.92E+10	→ 87	4.45E+11
607	7.82E+11	→ 156	5.55E+11	→ 9	1.31E+11	→ 7	4.05E+10	→ 6	2.10E+10	→ 155	1.70E+12
608	3.49E+11	→ 329	1.95E+11	→ 189	9.43E+10	→ 186	1.61E+10	→ 330	1.60E+10	→ 187	7.14E+11
609	3.63E+11	→ 330	3.26E+11	→ 187	6.62E+09	→ 328	3.73E+09	→ 293	3.16E+09	→ 296	7.21E+11
610	2.06E+11	→ 26	6.19E+10	→ 269	5.17E+10	→ 92	3.91E+10	→ 334	1.05E+10	→ 9	3.89E+11
611	4.47E+11	→ 77	2.84E+11	→ 318	1.34E+11	→ 73	2.57E+10	→ 78	2.31E+10	→ 56	1.03E+12
612	5.27E+11	→ 78	2.98E+11	→ 321	6.98E+10	→ 89	5.16E+10	→ 76	2.38E+10	→ 159	1.02E+12
613	5.17E+11	→ 327	3.00E+10	→ 191	1.47E+10	→ 328	3.67E+09	→ 163	2.88E+09	→ 330	5.75E+11
614	3.63E+11	→ 81	2.68E+11	→ 322	9.55E+10	→ 7	8.10E+10	→ 9	6.57E+10	→ 86	1.27E+12
615	5.34E+11	→ 328	2.92E+10	→ 192	2.83E+09	→ 172	2.72E+09	→ 164	1.66E+09	→ 293	5.74E+11
616	4.02E+11	→ 80	3.14E+11	→ 320	1.18E+11	→ 6	1.03E+11	→ 77	7.67E+10	→ 155	1.23E+12
617	1.07E+12	→ 3	3.40E+11	→ 136	9.93E+10	→ 199	8.32E+10	→ 301	7.26E+10	→ 307	1.82E+12
618	2.27E+12	→ 5	3.57E+11	→ 144	2.41E+11	→ 2	8.80E+10	→ 198	3.98E+10	→ 10	3.21E+12
619	5.37E+11	→ 3	3.03E+11	→ 136	7.40E+10	→ 197	6.83E+10	→ 317	5.68E+10	→ 302	1.29E+12
620	7.26E+11	→ 6	2.89E+11	→ 159	2.86E+11	→ 157	2.07E+11	→ 158	7.04E+10	→ 279	1.82E+12
621	1.56E+12	→ 3	1.27E+11	→ 5	1.27E+11	→ 47	1.14E+11	→ 301	9.63E+10	→ 136	2.57E+12
622	4.92E+11	→ 48	1.68E+11	→ 302	1.00E+10	→ 337	4.00E+09	→ 30	3.82E+09	→ 33	6.86E+11
623	9.31E+11	→ 7	6.69E+11	→ 6	3.42E+11	→ 157	2.79E+11	→ 160	8.20E+10	→ 9	2.76E+12
624	1.36E+12	→ 185	2.56E+11	→ 186	1.05E+11	→ 193	4.62E+10	→ 195	4.21E+10	→ 180	1.98E+12
625	1.30E+12	→ 3	1.72E+11	→ 51	1.39E+11	→ 47	7.43E+10	→ 301	6.62E+10	→ 36	1.91E+12
626	5.82E+11	→ 158	2.29E+11	→ 157	8.15E+10	→ 281	3.34E+10	→ 155	3.08E+10	→ 318	1.09E+12
627	8.73E+11	→ 159	8.57E+10	→ 280	3.39E+10	→ 321	1.77E+10	→ 87	1.37E+10	→ 279	1.09E+12
628	1.91E+11	→ 47	1.24E+11	→ 54	7.61E+10	→ 1	7.00E+10	→ 136	6.34E+10	→ 51	7.50E+11
629	9.98E+11	→ 186	2.30E+11	→ 189	1.76E+11	→ 190	1.43E+11	→ 4	1.41E+11	→ 187	1.98E+12
630	1.42E+12	→ 4	1.86E+11	→ 54	1.52E+11	→ 55	1.15E+11	→ 189	7.25E+10	→ 311	2.30E+12
631	5.84E+11	→ 4	2.57E+11	→ 1	1.88E+11	→ 54	1.60E+11	→ 48	1.01E+11	→ 55	1.52E+12
632	1.76E+12	→ 7	5.26E+11	→ 160	2.80E+11	→ 9	2.64E+11	→ 6	1.53E+11	→ 8	3.52E+12
633	2.66E+11	→ 136	1.73E+11	→ 4	1.15E+11	→ 3	5.22E+10	→ 51	4.08E+10	→ 200	8.90E+11
634	9.27E+11	→ 4	6.28E+11	→ 3	1.90E+11	→ 51	1.34E+11	→ 55	9.05E+10	→ 1	2.31E+12
635	1.52E+12	→ 187	1.91E+11	→ 330	2.83E+10	→ 328	2.00E+10	→ 296	1.05E+10	→ 188	1.83E+12
636	1.08E+12	→ 189	2.93E+11	→ 186	1.65E+11	→ 329	4.51E+10	→ 4	4.09E+10	→ 187	1.84E+12
637	2.02E+12	→ 7	6.87E+11	→ 160	6.90E+10	→ 153	6.13E+10	→ 290	5.13E+10	→ 287	3.13E+12
638	3.81E+12	→ 5	2.40E+11	→ 66	1.49E+11	→ 3	1.30E+11	→ 2	1.27E+11	→ 51	4.86E+12
639	2.46E+12	→ 9	9.69E+11	→ 8	3.54E+11	→ 161	2.27E+11	→ 162	5.51E+10	→ 6	4.54E+12
640	4.46E+12	→ 9	3.55E+11	→ 162	1.48E+11	→ 7	1.42E+11	→ 158	1.11E+11	→ 184	5.64E+12

Table 5. continued.

Index	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})
641	3.40E+11	→ 335	7.43E+10	→ 185	5.90E+10	→ 338	4.29E+10	→ 193	3.13E+10	→ 340	6.72E+11
642	9.20E+11	→ 9	2.78E+11	→ 84	2.27E+11	→ 86	1.37E+11	→ 324	1.34E+11	→ 326	2.21E+12
643	2.32E+11	→ 86	1.68E+11	→ 85	1.55E+11	→ 326	1.01E+11	→ 81	7.54E+10	→ 92	1.09E+12
644	3.54E+11	→ 338	5.86E+10	→ 339	4.21E+10	→ 186	3.91E+10	→ 190	3.69E+10	→ 200	6.69E+11
645	6.87E+11	→ 83	3.35E+11	→ 323	1.43E+10	→ 62	8.45E+09	→ 60	1.33E+09	→ 64	1.05E+12
646	4.40E+11	→ 89	3.09E+11	→ 332	1.22E+11	→ 78	3.61E+10	→ 87	3.44E+10	→ 76	1.02E+12
647	3.61E+11	→ 340	1.18E+11	→ 196	4.19E+10	→ 341	3.15E+10	→ 186	2.66E+10	→ 190	6.95E+11
648	3.71E+11	→ 339	1.54E+11	→ 188	5.05E+10	→ 342	4.39E+10	→ 197	3.00E+10	→ 192	7.04E+11
649	4.57E+11	→ 85	2.22E+11	→ 325	1.51E+11	→ 87	7.08E+10	→ 331	2.75E+10	→ 90	1.08E+12
650	4.26E+11	→ 341	1.69E+11	→ 191	3.05E+10	→ 336	8.08E+09	→ 342	6.44E+09	→ 303	6.65E+11
651	4.38E+11	→ 342	1.69E+11	→ 192	3.02E+10	→ 337	6.17E+09	→ 304	3.90E+09	→ 306	6.61E+11
652	4.07E+11	→ 90	2.34E+11	→ 333	8.70E+10	→ 89	5.83E+10	→ 85	5.54E+10	→ 332	1.06E+12
653	5.64E+11	→ 87	2.93E+11	→ 331	9.11E+10	→ 83	4.92E+10	→ 323	2.16E+10	→ 159	1.07E+12
654	5.52E+11	→ 336	8.92E+09	→ 337	5.45E+09	→ 342	2.63E+09	→ 176	1.77E+09	→ 164	5.74E+11
655	1.80E+12	→ 9	2.85E+11	→ 92	1.87E+11	→ 334	1.12E+11	→ 90	8.94E+10	→ 7	2.96E+12
656	5.67E+11	→ 337	5.43E+09	→ 165	9.97E+08	→ 306	5.38E+08	→ 83	1.60E+08	→ 304	5.74E+11