

Semi-Empirical Oscillator Strengths and Lifetimes for the P II Spectrum

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Abstract

In this work, the values of oscillator strengths and lifetimes in the spectrum P II are calculated. The semi-empirical method of using the values of experimental wavelengths and energy levels according to previous spectral analysis and data compilation work and are now used as the basis for calculations of fitting of the electrostatic parameters using Cowan codes in the energy matrix that represents the Hamiltonian of the ion. A Hartree-Fock relativistic (HFR) multiconfigurational approach is used and the parameters are now adjusted being optimized by a least-squares procedure, in order to improve the adjustment to experimental energy levels by the least squares method in both parities. The method produces simulated values that are difficult to obtain experimentally of oscillator strengths (gf) for known spectral lines and that in agreement with intensity observations, and lifetimes for energy levels, that are closer to the experimental ones.

Keywords: P II spectrum, atomic transitions, energy levels, oscillator strengths, lifetimes

Intensidades de Osciladores e Tempos de Vida Semiempíricos para o Espectro do P II

Resumo

Neste trabalho, são calculados os valores das intensidades de osciladores e dos tempos de vida no íon de fósforo uma vez ionizado, P II. É usado o método semi-empírico que consiste em substituir os valores experimentais conhecidos dos níveis de energia, advindos das análises espectrais, e compilações de dados existentes, dentro da matriz energia que representa a hamiltoniana do íon.

Se usa uma abordagem multiconfiguracional do tipo Hartree-Fock relativístico (HFR) nos códigos numéricos de Los Álamos. Os parâmetros eletrostáticos são agora ajustados pelo método dos mínimos quadrados em ambas as paridades. O método fornece valores, difíceis de serem obtidos de forma experimentais, das intensidades de osciladores (gf) para as linhas espectrais conhecidas, e os tempos de vida de ocupação para os níveis de energia, e que estão bem próximos daqueles observados experimentalmente nas intensidades das linhas espectrais, e nos valores dos níveis de energia.

Palavras-chaves: Espectro do P II. Transições atômicas. Níveis de energia. Intensidades de osciladores. Tempos de vida.

1. Introduction

The ground state configuration of one-time ionized phosphorus, P II is the term 3P_0 being this spectrum a member of the Si I-like isoelectronic sequence with a complete core plus a double-electron valence shell, $1s^2 2s^2 2p^6 3s^2 3p^2$. The ionization limit for this ion is estimated as being $149\,451.5 \pm 1 \text{ cm}^{-1}$ ($19.769\,63 \pm 0.00013 \text{ eV}$)[1].

The spectrum is also similar to that found for Si I isoelectronic sequence and have some term inverted while all others are normal according to the Hund theory for configurations of a four-electron system.

The interest and studies in this spectrum started in 1907 with P. Geuter[2] using various light sources which could give some hints as to ionization stages published the first comprehensive wavelengths list of phosphorus lines from P I to P V.

About 1925, R. A. Millikan and I. S. Bowen[3] analysed the series spectra of two, three and four-valence electron atoms of phosphorus combined with the predictions of the Hund theory. Still about 1927[4] Bowen using the same previous method and using Geuter measurements along with observations in the VUV region lowered up to 782 Å extending spectrum analysis emerging from the singly ionized phosphorus. One hundred and ten of strong lines were classified as arising from various combinations between thirty-two terms of triplet system.

Later in 1936, H. A. Robinson[5] using a Geissler tube discharge containing phosphorus vapor, originally analyzed the P II spectrum and reviewed Bowen's work extending the location of twenty-two new terms classifying 194 lines in both vacuum and air regions of the spectrum[6]. In this analysis Robinson virtually found all single terms, and more twenty intersystem combinations allowing single and triplet sequences were located accurately with respect to one another.

W. C. Martin in 1959[7] utilizing a hollow cathode tube published a considerably enlarged and revised analysis over the regions (782 - 8368) Å. Using an average of the original measurements reevaluated the $3s3p^3 \ ^5S_2$ level resulting lowering of some levels as first derived by Robinson.

In 1972, H. Li and K. L. Andrew published observations using a spark-excited electrodeless[8, 9] as light source reporting 44 new lines identifications in the range (2277 – 6867) Å. Zeeman spectrograms were also taken for 223 P II spectral lines in this range[10] resulting in spectral analysis based in Zeeman patterns and MCHF adjusting of the electrostatic parameters that led to changes of some levels label in this spectrum.

Two light sources were used, a pulsed high-frequency lamp and a high inductance sliding spark in the range of wavelength (500 - 12000) Å by N. Svendenius, C. E. Magnusson, and P. O. Zetterberg[11] in 1983 to report extensive analysis of spectrum P II. The term system included 159 energy levels and about 900 identified lines meaning a doubling of the numbers of levels and identified transitions with this work.

Martin et al.[1] compiles all energy levels of all the phosphorus ions, revising the earlier version of all the data published so far.

2. Methodology

Computations of wavelengths made with the aid of a Hartree-Fock Relativistic (HFR) computer program package and a program of least-square procedure as given by Cowan[12] adjusts the values of the energetic parameters, comparing the data and calculating its consistency with the identification of known energy levels. As these are considered adjustable parameters, their values are to be determined empirically so as to give the best possible fitting between the calculated eigenvalues and the observed energy levels. The fitting process is carried out by an automatic iterative procedure until the parameter values no longer change from one iteration cycle to the next. The main purpose is to reach a fitting to the experimental energy levels, which minimize the uncertainties as much as possible, using the least-squares method for each parity in which the standard deviation is less than one percent of the energy range covered by the energy levels. The values for these optimized electrostatic parameters substitute now their

corresponding theoretical values and are used again to calculate energy matrices and the determination of the oscillator strengths and lifetimes value. All strong configuration interactions are to be included and HFR[13] method is used to given better accuracy.

Wavelength values in vacuum were converted to air by the relation[14], $\lambda_{vac} = n\lambda_{air}$ where the index of refraction of standard air (dry air containing 0.03 CO₂ by volume at normal pressure and $T = 15^\circ C$) is

$$n = 1.0 + 8342.13 \times 10^{-8} + \frac{2406030.0}{130.0 \times 10^8 - \sigma^2} + \frac{15997.0}{38.9 \times 10^8 - \sigma^2}$$

3. Results and discussion

In our fitting process, the standard deviation reached for each parity as 34 cm^{-1} and 104 cm^{-1} , for even and odd configurations, respectively, is satisfactory for the aims of this work.

For the even-parity configurations we have the following picture: $3s^23p^2$, $3s^23p4p$, $3s^23p5p$, $3s^23p4f$, $3s^23p5f$, $3s^23p6f$. For the odd-parity case we study the configuration: $3s3p^3$, $3s^23p3d$, $3s^23p4s$, $3s^23p5s$, $3s^23p4d$, $3s^23p6s$, $3s^23p5d$, $3s^23p5g$, $3s^23p6g$, $3s^23p7g$.

These configurations are those that present a greater abundance of data and have been the most intensively studied.

Values for gf given in Tables 1. and 2., respectively, were calculated by the previously described method where are shown the references and results of the comparison between wavelength values as calculated by the method and the previously experimentally observed. The principal values are those as given by the work of Svendius *et alli*. [11].

In Tables 3. and 4. we present lifetimes, energy levels and an estimation of their percentage composition as given by the method.

The oscillator strengths and lifetimes for P II spectrum are of astrophysical interest for photo-ionization modelling of elemental abundances in cosmic objects since an extensive data source is not currently available. Transitions in this ion have been of particular importance in extrapolation analysis especially for the dense spectra from Si-like sequence in which the phosphorus is one element in isoelectronic sequence linking lighter elements where the analysis is more extensive. Is also an important testing ground for the development of theoretical methods which attempt to calculate atomic structure of many-electron systems.

4. Conclusion

We have presented oscillator strengths and lifetimes for many known transitions in P II. The gf -values are better agreement with line intensity observations and lifetime values that are closer to the experimental ones. We have been stimulated by the need to determine both important parameters in the study of plasma laboratory and solar spectra, as also phosphorus is an astrophysically important element. The present work is part of an ongoing program, whose goal is to obtain weighted oscillator strength, gf , and lifetimes for elements of astrophysical importance. Phosphorus occupies the fifteenth place with respect to cosmic distribution[15].

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Table 1. - P II wavelengths and semi-empirical oscillator strengths calculated in the region vacuum-ultraviolet.

<i>gf</i>	<i>Int.</i>	Wavelengths (Å)			Wavenumbers (cm ⁻¹)	Levels Lower	Level Upper	Configurations	Terms	Ref*
		Obs.	Obs. Prev.	Calc.						
0.0329	1	1 945.542		1 945.545	51 399.4793	77 710.200	- 129 109.700	3s ² 3p3d - 3s ² 3p5p	¹ D ₂ - ¹ P ₁	1 M
0.0008	0	1 910.382		1 910.380	52 345.6066	76 764.100	- 129 109.700	3s 3p ³ - 3s ² 3p5p	³ P ₂ - ¹ P ₁	1
0.0005	0	1 906.099		1 906.097	52 463.2271	77 710.200	- 130 173.400	3s ² 3p3d - 3s ² 3p5p	¹ D ₂ - ³ P ₁	1
0.0008	0	1 893.760		1 893.749	52 805.3084	76 764.100	- 129 569.400	3s 3p ³ - 3s ² 3p5p	³ P ₂ - ³ D ₁	1
0.0000	0	1 892.056		1 892.045	52 852.8655	76 812.300	- 129 665.200	3s 3p ³ - 3s ² 3p5p	³ P ₁ - ³ D ₂	2
0.0002	1	1 890.316		1 890.318	52 901.1520	76 764.100	- 129 665.200	3s 3p ³ - 3s ² 3p5p	³ P ₂ - ³ D ₂	2
0.0020	0	1 883.585		1 883.574	53 090.5608	77 710.200	- 130 800.700	3s ² 3p3d - 3s ² 3p5p	¹ D ₂ - ³ S ₁	1
0.1842	0	1 882.100		1 882.091	53 132.3937	88 192.100	- 141 324.500	3s ² 3p3d - 3s ² 3p(² P)5f ¹ F	³ F ₄ - F[5/2]	3
0.0058	0	1 880.492		1 880.480	53 177.9120	88 192.100	- 141 370.000	3s ² 3p3d - 3s ² 3p(² P)5f ³ F	³ F ₄ - F[7/2]	4
0.6232	5	1 879.602		1 879.606	53 202.6392	77 710.200	- 130 912.800	3s ² 3p3d - 3s ² 3p(² P)4f ¹ F	¹ D ₂ - F[5/2]	3
0.0035	0	1 878.351		1 878.319	53 239.0930	77 710.200	- 130 949.800	3s ² 3p3d - 3s ² 3p(² P)4f ³ F	¹ D ₂ - F[5/2]	2
0.0060	0	1 877.749		1 877.742	53 255.4525	76 764.100	- 130 019.500	3s 3p ³ - 3s ² 3p5p	³ P ₂ - ³ D ₃	3
0.0498	4	1 876.775		1 876.777	53 282.8354	77 710.200	- 130 993.000	3s ² 3p3d - 3s ² 3p(² P)4f ³ F	¹ D ₂ - F[7/2]	3
0.0010	0	1 874.403		1 874.403	53 350.3200	76 823.100	- 130 173.400	3s 3p ³ - 3s ² 3p5p	³ P ₀ - ³ P ₁	1
0.0143	0	1 874.153		1 874.143	53 357.7213	87 966.800	- 141 324.500	3s ² 3p3d - 3s ² 3p(² P)5f ¹ F	³ F ₃ - F[5/2]	3
0.0143	0	1 873.086		1 873.103	53 387.3470	87 966.800	- 141 354.200	3s ² 3p3d - 3s ² 3p(² P)5f ³ F	³ F ₃ - F[7/2]	3
0.3568	3	1 872.546		1 872.546	53 403.2274	87 966.800	- 141 370.000	3s ² 3p3d - 3s ² 3p(² P)5f ³ F	³ F ₃ - F[7/2]	4
0.0121	1	1 872.331		1 872.331	53 409.3597	76 764.100	- 130 173.400	3s 3p ³ - 3s ² 3p5p	³ P ₂ - ³ P ₁	1
0.0627	3	1 868.446		1 868.446	53 520.4121	87 804.100	- 141 324.500	3s ² 3p3d - 3s ² 3p(² P)5f ¹ F	³ F ₂ - F[5/2]	3
0.0323	0	1 868.064		1 868.063	53 531.3851	87 804.100	- 141 335.500	3s ² 3p3d - 3s ² 3p(² P)5f ³ F	³ F ₂ - F[5/2]	2
0.0627	1	1 867.413		1 867.412	53 550.0468	87 804.100	- 141 354.200	3s ² 3p3d - 3s ² 3p(² P)5f ³ F	³ F ₂ - F[7/2]	3
0.0001	0	1 866.106		1 866.109	53 587.4378	76 812.300	- 130 399.800	3s 3p ³ - 3s ² 3p5p	³ P ₁ - ³ P ₂	2
0.0015	0	1 864.957		1 864.945	53 620.8842	88 192.100	- 141 813.000	3s ² 3p3d - 3s ² 3p(² P)5f ³ G	³ F ₄ - G[7/2]	3
0.0064	1	1 864.418		1 864.429	53 635.7244	76 764.100	- 130 399.800	3s 3p ³ - 3s ² 3p5p	³ P ₂ - ³ P ₁	2
0.0512	3	1 864.203		1 864.204	53 642.1979	77 710.200	- 131 352.400	3s ² 3p3d - 3s ² 3p5p	¹ D ₂ - ¹ D ₂	2
0.0710	2	1 863.737		1 863.732	53 655.7831	88 192.100	- 141 847.900	3s ² 3p3d - 3s ² 3p(² P)5f ³ G	³ F ₄ - G[7/2]	4
0.5927	5	1 858.212		1 858.209	53 815.2597	88 192.100	- 142 007.400	3s ² 3p3d - 3s ² 3p(² P)5f ³ G	³ F ₄ - G[9/2]	5
0.0440	0	1 857.148		1 857.142	53 846.1787	87 966.800	- 141 813.000	3s ² 3p3d - 3s ² 3p(² P)5f ³ G	³ F ₃ - G[7/2]	3
0.2146	4	1 855.931		1 855.938	53 881.1102	87 966.800	- 141 847.900	3s ² 3p3d - 3s ² 3p(² P)5f ³ G	³ F ₃ - G[7/2]	4
0.0074	0	1 852.616	1 852.65	1 852.619	53 977.6392	76 823.100	- 130 800.700	3s 3p ³ - 3s ² 3p5p	³ P ₀ - ³ S ₁	1 M
0.0172	1	1 852.247	1 852.27	1 852.249	53 988.4216	76 812.300	- 130 800.700	3s 3p ³ - 3s ² 3p5p	³ P ₁ - ³ S ₁	1 M
0.1608	4	1 851.546		1 851.547	54 008.8909	87 804.100	- 141 813.000	3s ² 3p3d - 3s ² 3p(² P)5f ³ G	³ F ₂ - G[7/2]	3
0.0109	1	1 850.597	1 850.61	1 850.595	54 036.6746	76 764.100	- 130 800.700	3s 3p ³ - 3s ² 3p5p	³ P ₂ - ³ S ₁	1 M
0.0706	3	1 846.658		1 846.657	54 151.9080	87 966.800	- 142 118.700	3s ² 3p3d - 3s ² 3p(² P)5f ³ G	³ F ₃ - G[9/2]	4
0.0016	0	1 841.640		1 841.623	54 299.9300	87 804.100	- 142 104.000	3s ² 3p3d - 3s ² 3p(² P)5f ³ D	³ F ₂ - D[5/2]	2
0.0006	0	1 841.149		1 841.150	54 313.8799	87 966.800	- 142 280.700	3s ² 3p3d - 3s ² 3p(² P)5f ³ D	³ F ₃ - D[3/2]	2
0.0425	3	1 837.488		1 837.483	54 422.2722	77 710.200	- 132 132.500	3s ² 3p3d - 3s ² 3p(² P)4f ³ D	¹ D ₂ - D[5/2]	3
0.0319	2	1 836.432		1 836.437	54 453.2701	77 710.200	- 132 163.500	3s ² 3p3d - 3s ² 3p(² P)4f ³ D	¹ D ₂ - D[5/2]	2
0.0024	0	1 835.802		1 835.800	54 472.1647	87 804.100	- 142 276.200	3s ² 3p3d - 3s ² 3p(² P)5f ³ D	³ F ₂ - D[3/2]	1
0.0318	0	1 831.897		1 831.893	54 588.3411	76 764.100	- 131 352.400	3s 3p ³ - 3s ² 3p5p	³ P ₂ - ¹ D ₂	2
0.0512	3	1 828.599		1 828.597	54 686.7352	77 710.200	- 132 396.900	3s ² 3p3d - 3s ² 3p(² P)4f ¹ D	¹ D ₂ - D[3/2]	2
0.0000	0	1 810.391		1 810.3906	55 236.6986	21 575.632	- 76 812.300	3s ² 3p ² - 3s 3p ³	¹ S ₀ - ³ P ₁	1
0.0000	4	1 774.020		1 774.0203	56 369.1408	8 882.314	- 65 251.400	3s ² 3p ² - 3s 3p ³	¹ D ₂ - ³ D ₁	1
0.0000	4	1 772.266	1 772.30	1 772.2685	56 424.8589	8 882.314	- 65 307.200	3s ² 3p ² - 3s 3p ³	¹ D ₂ - ³ D ₃	3 M
0.3568	0	1 696.205		1 696.2104	58 954.9504	87 966.800	- 146 921.800	3s ² 3p3d - 3s ² 3p(² P)6f ³ F	³ F ₃ - F[7/2]	4
0.0323	0 d	1 692.710		1 692.6995	59 077.2314	87 804.100	- 146 881.300	3s ² 3p3d - 3s ² 3p(² P)6f ³ F	³ F ₂ - F[5/2]	2
0.0012	0	1 692.324		1 692.3257	59 090.2803	87 804.100	- 146 894.400	3s ² 3p3d - 3s ² 3p(² P)6f ³ F	³ F ₂ - F[5/2]	3
0.9954	1	1 685.864		1 685.8500	59 317.2584	88 192.100	- 147 509.400	3s ² 3p3d - 3s ² 3p(² P)6f ³ G	³ F ₄ - G[9/2]	5
0.0657	0 d	1 683.027		1 683.0461	59 416.0790	87 966.800	- 147 382.900	3s ² 3p3d - 3s ² 3p(² P)6f ³ G	³ F ₃ - G[7/2]	3
0.1442	2	1 682.907		1 682.8988	59 421.2795	87 966.800	- 147 388.100	3s ² 3p3d - 3s ² 3p(² P)6f ³ G	³ F ₃ - G[7/2]	4
0.1916	1	1 678.446		1 678.4497	59 578.7887	87 804.100	- 147 382.900	3s ² 3p3d - 3s ² 3p(² P)6f ³ G	³ F ₂ - G[7/2]	3
0.2146	0	1 677.218		1 677.2251	59 622.2892	87 966.800	- 147 589.100	3s ² 3p3d - 3s ² 3p(² P)6f ³ G	³ F ₃ - G[9/2]	4
0.0000	1	1 670.780		1 670.7698	59 852.6500	45 697.000	- 105 549.700	3s 3p ³ - 3s ² 3p4p	⁵ S ₂ - ³ P ₁	2
0.0704	4	1 571.976		1 571.9729	63 614.3282	77 710.200	- 141 324.500	3s ² 3p3d - 3s ² 3p(² P)5f ¹ F	¹ D ₂ - F[5/2]	3
0.0014	1	1 571.229		1 571.2408	63 643.9685	77 710.200	- 141 354.200	3s ² 3p3d - 3s ² 3p(² P)5f ³ F	¹ D ₂ - F[7/2]	3
0.0012	0	1 565.965		1 565.9689	63 858.2286	65 251.400	- 129 109.700	3s 3p ³ - 3s ² 3p5p	³ D ₁ - ¹ P ₁	1
0.0014	1	1 555.289		1 555.2823	64 297.0090	65 272.300	- 129 569.400	3s 3p ³ - 3s ² 3p5p	³ D ₂ - ³ D ₁	1
0.0095	0	1 554.778		1 554.7769	64 314.9095	65 251.400	- 129 569.400	3s 3p ³ - 3s ² 3p5p	³ D ₁ - ³ D ₁	1
0.0031	1	1 553.814	1 553.82	1 553.8077	64 358.0283	65 307.200	- 129 665.200	3s 3p ³ - 3s ² 3p5p	³ D ₃ - ³ D ₂	2 M

0.0014	0	1 553.258		1 553.2591	64 380.7591	77 710.200 - 142 090.900	$3s^2 3p3d - 3s^2 3p(^2P)5f \ ^3D$	$^1D_2 - D[5/2]$	3	
0.0005	1 b	1 552.954	1 552.94	1 552.9433	64 393.8513	77 710.200 - 142 104.000	$3s^2 3p3d - 3s^2 3p(^2P)5f \ ^3D$	$^1D_2 - D[5/2]$	2	M
0.0077	0	1 552.453	1 552.51	1 552.4636	64 413.7486	65 251.400 - 129 665.200	$3s 3p^3 - 3s^2 3p5p$	$^3D_1 - ^3D$	2	M
0.0027	1 b	1 548.688		1 548.6948	64 570.5016	77 710.200 - 142 280.700	$3s^2 3p3d - 3s^2 3p(^2P)5f \ ^1D$	$^1D_2 - D[3/2]$	2	
0.0147	2	1 545.303		1 545.3006	64 712.3285	65 307.200 - 130 019.500	$3s 3p^3 - 3s^2 3p5p$	$^3D_3 - ^3D$	3	
0.0360	1	1 544.471		1 544.4695	64 747.1510	65 272.300 - 130 019.500	$3s 3p^3 - 3s^2 3p5p$	$^3D_2 - ^3D$	3	
0.0001	4	1 543.630	1 543.61	1 543.6308	64 782.3301	469.122 - 65 251.400	$3s^2 3p^2 - 3s 3p^3$	$^3P_2 - ^3D$	1	M
0.0017	9	1 543.129	1 543.09	1 543.1330	64 803.2282	469.122 - 65 272.300	$3s^2 3p^2 - 3s 3p^3$	$^3P_2 - ^3D$	2	M
0.0156	?	1 543.050	1 543.05	1 543.0513	64 806.6594	65 251.400 - 130 058.100	$3s 3p^3 - 3s^2 3p5p$	$^3D_1 - ^3P$	0	
0.0129	12	1 542.297	1 542.29	1 542.3042	64 838.0521	469.122 - 65 307.200	$3s^2 3p^2 - 3s 3p^3$	$^3P_2 - ^3D$	3	M
0.0273	3	1 540.809		1 540.8064	64 901.0804	65 272.300 - 130 173.400	$3s 3p^3 - 3s^2 3p5p$	$^3D_2 - ^3P$	1	
0.0121	1	1 540.317		1 540.3104	64 921.9794	65 251.400 - 130 173.400	$3s 3p^3 - 3s^2 3p5p$	$^3D_1 - ^3P$	1	
0.0020	8	1 536.410	1 536.39	1 536.4157	65 086.5518	164.900 - 65 251.400	$3s^2 3p^2 - 3s 3p^3$	$^3P_1 - ^3D$	1	M
0.0001	11	1 535.917	1 535.90	1 535.9225	65 107.4517	164.900 - 65 272.300	$3s^2 3p^2 - 3s 3p^3$	$^3P_1 - ^3D$	2	M
0.0142	1	1 535.454		1 535.4513	65 127.4319	65 272.300 - 130 399.800	$3s 3p^3 - 3s^2 3p5p$	$^3D_2 - ^3P$	2	
0.0015	0	1 534.944		1 534.9588	65 148.3284	65 251.400 - 130 399.800	$3s 3p^3 - 3s^2 3p5p$	$^3D_1 - ^3P$	2	
0.0012	2	1 534.491		1 534.4877	65 168.3295	21 575.632 - 86 743.000	$3s^2 3p^2 - 3s^2 3p4s$	$^1S_0 - ^3P$	1	
0.0032	10	1 532.530	1 532.51	1 532.5330	65 251.4497	0.000 - 65 251.400	$3s^2 3p^2 - 3s 3p^3$	$^3P_0 - ^3D$	1	M
0.0014	0	1 514.125		1 514.1141	66 045.2208	65 307.200 - 131 352.400	$3s 3p^3 - 3s^2 3p5p$	$^3D_3 - ^1D$	2	
0.0005	0	1 513.326		1 513.3163	66 080.0389	65 272.300 - 131 352.400	$3s 3p^3 - 3s^2 3p5p$	$^3D_2 - ^1D$	2	
0.0020	0	1 512.87	1 512.87	1 512.8378	66 100.9396	65 251.400 - 131 352.400	$3s 3p^3 - 3s^2 3p5p$	$^3D_1 - ^1D$	2	M
0.1649	11	1 485.499	1 485.49	1 485.4958	67 317.5919	21 575.632 - 88 893.200	$3s^2 3p^2 - 3s^2 3p4s$	$^1S_0 - ^1P$	1	M
0.0104	2	1 473.149	1 473.129	1 473.1500	67 881.7500	8 882.314 - 76 764.100	$3s^2 3p^2 - 3s 3p^3$	$^1D_2 - ^3P$	2	M
0.0000	1	1 472.086		1 472.1032	67 930.0201	8 882.314 - 76 812.300	$3s^2 3p^2 - 3s 3p^3$	$^1D_2 - ^3P$	1	
0.0177	8	1 452.895	1 452.89	1 452.8996	68 827.8805	8 882.314 - 77 710.200	$3s^2 3p^2 - 3s^2 3p3d$	$^1D_2 - ^1D$	2	M
0.0171	3	1 445.685		1 445.6896	69 171.1416	77 710.200 - 146 881.300	$3s^2 3p3d - 3s^2 3p(^2P)6f \ ^3F$	$^1D_2 - F[5/2]$	2	
0.1522	1	1 445.064		1 445.0631	69 201.1304	77 710.200 - 146 911.300	$3s^2 3p3d - 3s^2 3p(^2P)6f \ ^1F$	$^1D_2 - F[7/2]$	3	
0.0294	12	1 310.700	1 310.70	1 310.7029	76 294.9407	469.122 - 76 764.100	$3s^2 3p^2 - 3s 3p^3$	$^3P_2 - ^3P$	2	M
0.0152	11	1 309.871	1 309.87	1 309.8742	76 343.2091	469.122 - 76 812.300	$3s^2 3p^2 - 3s 3p^3$	$^3P_2 - ^3P$	1	M
0.0106	11	1 305.493	1 305.48	1 305.4973	76 599.1626	164.900 - 76 764.100	$3s^2 3p^2 - 3s 3p^3$	$^3P_1 - ^3P$	2	M
0.0109	9	1 304.673	1 304.68	1 304.6752	76 647.4292	164.900 - 76 812.300	$3s^2 3p^2 - 3s 3p^3$	$^3P_1 - ^3P$	1	M
0.0136	10	1 304.489	1 304.47	1 304.4917	76 658.2110	164.900 - 76 823.100	$3s^2 3p^2 - 3s 3p^3$	$^3P_1 - ^3P$	0	M
0.0140	9	1 301.868	1 301.87	1 301.8743	76 812.3313	0.000 - 76 812.300	$3s^2 3p^2 - 3s 3p^3$	$^3P_0 - ^3P$	1	M
0.0187	7	1 294.646	1 294.64	1 294.6480	77 241.0725	469.122 - 77 710.200	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_2 - ^1D$	2	M
0.0056	30	1 289.566	1 289.57	1 289.5690	77 545.2884	164.900 - 77 710.200	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_1 - ^1D$	2	M
0.0110	6	1 284.329	1 284.31	1 284.3293	77 861.6512	8 882.314 - 86 743.000	$3s^2 3p^2 - 3s^2 3p4s$	$^1D_2 - ^3P$	1	M
0.0007	3	1 278.086	1 278.094	1 278.0812	78 242.2901	8 882.314 - 87 124.600	$3s^2 3p^2 - 3s^2 3p4s$	$^1D_2 - ^3P$	2	M
0.0001	1	1 267.078	1 267.06	1 267.0772	78 921.7895	8 882.314 - 87 804.100	$3s^2 3p^2 - 3s^2 3p3d$	$^1D_2 - ^3F$	2	M
0.0004	5	1 264.466	1 264.47	1 264.4703	79 084.4989	8 882.314 - 87 966.800	$3s^2 3p^2 - 3s^2 3p3d$	$^1D_2 - ^3F$	3	M
1.2970	13	1 249.829	1 249.82	1 249.8296	80 010.9071	8 882.314 - 88 893.200	$3s^2 3p^2 - 3s^2 3p4s$	$^1D_2 - ^1P$	1	M
0.1232	13	1 231.183	1 231.18	1 231.1840	81 222.6280	21 575.632 - 102 798.300	$3s^2 3p^2 - 3s^2 3p3d$	$^1S_0 - ^1P$	1	M
0.0002	4	1 216.834		1 216.8369	82 180.2823	21 575.632 - 103 755.900	$3s^2 3p^2 - 3s^2 3p3d$	$^1S_0 - ^3P$	1	
0.3954	12	1 159.090	1 159.08	1 159.0865	86 274.8380	469.122 - 86 743.000	$3s^2 3p^2 - 3s^2 3p4s$	$^3P_2 - ^3P$	1	M
0.3168	11	1 156.973	1 156.96	1 156.9702	86 432.6497	164.900 - 86 597.500	$3s^2 3p^2 - 3s^2 3p4s$	$^3P_1 - ^3P$	0	M
0.2356	10	1 155.017	1 155.00	1 155.0137	86 579.0596	164.900 - 86 743.000	$3s^2 3p^2 - 3s^2 3p4s$	$^3P_1 - ^3P$	1	M
1.2005	13	1 153.999	1 153.99	1 153.9951	86 655.4806	469.122 - 87 124.600	$3s^2 3p^2 - 3s^2 3p4s$	$^3P_2 - ^3P$	2	M
0.3171	11	1 152.820	1 152.81	1 152.8180	86 743.9613	0.000 - 86 743.000	$3s^2 3p^2 - 3s^2 3p4s$	$^3P_0 - ^3P$	1	M
0.4046	12	1 149.961	1 149.96	1 149.9580	86 959.6977	164.900 - 87 124.600	$3s^2 3p^2 - 3s^2 3p4s$	$^3P_1 - ^3P$	2	M
0.0000	1	1 145.012	1 145.01	1 145.0166	87 334.9784	469.122 - 87 804.100	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_2 - ^3F$	2	M
0.0003	4	1 142.897	1 142.88	1 142.8873	87 497.6912	469.122 - 87 966.800	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_2 - ^3F$	3	M
0.0001	3	1 141.041	1 141.00	1 141.0419	87 639.2006	164.900 - 87 804.100	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_1 - ^3F$	2	M
0.0014	4	1 130.908	1 130.925	1 130.9134	88 424.1004	469.122 - 88 893.200	$3s^2 3p^2 - 3s^2 3p4s$	$^3P_2 - ^1P$	1	M
0.0003	0	1 127.654		1 127.6609	88 679.1410	21 575.632 - 110 254.800	$3s^2 3p^2 - 3s 3p^3$	$^1S_0 - ^3S$	1	
0.0028	3	1 127.037		1 127.0359	88 728.3182	164.900 - 88 893.200	$3s^2 3p^2 - 3s^2 3p4s$	$^3P_1 - ^1P$	1	
0.0030	5	1 124.939	1 124.945	1 124.9452	88 893.2190	0.000 - 88 893.200	$3s^2 3p^2 - 3s^2 3p4s$	$^3P_0 - ^1P$	1	M
1.1196	8	1 064.780	1 064.80	1 064.7819	93 915.9465	8 882.314 - 102 798.300	$3s^2 3p^2 - 3s^2 3p3d$	$^1D_2 - ^1P$	1	M
0.0000	0	1 055.436		1 055.4380	94 747.3940	8 882.314 - 103 629.700	$3s^2 3p^2 - 3s^2 3p3d$	$^1D_2 - ^3P$	2	
0.0011	4	1 054.034		1 054.0340	94 873.5999	8 882.314 - 103 755.900	$3s^2 3p^2 - 3s^2 3p3d$	$^1D_2 - ^3P$	1	
0.0583	0 bl	1 050.790		1 050.7738	95 167.9610	8 882.314 - 104 050.300	$3s^2 3p^2 - 3s^2 3p3d$	$^1D_2 - ^3D$	3	
0.0015	0	1 050.204		1 050.2057	95 219.4413	8 882.314 - 104 101.700	$3s^2 3p^2 - 3s^2 3p3d$	$^1D_2 - ^3D$	2	
1.5254	7	1 033.419	1 033.41	1 033.4200	96 766.0777	21 575.632 - 118 341.700	$3s^2 3p^2 - 3s 3p^3$	$^1S_0 - ^1P$	1	M
7.2026	11	1 015.454	1 015.47	1 015.4558	98 477.9446	8 882.314 - 107 360.200	$3s^2 3p^2 - 3s^2 3p3d$	$^1D_2 - ^1F$	3	M
0.0021	0	986.460		986.4612	101 372.4615	8 882.314 - 110 254.800	$3s^2 3p^2 - 3s 3p^3$	$^1D_2 - ^3S$	1	
0.0093	1	981.549		981.5486	101 879.8254	21 575.632 - 123 455.500	$3s^2 3p^2 - 3s^2 3p5s$	$^1S_0 - ^3P$	1	

0.0034	4	977.240	977.258	977.2387	102 329.1444	469.122 - 102 798.300	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{2-1}P$	1	M
0.0003	3	974.342	974.36	974.3421	102 633.3564	164.900 - 102 798.300	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{1-1}P$	1	M
0.0001	4 bl	972.778	972.807	972.7791	102 798.2612	0.000 - 102 798.300	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{0-1}P$	1	M
0.0902	3	972.227	972.24	972.2271	102 856.6268	21 575.632 - 124 432.300	$3s^2 3p^2 - 3s^2 3p5s$	$^1S_{0-1}P$	1	M
2.1022	8	969.364	969.38	969.3625	103 160.5823	469.122 - 103 629.700	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{2-3}P$	2	M
0.7831	8	968.176		968.1780	103 286.7923	469.122 - 103 755.900	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{2-3}P$	1	
1.8308	9	966.512	966.52	966.5123	103 464.7981	164.900 - 103 629.700	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{1-3}P$	2	M
8.3958	11	965.421		965.4266	103 581.1526	469.122 - 104 050.300	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{2-3}D$	3	
0.2175	11	965.421	965.43	965.3936	103 584.6933	469.122 - 104 053.800	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{2-3}D$	1	M
0.3417	6	965.339		965.3347	103 591.0136	164.900 - 103 755.900	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{1-3}P$	1	
2.3136	9	964.948	964.95	964.9470	103 632.6347	469.122 - 104 101.700	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{2-3}D$	2	M
5.6638	8	964.092	964.09	964.0919	103 724.5516	8 882.314 - 112 606.900	$3s^2 3p^2 - 3s 3p^3$	$^1D_{2-1}D$	2	M
1.2381	7	963.800	963.81	963.8005	103 755.9121	0.000 - 103 755.900	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{0-3}P$	1	M
0.7791	7	963.621	963.59	963.6188	103 775.4764	164.900 - 103 940.400	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{1-3}P$	0	M
1.8020	8	962.566	962.57	962.5666	103 888.9153	164.900 - 104 053.800	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{1-3}D$	1	M
3.6714	8	962.123	962.13	962.1227	103 936.8471	164.900 - 104 101.700	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{1-3}D$	2	M
1.5853	7	961.040	961.04	961.0412	104 053.8116	0.000 - 104 053.800	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{0-3}D$	1	M
0.0016	0	943.187		943.1869	106 023.5251	21 575.632 - 127 599.200	$3s^2 3p^2 - 3s^2 3p4d$	$^1S_{0-3}D$	1	
0.0735	3	935.533		935.5313	106 891.1323	469.122 - 107 360.200	$3s^2 3p^2 - 3s^2 3p3d$	$^3P_{2-1}F$	3	
0.4915	7	913.582	913.59	913.5807	109 459.4052	8 882.314 - 118 341.700	$3s^2 3p^2 - 3s 3p^3$	$^1D_{2-1}P$	1	M
2.8080	9	910.869	910.88	910.8659	109 785.6446	469.122 - 110 254.800	$3s^2 3p^2 - 3s 3p^3$	$^3P_{2-3}S$	1	M
1.6025	8	908.346	908.38	908.3488	110 089.8686	164.900 - 110 254.800	$3s^2 3p^2 - 3s 3p^3$	$^3P_{1-3}S$	1	M
1.5760	6	907.554	907.56	907.5463	110 187.2158	21 575.632 - 131 762.800	$3s^2 3p^2 - 3s^2 3p4d$	$^1S_{0-1}P$	1	M
1.6025	7	906.992	906.987	906.9902	110 254.7745	0.000 - 110 254.800	$3s^2 3p^2 - 3s 3p^3$	$^3P_{0-3}S$	1	M
0.0014	2	891.759		891.7604	112 137.7446	469.122 - 112 606.900	$3s^2 3p^2 - 3s 3p^3$	$^3P_{2-1}D$	2	
0.0008	1	889.355		889.3477	112 441.9617	164.900 - 112 606.900	$3s^2 3p^2 - 3s 3p^3$	$^3P_{1-1}D$	2	
0.0056	3	872.805	872.84	872.8048	114 573.1554	8 882.314 - 123 455.500	$3s^2 3p^2 - 3s^2 3p5s$	$^1D_{2-3}P$	1	M
0.1177	7	865.423	865.44	865.4266	115 549.9496	8 882.314 - 124 432.300	$3s^2 3p^2 - 3s^2 3p5s$	$^1D_{2-1}P$	1	M
0.0069	1	861.588	861.61	861.5905	116 064.4181	8 882.314 - 124 946.700	$3s^2 3p^2 - 3s^2 3p4d$	$^1D_{2-3}F$	2	M
0.0035	1	860.248		860.2085	116 250.8857	21 575.632 - 137 826.500	$3s^2 3p^2 - 3s^2 3p6s$	$^1S_{0-3}P$	1	
0.0171	1	855.099		855.0950	116 946.0703	21 575.632 - 138 521.700	$3s^2 3p^2 - 3s^2 3p6s$	$^1S_{0-1}P$	1	
0.0047	0	847.803		847.8117	117 950.7195	21 575.632 - 139 526.300	$3s^2 3p^2 - 3s^2 3p5d$	$^1S_{0-3}D$	1	
0.0000	0	844.723		844.7207	118 382.3245	21 575.632 - 139 957.000	$3s^2 3p^2 - 3s^2 3p5d$	$^1S_{0-3}P$	1	
0.0983	8	843.994		843.9893	118 484.9144	8 882.314 - 127 367.200	$3s^2 3p^2 - 3s^2 3p4d$	$^1D_{2-3}P$	2	
1.8637	9	841.234	841.21	841.2326	118 873.1868	8 882.314 - 127 755.500	$3s^2 3p^2 - 3s^2 3p4d$	$^1D_{2-1}D$	2	M
0.0067	0	840.293		840.2930	119 006.1086	8 882.314 - 127 888.400	$3s^2 3p^2 - 3s^2 3p4d$	$^1D_{2-3}D$	3	
0.0005	1	840.04	840.04	839.9706	119 051.7859	8 882.314 - 127 934.100	$3s^2 3p^2 - 3s^2 3p4d$	$^1D_{2-3}P$	1	M
0.1382	3	839.860		839.8605	119 067.3927	8 882.314 - 127 949.700	$3s^2 3p^2 - 3s^2 3p4d$	$^1D_{2-3}D$	2	
1.6885	8	824.680	824.66	824.6715	121 260.4049	8 882.314 - 130 142.700	$3s^2 3p^2 - 3s^2 3p4d$	$^1D_{2-1}F$	3	M
0.2074	4	813.800	813.768	813.7986	122 880.5260	8 882.314 - 131 762.800	$3s^2 3p^2 - 3s^2 3p4d$	$^1D_{2-1}P$	1	M
0.0350	5	813.096	813.10	813.0984	122 986.3446	469.122 - 123 455.500	$3s^2 3p^2 - 3s^2 3p5s$	$^3P_{2-3}P$	1	M
0.0288	4	811.823	811.85	811.8248	123 179.2870	164.900 - 123 344.200	$3s^2 3p^2 - 3s^2 3p5s$	$^3P_{1-3}P$	0	M
0.0202	4	811.095	811.10	811.0921	123 290.5610	164.900 - 123 455.500	$3s^2 3p^2 - 3s^2 3p5s$	$^3P_{1-3}P$	1	M
0.1152	7	810.234	810.24	810.2304	123 421.6835	469.122 - 123 890.800	$3s^2 3p^2 - 3s^2 3p5s$	$^3P_{2-3}P$	2	M
0.0282	4	810.013	810.00	810.0087	123 455.4641	0.000 - 123 455.500	$3s^2 3p^2 - 3s^2 3p5s$	$^3P_{0-3}P$	1	M
0.0417	5	808.243	808.25	808.2381	123 725.9169	164.900 - 123 890.800	$3s^2 3p^2 - 3s^2 3p5s$	$^3P_{1-3}P$	2	M
0.0018	2	806.692		806.6914	123 963.1413	469.122 - 124 432.300	$3s^2 3p^2 - 3s^2 3p5s$	$^3P_{2-1}P$	1	
0.0014	1	804.709		804.7165	124 267.3662	164.900 - 124 432.300	$3s^2 3p^2 - 3s^2 3p5s$	$^3P_{1-1}P$	1	
0.0025	2	803.654		803.6501	124 432.2622	0.000 - 124 432.300	$3s^2 3p^2 - 3s^2 3p5s$	$^3P_{0-1}P$	1	
0.1070	3	788.040		788.0338	126 898.1102	469.122 - 127 367.200	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{2-3}P$	2	
0.0495	3	786.590	786.52	786.5961	127 130.0481	469.122 - 127 599.200	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{2-3}D$	1	M
0.2721	5	786.154	786.154	786.1491	127 202.3335	164.900 - 127 367.200	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{1-3}D$	2	M
1.3931	7	784.813	784.81	784.8105	127 419.2942	469.122 - 127 888.400	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{2-3}D$	3	M
0.3012	4	784.716		784.7183	127 434.2653	164.900 - 127 599.200	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{1-3}D$	1	
0.0544	3	784.529		784.5293	127 464.9653	469.122 - 127 934.100	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{2-3}P$	1	
0.3844	6	784.439	784.46	784.4332	127 480.5809	469.122 - 127 949.700	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{2-3}D$	2	M
0.0887	5 b	783.22		783.7568	127 590.5995	164.900 - 127 755.500	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{1-1}D$	2	
0.2086	5 b	783.722	783.71	783.7042	127 599.1631	0.000 - 127 599.200	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{0-3}D$	1	M
0.0688	3 bl	782.875	782.90	782.8730	127 734.6390	164.900 - 127 899.500	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{1-3}P$	0	M
0.0017	5	782.664	782.72	782.6613	127 769.1896	164.900 - 127 934.100	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{1-3}P$	1	M
0.4723	5	782.570	782.59	782.5657	127 784.7981	164.900 - 127 949.700	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{1-3}D$	2	M
0.1937	3	781.659		781.6525	127 934.0884	0.000 - 127 934.100	$3s^2 3p^2 - 3s^2 3p4d$	$^3P_{0-3}P$	1	
0.0016	1	775.527		775.5292	128 944.2100	8 882.314 - 137 826.500	$3s^2 3p^2 - 3s^2 3p6s$	$^1D_{2-3}P$	1	

0.0157	3	771.376	771.3705	129 639.3886	8 882.314 - 138 521.700	$3s^2 3p^2 - 3s^2 3p6s$	$1D_{2-} - 1P$	1
0.0138	1	771.190	771.1874	129 670.1684	8 882.314 - 138 552.500	$3s^2 3p^2 - 3s^2 3p5d$	$1D_{2-} - 3F$	2
0.0046	1	771.190	771.1670	129 673.5986	469.122 - 130 142.700	$3s^2 3p^2 - 3s^2 3p4d$	$3P_{2-} - 1F$	3
0.0041	1	770.056	770.0535	129 861.1071	8 882.314 - 138 743.400	$3s^2 3p^2 - 3s^2 3p5d$	$1D_{2-} - 3F$	3
0.1509	6	767.281	767.2806	130 330.4163	8 882.314 - 139 212.700	$3s^2 3p^2 - 3s^2 3p5d$	$1D_{2-} - 1D$	2
0.0630	5	764.881	764.8747	130 740.3683	8 882.314 - 139 622.700	$3s^2 3p^2 - 3s^2 3p5d$	$1D_{2-} - 3D$	2
0.0008	0	763.823	763.8139	130 921.9432	8 882.314 - 139 804.200	$3s^2 3p^2 - 3s^2 3p5d$	$1D_{2-} - 3D$	3
0.0630	0 d	763.104	763.1186	131 041.2300	8 882.314 - 139 923.500	$3s^2 3p^2 - 3s^2 3p5d$	$1D_{2-} - 3P$	2
0.0002	0 d	758.936	758.9393	131 762.8432	0.000 - 131 762.800	$3s^2 3p^2 - 3s^2 3p4d$	$3P_{0-} - 1P$	1
0.6532	6	757.194	757.1859	132 067.9638	8 882.314 - 140 950.300	$3s^2 3p^2 - 3s^2 3p5d$	$1D_{2-} - 1F$	3
0.1208	0	754.130	754.1162	132 605.5587	8 882.314 - 141 487.900	$3s^2 3p^2 - 3s^2 3p5d$	$1D_{2-} - 1P$	1
0.0078	3	728.036	728.0278	137 357.3921	469.122 - 137 826.500	$3s^2 3p^2 - 3s^2 3p6s$	$3P_{2-} - 3P$	1
0.0068	2	726.782	726.7854	137 592.1971	164.900 - 137 757.100	$3s^2 3p^2 - 3s^2 3p6s$	$3P_{1-} - 3P$	0
0.0044	2	726.422	726.4189	137 661.6165	164.900 - 137 826.500	$3s^2 3p^2 - 3s^2 3p6s$	$3P_{1-} - 3P$	1
0.0065	2	725.549	725.5498	137 826.5145	0.000 - 137 826.500	$3s^2 3p^2 - 3s^2 3p6s$	$3P_{0-} - 3P$	1
0.0283	4	725.490	725.4790	137 839.9650	469.122 - 138 309.100	$3s^2 3p^2 - 3s^2 3p6s$	$3P_{2-} - 3P$	2
0.0010	0	724.355	724.3617	138 521.5779	469.122 - 138 521.700	$3s^2 3p^2 - 3s^2 3p6s$	$3P_{2-} - 1P$	1
0.0119	4	723.886	723.8813	138 144.1957	164.900 - 138 309.100	$3s^2 3p^2 - 3s^2 3p6s$	$3P_{1-} - 3P$	2
0.0006	0 d	722.759	722.7690	138 356.7917	164.900 - 138 521.700	$3s^2 3p^2 - 3s^2 3p6s$	$3P_{1-} - 1P$	1
0.0019	0	722.610	722.6083	138 387.5607	164.900 - 138 552.500	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{1-} - 3F$	2
0.0013	1	721.910	721.9086	138 521.6910	0.000 - 138 521.700	$3s^2 3p^2 - 3s^2 3p6s$	$3P_{0-} - 1P$	1
0.0004	0	720.760	720.7540	138 743.5935	469.122 - 139 212.700	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{2-} - 1D$	2
0.0364	4	719.175	719.1770	139 047.8283	164.900 - 139 212.700	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{1-} - 1D$	2
0.3108	7	717.697	717.6941	139 335.1290	469.122 - 139 804.200	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{2-} - 3D$	3
0.0201	1	717.552	717.5586	139 361.4403	164.900 - 139 526.300	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{1-} - 3D$	1
0.0001	5 b	717.080	717.0802	139 454.4153	469.122 - 139 923.500	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{2-} - 3P$	2
0.1035	6 b	717.080	717.0630	139 457.7603	164.900 - 139 622.700	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{1-} - 3D$	2
0.0201	3	716.903	716.9032	139 488.8459	469.122 - 139 957.000	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{2-} - 3P$	1
0.0872	5	716.710	716.7105	139 526.3499	0.000 - 139 526.300	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{0-} - 3D$	1
0.0953	3	715.515	715.5193	139 758.6340	164.900 - 139 923.500	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{1-} - 3P$	2
0.0432	2 b	715.348	715.3431	139 793.0587	164.900 - 139 957.000	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{1-} - 3P$	1
0.0131	2	715.278	715.2747	139 806.4268	164.900 - 139 971.300	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{1-} - 3P$	0
0.0002	0	711.836	711.8393	140 481.1451	469.122 - 140 950.300	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{2-} - 1F$	3
0.0000	9 d	709.141	709.1256	141 018.7420	469.122 - 141 487.900	$3s^2 3p^2 - 3s^2 3p5d$	$3P_{2-} - 1P$	1

* References: M = Martin [7] ; L = Li [10].

Table 2. - P II semi-empirical oscillator strengths calculated in the region above 2000Å.

gf	Int	Wavelengths (Å)		Wavenumbers		Levels (cm ⁻¹)		Configurations	Transitions	Terms	Ref
		Obs.	Obs. Prev	Calc.	(cm ⁻¹)	Lower	Upper				
0.2124	0	11 688.133		11 688.1321	8 555.6885	132 396.900	140 950.300	$3s^2 3p(^2P)4f$	$1D - 3s^2 3p5d$	$D[3/2]_{2-}$	$1F_3$
0.1330	0	11 478.715		11 478.7181	8 711.7803	102 798.300	111 507.700	$3s^2 3p3d$	$- 3s^2 3p4P$	$1P_{1-}$	$1S_0$
0.6029	0	11 248.935		11 248.9706	8 889.7028	129 665.200	138 552.500	$3s^2 3p5p$	$- 3s^2 3p5d$	$3D_{2-}$	$3F_2$
0.0023	1	11 248.935		11 248.9623	8 889.7107	142 118.700	151 006.000	$3s^2 3p(^2P)5f$	$1G - 3s^2 3p(^2P_{<3/2>})7g$	$G[9/2]_{4-}$	$3/2[7/2]_3$
2.7638	1	11 128.951		11 128.9522	8 985.5737	129 569.400	138 552.500	$3s^2 3p5p$	$- 3s^2 3p5d$	$3D_{1-}$	$3F_2$
0.0028	7 bl	11 109.870		11 109.9109	9 000.9730	142 007.400	151 005.900	$3s^2 3p(^2P)5f$	$3G - 3s^2 3p(^2P_{<3/2>})7g$	$G[9/2]_{5-}$	$3/2[7/2]_4$
8.4609	2	11 083.183		11 083.1903	9 022.6731	130 019.500	139 039.700	$3s^2 3p5p$	$- 3s^2 3p5d$	$3D_{3-}$	$3F_4$
2.3364	0	11 075.480		11 075.4765	9 028.9622	142 007.400	151 033.900	$3s^2 3p(^2P)5f$	$3G - 3s^2 3p(^2P_{<3/2>})7g$	$G[9/2]_{5-}$	$3/2[11/2]_6$
6.0960	1	11 012.370		11 012.3703	9 080.6974	129 665.200	138 743.400	$3s^2 3p5p$	$- 3s^2 3p5d$	$3D_{2-}$	$3F_3$
0.2732	1	10 958.529		10 958.5508	9 125.2949	130 800.700	139 923.500	$3s^2 3p5p$	$- 3s^2 3p5d$	$3S_{1-}$	$3P_2$
0.0966	0	10 940.260		10 940.4012	9 140.4336	141 847.900	150 985.800	$3s^2 3p(^2P)5f$	$3G - 3s^2 3p(^2P_{<3/2>})7g$	$G[7/2]_{4-}$	$3/2[9/2]_4$
1.5881	0	10 940.260		10 940.2487	9 140.5673	141 847.900	150 986.000	$3s^2 3p(^2P)5f$	$3G - 3s^2 3p(^2P_{<3/2>})7g$	$G[7/2]_{4-}$	$3/2[9/2]_5$
1.5627	2 bl	10 917.329		10 917.3511	9 159.7320	130 800.700	139 957.000	$3s^2 3p5p$	$- 3s^2 3p5d$	$3S_{1-}$	$3P_1$
0.6924	1	10 901.430		10 901.4305	9 173.1085	130 800.700	139 971.300	$3s^2 3p5p$	$- 3s^2 3p5d$	$3S_{1-}$	$3P_0$
3.8760	2	10 630.315		10 630.3306	9 407.0457	130 399.800	139 804.200	$3s^2 3p5p$	$- 3s^2 3p5d$	$3P_{2-}$	$3D_3$
0.6764	5	10 621.800		10 621.8014	9 414.6002	129 109.700	138 521.700	$3s^2 3p5p$	$- 3s^2 3p6s$	$1P_{1-}$	$1P_1$
1.2436	2	10 558.744		10 558.7389	9 470.8360	130 058.100	139 526.300	$3s^2 3p5p$	$- 3s^2 3p5d$	$3P_{0-}$	$3D_1$
0.0058	3	10 497.192		10 497.1797	9 526.3771	130 399.800	139 923.500	$3s^2 3p5p$	$- 3s^2 3p5d$	$3P_{2-}$	$3P_2$
0.4889	0	10 459.385		10 459.3769	9 560.8053	130 399.800	139 957.000	$3s^2 3p5p$	$- 3s^2 3p5d$	$3P_{2-}$	$3P_1$
3.8276	6	10 416.100		10 416.1201	9 600.5038	131 352.400	140 950.300	$3s^2 3p5p$	$- 3s^2 3p5d$	$1D_{2-}$	$1F_3$
0.9379	3	10 387.660		10 387.6610	9 626.8072	132 163.500	141 787.600	$3s^2 3p(^2P)4f$	$3D - 3s^2 3p(^2P_{<1/2>})5g$	$D[5/2]_{2-}$	$1/2[7/2]_3$
1.3848	2	10 366.980		10 366.9912	9 646.0014	129 569.400	139 212.700	$3s^2 3p5p$	$- 3s^2 3p5d$	$3D_{1-}$	$1D_2$
6.4890	4	10 354.396		10 354.3949	9 657.7394	132 132.500	141 787.500	$3s^2 3p(^2P)4f$	$3D - 3s^2 3p(^2P_{<1/2>})5g$	$D[5/2]_{3-}$	$1/2[7/2]_4$
0.5911	4	10 354.396		10 354.2999	9 657.8326	132 132.500	141 787.600	$3s^2 3p(^2P)4f$	$3D - 3s^2 3p(^2P_{<1/2>})5g$	$D[5/2]_{3-}$	$1/2[7/2]_3$

2.1297	1	10 286.910	10 286.9007	9 721.1016	132 077.700	- 141 796.200	$3s^2 3p(^2P)4f \ ^1G$	- $3s^2 3p(^2P_{<1/2>})5g \ ^3G$	$G[9/2]_4$	-	$1/2[9/2]_5$	
0.2025	4	10 217.180	10 217.4111	9 787.2161	130 173.400	- 139 957.000	$3s^2 3p5p$	- $3s^2 3p5d$	3P_1	-	3P_1	
1.5954	4	10 217.180	10 217.1905	9 787.4269	130 019.500	- 139 804.200	$3s^2 3p5p$	- $3s^2 3p5d$	3D_3	-	3D_3	
0.0023	0	10 094.189	10 094.1211	9 906.7576	130 019.500	- 139 923.500	$3s^2 3p5p$	- $3s^2 3p5d$	3D_3	-	3P_2	
0.1183	3 bl	10 039.860	10 039.9603	9 960.1990	129 665.200	- 139 622.700	$3s^2 3p5p$	- $3s^2 3p5d$	3D_2	-	3D_2	
0.0891	6	9 922.171	9 922.4432	10 078.1561	132 396.900	- 142 472.300	$3s^2 3p(^2P)4f \ ^1D$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$D[3/2]_2$	-	$3/2[5/2]_2$	
4.8908	6	9 922.171	9 922.1787	10 078.4303	132 396.900	- 142 472.600	$3s^2 3p(^2P)4f \ ^1D$	- $3s^2 3p(^2P_{<3/2>})5g \ ^1G$	$D[3/2]_2$	-	$3/2[5/2]_3$	
0.0606	0	9 899.510	9 899.4698	10 101.5713	131 688.700	- 141 787.500	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<1/2>})5g \ ^3F$	$G[7/2]_4$	-	$1/2[7/2]_4$	
0.0164	0	9 899.510	9 899.3765	10 101.6631	131 688.700	- 141 787.600	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<1/2>})5g \ ^3G$	$G[7/2]_4$	-	$1/2[7/2]_3$	
3.7763	5	9 897.716	9 897.7208	10 103.3369	132 371.700	- 142 472.300	$3s^2 3p(^2P)4f \ ^3D$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$D[3/2]_1$	-	$3/2[5/2]_2$	
1.6702	3	9 895.295	9 895.3004	10 105.8078	129 109.700	- 139 212.700	$3s^2 3p5p$	- $3s^2 3p5d$	1P_1	-	1D_2	
9.3519	4	9 890.990	9 890.9904	10 110.2114	131 688.700	- 141 796.200	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<1/2>})5g \ ^3G$	$G[7/2]_4$	-	$1/2[9/2]_5$	
0.1185	0	9 860.150	9 860.1611	10 141.8233	129 665.200	- 139 804.200	$3s^2 3p5p$	- $3s^2 3p5d$	3D_2	-	3D_3	
0.0000	0	9 843.240	9 843.3132	10 159.1739	131 631.200	- 141 787.500	$3s^2 3p(^2P)4f \ ^3D$	- $3s^2 3p(^2P_{<1/2>})5g \ ^3G$	$G[7/2]_3$	-	$1/2[7/2]_4$	
0.2030	0	9 843.240	9 843.2376	10 159.2668	131 631.200	- 141 787.600	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3G$	$G[7/2]_3$	-	$1/2[7/2]_3$	
1.7312	0	9 835.298	9 835.2902	10 167.4684	131 631.200	- 141 795.800	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<1/2>})5g \ ^1G$	$G[7/2]_3$	-	$1/2[9/2]_4$	
3.6486	4	9 806.720	9 806.7200	10 197.0893	132 163.500	- 142 357.800	$3s^2 3p(^2P)4f \ ^3D$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$D[5/2]_2$	-	$3/2[7/2]_3$	
6.4890	4	9 777.200	9 777.1579	10 227.9399	132 132.500	- 142 357.600	$3s^2 3p(^2P)4f \ ^3D$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$D[5/2]_3$	-	$3/2[7/2]_4$	
0.7420	2	9 697.750	9 697.7531	10 311.6702	132 163.500	- 142 472.300	$3s^2 3p(^2P)4f \ ^3D$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$D[5/2]_2$	-	$3/2[5/2]_2$	
0.2569	1	9 668.407	9 668.4107	10 342.9623	132 132.500	- 142 472.600	$3s^2 3p(^2P)4f \ ^3D$	- $3s^2 3p(^2P_{<3/2>})5g \ ^1F$	$D[5/2]_3$	-	$3/2[5/2]_3$	
3.2141	7	9 667.390	9 667.4102	10 344.0322	131 762.800	- 142 104.000	$3s^2 3p4d$	- $3s^2 3p(^2P)5f \ ^3D$	1P_0	-	$D[5/2]_2$	
9.3519	7	9 667.390	9 667.4007	10 344.0429	132 077.700	- 142 418.900	$3s^2 3p(^2P)4f \ ^1G$	- $3s^2 3p(^2P_{<3/2>})5g \ ^1H$	$G[9/2]_4$	-	$3/2[11/2]_5$	
0.8392	3	9 654.300	9 654.3000	10 358.0788	131 940.300	- 142 295.500	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3H$	$G[9/2]_5$	-	$3/2[9/2]_5$	
12.3436	11	9 541.040	9 541.0400	10 481.0377	131 940.300	- 142 418.400	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3H$	$G[9/2]_5$	-	$3/2[11/2]_6$	
0.4614	3	9 509.440	9 509.4336	10 515.8774	129 109.700	- 139 622.700	$3s^2 3p5p$	- $3s^2 3p5d$	1P_1	-	3D_2	
6.4972	14	9 425.341	9 425.3368	10 609.7081	131 688.700	- 142 295.500	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3H$	$G[7/2]_4$	-	$3/2[9/2]_5$	
6.0862	12	9 374.688	9 374.7013	10 667.0080	131 631.200	- 142 295.200	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3H$	$G[7/2]_3$	-	$3/2[9/2]_4$	
0.4459	4	9 370.500	9 370.5071	10 671.7891	131 688.700	- 142 357.600	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$G[7/2]_4$	-	$3/2[7/2]_4$	
1.7312	1	9 320.054	9 320.1438	10 729.3835	131 631.200	- 142 357.600	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$G[7/2]_3$	-	$3/2[7/2]_4$	
0.2030	1	9 320.054	9320.0601	10 729.5447	131 631.200	- 142 357.800	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$G[7/2]_3$	-	$3/2[7/2]_3$	
0.0803	2	9 288.857	9 288.8469	10 765.6069	131 024.900	- 141 787.500	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<1/2>})5g \ ^3G$	$F[7/2]_4$	-	$1/2[7/2]_4$	
0.0022	2	9 288.857	9 288.7699	10 765.6996	131 024.900	- 141 787.600	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<1/2>})5g \ ^3G$	$F[7/2]_4$	-	$1/2[7/2]_3$	
7.8204	14	9 281.410	9 281.4079	10 774.2366	131 024.900	- 141 796.200	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<1/2>})5g \ ^3G$	$F[7/2]_4$	-	$1/2[9/2]_5$	
0.0004	7	9 261.380	9 261.3468	10 797.5736	130 993.000	- 141 787.600	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<1/2>})5g \ ^3G$	$F[7/2]_3$	-	$1/2[7/2]_3$	
5.4242	12	9 254.300	9 254.3116	10 805.7759	130 993.000	- 141 795.800	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<1/2>})5g \ ^1G$	$F[7/2]_3$	-	$1/2[9/2]_4$	
5.0192	10	9 223.942	9 223.9702	10 841.3189	130 949.300	- 141 787.600	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<1/2>})5g \ ^3G$	$F[5/2]_2$	-	$1/2[7/2]_3$	
0.0249	4	9 221.572	9 221.5801	10 844.1287	131 631.200	- 142 472.300	$3s^2 3p(^2P)4f \ ^3G$	- $3s^2 3p(^2P_{<3/2>})5g \ ^1G$	$G[7/2]_3$	-	$3/2[5/2]_2$	
5.4844	10	9 193.090	9 193.1213	10 877.6880	130 912.800	- 141 787.500	$3s^2 3p(^2P)4f \ ^1F$	- $3s^2 3p(^2P_{<1/2>})5g \ ^3F$	$F[5/2]_3$	-	$1/2[7/2]_4$	
0.3072	10	9 193.090	9 193.0597	10 877.7827	130 912.800	- 141 787.600	$3s^2 3p(^2P)4f \ ^1F$	- $3s^2 3p(^2P_{<1/2>})5g \ ^3G$	$F[5/2]_3$	-	$1/2[7/2]_3$	
0.8955	5	9 112.287	9 112.3056	10 974.1778	101 635.700	- 112 606.900	$3s^2 3p4p$	- $3s \ 3p^3$	1P_1	-	1D_2	
0.3761	0	8 940.640	8 940.6502	11 184.8691	130 142.700	- 141 324.500	$3s^2 3p4d$	- $3s^2 3p(^2P)5f \ ^1F$	1F_0	-	$F[5/2]_3$	
0.4993	1	8 904.407	8 904.4112	11 230.3903	130 142.700	- 141 370.000	$3s^2 3p4d$	- $3s^2 3p(^2P)5f \ ^3F$	1F_0	-	$F[7/2]_4$	
7.8204	3	8 870.173	8 870.1828	11 273.7284	131 024.900	- 142 295.500	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3H$	$F[7/2]_4$	-	$3/2[9/2]_5$	
1.3038	3	8 845.386	8 845.3906	11 305.3240	130 993.000	- 142 295.200	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3H$	$F[7/2]_3$	-	$3/2[9/2]_4$	
0.1673	2	8 821.607	8 821.6012	11 335.8121	131 024.900	- 142 357.600	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$F[7/2]_4$	-	$3/2[7/2]_4$	
0.0022	2	8 821.607	8 821.4952	11 335.9663	131 024.900	- 142 357.800	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$F[7/2]_4$	-	$3/2[7/2]_3$	
5.4242	2	8 796.750	8 796.8524	11 367.6926	130 993.000	- 142 357.600	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$F[7/2]_3$	-	$3/2[7/2]_4$	
0.0004	2	8 796.750	8 796.7368	11 367.8606	130 993.000	- 142 357.800	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$F[7/2]_3$	-	$3/2[7/2]_3$	
5.0192	2	8 763.015	8 763.0141	11 411.6040	130 949.300	- 142 357.800	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$F[5/2]_2$	-	$3/2[7/2]_3$	
5.4844	3	8 735.231	8 735.2258	11 447.9086	130 912.800	- 142 357.600	$3s^2 3p(^2P)4f \ ^1F$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$F[5/2]_3$	-	$3/2[7/2]_4$	
0.1752	1	8 675.900	8 675.9005	11 526.1817	130 949.300	- 142 472.300	$3s^2 3p(^2P)4f \ ^3F$	- $3s^2 3p(^2P_{<3/2>})5g \ ^3F$	$F[5/2]_2$	-	$3/2[5/2]_2$	
0.2161	2	8 648.341	8 648.3379	11 562.9260	130 912.800	- 142 472.600	$3s^2 3p(^2P)4f \ ^1F$	- $3s^2 3p(^2P_{<3/2>})5g \ ^1F$	$F[5/2]_3$	-	$3/2[5/2]_3$	
0.1274	2	8 566.433	8 566.4227	11 673.4879	130 142.700	- 141 813.000	$3s^2 3p4d$	- $3s^2 3p(^2P)5f \ ^3G$	1F_0	-	$G[7/2]_3$	
0.4046	4	8 540.884	8 540.8709	11 708.4091	130 142.700	- 141 847.900	$3s^2 3p4d$	- $3s^2 3p(^2P)5f \ ^3G$	1F_0	-	$G[7/2]_4$	
4.6523	8	8 347.745	8 347.7438	11 799.2902	130 142.700	- 141 118.700	$3s^2 3p4d$	- $3s^2 3p(^2P)5f \ ^1G$	1F_0	-	$G[9/2]_4$	
0.3870	2	8 076.508	8 076.5103	12 381.5856	129 109.700	- 141 487.900	$3s^2 3p5p$	- $3s^2 3p5d$	1P_1	-	1P_1	
1.0268	14	7 845.617	7 845.6158	12 745.9815	88 893.200	- 101 635.700	$3s^2 3p4s$	- $3s^2 3p4p$	1P_1	-	1P_1	M
0.1553	4	7 735.060	7 735.0579	12 928.1647	111 507.700	- 124 432.300	$3s^2 3p4p$	- $3s^2 3p5s$	1S_0	-	1P_1	M
0.6887	4	7 683.873	7 683.8802	13 014.2584	118 341.700	- 131 352.400	$3s \ 3p^3$	- $3s^2 3p5p$	1P_1	-	1D_2	M
0.0006	1	7 468.562	7 468.5545	13 389.4799	127 949.700	- 141 335.500	$3s^2 3p4d$	- $3s^2 3p(^2P)5f \ ^3F$	3D_2	-	$F[5/2]_2$	
0.0761	3	7 458.143	7 458.1479	13 408.1508	127 949.700	- 141 354.200	$3s^2 3p4d$	- $3s^2 3p(^2P)5f \ ^3F$	3D_2	-	$F[7/2]_3$	
0.0512	0	7 424.202	7 424.2106	13 469.4466	127 888.400	- 141 354.200	$3s^2 3p4d$	- $3s^2 3p(^2P)5f \ ^3F$	3D_3			

0.0983	1	7 351.642	7 351.6436	13 602.4071	127 755.500 - 141 354.200	3s ² 3p4d	- 3s ² 3p(2P)5f	³ F	¹ D ₂ -	F[7/2] ₃	
0.7650	6	7 277.966	7 277.9619	13 740.1140	127 599.200 - 141 335.500	3s ² 3p4d	- 3s ² 3p(2P)5f	³ F	³ D ₁ -	F[5/2] ₂	
0.3722	0	7 069.570	7 069.5652	14 145.1519	127 949.700 - 142 090.900	3s ² 3p4d	- 3s ² 3p(2P)5f	³ D	³ D ₂ -	D[5/2] ₃	
0.2204	2	7 063.025	7 063.0272	14 158.2496	127 949.700 - 142 104.000	3s ² 3p4d	- 3s ² 3p(2P)5f	³ D	³ D ₂ -	D[5/2] ₂	
0.2323	3	7 055.245	7 055.2438	14 173.8623	127 934.100 - 142 104.000	3s ² 3p4d	- 3s ² 3p(2P)5f	³ D	³ P ₁ -	D[5/2] ₂	
0.2812	2	7 039.062	7 039.0619	14 206.4423	127 888.400 - 142 090.900	3s ² 3p4d	- 3s ² 3p(2P)5f	³ D	³ D ₃ -	D[5/2] ₃	
0.0467	3	7 004.605	7 004.6039	14 276.3327	88 893.200 - 103 165.600	3s ² 3p4s	- 3s ² 3p4p	¹ P ₁ -	³ D ₁ -		M
0.0306	0	6 978.130	6 978.1318	14 330.4868	127 949.700 - 142 276.200	3s ² 3p4d	- 3s ² 3p(2P)5f	³ D	³ D ₂ -	D[3/2] ₁	
0.2204	2	6 975.956	6 975.9605	14 334.9446	127 949.700 - 142 280.700	3s ² 3p4d	- 3s ² 3p(2P)5f	¹ D	³ D ₂ -	D[3/2] ₂	
0.0993	2	6 973.787	6 973.7916	14 339.4051	127 755.500 - 142 090.900	3s ² 3p4d	- 3s ² 3p(2P)5f	³ D	¹ D ₂ -	D[5/2] ₃	
0.0846	2	6 970.524	6 970.5318	14 346.1114	127 934.100 - 142 276.200	3s ² 3p4d	- 3s ² 3p(2P)5f	³ D	³ P ₁ -	D[3/2] ₁	
0.2323	1	6 968.370	6 968.3731	14 350.5583	127 934.100 - 142 280.700	3s ² 3p4d	- 3s ² 3p(2P)5f	¹ D	³ P ₁ -	D[3/2] ₂	
0.0687	0	6 967.416	6 967.4251	14 352.4944	127 755.500 - 142 104.000	3s ² 3p4d	- 3s ² 3p(2P)5f	³ D	¹ D ₂ -	D[5/2] ₂	
0.2170	2	6 953.772	6 953.7718	14 380.6885	127 899.500 - 142 276.200	3s ² 3p4d	- 3s ² 3p(2P)5f	³ D	³ P ₀ -	D[3/2] ₁	
0.0044	4	6 920.470	6 920.4638	14 449.9065	88 893.200 - 103 339.100	3s ² 3p4s	- 3s ² 3p4p	¹ P ₁ -	³ D ₂ -		M
0.0002	0	6 889.388	6 889.3891	14 515.0942	87 124.600 - 101 635.700	3s ² 3p4s	- 3s ² 3p4p	³ P ₂ -	¹ P ₁ -		
0.0507	1	6 882.701	6 882.6956	14 529.2030	127 755.500 - 142 280.700	3s ² 3p4d	- 3s ² 3p(2P)5f	¹ D	¹ D ₂ -	D[3/2] ₂	
0.1593	1	6 809.401	6 809.4009	14 685.5817	127 599.200 - 142 280.700	3s ² 3p4d	- 3s ² 3p(2P)5f	¹ D	³ D ₁ -	D[3/2] ₂	
0.4481	2	6 789.880	6 789.8903	14 727.7791	127 367.200 - 142 090.900	3s ² 3p4d	- 3s ² 3p(2P)5f	³ D	³ P ₂ -	D[5/2] ₃	
0.0471	1	6 783.853	6 783.8600	14 740.8702	127 367.200 - 142 104.000	3s ² 3p4d	- 3s ² 3p(2P)5f	³ D	³ P ₂ -	D[5/2] ₂	
0.0616	11	6 713.279	6 713.2803	14 895.8260	86 743.000 - 101 635.700	3s ² 3p4s	- 3s ² 3p4p	³ P ₁ -	¹ P ₁ -		M
0.1169	3	6 649.383	6 649.3767	15 039.0187	132 163.500 - 147 198.300	3s ² 3p(2P)4f	³ D	- 3s ² 3p(2P<1/2>)6g	³ G	D[5/2] ₂ -	1/2[7/2] ₃
0.0062	5	6 647.920	6 647.9206	15 042.2989	86 597.500 - 101 635.700	3s ² 3p4s	- 3s ² 3p4p	³ P ₀ -	¹ P ₁ -		M
0.3004	2	6 635.745	6 635.7437	15 069.9093	132 132.500 - 147 198.200	3s ² 3p(2P)4f	³ D	- 3s ² 3p(2P<1/2>)6g	³ G	D[5/2] ₃ -	1/2[7/2] ₄
0.1291	1	6 610.838	6 610.8381	15 126.6936	132 077.700 - 147 200.200	3s ² 3p(2P)4f	¹ G	- 3s ² 3p(2P<1/2>)6g	³ G	G[9/2] ₄ -	1/2[9/2] ₅
0.0062	0	6 587.502	6 587.4988	15 180.2887	103 165.600 - 118 341.700	3s ² 3p4p	- 3s 3p ³	³ D ₁ -	¹ P ₁ -		
0.3721	15	6 507.984	6 507.9831	15 365.7510	87 804.100 - 103 165.600	3s ² 3p3d	- 3s ² 3p4p	³ F ₂ -	³ D ₁ -		M
0.5631	16	6 503.410	6 503.3987	15 376.5959	87 966.800 - 103 339.100	3s ² 3p3d	- 3s ² 3p4p	³ F ₃ -	³ D ₂ -		M
0.1226	0	6 480.597	6 480.6153	15 430.6224	132 396.900 - 147 823.300	3s ² 3p(2P)4f	¹ D	- 3s ² 3p(2P<1/2>)6g	³ F	D[3/2] ₂ -	3/2[5/2] ₂
0.5421	5	6 480.507	6 480.5201	15 430.8605	132 396.900 - 147 823.300	3s ² 3p(2P)4f	¹ D	- 3s ² 3p(2P<1/2>)6g	³ F	D[3/2] ₂ -	3/2[5/2] ₃
0.6116	4	6 470.062	6 470.0617	15 455.8072	132 371.700 - 147 823.300	3s ² 3p(2P)4f	³ D	- 3s ² 3p(2P<1/2>)6g	³ F	D[3/2] ₁ -	3/2[5/2] ₂
0.8248	17	6 459.947	6 459.9438	15 480.0199	88 192.100 - 103 667.900	3s ² 3p3d	- 3s ² 3p4p	³ F ₄ -	³ D ₃ -		M
0.0048	1	6 445.895	6 445.8909	15 513.7615	131 688.700 - 147 198.200	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	¹ G	G[7/2] ₄ -	1/2[7/2] ₄
0.0004	1	6 445.895	6 445.8743	15 513.8818	131 688.700 - 147 198.300	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	³ G	G[7/2] ₄ -	1/2[7/2] ₃
0.0930	6	6 445.053	6 445.0527	15 515.7834	131 688.700 - 147 200.200	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	¹ G	G[7/2] ₄ -	1/2[9/2] ₅
0.0483	5	6 436.316	6 436.3176	15 536.8285	107 922.900 - 123 455.500	3s ² 3p4p	- 3s ² 3p5s	¹ D ₂ -	³ P ₁ -		M
0.0698	13	6 435.293	6 435.2809	15 539.3394	87 804.100 - 103 339.100	3s ² 3p3d	- 3s ² 3p4p	³ F ₂ -	³ D ₂ -		M
0.0217	2	6 421.986	6 422.0000	15 571.4731	131 631.200 - 147 198.300	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	³ G	G[7/2] ₃ -	1/2[7/2] ₃
0.0031	5	6 421.360	6 421.3702	15 573.0008	131 631.200 - 147 199.900	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	³ G	G[7/2] ₃ -	1/2[9/2] ₄
0.1499	5	6 413.758	6 413.7543	15 591.5026	132 163.500 - 147 750.700	3s ² 3p(2P)4f	³ D	- 3s ² 3p(2P<1/2>)6g	³ F	D[5/2] ₂ -	3/2[7/2] ₃
0.9681	6	6 401.083	6 401.0831	15 622.3637	132 132.500 - 147 750.500	3s ² 3p(2P)4f	³ D	- 3s ² 3p(2P<1/2>)6g	³ F	D[5/2] ₃ -	3/2[7/2] ₄
0.0391	6	6 401.083	6 401.0743	15 622.5102	132 132.500 - 147 750.700	3s ² 3p(2P)4f	³ D	- 3s ² 3p(2P<1/2>)6g	³ F	D[5/2] ₃ -	3/2[7/2] ₃
0.0696	1 bl	6 392.383	6 392.3826	15 643.6257	132 077.700 - 147 717.000	3s ² 3p(2P)4f	¹ G	- 3s ² 3p(2P<1/2>)6g	³ H	G[9/2] ₄ -	3/2[9/2] ₄
0.9925	1	6 392.313	6 392.2979	15 643.8459	132 077.700 - 147 717.200	3s ² 3p(2P)4f	¹ G	- 3s ² 3p(2P<1/2>)6g	³ H	G[9/2] ₄ -	3/2[9/2] ₅
0.1226	0	6 384.003	6 384.0189	15 664.1359	132 163.500 - 147 823.300	3s ² 3p(2P)4f	³ D	- 3s ² 3p(2P<1/2>)6g	³ F	D[5/2] ₂ -	3/2[5/2] ₂
0.0055	0	6 378.669	6 378.6704	15 677.2493	132 077.700 - 147 750.700	3s ² 3p(2P)4f	¹ G	- 3s ² 3p(2P<1/2>)6g	³ F	G[9/2] ₄ -	3/2[7/2] ₃
0.0706	12	6 367.252	6 367.2280	15 705.3920	87 966.800 - 103 667.900	3s ² 3p3d	- 3s ² 3p4p	³ F ₃ -	³ D ₃ -		M
0.1878	6	6 361.702	6 361.7420	15 718.8464	132 077.700 - 147 792.200	3s ² 3p(2P)4f	¹ G	- 3s ² 3p(2P<1/2>)6g	¹ H	G[9/2] ₄ -	3/2[11/2] ₅
0.0298	7	6 336.605	6 336.6065	15 781.3089	131 940.300 - 147 717.200	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	³ H	G[9/2] ₅ -	3/2[9/2] ₅
2.0562	7	6 306.821	6 306.8307	15 855.8261	131 940.300 - 147 791.700	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	³ H	G[9/2] ₅ -	3/2[11/2] ₆
0.0020	5	6 301.930	6 301.9412	15 868.1295	87 804.100 - 103 667.900	3s ² 3p3d	- 3s ² 3p4p	³ F ₂ -	³ D ₃ -		M
0.0026	0	6 260.850	6 260.8451	15 972.2976	107 922.900 - 123 890.800	3s ² 3p4p	- 3s ² 3p5s	¹ D ₂ -	³ P ₂ -		M
0.0509	1	6 256.519	6 256.5206	15 983.3262	125 391.100 - 141 370.000	3s ² 3p4d	- 3s ² 3p(2P)5f	³ F	³ F ₄ -	F[7/2] ₄	
0.0061	6	6 237.161	6 237.2213	16 032.7324	131 688.700 - 147 717.000	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	³ H	G[7/2] ₄ -	3/2[9/2] ₄
0.4413	6	6 237.161	6 237.1508	16 032.9638	131 688.700 - 147 717.200	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	³ H	G[7/2] ₄ -	3/2[9/2] ₅
0.0207	9	6 232.304	6 232.3008	16 045.4407	87 124.600 - 103 165.600	3s ² 3p4s	- 3s ² 3p4p	³ P ₂ -	³ D ₁ -		M
0.0266	2	6 224.255	6 224.2409	16 066.2185	131 688.700 - 147 750.500	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	³ F	G[7/2] ₄ -	3/2[7/2] ₄
0.0005	2	6 224.255	6 224.2189	16 066.3476	131 688.700 - 147 750.700	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	³ F	G[7/2] ₄ -	3/2[7/2] ₃
0.0031	6	6 214.916	6 214.9211	16 090.3117	131 631.200 - 147 717.000	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	³ H	G[7/2] ₃ -	3/2[9/2] ₄
0.0217	2	6 201.945	6 201.9504	16 123.9610	131 631.200 - 147 750.700	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	³ F	G[7/2] ₃ -	3/2[7/2] ₃
0.0055	0	6 196.081	6 196.0808	16 139.2364	131 688.700 - 147 823.500	3s ² 3p(2P)4f	³ G	- 3s ² 3p(2P<1/2>)6g	³ F	G[7/2] ₄ -	3/2[5/2] ₃
0.0254	0	6 181.310	6 181.3203	16 177.7743	131 024.900 - 147 198.200	3s ² 3p(2P)4f	³ F	- 3s ² 3p(2P<1/2>)6g	³ G	F[7/2] ₄ -	1/2[7/2] ₄
0.0006	0	6 181.310	6 181.2787	16 177.9052	131 024.900 - 147 198.300	3s ² 3p(2P)4f	³ F	- 3s ² 3p(2P<1/2>)6g	³ G	F[7/2] ₄ -	1/2[7/2] ₃
1.1945</											

0.0013	4	6 169.117		6 169.1136	16 209.7936	130 993.000 - 147 198.300	$3s^2 3p(^2P)4f \ ^3F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3G$	$F[7/2]_3$	-	$1/2[7/2]_3$	
0.9004	6	6 168.521		6 168.5219	16 211.3441	130 993.000 - 147 199.900	$3s^2 3p(^2P)4f \ ^3F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3G$	$F[7/2]_3$	-	$1/2[9/2]_4$	
0.3643	12	6 165.603	6 165.59	6 165.5934	16 219.0480	87 124.600 - 103 339.100	$3s^2 3p4s$	-	$3s^2 3p4p$	3P_2	-	3D_2	M
0.0509	1	6 161.504		6 161.5108	16 229.7878	125 128.900 - 141 354.200	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^3F$	3F_3	-	$F[7/2]_3$	
0.0943	6	6 155.482		6 155.5015	16 245.6340	125 128.900 - 141 370.000	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^3F$	3F_3	-	$F[7/2]_4$	
0.7777	6	6 152.513		6 152.5126	16 253.5290	130 949.300 - 147 198.300	$3s^2 3p(^2P)4f \ ^3F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3G$	$F[5/2]_2$	-	$1/2[7/2]_3$	
0.1479	6	6 138.762		6 138.7802	16 289.8817	130 912.800 - 147 198.200	$3s^2 3p(^2P)4f \ ^1F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^1G$	$F[5/2]_3$	-	$1/2[7/2]_4$	
0.0541	6	6 138.762		6 138.7499	16 289.9878	130 912.800 - 147 198.300	$3s^2 3p(^2P)4f \ ^1F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3G$	$F[5/2]_3$	-	$1/2[7/2]_3$	
0.0018	3	6 121.690	6 121.65	6 121.6690	16 335.3584	88 893.200 - 105 224.100	$3s^2 3p4s$	-	$3s^2 3p4p$	1P_1	-	3P_0	M
0.0908	5	6 104.139		6 104.1428	16 382.3241	124 946.700 - 141 324.500	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^1F$	3F_2	-	$F[5/2]_3$	
0.0184	2	6 100.059		6 100.0687	16 393.2814	124 946.700 - 141 335.500	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^3F$	3F_2	-	$F[5/2]_2$	
0.0488	3	6 093.120		6 093.1125	16 411.9801	124 946.700 - 141 354.200	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^3F$	3F_2	-	$F[7/2]_3$	
0.0149	7	6 092.478	6 092.49	6 092.4768	16 413.7041	88 893.200 - 105 302.400	$3s^2 3p4s$	-	$3s^2 3p4p$	1P_1	-	3P_1	M
0.3888	12	6 087.830	6 087.82	6 087.8334	16 426.2143	86 743.000 - 103 165.600	$3s^2 3p4s$	-	$3s^2 3p4p$	3P_1	-	3D_1	M
0.0509	3	6 074.828		6 074.8406	16 461.3389	125 391.100 - 141 847.900	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^3G$	3F_4	-	$G[7/2]_4$	
0.2277	10	6 057.885	6 057.86	6 057.8962	16 507.3978	112 606.900 - 129 109.700	$3s \ 3p^3$	-	$3s^2 3p5p$	1D_2	-	1P_1	M
2.2310	11	6 055.498	6 055.50	6 055.5006	16 513.9130	107 922.900 - 124 432.300	$3s^2 3p4p$	-	$3s^2 3p5s$	1D_2	-	1P_1	M
2.6846	17	6 043.090	6 043.12	6 043.0989	16 547.8257	87 124.600 - 103 667.900	$3s^2 3p4s$	-	$3s^2 3p4p$	3P_2	-	3D_3	M
0.6870	14	6 034.036	6 034.04	6 034.0407	16 572.6445	86 597.500 - 103 165.600	$3s^2 3p4s$	-	$3s^2 3p4p$	3P_0	-	3D_1	M
1.5436	16	6 024.175	6 024.18	6 024.1815	16 599.7696	86 743.000 - 103 339.100	$3s^2 3p4s$	-	$3s^2 3p4p$	3P_1	-	3D_2	M
0.3146	7	6 016.547	6 016.55	6 016.5358	16 620.8762	125 391.100 - 142 007.400	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^3G$	3F_4	-	$G[9/2]_3$	M
0.0227	3	5 992.056		5 992.0602	16 688.7514	125 128.900 - 141 813.000	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^3G$	3F_3	-	$G[7/2]_3$	
0.0223	4	5 989.110		5 989.1205	16 696.7486	131 024.900 - 147 717.000	$3s^2 3p(^2P)4f \ ^3F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3H$	$F[7/2]_4$	-	$3/2[9/2]_4$	
1.1945	4	5 989.110		5 989.1102	16 696.9717	131 024.900 - 147 717.200	$3s^2 3p(^2P)4f \ ^3F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3H$	$F[7/2]_4$	-	$3/2[9/2]_5$	
0.0020	0	5 986.433		5 986.4328	16 704.4466	125 391.100 - 142 090.900	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^3D$	3F_4	-	$D[5/2]_3$	
0.3005	4	5 984.201	5 984.23	5 984.2111	16 710.6435	101 635.700 - 118 341.700	$3s^2 3p4p$	-	$3s \ 3p^3$	1P_1	-	1P_1	M
0.0943	4	5 979.551	5 979.54	5 979.5405	16 723.6945	125 128.900 - 141 847.900	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^3G$	3F_3	-	$G[7/2]_4$	M
0.2507	1	5 977.771		5 977.7707	16 728.6463	130 993.000 - 147 717.000	$3s^2 3p(^2P)4f \ ^3F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3H$	$F[7/2]_3$	-	$3/2[9/2]_4$	
0.0872	1	5 977.196		5 977.2034	16 730.2416	131 024.900 - 147 750.500	$3s^2 3p(^2P)4f \ ^3F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3F$	$F[7/2]_4$	-	$3/2[7/2]_4$	
0.0014	1	5 977.196		5 977.1688	16 730.4095	131 024.900 - 147 750.700	$3s^2 3p(^2P)4f \ ^3F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3F$	$F[7/2]_4$	-	$3/2[7/2]_3$	
0.0070	1	5 965.771		5 965.7817	16 762.2675	130 993.000 - 147 750.700	$3s^2 3p(^2P)4f \ ^3F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3F$	$F[7/2]_3$	-	$3/2[7/2]_3$	
0.0012	1	5 961.875		5 961.8807	16 773.2326	130 142.700 - 146 911.300	$3s^2 3p4d$	-	$3s^2 3p(^2P)6f \ ^1F$	1F_3	-	$F[7/2]_3$	
0.0014	2	5 958.158		5 958.1713	16 783.6769	130 142.700 - 146 921.800	$3s^2 3p4d$	-	$3s^2 3p(^2P)6f \ ^3F$	1F_3	-	$F[7/2]_4$	
0.0036	2	5 950.245		5 950.256	16 806.0166	130 949.300 - 147 750.700	$3s^2 3p(^2P)4f \ ^3F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3F$	$F[5/2]_2$	-	$3/2[7/2]_3$	
0.2247	2	5 937.416		5 937.4108	16 842.3606	130 912.800 - 147 750.500	$3s^2 3p(^2P)4f \ ^1F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3F$	$F[5/2]_3$	-	$3/2[7/2]_4$	
0.0571	3	5 927.342		5 927.3521	16 870.9457	124 946.700 - 141 813.000	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^3G$	3F_2	-	$G[7/2]_3$	
0.0332	1	5 924.598		5 924.6432	16 878.6627	130 949.300 - 147 823.300	$3s^2 3p(^2P)4f \ ^3F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^3F$	$F[5/2]_2$	-	$3/2[5/2]_2$	
0.0009	1	5 924.598		5 924.5739	16 878.9191	130 949.300 - 147 823.500	$3s^2 3p(^2P)4f \ ^3F$	-	$3s^2 3p(^2P_{<1/2>})6g \ ^1F$	$F[5/2]_2$	-	$3/2[5/2]_3$	
0.0302	1	5 893.721	5 893.70	5 893.7312	16 967.1838	112 606.900 - 129 569.400	$3s \ 3p^3$	-	$3s^2 3p5p$	1D_2	-	3D_1	M
0.0943	1	5 884.229		5 884.2402	16 994.5481	125 128.900 - 142 118.700	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^1G$	3F_3	-	$G[9/2]_4$	
0.0079	2	5 843.586	5 843.61	5 843.5904	17 112.7680	88 893.200 - 106 001.200	$3s^2 3p4s$	-	$3s^2 3p4p$	1P_1	-	3S_1	M
0.0039	1	5 798.803		5 798.7997	17 244.9502	130 142.700 - 147 382.900	$3s^2 3p4d$	-	$3s^2 3p(^2P)6f \ ^3G$	1F_3	-	$G[7/2]_3$	
0.1833	3	5 797.049		5 797.0512	17 250.1501	130 142.700 - 147 388.100	$3s^2 3p4d$	-	$3s^2 3p(^2P)6f \ ^3G$	1F_3	-	$G[7/2]_4$	
0.0002	0	5 768.893		5 768.9001	17 334.3272	124 946.700 - 142 276.200	$3s^2 3p4d$	-	$3s^2 3p(^2P)5f \ ^3D$	3F_2	-	$D[3/2]_1$	
0.0040	6	5 764.460	5 764.46	5 764.4369	17 347.7509	106 001.200 - 123 344.200	$3s^2 3p4p$	-	$3s^2 3p5s$	3S_1	-	3P_0	M
0.0002	0	5 741.353		5 741.3620	17 417.4699	112 606.900 - 130 019.500	$3s \ 3p^3$	-	$3s^2 3p5p$	1D_2	-	3D_3	
0.0213	9	5 730.255		5 730.2581	17 451.2212	130 142.700 - 147 589.100	$3s^2 3p4d$	-	$3s^2 3p(^2P)6f \ ^1G$	1F_3	-	$G[9/2]_4$	
0.0337	9	5 727.697	5 727.71	5 727.6885	17 459.0515	106 001.200 - 123 455.500	$3s^2 3p4p$	-	$3s^2 3p5s$	3S_1	-	3P_1	M
0.0069	3	5 691.052	5 691.05	5 691.0524	17 571.4437	112 606.900 - 130 173.400	$3s \ 3p^3$	-	$3s^2 3p5p$	1D_2	-	3P_1	M
0.2340	10	5 588.307	5 588.34	5 588.3002	17 894.5296	106 001.200 - 123 890.800	$3s^2 3p4p$	-	$3s^2 3p5s$	3S_1	-	3P_2	M
0.3413	11	5 583.235	5 583.27	5 583.2363	17 910.7600	105 549.700 - 123 455.500	$3s^2 3p4p$	-	$3s^2 3p5s$	3P_2	-	3P_1	M
0.3211	11	5 541.143	5 541.14	5 541.1391	18 046.8312	105 302.400 - 123 344.200	$3s^2 3p4p$	-	$3s^2 3p5s$	3P_1	-	3P_0	M
0.2863	7	5 507.176	5 507.19	5 507.1744	18 158.1334	105 302.400 - 123 455.500	$3s^2 3p4p$	-	$3s^2 3p5s$	3P_1	-	3P_1	M
0.3767	13	5 499.701	5 499.73	5 499.6976	18 182.8199	87 124.600 - 105 302.400	$3s^2 3p4s$	-	$3s^2 3p4p$	3P_2	-	3P_1	M
0.3119	11	5 483.523	5 483.55	5 483.5183	18 236.4679	105 224.100 - 123 455.500	$3s^2 3p4p$	-	$3s^2 3p5s$	3P_0	-	3P_1	M
0.1487	2	5 465.280		5 465.2803	18 297.3242	132 163.500 - 150 455.700	$3s^2 3p(^2P)4f \ ^3D$	-	$3s^2 3p(^2P_{<1/2>})7g \ ^3G$	$D[5/2]_2$	-	$1/2[7/2]_3$	
0.2612	2	5 456.041		5 456.0401	18 328.3114	132 132.500 - 150 455.700	$3s^2 3p(^2P)4f \ ^3D$	-	$3s^2 3p(^2P_{<1/2>})7g \ ^3G$	$D[5/2]_3$	-	$1/2[7/2]_4$	
1.3089	13	5 450.713	5 450.74	5 450.7098	18 346.2372	105 549.700 - 123 890.800	$3s^2 3p4p$	-	$3s^2 3p5s$	3P_2	-	3P_2	M
1.8868	16	5 425.882	5 425.91	5 425.8804	18 430.1901	87 124.600 - 105 549.700	$3s^2 3p4s$	-	$3s^2 3p4p$	3P_2	-	3P_2	M
0.4708	14	5 409.722	5 409.72	5 409.7222	18 485.2382	86 743.000 - 105 224.100	$3s^2 3p4s$	-	$3s^2 3p4p$	3P_1	-	3P_0	M
0.5237	14	5 386.895	5 386.88	5 386.8955	18 563.5696	86 743.000 - 105 302.400	$3s^2 3p4s$	-	$3s^2 3p4p$	3P_1	-	3P_1	M
0.3363	9	5 378.194	5 378.193	5 378.1932	18 593.6057	105 302.400 - 123 890.800	$3s^2 3p4p$	-	$3s^2 3p5s$	3P_1	-	3P_2	M
0.0471	4	5 358.365		5 358.3654	18 662.4091	132 396.900 - 151 054.100	$3s^2 3p(^2P)4f \ ^1D$	-	3				

0.4925	14	5 344.730	5 344.75	5 344.7296	18 710.0225	86 597.500	- 105 302.400	3s ² 3p4s	- 3s ² 3p4p	³ P ₀ -	³ P ₁ M
0.0030	7	5 333.125	5 333.11	5 333.1229	18 750.7430	112 606.900	- 131 352.400	3s 3p ³	- 3s ² 3p5p	¹ D ₂ -	¹ D ₂ M
0.0343	4	5 327.032		5 327.0370	18 772.1617	131 688.700	- 150 455.700	3s ² 3p(² P)4f ³ G	- 3s ² 3p(² P _{<1/2>)7g ³G}	G[7/2] ₄ -	1/2[7/2] ₄
0.0001	4	5 327.032		5 327.0298	18 772.1899	131 688.700	- 150 455.700	3s ² 3p(² P)4f ³ G	- 3s ² 3p(² P _{<1/2>)7g ³G}	G[7/2] ₄ -	1/2[7/2] ₃
0.3537	4	5 327.032		5 327.0295	18 772.1899	131 688.700	- 150 455.700	3s ² 3p(² P)4f ³ G	- 3s ² 3p(² P _{<1/2>)7g ³G}	G[7/2] ₄ -	1/2[9/2] ₅
0.4826	14	5 316.051	5 316.07	5 316.0551	18 810.9416	86 743.000	- 105 549.700	3s ² 3p4s	- 3s ² 3p4p	³ P ₁ -	³ P ₂ M
0.1259	3	5 310.808		5 310.8079	18 829.5301	131 631.200	- 150 455.400	3s ² 3p(² P)4f ³ G	- 3s ² 3p(² P _{<1/2>)7g ³G}	G[7/2] ₃ -	1/2[9/2] ₄
0.0020	4	5 296.979		5 296.9774	18 878.6925	132 132.500	- 151 005.900	3s ² 3p(² P)4f ³ D	- 3s ² 3p(² P _{<1/2>)7g ³F}	D[5/2] ₃ -	3/2[7/2] ₄
0.8293	14	5 296.073	5 296.13	5 296.0762	18 881.9043	87 124.600	- 106 001.200	3s ² 3p4s	- 3s ² 3p4p	³ P ₂ -	³ S ₁ M
0.0075	3	5 294.410	5 294.39	5 294.4115	18 887.8423	105 549.700	- 124 432.300	3s ² 3p4p	- 3s ² 3p5s	³ P ₂ -	¹ P ₁ M
0.0338	0	5 292.242		5 292.2417	18 895.5870	132 163.500	- 151 053.800	3s ² 3p(² P)4f ³ D	- 3s ² 3p(² P _{<1/2>)7g ³F}	D[5/2] ₂ -	3/2[5/2] ₂
0.0042	0	5 287.256		5 287.2682	18 913.3594	132 077.700	- 150 985.800	3s ² 3p(² P)4f ³ G	- 3s ² 3p(² P _{<1/2>)7g ³H}	G[9/2] ₄ -	3/2[9/2] ₄
0.0245	0	5 287.256		5 287.2393	18 913.4918	132 077.700	- 150 986.000	3s ² 3p(² P)4f ³ G	- 3s ² 3p(² P _{<1/2>)7g ³H}	G[9/2] ₄ -	3/2[9/2] ₅
0.0291	0	5 283.474		5 283.4736	18 926.9445	132 132.500	- 151 054.100	3s ² 3p(² P)4f ³ D	- 3s ² 3p(² P _{<1/2>)7g ³F}	D[5/2] ₃ -	3/2[5/2] ₃
0.0200	3	5 277.054		5 277.0584	18 949.9528	127 949.700	- 146 894.400	3s ² 3p4d	- 3s ² 3p(² P)6f ³ F	³ D ₂ -	F[5/2] ₃
0.3909	5	5 273.747		5 273.7450	18 961.8573	132 077.700	- 151 034.300	3s ² 3p(² P)4f ¹ G	- 3s ² 3p(² P _{<1/2>)7g ¹H}	G[9/2] ₄ -	3/2[11/2] ₅
0.0675	0	5 272.348		5 272.3446	18 966.8959	127 949.700	- 146 911.300	3s ² 3p4d	- 3s ² 3p(² P)6f ¹ F	³ D ₂ -	F[7/2] ₃
0.0000	0	5 263.652		5 263.6583	18 998.1948	127 888.400	- 146 881.300	3s ² 3p4d	- 3s ² 3p(² P)6f ³ F	³ D ₃ -	F[5/2] ₂
0.0003	2	5 260.050		5 260.0438	19 011.2514	127 888.400	- 146 894.400	3s ² 3p4d	- 3s ² 3p(² P)6f ³ F	³ D ₃ -	F[5/2] ₃
2.2310	16	5 253.471	5 253.52	5 253.4792	19 035.0052	88 893.200	- 107 922.900	3s ² 3p4s	- 3s ² 3p4p	¹ P ₁ -	¹ D ₂ M
0.1092	5	5 225.479		5 252.4774	19 038.6364	127 888.400	- 146 921.800	3s ² 3p4d	- 3s ² 3p(² P)6f ³ F	³ D ₃ -	F[7/2] ₄
0.0002	1	5 249.139		5 249.1091	19 050.8522	131 940.300	- 150 985.800	3s ² 3p(² P)4f ³ G	- 3s ² 3p(² P _{<1/2>)7g ³H}	G[9/2] ₅ -	3/2[9/2] ₄
0.0000	1	5 249.072		5 249.0747	19 050.9793	131 940.300	- 150 986.000	3s ² 3p(² P)4f ³ G	- 3s ² 3p(² P _{<1/2>)7g ³H}	G[9/2] ₅ -	3/2[9/2] ₅
0.7336	7	5 235.901		5 235.9020	19 098.9060	131 940.300	- 151 033.900	3s ² 3p(² P)4f ³ G	- 3s ² 3p(² P _{<1/2>)7g ³H}	G[9/2] ₅ -	3/2[11/2] ₆
0.0294	7	5 225.966	5 225.97	5 225.9674	19 135.2146	105 302.400	- 124 432.300	3s ² 3p4p	- 3s ² 3p5s	³ P ₁ -	¹ P ₁ M
0.0010	3	5 223.515		5 223.5125	19 144.2080	127 755.500	- 146 894.400	3s ² 3p4d	- 3s ² 3p(² P)6f ³ F	¹ D ₂ -	F[5/2] ₃
0.0010	0	5 218.896		5 218.8930	19 161.1516	127 755.500	- 146 911.300	3s ² 3p4d	- 3s ² 3p(² P)6f ¹ F	¹ D ₂ -	F[7/2] ₃
0.0199	4	5 204.657	5 204.66	5 204.6610	19 213.5472	105 224.100	- 124 432.300	3s ² 3p4p	- 3s ² 3p5s	³ P ₀ -	¹ P ₁ M
0.2186	12	5 191.397	5 191.41	5 191.3937	19 262.6526	86 743.000	- 106 001.200	3s ² 3p4s	- 3s ² 3p4p	³ P ₁ -	³ S ₁ M
0.0716	2	5 184.702		5 184.6946	19 287.5414	127 959.200	- 146 881.300	3s ² 3p4d	- 3s ² 3p(² P)6f ³ F	³ D ₁ -	F[5/2] ₂
1.0619	13	4 943.497	4 943.53	4 943.4979	20 228.5952	103 667.900	- 123 890.800	3s ² 3p4p	- 3s ² 3p5s	³ D ₃ -	³ P ₂ M
0.7403	11	4 935.629	4 935.62	4 935.6314	20 260.8339	111 507.700	- 131 762.800	3s ² 3p4p	- 3s ² 3p4d	¹ S ₀ -	¹ P ₁ M
0.1306	10	4 927.200	4 927.20	4 927.1987	20 295.5107	103 165.600	- 123 455.500	3s ² 3p4p	- 3s ² 3p5s	³ D ₁ -	³ P ₁ M
0.1300	10	4 864.426	4 864.42	4 864.4262	20 557.4100	103 339.100	- 123 890.800	3s ² 3p4p	- 3s ² 3p5s	³ D ₂ -	³ P ₂ M
0.0062	4	4 823.696	4 823.68	4 823.6961	20 730.9913	103 165.600	- 123 890.800	3s ² 3p4p	- 3s ² 3p5s	³ D ₁ -	³ P ₂ M
0.0038	5	4 806.733	4 806.72	4 806.7354	20 804.1425	87 124.600	- 107 922.900	3s ² 3p4s	- 3s ² 3p4p	³ P ₂ -	¹ D ₂ M
0.0250	7	4 739.558		4 739.5565	21 099.0227	103 339.100	- 124 432.300	3s ² 3p4p	- 3s ² 3p5s	³ D ₂ -	¹ P ₁
0.0039	7	4 720.336	4 720.32	4 720.3443	21 184.8966	86 743.000	- 107 922.900	3s ² 3p4s	- 3s ² 3p4p	³ P ₁ -	¹ D ₂ M
0.0394	7	4 700.887	4 700.86	4 700.8831	21 272.5992	103 165.600	- 124 432.300	3s ² 3p4p	- 3s ² 3p5s	³ D ₁ -	¹ P ₁ M
0.0127	4	4 698.185	4 698.16	4 698.1839	21 284.8243	103 667.900	- 124 946.700	3s ² 3p4p	- 3s ² 3p4d	³ D ₃ -	³ F ₂ M
0.0006	9	4 679.027	4 679.01	4 679.0287	21 371.9601	106 001.200	- 127 367.200	3s ² 3p4p	- 3s ² 3p4d	³ S ₁ -	³ P ₂ M
0.4797	10	4 658.308	4 658.31	4 658.3092	21 467.0173	103 667.900	- 125 128.900	3s ² 3p4p	- 3s ² 3p4d	³ D ₃ -	³ F ₃ M
0.0819	0	4 643.239		4 643.2467	21 536.6577	125 391.100	- 146 921.800	3s ² 3p4d	- 3s ² 3p(² P)6f ³ F	³ F ₄ -	F[7/2] ₄
0.5096	10	4 626.707	4 626.707	4 626.7076	21 613.6444	103 339.100	- 124 946.700	3s ² 3p4p	- 3s ² 3p4d	³ D ₂ -	³ F ₂ M
0.0025	2	4 605.193	4 605.18	4 605.2013	21 714.5788	101 635.700	- 123 344.200	3s ² 3p4p	- 3s ² 3p5s	¹ P ₁ -	³ P ₀ M
6.3241	14	4 602.071	4 602.08	4 602.0702	21 729.3522	103 667.900	- 125 391.100	3s ² 3p4p	- 3s ² 3p4d	³ D ₃ -	³ F ₄ M
0.0105	12	4 589.545		4 589.5660	21 788.5525	125 128.900	- 146 911.300	3s ² 3p4d	- 3s ² 3p(² P)6f ¹ F	³ F ₃ -	F[7/2] ₃
4.4424	13	4 588.037	4 588.04	4 588.0326	21 795.8375	103 339.100	- 125 128.900	3s ² 3p4p	- 3s ² 3p4d	³ D ₂ -	³ F ₃ M
0.0008	4	4 587.371		4 587.3684	21 798.9923	125 128.900	- 146 921.800	3s ² 3p4d	- 3s ² 3p(² P)6f ³ F	³ F ₃ -	F[7/2] ₄
0.3863	5	4 582.177	4 582.17	4 582.1802	21 823.6734	105 549.700	- 127 367.200	3s ² 3p4p	- 3s ² 3p4d	³ P ₂ -	³ P ₂ M
0.0798	7	4 581.717	4 581.71	4 581.7164	21 825.8835	101 635.700	- 123 455.500	3s ² 3p4p	- 3s ² 3p5s	¹ P ₁ -	³ P ₁ M
0.4481	9	4 565.288	4 565.27	4 565.2871	21 904.4279	106 001.200	- 127 899.500	3s ² 3p4p	- 3s ² 3p4d	³ S ₁ -	³ P ₀ M
0.9193	10	4 558.093	4 558.07	4 558.0956	21 938.9898	106 001.200	- 127 934.100	3s ² 3p4p	- 3s ² 3p4d	³ S ₁ -	³ P ₁ M
0.0397	3	4 555.020		4 555.0193	21 953.8052	124 946.700	- 146 894.400	3s ² 3p4d	- 3s ² 3p(² P)6f ³ F	³ F ₂ -	F[5/2] ₃
0.0926	1	4 551.499		4 551.5066	21 970.7499	124 946.700	- 146 911.300	3s ² 3p4d	- 3s ² 3p(² P)6f ¹ F	³ F ₂ -	F[7/2] ₃
0.0024	3	4 544.810		4 544.8094	22 003.1248	125 391.100	- 147 388.100	3s ² 3p4d	- 3s ² 3p(² P)6f ³ G	³ F ₄ -	G[7/2] ₄
0.1566	3	4 533.986	4 533.96	4 533.9812	22 055.6724	105 549.700	- 127 599.200	3s ² 3p4p	- 3s ² 3p4d	³ P ₂ -	³ D ₁ M
1.1733	10	4 530.822	4 530.81	4 530.8236	22 071.0453	105 302.400	- 127 367.200	3s ² 3p4p	- 3s ² 3p4d	³ P ₁ -	³ P ₂ M
0.5656	7	4 519.884	4 519.87	4 519.8833	22 124.4665	125 391.100	- 147 509.400	3s ² 3p4d	- 3s ² 3p(² P)6f ³ G	³ F ₄ -	G[9/2] ₅ M
0.0819	0	4 503.649		4 503.6538	22 204.1973	125 391.100	- 147 589.100	3s ² 3p4d	- 3s ² 3p(² P)6f ¹ G	³ F ₄ -	G[9/2] ₄
4.0485	12	4 499.231	4 499.24	4 499.2317	22 226.0204	107 922.900	- 130 142.700	3s ² 3p4p	- 3s ² 3p4d	¹ D ₂ -	¹ F ₃ M
0.0395	0	4 492.303		4 492.3105	22 260.2625	125 128.900	- 147 382.900	3s ² 3p4d	- 3s ² 3p(² P)6f ³ G	³ F ₃ -	G[7/2] ₃
0.0005	0	4 492.071		4 492.0882	22 261.3626	101 635.700					

0.6644	7	4 483.693	4 483.68	4 483.6931	22 303.0435	105 302.400 - 127 599.200	3s ² 3p4p	- 3s ² 3p4d	³ P ₁ -	³ D ₁	M
0.0009	1	4 482.042		4 482.0525	22 311.2092	107 360.200 - 129 665.200	3s ² 3p3d	- 3s ² 3p5p	¹ F ₃ -	³ D ₂	
3.3062	11	4 475.271	4 475.26	4 475.2702	22 345.0205	105 549.700 - 127 888.400	3s ² 3p4p	- 3s ² 3p4d	³ P ₂ -	³ D ₃	M
0.4608	10	4 467.998	4 467.98	4 468.0003	22 381.3786	105 224.100 - 127 599.200	3s ² 3p4p	- 3s ² 3p4d	³ P ₀ -	³ D ₁	M
0.2004	8	4 466.140	4466140	4 466.1409	22 390.6998	105 549.700 - 127 934.100	3s ² 3p4p	- 3s ² 3p4d	³ P ₂ -	³ P ₁	M
1.0945	10	4 463.024	4 463.00	4 463.0278	22 406.3175	105 549.700 - 127 949.700	3s ² 3p4p	- 3s ² 3p4d	³ P ₂ -	³ D ₂	M
0.0926	3	4 455.849		4 455.8404	22 442.4575	124 946.700 - 147 382.900	3s ² 3p4d	- 3s ² 3p(2P)6f ³ G	³ F ₂ -	G[7/2] ₃	
0.0339	10	4 452.474	4 452.46	4 452.4722	22 459.4337	105 302.400 - 127 755.500	3s ² 3p4p	- 3s ² 3p4d	³ P ₁ -	¹ D ₂	M
0.1339	3	4 451.069		4 451.0657	22 466.5332	125 128.900 - 147 589.100	3s ² 3p4d	- 3s ² 3p(2P)6f ¹ G	³ F ₃ -	G[9/2] ₄	
0.1407	7	4 424.088	4424091	4 424.0915	22 603.5133	105 302.400 - 127 899.500	3s ² 3p4p	- 3s ² 3p4d	³ P ₁ -	³ P ₀	M
0.3700	16	4 420.711	4 420.71	4 420.7122	22 620.7905	88 893.200 - 111 507.700	3s ² 3p4s	- 3s ² 3p4p	¹ P ₁ -	¹ S ₀	M
0.0042	9	4 417.336	4 417.30	4 417.3364	22 638.0787	105 302.400 - 127 934.100	3s ² 3p4p	- 3s ² 3p4d	³ P ₁ -	³ P ₁	M
0.8232	8	4 414.300	4 414.28	4 414.2921	22 653.6894	105 302.400 - 127 949.700	3s ² 3p4p	- 3s ² 3p4d	³ P ₁ -	³ D ₂	M
0.0007	0	4 411.963		4 411.9702	22 665.6119	107 360.200 - 130 019.500	3s ² 3p3d	- 3s ² 3p5p	¹ F ₃ -	³ D ₃	
0.5738	4	4 402.105	4 402.09	4 402.1050	22 716.4049	105 224.100 - 127 934.100	3s ² 3p4p	- 3s ² 3p4d	³ P ₀ -	³ P ₁	M
0.4847	10	4 385.394	4 385.35	4 385.3939	22 802.9734	101 635.700 - 124 432.300	3s ² 3p4p	- 3s ² 3p5s	¹ P ₁ -	¹ P ₁	M
0.4387	8	4 244.625	4 244.63	4 244.6235	23 559.2183	107 360.200 - 130 912.800	3s ² 3p3d	- 3s ² 3p(2P)4f ¹ F	¹ F ₃ -	F[5/2] ₃	M
0.0030	0	4 238.074		4 238.0642	23 595.6795	107 360.200 - 130 949.300	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	¹ F ₃ -	F[5/2] ₂	
0.0438	6	4 230.217	4 230.22	4 230.2200	23 639.4324	107 360.200 - 130 993.000	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	¹ F ₃ -	F[7/2] ₃	M
0.0841	7	4 224.527	4 224.52	4 224.5229	23 671.3171	107 360.200 - 131 024.900	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	¹ F ₃ -	F[7/2] ₄	M
0.0338	1	4 218.326	4 218.36	4 218.3337	23 706.0469	103 667.900 - 127 367.200	3s ² 3p4p	- 3s ² 3p4d	³ D ₃ -	³ P ₂	L
0.0287	5	4 193.468	4 193.47	4 193.4651	23 846.6280	107 922.900 - 131 762.800	3s ² 3p4p	- 3s ² 3p4d	¹ D ₂ -	¹ P ₁	M
0.2153	14	4 178.463	4 178.48	4 178.4638	23 932.2449	77 710.200 - 101 635.700	3s ² 3p3d	- 3s ² 3p4p	¹ D ₂ -	¹ P ₁	M
0.0867	6	4 166.849	4 166.87	4 166.8573	23 998.9037	107 360.200 - 131 352.400	3s ² 3p3d	- 3s ² 3p5p	¹ F ₃ -	¹ D ₂	M
0.1305	7	4 160.626	4 160.64	4 160.6237	24 034.8620	103 339.100 - 127 367.200	3s ² 3p4p	- 3s ² 3p4d	³ D ₂ -	³ P ₂	M
0.0454	6	4 130.789	4 130.80	4 130.7953	24 208.4443	103 165.600 - 127 367.200	3s ² 3p4p	- 3s ² 3p4d	³ D ₁ -	³ P ₂	M
0.8827	10	4 127.568	4 127.57	4 127.5656	24 227.3885	103 667.900 - 127 888.400	3s ² 3p4p	- 3s ² 3p4d	³ D ₃ -	³ D ₃	M
0.1135	3	4 120.850	4 120.82	4 120.8455	24 266.8676	103 339.100 - 127 599.200	3s ² 3p4p	- 3s ² 3p4d	³ D ₂ -	³ D ₁	M
0.0410	5	4 119.006	4 119.00	4 118.9993	24 277.7550	107 360.200 - 131 631.200	3s ² 3p3d	- 3s ² 3p(2P)4f ³ G	¹ F ₃ -	G[7/2] ₃	M
0.1490	7	4 117.146	4 117.16	4 117.1492	24 288.6934	103 667.900 - 127 949.700	3s ² 3p4p	- 3s ² 3p4d	³ D ₃ -	³ D ₂	M
0.7463	10	4 109.242	4 109.28	4 109.2479	24 335.3587	107 360.200 - 131 688.700	3s ² 3p3d	- 3s ² 3p(2P)4f ³ G	¹ F ₃ -	G[7/2] ₄	M
0.0454	6	4 094.463	4 094.47	4 094.4596	24 423.2510	103 339.100 - 127 755.500	3s ² 3p4p	- 3s ² 3p4d	³ D ₂ -	¹ D ₂	M
0.1820	7	4 091.582	4 091.60	4 091.5784	24 440.4481	103 165.600 - 127 599.200	3s ² 3p4p	- 3s ² 3p4d	³ D ₁ -	³ D ₁	M
0.1049	6	4 072.286	4 072.29	4 072.2897	24 556.2139	103 339.100 - 127 888.400	3s ² 3p4p	- 3s ² 3p4d	³ D ₂ -	³ D ₃	M
0.0170	0	4 065.562		4 065.5644	24 596.8333	103 165.600 - 127 755.500	3s ² 3p4p	- 3s ² 3p4d	³ D ₁ -	¹ D ₂	
0.0035	6	4 064.726	4 064.73	4 064.7277	24 601.8982	103 339.100 - 127 934.100	3s ² 3p4p	- 3s ² 3p4d	³ D ₂ -	³ P ₁	M
0.2876	6	4 062.144	4 062.15	4 062.1494	24 617.5115	103 339.100 - 127 949.700	3s ² 3p4p	- 3s ² 3p4d	³ D ₂ -	³ D ₂	M
5.1928	11	4 044.572	4 044.61	4 044.5756	24 724.4766	107 360.200 - 132 077.700	3s ² 3p3d	- 3s ² 3p(2P)4f ¹ G	¹ F ₃ -	G[9/2] ₄	M
0.0126	2	4 041.892	4 041.89	4 041.8874	24 740.9192	103 165.600 - 127 899.500	3s ² 3p4p	- 3s ² 3p4d	³ D ₁ -	³ P ₀	M
0.0009	4	4 037.021	4 037.04	4 037.0385	24 770.6976	86 743.000 - 111 507.700	3s ² 3p4s	- 3s ² 3p4p	³ P ₁ -	¹ S ₀	M
0.0832	5	4 036.257	4 036.25	4 036.2490	24 775.4784	103 165.600 - 127 934.100	3s ² 3p4p	- 3s ² 3p4d	³ D ₁ -	³ P ₁	M
0.0385	2	4 035.642	4 035.65	4 035.6428	24 779.2048	107 360.200 - 132 132.500	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	¹ F ₃ -	D[5/2] ₃	M
0.1023	4	4 033.708	4 033.71	4 033.7074	24 791.0916	103 165.600 - 127 949.700	3s ² 3p4p	- 3s ² 3p4d	³ D ₁ -	³ D ₂	M
0.0003	0	4 030.614	4 030.61	4 030.5969	24 810.2265	107 360.200 - 132 163.500	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	¹ F ₃ -	D[5/2] ₂	L
0.0000	0	4 029.068		4 029.0756	24 819.5925	76 823.100 - 101 635.700	3s 3p ³	- 3s ² 3p4p	³ P ₀ -	¹ P ₁	
0.0003	2	4 027.337	4 027.34	4 027.3263	24 830.3713	76 812.300 - 101 635.700	3s 3p ³	- 3s ² 3p4p	³ P ₁ -	¹ P ₁	M
0.1135	9	4 019.509	4 019.53	4 019.5097	24 878.6605	76 764.100 - 101 635.700	3s 3p ³	- 3s ² 3p4p	³ P ₂ -	¹ P ₁	M
0.0003	0	3 993.010		3 993.0128	25 043.7514	107 360.200 - 132 396.900	3s ² 3p3d	- 3s ² 3p(2P)4f ¹ D	¹ F ₃ -	D[3/2] ₂	
0.0014	0	3 943.076		3 943.0711	25 360.9432	103 755.900 - 129 109.700	3s ² 3p3d	- 3s ² 3p5p	³ P ₁ -	¹ P ₁	
0.0170	5	3 927.332	3 927.34	3 927.3245	25 462.6305	77 710.200 - 103 165.600	3s ² 3p3d	- 3s ² 3p4p	¹ D ₂ -	³ D ₁	M
0.0044	0	3 925.430		3 925.4443	25 474.8252	104 101.700 - 129 569.400	3s ² 3p3d	- 3s ² 3p5p	³ D ₂ -	³ D ₁	
0.0039	1	3 903.410	3 903.39	3 903.4079	25 618.6454	104 053.800 - 129 665.200	3s ² 3p3d	- 3s ² 3p5p	³ D ₁ -	³ D ₂	M
0.0078	1	3 902.871	3 902.86	3 902.8679	25 622.1900	104 050.300 - 129 665.200	3s ² 3p3d	- 3s ² 3p5p	³ D ₃ -	³ D ₂	M
0.0108	1	3 900.741	3 900.72	3 900.7288	25 636.2402	103 940.400 - 129 569.400	3s ² 3p3d	- 3s ² 3p5p	³ P ₀ -	³ D ₁	M
0.0063	0	3 872.848	3 872.85	3 872.8517	25 820.7713	103 755.900 - 129 569.400	3s ² 3p3d	- 3s ² 3p5p	³ P ₁ -	³ D ₁	M
0.0232	1	3 858.533	3 858.53	3 858.5255	25 916.6391	103 755.900 - 129 665.200	3s ² 3p3d	- 3s ² 3p5p	³ P ₁ -	³ D ₂	M
0.0049	3	3 857.265	3 857.27	3 857.2664	25 925.0982	104 101.700 - 130 019.500	3s ² 3p3d	- 3s ² 3p5p	³ D ₂ -	³ D ₃	M
0.0022	0 bl	3 853.997	3 854.01	3 854.0083	25 947.0141	103 629.700 - 129 569.400	3s ² 3p3d	- 3s ² 3p5p	³ P ₂ -	³ D ₁	M
0.0046	3	3 851.337	3 851.32	3 851.3341	25 965.0292	77 710.200 - 103 667.900	3s ² 3p3d	- 3s ² 3p4p	¹ D ₂ -	³ D ₃	M
0.0739	2	3 850.476	3 850.48	3 850.4733	25 970.8352	101 635.700 - 127 599.200	3s ² 3p4p	- 3s ² 3p4d	¹ P ₁ -	³ D ₁	M
0.0166	1	3 849.623	3 849.62	3 849.6196	25 976.5966	104 050.300 - 130 019.500	3s ² 3p3d	- 3s ² 3p5p	³ D ₃ -	³ D ₃	M
0.0105	2	3 839.814	3 839.82	3 839.8219	26 042.8806	103 629.700 - 129 665.200	3s ² 3p3d	- 3s ² 3p5p	³ P ₂ -	³ D ₂	M
0.0105	1	3 834.489	3 834.49	3 834.4915	26 079.0806	104 101.700 - 130 173.400	3s ² 3p3d	- 3s ² 3p5p	³ D ₂ -	³ P ₁	M
1.2783	11	3 827.433	3 827.43	3 827.4262	26 127.2197	101 635.700 - 127 755.500	3s ² 3p4p	- 3s ² 3p4d	¹ P ₁ -	¹ D ₂	M

0.0074	3	3 801.484	3 801.47	3 801.4878	26 305.4957	104 101.700	- 130 399.800	3s ² 3p3d	- 3s ² 3p5p	³ D ₂ -	³ P ₂	M
0.0739	4	3 799.186		3 799.1787	26 321.4832	101 635.700	- 127 949.700	3s ² 3p4p	- 3s ² 3p4d	¹ P ₁ -	³ D ₂	
0.0006	0	3 798.492		3 798.4792	26 326.3269	111 507.700	- 137 826.500	3s ² 3p4p	- 3s ² 3p6s	¹ S ₀ -	³ P ₁	
0.0027	6	3 795.073	3 795.07	3 795.0696	26 349.9820	76 823.100	- 103 165.600	3s 3p ³	- 3s ² 3p4p	³ P ₀ -	³ D ₁	M
0.0280	5	3 794.050	3 794.06	3 794.0605	26 356.9896	104 050.300	- 130 399.800	3s ² 3p3d	- 3s ² 3p5p	³ D ₃ -	³ P ₂	M
0.0021	5	3 793.517	3 793.53	3 793.5174	26 360.7623	76 812.300	- 103 165.600	3s 3p ³	- 3s ² 3p4p	³ P ₁ -	³ D ₁	M
0.0105	4	3 788.262	3 788.27	3 788.2670	26 397.2945	103 629.700	- 130 019.500	3s ² 3p3d	- 3s ² 3p5p	³ P ₂ -	³ D ₃	M
0.0010	3	3 786.587	3 786.58	3 786.5817	26 409.0481	76 764.100	- 103 165.600	3s 3p ³	- 3s ² 3p4p	³ P ₂ -	³ D ₁	M
0.0061	1	3 784.303		3 784.2929	26 425.0221	103 755.900	- 130 173.400	3s ² 3p3d	- 3s ² 3p5p	³ P ₁ -	³ P ₁	
0.0060	8	3 768.699	3 768.72	3 768.7003	26 534.3487	76 812.300	- 103 339.100	3s 3p ³	- 3s ² 3p4p	³ P ₁ -	³ D ₂	M
0.0040	3	3 766.287		3 766.2981	26 551.2713	103 629.700	- 130 173.400	3s ² 3p3d	- 3s ² 3p5p	³ P ₂ -	³ P ₁	
0.0011	6	3 761.853	3 761.86	3 761.8556	26 582.6301	76 764.100	- 103 339.100	3s 3p ³	- 3s ² 3p4p	³ P ₂ -	³ D ₂	M
0.0008	0	3 752.121		3 752.1435	26 651.4362	103 755.900	- 130 399.800	3s ² 3p3d	- 3s ² 3p5p	³ P ₁ -	³ P ₂	
1.8254	8	3 728.735		3 728.7403	26 818.7108	104 101.700	- 130 912.800	3s ² 3p3d	- 3s ² 3p(2P)4f ¹ F	³ D ₂ -	F[5/2] ₃	
0.2056	6	3 723.676		3 723.6772	26 855.1756	104 101.700	- 130 949.300	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	³ D ₂ -	F[5/2] ₂	
0.0048	0	3 721.901		3 721.8990	26 868.0047	103 940.400	- 130 800.700	3s ² 3p3d	- 3s ² 3p5p	³ P ₀ -	³ S ₁	
0.1954	1	3 721.587		3 721.5938	26 870.2139	104 050.300	- 130 912.800	3s ² 3p3d	- 3s ² 3p(2P)4f ¹ F	³ D ₃ -	F[5/2] ₃	
1.8254	10	3 717.618		3 717.6214	26 898.9227	104 101.700	- 130 993.000	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	³ D ₂ -	F[7/2] ₃	
1.6468	9	3 717.039		3 717.0404	26 903.1272	104 053.800	- 130 949.300	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	³ D ₁ -	F[5/2] ₂	
0.0032	0	3 716.568		3 716.5516	26 906.6669	104 050.300	- 130 949.300	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	³ D ₃ -	F[5/2] ₂	
0.0082	9	3 715.893	3 715.90	3 715.8918	26 911.4532	76 764.100	- 103 667.900	3s 3p ³	- 3s ² 3p4p	³ P ₂ -	³ D ₃	M
0.1959	7	3 710.518		3 710.5169	26 950.4295	104 050.300	- 130 993.000	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	³ D ₃ -	F[7/2] ₃	
3.4221	12	3 706.129		3 706.1321	26 982.3093	104 050.300	- 131 024.900	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	³ D ₃ -	F[7/2] ₄	
0.0038	0	3 700.724		3 700.7264	27 021.7249	111 507.700	- 138 521.700	3s ² 3p4p	- 3s ² 3p6s	¹ S ₀ -	¹ D ₁	
0.0283	1	3 662.132		3 662.1512	27 306.3562	104 053.800	- 131 352.400	3s ² 3p3d	- 3s ² 3p5p	³ D ₁ -	¹ D ₂	
0.0066	4	3 623.182	3 623.188	3 623.1824	27 600.0488	77 710.200	- 105 302.400	3s ² 3p3d	- 3s ² 3p4p	¹ D ₂ -	³ P ₁	M
0.0009	0	3 622.608		3 622.6181	27 604.3458	103 755.900	- 131 352.400	3s ² 3p3d	- 3s ² 3p5p	³ P ₁ -	¹ D ₂	
0.0000	4	3 570.231		3 570.0938	28 010.4748	102 798.300	- 130 800.700	3s ² 3p3d	- 3s ² 3p5p	¹ P ₁ -	³ S ₁	
0.1051	9	3 566.496	3 566.510	3 566.4981	28 038.7091	104 101.700	- 132 132.500	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ D ₂ -	D[5/2] ₃	M
0.4033	8	3 562.555	3 562.570	3 562.5569	28 069.7342	104 101.700	- 132 163.500	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ D ₂ -	D[5/2] ₂	M
0.5180	8	3 559.961	3 559.971	3 559.9594	28 090.2111	104 050.300	- 132 132.500	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ D ₃ -	D[5/2] ₃	M
0.0127	9	3 556.498	3 556.492	3 556.4807	28 117.6894	104 053.800	- 132 163.500	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ D ₁ -	D[5/2] ₂	M
0.0056	2	3 556.033	3 556.040	3 556.0326	28 121.2317	104 050.300	- 132 163.500	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ D ₃ -	D[5/2] ₂	M
0.0619	4	3 536.311	3 536.309	3 536.3099	28 278.0718	104 101.700	- 132 371.700	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ D ₂ -	D[3/2] ₁	M
0.0379	7	3 533.166	3 533.174	3 533.1622	28 303.2592	104 101.700	- 132 396.900	3s ² 3p3d	- 3s ² 3p(2P)4f ¹ D	³ D ₂ -	D[3/2] ₂	M
0.2295	8	3 530.325	3 530.327	3 530.3239	28 326.0200	104 053.800	- 132 371.700	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ D ₁ -	D[3/2] ₁	M
0.0395	5	3 527.181	3 527.191	3 527.1865	28 351.2125	104 053.800	- 132 396.900	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ D ₁ -	D[3/2] ₂	M
0.0514	3	3 526.745		3 526.7464	28 354.7496	104 050.300	- 132 396.900	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ D ₃ -	D[3/2] ₂	M
0.8026	4	3 519.186	3 519.194	3 519.1847	28 415.6781	103 755.900	- 132 163.500	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ P ₁ -	D[5/2] ₂	M
0.0083	5	3 518.667	3 518.676	3 518.6674	28 419.8533	76 812.300	- 105 224.100	3s 3p ³	- 3s ² 3p4p	³ P ₁ -	³ P ₀	M
0.4667	9	3 516.238	3 516.251	3 516.2375	28 439.4937	103 940.400	- 132 371.700	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ P ₀ -	D[3/2] ₁	M
0.0041	4	3 510.324	3 510.331	3 510.3239	28 487.4070	76 823.100	- 105 302.400	3s 3p ³	- 3s ² 3p4p	³ P ₀ -	³ P ₁	M
1.7290	11	3 507.428		3 507.4298	28 510.9121	103 629.700	- 132 132.500	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ P ₂ -	D[5/2] ₃	M
0.1850	2	3 503.614	3 503.618	3 503.6171	28 541.9325	103 629.700	- 132 163.500	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ P ₂ -	D[5/2] ₂	M
0.0215	9	3 503.058	3 503.071	3 503.0602	28 546.4708	76 764.100	- 105 302.400	3s 3p ³	- 3s ² 3p4p	³ P ₂ -	³ P ₁	M
0.0727	4	3 501.107	3 501.122	3 501.1184	28 562.3049	102 798.300	- 131 352.400	3s ² 3p3d	- 3s ² 3p5p	¹ P ₁ -	¹ D ₂	M
0.0021	1	3 495.833		3 495.8421	28 605.4118	103 165.600	- 131 762.800	3s ² 3p4p	- 3s ² 3p4d	³ D ₁ -	¹ P ₁	
0.2723	3	3 493.564	3 493.577	3 493.5699	28 624.0231	103 755.900	- 132 371.700	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ P ₁ -	D[3/2] ₁	M
0.8026	8	3 490.505	3 490.514	3 490.4987	28 649.2070	103 755.900	- 132 396.900	3s ² 3p3d	- 3s ² 3p(2P)4f ¹ D	³ P ₁ -	D[3/2] ₂	M
0.0124	7	3 478.792	3 478.810	3 478.7973	28 745.5692	76 812.300	- 105 549.700	3s 3p ³	- 3s ² 3p4p	³ P ₁ -	³ P ₂	M
0.0417	3	3 475.180	3 475.199	3 475.1847	28 775.4547	103 629.700	- 132 396.900	3s ² 3p3d	- 3s ² 3p(2P)4f ¹ D	³ P ₂ -	D[3/2] ₂	M
0.0178	9	3 472.961	3 472.977	3 472.9645	28 793.8487	76 764.100	- 105 549.700	3s 3p ³	- 3s ² 3p4p	³ P ₂ -	³ P ₂	M
0.0309	8	3 426.239	3 426.260	3 426.2412	29 186.5049	76 823.100	- 106 001.200	3s 3p ³	- 3s ² 3p4p	³ P ₀ -	³ S ₁	M
0.0833	9	3 424.976	3 424.997	3 424.9763	29 197.2848	76 812.300	- 106 001.200	3s 3p ³	- 3s ² 3p4p	³ P ₁ -	³ S ₁	M
0.0768	11	3 419.320	3 419.343	3 419.3202	29 245.5809	76 764.100	- 106 001.200	3s 3p ³	- 3s ² 3p4p	³ P ₂ -	³ S ₁	M
0.1117	9	3 404.403	3 404.430	3 404.4138	29 373.6394	102 798.300	- 132 163.500	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	¹ P ₁ -	D[5/2] ₂	M
0.6481	8	3 377.558	3 377.576	3 377.5617	29 607.1632	102 798.300	- 132 396.900	3s ² 3p3d	- 3s ² 3p(2P)4f ¹ D	¹ P ₁ -	D[3/2] ₂	M
0.0309	7	3 318.310	3 318.308	3 318.3103	30 135.8221	101 635.700	- 131 762.800	3s ² 3p4p	- 3s ² 3p4d	¹ P ₁ -	¹ P ₁	M
0.0748	11	3 308.907	3 308.925	3 308.9106	30 221.4324	77 710.200	- 107 922.900	3s ² 3p3d	- 3s ² 3p4p	¹ D ₂ -	¹ D ₂	M
0.0074	4	3 267.164	3 267.156	3 267.1635	30 607.5944	107 922.900	- 138 521.700	3s ² 3p4p	- 3s ² 3p6s	¹ D ₂ -	¹ P ₁	M
0.0521	4	3 208.434	3 208.442	3 208.4326	31 167.8726	76 764.100	- 107 922.900	3s 3p ³	- 3s ² 3p4p	³ P ₂ -	¹ D ₂	M
0.0005	1	3 195.008		3 195.0074	31 298.8359	107 922.900	- 139 212.700	3s ² 3p4p	- 3s ² 3p5d	¹ D ₂ -	¹ D ₂	
0.0197	0	3 141.256		3 141.2471	31 834.4912	106 001.200	- 137 826.500	3s ² 3p4p	- 3s ² 3p6s	³ S ₁ -	³ P ₁	
0.0061	1	3 097.296	3 097.28	3 097.2970	32 286.2160	105 549.70						

0.0494	3	3 094.328	3 094.31	3 094.3266	32 317.2154	106 001.200	- 138 309.100	3s ² 3p4p	- 3s ² 3p6s	³ S ₁ -	³ P ₂	M
0.0105	1	3 080.329	3 080.30	3 080.3214	32 464.1490	105 302.400	- 137 757.100	3s ² 3p4p	- 3s ² 3p6s	³ P ₁ -	³ P ₀	L
0.0132	0	3 073.762	3 073.72	3 073.7458	32 533.6031	105 302.400	- 137 826.500	3s ² 3p4p	- 3s ² 3p6s	³ P ₁ -	³ P ₁	L
0.0090	1	3 066.362	3 066.32	3 066.3620	32 611.9355	105 224.100	- 137 826.500	3s ² 3p4p	- 3s ² 3p6s	³ P ₀ -	³ P ₁	L
0.0475	3	3 051.668	3 051.660	3 051.6699	32 768.9536	105 549.700	- 138 309.100	3s ² 3p4p	- 3s ² 3p6s	³ P ₂ -	³ P ₂	M
0.0077	1	3 028.800	3 028.80	3 028.8046	33 016.3325	105 302.400	- 138 309.100	3s ² 3p4p	- 3s ² 3p6s	³ P ₁ -	³ P ₂	L
0.3092	5	3 026.921	3 026.904	3 026.9148	33 036.9478	107 922.900	- 140 950.300	3s ² 3p4p	- 3s ² 3p5d	¹ D ₂ -	¹ F ₃	M
0.0255	2	2 948.091	2 948.070	2 948.0901	33 920.2670	105 302.400	- 139 212.700	3s ² 3p4p	- 3s ² 3p5d	³ P ₁ -	¹ D ₂	M
0.0868	3	2 947.057	2 947.050	2 947.0533	33 932.2027	106 001.200	- 139 923.500	3s ² 3p4p	- 3s ² 3p5d	³ S ₁ -	³ P ₂	M
0.1464	2	2 944.066	2 944.060	2 944.0655	33 966.6413	106 001.200	- 139 957.000	3s ² 3p4p	- 3s ² 3p5d	³ S ₁ -	³ P ₁	M
0.0774	0	2 943.406		2 943.4103	33 974.1999	107 360.200	- 141 324.500	3s ² 3p3d	- 3s ² 3p(² P)5f ¹ F	¹ F ₃ -	F[5/2] ₃	
0.0649	1	2 942.907	2 942.899	2 942.9076	33 980.0068	106 001.200	- 139 971.300	3s ² 3p4p	- 3s ² 3p5d	³ S ₁ -	³ P ₀	M
0.1341	2	2 939.467		2 939.4714	34 019.7266	107 360.200	- 141 370.000	3s ² 3p3d	- 3s ² 3p(² P)5f ³ F	¹ F ₃ -	F[7/2] ₄	
0.1713	4	2 918.472	2 918.459	2 918.4642	34 264.5994	105 549.700	- 139 804.200	3s ² 3p4p	- 3s ² 3p5d	³ P ₂ -	³ D ₃	M
0.0526	1	2 914.415	2 914.433	2 914.4043	34 312.3328	105 224.100	- 139 526.300	3s ² 3p4p	- 3s ² 3p5d	³ P ₀ -	³ D ₁	M
0.0069	3	2 912.874	2 912.872	2 912.8748	34 330.3555	105 302.400	- 139 622.700	3s ² 3p4p	- 3s ² 3p5d	³ P ₁ -	³ D ₂	M
0.0000	3	2 908.342	2 908.334	2 908.3356	34 383.9344	105 549.700	- 139 923.500	3s ² 3p4p	- 3s ² 3p5d	³ P ₂ -	³ P ₂	M
0.0180	0	2 905.434	2 905.43	2 905.4252	34 418.3725	105 549.700	- 139 957.000	3s ² 3p4p	- 3s ² 3p5d	³ P ₂ -	³ P ₁	L
1.6175	4	2 898.746	2 898.745	2 898.7387	34 497.7711	107 360.200	- 141 847.900	3s ² 3p3d	- 3s ² 3p(² P)5f ³ G	¹ F ₃ -	G[7/2] ₄	M
0.0915	2	2 890.036	2 890.02	2 890.0386	34 601.6211	103 165.600	- 137 757.100	3s ² 3p4p	- 3s ² 3p6s	³ D ₁ -	³ P ₀	M
0.3696	4	2 885.888	2 885.883	2 885.8885	34 651.3794	103 667.900	- 138 309.100	3s ² 3p4p	- 3s ² 3p6s	³ D ₃ -	³ P ₂	M
0.0107	1	2 884.680	2 884.70	2 884.6914	34 665.7579	105 302.400	- 139 957.000	3s ² 3p4p	- 3s ² 3p5d	³ P ₁ -	³ P ₁	L
0.0433	1 bl	2 884.237	2 884.23	2 884.2480	34 671.0823	103 165.600	- 137 826.500	3s ² 3p4p	- 3s ² 3p6s	³ D ₁ -	³ P ₁	L
1.6175	4	2 876.152	2 876.153	2 876.1531	34 768.6649	107 360.200	- 142 118.700	3s ² 3p3d	- 3s ² 3p(² P)5f ¹ G	¹ F ₃ -	G[9/2] ₄	M
0.0541	1	2 858.764	2 858.75	2 858.7583	34 980.2256	103 339.100	- 138 309.100	3s ² 3p4p	- 3s ² 3p6s	³ D ₂ -	³ P ₂	L
0.0294	1	2 850.159	2 850.16	2 850.1519	35 085.8603	103 667.900	- 138 743.400	3s ² 3p4p	- 3s ² 3p5d	³ D ₃ -	³ F ₃	L
0.0241	0	2 841.475	2 841.49	2 841.4826	35 192.9028	103 339.100	- 138 521.700	3s ² 3p4p	- 3s ² 3p6s	³ D ₂ -	¹ P ₁	L
0.0474	1	2 838.996	2 839.01	2 838.9997	35 223.6827	103 339.100	- 138 552.500	3s ² 3p4p	- 3s ² 3p5d	³ D ₂ -	³ F ₂	L
0.7824	6	2 826.279	2 826.272	2 826.2764	35 382.2485	103 667.900	- 139 039.700	3s ² 3p4p	- 3s ² 3p5d	³ D ₃ -	³ F ₄	M
0.5725	4	2 825.083	2 825.069	2 825.0774	35 397.2652	103 165.600	- 138 552.500	3s ² 3p4p	- 3s ² 3p5d	³ D ₁ -	³ F ₂	M
0.0135	5	2 823.689	2 823.689	2 823.6871	35 414.6900	103 339.100	- 138 743.400	3s ² 3p4p	- 3s ² 3p5d	³ D ₂ -	³ F ₃	M
0.0680	1	2 773.333	2 773.32	2 773.3281	36 057.7616	103 165.600	- 139 212.700	3s ² 3p4p	- 3s ² 3p5d	³ D ₁ -	¹ D ₂	L
0.2729	3	2 766.479	2 766.48	2 766.4772	36 147.0563	103 667.900	- 139 804.200	3s ² 3p4p	- 3s ² 3p5d	³ D ₃ -	³ D ₃	L
0.0438	1	2 762.312	2 762.31	2 762.3153	36 201.5193	101 635.700	- 137 826.500	3s ² 3p4p	- 3s ² 3p6s	¹ P ₁ -	³ P ₁	L
0.0543	1	2 755.255	2 755.27	2 755.2578	36 294.2549	103 339.100	- 139 622.700	3s ² 3p4p	- 3s ² 3p5d	³ D ₂ -	³ D ₂	L
0.0719	1	2 749.398	2 749.43	2 749.4064	36 371.4926	103 165.600	- 139 526.300	3s ² 3p4p	- 3s ² 3p5d	³ D ₁ -	³ D ₁	L
0.0007	1	2 747.644	2 747.630	2 747.6303	36 395.0022	65 251.400	- 101 635.700	3s 3p ³	- 3s ² 3p4p	³ D ₁ -	¹ P ₁	M
0.1860	5 bl	2 710.274	2 710.254	2 710.2522	36 896.9380	101 635.700	- 138 521.700	3s ² 3p4p	- 3s ² 3p6s	¹ P ₁ -	¹ P ₁	M
0.4998	3	2 683.589		2 683.5933	37 263.4747	104 101.700	- 141 354.200	3s ² 3p3d	- 3s ² 3p(² P)5f ³ F	³ D ₂ -	F[7/2] ₃	
0.4674	1	2 681.482		2 681.4866	37 292.7548	104 053.800	- 141 335.500	3s ² 3p3d	- 3s ² 3p(² P)5f ³ F	³ D ₁ -	F[5/2] ₂	
0.7719	4	2 678.739		2 678.7501	37 330.8446	104 050.300	- 141 370.000	3s ² 3p3d	- 3s ² 3p(² P)5f ³ F	³ D ₃ -	F[7/2] ₄	
0.3224	3	2 660.415	2 660.42	2 660.4090	37 588.2054	101 635.700	- 139 212.700	3s ² 3p4p	- 3s ² 3p5d	¹ P ₁ -	¹ D ₂	L
0.0096	6	2 638.205	2 638.209	2 638.2069	37 904.5457	65 272.300	- 103 165.600	3s 3p ³	- 3s ² 3p4p	³ D ₂ -	³ D ₁	M
0.0170	7	2 636.752	2 636.756	2 636.7519	37 925.4620	65 251.400	- 103 165.600	3s 3p ³	- 3s ² 3p4p	³ D ₁ -	³ D ₁	M
0.1735	1	2 630.637		2 630.6367	38 013.6210	104 101.700	- 142 104.000	3s ² 3p3d	- 3s ² 3p(² P)5f ³ D	³ D ₂ -	D[5/2] ₂	
0.0121	6	2 628.579	2 628.582	2 628.5833	38 043.3107	65 307.200	- 103 339.100	3s 3p ³	- 3s ² 3p4p	³ D ₃ -	³ D ₂	M
0.2149	2	2 627.991		2 627.9811	38 052.0254	104 050.300	- 142 090.900	3s ² 3p3d	- 3s ² 3p(² P)5f ³ D	³ D ₃ -	D[5/2] ₃	
0.0548	2	2 627.308		2 627.3217	38 061.5844	104 053.800	- 142 104.000	3s ² 3p3d	- 3s ² 3p(² P)5f ³ D	³ D ₁ -	D[5/2] ₂	
0.0268	9	2 626.175	2 626.178	2 626.1796	38 078.1355	65 272.300	- 103 339.100	3s 3p ³	- 3s ² 3p4p	³ D ₂ -	³ D ₂	M
0.0060	6	2 624.736	2 624.731	2 624.7374	38 099.0552	65 251.400	- 103 339.100	3s 3p ³	- 3s ² 3p4p	³ D ₁ -	³ D ₂	M
0.0223	1	2 618.466		2 618.4646	38 190.3283	104 101.700	- 142 280.700	3s ² 3p3d	- 3s ² 3p(² P)5f ¹ D	³ D ₂ -	D[3/2] ₂	
0.0905	2	2 615.492		2 615.4834	38 233.8558	104 053.800	- 142 276.200	3s ² 3p3d	- 3s ² 3p(² P)5f ³ D	³ D ₁ -	D[3/2] ₁	
0.0090	0	2 615.213		2 615.1799	38 238.3003	104 053.800	- 142 280.700	3s ² 3p3d	- 3s ² 3p(² P)5f ¹ D	³ D ₁ -	D[3/2] ₂	
0.1795	2	2 607.746	2 607.75	2 607.7448	38 347.3224	103 940.400	- 142 276.200	3s ² 3p3d	- 3s ² 3p(² P)5f ³ D	³ P ₀ -	D[3/2] ₁	L
0.0545	10	2 606.051	2 606.059	2 606.0563	38 372.1608	65 307.200	- 103 667.900	3s 3p ³	- 3s ² 3p4p	³ D ₃ -	³ D ₃	M
0.0066	6	2 603.689	2 603.688	2 603.6932	38 406.9857	65 272.300	- 103 667.900	3s 3p ³	- 3s ² 3p4p	³ D ₂ -	³ D ₃	M
0.0535	0	2 598.369		2 598.3584	38 485.8437	103 629.700	- 142 104.000	3s ² 3p3d	- 3s ² 3p(² P)5f ³ D	³ P ₂ -	D[5/2] ₂	
0.2396	2	2 594.955		2 594.9561	38 536.2988	103 755.900	- 142 280.700	3s ² 3p3d	- 3s ² 3p(² P)5f ¹ D	³ P ₁ -	D[3/2] ₂	
0.0001	3	2 543.388		2 543.3918	39 317.5882	102 798.300	- 142 104.000	3s ² 3p3d	- 3s ² 3p(² P)5f ³ D	¹ P ₁ -	D[5/2] ₂	
0.2421	1	2 532.003		2 532.0117	39 494.2992	102 798.300	- 142 280.700	3s ² 3p3d	- 3s ² 3p(² P)5f ¹ D	¹ P ₁ -	D[3/2] ₂	
0.2501	0	2 508.508	2 508.53	2 508.5175	39 864.1906	101 635.700	- 141 487.900	3s ² 3p4p	- 3s ² 3p5d	¹ P ₁ -	¹ P ₁	L
0.0398	6	2 500.958	2 500.960	2 500.9597	39 984.6618	65 251.400	- 105 224.100	3s 3p ³	- 3s ² 3p4p	³ D ₁ -	³ P ₀	M
0.0390	2	2 497.514		2 497.5082	40 039.9117	107 360.200	- 147 388.100	3s ² 3p3d	- 3s ² 3p(² P)6f ³ G	¹ F ₃ -	G[7/2] ₄	

0.0306	5	2 496.070	2 496.067	2 496.0694	40 062.9950	65 251.400 - 105 302.400	3s 3p ³	- 3s ² 3p4p	³ D ₁ -	³ P ₁	M
0.0449	2	2 485.789	2 485.79	2 485.7942	40 228.5949	88 893.200 - 129 109.700	3s ² 3p4s	- 3s ² 3p5p	¹ P ₁ -	¹ P ₁	M
0.0017	1	2 485.026		2 485.0280	40 240.9952	107 360.200 - 147 589.100	3s ² 3p3d	- 3s ² 3p(2P)6f ¹ G	¹ F ₃ -	G[9/2] ₄	
0.1595	9	2 484.187	2 484.193	2 484.1858	40 254.6509	65 307.200 - 105 549.700	3s 3p ³	- 3s ² 3p4p	³ D ₃ -	³ P ₂	M
0.0843	5	2 482.041	2 482.041	2 482.0386	40 289.4718	65 272.300 - 105 549.700	3s 3p ³	- 3s ² 3p4p	³ D ₂ -	³ P ₂	M
0.0023	2	2 480.749	2 480.75	2 480.7506	40 310.3900	65 251.400 - 105 549.700	3s 3p ³	- 3s ² 3p4p	³ D ₁ -	³ P ₂	M
0.0000	0	2 457.709		2 457.7003	40 688.4485	88 893.200 - 129 569.400	3s ² 3p4s	- 3s ² 3p5p	¹ P ₁ -	³ D ₁	
0.0485	3	2 397.44	2 397.444	2 397.4445	41 711.0889	87 966.800 - 129 665.200	3s ² 3p3d	- 3s ² 3p5p	³ F ₃ -	³ D ₂	M
0.0287	3	2 393.59	2 393.605	2 393.6051	41 777.9876	87 804.100 - 129 569.400	3s ² 3p3d	- 3s ² 3p5p	³ F ₂ -	³ D ₁	M
0.0729	4	2 390.05	2 390.051	2 390.0518	41 840.1113	88 192.100 - 130 019.500	3s ² 3p3d	- 3s ² 3p5p	³ F ₄ -	³ D ₃	M
0.0006	0	2 351.570		2 351.5506	42 525.1429	86 597.500 - 129 109.700	3s ² 3p4s	- 3s ² 3p5p	³ P ₀ -	¹ P ₁	
0.0966	4	2 333.941	2 333.95	2 333.9456	42 845.9111	88 192.100 - 131 024.900	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	³ F ₄ -	F[7/2] ₄	M
0.0129	0	2 330.551	2 330.564	2 330.5644	42 908.0686	87 124.600 - 130 019.500	3s ² 3p4s	- 3s ² 3p5p	³ P ₂ -	³ D ₃	L
0.0045	0	2 329.117	2 329.134	2 329.1344	42 934.4125	86 743.000 - 129 665.200	3s ² 3p4s	- 3s ² 3p5p	³ P ₁ -	³ D ₂	L
0.0372	3	2 327.787	2 327.79	2 327.7908	42 959.2016	87 966.800 - 130 912.800	3s ² 3p3d	- 3s ² 3p(2P)4f ¹ F	³ F ₃ -	F[5/2] ₃	L
0.0093	0	2 325.813	2 325.81	2 325.8159	42 995.6810	87 966.800 - 130 949.300	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	³ F ₃ -	F[5/2] ₂	L
0.0463	3	2 323.449	2 323.451	2 323.4513	43 039.4271	87 966.800 - 130 993.000	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	³ F ₃ -	F[7/2] ₃	M
0.2758	5	2 321.74	2 321.731	2 321.7312	43 071.3118	87 966.800 - 131 024.900	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	³ F ₃ -	F[7/2] ₄	M
0.2822	1	2 319.002	2 319.00	2 319.0034	43 121.9795	87 804.100 - 130 912.800	3s ² 3p3d	- 3s ² 3p(2P)4f ¹ F	³ F ₂ -	F[5/2] ₃	L
0.1013	4	2 317.042	2 317.04	2 317.0435	43 158.4567	87 804.100 - 130 949.300	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	³ F ₂ -	F[5/2] ₂	M
0.0158	6	2 314.695	2 314.70	2 314.6961	43 202.2174	87 804.100 - 130 993.000	3s ² 3p3d	- 3s ² 3p(2P)4f ³ F	³ F ₂ -	F[7/2] ₃	M
0.2104	4	2 298.321	2 298.32	2 298.3222	43 510.0042	88 192.100 - 131 688.700	3s ² 3p3d	- 3s ² 3p(2P)4f ³ G	³ F ₄ -	G[7/2] ₄	M
0.0026	1	2 295.588		2 295.5948	43 561.7099	87 804.100 - 131 352.400	3s ² 3p3d	- 3s ² 3p5p	³ F ₂ -	¹ D ₂	
0.1692	5	2 289.493		2 289.4928	43 677.8115	87 966.800 - 131 631.200	3s ² 3p3d	- 3s ² 3p(2P)4f ³ G	³ F ₃ -	G[7/2] ₃	
1.2049	8	2 286.475	2 286.48	2 286.4773	43 735.4060	87 966.800 - 131 688.700	3s ² 3p3d	- 3s ² 3p(2P)4f ³ G	³ F ₃ -	G[7/2] ₄	M
2.2177	10	2 285.103	2 285.11	2 285.1058	43 761.6652	88 192.100 - 131 940.300	3s ² 3p3d	- 3s ² 3p(2P)4f ³ G	³ F ₄ -	G[9/2] ₅	M
1.0058	8	2 280.990	2 281.00	2 280.9911	43 840.5938	87 804.100 - 131 631.200	3s ² 3p3d	- 3s ² 3p(2P)4f ³ G	³ F ₂ -	G[7/2] ₃	M
0.0080	1	2 277.958	2 277.95	2 277.9473	43 899.1776	88 192.100 - 132 077.700	3s ² 3p3d	- 3s ² 3p(2P)4f ¹ G	³ F ₄ -	G[9/2] ₄	L
0.0000	0	2 261.913		2 261.9145	44 210.3457	87 966.800 - 132 163.500	3s ² 3p3d	- 3s ² 3p(2P)4f ³ D	³ F ₃ -	D[5/2] ₂	
0.0000	1	2 210.330	2 210.34	2 210.3361	45 241.9903	469.122 - 45 697.000	3s ² 3p ²	- 3s 3p ³	³ P ₂ -	⁵ S ₂	M
0.0000	2	2 195.549	2 195.57	2 195.5664	45 546.3420	164.900 - 45 697.000	3s ² 3p ²	- 3s 3p ³	³ P ₁ -	⁵ S ₂	M

* References: M = Martin [7] ; L = L i [9].

Table 3. - P II energy levels and lifetimes for the even configurations.

Lifetimes (s ⁻¹)	Energy Levels (cm ⁻¹)		Configurations	Terms	Leading Percentages ^a	
	Experimental	Calculated				
	0.00	0.000	3s ² 3p ²	(³ P)	³ P ₀	98%
	164.90	164.900	3s ² 3p ²	(³ P)	³ P ₁	98%
	469.12	469.122	3s ² 3p ²	(³ P)	³ P ₂	98%
	8 882.31	8 882.314	3s ² 3p ²	(¹ D)	¹ D ₂	99%
	21 575.63	21 575.632	3s ² 3p ²	(¹ S)	¹ S ₀	99%
1.002 ⁻⁸	101 635.69	101 635.700	3s ² 3p4p	(² P)	¹ P ₁	97%
1.005 ⁻⁸	103 165.61	103 165.600	3s ² 3p4p	(² P)	³ D ₁	98%
9.968 ⁻⁹	103 339.14	103 339.100	3s ² 3p4p	(² P)	³ D ₂	99%
9.854 ⁻⁹	103 667.86	103 667.900	3s ² 3p4p	(² P)	³ D ₃	100%
6.184 ⁻⁹	105 224.06	105 224.100	3s ² 3p4p	(² P)	³ P ₀	98%
6.187 ⁻⁹	105 302.37	105 302.400	3s ² 3p4p	(² P)	³ P ₁	93% + 5% 3s ² 3p4p (² P) ³ S ₁
6.126 ⁻⁹	105 549.67	105 549.700	3s ² 3p4p	(² P)	³ P ₂	97%
7.013 ⁻⁹	106 001.25	106 001.200	3s ² 3p4p	(² P)	³ S ₁	95% + 5% 3s ² 3p4p (² P) ³ P ₁
8.018 ⁻⁹	107 922.93	107 922.900	3s ² 3p4p	(² P)	¹ D ₂	97%
7.508 ⁻⁹	111 507.66	111 507.700	3s ² 3p4p	(² P)	¹ S ₀	94% + 5% 3s ² 3p5p (² P) ¹ S ₀
1.535 ⁻⁸	129 109.68	129 109.700	3s ² 3p5p	(² P)	¹ P ₁	73% + 18% 3s ² 3p5p (² P) ³ S ₁ + 8% (² P) ³ D ₁
2.128 ⁻⁸	129 569.36	129 569.400	3s ² 3p5p	(² P)	³ D ₁	78% + 17% 3s ² 3p5p (² P) ¹ P ₁ + 5% (² P) ³ S ₁
2.293 ⁻⁸	129 665.20	129 665.200	3s ² 3p5p	(² P)	³ D ₂	99%
2.340 ⁻⁸	130 019.50	130 019.500	3s ² 3p5p	(² P)	³ D ₃	99%
1.213 ⁻⁸	130 058.100	130 058.100	3s ² 3p5p	(² P)	³ P ₀	96%
1.285 ⁻⁸	130 173.43	130 173.400	3s ² 3p5p	(² P)	³ P ₁	88% + 13% 3s ² 3p5p (² P) ³ S ₁ + 9% 3s ² 3p5p (² P) ¹ P ₁
1.233 ⁻⁸	130 399.78	*130 399.800	3s ² 3p5p	(² P)	³ P ₂	88% + 10% 3s ² 3p4f (² P) ³ F ₂
1.723 ⁻⁸	130 800.74	130 800.700	3s ² 3p5p	(² P)	³ S ₁	76% + 13% 3s ² 3p5p (² P) ¹ P ₁ + 9% (² P) ³ P ₁
1.009 ⁻⁸	131 352.39	131 352.400	3s ² 3p5p	(² P)	¹ D ₂	87% + 8% 3s ² 3p4f (² P) ¹ D ₂
7.032 ⁻⁹	132 901.000	*132 901.000	3s ² 3p5p	(² P)	¹ S ₀	91% + 5% 3s ² 3p4p (² P) ¹ S
2.967 ⁻⁹	130 912.84	130 912.800	3s ² 3p(² P ⁰)4f F	² [5/2]	¹ F ₃	97%
3.358 ⁻⁹	130 949.29	*130 949.300	3s ² 3p(² P ⁰)4f F	² [5/2]	³ F ₂	82% + 8% 3s ² 3p(² P ⁰)4f D ² [3/2] ¹ D ₂ + 8% 3p(² P ⁰)5p ³ P ₂
3.321 ⁻⁹	130 993.03	130 993.000	3s ² 3p(² P ⁰)4f F	² [7/2]	³ F ₃	96%
3.381 ⁻⁹	131 024.90	131 024.900	3s ² 3p(² P ⁰)4f F	² [7/2]	³ F ₄	96%
3.616 ⁻⁹	131 631.16	131 631.200	3s ² 3p(² P ⁰)4f G	² [7/2]	³ G ₃	96%
3.691 ⁻⁹	131 688.74	131 688.700	3s ² 3p(² P ⁰)4f G	² [7/2]	³ G ₄	90% + 7% 3s ² 3p(² P ⁰)4f F ² [7/2] ³ F ₄
3.743 ⁻⁹	131 940.29	131 940.300	3s ² 3p(² P ⁰)4f G	² [9/2]	³ G ₅	100%
3.737 ⁻⁹	132 077.74	132 077.700	3s ² 3p(² P ⁰)4f G	² [9/2]	¹ G ₄	92% + 8% 3s ² 3p(² P ⁰)4f G ² [7/2] ³ G ₄
3.640 ⁻⁹	132 132.46	132 132.500	3s ² 3p(² P ⁰)4f D	² [5/2]	³ D ₃	98%
3.857 ⁻⁹	132 163.47	132 163.500	3s ² 3p(² P ⁰)4f D	² [5/2]	³ D ₂	96%
3.658 ⁻⁹	132 371.74	132 371.700	3s ² 3p(² P ⁰)4f D	² [3/2]	³ D ₁	100%
4.458 ⁻⁹	132 396.92	132 396.900	3s ² 3p(² P ⁰)4f D	² [3/2]	¹ D ₂	84% + 8% 3s ² 3p(² P ⁰)4f F ² [5/2] ³ F ₂ + 6% 3s ² 3p5p ¹ D ₂

7.826 ⁻⁹	141 324.52	141 324.500	3s ² 3p(² P ⁰)5f F	² [5/2]	¹ F ₃	56% +	25%	3s ² 3p(² P ⁰)5f F	² [7/2]	³ F ₃ +	15%	³ D ₃
6.483 ⁻⁹	141 335.48	141 335.500	3s ² 3p(² P ⁰)5f F	² [5/2]	³ F ₂	85% +	7%	3s ² 3p(² P ⁰)5f D	² [3/2]	¹ D ₂ +	7%	³ D ₂
7.021 ⁻⁹	141 354.16	141 354.200	3s ² 3p(² P ⁰)5f F	² [7/2]	³ F ₃	46% +	39%	3s ² 3p(² P ⁰)5f G	² [7/2]	³ G ₃ +	13%	¹ F ₃
6.720 ⁻⁹	141 370.03	141 370.000	3s ² 3p(² P ⁰)5f F	² [7/2]	³ F ₄	63% +	25%	3s ² 3p(² P ⁰)5f G	² [7/2]	³ G ₄ +	12%	¹ G ₄
7.982 ⁻⁹	141 813.00	141 813.000	3s ² 3p(² P ⁰)5f G	² [7/2]	³ G ₃	58% +	24%	3s ² 3p(² P ⁰)5f F	² [5/2]	¹ F ₃ +	19%	³ F ₃
7.420 ⁻⁹	141 847.91	141 847.900	3s ² 3p(² P ⁰)5f G	² [7/2]	³ G ₄	54% +	36%	3s ² 3p(² P ⁰)5f F	² [7/2]	³ F ₄ +	10%	¹ G ₄
8.917 ⁻⁹	142 007.39	142 007.400	3s ² 3p(² P ⁰)5f G	² [9/2]	³ G ₅	100%						
6.346 ⁻⁹	142 090.95	142 090.900	3s ² 3p(² P ⁰)5f D	² [5/2]	³ D ₃	82% +	11%	3s ² 3p(² P ⁰)5f F	² [7/2]	³ F ₃ +	7%	¹ F ₃
6.222 ⁻⁹	142 104.04	142 104.000	3s ² 3p(² P ⁰)5f D	² [5/2]	³ D ₂	68% +	19%	3s ² 3p(² P ⁰)5f D	² [3/2]	¹ D ₂ +	13%	³ F ₂
4.764 ⁻⁹	142 118.72	142 118.700	3s ² 3p(² P ⁰)5f G	² [9/2]	¹ G ₄	78% +	21%	3s ² 3p(² P ⁰)5f G	² [7/2]	³ G ₄		
6.227 ⁻⁹	142 276.25	142 276.200	3s ² 3p(² P ⁰)5f D	² [3/2]	³ D ₁	100%						
6.024 ⁻⁹	142 280.69	142 280.700	3s ² 3p(² P ⁰)5f D	² [3/2]	¹ D ₂	73% +	25%	3s ² 3p(² P ⁰)5f D	² [5/2]	³ D ₂		
4.858 ⁻⁹	146 881.33	146 881.300	3s ² 3p(² P ⁰)6f F	² [5/2]	³ F ₂	96%						
3.923 ⁻⁹	146 894.38	146 894.400	3s ² 3p(² P ⁰)6f F	² [5/2]	³ F ₃	62% +	34%	3s ² 3p(² P ⁰)6f D		³ D ₃		
4.384 ⁻⁹	146 911.32	146 911.300	3s ² 3p(² P ⁰)6f F	² [7/2]	¹ F ₃	62% +	34%	3s ² 3p(² P ⁰)6f D		³ D ₃		
5.340 ⁻⁹	146 921.76	146 921.800	3s ² 3p(² P ⁰)6f F	² [7/2]	³ F ₄	90% +	10%	3s ² 3p(² P ⁰)6f G		¹ G ₄		
3.943 ⁻⁹	147 382.89	147 382.900	3s ² 3p(² P ⁰)6f G	² [7/2]	³ G ₃	61% +	33%	3s ² 3p(² P ⁰)6f F		¹ F ₃		
4.574 ⁻⁹	147 388.09	147 388.100	3s ² 3p(² P ⁰)6f G	² [7/2]	³ G ₄	77% +	14%	3s ² 3p(² P ⁰)6f F		³ F ₄ +	9%	¹ G ₄
4.383 ⁻⁹	147 509.39	147 509.400	3s ² 3p(² P ⁰)6f G	² [9/2]	³ G ₅	100%						
1.798 ⁻⁸	N.O.	147 589.400	3s ² 3p(² P ⁰)6f G	² [9/2]	¹ G ₄	77% +	14%	3s ² 3p(² P ⁰)5f G		³ G ₄ +	9%	¹ G ₄
4.566 ⁻⁹	N.O.	147 742.000	3s ² 3p(² P ⁰)6f D	² [5/2]	³ D ₃	65% +	34%	3s ² 3p(² P ⁰)6f F		³ F ₃		
5.104 ⁻⁹	N.O.	147 748.000	3s ² 3p(² P ⁰)6f D	² [5/2]	³ D ₂	97%						
7.054 ⁻⁹	N.O.	147 903.000	3s ² 3p(² P ⁰)6f D	² [3/2]	¹ D ₂	95%						
4.857 ⁻⁹	N.O.	147 909.200	3s ² 3p(² P ⁰)6f D	² [3/2]	³ D ₁	100%						

^a Percentage composition lower than 5% were omitted.

* Level value was kept fixed during fitting.

Table 4. - P IV energy levels and lifetimes for the odd configurations.

Lifetimes (s ⁻¹)	Energy Levels (cm ⁻¹)		Configurations	Terms	Leading Percentages ^a						
	Experimental	Calculated									
1.079 ⁻⁴	45 697.02	45 697.000	3s 3p ³	(⁴ S) ⁵ S ₂	100%						
4.348 ⁻⁸	65 251.45	65 251.400	3s 3p ³	(² D) ³ D ₁	63% + 35%	3s ² 3p(² P)3d	³ D				
4.336 ⁻⁸	65 272.35	65 272.300	3s 3p ³	(² D) ³ D ₂	64% + 35%	3s ² 3p(² P)3d	³ D				
4.311 ⁻⁸	65 307.17	65 307.200	3s 3p ³	(² D) ³ D ₃	64% + 35%	3s ² 3p(² P)3d	³ D				
5.318 ⁻⁸	76 764.06	76 764.100	3s 3p ³	(² P) ³ P ₂	59% + 37%	3s ² 3p(² P)3d	³ P				
5.275 ⁻⁸	76 812.33	76 812.300	3s 3p ³	(² P) ³ P ₁	61% + 37%	3s ² 3p(² P)3d	³ P				
5.375 ⁻⁸	76 823.11	76 823.100	3s 3p ³	(² P) ³ P ₀	61% + 37%	3s ² 3p(² P)3d	³ P				
7.562 ⁻¹¹	110 254.77	110 254.800	3s 3p ³	(⁴ S) ³ S ₁	86% + 9%	3s ² 3p(² P)4d	³ D				
1.098 ⁻¹⁰	112 606.86	112 606.900	3s 3p ³	(² D) ¹ D ₂	39% + 25%	3s ² 3p(² P)5d	¹ D	+	21%	3s ² 3p(² P)4d	¹ D
1.768 ⁻¹⁰	118 341.71	118 341.700	3s 3p ³	(² P) ¹ P ₁	50% + 38%	3s ² 3p(² P)3d	¹ P	+	6%	3s ² 3p(² P)4d	¹ P
2.208 ⁻⁷	77 710.19	77 710.200	3s ² 3p(² P)3d	¹ D ₂	78% + 18%	3s 3p ³	(² D) ¹ D				
8.209 ⁻⁸	*87 804.10	*87 804.100	3s ² 3p(² P)3d	³ F ₂	99%						
1.251 ⁻⁶	87 966.81	87 966.800	3s ² 3p(² P)3d	³ F ₃	99%						
	88 192.13	88 192.100	3s ² 3p(² P)3d	³ F ₄	99%						

8.748 ⁻¹⁰	102 798.26	102 798.300	3s ² 3p(² P)3d	¹ P ₁	74% + 24%	3s 3p ³	(² P) ¹ P					
1.937 ⁻¹⁰	103 629.70	103 629.700	3s ² 3p(² P)3d	³ P ₂	52% + 31%	3s 3p ³	³ P	+	9%	3s ² 3p(² P)3d	(² P) ³ D	
1.876 ⁻¹⁰	103 755.91	103 755.900	3s ² 3p(² P)3d	³ P ₁	61% + 35%	3s 3p ³	³ P					
2.305 ⁻¹⁰	103 940.38	103 940.400	3s ² 3p(² P)3d	³ P ₀	61% + 15%	3s 3p ³	(² P) ³ P					
1.148 ⁻¹⁰	104 050.27	104 050.300	3s ² 3p(² P)3d	³ D ₃	61% + 29%	3s 3p ³	(² D) ³ D	+	9%	3s ² 3p(² P)4d	(² D) ³ D	
1.328 ⁻¹⁰	104 053.81	104 053.800	3s ² 3p(² P)3d	³ D ₁	57% + 27%	3s 3p ³	³ D	+	9%	3s ² 3p(² P)4d	(² D) ³ D	
1.297 ⁻¹⁰	104 101.75	104 101.700	3s ² 3p(² P)3d	³ D ₂	52% + 31%	3s 3p ³	³ P	+	9%	3s ² 3p(² P)3d	(² D) ³ D	
1.486 ⁻¹⁰	107 360.25	107 360.200	3s ² 3p(² P)3d	¹ F ₃	88% + 10%	3s ² 3p(² P)4d	¹ F					
4.295 ⁻¹⁰	86 597.55	86 597.500	3s ² 3p(² P)4s	³ P ₀	98%							
4.182 ⁻¹⁰	86 743.96	86 744.000	3s ² 3p(² P)4s	³ P ₁	90% + 9%	3s ² 3p(² P)4s	¹ P					
3.992 ⁻¹⁰	87 124.60	*87 124.600	3s ² 3p(² P)4s	³ P ₂	99%							
3.541 ⁻¹⁰	88 893.22	88 893.200	3s ² 3p(² P)4s	¹ P ₁	91% + 9%	3s ² 3p(² P)4s	³ P					
2.104 ⁻⁹	123 344.19	123 344.200	3s ² 3p(² P)5s	³ P ₀	99%							
2.024 ⁻⁹	123 455.46	123 455.500	3s ² 3p(² P)5s	³ P ₁	91%							
2.015 ⁻⁹	123 890.81	123 890.800	3s ² 3p(² P)5s	³ P ₂	99%							
1.518 ⁻⁹	124 432.26	124 432.300	3s ² 3p(² P)5s	¹ P ₁	95%							
4.143 ⁻⁹	124 946.73	124 946.700	3s ² 3p(² P)4d	³ F ₂	97%							
4.266 ⁻⁹	125 128.87	125 128.900	3s ² 3p(² P)4d	³ F ₃	96%							
4.542 ⁻⁹	125 391.13	125 391.100	3s ² 3p(² P)4d	³ F ₄	98%							
5.867 ⁻¹⁰	127 367.23	127 367.200	3s ² 3p(² P)4d	³ P ₂	95%							
6.725 ⁻¹⁰	127 599.16	127 599.200	3s ² 3p(² P)4d	³ D ₁	72% + 13%	3s 3p ³	(⁴ S) ³ S	+	5%	3s 3p ³	(² D) ³ D	
5.528 ⁻¹⁰	127 888.42	127 888.400	3s ² 3p(² P)4d	³ D ₃	88% + 5%	3s 3p ³	(² D) ³ D					
5.377 ⁻¹⁰	127 755.50	127 755.500	3s ² 3p(² P)4d	¹ D ₂	50% + 42%	3s 3p(² P)4d	³ D	+	7%	3s 3p ³	(² P) ³ P	
9.033 ⁻¹⁰	127 934.09	127 934.100	3s ² 3p(² P)4d	³ P ₁	92%							
1.316 ⁻⁹	127 899.54	127 899.500	3s ² 3p(² P)4d	³ P ₀	95%							
6.115 ⁻¹⁰	127 949.70	127 949.700	3s ² 3p(² P)4d	³ D ₂	72% + 16%	3s 3p(² P)4d	¹ D	+	7%	3s 3p(² P)4d	³ P	
3.959 ⁻¹⁰	130 142.72	130 142.700	3s ² 3p(² P)4d	¹ F ₃	80% + 10%	3s ² 3p(² P)5d	¹ F	+	7%	3s ² 3p(² P)3d	¹ F	
2.185 ⁻¹⁰	131 762.84	131 762.800	3s ² 3p(² P)4d	¹ P ₁	57% + 17%	3s ² 3p(² P)5d	³ P	+	9%	3s 3p ³	(² P) ¹ P	
4.286 ⁻⁹	137 757.09	137 757.100	3s ² 3p(² P) 6s	³ P ₀	99%							
4.366 ⁻⁹	137 826.52	137 826.500	3s ² 3p(² P) 6s	³ P ₁	85% + 14%	3s ² 3p(² P)6s	¹ P					
4.078 ⁻⁹	138 309.09	138 309.100	3s ² 3p(² P) 6s	³ P ₂	97% +							
5.064 ⁻⁹	138 521.70	138 521.700	3s ² 3p(² P) 6s	¹ P ₁	87% + 14%	3s ² 3p(² P)6s	³ P					
6.288 ⁻⁹	138 552.47	138 552.500	3s ² 3p(² P) 5d	³ F ₂	95%							
6.599 ⁻⁹	138 743.41	138 743.400	3s ² 3p(² P) 5d	³ F ₃	92% + 6%	3s ² 3p(² P)5d	³ D					
7.646 ⁻⁹	139 039.70	139 039.700	3s ² 3p(² P) 5d	³ F ₄	100%							
2.140 ⁻⁹	139 212.72	139 212.700	3s ² 3p(² P) 5d	¹ D ₂	48% + 28%	3s ² 3p(² P)5d	³ P	+	15%	3s ² 3p(² P)5d	¹ D	
1.972 ⁻⁹	139 526.35	139 526.300	3s ² 3p(² P) 5d	³ D ₁	52% + 45%	3s ² 3p(² P) 5d	³ P					

1.799 ⁻⁹	139 804.25	139 804.200	3s ² 3p(² P) 5d	³ D ₃	91% + 6%	3s ² 3p(² P)5d	³ F				
2.398 ⁻⁹	139 622.67	139 622.700	3s ² 3p(² P) 5d	³ D ₂	42% + 31%	3s ² 3p(² P)5d	¹ D	+	14%	3s ² 3p(² P)5d	³ F
3.987 ⁻⁹	139 971.33	139 971.300	3s ² 3p(² P) 5d	³ P ₀	98%						
3.071 ⁻⁹	139 957.96	139 958.000	3s ² 3p(² P) 5d	³ P ₁	52% + 45%	3s ² 3p(² P)5d	³ D				
1.928 ⁻⁹	139 923.54	139 923.500	3s ² 3p(² P) 5d	³ P ₂	82% + 9%	3s ² 3p(² P)5d	³ D	+	7%	3s 3p ³ (² D)	¹ D
9.181 ⁻¹⁰	140 950.27	*140 950.300	3s ² 3p(² P) 5d	¹ F ₃	68% + 19%	3s ² 3p(² P)5d	³ F	+	5%	3s ² 3p(² P)5d	³ D
3.710 ⁻¹⁰	141 487.87	*141 487.900	3s ² 3p(² P) 5d	¹ P ₁	39% + 18%	3s 3p ³	(² P) ¹ P	+	16%	3s ² 3p(² P)5d	¹ P
1.256 ⁻⁸	141 787.64	*141 787.600	3s ² 3p(² P) 5g	³ G ₃	58% + 24%	3s ² 3p(² P)5g	¹ F	+	18%	3s ² 3p(² P)5g	³ F
1.388 ⁻⁸	141 795.84	141 795.800	3s ² 3p(² P) 5g	¹ G ₄	54% + 37%	3s ² 3p(² P)5g	¹ G	+	7%	3s ² 3p(² P)5g	³ G
1.393 ⁻⁸	141 787.55	141 787.500	3s ² 3p(² P) 5g	³ G ₄	44% + 39%	3s ² 3p(² P)5g	³ G	+	13%	3s ² 3p(² P)5g	¹ G
1.402 ⁻⁸	141 796.18	141 796.200	3s ² 3p(² P) 5g	³ G ₅	41% + 32%	3s ² 3p(² P)5g	³ H	+	27%	3s ² 3p(² P)5g	¹ H
1.383 ⁻⁸	142 295.25	142 295.200	3s ² 3p(² P) 5g	³ H ₄	42% + 30%	3s ² 3p(² P)5g	³ H	+	28%	3s ² 3p(² P)5g	¹ G
9.012 ⁻⁹	142 357.76	*142 357.800	3s ² 3p(² P) 5g	³ F ₃	42% + 33%	3s ² 3p(² P)5g	³ F	+	25%	3s ² 3p(² P)5g	¹ F
1.390 ⁻⁸	142 295.53	142 295.500	3s ² 3p(² P) 5g	³ H ₅	63% + 28%	3s ² 3p(² P)5g	¹ H	+	8%	3s ² 3p(² P)5g	³ G
1.470 ⁻⁸	142 472.31	142 472.300	3s ² 3p(² P) 5g	³ F ₂	100%						
1.453 ⁻⁸	142 418.95	142 418.900	3s ² 3p(² P) 5g	¹ H ₅	65% + 32%	3s ² 3p(² P)5g	³ H				
1.422 ⁻⁸	142 357.60	142 357.600	3s ² 3p(² P) 5g	³ F ₄	58% + 22%	3s ² 3p(² P)5g	¹ G	+	19%	3s ² 3p(² P)5g	³ G
1.436 ⁻⁸	142 418.45	142 418.400	3s ² 3p(² P) 5g	³ H ₆	100%						
9.217 ⁻⁹	142 472.59	142 472.600	3s ² 3p(² P) 5g	¹ F ₃	50% + 49%	3s ² 3p(² P)5g	³ F				
2.283 ⁻⁸	147 198.21	147 198.200	3s ² 3p(² P) 6g	¹ G ₄	46% + 28%	3s ² 3p(² P)6g	³ G	+	26%	3s ² 3p(² P)6g	³ F
2.176 ⁻⁸	147 198.33	147 198.300	3s ² 3p(² P) 6g	³ G ₃	54% + 26%	3s ² 3p(² P)6g	¹ F	+	20%	3s ² 3p(² P)6g	³ F
2.304 ⁻⁸	147 199.88	147 199.900	3s ² 3p(² P) 6g	³ G ₄	65% + 17%	3s ² 3p(² P)6g	³ H	+	17%	3s ² 3p(² P)6g	¹ G
2.285 ⁻⁸	147 200.24	147 200.200	3s ² 3p(² P) 6g	³ G ₅	65% + 20%	3s ² 3p(² P)6g	³ H	+	15%	3s ² 3p(² P)6g	¹ H
2.305 ⁻⁸	147 717.03	147 717.000	3s ² 3p(² P) 6g	³ H ₄	36% + 35%	3s ² 3p(² P)6g	¹ H	+	29%	3s ² 3p(² P)6g	³ G
2.309 ⁻⁸	147 717.25	147 717.200	3s ² 3p(² P) 6g	³ H ₅	65% + 20%	3s ² 3p(² P)6g	³ G	+	15%	3s ² 3p(² P)6g	¹ H
2.306 ⁻⁸	147 750.51	147 750.500	3s ² 3p(² P) 6g	³ F ₄	53% + 26%	3s ² 3p(² P)6g	³ G	+	20%	3s ² 3p(² P)6g	¹ G
2.156 ⁻⁸	147 750.66	147 750.700	3s ² 3p(² P) 6g	³ F ₃	46% + 29%	3s ² 3p(² P)6g	¹ F	+	25%	3s ² 3p(² P)6g	³ G
2.328 ⁻⁸	147 791.75	147 791.700	3s ² 3p(² P) 6g	³ H ₆	100%						
2.335 ⁻⁸	147 792.23	147 792.200	3s ² 3p(² P) 6g	¹ H ₅	56% + 44%	3s ² 3p(² P)6g	³ H				
2.350 ⁻⁸	147 823.28	147 823.300	3s ² 3p(² P) 6g	³ F ₂	100%						
2.128 ⁻⁸	147 823.53	147 823.500	3s ² 3p(² P) 6g	¹ F ₃	55% + 45%	3s ² 3p(² P)6g	³ F				
3.187 ⁻⁸	150.455.68	150.455.700	3s ² 3p(² P) 7g	¹ G ₄	49% + 29%	3s ² 3p(² P)7g	³ G	+	15%	3s ² 3p(² P)7g	³ H
3.146 ⁻⁸	150.455.45	150.455.400	3s ² 3p(² P) 7g	³ G ₄	66% + 21%	3s ² 3p(² P)7g	¹ G	+	11%	3s ² 3p(² P)7g	³ F
1.998 ⁻⁸	150.455.71	150.455.700	3s ² 3p(² P) 7g	³ G ₃	49% + 29%	3s ² 3p(² P)7g	¹ F	+	22%	3s ² 3p(² P)7g	³ F
3.540 ⁻⁸	150.455.71	150.455.700	3s ² 3p(² P) 7g	³ G ₅	37% + 32%	3s ² 3p(² P)7g	³ H	+	31%	3s ² 3p(² P)7g	¹ H
2.916 ⁻⁸	150.985.84	150.985.800	3s ² 3p(² P) 7g	³ H ₄	38% + 32%	3s ² 3p(² P)7g	³ G	+	30%	3s ² 3p(² P)7g	¹ G
3.084 ⁻⁸	150.985.97	150.986.000	3s ² 3p(² P) 7g	³ H ₅	68% + 18%	3s ² 3p(² P)7g	³ G	+	13%	3s ² 3p(² P)7g	¹ H
2.916 ⁻⁸	151.005.90	151.005.900	3s ² 3p(² P) 7g	³ F ₄	49% + 29%	3s ² 3p(² P)7g	³ G	+	22%	3s ² 3p(² P)7g	¹ G
2.030 ⁻⁸	151.006.00	151.006.000	3s ² 3p(² P) 7g	¹ F ₃	51% + 26%	3s ² 3p(² P)7g	³ F	+	23%	3s ² 3p(² P)7g	³ G
3.473 ⁻⁸	151.033.88	151.033.900	3s ² 3p(² P) 7g	³ H ₆	100%						

4.183 ⁻⁸	151.034.32	151.034.300	$3s^2 3p(^2P) 7g$	1H_5	56%	+	44%	$3s^2 3p(^2P) 7g$	3H
3.631 ⁻⁸	151.053.80	151.053.800	$3s^2 3p(^2P) 7g$	3F_2	100%				
1.783 ⁻⁸	151.054.14	151.054.100	$3s^2 3p(^2P) 7g$	3F_3	55%	+	45%	$3s^2 3p(^2P) 7g$	1F

^a Percentage composition lower than 5% were omitted.

* Level value was kept fixed during fitting.