The Spectrum and Energy Levels of the Neutral Atom of Boron (B I)

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The published data on the spectrum of the neutral atom of boron are compiled and presented. In one table 164 lines in the range 36010-993 Å are listed with their intensities and classifications. A second table gives 92 levels with the numerical values of the energy.

Key words: Atomic energy levels; atomic spectra; boron.

1. Introduction

For a long time the spectrum of the neutral atom of boron has remained insufficiently studied, in comparison with that of neighboring elements. By 1952 about 40 classified lines in the range of 2408-1378 Å were known. The ionization potential was determined through these data and 19 doublet and 3 quartet levels were found, which were presented in the book "Atomic Energy Levels" by Moore. During the ensuing years great attention was given to the study of the fine structure of the multiplet 2066 Å ($2s2p^2\ ^4P$-$2s2p3s\ ^4P^o$), which should consist of ten components. In the works [1,2,3,6][1] five components were found. The rest are overlapped and as yet not resolved by spectroscopic methods as a result of a great broadening of lines. Beginning in 1970 the spectrum of B I was measured in detail in the infrared, visible, and ultraviolet regions in the range of 36010-1378 Å [4-6]. The doublet splitting of the ground state turned out to be 15.25 cm^{-1}. A more accurate value (66928.10 ±0.1) cm^{-1} of the ionization potential was determined through the series of $2s2p^2\ ^2D$-$2s^2nf\ ^2F^o$ and $2s^23d\ ^2D$-$2s^2nf\ ^2F^o$ [4]. The atomic absorption spectra were investigated in more detail in the vacuum ultraviolet range [7,8]. In these investigations use was made of enriched samples of B^{11} (99.8%). In the first one the resonance lines of transitions of $2s^22p\ ^2P^o$-$2s^2nd\ ^2D$ from $n=3$ to $n=39$ and $2s^22p\ ^2P^o$-$2s^2ns\ ^2S$ from $n=4$ to $n=10$ were measured. In the second paper the autoionized lines, corresponding to transitions to the ground doublet state $2s^22p\ ^2P^o$ and to the metastable quartet state $2s2p^2\ ^4P$, were studied. The upper levels of these transitions lie beyond the ionization limit of the neutral atom of boron.

As yet no intercombination line for B I between the doublet system and the metastable quartet system has been found. However, in paper [9] an estimate of the interval between the levels $2s^22p\ ^2P^o_{3/2}$ and $2s2p^2\ ^4P_{5/2}$ is given by means of a study of the isoelectronic sequence of B I, C II, N III, O IV, F V, and Ne VI. The value E=28866 ±15 cm^{-1} was obtained for B I. Hence, the wavelength in air of the $2s^22p\ ^2P^o_{3/2}$-$2s2p^2\ ^4P_{5/2}$ intercombination line is predicted to be 3463.3 ±1.8 Å.

As a result of the above-mentioned works more extensive results on the spectrum of B I and its energy levels have been obtained. However, the new data remained separate, and were not until now analysed and collected into united tables.

2. Table of Spectral Lines and Levels

In table 1 is given the complete list of spectral lines for the neutral atom of boron in the range of 36010-993 Å. Presented here are their wavelengths, intensities, and classifications. In the infrared region use was made of wavelengths and estimates of intensity (reduced tenfold) from the paper [5]. The visible region includes results of the works [3,4]. Here are added the lines which we have predicted, in accordance with transitions between known levels. These lines are marked by the letter P. Wavelengths of resonance multiplets in the shortwave region are given from reference [4]. For four lines of the multiplet 2066 Å we give the averaged results from [3,6]. The wavelength of the fifth, 2067.02 Å, of this multiplet is taken from [2]. The vacuum ultraviolet region is given through the absorption spectrum [7,8]. Intensities for some of these lines are taken from reference [6]. Lines with autoionized upper levels are marked with the letter A.

In table 2 are listed the known energy levels. In four columns the electron configuration, the term symbol, the quantum number, J, and the numerical value of energy in cm^{-1} are given for each level [3-7].

The wavelengths and levels are based on reliable and sufficiently accurate measurements that are confirmed by the good agreement of parallel results. The mean error for the majority of lines given to 3 decimal places amounts to ±0.002 Å [4,5,7]; for autoionized lines it reaches the order of ±(0.005-0.008) Å [6,8]. The wavelengths with two decimal places have errors of ±(0.01-0.02) Å. The error in the numerical values of the energy levels within the doublet and quartet systems amounts to several units in the last decimal

[1] Figures in brackets indicate literature references at the end of this paper.

place. The connection of the systems is estimated to an accuracy of ± 15 cm^{-1} [9].

When comparing our table of energy levels of B I with the corresponding diagram of levels in the book of Bashkin & Stoner [10] we found a number of errors in this diagram. No doublet structure is given for the level $2s^2 3p\ ^2P^\circ$, whereas for the following higher level, $2s^2 4p\ ^2P^\circ$, such a structure is provided. The Grotrian diagram points out one line 2497.1 Å although the transition $2s^2 2p\ ^2P^\circ - 2s^2 3s\ ^2S$ yields two well-known resonance lines of B I: 2496.7717 and 2497.7233 Å [4]. The transition $2s^2 2p\ ^2P^\circ - 2s 2p^2\ ^2D$ is assigned the line 1826.1 Å instead of the doublet 2098.885 and 2089.570 Å.

TABLE 1. Spectral lines and classifications of B I (b—blended, R—resonance, A—autoionized, P—predicted)

λ, Å	Int.	σ, cm^{-1}	Transition	ΔJ
λ_{air}				
36010.65	3	2776.199	$4s\ ^2S - 4p\ ^2P^\circ$	1/2-1/2
36002.41	5	2776.835	$4s\ ^2S - 4p\ ^2P^\circ$	1/2-3/2
33117.37	1	3018.740	$3d\ ^2D - 4p\ ^2P^\circ$	3/2-1/2
33112.05	2	3019.225	$3d\ ^2D - 4p\ ^2P^\circ$	5/2,3/2-3/2
18994.333	56	5263.291	$3d\ ^2D - 4f\ ^2F^\circ$	5/2,3/2-5/2,3/2
16244.670	65	6154.184	$3p\ ^2P^\circ - 3d\ ^2D$	3/2-5/2,3/2
16240.375	40	6155.812	$3p\ ^2P^\circ - 3d\ ^2D$	1/2-3/2
15629.080	15	6396.582	$3p\ ^2P^\circ - 4s\ ^2S$	3/2-1/2
15624.715	7	6398.368	$3p\ ^2P^\circ - 4s\ ^2S$	1/2-1/2
12901.721	6	7748.784	$3d\ ^2D - 5f\ ^2F^\circ$	5/2,3/2-5/2,3/2
11662.467	320	8572.169	$3s\ ^2S - 3p\ ^2P^\circ$	1/2-1/2
11660.045	660	8573.949	$3s\ ^2S - 3p\ ^2P^\circ$	1/2-3/2
8668.570	4	11532.76	$3p\ ^2P^\circ - 5s\ ^2S$	3/2-1/2
8667.223	2	11534.55	$3p\ ^2P^\circ - 5s\ ^2S$	1/2-1/2
8212.118	4	12173.78	$2p^2\ ^2D - 4f\ ^2F^\circ$	5/2-7/2,5/2
8211.906	4	12174.09	$2p^2\ ^2D - 4f\ ^2F^\circ$	3/2-5/2
7208.531 P		13868.63	$3p\ ^2P^\circ - 6s\ ^2S$	3/2-1/2
7207.605 P		13870.41	$3p\ ^2P^\circ - 6s\ ^2S$	1/2-1/2
6819.737 P		14659.28	$2p^2\ ^2D - 5f\ ^2F^\circ$	5/2-7/2,5/2
6819.593 P		14659.59	$2p^2\ ^2D - 5f\ ^2F^\circ$	3/2-5/2
6432.234 P		15542.40	$3p\ ^2P^\circ - 7s\ ^2S$	3/2-1/2
6431.498 P		15544.18	$3p\ ^2P^\circ - 7s\ ^2S$	1/2-1/2
6244.710	5	16009.12	$2p^2\ ^2D - 6f\ ^2F^\circ$	5/2-7/2,5/2
6244.613	7	16009.37	$2p^2\ ^2D - 6f\ ^2F^\circ$	3/2-5/2
6179.342		16178.47	$3p\ ^2P^\circ - 8s\ ^2S$	3/2-1/2
6178.419 P		16180.89	$3p\ ^2P^\circ - 8s\ ^2S$	1/2-1/2
6001.978 P		16656.56	$3p\ ^2P^\circ - 9s\ ^2S$	3/2-1/2
6001.337 P		16658.34	$3p\ ^2P^\circ - 9s\ ^2S$	1/2-1/2
5942.763	5	16822.53	$2p^2\ ^2D - 7f\ ^2F^\circ$	5/2-7/2,5/2
5942.670	6	16822.79	$2p^2\ ^2D - 7f\ ^2F^\circ$	3/2-5/2
5882.18 P		16995.8	$3p\ ^2P^\circ - 10s\ ^2S$	3/2-1/2
5881.55 P		16997.6	$3p\ ^2P^\circ - 10s\ ^2S$	1/2-1/2
5761.943		17350.44	$2p^2\ ^2D - 8f\ ^2F^\circ$	5/2,3/2-7/2,5/2
5644.321		17712.01	$2p^2\ ^2D - 9f\ ^2F^\circ$	5/2,3/2-7/2,5/2
5563.185		17970.32	$2p^2\ ^2D - 10f\ ^2F^\circ$	5/2,3/2-7/,5/2
5504.565		18161.69	$2p^2\ ^2D - 11f\ ^2F^\circ$	5/2,3/2-7/2,5/2
2497.7233	10R	40024.393	$2p\ ^2P^\circ - 3s\ ^2S$	3/2-1/2
2496.7717	8R	40039.647	$2p\ ^2P^\circ - 3s\ ^2S$	1/2-1/2
2089.570	10R	47841.53	$2p\ ^2P^\circ - 2p^2\ ^2D$	3/2-5/2,3/2
2088.885	9R	47857.22	$2p\ ^2P^\circ - 2p^2\ ^2D$	1/2-3/2
2067.186 A	4b	48359.50	$2p^2\ ^4P - 3s'\ ^4P^\circ$ $2p^2\ ^4P - 3s'\ ^4P^\circ$	3/2-1/2 5/2-3/2
2067.02 A	1	48363.4	$2p^2\ ^4P - 3s'\ ^4P^\circ$	1/2-1/2
2066.915 A	2	48365.84	$2p^2\ ^4P - 3s'\ ^4P^\circ$	3/2-3/2
2066.646 A	7b	48372.15	$2p^2\ ^4P - 3s'\ ^4P^\circ$ $2p^2\ ^4P - 3s'\ ^4P^\circ$	1/2-3/2 5/2-5/2
2066.364 A	5	48378.75	$2p^2\ ^4P - 3s'\ ^4P^\circ$	3/2-5/2
λ_{vac}				
1826.400	30R	54752.52	$2p\ ^2P^\circ - 3d\ ^2D$	3/2-5/2,3/2
1825.891	30R	54767.78	$2p\ ^2P^\circ - 3d\ ^2D$	1/2-3/2

TABLE 1. Spectral lines and classifications of B I (b—blended, R—resonance, A—autoionized, P—predicted)—Continued

λ, Å	Int.	σ, cm^{-1}	Transition	ΔJ
1818.348	20R	54994.97	$2p\ ^2P^\circ$–$4s\ ^2S$	3/2–1/2
1817.843	15R	55010.25	$2p\ ^2P^\circ$–$4s\ ^2S$	1/2–1/2
1667.272	20R	59978.22	$2p\ ^2P^\circ$–$4d\ ^2D$	3/2–5/2,3/2
1666.850	15R	59993.40	$2p\ ^2P^\circ$–$4d\ ^2D$	1/2–3/2
1663.031	10R	60131.17	$2p\ ^2P^\circ$–$5s\ ^2S$	3/2–1/2
1662.608	5R	60146.47	$2p\ ^2P^\circ$–$5s\ ^2S$	1/2–1/2
1607.932 A		62191.68	$2p^2\ ^4P$–$3d'\ ^4D^\circ$	5/2–3/2
1607.890 A		62193.31	$2p^2\ ^4P$–$3d'\ ^4D^\circ$	5/2–5/2
1607.820 A		62196.02	$2p^2\ ^4P$–$3d'\ ^4D^\circ$	5/2–7/2
1607.733 A		62199.38	$2p^2\ ^4P$–$3d'\ ^4D^\circ$	3/2–5/2
1607.645 A		62202.78	$2p^2\ ^4P$–$3d'\ ^4D^\circ$	1/2–3/2
1600.846 P	1R	62466.98	$2p\ ^2P^\circ$–$6s\ ^2S$	3/2–1/2
1600.761	12R	62470.28	$2p\ ^2P^\circ$–$5d\ ^2D$	3/2–5/2,3/2
1600.455	1R	62482.23	$2p\ ^2P^\circ$–$6s\ ^2S$	1/2–1/2
1600.373	7R	62485.42	$2p\ ^2P^\circ$–$5d\ ^2D$	1/2–3/2
1587.747 A		62982.23	$2p^2\ ^4P$–$3d'\ ^4P^\circ$	5/2–5/2
1587.653 A		62986.06	$2p^2\ ^4P$–$3d'\ ^4P^\circ$	5/2–3/2
1587.596 A		62988.32	$2p^2\ ^4P$–$3d'\ ^4P^\circ$	3/2–5/2
1587.500 A		62992.13	$2p^2\ ^4P$–$3d'\ ^4P^\circ$	3/2–3/2
1587.451 A		62994.07	$2p^2\ ^4P$–$3d'\ ^4P^\circ$	3/2–1/2
1587.385 A		62996.69	$2p^2\ ^4P$–$3d'\ ^4P^\circ$	1/2–3/2
1587.340 A		62998.48	$2p^2\ ^4P$–$3d'\ ^4P^\circ$	1/2–1/2
1574.868 A		63497.39	$2p^2\ ^4P$–$4s'\ ^4P^\circ$	5/2–(5/2)
1573.679	5R	63545.38	$2p\ ^2P^\circ$–$2p^2\ ^2S$	3/2–1/2
1573.301	3R	63560.64	$2p\ ^2P^\circ$–$2p^2\ ^2S$	1/2–1/2
1566.660	2R	63830.05	$2p\ ^2P^\circ$–$6d\ ^2D$	3/2–5/2,3/2
1566.286	1R	63845.29	$2p\ ^2P^\circ$–$6d\ ^2D$	1/2–3/2
1559.071		64140.76	$2p\ ^2P^\circ$–$7s\ ^2S$	3/2–1/2
1558.701		64155.99	$2p\ ^2P^\circ$–$7s\ ^2S$	1/2–1/2
1546.789	3R	64650.04	$2p\ ^2P^\circ$–$7d\ ^2D$	3/2–5/2,3/2
1546.423	2R	64665.34	$2p\ ^2P^\circ$–$7d\ ^2D$	1/2–3/2
1543.763		64776.78	$2p\ ^2P^\circ$–$8s\ ^2S$	3/2–1/2
1543.398		64792.11	$2p\ ^2P^\circ$–$8s\ ^2S$	1/2–1/2
1534.166		65181.99	$2p\ ^2P^\circ$–$8d\ ^2D$	3/2–5/2,3/2
1533.806		65197.31	$2p\ ^2P^\circ$–$8d\ ^2D$	1/2–3/2
1532.451		65254.94	$2p\ ^2P^\circ$–$9s\ ^2S$	3/2–1/2
1532.094		65270.13	$2p\ ^2P^\circ$–$9s\ ^2S$	1/2–1/2
1525.637		65546.39	$2p\ ^2P^\circ$–$9d\ ^2D$	3/2–5/2,3/2
1525.281		65561.69	$2p\ ^2P^\circ$–$9d\ ^2D$	1/2–3/2
1524.530		65593.99	$2p\ ^2P^\circ$–$10s\ ^2S$	3/2–1/2
1524.170		65609.48	$2p\ ^2P^\circ$–$10s\ ^2S$	1/2–1/2
1519.598		65806.88	$2p\ ^2P^\circ$–$10d\ ^2D$	3/2–5/2,3/2
1519.246		65822.13	$2p\ ^2P^\circ$–$10d\ ^2D$	1/2–3/2
1515.168		65999.30	$2p\ ^2P^\circ$–$11d\ ^2D$	3/2–5/2,3/2
1514.816		66014.61	$2p\ ^2P^\circ$–$11d\ ^2D$	1/2–3/2
1511.816		66145.60	$2p\ ^2P^\circ$–$12d\ ^2D$	3/2–5/2,3/2
1511.465		66160.98	$2p\ ^2P^\circ$–$12d\ ^2D$	1/2–3/2
1509.220		66259.39	$2p\ ^2P^\circ$–$13d\ ^2D$	3/2–5/2,3/2
1508.872		66274.66	$2p\ ^2P^\circ$–$13d\ ^2D$	1/2–3/2
1507.168		66349.62	$2p\ ^2P^\circ$–$14d\ ^2D$	3/2–5/2,3/2
1506.820		66364.94	$2p\ ^2P^\circ$–$14d\ ^2D$	1/2–3/2
1505.517		66422.36	$2p\ ^2P^\circ$–$15d\ ^2D$	3/2–5/2,3/2
1505.171		66437.62	$2p\ ^2P^\circ$–$15d\ ^2D$	1/2–3/2
1504.169		66481.88	$2p\ ^2P^\circ$–$16d\ ^2D$	3/2–5/2,3/2
1503.824		66497.16	$2p\ ^2P^\circ$–$16d\ ^2D$	1/2–3/2
1503.054		66531.19	$2p\ ^2P^\circ$–$17d\ ^2D$	3/2–5/2,3/2
1502.709		66546.50	$2p\ ^2P^\circ$–$17d\ ^2D$	1/2–3/2
1502.121		66572.53	$2p\ ^2P^\circ$–$18d\ ^2D$	3/2–5/2,3/2
1501.777		66587.77	$2p\ ^2P^\circ$–$18d\ ^2D$	1/2–3/2
1501.334		66607.45	$2p\ ^2P^\circ$–$19d\ ^2D$	3/2–5/2,3/2
1500.989		66622.73	$2p\ ^2P^\circ$–$19d\ ^2D$	1/2–3/2
1500.662		66637.25	$2p\ ^2P^\circ$–$20d\ ^2D$	3/2–5/2,3/2
1500.318		66652.52	$2p\ ^2P^\circ$–$20d\ ^2D$	1/2–3/2
1500.088		66662.99	$2p\ ^2P^\circ$–$21d\ ^2D$	3/2–5/2,3/2
1499.743		66678.11	$2p\ ^2P^\circ$–$21d\ ^2D$	1/2–3/2
1499.585		66685.13	$2p\ ^2P^\circ$–$22d\ ^2D$	3/2–5/2,3/2

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λ, Å	Int.	σ, cm^{-1}	Transition	ΔJ
1499.240		66700.48	$2p\ ^2P^o$–$22d\ ^2D$	1/2-3/2
1499.148		66704.55	$2p\ ^2P^o$–$23d\ ^2D$	3/2-5/2,3/2
1498.806		66719.79	$2p\ ^2P^o$–$23d\ ^2D$	1/2-3/2
1498.765		66721.59	$2p\ ^2P^o$–$24d\ ^2D$	3/2-5/2,3/2
1498.423		66736.82	$2p\ ^2P^o$–$24d\ ^2D$	1/2-3/2
			$2p\ ^2P^o$–$25d\ ^2D$	3/2-5/2,3/2
1498.129		66749.92	$2p\ ^2P^o$–$26d\ ^2D$	3/2-5/2,3/2
1498.082		66752.02	$2p\ ^2P^o$–$25d\ ^2D$	1/2-3/2
1497.863		66761.76	$2p\ ^2P^o$–$27d\ ^2D$	3/2-5/2,3/2
1497.786		66765.22	$2p\ ^2P^o$–$26d\ ^2D$	1/2-3/2
1497.624		66772.44	$2p\ ^2P^o$–$28d\ ^2D$	3/2-5/2,3/2
1497.519		66772.12	$2p\ ^2P^o$–$27d\ ^2D$	1/2-3/2
1497.409		66782.00	$2p\ ^2P^o$–$29d\ ^2D$	3/2-5/2,3/2
1497.283		66787.66	$2p\ ^2P^o$–$28d\ ^2D$	1/2-3/2
1497.221		66790.41	$2p\ ^2P^o$–$30d\ ^2D$	3/2-5/2,3/2
1497.045		66798.25	$2p\ ^2P^o$–$31d\ ^2D$	3/2-5/2,3/2
1496.880		66805.61	$2p\ ^2P^o$–$32d\ ^2D$	3/2-5/2,3/2
			$2p\ ^2P^o$–$30d\ ^2D$	1/2-3/2
1496.742		66811.76	$2p\ ^2P^o$–$33d\ ^2D$	3/2-5/2,3/2
1496.696		66813.83	$2p\ ^2P^o$–$31d\ ^2D$	1/2-3/2
1496.615		66817.43	$2p\ ^2P^o$–$34d\ ^2D$	3/2-5/2,3/2
1496.532		66821.53	$2p\ ^2P^o$–$32d\ ^2D$	1/2-3/2
1496.489		68823.08	$2p\ ^2P^o$–$35d\ ^2D$	3/2-5/2,3/2
1496.378		66828.03	$2p\ ^2P^o$–$36d\ ^2D$	3/2-5/2,3/2
1496.277		66832.56	$2p\ ^2P^o$–$37d\ ^2D$	3/2-5/2,3/2
1496.183		66836.74	$2p\ ^2P^o$–$38d\ ^2D$	3/2-5/2,3/2
1496.103		66840.33	$2p\ ^2P^o$–$39d\ ^2D$	3/2-5/2,3/2
1469.297 A		68059.76	$2p^2\ ^4P$–$4d'\ ^4D^o$	5/2-3/2
1469.070 A		68070.28	$2p^2\ ^4P$–$4d'\ ^4D^o$	5/2-7/2
1469.015 A		68072.82	$2p^2\ ^4P$–$4d'\ ^4D^o$	3/2-5/2
1465.801 A		68222.08	$2p^2\ ^4P$–$2p^3\ ^4S^o$	5/2-3/2
1465.663 A	4	68228.51	$2p^2\ ^4P$–$2p^3\ ^4S^o$	3/2-3/2
1465.548 A	3	68233.86	$2p^2\ ^4P$–$2p^3\ ^4S^o$	1/2-3/2
1413.940 A		70724.36	$2p^2\ ^4P$–$5d'\ ^4D^o$	5/2-7/2
1379.166 A	1R	72507.59	$2p\ ^2P^o$–$2p^2\ ^2P$	3/2-1/2
1378.943 A	4R	72519.31	$2p\ ^2P^o$–$2p^2\ ^2P$	3/2-3/2
1378.875 A	2R	72522.89	$2p\ ^2P^o$–$2p^2\ ^2P$	1/2-1/2
1378.654 A	1R	72534.52	$2p\ ^2P^o$–$2p^2\ ^2P$	1/2-3/2
1151.489 A		86844.08	$2p\ ^2P^o$–$3p'\ ^2P$	3/2-1/2
1151.422 A		86849,13	$2p\ ^2P^o$–$3p'\ ^2P$	3/2-3/2
1151.281 A		86859.77	$2p\ ^2P^o$–$3p'\ ^2P$	1/2-1/2
1151.207 A		86865.35	$2p\ ^2P^o$–$3p'\ ^2P$	1/2-3/2
1142.304 A		87542.37	$2p\ ^2P^o$–$3p'\ ^2D$	3/2-3/2
1442.269 A		87545.05	$2p\ ^2P^o$–$3p'\ ^2D$	3/2-5/2
1129.881 A		88504.90	$2p\ ^2P^o$–$3p'\ ^2S$	3/2-1/2
1129.701 A		88519.00	$2p\ ^2P^o$–$3p'\ ^2S$	1/2-1/2
1047.867 A		95431.96	$2p\ ^2P^o$–$4p'\ ^2P$	3/2-1/2
1047.825 A		95435.78	$2p\ ^2P^o$–$4p'\ ^2P$	3/2-3/2
1047.695 A		95447.63	$2p\ ^2P^o$–$4p'\ ^2P$	1/2-1/2
1047.647 A		95452.00	$2p\ ^2P^o$–$4p'\ ^2P$	1/2-3/2
1011.058 A		98906.29	$2p\ ^2P^o$–$5p'\ ^2P$	3/2 3/2
1010.902 A		98921.56	$2p\ ^2P^o$–$5p'\ ^2P$	1/2-3/2
993.380 A		100666.41	$2p\ ^2P^o$–$6p'\ ^2P$	3/2-3/2

TABLE 2. Energy levels of B I

Configuration	Term	J	Level, cm^{-1}	Configuration	Term	J	Level, cm^{-1}
$2s^2(^1S)2p$	$2p\ ^2P^\circ$	1/2	0.00	$2s^2(^1S)23d$	$23d\ ^2D$	3/2,5/2	66719.79
		3/2	15.254	$2s^2(^1S)24d$	$24d\ ^2D$	3/2,5/2	66736.82
$2s2p^2$	$2p^2\ ^4P$	1/2	28870.0 + x	$2s^2(^1S)25d$	$25d\ ^2D$	3/2,5/2	66752.02
		3/2	28875.0 + x	$2s^2(^1S)26d$	$26d\ ^2D$	3/2,5/2	66765.22
		5/2	28881.3 + x	$2s^2(^1S)27d$	$27d\ ^2D$	3/2,5/2	66777.12
$2s^2(^1S)3s$	$3s\ ^2S$	1/2	40039.650	$2s^2(^1S)28d$	$28d\ ^2D$	3/2,5/2	66787.66
$2s2p^2$	$2p^2\ ^2D$	3/2	47856.93	$2s^2(^1S)29d$	$29d\ ^2D$	3/2,5/2	66797.25
		5/2	47857.24	$2s^2(^1S)30d$	$30d\ ^2D$	3/2,5/2	66805.63
$2s^2(^1S)3p$	$3p\ ^2P^\circ$	1/2	48611.817	$2s^2(^1S)31d$	$31d\ ^2D$	3/2,5/2	66813.66
		3/2	48613.600	$2s^2(^1S)32d$	$32d\ ^2D$	3/2,5/2	66821.00
$2s^2(^1S)3d$	$3d\ ^2D$	3/2	54767.633	$2s^2(^1S)33d$	$33d\ ^2D$	3/2,5/2	66827.01
		5/2	54767.804	$2s^2(^1S)34d$	$34d\ ^2D$	3/2,5/2	66832.68
$2s^2(^1S)4s$	$4s\ ^2S$	1/2	55010.181	$2s^2(^1S)35d$	$35d\ ^2D$	3/2,5/2	66838.33
$2s^2(^1S)4p$	$4p\ ^2P^\circ$	1/2	57786.376	$2s^2(^1S)36d$	$36d\ ^2D$	3/2,5/2	66843.28
		3/2	57787.014	$2s^2(^1S)37d$	$37d\ ^2D$	3/2,5/2	66847.81
$2s^2(^1S)4d$	$4d\ ^2D$	3/2,5/2	59993.43	$2s^2(^1S)38d$	$38d\ ^2D$	3/2,5/2	66851.99
$2s^2(^1S)4f$	$4f\ ^2F$	5/2,7/2	60031.03	$2s^2(^1S)39d$	$39d\ ^2D$	3/2,5/2	66855.78
$2s^2(^1S)5s$	$5s\ ^2S$	1/2	60146.45				
$2s^2(^1S)6s$	$6s\ ^2S$	1/2	62482.23	B II $2s^2(^1S)$	Limit		**66928.10±0.1**
$2s^2(^1S)5d$	$5d\ ^2D$	3/2,5/2	62485.47				
$2s^2(^1S)5f$	$5f\ ^2F^\circ$	5/2,7/2	62516.52	$2s2p^2$	$2p^2\ ^2P$	1/2	72522.87
$2s2p^2$	$2p^2\ ^2S$	1/2	63560.64			3/2	72534.52
$2s^2(^1S)6d$	$6d\ ^2D$	3/2,5/2	63845.29	$2s2p(^3P)3s$	$3s'\ ^4P^\circ$	1/2	77233.4 + x
$2s^2(^1S)6f$	$6f\ ^2F^\circ$	5/2,7/2	63866.33			3/2	77240.83 + x
$2s^2(^1S)7s$	$7s\ ^2S$	1/2	64156.00			5/2	77253.75 + x
$2s^2(^1S)7d$	$7d\ ^2D$	3/2,5/2	64665.32	$2s2p(^3P)3p$	$3p'\ ^2P$	1/2	86859.6
$2s^2(^1S)7f$	$7f\ ^2F^\circ$	5/2,7/2	64679.74			3/2	86864.9
$2s^2(^1S)8s$	$8s\ ^2S$	1/2	64792.07	$2s2p(^3P)3p$	$3p'\ ^2D$	3/2	87557.6
$2s^2(^1S)8d$	$8d\ ^2D$	3/2,5/2	65197.32			5/2	87560.3
$2s^2(^1S)8f$	$8f\ ^2F^\circ$	5/2,7/2	65207.50	$2s2p(^3P)3p$	$3p'\ ^2S$	1/2	88519.6
$2s^2(^1S)9s$	$9s\ ^2S$	1/2	65270.16	$2s2p(^3P)3d$	$3d'\ ^4D^\circ$	3/2	91072.9 + x
$2s^2(^1S)9d$	$9d\ ^2D$	3/2,5/2	65561.64			5/2	91074.5 + x
$2s^2(^1S)9f$	$9f\ ^2F^\circ$	5/2,7/2	65569.06			7/2	91077.3 + x
$2s^2(^1S)10s$	$10s\ ^2S$	1/2	65609.35	$2s2p(^3P)3d$	$3d'\ ^4P^\circ$	1/2	91868.8 + x
$2s^2(^1S)10d$	$10d\ ^2D$	3/2,5/2	65822.12			3/2	91867.0 + x
$2s^2(^1S)10f$	$10f\ ^2F^\circ$	5/2,7/2	65827.38			5/2	91863.5 + x
$2s^2(^1S)11d$	$11d\ ^2D$	3/2,5/2	66014.58	$2s2p(^3P)4s$	$4s'\ ^4P^\circ$	(5/2)	92378.7 + x
$2s^2(^1S)11f$	$11f\ ^2F^\circ$	5/2,7/2	66018.75	$2s2p(^3P)4p$	$4p'\ ^2P$	1/2	95447.4
$2s^2(^1S)12d$	$12d\ ^2D$	3/2,5/2	66160.92			3/2	95451.5
$2s^2(^1S)13d$	$13d\ ^2D$	3/2,5/2	66274.65	$2s2p(^3P)4d$	$4d'\ ^4D^\circ$	3/2	96941.1 + x
$2s^2(^1S)14d$	$14d\ ^2D$	3/2,5/2	66364.90			5/2	96947.8 + x
$2s^2(^1S)15d$	$15d\ ^2D$	3/2,5/2	66437.62			7/2	96951.6 + x
$2s^2(^1S)16d$	$16d\ ^2D$	3/2,5/2	66497.15	$2p^3$	$2p^3\ ^4S^\circ$	3/2	97103.7 + x
$2s^2(^1S)17d$	$17d\ ^2D$	3/2,5/2	66546.47	$2s2p(^3P)5p$	$5p'\ ^2P$	3/2	98921.5
$2s^2(^1S)18d$	$18d\ ^2D$	3/2,5/2	66587.77	$2s2p(^3P)5d$	$5d'\ ^4D^\circ$	7/2	99605.7 + x
$2s^2(^1S)19d$	$19d\ ^2D$	3/2,5/2	66622.72	$2s2p(^3P)6p$	$6p'\ ^2P$	3/2	100681.7
$2s^2(^1S)20d$	$20d\ ^2D$	3/2,5/2	66652.52				
$2s^2(^1S)21d$	$21d\ ^2D$	3/2,5/2	66678.17	Limits: $^3P_0$=104260.1; $^3P_1$=104266.5; $^3P_2$=104282.9 cm^{-1}.			
$2s^2(^1S)22d$	$22d\ ^2D$	3/2,5/2	66700.43				

References

[1] Clearman, H.E., J. Opt.Soc.Am., **42**, 373 (1952).

[2] Burke, E.W., and Mack, J.E., J.Opt.Soc.Am. **46**, 100 (1956).

[3] Gunnvald, P., and Minnhagen, L., Ark.Fys. **22**, 327 (1962)

[4] Edlén, B., Ölme, A., Herzberg, G., and Johns, J.W.C., J.Opt.Soc.Am., **60**, 889 (1970).

[5] Litzén, U., Phys.Scripta **1**, 251 (1970).

[6] Goorvitch, D., and Valero, F.P.J., Astrophys. J. **171**, 643 (1972).

[7] Brown, C.M., Tilford, S.G., and Ginter, M.L., J. Opt.Soc.Am. **64**, 877 (1974).

[8] Roig, R.A., and Tondello, G., J.Phys. B:Atom.Molec.Phys. **9**, 2373 (1976).

[9] Edlén, B., Palenius, H.P., Bockasten, K., Hallin, R., and Bromander, J., Solar Physics **9**, 432 (1969).

[10] Bashkin, S., and Stoner, J.O. "Atomic Energy Levels and Grotrian Diagrams", v.1 (HI-PXV). North Holland Publishing Company Amsterdam-Oxford; American Elsevier Publishing Company, Inc., New York, 1976.