Wavelengths, Transition Probabilities, and Energy Levels for the Spectra of Barium (Ba III through Ba LVI)

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Energy levels, with designations and uncertainties, have been compiled for the spectra of barium (Z=56) ions from doubly ionized to hydrogenlike. Wavelengths with classifications, intensities, and transition probabilities are also tabulated. In addition, ground states and ionization energies are listed. For many ionization stages experimental data are available; however, for those for which only theoretical calculations or fitted values exist, these are reported. There are a few ionization stages for which only a calculated ionization potential is available. © *2010 by the U.S. Secretary of Commerce on behalf of the United States. All rights reserved.*. [doi:10.1063/1.3432516]

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1. Introduction

Baryta (barium oxide, BaO) was distinguished from lime (calcium oxide, CaO) by Scheele in 1774, but barium was not isolated until 1808 by Sir Humphrey Davy, who used electrolysis to do so. Its name comes from the Greek word "barys," meaning heavy. As a member of the alkaline earth group of elements, it has chemical properties similar to calcium and is a soft, silvery metal at room temperature. It oxidizes rapidly when exposed to air. It has a melting point of 727 °C and a boiling point of 1897 °C. Its atomic number is 56; the atomic weight is 137.327(7); and its specific gravity at 20 °C is 3.5 [05CRC]. There are seven naturally occurring isotopes of barium (which are listed along with their isotopic data in Table 1) and 36 other radioactive isotopes and isomers are known. Compounds of barium are used in paint pigments, in x-ray diagnostic work, and in pyrotechnics.

TABLE 1. Stable Isotopes of Barium

Isotope	Atomic Weight[a]	Natural Abundance[a] (Atom %)	Nuclear Spin[a]	Nuclear Magnetic Moment[b] (μ/μ_N)
^{130}Ba	129.906 321	0.106(1)	0	
^{132}Ba	131.905 061	0.101(1)	0	
^{134}Ba	133.904 508	2.417(18)	0	
^{135}Ba	134.905 6886	6.952(12)	3/2	+0.832 293(25)
^{136}Ba	135.904 5759	7.854(24)	0	
^{137}Ba	136.905 8274	11.232(24)	3/2	+0.931 074(55)
^{138}Ba	137.905 2472	71.70(4)	0	

[a]From [05CRC]
[b]From [56WAL/ROW]

For this compilation of spectral data of barium, the literature for each ionization stage, from doubly ionized to hydrogenlike, has been reviewed and the lists of the most accurate wavelengths and energy levels have been assembled. A brief summary of the history of research for each spectrum and details regarding the data included in this compilation are given. Data for neutral and singly-ionized barium can be found in Curry [04CUR].

Where available, experimental data are presented; however, when only fitted data or theoretically calculated data are available, these are included. To clarify which data are not obtained by experimental observation, wavelengths, energy levels, and ionization energies that have been obtained by isoelectronic fitting are indicated by being enclosed in square brackets while theoretical values are presented enclosed in parentheses.

2. Wavelength Table Description

In the tables of wavelengths the following information is included

(a) **Wavelengths** are reported in units of Ångströms, with all lines with wave numbers below 10 000 cm^{-1} or above 50 000 cm^{-1} given as vacuum wavelengths and those between 10 000 and 50 000 cm^{-1} as air wavelengths. The index of refraction used for conversions is obtained using the three-term formula of Peck and Reeder [72PEC/REE]. Occasionally wavelengths calculated from optimized energy levels (known as Ritz wavelengths) are given because they are much more accurate than experimentally observed ones, in which case the calculated wavelength is followed by the notation "R."

(b) **Uncertainty** of the wavelength measurement or calculation is also in Ångströms.

(c) **Wave number** of the transition is given in units of cm^{-1}.

(d) **Intensity** as observed by the original investigator, except as noted in the discussion for a particular spectrum. Since, in general, there is no way to normalize data taken from different sources, this means that intensities taken from different sources are not on the same scale and should not be used for comparison. Intensities marked by an asterisk indicate that the measured spectral line either is blended with another line or has two classifications. In either case the intensity cannot be assumed to be entirely due to the transition indicated.

(e) **Line codes** indicate additional descriptive information about the appearance of the spectral line. In general, the character of a line depends on the light source used and the resolution of the spectrometer. For ease of use we utilize a uniform set of line codes to describe the line characteristics provided by various authors. They have the following meanings:

a = asymmetric
b = blend
c = complex
d = line consists of two unresolved lines
h = hazy
l = shaded to longer wavelengths
m = masked by another line
p = perturbed by close line
r = easily self-reversed
s = shaded to shorter wavelengths
u = unresolved shoulder on strong line
w = wide
* = intensity may be affected by nearby line
? = classification is uncertain

(f) **Transition probabilities** (A_{ki}) for transitions from the upper state (k) to the lower (i) are given in units of s^{-1}. Exponential notation is used for these values; thus, for example, 3.2E+5 stands for 3.2×10^5. Virtually all transition probabilities are theoretically calculated. The method used for each spectrum is discussed in the text.

(g) **Lower level** and **Upper level** indicate the classification given for the transition.

(h) λ **Ref.** and A_{ki} **Ref.** indicate the references for the wavelength measurement and transition probability, respectively. The list of references for each ionization stage is located at the bottom of the discussion for that particular spectrum.

3. Energy Level Table Description

The energy level tables contain the following information.

(a) **Configuration** of the energy level. For visual clarity only the first member of the term has the configuration written out. All members of the same term are grouped together and set off from other terms by a blank line.

(b) **Term** is listed for each energy level. There are several kinds of coupling indicated for the energy levels. Most levels are best described by *LS* coupling, with the core indicated in parentheses when needed. Some levels are better described by in either J_1j or J_1J_2 coupling, with the angular momentum of the core and of the final electron or group of electrons in parentheses. Levels best described by pair coupling, or J_1l, notation, have *J*-value of the core state listed first with the value of $K=J_1+l$ in square brackets, where *l* is the orbital angular momentum of the final electron.

(c) *J* **value** is also listed for each energy level.

(d) **Level value** is given in the customary units of cm^{-1}. As reported in [05MOH/TAY] the unit cm^{-1} is related to the SI unit for energy, the joule, by 1 cm^{-1} $=1.986\,445\,61(34)\times10^{-23}$ J. As discussed above, values enclosed in parentheses are calculated and those in square brackets are obtained by isoelectronic fitting.

(e) **Uncertainty** of the level value, also given in cm^{-1}.

(f) **Leading percentages** of components of the level configurations are included if there is significant configuration mixing and if they are available.

(g) **Reference** refers to the source of the energy level value. The list of references can be found at the end of the discussion for that ionization stage.

4. Uncertainties and Significant Figures

The energy levels, wavelengths, and ionization energies reported here are given with uncertainties, as reported by the original authors. In the case of energy levels it was sometimes necessary to calculate uncertainties from the reported uncertainties of the transitions involved. Many theoretical papers do not contain estimates of the uncertainty of the reported values, and hence we are unable to include that information. The estimated uncertainty of the wave number of a transition can be calculated from that of the wavelength. Most transition probabilities contained herein are calculated values whose uncertainties are unknown. Since the scatter between transition probabilities from different sources is substantial (virtually always greater than 10% and frequently much more), it would be prudent to check the details of the calculations in the original source if the uncertainty of the transition probability is important.

In general, the number of significant figures included here is such that the uncertainty in the last digit is between 1 and 15. If a decimal point follows a value which is a whole number this implies that the last digit given is significant, even if it is a zero. If there is no decimal point the uncertainty is greater than 15.

5. References for the Introduction

56WAL/ROW H. E. Walchli and T. J. Rowland, Phys. Rev. **102**, 1334 (1956).

72PEC/REE E. R. Peck and K. Reeder, J. Opt. Soc. Am. **63**, 958 (1972).

04CUR J. J. Curry, J. Phys. Chem. Ref. Data **33**, 725 (2004).

05CRC *CRC Handbook of Chemistry and Physics*, 86th ed., edited by D. R. Lide (Taylor & Francis, New York, 2005), pp. 4–31.

05MOH/TAY P. J. Mohr and B. N. Taylor, Rev. Mod. Phys. **77**, 1 (2005).

6. Spectroscopic Data

6.1. Ba III

Xe isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^25p^6\ {}^1S_0$
Ionization energy 289 100(20) cm^{-1}; 35.844(2) eV

Research on the Ba III spectrum was first reported by Reader and Epstein [75REA/EPS], who classified ten resonance transitions between 400 and 800 Å and located several $J=1$ levels in the 6*s* and 7*s* and 5*d*−7*d* configurations. A more extensive set of measurements was published by Hellentin [76HEL], also using a sliding spark discharge as the source. Hellentin observed and classified about 480 transitions involving levels up to 8*s*, 7*p*, 7*d*, 6*f*, 6*g*, and 6*h*. The $5p^5nl$ ($J=1$) Rydberg series was further investigated by Hill *et al.* [87HIL/SUG], who used laser-driven ionization to produce barium ions, then measured the absorption spectrum between 330 and 390 Å. The transitions and energy levels are listed in Tables 2 and 3. The ionization energy cited was taken from the Hellentin paper [76HEL] and the $5p^5\ {}^2P^\circ_{1/2}$ limit is from Hill *et al.* [87HIL/SUG].

Radiative lifetimes for several of the low-lying energy levels of Ba III have been calculated by Loginov [02LOG] using the Hartree–Fock code developed by Cowan [81COW]. The transition probabilities included here are calculated from the [02LOG] radiative lifetimes.

6.1.1. References for Ba III

75REA/EPS J. Reader and G. L. Epstein, J. Opt. Soc. Am. **65**, 638 (1975).

76HEL P. Hellentin, Phys. Scr. **13**, 155 (1976).
81COW R. D. Cowan, *The Theory of Atomic Structure and Spectra* (University of California, Berkeley, CA, 1981).
87HIL/SUG W. T. Hill III, J. Sugar, T. B. Lucatorto, and K. T. Cheng, Phys. Rev. A **36**, 1200 (1987).
02LOG A. V. Loginov, Opt. Spectrosc. **93**, 649 (2002).

TABLE 2. Observed spectral lines of Ba III

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
Vacuum									
331.72	0.03	301 460		b		$5p^6\ ^1S_0$	$5p^5 17s\ (1/2,1/2)^\circ_1, 16d\ (1/2,3/2)^\circ_1$	87HIL/SUG	
332.65	0.03	300 620		b		$5p^6\ ^1S_0$	$5p^5 16s\ (1/2,1/2)^\circ_1, 15d\ (1/2,3/2)^\circ_1$	87HIL/SUG	
333.80	0.03	299 580				$5p^6\ ^1S_0$	$5p^5 14d\ (1/2,3/2)^\circ_1$	87HIL/SUG	
333.90	0.03	299 490				$5p^6\ ^1S_0$	$5p^5 15s\ (1/2,1/2)^\circ_1$	87HIL/SUG	
335.32	0.03	298 220				$5p^6\ ^1S_0$	$5p^5 13d\ (1/2,3/2)^\circ_1$	87HIL/SUG	
335.41	0.03	298 140				$5p^6\ ^1S_0$	$5p^5 14s\ (1/2,1/2)^\circ_1$	87HIL/SUG	
337.34	0.03	296 430				$5p^6\ ^1S_0$	$5p^5 12d\ (1/2,3/2)^\circ_1$	87HIL/SUG	
337.51	0.03	296 290				$5p^6\ ^1S_0$	$5p^5 13s\ (1/2,1/2)^\circ_1$	87HIL/SUG	
340.14	0.03	294 000				$5p^6\ ^1S_0$	$5p^5 11d\ (1/2,3/2)^\circ_1$	87HIL/SUG	
340.35	0.03	293 810				$5p^6\ ^1S_0$	$5p^5 12s\ (1/2,1/2)^\circ_1$	87HIL/SUG	
344.16	0.03	290 560				$5p^6\ ^1S_0$	$5p^5 16d\ (1/2,3/2)^\circ_1$	87HIL/SUG	
344.48	0.03	290 290				$5p^6\ ^1S_0$	$5p^5 11s\ (1/2,1/2)^\circ_1$	87HIL/SUG	
348.91	0.03	286 600		b		$5p^6\ ^1S_0$	$5p^5 23s\ (3/2,1/2)^\circ_1, 22d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
349.27	0.03	286 310		b		$5p^6\ ^1S_0$	$5p^5 22s\ (3/2,1/2)^\circ_1, 21d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
349.65	0.03	286 000		b		$5p^6\ ^1S_0$	$5p^5 21s\ (3/2,1/2)^\circ_1, 20d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
350.08	0.03	285 650		b		$5p^6\ ^1S_0$	$5p^5 19d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
350.14	0.03	285 990		b		$5p^6\ ^1S_0$	$5p^5 20s\ (3/2,1/2)^\circ_1, 19d\ (3/2,3/2)^\circ_1$	87HIL/SUG	
350.29	0.03	285 470				$5p^6\ ^1S_0$	$5p^5 9d\ (1/2,3/2)^\circ_1$	87HIL/SUG	
350.70	0.03	285 140		b		$5p^6\ ^1S_0$	$5p^5 19s\ (3/2,1/2)^\circ_1$	87HIL/SUG	
350.77	0.03	285 090				$5p^6\ ^1S_0$	$5p^5 10s\ (1/2,1/2)^\circ_1$	87HIL/SUG	
351.34	0.03	284 630				$5p^6\ ^1S_0$	$5p^5 17d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
351.39	0.03	284 580				$5p^6\ ^1S_0$	$5p^5 18s\ (3/2,1/2)^\circ_1$	87HIL/SUG	
352.15	0.03	283 970				$5p^6\ ^1S_0$	$5p^5 16d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
352.23	0.03	283 910				$5p^6\ ^1S_0$	$5p^5 17s\ (3/2,1/2)^\circ_1$	87HIL/SUG	
353.18	0.03	283 140				$5p^6\ ^1S_0$	$5p^5 15d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
353.28	0.03	283 060				$5p^6\ ^1S_0$	$5p^5 16s\ (3/2,1/2)^\circ_1$	87HIL/SUG	
354.48	0.03	282 110				$5p^6\ ^1S_0$	$5p^5 14d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
354.62	0.03	281 990				$5p^6\ ^1S_0$	$5p^5 15s\ (3/2,1/2)^\circ_1$	87HIL/SUG	
356.18	0.03	280 760				$5p^6\ ^1S_0$	$5p^5 13d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
356.36	0.03	280 610				$5p^6\ ^1S_0$	$5p^5 14s\ (3/2,1/2)^\circ_1$	87HIL/SUG	
358.42	0.03	279 010				$5p^6\ ^1S_0$	$5p^5 12d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
358.69	0.03	278 790				$5p^6\ ^1S_0$	$5p^5 13s\ (3/2,1/2)^\circ_1$	87HIL/SUG	
360.25	0.03	277 580				$5p^6\ ^1S_0$	$5p^5 8d\ (1/2,3/2)^\circ_1$	87HIL/SUG	
361.12	0.03	276 920				$5p^6\ ^1S_0$	$5p^5 9s\ (1/2,1/2)^\circ_1$	87HIL/SUG	
361.63	0.03	276 520				$5p^6\ ^1S_0$	$5p^5 11d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
361.93	0.03	276 300				$5p^6\ ^1S_0$	$5p^5 12s\ (3/2,1/2)^\circ_1$	87HIL/SUG	
366.06	0.03	273 180				$5p^6\ ^1S_0$	$5p^5 10d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
366.58	0.03	272 790				$5p^6\ ^1S_0$	$5p^5 11s\ (3/2,1/2)^\circ_1$	87HIL/SUG	
366.79	0.03	272 640				$5p^6\ ^1S_0$		87HIL/SUG	
366.87	0.03	272 570				$5p^6\ ^1S_0$		87HIL/SUG	
372.78	0.03	268 250				$5p^6\ ^1S_0$	$5p^5 9d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
373.67	0.03	267 620		b		$5p^6\ ^1S_0$	$5p^5 10s\ (3/2,1/2)^\circ_1$	87HIL/SUG	
373.73	0.03	267 570		b		$5p^6\ ^1S_0$		87HIL/SUG	
377.53	0.03	264 880				$5p^6\ ^1S_0$		87HIL/SUG	
378.60	0.03	264 130				$5p^6\ ^1S_0$	$5p^5 7d\ (1/2,3/2)^\circ_1$	87HIL/SUG	
380.29	0.03	262 960				$5p^6\ ^1S_0$	$5p^5 8s\ (1/2,1/2)^\circ_1$	87HIL/SUG	
384.04	0.03	260 390				$5p^6\ ^1S_0$	$5p^5 8d\ (3/2,5/2)^\circ_1$	87HIL/SUG	
384.16	0.03	260 310				$5p^6\ ^1S_0$		87HIL/SUG	
385.40	0.03	259 470				$5p^6\ ^1S_0$	$5p^5 9s\ (3/2,1/2)^\circ_1$	87HIL/SUG	
386.19	0.03	258 940				$5p^6\ ^1S_0$		87HIL/SUG	

TABLE 2. Observed spectral lines of Ba III—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
403.821	0.003	247 634.5	5			$5p^6\ ^1S_0$	$5p^57d\ 3/2[3/2]^\circ_1$	76HEL	
407.118	0.003	245 629.2	2			$5p^6\ ^1S_0$	$5p^58s\ 3/2[3/2]^\circ_1$	76HEL	
420.119	0.003	238 028.0	7			$5p^6\ ^1S_0$	$5p^56d\ 1/2[3/2]^\circ_1$	76HEL	
423.843	0.003	235 936.4	4			$5p^6\ ^1S_0$	$5p^57s\ 1/2[1/2]^\circ_1$	76HEL	
448.947	0.003	222 743.4	9			$5p^6\ ^1S_0$	$5p^56d\ 3/2[3/2]^\circ_1$	76HEL	
456.961	0.003	218 836.9	8			$5p^6\ ^1S_0$	$5p^57s\ 3/2[3/2]^\circ_1$	76HEL	
555.478	0.005	180 025.1	14	b	5.88E+10	$5p^6\ ^1S_0$	$5p^55d\ 1/2[3/2]^\circ_1$	75REA/EPS	02LOG
587.548	0.005	170 198.9	14		1.43E+8	$5p^6\ ^1S_0$	$5p^56s\ 1/2[1/2]^\circ_1$	75REA/EPS	02LOG
647.279	0.005	154 492.9	18		4.00E+9	$5p^6\ ^1S_0$	$5p^56s\ 3/2[3/2]^\circ_1$	75REA/EPS	02LOG
653.364	0.005	153 054.0	9		4.24E+8	$5p^6\ ^1S_0$	$5p^55d\ 3/2[3/2]^\circ_1$	75REA/EPS	02LOG
743.121	0.005	134 567.6	15		3.13E+7	$5p^6\ ^1S_0$	$5p^55d\ 3/2[1/2]^\circ_1$	75REA/EPS	02LOG
898.145	0.010	111 340.6	9			$5p^55d\ 3/2[7/2]^\circ_4$	$5p^56f\ 3/2[9/2]_5$	76HEL	
910.910	0.010	109 780.4	8			$5p^55d\ 3/2[7/2]^\circ_3$	$5p^56f\ 3/2[9/2]_4$	76HEL	
921.795	0.010	108 484.0	6			$5p^55d\ 3/2[3/2]^\circ_2$	$5p^55f\ 1/2[5/2]_3$	76HEL	
927.193	0.010	107 852.5	6			$5p^55d\ 3/2[5/2]^\circ_2$	$5p^56f\ 3/2[7/2]_3$	76HEL	
942.860	0.010	106 060.2	5			$5p^55d\ 3/2[7/2]^\circ_3$	$5p^55f\ 1/2[7/2]_4$	76HEL	
963.602	0.010	103 777.3	7			$5p^55d\ 3/2[5/2]^\circ_3$	$5p^56f\ 3/2[7/2]_4$	76HEL	
965.472	0.010	103 576.3	2			$5p^55d\ 3/2[5/2]^\circ_2$	$5p^55f\ 1/2[5/2]_2$	76HEL	
967.016	0.010	103 410.9	6	p		$5p^55d\ 3/2[5/2]^\circ_2$	$5p^55f\ 1/2[7/2]_3$	76HEL	
1 046.044	0.010	95 598.3	2			$5p^55d\ 3/2[1/2]^\circ_0$	$5p^57p\ 3/2[1/2]_1$	76HEL	
1 048.265	0.010	95 395.8	10			$5p^55d\ 3/2[1/2]^\circ_0$	$5p^55f\ 3/2[3/2]_1$	76HEL	
1 053.877	0.010	94 887.7	7			$5p^55d\ 3/2[1/2]^\circ_1$	$5p^55f\ 3/2[5/2]_2$	76HEL	
1 058.310	0.010	94 490.3	4			$5p^55d\ 3/2[1/2]^\circ_1$	$5p^57p\ 3/2[5/2]_2$	76HEL	
1 066.084	0.010	93 801.2	9			$5p^55d\ 3/2[1/2]^\circ_1$	$5p^57p\ 3/2[1/2]_1$	76HEL	
1 066.748	0.010	93 742.8	10			$5p^55d\ 3/2[1/2]^\circ_1$	$5p^55f\ 3/2[3/2]_2$	76HEL	
1 068.390	0.010	93 598.8	8			$5p^55d\ 3/2[1/2]^\circ_1$	$5p^55f\ 3/2[3/2]_1$	76HEL	
1 070.068	0.010	93 452.0	6			$5p^55d\ 3/2[3/2]^\circ_1$	$5p^55f\ 1/2[5/2]_2$	76HEL	
1 078.880	0.010	92 688.7	4			$5p^55d\ 3/2[3/2]^\circ_2$	$5p^57p\ 3/2[3/2]_2$	76HEL	
1 086.665	0.010	92 024.7	8			$5p^55d\ 3/2[3/2]^\circ_2$	$5p^57p\ 3/2[5/2]_3$	76HEL	
1 086.802	0.010	92 013.1	6			$5p^56s\ 3/2[3/2]^\circ_1$	$5p^55f\ 1/2[5/2]_2$	76HEL	
1 093.215	0.010	91 473.3	5			$5p^55d\ 3/2[3/2]^\circ_2$	$5p^55d\ 3/2[3/2]^\circ_2$	76HEL	
1 097.410	0.010	91 123.6	12			$5p^55d\ 3/2[3/2]^\circ_2$	$5p^55f\ 3/2[5/2]_3$	76HEL	
1 097.981	0.010	91 076.2	7			$5p^55d\ 3/2[7/2]^\circ_4$	$5p^57p\ 3/2[5/2]_3$	76HEL	
1 099.315	0.010	90 965.7	8			$5p^55d\ 3/2[7/2]^\circ_4$	$5p^55f\ 3/2[7/2]_4$	76HEL	
1 107.084	0.010	90 327.4	8			$5p^55d\ 3/2[3/2]^\circ_2$	$5p^55f\ 3/2[3/2]_2$	76HEL	
1 108.841	0.010	90 184.3	3			$5p^55d\ 3/2[3/2]^\circ_2$	$5p^55f\ 3/2[3/2]_1$	76HEL	
1 108.944	0.010	90 175.8	5			$5p^55d\ 3/2[7/2]^\circ_4$	$5p^55f\ 3/2[5/2]_3$	76HEL	
1 112.672	0.010	89 873.7	2			$5p^54f\ 3/2[9/2]_5$	$5p^56g\ 3/2[11/2]^\circ_6$	76HEL	
1 113.665	0.010	89 793.6	15			$5p^55d\ 3/2[7/2]^\circ_4$	$5p^55f\ 3/2[9/2]_5$	76HEL	
1 113.948	0.010	89 770.8	3			$5p^55d\ 1/2[5/2]^\circ_2$	$5p^55f\ 1/2[5/2]_2$	76HEL	
1 116.006	0.010	89 605.3	11			$5p^55d\ 1/2[5/2]^\circ_2$	$5p^55f\ 1/2[7/2]_3$	76HEL	
1 116.876	0.010	89 535.5	4			$5p^55d\ 3/2[7/2]^\circ_3$	$5p^57p\ 3/2[5/2]_3$	76HEL	
1 118.266	0.010	89 424.1	7			$5p^55d\ 3/2[7/2]^\circ_3$	$5p^55f\ 3/2[7/2]_4$	76HEL	
1 120.061	0.010	89 280.9	8			$5p^55d\ 3/2[7/2]^\circ_3$	$5p^55f\ 3/2[7/2]_3$	76HEL	
1 126.725	0.010	88 752.8	2			$5p^54f\ 3/2[9/2]_4$	$5p^56g\ 3/2[11/2]^\circ_5$	76HEL	
1 128.226	0.010	88 634.8	4			$5p^55d\ 3/2[7/2]^\circ_3$	$5p^55f\ 3/2[5/2]_3$	76HEL	
1 128.849	0.010	88 585.8	3			$5p^55d\ 3/2[7/2]^\circ_3$	$5p^57p\ 3/2[5/2]_2$	76HEL	
1 133.052	0.010	88 257.2	14			$5p^55d\ 3/2[7/2]^\circ_3$	$5p^55f\ 3/2[9/2]_4$	76HEL	
1 138.458	0.010	87 838.1	1			$5p^55d\ 3/2[7/2]^\circ_3$	$5p^55f\ 3/2[3/2]_2$	76HEL	
1 146.172	0.010	87 246.9	4			$5p^55d\ 3/2[5/2]^\circ_2$	$5p^57p\ 3/2[3/2]_1$	76HEL	
1 148.398	0.010	87 077.8	4			$5p^55d\ 3/2[5/2]^\circ_2$	$5p^57p\ 3/2[5/2]_3$	76HEL	
1 149.454	0.010	86 997.8	1			$5p^55d\ 1/2[3/2]^\circ_2$	$5p^55f\ 1/2[5/2]_2$	76HEL	
1 149.971	0.010	86 958.7	10			$5p^55d\ 1/2[3/2]^\circ_2$	$5p^55f\ 1/2[5/2]_3$	76HEL	
1 151.757	0.010	86 823.9	12			$5p^55d\ 3/2[5/2]^\circ_2$	$5p^55f\ 3/2[7/2]_3$	76HEL	
1 155.722	0.010	86 526.0	8			$5p^55d\ 3/2[5/2]^\circ_2$	$5p^55f\ 3/2[5/2]_2$	76HEL	
1 160.402	0.010	86 177.1	2			$5p^55d\ 3/2[5/2]^\circ_2$	$5p^55f\ 3/2[5/2]_3$	76HEL	
1 170.621	0.010	85 424.8	12			$5p^55d\ 1/2[5/2]^\circ_3$	$5p^55f\ 1/2[7/2]_4$	76HEL	

TABLE 2. Observed spectral lines of Ba III—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
1 171.524	0.010	85 358.9	5			$5p^55d\ 1/2[5/2]^\circ_3$	$5p^55f\ 1/2[5/2]_3$	76HEL	
1 173.194	0.010	85 237.4	3			$5p^55d\ 3/2[5/2]^\circ_2$	$5p^55f\ 3/2[3/2]_1$	76HEL	
1 173.268	0.010	85 232.0	6			$5p^55d\ 1/2[5/2]^\circ_3$	$5p^55f\ 1/2[7/2]_3$	76HEL	
1 196.098	0.010	83 605.2	8	b		$5p^55d\ 3/2[5/2]^\circ_3$	$5p^57p\ 3/2[3/2]_2$	76HEL	
1 205.681	0.010	82 940.7	10			$5p^55d\ 3/2[5/2]^\circ_3$	$5p^57p\ 3/2[5/2]_3$	76HEL	
1 207.286	0.010	82 830.4	13			$5p^55d\ 3/2[5/2]^\circ_3$	$5p^55f\ 3/2[7/2]_4$	76HEL	
1 214.159	0.010	82 361.6	5			$5p^54f\ 3/2[3/2]_1$	$5p^55g\ 3/2[5/2]^\circ_2$	76HEL	
1 218.917	0.010	82 040.0	11			$5p^55d\ 3/2[5/2]^\circ_3$	$5p^55f\ 3/2[5/2]_3$	76HEL	
1 219.633	0.010	81 991.9	4			$5p^55d\ 3/2[5/2]^\circ_3$	$5p^57p\ 3/2[5/2]_2$	76HEL	
1 224.545	0.010	81 663.0	12			$5p^55d\ 3/2[5/2]^\circ_3$	$5p^55f\ 3/2[9/2]_4$	76HEL	
1 230.852	0.010	81 244.5	3			$5p^55d\ 3/2[5/2]^\circ_3$	$5p^55f\ 3/2[3/2]_2$	76HEL	
1 239.603	0.010	80 671.0	2			$5p^54f\ 3/2[3/2]_2$	$5p^55g\ 3/2[7/2]^\circ_3$	76HEL	
1 244.762	0.010	80 336.6	6			$5p^54f\ 3/2[3/2]_2$	$5p^55g\ 3/2[5/2]^\circ_3$	76HEL	
1 282.556	0.010	77 969.3	2			$5p^54f\ 3/2[9/2]_5$	$5p^55g\ 3/2[9/2]^\circ_5$	76HEL	
1 288.526	0.010	77 608.1	12			$5p^54f\ 3/2[9/2]_5$	$5p^55g\ 3/2[11/2]^\circ_6$	76HEL	
1 289.722	0.010	77 536.1	2			$5p^56s\ 3/2[3/2]^\circ_1$	$5p^57p\ 3/2[1/2]_0$	76HEL	
1 290.031	0.010	77 517.5	10			$5p^54f\ 3/2[5/2]_3$	$5p^55g\ 3/2[7/2]^\circ_4$	76HEL	
1 290.701	0.010	77 477.3	6			$5p^54f\ 1/2[7/2]_3$	$5p^55g\ 1/2[9/2]^\circ_4$	76HEL	
1 293.308	0.010	77 321.1	3			$5p^56s\ 3/2[3/2]^\circ_2$	$5p^55f\ 3/2[5/2]_2$	76HEL	
1 295.486	0.010	77 191.1	2			$5p^54f\ 3/2[5/2]_3$	$5p^55g\ 3/2[5/2]^\circ_3$	76HEL	
1 299.177	0.010	76 971.8	11			$5p^56s\ 3/2[3/2]^\circ_2$	$5p^55f\ 3/2[5/2]_3$	76HEL	
1 301.349	0.010	76 843.4	2	b		$5p^54f\ 3/2[9/2]_4$	$5p^55g\ 3/2[9/2]^\circ_4$	76HEL	
1 307.401	0.010	76 487.6	11			$5p^54f\ 3/2[9/2]_4$	$5p^55g\ 3/2[11/2]^\circ_5$	76HEL	
1 308.873	0.010	76 401.6	12			$5p^55d\ 3/2[3/2]^\circ_1$	$5p^55f\ 3/2[5/2]_2$	76HEL	
1 311.744	0.010	76 234.4	8			$5p^56s\ 3/2[3/2]^\circ_2$	$5p^57p\ 3/2[1/2]_1$	76HEL	
1 312.754	0.010	76 175.7	8			$5p^56s\ 3/2[3/2]^\circ_2$	$5p^55f\ 3/2[3/2]_2$	76HEL	
1 315.242	0.010	76 031.6	3			$5p^56s\ 3/2[3/2]^\circ_2$	$5p^55f\ 3/2[3/2]_1$	76HEL	
1 315.722	0.010	76 003.9	12			$5p^55d\ 3/2[3/2]^\circ_1$	$5p^57p\ 3/2[5/2]_2$	76HEL	
1 321.313	0.010	75 682.3	4			$5p^56s\ 3/2[3/2]^\circ_1$	$5p^57p\ 3/2[3/2]_1$	76HEL	
1 323.266	0.010	75 570.6	6			$5p^54f\ 1/2[5/2]_3$	$5p^55g\ 1/2[7/2]^\circ_4$	76HEL	
1 327.752	0.010	75 315.3	4			$5p^55d\ 3/2[3/2]^\circ_1$	$5p^57p\ 3/2[1/2]_1$	76HEL	
1 328.817	0.010	75 254.9	8	b		$5p^55d\ 3/2[3/2]^\circ_1$	$5p^55f\ 3/2[3/2]_2$	76HEL	
1 331.333	0.010	75 112.7	8			$5p^55d\ 3/2[3/2]^\circ_1$	$5p^55f\ 3/2[3/2]_1$	76HEL	
1 334.011	0.010	74 961.9	12			$5p^56s\ 3/2[3/2]^\circ_1$	$5p^55f\ 3/2[5/2]_2$	76HEL	
1 339.331	0.010	74 664.2	8			$5p^54f\ 1/2[7/2]_4$	$5p^55g\ 1/2[9/2]^\circ_5$	76HEL	
1 341.122	0.010	74 564.4	8			$5p^56s\ 3/2[3/2]^\circ_1$	$5p^57p\ 3/2[5/2]_2$	76HEL	
1 346.439	0.010	74 270.0	7			$5p^54f\ 3/2[9/2]_5$	$5p^57d\ 3/2[7/2]^\circ_4$	76HEL	
1 354.708	0.010	73 816.7	11			$5p^56s\ 3/2[3/2]^\circ_1$	$5p^55f\ 3/2[3/2]_2$	76HEL	
1 358.929	0.010	73 587.4	10			$5p^54f\ 3/2[7/2]_3$	$5p^55g\ 3/2[9/2]^\circ_4$	76HEL	
1 360.981	0.010	73 476.4	2			$5p^54f\ 3/2[7/2]_3$	$5p^55g\ 3/2[7/2]^\circ_3$	76HEL	
1 364.787	0.010	73 271.5	3			$5p^55d\ 1/2[5/2]^\circ_2$	$5p^57p\ 3/2[5/2]_3$	76HEL	
1 366.050	0.010	73 203.8	5			$5p^54f\ 3/2[9/2]_4$	$5p^57d\ 3/2[7/2]^\circ_3$	76HEL	
1 369.534	0.010	73 017.5	11			$5p^55d\ 1/2[5/2]^\circ_2$	$5p^55f\ 3/2[7/2]_3$	76HEL	
1 375.138	0.010	72 720.0	4			$5p^55d\ 1/2[5/2]^\circ_2$	$5p^55f\ 3/2[5/2]_2$	76HEL	
1 416.611	0.010	70 591.0	11			$5p^54f\ 3/2[7/2]_4$	$5p^55g\ 3/2[9/2]^\circ_5$	76HEL	
1 418.472	0.010	70 498.4	10			$5p^55d\ 1/2[3/2]^\circ_2$	$5p^57p\ 3/2[5/2]_3$	76HEL	
1 419.050	0.010	70 469.7	2			$5p^54f\ 3/2[7/2]_4$	$5p^55g\ 3/2[7/2]^\circ_4$	76HEL	
1 421.602	0.010	70 343.2	2			$5p^54f\ 3/2[7/2]_3$	$5p^57d\ 3/2[5/2]^\circ_3$	76HEL	
1 422.862	0.010	70 280.9	3			$5p^54f\ 1/2[5/2]_2$	$5p^55g\ 1/2[7/2]^\circ_3$	76HEL	
1 436.831	0.010	69 597.6	10			$5p^55d\ 1/2[3/2]^\circ_2$	$5p^55f\ 3/2[5/2]_3$	76HEL	
1 437.825	0.010	69 549.5	5			$5p^55d\ 1/2[3/2]^\circ_2$	$5p^57p\ 3/2[5/2]7_2$	76HEL	
1 453.460	0.010	68 801.4	9			$5p^55d\ 1/2[3/2]^\circ_2$	$5p^57p\ 3/2[5/2]_2$	76HEL	
1 456.496	0.010	68 657.9	1	p		$5p^55d\ 1/2[3/2]^\circ_2$	$5p^55f\ 3/2[3/2]_1$	76HEL	
1 456.786	0.010	68 644.2	3			$5p^55d\ 1/2[5/2]^\circ_3$	$5p^55f\ 3/2[7/2]_3$	76HEL	
1 464.901	0.010	68 264.0	7			$5p^56p\ 3/2[1/2]_1$	$5p^57d\ 3/2[3/2]^\circ_2$	76HEL	
1 470.644	0.010	67 997.4	1			$5p^55d\ 1/2[5/2]^\circ_3$	$5p^55f\ 3/2[5/2]_3$	76HEL	
1 475.575	0.010	67 770.2	1			$5p^56p\ 3/2[1/2]_1$	$5p^57d\ 3/2[1/2]^\circ_1$	76HEL	

TABLE 2. Observed spectral lines of Ba III—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
1 476.389	0.010	67 732.8	9			$5p^56p\ 3/2[1/2]_1$	$5p^58s\ 3/2[3/2]^{\circ}_2$	76HEL	
1 478.847	0.010	67 620.3	12			$5p^55d\ 1/2[5/2]^{\circ}_3$	$5p^55f\ 3/2[9/2]_4$	76HEL	
1 479.915	0.010	67 571.4	6			$5p^54f\ 3/2[7/2]_4$	$5p^57d\ 3/2[5/2]^{\circ}_3$	76HEL	
1 481.846	0.010	67 483.4	7	b		$5p^56p\ 3/2[1/2]_1$	$5p^57d\ 3/2[1/2]^{\circ}_0$	76HEL	
1 498.330	0.010	66 741.0	9			$5p^55d\ 3/2[1/2]^{\circ}_1$	$5p^56p\ 1/2[1/2]_0$	76HEL	
1 500.244	0.010	66 655.8	8			$5p^54f\ 3/2[5/2]_2$	$5p^55g\ 3/2[7/2]^{\circ}_3$	76HEL	
1 501.714	0.010	66 590.6	7			$5p^56p\ 3/2[5/2]_2$	$5p^57d\ 3/2[5/2]^{\circ}_2$	76HEL	
1 504.220	0.010	66 479.7	10			$5p^55d\ 1/2[3/2]^{\circ}_1$	$5p^55f\ 1/2[5/2]_2$	76HEL	
1 507.673	0.010	66 327.4	3			$5p^56p\ 3/2[5/2]_2$	$5p^57d\ 3/2[3/2]^{\circ}_2$	76HEL	
1 507.809	0.010	66 321.4	4			$5p^54f\ 3/2[5/2]_2$	$5p^55g\ 3/2[5/2]^{\circ}_3$	76HEL	
1 510.676	0.010	66 195.5	12			$5p^56p\ 3/2[5/2]_2$	$5p^57d\ 3/2[7/2]^{\circ}_3$	76HEL	
1 512.891	0.010	66 098.6	7			$5p^56p\ 3/2[5/2]_2$	$5p^58s\ 3/2[3/2]^{\circ}_1$	76HEL	
1 514.223	0.010	66 040.5	12			$5p^55d\ 3/2[1/2]^{\circ}_1$	$5p^56p\ 1/2[3/2]_2$	76HEL	
1 518.986	0.010	65 833.4	7			$5p^56p\ 3/2[5/2]_2$	$5p^57d\ 3/2[1/2]^{\circ}_1$	76HEL	
1 519.857	0.010	65 795.6	6			$5p^56p\ 3/2[5/2]_2$	$5p^58s\ 3/2[3/2]^{\circ}_2$	76HEL	
1 540.526	0.010	64 912.9	5			$5p^56p\ 3/2[3/2]_1$	$5p^57d\ 3/2[3/2]^{\circ}_1$	76HEL	
1 549.600	0.010	64 532.8	7	p		$5p^56p\ 3/2[5/2]_3$	$5p^57d\ 3/2[5/2]^{\circ}_3$	76HEL	
1 564.694	0.010	63 910.3	3			$5p^56p\ 3/2[5/2]_3$	$5p^57d\ 3/2[7/2]^{\circ}_3$	76HEL	
1 565.611	0.010	63 872.8	12			$5p^55d\ 3/2[1/2]^{\circ}_0$	$5p^56p\ 1/2[3/2]_1$	76HEL	
1 566.123	0.010	63 851.9	12			$5p^56p\ 3/2[5/2]_3$	$5p^57d\ 3/2[7/2]^{\circ}_4$	76HEL	
1 574.547	0.010	63 510.3	12			$5p^56p\ 3/2[5/2]_3$	$5p^58s\ 3/2[3/2]^{\circ}_2$	76HEL	
1 577.323	0.010	63 398.5	9			$5p^56p\ 3/2[3/2]_1$	$5p^57d\ 3/2[5/2]^{\circ}_2$	76HEL	
1 589.657	0.010	62 906.7	7			$5p^56p\ 3/2[3/2]_1$	$5p^58s\ 3/2[3/2]^{\circ}_1$	76HEL	
1 594.188	0.010	62 727.9	3			$5p^54f\ 3/2[5/2]_2$	$5p^58s\ 3/2[3/2]^{\circ}_2$	76HEL	
1 596.796	0.010	62 625.4	12			$5p^55d\ 3/2[3/2]^{\circ}_2$	$5p^56p\ 1/2[3/2]_2$	76HEL	
1 610.954	0.010	62 075.0	12			$5p^55d\ 3/2[1/2]^{\circ}_1$	$5p^56p\ 1/2[3/2]_1$	76HEL	
1 612.746	0.010	62 006.0	10			$5p^56p\ 3/2[3/2]_2$	$5p^57d\ 3/2[5/2]^{\circ}_3$	76HEL	
1 615.778	0.010	61 889.7	12			$5p^55d\ 3/2[3/2]^{\circ}_2$	$5p^56p\ 1/2[1/2]_1$	76HEL	
1 617.014	0.010	61 842.4	5			$5p^55d\ 3/2[1/2]^{\circ}_1$	$5p^54f\ 1/2[5/2]_2$	76HEL	
1 625.629	0.010	61 514.6	8	b		$5p^56p\ 3/2[3/2]_2$	$5p^57d\ 3/2[3/2]^{\circ}_2$	76HEL	
1 631.693	0.010	61 286.0	4			$5p^56p\ 3/2[3/2]_2$	$5p^58s\ 3/2[3/2]^{\circ}_1$	76HEL	
1 639.790	0.010	60 983.4	4			$5p^56p\ 3/2[3/2]_2$	$5p^58s\ 3/2[3/2]^{\circ}_2$	76HEL	
1 662.911	0.010	60 135.5	10			$5p^55d\ 3/2[7/2]^{\circ}_3$	$5p^56p\ 1/2[3/2]_2$	76HEL	
1 667.364	0.010	59 974.9	4			$5p^56p\ 3/2[1/2]_0$	$5p^57d\ 3/2[3/2]^{\circ}_1$	76HEL	
1 711.532	0.010	58 427.2	12			$5p^55d\ 3/2[3/2]^{\circ}_2$	$5p^54f\ 1/2[5/2]_2$	76HEL	
1 725.076	0.010	57 968.5	6			$5p^56p\ 3/2[1/2]_0$	$5p^58s\ 3/2[3/2]^{\circ}_1$	76HEL	
1 787.712	0.010	55 937.4	10			$5p^55d\ 3/2[7/2]^{\circ}_3$	$5p^54f\ 1/2[5/2]_2$	76HEL	
1 861.740	0.010	53 713.2	12			$5p^55d\ 3/2[5/2]^{\circ}_2$	$5p^56p\ 1/2[3/2]_1$	76HEL	
1 869.852	0.010	53 480.2	3			$5p^55d\ 3/2[5/2]^{\circ}_2$	$5p^54f\ 1/2[5/2]_2$	76HEL	
1 883.506	0.010	53 092.5	7			$5p^55d\ 3/2[1/2]^{\circ}_1$	$5p^56p\ 3/2[1/2]_0$	76HEL	
1 883.922	0.010	53 080.7	4			$5p^55d\ 3/2[7/2]^{\circ}_4$	$5p^54f\ 1/2[7/2]_4$	76HEL	
1 916.405	0.010	52 181.0	1	*		$5p^55d\ 3/2[7/2]^{\circ}_4$	$5p^54f\ 1/2[5/2]_3$	76HEL	
1 916.405	0.010	52 181.0	1	*		$5p^54f\ 3/2[3/2]_1$	$5p^56d\ 3/2[3/2]^{\circ}_2$	76HEL	
1 950.814	0.010	51 260.7	1			$5p^54f\ 3/2[3/2]_2$	$5p^56d\ 3/2[5/2]^{\circ}_3$	76HEL	
1 965.541	0.010	50 876.6	4			$5p^54f\ 3/2[3/2]_1$	$5p^56d\ 3/2[1/2]^{\circ}_1$	76HEL	
1 973.231	0.010	50 678.3	3			$5p^54f\ 3/2[3/2]_2$	$5p^56d\ 3/2[5/2]^{\circ}_2$	76HEL	
1 974.757	0.010	50 639.2	1			$5p^55d\ 3/2[7/2]^{\circ}_3$	$5p^54f\ 1/2[5/2]_3$	76HEL	
1 987.944	0.010	50 303.2	4			$5p^54f\ 3/2[3/2]_1$	$5p^56d\ 3/2[1/2]^{\circ}_0$	76HEL	
1 989.500	0.010	50 263.9	4			$5p^55d\ 3/2[7/2]^{\circ}_4$	$5p^54f\ 1/2[7/2]_3$	76HEL	
1 994.354	0.010	50 141.6	5			$5p^54f\ 3/2[3/2]_2$	$5p^56d\ 3/2[3/2]^{\circ}_2$	76HEL	
Air									
2 001.297	0.020	49 951.4	10			$5p^55d\ 3/2[1/2]^{\circ}_0$	$5p^56p\ 3/2[3/2]_1$	76HEL	
2 005.846	0.020	49 838.2	4			$5p^54f\ 3/2[3/2]_2$	$5p^56d\ 3/2[7/2]^{\circ}_3$	76HEL	
2 008.403	0.020	49 774.7	15			$5p^55d\ 3/2[1/2]^{\circ}_1$	$5p^56p\ 3/2[3/2]_2$	76HEL	
2 022.445	0.020	49 429.2	13			$5p^55d\ 1/2[3/2]^{\circ}_1$	$5p^55f\ 3/2[5/2]_2$	76HEL	
2 025.965	0.020	49 343.3	4			$5p^55d\ 3/2[5/2]^{\circ}_3$	$5p^54f\ 1/2[5/2]_2$	76HEL	
2 038.840	0.020	49 031.7	10			$5p^55d\ 1/2[3/2]^{\circ}_1$	$5p^57p\ 3/2[5/2]_2$	76HEL	

TABLE 2. Observed spectral lines of Ba III—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
2 046.978	0.020	48 836.8	5			$5p^54f\ 3/2[3/2]_2$	$5p^56d\ 3/2[1/2]^{\circ}_1$	76HEL	
2 051.790	0.020	48 722.3	4			$5p^55d\ 3/2[7/2]^{\circ}_3$	$5p^54f\ 1/2[7/2]_3$	76HEL	
2 070.425	0.020	48 283.8	12			$5p^55d\ 1/2[3/2]^{\circ}_1$	$5p^55f\ 3/2[3/2]_2$	76HEL	
2 071.683	0.020	48 254.5	12			$5p^55d\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 1/2[1/2]_0$	76HEL	
2 074.798	0.020	48 182.1	4			$5p^55d\ 3/2[5/2]^{\circ}_2$	$5p^54f\ 1/2[5/2]_3$	76HEL	
2 075.999	0.020	48 154.2	10			$5p^55d\ 3/2[1/2]^{\circ}_1$	$5p^56p\ 3/2[3/2]_1$	76HEL	
2 077.668	0.020	48 115.6	8			$5p^54f\ 3/2[5/2]_3$	$5p^56d\ 3/2[5/2]^{\circ}_3$	76HEL	
2 081.351	0.020	48 030.4	12			$5p^55d\ 3/2[1/2]^{\circ}_1$	$5p^54f\ 3/2[5/2]_2$	76HEL	
2 094.117	0.020	47 737.7	8			$5p^56s\ 3/2[3/2]^{\circ}_2$	$5p^56p\ 1/2[1/2]_1$	76HEL	
2 102.211	0.020	47 553.9	4			$5p^55d\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 1/2[3/2]_2$	76HEL	
2 103.107	0.020	47 533.6	4			$5p^54f\ 3/2[5/2]_3$	$5p^56d\ 3/2[5/2]^{\circ}_2$	76HEL	
2 127.131	0.020	46 996.8	8			$5p^54f\ 3/2[5/2]_3$	$5p^56d\ 3/2[3/2]^{\circ}_2$	76HEL	
2 134.873	0.020	46 826.4	10			$5p^54f\ 3/2[9/2]_5$	$5p^56d\ 3/2[7/2]^{\circ}_4$	76HEL	
2 135.253	0.020	46 818.1	9			$5p^55d\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 1/2[1/2]_1$	76HEL	
2 135.397	0.020	46 814.9	8			$5p^56s\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 1/2[1/2]_0$	76HEL	
2 140.959	0.020	46 693.3	4			$5p^54f\ 3/2[5/2]_3$	$5p^56d\ 3/2[7/2]^{\circ}_3$	76HEL	
2 150.034	0.020	46 496.3	9			$5p^54f\ 3/2[5/2]_3$	$5p^56d\ 3/2[7/2]^{\circ}_4$	76HEL	
2 154.769	0.020	46 394.1	7			$5p^54f\ 1/2[7/2]_3$	$5p^56d\ 1/2[5/2]^{\circ}_2$	76HEL	
2 156.370	0.020	46 359.7	16			$5p^55d\ 3/2[3/2]^{\circ}_2$	$5p^56p\ 3/2[3/2]_2$	76HEL	
2 160.757	0.020	46 265.5	10			$5p^55d\ 3/2[5/2]^{\circ}_2$	$5p^54f\ 1/2[7/2]_3$	76HEL	
2 178.009	0.020	45 899.1	9			$5p^54f\ 3/2[9/2]_4$	$5p^56d\ 3/2[7/2]^{\circ}_3$	76HEL	
2 202.992	0.020	45 378.6	8			$5p^56s\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 1/2[1/2]_1$	76HEL	
2 223.392	0.020	44 962.3	18			$5p^55d\ 3/2[1/2]^{\circ}_1$	$5p^56p\ 3/2[5/2]_2$	76HEL	
2 223.830	0.020	44 953.5	7			$5p^56p\ 3/2[5/2]_2$	$5p^56d\ 1/2[3/2]^{\circ}_2$	76HEL	
2 224.249	0.020	44 945.0	12			$5p^55d\ 3/2[5/2]^{\circ}_3$	$5p^54f\ 1/2[7/2]_4$	76HEL	
2 230.330	0.020	44 822.5	20			$5p^55d\ 3/2[1/2]^{\circ}_0$	$5p^56p\ 3/2[1/2]_1$	76HEL	
2 234.483	0.020	44 739.2	13			$5p^55d\ 3/2[3/2]^{\circ}_2$	$5p^56p\ 3/2[3/2]_1$	76HEL	
2 240.683	0.020	44 615.4	12			$5p^55d\ 3/2[3/2]^{\circ}_2$	$5p^54f\ 3/2[5/2]_2$	76HEL	
2 250.976	0.020	44 411.4	7			$5p^54f\ 1/2[7/2]_4$	$5p^56d\ 1/2[5/2]^{\circ}_3$	76HEL	
2 257.902	0.020	44 275.2	8			$5p^56s\ 3/2[3/2]^{\circ}_2$	$5p^54f\ 1/2[5/2]_2$	76HEL	
2 269.687	0.020	44 045.3	12			$5p^55d\ 3/2[5/2]^{\circ}_3$	$5p^54f\ 1/2[5/2]_3$	76HEL	
2 278.639	0.020	43 872.3	13			$5p^55d\ 1/2[5/2]^{\circ}_2$	$5p^56p\ 1/2[3/2]_2$	76HEL	
2 278.746	0.020	43 870.2	6			$5p^55d\ 3/2[7/2]^{\circ}_3$	$5p^56p\ 3/2[3/2]_2$	76HEL	
2 280.684	0.020	43 833.0	30			$5p^55d\ 3/2[3/2]^{\circ}_2$	$5p^56p\ 3/2[5/2]_3$	76HEL	
2 293.471	0.020	43 588.6	7			$5p^55d\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 1/2[3/2]_1$	76HEL	
2 298.988	0.020	43 484.0	8			$5p^54f\ 3/2[7/2]_3$	$5p^56d\ 3/2[5/2]^{\circ}_2$	76HEL	
2 305.785	0.020	43 355.8	3			$5p^55d\ 3/2[3/2]^{\circ}_1$	$5p^54f\ 1/2[5/2]_2$	76HEL	
2 313.413	0.020	43 212.9	7			$5p^56p\ 3/2[5/2]_2$	$5p^56d\ 3/2[3/2]^{\circ}_1$	76HEL	
2 317.500	0.020	43 136.7	7			$5p^55d\ 1/2[5/2]^{\circ}_2$	$5p^56p\ 1/2[1/2]_1$	76HEL	
2 323.505	0.020	43 025.2	35			$5p^55d\ 3/2[1/2]^{\circ}_1$	$5p^55d\ 3/2[1/2]^{\circ}_1$	76HEL	
2 331.101	0.020	42 885.0	60			$5p^55d\ 3/2[7/2]^{\circ}_4$	$5p^56p\ 3/2[5/2]_3$	76HEL	
2 344.276	0.020	42 644.0	3			$5p^54f\ 3/2[7/2]_3$	$5p^56d\ 3/2[7/2]^{\circ}_3$	76HEL	
2 371.804	0.020	42 149.1	10			$5p^56s\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 1/2[3/2]_1$	76HEL	
2 372.976	0.020	42 128.3	7	p		$5p^55d\ 3/2[5/2]^{\circ}_3$	$5p^54f\ 1/2[7/2]_3$	76HEL	
2 373.121	0.020	42 125.7	13			$5p^55d\ 3/2[7/2]^{\circ}_3$	$5p^54f\ 3/2[5/2]_2$	76HEL	
2 384.994	0.020	41 916.1	13			$5p^56s\ 3/2[3/2]^{\circ}_1$	$5p^54f\ 1/2[5/2]_2$	76HEL	
2 399.143	0.020	41 668.9	7			$5p^56p\ 3/2[1/2]_1$	$5p^56d\ 3/2[5/2]^{\circ}_2$	76HEL	
2 402.143	0.020	41 616.8	5			$5p^54f\ 1/2[5/2]_2$	$5p^56d\ 1/2[3/2]^{\circ}_1$	76HEL	
2 413.968	0.020	41 413.0	13	b		$5p^55d\ 3/2[5/2]^{\circ}_2$	$5p^56p\ 3/2[3/2]_2$	76HEL	
2 415.673	0.020	41 383.8	9			$5p^56p\ 1/2[3/2]_1$	$5p^56d\ 1/2[3/2]^{\circ}_1$	76HEL	
2 418.039	0.020	41 343.3	18			$5p^55d\ 3/2[7/2]^{\circ}_3$	$5p^56p\ 3/2[5/2]_3$	76HEL	
2 423.866	0.020	41 243.9	3			$5p^56p\ 3/2[1/2]_1$	$5p^57s\ 3/2[3/2]^{\circ}_1$	76HEL	
2 430.462	0.020	41 132.0	9			$5p^56p\ 3/2[1/2]_1$	$5p^56d\ 3/2[3/2]^{\circ}_2$	76HEL	
2 432.393	0.020	41 099.3	12			$5p^55d\ 1/2[3/2]^{\circ}_2$	$5p^56p\ 1/2[3/2]_2$	76HEL	
2 434.243	0.020	41 068.1	9			$5p^54f\ 3/2[7/2]_4$	$5p^56d\ 3/2[5/2]^{\circ}_3$	76HEL	
2 475.621	0.020	40 381.7	18			$5p^56p\ 3/2[1/2]_1$	$5p^57s\ 3/2[3/2]^{\circ}_2$	76HEL	
2 476.732	0.020	40 363.6	25			$5p^55d\ 1/2[3/2]^{\circ}_2$	$5p^56p\ 1/2[1/2]_1$	76HEL	

TABLE 2. Observed spectral lines of Ba III—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
2 479.776	0.020	40 314.1	9			$5p^5$6p 3/2[5/2]$_2$	$5p^5$6d 3/2[5/2]$^\circ_3$	76HEL	
2 490.224	0.020	40 144.9	7			$5p^5$4f 3/2[5/2]$_2$	$5p^5$6d 3/2[3/2]$^\circ_1$	76HEL	
2 497.925	0.020	40 021.2	12			$5p^5$6p 3/2[3/2]$_1$	$5p^5$6d 3/2[3/2]$^\circ_1$	76HEL	
2 498.426	0.020	40 013.1	11			$5p^5$4f 1/2[5/2]$_2$	$5p^5$6d 1/2[5/2]$^\circ_3$	76HEL	
2 505.067	0.020	39 907.1	25			$5p^5$5d 1/2[5/2]$^\circ_2$	$5p^5$6p 1/2[3/2]$_1$	76HEL	
2 508.953	0.020	39 845.3	18			$5p^5$5d 3/2[7/2]$^\circ_4$	$5p^5$4f 3/2[7/2]$_4$	76HEL	
2 510.088	0.020	39 827.3	18			$5p^5$6p 3/2[1/2]$_1$	$5p^5$6d 3/2[1/2]$^\circ_1$	76HEL	
2 512.284	0.020	39 792.4	40			$5p^5$5d 3/2[5/2]$^\circ_2$	$5p^5$6p 3/2[3/2]$_1$	76HEL	
2 516.124	0.020	39 731.7	13			$5p^5$6p 3/2[5/2]$_2$	$5p^5$6d 3/2[5/2]$^\circ_2$	76HEL	
2 519.783	0.020	39 674.0	3			$5p^5$5d 1/2[5/2]$^\circ_2$	$5p^5$4f 1/2[5/2]$_2$	76HEL	
2 520.124	0.020	39 668.7	13			$5p^5$5d 3/2[5/2]$^\circ_2$	$5p^5$4f 3/2[5/2]$_2$	76HEL	
2 523.825	0.020	39 610.5	40			$5p^5$5d 3/2[3/2]$^\circ_2$	$5p^5$5d 3/2[3/2]$^\circ_2$	76HEL	
2 529.276	0.020	39 525.1	6			$5p^5$4f 1/2[5/2]$_2$	$5p^5$7s 1/2[1/2]$^\circ_1$	76HEL	
2 530.919	0.020	39 499.5	25			$5p^5$5d 1/2[5/2]$^\circ_3$	$5p^5$6p 1/2[3/2]$_2$	76HEL	
2 543.339	0.020	39 306.6	12			$5p^5$6p 3/2[5/2]$_2$	$5p^5$7s 3/2[3/2]$^\circ_1$	76HEL	
2 544.283	0.020	39 292.0	8			$5p^5$6p 1/2[3/2]$_1$	$5p^5$7s 1/2[1/2]$^\circ_1$	76HEL	
2 546.754	0.020	39 253.9	13			$5p^5$6p 3/2[1/2]$_1$	$5p^5$6d 3/2[1/2]$^\circ_0$	76HEL	
2 550.591	0.020	39 194.8	12			$5p^5$6p 3/2[5/2]$_2$	$5p^5$6d 3/2[3/2]$^\circ_2$	76HEL	
2 559.535	0.020	39 057.9	50			$5p^5$5d 3/2[7/2]$^\circ_3$	$5p^5$6p 3/2[5/2]$_2$	76HEL	
2 561.141	0.020	39 033.4	8			$5p^5$6p 1/2[3/2]$_1$	$5p^5$7s 1/2[1/2]$^\circ_0$	76HEL	
2 564.835	0.020	38 977.2	13			$5p^5$6s 3/2[3/2]$^\circ_2$	$5p^5$4f 1/2[5/2]$_3$	76HEL	
2 566.864	0.020	38 946.4	14			$5p^5$6p 1/2[3/2]$_1$	$5p^5$6d 1/2[5/2]$^\circ_2$	76HEL	
2 570.480	0.020	38 891.6	25			$5p^5$6p 3/2[5/2]$_2$	$5p^5$6d 3/2[7/2]$^\circ_3$	76HEL	
2 570.833	0.020	38 886.2	7			$5p^5$5d 3/2[5/2]$^\circ_2$	$5p^5$6p 3/2[5/2]$_3$	76HEL	
2 600.361	0.020	38 444.7	8			$5p^5$6p 3/2[5/2]$_2$	$5p^5$7s 3/2[3/2]$^\circ_2$	76HEL	
2 609.931	0.020	38 303.8	9			$5p^5$5d 3/2[7/2]$^\circ_3$	$5p^5$4f 3/2[7/2]$_4$	76HEL	
2 620.172	0.020	38 154.1	7			$5p^5$6p 1/2[1/2]$_1$	$5p^5$6d 1/2[3/2]$^\circ_1$	76HEL	
2 628.827	0.020	38 028.4	14			$5p^5$6p 3/2[5/2]$_3$	$5p^5$6d 3/2[5/2]$^\circ_3$	76HEL	
2 638.425	0.020	37 890.1	13			$5p^5$6p 3/2[5/2]$_2$	$5p^5$6d 3/2[1/2]$^\circ_1$	76HEL	
2 669.713	0.020	37 446.1	7			$5p^5$6p 3/2[5/2]$_3$	$5p^5$6d 3/2[5/2]$^\circ_2$	76HEL	
2 681.891	0.020	37 276.1	40			$5p^5$5d 3/2[5/2]$^\circ_3$	$5p^5$6p 3/2[3/2]$_2$	76HEL	
2 684.053	0.020	37 246.0	13			$5p^5$4f 3/2[5/2]$_2$	$5p^5$6d 3/2[5/2]$^\circ_3$	76HEL	
2 697.502	0.020	37 060.3	8			$5p^5$6s 3/2[3/2]$^\circ_2$	$5p^5$4f 1/2[7/2]$_3$	76HEL	
2 708.550	0.020	36 909.2	8			$5p^5$6p 3/2[5/2]$_3$	$5p^5$6d 3/2[3/2]$^\circ_2$	76HEL	
2 713.136	0.020	36 846.8	7			$5p^5$5d 3/2[7/2]$^\circ_4$	$5p^5$4f 3/2[7/2]$_3$	76HEL	
2 722.656	0.020	36 718.0	10			$5p^5$6p 1/2[1/2]$_0$	$5p^5$6d 1/2[3/2]$^\circ_1$	76HEL	
2 726.691	0.020	36 663.6	7			$5p^5$4f 3/2[5/2]$_2$	$5p^5$6d 3/2[5/2]$^\circ_2$	76HEL	
2 730.998	0.020	36 605.8	12			$5p^5$6p 3/2[5/2]$_3$	$5p^5$6p 3/2[5/2]$_3$	76HEL	
2 731.387	0.020	36 600.6	15			$5p^5$5d 3/2[5/2]$^\circ_2$	$5p^5$6p 3/2[5/2]$_2$	76HEL	
2 735.929	0.020	36 539.8	15			$5p^5$6p 3/2[3/2]$_1$	$5p^5$6d 3/2[5/2]$^\circ_2$	76HEL	
2 745.783	0.020	36 408.7	30			$5p^5$6p 3/2[5/2]$_3$	$5p^5$6d 3/2[7/2]$^\circ_4$	76HEL	
2 762.171	0.020	36 192.7	14			$5p^5$6p 1/2[1/2]$_1$	$5p^5$6d 1/2[3/2]$^\circ_2$	76HEL	
2 764.745	0.020	36 159.0	15			$5p^5$6p 3/2[5/2]$_3$	$5p^5$7s 3/2[3/2]$^\circ_2$	76HEL	
2 767.200	0.020	36 126.9	13			$5p^5$4f 3/2[5/2]$_2$	$5p^5$6d 3/2[3/2]$^\circ_2$	76HEL	
2 768.128	0.020	36 114.8	13			$5p^5$6p 3/2[3/2]$_1$	$5p^5$7s 3/2[3/2]$^\circ_1$	76HEL	
2 772.140	0.020	36 062.6	7			$5p^5$6p 1/2[1/2]$_1$	$5p^5$7s 1/2[1/2]$^\circ_1$	76HEL	
2 776.719	0.020	36 003.1	9			$5p^5$6p 3/2[3/2]$_1$	$5p^5$6d 3/2[3/2]$^\circ_2$	76HEL	
2 790.647	0.020	35 823.4	8			$5p^5$4f 3/2[5/2]$_2$	$5p^5$6d 3/2[7/2]$^\circ_3$	76HEL	
2 791.309	0.020	35 814.9	15			$5p^5$6p 1/2[3/2]$_2$	$5p^5$6d 1/2[5/2]$^\circ_3$	76HEL	
2 792.178	0.020	35 803.8	9			$5p^5$6p 1/2[1/2]$_1$	$5p^5$7s 1/2[1/2]$^\circ_0$	76HEL	
2 813.556	0.020	35 531.8	15			$5p^5$5d 3/2[5/2]$^\circ_3$	$5p^5$4f 3/2[5/2]$_2$	76HEL	
2 815.942	0.020	35 501.6	18			$5p^5$6p 3/2[3/2]$_2$	$5p^5$6d 3/2[5/2]$^\circ_3$	76HEL	
2 819.478	0.020	35 457.1	9			$5p^5$6p 1/2[3/2]$_2$	$5p^5$6d 1/2[3/2]$^\circ_2$	76HEL	
2 829.886	0.020	35 326.7	10			$5p^5$6p 1/2[3/2]$_2$	$5p^5$7s 1/2[1/2]$^\circ_1$	76HEL	
2 831.610	0.020	35 305.2	15			$5p^5$5d 3/2[7/2]$^\circ_3$	$5p^5$4f 3/2[7/2]$_3$	76HEL	
2 831.943	0.020	35 301.1	15			$5p^5$5d 1/2[5/2]$^\circ_3$	$5p^5$4f 1/2[5/2]$_2$	76HEL	
2 835.822	0.020	35 252.8	7	p		$5p^5$6p 3/2[3/2]$_1$	$5p^5$7s 3/2[3/2]$^\circ_2$	76HEL	

TABLE 2. Observed spectral lines of Ba III—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
2 849.559	0.020	35 082.8	12			$5p^56p\ 3/2[1/2]_0$	$5p^56d\ 3/2[3/2]^{\circ}_1$	76HEL	
2 857.849	0.020	34 981.1	10			$5p^56p\ 1/2[3/2]_2$	$5p^56d\ 1/2[5/2]^{\circ}_2$	76HEL	
2 862.902	0.020	34 919.3	7			$5p^56p\ 3/2[3/2]_2$	$5p^56d\ 3/2[5/2]^{\circ}_2$	76HEL	
2 870.898	0.020	34 822.1	8			$5p^54f\ 3/2[5/2]_2$	$5p^56d\ 3/2[1/2]^{\circ}_1$	76HEL	
2 876.908	0.020	34 749.3	16			$5p^55d\ 3/2[5/2]^{\circ}_3$	$5p^56p\ 3/2[5/2]_3$	76HEL	
2 884.041	0.020	34 663.4	12			$5p^55d\ 3/2[5/2]^{\circ}_2$	$5p^56p\ 3/2[1/2]_1$	76HEL	
2 887.146	0.020	34 626.1	7			$5p^56p\ 1/2[1/2]_0$	$5p^57s\ 1/2[1/2]^{\circ}_1$	76HEL	
2 888.830	0.020	34 605.9	7			$5p^55d\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 3/2[1/2]_0$	76HEL	
2 898.181	0.020	34 494.3	14			$5p^56p\ 3/2[3/2]_2$	$5p^57s\ 3/2[3/2]^{\circ}_1$	76HEL	
2 907.602	0.020	34 382.5	16			$5p^56p\ 3/2[3/2]_2$	$5p^56d\ 3/2[3/2]^{\circ}_2$	76HEL	
2 908.162	0.020	34 375.9	6			$5p^55d\ 1/2[5/2]^{\circ}_2$	$5p^54f\ 1/2[5/2]_3$	76HEL	
2 933.493	0.020	34 079.1	7			$5p^56p\ 3/2[3/2]_2$	$5p^56d\ 3/2[7/2]^{\circ}_3$	76HEL	
2 938.952	0.020	34 015.8	25			$5p^55d\ 3/2[1/2]^{\circ}_1$	$5p^54f\ 3/2[3/2]_2$	76HEL	
2 960.053	0.020	33 773.3	25			$5p^55d\ 3/2[1/2]^{\circ}_0$	$5p^54f\ 3/2[3/2]_1$	76HEL	
2 962.484	0.020	33 745.6	30			$5p^55d\ 3/2[3/2]^{\circ}_2$	$5p^54f\ 3/2[5/2]_3$	76HEL	
2 976.060	0.020	33 591.7	15			$5p^55d\ 3/2[7/2]^{\circ}_4$	$5p^54f\ 3/2[9/2]_4$	76HEL	
3 014.219	0.020	33 166.4	20			$5p^56s\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 3/2[1/2]_0$	76HEL	
3 022.297	0.020	33 077.8	9			$5p^56p\ 3/2[3/2]_2$	$5p^56d\ 3/2[1/2]^{\circ}_1$	76HEL	
3 043.421	0.020	32 848.2	30			$5p^55d\ 3/2[5/2]^{\circ}_2$	$5p^54f\ 3/2[7/2]_3$	76HEL	
3 048.136	0.020	32 797.4	12			$5p^55d\ 3/2[7/2]^{\circ}_4$	$5p^54f\ 3/2[5/2]_3$	76HEL	
3 071.677	0.020	32 546.0	3	h		$5p^55f\ 3/2[9/2]_4$	$5p^56g\ 3/2[11/2]^{\circ}_5$	76HEL	
3 079.136	0.020	32 467.2	40			$5p^55d\ 3/2[7/2]^{\circ}_4$	$5p^54f\ 3/2[9/2]_5$	76HEL	
3 079.465	0.020	32 463.7	15			$5p^55d\ 3/2[5/2]^{\circ}_3$	$5p^56p\ 3/2[5/2]_2$	76HEL	
3 079.902	0.020	32 459.1	20			$5p^55d\ 1/2[5/2]^{\circ}_2$	$5p^54f\ 1/2[7/2]_3$	76HEL	
3 103.924	0.020	32 207.9	30			$5p^56s\ 3/2[3/2]^{\circ}_2$	$5p^56p\ 3/2[3/2]_2$	76HEL	
3 119.221	0.020	32 050.0	30			$5p^55d\ 3/2[7/2]^{\circ}_3$	$5p^54f\ 3/2[9/2]_4$	76HEL	
3 119.477	0.020	32 047.4	10	p		$5p^56d\ 3/2[7/2]^{\circ}_4$	$5p^56f\ 3/2[9/2]_5$	76HEL	
3 126.446	0.020	31 975.9	15			$5p^55d\ 3/2[1/2]^{\circ}_1$	$5p^54f\ 3/2[3/2]_1$	76HEL	
3 140.601	0.020	31 831.8	10			$5p^56d\ 3/2[7/2]^{\circ}_3$	$5p^56f\ 3/2[9/2]_4$	76HEL	
3 151.202	0.020	31 724.7	2	h,p		$5p^55f\ 3/2[7/2]_3$	$5p^56g\ 3/2[9/2]^{\circ}_4$	76HEL	
3 152.697	0.020	31 709.7	30			$5p^55d\ 3/2[5/2]^{\circ}_3$	$5p^54f\ 3/2[7/2]_4$	76HEL	
3 163.345	0.020	31 602.96	18			$5p^55d\ 1/2[3/2]^{\circ}_2$	$5p^54f\ 1/2[5/2]_3$	76HEL	
3 165.296	0.020	31 583.48	2	h		$5p^55f\ 3/2[7/2]_4$	$5p^56g\ 3/2[9/2]^{\circ}_5$	76HEL	
3 171.603	0.020	31 520.68	8			$5p^56d\ 3/2[5/2]^{\circ}_2$	$5p^56f\ 3/2[7/2]_3$	76HEL	
3 195.167	0.020	31 288.23	25			$5p^55d\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 3/2[3/2]_2$	76HEL	
3 198.490	0.020	31 255.72	12			$5p^55d\ 3/2[7/2]^{\circ}_3$	$5p^54f\ 3/2[5/2]_3$	76HEL	
3 206.608	0.020	31 176.60	9			$5p^56p\ 3/2[1/2]_0$	$5p^57s\ 3/2[3/2]^{\circ}_1$	76HEL	
3 212.806	0.020	31 116.45	16			$5p^56s\ 1/2[1/2]^{\circ}_1$	$5p^56p\ 1/2[1/2]_0$	76HEL	
3 224.890	0.020	30 999.86	9			$5p^56d\ 3/2[5/2]^{\circ}_3$	$5p^56f\ 3/2[7/2]_4$	76HEL	
3 235.040	0.020	30 902.60	25			$5p^55d\ 1/2[5/2]^{\circ}_3$	$5p^54f\ 1/2[7/2]_4$	76HEL	
3 266.971	0.020	30 600.57	16			$5p^55d\ 3/2[3/2]^{\circ}_2$	$5p^54f\ 3/2[3/2]_2$	76HEL	
3 268.379	0.020	30 587.39	12			$5p^56s\ 3/2[3/2]^{\circ}_2$	$5p^56p\ 3/2[3/2]_1$	76HEL	
3 269.618	0.020	30 575.80	16			$5p^56s\ 1/2[1/2]^{\circ}_0$	$5p^56p\ 1/2[1/2]_1$	76HEL	
3 281.654	0.020	30 463.66	25			$5p^56s\ 3/2[3/2]^{\circ}_2$	$5p^54f\ 3/2[5/2]_2$	76HEL	
3 286.788	0.020	30 416.08	20			$5p^56s\ 1/2[1/2]^{\circ}_1$	$5p^56p\ 1/2[3/2]_2$	76HEL	
3 332.053	0.020	30 002.90	8			$5p^55d\ 1/2[5/2]^{\circ}_3$	$5p^54f\ 1/2[5/2]_3$	76HEL	
3 349.261	0.020	29 848.75	16			$5p^56s\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 3/2[3/2]_2$	76HEL	
3 368.175	0.020	29 681.14	50			$5p^56s\ 3/2[3/2]^{\circ}_2$	$5p^56p\ 3/2[5/2]_3$	76HEL	
3 369.677	0.020	29 667.91	30			$5p^55d\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 3/2[3/2]_1$	76HEL	
3 383.812	0.020	29 543.99	12			$5p^55d\ 3/2[3/2]^{\circ}_1$	$5p^54f\ 3/2[5/2]_2$	76HEL	
3 471.394	0.020	28 798.62	10			$5p^55d\ 3/2[5/2]^{\circ}_2$	$5p^54f\ 3/2[5/2]_3$	76HEL	
3 500.290	0.020	28 560.89	10			$5p^55d\ 3/2[3/2]^{\circ}_2$	$5p^54f\ 3/2[3/2]_1$	76HEL	
3 541.548	0.020	28 228.17	16			$5p^56s\ 3/2[3/2]^{\circ}_1$	$5p^56p\ 3/2[3/2]_1$	76HEL	
3 556.327	0.020	28 110.87	7			$5p^55d\ 3/2[7/2]^{\circ}_3$	$5p^54f\ 3/2[3/2]_2$	76HEL	
3 557.160	0.020	28 104.29	14			$5p^56s\ 3/2[3/2]^{\circ}_1$	$5p^54f\ 3/2[5/2]_2$	76HEL	
3 559.478	0.020	28 085.99	10			$5p^55d\ 1/2[5/2]^{\circ}_3$	$5p^54f\ 1/2[7/2]_3$	76HEL	
3 649.184	0.020	27 395.58	25			$5p^56s\ 3/2[3/2]^{\circ}_2$	$5p^56p\ 3/2[5/2]_2$	76HEL	

TABLE 2. Observed spectral lines of Ba III—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
3 655.781	0.020	27 346.15	16			$5p^{5}6s\ 1/2[1/2]^{\circ}_{0}$	$5p^{5}6p\ 1/2[3/2]_{1}$	76HEL	
3 775.928	0.020	26 476.03	16			$5p^{5}5d\ 3/2[3/2]^{\circ}_{1}$	$5p^{5}6p\ 3/2[5/2]_{2}$	76HEL	
3 779.531	0.020	26 450.80	16			$5p^{5}6s\ 1/2[1/2]^{\circ}_{1}$	$5p^{5}6p\ 1/2[3/2]_{1}$	76HEL	
3 813.133	0.020	26 217.71	16			$5p^{5}6s\ 1/2[1/2]^{\circ}_{1}$	$5p^{5}4f\ 1/2[5/2]_{2}$	76HEL	
3 847.113	0.020	25 986.15	5			$5p^{5}5d\ 1/2[5/2]^{\circ}_{2}$	$5p^{5}6p\ 3/2[3/2]_{1}$	76HEL	
3 896.958	0.020	25 653.77	12			$5p^{5}5d\ 3/2[5/2]^{\circ}_{2}$	$5p^{5}4f\ 3/2[3/2]_{2}$	76HEL	
3 926.851	0.020	25 458.49	25			$5p^{5}6s\ 3/2[3/2]^{\circ}_{2}$	$5p^{5}6p\ 3/2[1/2]_{1}$	76HEL	
3 927.227	0.020	25 456.05	10			$5p^{5}5d\ 3/2[5/2]^{\circ}_{3}$	$5p^{5}4f\ 3/2[9/2]_{4}$	76HEL	
3 993.061	0.020	25 036.37	25			$5p^{5}6s\ 3/2[3/2]^{\circ}_{1}$	$5p^{5}6p\ 3/2[5/2]_{2}$	76HEL	
4 053.709	0.020	24 661.80	18	b		$5p^{5}5d\ 3/2[5/2]^{\circ}_{3}$	$5p^{5}4f\ 3/2[5/2]_{3}$	76HEL	
4 327.942	0.020	23 099.18	10			$5p^{5}6s\ 3/2[3/2]^{\circ}_{1}$	$5p^{5}6p\ 3/2[1/2]_{1}$	76HEL	
4 385.832	0.020	22 794.29	9			$5p^{5}5d\ 1/2[5/2]^{\circ}_{2}$	$5p^{5}6p\ 3/2[5/2]_{2}$	76HEL	
4 481.654	0.020	22 306.93	14			$5p^{5}5d\ 1/2[3/2]^{\circ}_{2}$	$5p^{5}6p\ 3/2[5/2]_{3}$	76HEL	
4 646.217	0.020	21 516.86	9			$5p^{5}5d\ 3/2[5/2]^{\circ}_{3}$	$5p^{5}4f\ 3/2[3/2]_{2}$	76HEL	
4 697.438	0.020	21 282.25	15			$5p^{5}5d\ 1/2[3/2]^{\circ}_{1}$	$5p^{5}6p\ 1/2[1/2]_{0}$	76HEL	
4 773.366	0.020	20 943.72	2			$5p^{5}5f\ 3/2[3/2]_{2}$	$5p^{5}5g\ 3/2[7/2]^{\circ}_{3}$	76HEL	
4 820.646	0.020	20 738.31	10			$5p^{5}5f\ 3/2[3/2]_{1}$	$5p^{5}5g\ 3/2[5/2]^{\circ}_{2}$	76HEL	
4 842.873	0.020	20 643.13	5			$5p^{5}5f\ 3/2[9/2]_{5}$	$5p^{5}5g\ 3/2[9/2]^{\circ}_{5}$	76HEL	
4 844.574	0.020	20 635.89	5			$5p^{5}5f\ 3/2[9/2]_{4}$	$5p^{5}5g\ 3/2[9/2]^{\circ}_{4}$	76HEL	
4 850.838	0.020	20 609.24	10			$5p^{5}5f\ 3/2[3/2]_{2}$	$5p^{5}5g\ 3/2[5/2]^{\circ}_{3}$	76HEL	
4 854.222	0.020	20 594.87	3			$5p^{5}5f\ 3/2[3/2]_{2}$	$5p^{5}5g\ 3/2[5/2]^{\circ}_{2}$	76HEL	
4 868.166	0.020	20 535.88	3			$5p^{5}7p\ 3/2[1/2]_{1}$	$5p^{5}5g\ 3/2[5/2]^{\circ}_{2}$	76HEL	
4 917.170	0.020	20 331.22	8			$5p^{5}5f\ 1/2[7/2]_{3}$	$5p^{5}5g\ 1/2[9/2]^{\circ}_{4}$	76HEL	
4 929.191	0.020	20 281.64	12	p		$5p^{5}5f\ 3/2[9/2]_{5}$	$5p^{5}5g\ 3/2[11/2]^{\circ}_{6}$	76HEL	
4 929.370	0.020	20 280.91	10	p		$5p^{5}5f\ 3/2[9/2]_{4}$	$5p^{5}5g\ 3/2[11/2]^{\circ}_{5}$	76HEL	
4 945.434	0.020	20 215.03	8			$5p^{5}5f\ 1/2[5/2]_{3}$	$5p^{5}5g\ 1/2[7/2]^{\circ}_{4}$	76HEL	
4 950.127	0.020	20 195.87	1			$5p^{5}7p\ 3/2[5/2]_{2}$	$5p^{5}5g\ 3/2[7/2]^{\circ}_{3}$	76HEL	
4 952.912	0.020	20 184.51	8			$5p^{5}5f\ 1/2[5/2]_{2}$	$5p^{5}5g\ 1/2[7/2]^{\circ}_{3}$	76HEL	
4 961.641	0.020	20 149.00	1			$5p^{5}5f\ 1/2[7/2]_{4}$	$5p^{5}5g\ 1/2[7/2]^{\circ}_{4}$	76HEL	
4 963.233	0.020	20 142.54	8			$5p^{5}5f\ 1/2[7/2]_{4}$	$5p^{5}5g\ 1/2[9/2]^{\circ}_{5}$	76HEL	
4 964.039	0.020	20 139.27	10			$5p^{5}5f\ 3/2[5/2]_{3}$	$5p^{5}5g\ 3/2[7/2]^{\circ}_{4}$	76HEL	
4 993.261	0.020	20 021.41	2			$5p^{5}5d\ 1/2[3/2]^{\circ}_{2}$	$5p^{5}6p\ 3/2[5/2]_{2}$	76HEL	
5 033.506	0.020	19 861.33	8			$5p^{5}7p\ 3/2[5/2]_{2}$	$5p^{5}5g\ 3/2[5/2]^{\circ}_{3}$	76HEL	
5 037.334	0.020	19 846.24	8			$5p^{5}5d\ 1/2[3/2]^{\circ}_{1}$	$5p^{5}6p\ 1/2[1/2]_{1}$	76HEL	
5 045.790	0.020	19 812.98	3			$5p^{5}5f\ 3/2[5/2]_{3}$	$5p^{5}5g\ 3/2[5/2]^{\circ}_{3}$	76HEL	
5 049.551	0.020	19 798.22	10			$5p^{5}5f\ 3/2[5/2]_{2}$	$5p^{5}5g\ 3/2[7/2]^{\circ}_{3}$	76HEL	
5 097.539	0.020	19 611.84	10			$5p^{5}5f\ 3/2[7/2]_{3}$	$5p^{5}5g\ 3/2[9/2]^{\circ}_{4}$	76HEL	
5 102.248	0.020	19 593.74	12	b		$5p^{5}6s\ 3/2[3/2]^{\circ}_{2}$	$5p^{5}4f\ 3/2[5/2]_{3}$	76HEL	
5 126.549	0.020	19 500.87	4			$5p^{5}5f\ 3/2[7/2]_{3}$	$5p^{5}5g\ 3/2[7/2]^{\circ}_{3}$	76HEL	
5 134.542	0.020	19 470.51	10			$5p^{5}5g\ 3/2[7/2]^{\circ}_{3}$	$5p^{5}5g\ 3/2[9/2]^{\circ}_{5}$	76HEL	
5 136.290	0.020	19 463.88	1			$5p^{5}5f\ 3/2[5/2]_{2}$	$5p^{5}5g\ 3/2[5/2]^{\circ}_{3}$	76HEL	
5 140.105	0.020	19 449.44	2			$5p^{5}5f\ 3/2[5/2]_{2}$	$5p^{5}5f\ 3/2[5/2]_{2}$	76HEL	
5 166.698	0.020	19 349.33	4			$5p^{5}5f\ 3/2[7/2]_{4}$	$5p^{5}5g\ 3/2[7/2]^{\circ}_{4}$	76HEL	
5 173.228	0.020	19 324.91	1			$5p^{5}5f\ 3/2[3/2]_{2}$	$5p^{5}7d\ 3/2[3/2]^{\circ}_{1}$	76HEL	
5 196.430	0.020	19 238.62	7			$5p^{5}7p\ 3/2[5/2]_{3}$	$5p^{5}5g\ 3/2[7/2]^{\circ}_{4}$	76HEL	
5 286.081	0.020	18 912.34	1			$5p^{5}7p\ 3/2[5/2]_{3}$	$5p^{5}5g\ 3/2[5/2]^{\circ}_{3}$	76HEL	
5 426.995	0.020	18 421.28	9			$5p^{5}5d\ 1/2[5/2]^{\circ}_{3}$	$5p^{5}6p\ 3/2[5/2]_{2}$	76HEL	
5 499.174	0.020	18 179.50	3			$5p^{5}5f\ 3/2[5/2]_{2}$	$5p^{5}7d\ 3/2[3/2]^{\circ}_{1}$	76HEL	
5 518.162	0.020	18 116.94	2			$5p^{5}6p\ 1/2[3/2]_{2}$	$5p^{5}6d\ 3/2[3/2]^{\circ}_{2}$	76HEL	
5 528.142	0.020	18 084.24	7			$5p^{5}5d\ 1/2[3/2]^{\circ}_{2}$	$5p^{5}6p\ 3/2[1/2]_{1}$	76HEL	
5 568.288	0.020	17 953.86	15			$5p^{5}5f\ 3/2[3/2]_{1}$	$5p^{5}7d\ 3/2[5/2]^{\circ}_{2}$	76HEL	
5 613.132	0.020	17 810.42	3			$5p^{5}5f\ 3/2[3/2]_{2}$	$5p^{5}7d\ 3/2[5/2]^{\circ}_{2}$	76HEL	
5 658.597	0.020	17 667.32	6			$5p^{5}5d\ 1/2[5/2]^{\circ}_{3}$	$5p^{5}4f\ 3/2[7/2]_{4}$	76HEL	
5 697.388	0.020	17 547.03	6			$5p^{5}5f\ 3/2[3/2]_{2}$	$5p^{5}7d\ 3/2[3/2]^{\circ}_{2}$	76HEL	
5 716.613	0.020	17 488.02	6			$5p^{5}7p\ 3/2[1/2]_{1}$	$5p^{5}7d\ 3/2[3/2]^{\circ}_{2}$	76HEL	
5 725.213	0.020	17 461.75	1			$5p^{5}5f\ 3/2[3/2]_{1}$	$5p^{5}8s\ 3/2[3/2]^{\circ}_{1}$	76HEL	
5 726.181	0.020	17 458.80	6			$5p^{5}7p\ 3/2[3/2]_{1}$	$5p^{5}7d\ 3/2[3/2]^{\circ}_{1}$	76HEL	

TABLE 2. Observed spectral lines of Ba III—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
5 740.384	0.020	17 415.61	7			$5p^{5}5f\ 3/2[3/2]_{2}$	$5p^{5}7d\ 3/2[7/2]^{\circ}_{3}$	76HEL	
5 772.653	0.020	17 318.26	3			$5p^{5}5f\ 3/2[3/2]_{2}$	$5p^{5}8s\ 3/2[3/2]^{\circ}_{1}$	76HEL	
5 798.255	0.020	17 241.79	7			$5p^{5}5f\ 3/2[5/2]_{3}$	$5p^{5}7d\ 3/2[5/2]^{\circ}_{3}$	76HEL	
5 813.544	0.020	17 196.44	6			$5p^{5}5f\ 3/2[3/2]_{1}$	$5p^{5}7d\ 3/2[1/2]^{\circ}_{1}$	76HEL	
5 859.200	0.020	17 062.45	7			$5p^{5}7p\ 3/2[5/2]_{2}$	$5p^{5}7d\ 3/2[5/2]^{\circ}_{2}$	76HEL	
5 881.869	0.020	16 996.69	7			$5p^{5}5f\ 3/2[9/2]_{4}$	$5p^{5}7d\ 3/2[7/2]^{\circ}_{3}$	76HEL	
5 882.805	0.020	16 993.99	8	b		$5p^{5}7p\ 3/2[1/2]_{1}$	$5p^{5}7d\ 3/2[1/2]^{\circ}_{1}$	76HEL	
5 895.778	0.020	16 956.59	6	b		$5p^{5}7p\ 3/2[1/2]_{1}$	$5p^{5}8s\ 3/2[3/2]^{\circ}_{2}$	76HEL	
5 900.285	0.020	16 943.64	8			$5p^{5}5f\ 3/2[9/2]_{5}$	$5p^{5}7d\ 3/2[7/2]^{\circ}_{4}$	76HEL	
5 951.080	0.020	16 799.02	4			$5p^{5}7p\ 3/2[5/2]_{2}$	$5p^{5}7d\ 3/2[3/2]^{\circ}_{2}$	76HEL	
5 968.271	0.020	16 750.63	4			$5p^{5}5f\ 3/2[5/2]_{3}$	$5p^{5}7d\ 3/2[3/2]^{\circ}_{2}$	76HEL	
5 983.719	0.020	16 707.39	7			$5p^{5}7p\ 3/2[1/2]_{1}$	$5p^{5}7d\ 3/2[1/2]^{\circ}_{0}$	76HEL	
5 998.004	0.020	16 667.60	10			$5p^{5}7p\ 3/2[5/2]_{2}$	$5p^{5}7d\ 3/2[7/2]^{\circ}_{3}$	76HEL	
6 016.409	0.020	16 616.61	8			$5p^{5}5d\ 1/2[3/2]^{\circ}_{1}$	$5p^{5}6p\ 1/2[3/2]_{1}$	76HEL	
6 033.206	0.020	16 570.35	4			$5p^{5}7p\ 3/2[5/2]_{2}$	$5p^{5}8s\ 3/2[3/2]^{\circ}_{1}$	76HEL	
6 036.582	0.020	16 561.08	8			$5p^{5}5f\ 3/2[5/2]_{3}$	$5p^{5}7d\ 3/2[7/2]^{\circ}_{4}$	76HEL	
6 076.663	0.020	16 451.85	6			$5p^{5}5f\ 3/2[7/2]_{4}$	$5p^{5}7d\ 3/2[5/2]^{\circ}_{3}$	76HEL	
6 077.815	0.020	16 448.73	8			$5p^{5}6s\ 3/2[3/2]^{\circ}_{2}$	$5p^{5}4f\ 3/2[3/2]_{2}$	76HEL	
6 101.988	0.020	16 383.57	13			$5p^{5}5d\ 1/2[3/2]^{\circ}_{1}$	$5p^{5}4f\ 1/2[5/2]_{2}$	76HEL	
6 107.997	0.020	16 367.45	5			$5p^{5}5f\ 3/2[7/2]_{3}$	$5p^{5}7d\ 3/2[5/2]^{\circ}_{2}$	76HEL	
6 117.811	0.020	16 341.19	5			$5p^{5}7p\ 3/2[5/2]_{3}$	$5p^{5}7d\ 3/2[5/2]^{\circ}_{3}$	76HEL	
6 131.377	0.020	16 305.04	6			$5p^{5}7p\ 3/2[5/2]_{2}$	$5p^{5}7d\ 3/2[1/2]^{\circ}_{1}$	76HEL	
6 144.562	0.020	16 270.05	4			$5p^{5}5f\ 3/2[5/2]_{2}$	$5p^{5}7d\ 3/2[7/2]^{\circ}_{3}$	76HEL	
6 145.455	0.020	16 267.69	5			$5p^{5}7p\ 3/2[5/2]_{2}$	$5p^{5}8s\ 3/2[3/2]^{\circ}_{2}$	76HEL	
6 163.773	0.020	16 219.34	5			$5p^{5}5f\ 3/2[5/2]_{3}$	$5p^{5}8s\ 3/2[3/2]^{\circ}_{2}$	76HEL	
6 270.078	0.020	15 944.35	8			$5p^{5}7p\ 3/2[3/2]_{1}$	$5p^{5}7d\ 3/2[5/2]^{\circ}_{2}$	76HEL	
6 307.371	0.020	15 850.08	1			$5p^{5}7p\ 3/2[5/2]_{3}$	$5p^{5}7d\ 3/2[3/2]^{\circ}_{2}$	76HEL	
6 360.133	0.020	15 718.60	3			$5p^{5}7p\ 3/2[5/2]_{3}$	$5p^{5}7d\ 3/2[7/2]^{\circ}_{3}$	76HEL	
6 377.106	0.020	15 676.76	10			$5p^{5}7p\ 3/2[3/2]_{2}$	$5p^{5}7d\ 3/2[5/2]^{\circ}_{3}$	76HEL	
6 383.763	0.020	15 660.41	10			$5p^{5}7p\ 3/2[5/2]_{3}$	$5p^{5}7d\ 3/2[7/2]^{\circ}_{4}$	76HEL	
6 406.154	0.020	15 605.68	6			$5p^{5}7p\ 3/2[1/2]_{0}$	$5p^{5}7d\ 3/2[3/2]^{\circ}_{1}$	76HEL	
6 469.779	0.020	15 452.21	6			$5p^{5}7p\ 3/2[3/2]_{1}$	$5p^{5}8s\ 3/2[3/2]^{\circ}_{1}$	76HEL	
6 526.166	0.020	15 318.70	8			$5p^{5}7p\ 3/2[5/2]_{3}$	$5p^{5}8s\ 3/2[3/2]^{\circ}_{2}$	76HEL	
6 583.333	0.020	15 185.68	7			$5p^{5}7p\ 3/2[3/2]_{2}$	$5p^{5}7d\ 3/2[3/2]^{\circ}_{2}$	76HEL	
6 684.007	0.020	14 956.96	6			$5p^{5}7p\ 3/2[3/2]_{2}$	$5p^{5}8s\ 3/2[3/2]^{\circ}_{1}$	76HEL	
6 822.042	0.020	14 654.32	2			$5p^{5}7p\ 3/2[3/2]_{2}$	$5p^{5}8s\ 3/2[3/2]^{\circ}_{2}$	76HEL	
7 095.49	0.03	14 089.57	8			$5p^{5}6s\ 3/2[3/2]^{\circ}_{1}$	$5p^{5}4f\ 3/2[3/2]_{2}$	76HEL	
7 411.19	0.03	13 489.39	2			$5p^{5}5d\ 3/2[3/2]^{\circ}_{1}$	$5p^{5}4f\ 3/2[3/2]_{1}$	76HEL	
7 577.95	0.03	13 192.54	2			$5p^{5}7s\ 3/2[3/2]^{\circ}_{1}$	$5p^{5}7p\ 3/2[1/2]_{0}$	76HEL	
7 873.93	0.03	12 696.65	1			$5p^{5}7s\ 3/2[3/2]^{\circ}_{2}$	$5p^{5}7p\ 3/2[3/2]_{2}$	76HEL	
7 924.44	0.03	12 615.72	1	h		$5p^{5}5g\ 3/2[5/2]^{\circ}_{2}$	$5p^{5}6h\ 3/2[7/2]_{3}$	76HEL	
7 933.38	0.03	12 601.50	1	h		$5p^{5}5g\ 3/2[5/2]^{\circ}_{3}$	$5p^{5}6h\ 3/2[7/2]_{4}$	76HEL	
7 970.84	0.03	12 542.28	4	h		$5p^{5}5g\ 3/2[11/2]^{\circ}_{6}$	$5p^{5}6h\ 3/2[13/2]_{7}$	76HEL	
7 973.66	0.03	12 537.84	3	h		$5p^{5}5g\ 3/2[11/2]^{\circ}_{5}$	$5p^{5}6h\ 3/2[13/2]_{6}$	76HEL	
8 074.13	0.03	12 381.83	2	h		$5p^{5}5g\ 3/2[7/2]^{\circ}_{4}$	$5p^{5}6h\ 3/2[9/2]_{5}$	76HEL	
8 079.43	0.03	12 373.71	1	h		$5p^{5}5g\ 3/2[7/2]^{\circ}_{3}$	$5p^{5}6h\ 3/2[9/2]_{4}$	76HEL	
8 133.02	0.03	12 292.18	2	h		$5p^{5}5g\ 3/2[9/2]^{\circ}_{4}$	$5p^{5}6h\ 3/2[11/2]_{5}$	76HEL	
8 134.32	0.03	12 290.21	3	h		$5p^{5}5g\ 3/2[9/2]^{\circ}_{5}$	$5p^{5}6h\ 3/2[11/2]_{6}$	76HEL	
8 308.68	0.03	12 032.29	8			$5p^{5}7s\ 3/2[3/2]^{\circ}_{2}$	$5p^{5}7p\ 3/2[5/2]_{3}$	76HEL	
8 368.41	0.03	11 946.43	5			$5p^{5}6d\ 3/2[3/2]^{\circ}_{2}$	$5p^{5}7p\ 3/2[3/2]_{2}$	76HEL	
8 484.80	0.03	11 782.55	6			$5p^{5}6d\ 3/2[7/2]^{\circ}_{4}$	$5p^{5}7p\ 3/2[5/2]_{3}$	76HEL	
8 565.25	0.03	11 671.88	1			$5p^{5}6d\ 3/2[7/2]^{\circ}_{4}$	$5p^{5}5f\ 3/2[7/2]_{4}$	76HEL	
8 590.28	0.03	11 637.86	1			$5p^{5}6d\ 3/2[1/2]^{\circ}_{1}$	$5p^{5}7p\ 3/2[5/2]_{2}$	76HEL	
8 676.54	0.03	11 522.17	1			$5p^{5}6d\ 3/2[1/2]^{\circ}_{0}$	$5p^{5}7p\ 3/2[1/2]_{1}$	76HEL	
8 816.36	0.03	11 339.43	7			$5p^{5}7s\ 3/2[3/2]^{\circ}_{1}$	$5p^{5}7p\ 3/2[3/2]_{1}$	76HEL	
8 822.53	0.03	11 331.51	2			$5p^{5}6d\ 3/2[7/2]^{\circ}_{3}$	$5p^{5}5f\ 3/2[7/2]_{3}$	76HEL	
8 831.69	0.03	11 319.76	2			$5p^{5}6d\ 3/2[1/2]^{\circ}_{0}$	$5p^{5}5f\ 3/2[3/2]_{1}$	76HEL	

TABLE 2. Observed spectral lines of Ba III—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
9 070.59	0.03	11 021.61	2	h		$5p^5 6f\ 3/2[9/2]_4$	$5p^5 6g\ 3/2[11/2]^\circ_5$	76HEL	
9 088.98	0.03	10 999.31	2	h		$5p^5 6f\ 3/2[9/2]_5$	$5p^5 6g\ 3/2[11/2]^\circ_6$	76HEL	
9 130.84	0.03	10 948.88	1			$5p^5 6d\ 3/2[1/2]^\circ_1$	$5p^5 7p\ 3/2[1/2]_1$	76HEL	
9 159.65	0.03	10 914.45	6			$5p^5 6d\ 3/2[5/2]^\circ_2$	$5p^5 7p\ 3/2[3/2]_1$	76HEL	
9 180.23	0.03	10 889.98	2			$5p^5 6d\ 3/2[1/2]^\circ_1$	$5p^5 5f\ 3/2[3/2]_2$	76HEL	
9 233.36	0.03	10 827.32	7			$5p^5 6d\ 3/2[5/2]^\circ_3$	$5p^5 7p\ 3/2[3/2]_2$	76HEL	
9 298.37	0.03	10 751.62	3			$5p^5 6d\ 1/2[5/2]^\circ_2$	$5p^5 5f\ 1/2[7/2]_3$	76HEL	
9 302.80	0.03	10 746.50	3			$5p^5 6d\ 3/2[1/2]^\circ_1$	$5p^5 5f\ 3/2[3/2]_1$	76HEL	
9 347.54	0.03	10 695.06	1	h		$5p^5 6f\ 3/2[7/2]_3$	$5p^5 6g\ 3/2[9/2]^\circ_4$	76HEL	
9 398.98	0.03	10 636.54	6			$5p^5 6d\ 3/2[7/2]^\circ_3$	$5p^5 7p\ 3/2[5/2]_2$	76HEL	
9 399.48	0.03	10 635.97	1	h,p		$5p^5 6f\ 3/2[7/2]_4$	$5p^5 6g\ 3/2[9/2]^\circ_5$	76HEL	
9 521.76	0.03	10 499.38	8			$5p^5 6d\ 3/2[7/2]^\circ_4$	$5p^5 5f\ 3/2[9/2]_5$	76HEL	
9 529.11	0.03	10 491.28	6			$5p^5 6d\ 3/2[5/2]^\circ_2$	$5p^5 5f\ 3/2[7/2]_3$	76HEL	
9 610.89	0.03	10 402.02	3			$5p^5 6d\ 1/2[3/2]^\circ_2$	$5p^5 5f\ 1/2[5/2]_3$	76HEL	
9 618.00	0.03	10 394.33	6			$5p^5 7s\ 3/2[3/2]^\circ_2$	$5p^5 7p\ 3/2[1/2]_1$	76HEL	
9 629.95	0.03	10 381.42	6			$5p^5 6d\ 3/2[3/2]^\circ_2$	$5p^5 5f\ 3/2[5/2]_3$	76HEL	
9 675.03	0.03	10 333.05	1			$5p^5 6d\ 3/2[3/2]^\circ_2$	$5p^5 7p\ 3/2[5/2]_2$	76HEL	
9 699.01	0.03	10 307.50	6			$5p^5 6d\ 3/2[7/2]^\circ_3$	$5p^5 5f\ 3/2[9/2]_4$	76HEL	
9 780.79	0.03	10 221.32	4			$5p^5 7s\ 3/2[3/2]^\circ_1$	$5p^5 7p\ 3/2[5/2]_2$	76HEL	
9 888.34	0.03	10 110.15	5			$5p^5 6d\ 1/2[5/2]^\circ_3$	$5p^5 5f\ 1/2[7/2]_4$	76HEL	
9 945.26	0.03	10 052.28	6			$5p^5 6d\ 3/2[5/2]^\circ_3$	$5p^5 5f\ 3/2[7/2]_4$	76HEL	
10 205.14	0.03	9 796.30	4			$5p^5 6d\ 3/2[5/2]^\circ_2$	$5p^5 7p\ 3/2[5/2]_2$	76HEL	
10 429.90	0.03	9 585.19	5			$5p^5 6d\ 3/2[3/2]^\circ_2$	$5p^5 5f\ 3/2[3/2]_2$	76HEL	
10 552.94	0.03	9 473.44	3			$5p^5 7s\ 3/2[3/2]^\circ_1$	$5p^5 5f\ 3/2[3/2]_2$	76HEL	
10 793.43	0.03	9 262.35	5			$5p^5 6d\ 3/2[5/2]^\circ_3$	$5p^5 5f\ 3/2[5/2]_3$	76HEL	

TABLE 3. Energy levels of Ba III

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$5p^6$	^1S	0	0.00		76HEL
$5p^5 5d$	$3/2[1/2]^\circ$	0	132 770.79	0.5	76HEL
	$3/2[1/2]^\circ$	1	134 568.12	0.5	76HEL
	$3/2[3/2]^\circ$	2	137 983.14	0.5	76HEL
	$3/2[7/2]^\circ$	4	138 931.25	0.5	76HEL
	$3/2[7/2]^\circ$	3	140 472.87	0.5	76HEL
	$3/2[5/2]^\circ$	2	142 929.99	0.5	76HEL
	$3/2[5/2]^\circ$	3	147 066.86	0.5	76HEL
	$3/2[3/2]^\circ$	1	153 054.62	0.5	76HEL
	$1/2[5/2]^\circ$	2	156 736.25	0.5	76HEL
	$1/2[3/2]^\circ$	2	159 509.20	0.5	76HEL
	$1/2[5/2]^\circ$	3	161 109.28	0.5	76HEL
	$1/2[3/2]^\circ$	1	180 026.71	0.5	76HEL
$5p^5 6s$	$3/2[3/2]^\circ$	2	152 135.02	0.5	76HEL
	$3/2[3/2]^\circ$	1	154 494.21	0.5	76HEL
	$1/2[1/2]^\circ$	0	169 297.15	0.5	76HEL
	$1/2[1/2]^\circ$	1	170 192.53	0.5	76HEL
$5p^5 4f$	$3/2[3/2]$	1	166 544.02	0.5	76HEL
	$3/2[3/2]$	2	168 583.77	0.5	76HEL
	$3/2[9/2]$	5	171 398.38	0.5	76HEL
	$3/2[5/2]$	3	171 728.66	0.5	76HEL
	$3/2[9/2]$	4	172 522.89	0.5	76HEL
	$3/2[7/2]$	3	175 778.09	0.5	76HEL
	$3/2[7/2]$	4	178 776.59	0.5	76HEL
	$3/2[5/2]$	2	182 598.59	0.5	76HEL
	$1/2[7/2]$	3	189 195.30	0.5	76HEL
	$1/2[5/2]$	3	191 112.15	0.5	76HEL
	$1/2[7/2]$	4	192 011.93	0.5	76HEL
	$1/2[5/2]$	2	196 410.28	0.5	76HEL
$5p^5 6p$	$3/2[1/2]$	1	177 593.45	0.5	76HEL
	$3/2[5/2]$	2	179 530.58	0.5	76HEL
	$3/2[5/2]$	3	181 816.17	0.5	76HEL
	$3/2[3/2]$	1	182 722.42	0.5	76HEL
	$3/2[3/2]$	2	184 342.92	0.5	76HEL
	$3/2[1/2]$	0	187 660.61	0.5	76HEL
	$1/2[3/2]$	1	196 643.31	0.5	76HEL
	$1/2[1/2]$	1	199 872.92	0.5	76HEL
	$1/2[3/2]$	2	200 608.56	0.5	76HEL
	$1/2[1/2]$	0	201 309.00	0.5	76HEL
$5p^5 6d$	$3/2[1/2]^\circ$	0	216 847.43	0.5	76HEL
	$3/2[1/2]^\circ$	1	217 420.70	0.5	76HEL
	$3/2[7/2]^\circ$	4	218 225.00	0.5	76HEL
	$3/2[7/2]^\circ$	3	218 422.03	0.5	76HEL
	$3/2[3/2]^\circ$	2	218 725.50	0.5	76HEL
	$3/2[5/2]^\circ$	2	219 262.27	0.5	76HEL
	$3/2[5/2]^\circ$	3	219 844.60	0.5	76HEL
	$3/2[3/2]^\circ$	1	222 743.50	0.5	76HEL
	$1/2[5/2]^\circ$	2	235 589.63	0.5	76HEL
	$1/2[3/2]^\circ$	2	236 065.63	0.5	76HEL

TABLE 3. Energy levels of Ba III—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
	1/2[5/2]°	3	236 423.50	0.5	76HEL
	1/2[3/2]°	1	238 027.02	0.5	76HEL
$5p^5 5f$	3/2[3/2]	1	228 167.18	0.5	76HEL
	3/2[3/2]	2	228 310.67	0.5	76HEL
	3/2[9/2]	5	228 724.37	0.5	76HEL
	3/2[9/2]	4	228 729.53	0.5	76HEL
	3/2[5/2]	3	229 106.94	0.5	76HEL
	3/2[5/2]	2	229 456.10	0.5	76HEL
	3/2[7/2]	3	229 753.55	0.5	76HEL
	3/2[7/2]	4	229 896.89	0.5	76HEL
	1/2[7/2]	3	246 341.26	0.5	76HEL
	1/2[5/2]	3	246 467.64	0.5	76HEL
	1/2[5/2]	2	246 506.79	0.5	76HEL
	1/2[7/2]	4	246 533.65	0.5	76HEL
$5p^5 7p$	3/2[1/2]	1	228 369.60	0.5	76HEL
	3/2[5/2]	2	229 058.57	0.5	76HEL
	3/2[5/2]	3	230 007.57	0.5	76HEL
	3/2[3/2]	1	230 176.70	0.5	76HEL
	3/2[3/2]	2	230 671.94	0.5	76HEL
	3/2[1/2]	0	232 029.83	0.5	76HEL
$5p^5 7s$	3/2[3/2]°	2	217 975.27	0.5	76HEL
	3/2[3/2]°	1	218 837.25	0.5	76HEL
	1/2[1/2]°	0	235 676.70	0.5	76HEL
	1/2[1/2]°	1	235 935.32	0.5	76HEL
$5p^5 7d$	3/2[1/2]°	0	245 076.98	0.5	76HEL
	3/2[1/2]°	1	245 363.62	0.5	76HEL
	3/2[7/2]°	4	245 668.00	0.5	76HEL
	3/2[7/2]°	3	245 726.19	0.5	76HEL
	3/2[3/2]°	2	245 857.62	0.5	76HEL
	3/2[5/2]°	2	246 121.04	0.5	76HEL
	3/2[5/2]°	3	246 348.73	0.5	76HEL
	3/2[3/2]°	1	247 635.54	0.5	76HEL
$5p^5 8s$	3/2[3/2]°	2	245 326.27	0.5	76HEL
	3/2[3/2]°	1	245 628.92	0.5	76HEL
$5p^5 5g$	3/2[5/2]°	2	248 905.51	0.5	76HEL
	3/2[5/2]°	3	248 919.93	0.5	76HEL
	3/2[11/2]°	6	249 006.03	0.5	76HEL
	3/2[11/2]°	5	249 010.44	0.5	76HEL
	3/2[7/2]°	4	249 246.21	0.5	76HEL
	3/2[7/2]°	3	249 254.39	0.5	76HEL
	3/2[9/2]°	4	249 365.40	0.5	76HEL
	3/2[9/2]°	5	249 367.45	0.5	76HEL
	1/2[9/2]°	4	266 672.48	0.5	76HEL
	1/2[9/2]°	5	266 676.18	0.5	76HEL
	1/2[7/2]°	4	266 682.66	0.5	76HEL
	1/2[7/2]°	3	266 691.29	0.5	76HEL
$5p^5 6f$	3/2[9/2]	4	250 253.84	0.5	76HEL
	3/2[9/2]	5	250 272.35	0.5	76HEL
	3/2[7/2]	3	250 782.93	0.5	76HEL
	3/2[7/2]	4	250 844.45	0.5	76HEL
$5p^5 9s$	(3/2,1/2)°	1	259 470	20	87HIL/SUG

TABLE 3. Energy levels of Ba III—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$5p^5 8d$	(3/2,5/2)°	1	260 390	20	87HIL/SUG
$5p^5 6g$	3/2[11/2]°	6	261 271.66	0.5	76HEL
	3/2[11/2]°	5	261 275.46	0.5	76HEL
	3/2[9/2]°	4	261 478.00	0.5	76HEL
	3/2[9/2]°	5	261 480.42	0.5	76HEL
$5p^5 6h$	3/2[7/2]	3	261 521.23	0.5	76HEL
	3/2[7/2]	4	261 521.43	0.5	76HEL
	3/2[13/2]	6	261 548.28	0.5	76HEL
	3/2[13/2]	7	261 548.31	0.5	76HEL
	3/2[9/2]	5	261 628.03	0.5	76HEL
	3/2[9/2]	4	261 628.10	0.5	76HEL
	3/2[11/2]	5	261 657.59	0.5	76HEL
	3/2[11/2]	6	261 657.66	0.5	76HEL
$5p^5 8s$	(1/2,1/2)°	1	262 960	20	87HIL/SUG
$5p^5 7d$	(1/2,3/2)°	1	264 130	20	87HIL/SUG
$5p^5 10s$	(3/2,1/2)°	1	267 620	20	87HIL/SUG
$5p^5 9d$	(3/2,5/2)°	1	268 250	20	87HIL/SUG
$5p^5 11s$	(3/2,1/2)°	1	272 790	20	87HIL/SUG
$5p^5 10d$	(3/2,5/2)°	1	273 180	20	87HIL/SUG
$5p^5 12s$	(3/2,1/2)°	1	276 300	25	87HIL/SUG
$5p^5 11d$	(3/2,5/2)°	1	276 520	25	87HIL/SUG
$5p^5 9s$	(1/2,1/2)°	1	276 920	25	87HIL/SUG
$5p^5 8d$	(1/2,3/2)°	1	277 580	25	87HIL/SUG
$5p^5 13s$	(3/2,1/2)°	1	278 790	25	87HIL/SUG
$5p^5 12d$	(3/2,5/2)°	1	279 010	25	87HIL/SUG
$5p^5 14s$	(3/2,1/2)°	1	280 610	25	87HIL/SUG
$5p^5 13d$	(3/2,5/2)°	1	280 760	25	87HIL/SUG
$5p^5 15s$	(3/2,1/2)°	1	281 990	25	87HIL/SUG
$5p^5 14d$	(3/2,5/2)°	1	282 110	25	87HIL/SUG
$5p^5 16s$	(3/2,1/2)°	1	283 060	25	87HIL/SUG
$5p^5 15d$	(3/2,5/2)°	1	283 140	25	87HIL/SUG
$5p^5 17s$	(3/2,1/2)°	1	283 910	25	87HIL/SUG
$5p^5 16d$	(3/2,5/2)°	1	283 970	25	87HIL/SUG
$5p^5 18s$	(3/2,1/2)°	1	284 580	25	87HIL/SUG
$5p^5 17d$	(3/2,5/2)°	1	284 630	25	87HIL/SUG
$5p^5 10s$	(1/2,1/2)°	1	285 090	25	87HIL/SUG
$5p^5 19s$	(3/2,1/2)°	1	285 140	25	87HIL/SUG
$5p^5 9d$	(1/2,3/2)°	1	285 470	25	87HIL/SUG
$5p^5 19d$	(3/2,5/2)°	1	285 650	25	87HIL/SUG

TABLE 3. Energy levels of Ba III—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$5p^5 20s$	$(3/2,1/2)^\circ$	1	285 990	25	87HIL/SUG
$5p^5 19d$	$(3/2,3/2)^\circ$	1	285 990	25	87HIL/SUG
$5p^5 21s$	$(3/2,1/2)^\circ$	1	286 000	25	87HIL/SUG
$5p^5 20d$	$(3/2,5/2)^\circ$	1	286 000	25	87HIL/SUG
$5p^5 22s$	$(3/2,1/2)^\circ$	1	286 310	25	87HIL/SUG
$5p^5 21d$	$(3/2,5/2)^\circ$	1	286 310	25	87HIL/SUG
$5p^5 23s$	$(3/2,1/2)^\circ$	1	286 600	25	87HIL/SUG
$5p^5 22d$	$(3/2,5/2)^\circ$	1	286 600	25	87HIL/SUG
Ba IV ($5p^5\ ^2P^\circ_{3/2}$)		*Limit*	289 100	20	76HEL
$5p^5 11s$	$(1/2,1/2)^\circ$	1	290 290	25	87HIL/SUG
$5p^5 16d$	$(1/2,3/2)^\circ$	1	290 560	25	87HIL/SUG
$5p^5 12s$	$(1/2,1/2)^\circ$	1	293 810	25	87HIL/SUG
$5p^5 11d$	$(1/2,3/2)^\circ$	1	294 000	25	87HIL/SUG
$5p^5 13s$	$(1/2,1/2)^\circ$	1	296 290	25	87HIL/SUG
$5p^5 12d$	$(1/2,3/2)^\circ$	1	296 430	25	87HIL/SUG
$5p^5 14s$	$(1/2,1/2)^\circ$	1	298 140	25	87HIL/SUG
$5p^5 13d$	$(1/2,3/2)^\circ$	1	298 220	25	87HIL/SUG
$5p^5 15s$	$(1/2,1/2)^\circ$	1	299 490	25	87HIL/SUG
$5p^5 14d$	$(1/2,3/2)^\circ$	1	299 580	25	87HIL/SUG
$5p^5 16s$	$(1/2,1/2)^\circ$	1	300 620	25	87HIL/SUG
$5p^5 15d$	$(1/2,3/2)^\circ$	1	300 620	25	87HIL/SUG
$5p^5 17s$	$(1/2,1/2)^\circ$	1	301 460	25	87HIL/SUG
$5p^5 16d$	$(1/2,3/2)^\circ$	1	301 460	25	87HIL/SUG
Ba IV ($5p^5\ ^2P^\circ_{1/2}$)		*Limit*	306 650	20	87HIL/SUG

6.2. Ba IV

I isoelectronic sequence
Ground state
$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^5\ ^2P^\circ_{3/2}$
Ionization energy 379 300(2700) cm^{-1}; 47.03(33) eV

The first measurements of the Ba IV spectrum were reported in 1934 by Fitzgerald and Sawyer [34FIT/SAW] using a vacuum spark source, yielding a fragmentary analysis. In 1976 Epstein and Reader [76EPS/REA] published new and much more accurate measurements of the resonance transitions from the $5s5p^6\ ^2S_{1/2}$ level and corrected the $5s^2 5p^5\ ^2P$ interval. While studying the Ba III spectrum, Hellentin [76HEL] independently observed the $5s5p^6\ ^2S_{1/2}$ resonance lines. The observations agreed with the [76EPS/REA] values to ±0.006 Å. Subsequently Sansonetti *et al.* [93SAN/REA] revised and extended the experimentally determined energy levels of Ba IV, based on observations of 39 lines in the spectrum in the region between 460 and 925 Å. All but two of the $J=1/2$, $3/2$, and $5/2$ levels of the $5s5p^6$, $5s^2 5p^4 5d$, and $5s^2 5p^4 6s$ configurations were located. It should be noted that due to extensive mixing of states, the names assigned to some of the $5s^2 5p^4 5d$ levels in Tables 4 and 5 are not those of the largest component. Although *LS* percentages are listed for the 6*s* levels, the names assigned are given in $J_1 j$ coupling, which fits somewhat better.

More recently the extreme ultraviolet (EUV) photoabsorption spectrum of Ba IV was recorded by Murphy *et al.* [06MUR/NIG], resulting in values for levels in which a 4*d* electron is promoted into the 5*p* shell. Although no experimental uncertainties are given in the [06MUR/NIG] paper, they do state that the resolving power of their spectrograph is between 1300 and 1900. Except for the data involving levels with an incomplete 4*d* shell, the wavelengths, intensities, and energy levels reported here are from [93SAN/REA], as is the ionization energy. To avoid clutter in the tables the 4*d* occupancy is only specified if the shell is not full.

The transition probabilities for the Ba IV spectral lines given in Table 4 are calculated by Murphy *et al.* [06MUR/NIG] using the Hartree–Fock method. In addition, Biémont *et al.* [95BIE/HAN] have reported a magnetic dipole transition probability of 97.6 s^{-1} for the forbidden transition within the ground configuration. The electric quadrupole probability is two orders of magnitude smaller.

6.2.1. References for Ba IV

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TABLE 4. Observed spectral lines of Ba IV

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
Vacuum								
157.3		635 800		4.7E+9	$5s^25p^5\ ^2P^\circ_{3/2}$	$4d^95s^25p^6\ ^2D_{3/2}$	06MUR/NIG	06MUR/NIG
161.7		618 300		2.1E+10	$5s^25p^5\ ^2P^\circ_{3/2}$	$4d^95s^25p^6\ ^2D_{3/2}$	06MUR/NIG	06MUR/NIG
162.7		614 700		2.5E+10	$5s^25p^5\ ^2P^\circ_{3/2}$	$4d^95s^25p^6\ ^2D_{5/2}$	06MUR/NIG	06MUR/NIG
463.690	0.005	215 661.3	15		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)5d\ ^2D_{3/2}$	93SAN/REA	
468.664	0.005	213 373.5	75		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^1S)6s\ (0,1/2)_{1/2}$	93SAN/REA	
486.325	0.005	205 624.8	2 500		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^1D)6s\ (2,1/2)_{5/2}$	93SAN/REA	
486.676	0.005	205 476.5	100		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^1D)6s\ (2,1/2)_{3/2}$	93SAN/REA	
492.360	0.005	203 103.4	2 500		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^1S)5d\ ^2D_{5/2}$	93SAN/REA	
502.840	0.005	198 870.4	25 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)6s\ (1,1/2)_{1/2}$	93SAN/REA	
503.946	0.005	198 434.0	30 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)5d\ ^2P_{3/2}$	93SAN/REA	
504.767	0.005	198 111.2	22 500		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^3P)5d\ ^2D_{3/2}$	93SAN/REA	
506.229	0.005	197 539.1	50 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)5d\ ^2D_{5/2}$	93SAN/REA	
510.402	0.005	195 924.0	100		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)6s\ (1,1/2)_{3/2}$	93SAN/REA	
520.007	0.005	192 305.1	9 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^1S)5d\ ^2D_{3/2}$	93SAN/REA	
523.183	0.005	191 137.7	1 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)6s\ (0,1/2)_{1/2}$	93SAN/REA	
529.797	0.005	188 751.5	6 000		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^1D)5d\ ^2S_{1/2}$	93SAN/REA	
532.123	0.005	187 926.5	3 250		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^1D)6s\ (2,1/2)_{3/2}$	93SAN/REA	
546.378	0.005	183 023.5	2		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^3P)5d\ ^2P_{1/2}$	93SAN/REA	
548.085	0.005	182 453.4	30 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)6s\ (2,1/2)_{3/2}$	93SAN/REA	
559.690	0.005	178 670.3	30 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^1D)5d\ ^2F_{5/2}$	93SAN/REA	
560.618	0.005	178 374.6	4 250		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^3P)6s\ (1,1/2)_{3/2}$	93SAN/REA	
572.230	0.005	174 754.9	3 000		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^1S)5d\ ^2D_{3/2}$	93SAN/REA	
578.038	0.005	172 999.0	45 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)5d\ ^2F_{5/2}$	93SAN/REA	
585.446	0.005	170 810.0	45 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^1D)5d\ ^2D_{5/2}$	93SAN/REA	
591.222	0.005	169 141.2	2 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^1D)5d\ ^2P_{3/2}$	93SAN/REA	
610.142	0.005	163 896.3	10 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^1D)5d\ ^2D_{3/2}$	93SAN/REA	
610.469	0.005	163 808.5	45 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)5d\ ^4P_{5/2}$	93SAN/REA	
615.024	0.005	162 595.3	30 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)5d\ ^4F_{3/2}$	93SAN/REA	
618.114	0.005	161 782.5	50 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)5d\ ^4F_{5/2}$	93SAN/REA	
626.274	0.005	159 674.5	15 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)5d\ ^4P_{1/2}$	93SAN/REA	
631.060	0.005	158 463.5	15 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^1D)5d\ ^2P_{1/2}$	93SAN/REA	
632.326	0.005	158 146.3	25 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)5d\ ^4P_{3/2}$	93SAN/REA	
659.670	0.005	151 591.0	4 500		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^1D)5d\ ^2P_{3/2}$	93SAN/REA	
683.308	0.005	146 346.9	4 000		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^1D)5d\ ^2D_{3/2}$	93SAN/REA	
689.439	0.005	145 045.5	500		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^3P)5d\ ^4F_{3/2}$	93SAN/REA	
691.630	0.005	144 586.0	5 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)5d\ ^4D_{3/2}$	93SAN/REA	
694.628	0.005	143 962.0	25 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s^25p^4(^3P)5d\ ^4D_{5/2}$	93SAN/REA	
703.606	0.005	142 125.0	100		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^3P)5d\ ^4P_{1/2}$	93SAN/REA	
711.256	0.005	140 596.4	1		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^3P)5d\ ^4P_{3/2}$	93SAN/REA	
775.365	0.005	128 971.5	12 500		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s^25p^4(^3P)5d\ ^4D_{1/2}$	93SAN/REA	
794.882	0.005	125 804.8	150 000		$5s^25p^5\ ^2P^\circ_{3/2}$	$5s5p^6\ ^2S_{1/2}$	93SAN/REA	
923.739	0.005	108 255.7	100 000		$5s^25p^5\ ^2P^\circ_{1/2}$	$5s5p^6\ ^2S_{1/2}$	93SAN/REA	

TABLE 5. Energy levels of Ba IV

Configuration	Term	J	Energy (cm^{-1})	Unc. (cm^{-1})	Leading percentages	Reference
$5s^25p^5$	$^2P^\circ$	3/2	0.0			93SAN/REA
	$^2P^\circ$	1/2	17 549.5	0.4		93SAN/REA
$5s5p^6$	^2S	1/2	125 805.1	0.6	63% $5s5p^6\ ^2S$+35% $5s^25p^4(^1D)5d\ ^2S$	93SAN/REA

TABLE 5. Energy levels of Ba IV—Continued

Configuration	Term	J	Energy (cm^{-1})	Unc. (cm^{-1})	Leading percentages	Reference
$5s^25p^4(^3P)5d$	^4D	5/2	143 961.9	1.2	78%+6% $5p^4(^3P)5d\ ^4F$+6% $5p^4(^1D)5d\ ^2D$+5% $5p^4(^3P)5d\ ^4P$	93SAN/REA
	^4D	3/2	144 586.0	1.2	69%+10% $5p^4(^3P)5d^4P$+8% $5p^4(^1D)5d^2D$	93SAN/REA
	^4D	1/2	146 521.0	0.9	57%+19% $5p^4(^1D)5d\ ^2P$+15% $5p^4(^3P)5d\ ^2P$+9% $5p^4(^3P)5d\ ^4P$	93SAN/REA
	^4P	3/2	158 146.0	0.9	36%+17% $5p^4(^3P)5d\ ^2D$+16% $5p^4(^1S)5d\ ^2D$+13% $5p^4(^1D)5d\ ^2D$	93SAN/REA
	^4P	1/2	159 674.5	0.9	82%+14% $5p^4(^3P)5d\ ^4D$	93SAN/REA
	^4F	5/2	161 782.5	1.4	82%+6% $5p^4(^3P)5d\ ^4D$	93SAN/REA
	^4F	3/2	162 595.1	0.9	75%+14% $5p^4(^3P)5d\ ^4P$+6% $5p^4(^1S)5d\ ^2D$	93SAN/REA
	^4P	5/2	163 808.5	1.4	54%+15% $5p^4(^3P)5d\ ^2F$+14% $5p^4(^1S)5d\ ^2D$+10% $5p^4(^3P)5d\ ^2D$	93SAN/REA
	^2F	5/2	172 999.0	1.6	54%+19% $5p^4(^1D)5d\ ^2F$+12% $5p^4(^1D)5d\ ^2D$+6% $5p^4(^3P)5d\ ^2D$	93SAN/REA
	^2D	5/2	197 539.1	2.0	61%+24% $5p^4(^1D)5d\ ^2D$+7% $5p^4(^1S)5d\ ^2D$+5% $5p^4(^1D)5d\ ^2F$	93SAN/REA
	^2P	3/2	198 434.0	2.0	25%+34% $5p^4(^1D)5d\ ^2D$+17% $5p^4(^3P)5d\ ^2D$+11% $5p^4(^1D)5d\ ^2P$	93SAN/REA
	^2P	1/2	200 573.0	1.8	31%+35% $5p^4(^1D)5d\ ^2P$+19% $5p^4(^1D)5d\ ^2S$+12% $5s5p^6\ ^2S$	93SAN/REA
	^2D	3/2	215 660.2	1.6	41%+36% $5p^4(^1S)5d\ ^2D$+9% $5p^4(^3P)^2P$+6% $5p^4(^1D)5d\ ^2D$	93SAN/REA
$5s^25p^4(^1D)5d$	^2P	1/2	158 463.5	1.4	32%+34% $5p^4(^3P)5d\ ^2P$+29% $5p^4(^3P)5d\ ^4D$	93SAN/REA
	^2D	3/2	163 896.3	0.9	23%+27% $5p^4(^3P)5d\ ^4D$+15% $5p^4(^3P)5d\ ^2P$+14% $5p^4(^1D)5d\ ^2P$	93SAN/REA
	^2P	3/2	169 140.7	1.0	29%+29% $5p^4(^3P)5d\ ^4P$+26% $5p^4(^3P)5d\ ^2P$	93SAN/REA
	^2D	5/2	170 809.9	1.6	28%+24% $5p^4(^3P)5d\ ^4P$+17% $5p^4(^3P)5d\ ^2D$+14% $5p^4(^3P)5d\ ^2F$	93SAN/REA
	^2F	5/2	178 670.3	1.7	40%+39% $5p^4(^3P)6s\ ^4P$+10% $5p^4(^1D)5d\ ^2D$+8% $5p^4(^1D)6s\ ^2D$	93SAN/REA
	^2S	1/2	206 301.0	1.8	43%+21% $5s5p^6\ ^2S$+18% $5p^4(^3P)5d^2P$+14% $5p^4(^1D)5d\ ^2P$	93SAN/REA
$5s^25p^4(^3P)6s$	(2,1/2)	3/2	182 453.5	1.7	58% $5p^4(^3P)6s\ ^2P$+23% $5p^4(^3P)6s\ ^4P$+17% $5p^4(^1D)6s\ ^2D$	93SAN/REA
	(0,1/2)	1/2	191 137.7	1.9	66% $5p^4(^3P)6s\ ^4P$+26% $5p^4(^1S)6s\ ^2S$+6% $5p^4(^3P)6s\ ^2P$	93SAN/REA
	(1,1/2)	3/2	195 924.0	1.3	73% $5p^4(^3P)6s\ ^4P$+22% $5p^4(^3P)6s\ ^2P$	93SAN/REA
	(1,1/2)?	1/2	198 870.4	2.0	80% $5p^4(^3P)6s\ ^2P$+16% $5p^4(^3P)6s\ ^4P$	93SAN/REA
$5s^25p^4(^1S)5d$	^2D	3/2	192 304.7	1.2	31%+30% $5p^4(^1D)5d\ ^2P$+20% $5p^4(^3P)5d\ ^2P$+8% $5p^4(^1D)5d\ ^2D$	93SAN/REA
	^2D	5/2	203 103.4	2.1	38%+36% $5p^4(^1D)6s\ ^2D$+6% $5p^4(^1D)5d\ ^2D$+6% $5p^4(^3P)5d\ ^2F$	93SAN/REA
$5s^25p^4(^1D)6s$	(2,1/2)	3/2	205 475.8	1.4	79% $5p^4(^1D)6s\ ^2D$+19% $5p^4(^3P)6s\ ^2P$	93SAN/REA
	(2,1/2)	5/2	205 623.8	2.2	49% $5p^4(^1D)6s\ ^2D$+33% $5p^4(^1S)5d\ ^2D$+8% $5p^4(^3P)6s\ ^4P$	93SAN/REA
$5s^25p^4(^1S)6s$	(0,1/2)	1/2	230 922.0	2.3	71% $5p^4(^1S)6s\ ^2S$+17% $5p^4(^3P)6s\ ^4P$+11% $5p^4(^3P)6s\ ^2P$	93SAN/REA
Ba V ($5s^25p^4\ ^3P_2$)		*Limit*	379 300	2 700		93SAN/REA
$4d^95s^25p^6$	^2D	5/2	614 700	500	99.7%	06MUR/NIG
	^2D	3/2	635 800	500	99.8%	06MUR/NIG

6.3. Ba V

Te isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^25p^4\ ^3P_2$
Ionization energy (468 000 cm^{-1}); (58 eV)

The first measurements of the Ba V spectrum were reported in 1983 by Reader [83REA] using a low-voltage sliding spark source. His observations yielded 13 transitions in the 600–950 Å region, classified as being between the ground and $5s5p^5$ configurations. In 1995 Tauheed and Joshi [95TAU/JOS] extended the wavelength region studied to 400–1220 Å and they published measurements of an additional 113 transitions and 42 new levels in the $5s^25p^35d$ and $6s$ configurations. Although the usual practice in this compilation is to give intensities as reported in the paper from which each wavelength is taken, in Table 6 all the intensities given are from Tauheed and Joshi [95TAU/JOS] to present a more consistent set of values. An error in the caption of Table 2 in the Tauheed and Joshi [95TAU/JOS] paper gives incorrect values for the energy levels in the ground configuration. The values from Reader [83REA] are retained in Table 7 below. It should be noted that due to extensive mixing of states, the names assigned to some of the $5s^25p^45d$ and $6s$ levels are not those of the largest component.

More recently the EUV photoabsorption spectrum of Ba V was recorded by Murphy *et al.* [06MUR/NIG]. They assign several unresolved spectral features to transitions from the ground configuration to levels in which a $4d$ electron is promoted into the $5p$ shell. Although no experimental uncertainties are given in the [06MUR/NIG] paper, they do state that the resolving power of their spectrograph is between 1300 and 1900. Since the majority of the features observed were blends and since the internal consistency of the level values obtained using the Murphy *et al.* [06MUR/NIG] classifications is not good, the designations and level values are not included in this compilation.

The ionization energy cited here has been calculated from atomic binding energies obtained by Rodrigues *et al.*

[04ROD/IND] using the Dirac–Fock approximation. The uncertainty is unknown; however, Rodrigues *et al.* [04ROD/IND] compared their results for neutral and singly ionized spectra with available experimental values, obtaining a standard deviation of about 1.3 eV. Experimental data for higher ionization stages are not generally available for comparison.

6.3.1. References for Ba V

83REA J. Reader, J. Opt. Soc. Am. **73**, 349 (1983).

95TAU/JOS A. Tauheed and Y. N. Joshi, J. Phys. B **28**, 3753 (1995).

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

06MUR/NIG N. Murphy, P. Niga, A. Cummings, P. Dunne, and G. O'Sullivan, J. Phys. B **39**, 365 (2006).

TABLE 6. Observed spectral lines of Ba V

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	Lower Level	Upper Level	λ Ref.
Vacuum							
152.7		654 900		b			06MUR/NIG
153.5		651 500					06MUR/NIG
154.4		647 800					06MUR/NIG
155.7		642 200					06MUR/NIG
156.6		638 700		b			06MUR/NIG
157.4		635 500		b			06MUR/NIG
158.1		632 500		b			06MUR/NIG
158.6		630 600		b			06MUR/NIG
159.6		626 500		b			06MUR/NIG
408.583	0.005	244 749	30		$5s^25p^4\ ^3P_1$	$5p^3(^2P°)6s\ ^3P°_2$	95TAU/JOS
418.169	0.005	239 138	24		$5s^25p^4\ ^3P_0$	$5p^3(^2P°)6s\ ^3P°_1$	95TAU/JOS
418.633	0.005	238 873	15		$5s^25p^4\ ^1D_2$	$5p^3(^2P°)6s\ ^1P°_1$	95TAU/JOS
419.343	0.005	238 469	25		$5s^25p^4\ ^3P_2$	$5p^3(^2D°)6s\ ^1D°_2$	95TAU/JOS
422.918	0.005	236 453	45	b	$5s^25p^4\ ^1D_2$	$5p^3(^2P°)6s\ ^3P°_2$	95TAU/JOS
423.529	0.005	236 112	20		$5s^25p^4\ ^3P_0$	$5p^3(^2P°)5d\ ^1P°_1$	95TAU/JOS
424.032	0.005	235 832	55		$5s^25p^4\ ^3P_2$	$5p^3(^2D°)6s\ ^3D°_3$	95TAU/JOS
427.287	0.005	234 035	22		$5s^25p^4\ ^3P_2$	$5p^3(^2D°)5d\ ^1F°_3$	95TAU/JOS
427.320	0.005	234 016	22	*	$5s^25p^4\ ^3P_1$	$5p^3(^2P°)6s\ ^3P°_1$	95TAU/JOS
432.148	0.005	231 402	22		$5s^25p^4\ ^3P_1$	$5p^3(^2P°)6s\ ^3P°_0$	95TAU/JOS
432.423	0.005	231 254	25		$5s^25p^4\ ^3P_2$	$5p^3(^2D°)6s\ ^3D°_1$	95TAU/JOS
432.545	0.005	231 190	12		$5s^25p^4\ ^3P_2$	$5p^3(^2D°)5d\ ^1D°_2$	95TAU/JOS
435.405	0.005	229 671	50		$5s^25p^4\ ^3P_2$	$5p^3(^2D°)6s\ ^3D°_2$	95TAU/JOS
441.276	0.005	226 615	14		$5s^25p^4\ ^3P_2$	$5p^3(^2D°)5d\ ^1P°_1$	95TAU/JOS
443.024	0.005	225 721	20		$5s^25p^4\ ^1D_2$	$5p^3(^2P°)6s\ ^3P°_1$	95TAU/JOS
449.050	0.005	222 692	22		$5s^25p^4\ ^1D_2$	$5p^3(^2P°)5d\ ^1P°_1$	95TAU/JOS
450.371	0.005	222 039	45		$5s^25p^4\ ^3P_1$	$5p^3(^2D°)6s\ ^1D°_2$	95TAU/JOS
451.974	0.005	221 252	10		$5s^25p^4\ ^3P_2$	$5p^3(^2P°)5d\ ^3D°_1$	95TAU/JOS
454.652	0.005	219 948	15		$5s^25p^4\ ^3P_0$	$5p^3(^2D°)6s\ ^3D°_1$	95TAU/JOS
455.309	0.005	219 631	30		$5s^25p^4\ ^3P_2$	$5p^3(^2P°)5d\ ^3D°_2$	95TAU/JOS
457.846	0.005	218 414	50		$5s^25p^4\ ^3P_2$	$5p^3(^4S°)6s\ ^3S°_1$	95TAU/JOS
464.440	0.005	215 313	25		$5s^25p^4\ ^3P_0$	$5p^3(^2D°)5d\ ^1P°_1$	95TAU/JOS
465.492	0.005	214 826	50		$5s^25p^4\ ^3P_1$	$5p^3(^2D°)6s\ ^3D°_1$	95TAU/JOS
465.632	0.005	214 762	50		$5s^25p^4\ ^3P_1$	$5p^3(^2D°)5d\ ^1D°_2$	95TAU/JOS
466.639	0.005	214 299	50		$5s^25p^4\ ^3P_2$	$5p^3(^2P°)5d\ ^3P°_2$	95TAU/JOS
467.845	0.005	213 746	60		$5s^25p^4\ ^1D_2$	$5p^3(^2D°)6s\ ^1D°_2$	95TAU/JOS
468.950	0.005	213 242	60		$5s^25p^4\ ^3P_1$	$5p^3(^2D°)6s\ ^3D°_2$	95TAU/JOS
469.489	0.005	212 998	60		$5s^25p^4\ ^3P_2$	$5p^3(^2D°)5d\ ^3P°_1$	95TAU/JOS
470.785	0.005	212 411	50		$5s^25p^4\ ^1S_0$	$5p^3(^2P°)6s\ ^1P°_1$	95TAU/JOS
472.926	0.005	211 450	65		$5s^25p^4\ ^3P_2$	$5p^3(^2P°)5d\ ^3D°_3$	95TAU/JOS
473.682	0.005	211 112	50		$5s^25p^4\ ^1D_2$	$5p^3(^2D°)6s\ ^3D°_3$	95TAU/JOS
475.772	0.005	210 185	45		$5s^25p^4\ ^3P_1$	$5p^3(^2D°)5d\ ^1P°_1$	95TAU/JOS
476.306	0.005	209 949	60		$5s^25p^4\ ^3P_0$	$5p^3(^2P°)5d\ ^3D°_1$	95TAU/JOS
477.747	0.005	209 316	60		$5s^25p^4\ ^1D_2$	$5p^3(^2D°)5d\ ^1F°_3$	95TAU/JOS
477.930	0.005	209 236	55		$5s^25p^4\ ^3P_2$	$5p^3(^2D°)5d\ ^3S°_1$	95TAU/JOS

TABLE 6. Observed spectral lines of Ba V—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	Lower Level	Upper Level	λ Ref.
479.348	0.005	208 617	50		$5s^25p^4\ ^3P_1$	$5p^3(^2D^\circ)5d\ ^3P^\circ_0$	95TAU/JOS
479.712	0.005	208 458	75		$5s^25p^4\ ^3P_2$	$5p^3(^2D^\circ)5d\ ^3P^\circ_2$	95TAU/JOS
482.830	0.005	207 112	50		$5s^25p^4\ ^3P_0$	$5p^3(^4S^\circ)6s\ ^3S^\circ_1$	95TAU/JOS
484.184	0.005	206 533	22		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)6s\ ^3D^\circ_1$	95TAU/JOS
484.337	0.005	206 468	60		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)5d\ ^1D^\circ_2$	95TAU/JOS
487.923	0.005	204 951	20		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)6s\ ^3D^\circ_2$	95TAU/JOS
488.236	0.005	204 819	20		$5s^25p^4\ ^3P_1$	$5p^3(^2P^\circ)5d\ ^3D^\circ_1$	95TAU/JOS
489.040	0.005	204 482	70		$5s^25p^4\ ^3P_2$	$5p^3(^2P^\circ)5d\ ^3F^\circ_3$	95TAU/JOS
490.746	0.005	203 771	50		$5s^25p^4\ ^3P_2$	$5p^3(^2P^\circ)5d\ ^3F^\circ_2$	95TAU/JOS
490.969	0.005	203 679	65		$5s^25p^4\ ^3P_2$	$5p^3(^2D^\circ)5d\ ^3D^\circ_3$	95TAU/JOS
492.127	0.005	203 200	65		$5s^25p^4\ ^3P_1$	$5p^3(^2P^\circ)5d\ ^3D^\circ_2$	95TAU/JOS
495.089	0.005	201 984	65		$5s^25p^4\ ^3P_1$	$5p^3(^4S^\circ)6s\ ^3S^\circ_1$	95TAU/JOS
495.310	0.005	201 894	65		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)5d\ ^1P^\circ_1$	95TAU/JOS
495.798	0.005	201 695	62		$5s^25p^4\ ^3P_0$	$5p^3(^2D^\circ)5d\ ^3P^\circ_1$	95TAU/JOS
500.611	0.005	199 755.9	49		$5s^25p^4\ ^3P_2$	$5p^3(^4S^\circ)5d\ ^3D^\circ_2$	95TAU/JOS
501.866	0.005	199 256.3	60		$5s^25p^4\ ^1S_0$	$5p^3(^2P^\circ)6s\ ^3P^\circ_1$	95TAU/JOS
505.223	0.005	197 932.3	2		$5s^25p^4\ ^3P_0$	$5p^3(^2D^\circ)5d\ ^3S^\circ_1$	95TAU/JOS
505.394	0.005	197 865.4	45		$5s^25p^4\ ^3P_1$	$5p^3(^2P^\circ)5d\ ^3P^\circ_2$	95TAU/JOS
505.394	0.005	197 865.3	45		$5s^25p^4\ ^1D_2$	$5p^3(^2P^\circ)5d\ ^1F^\circ_3$	95TAU/JOS
506.777	0.005	197 325.5	50		$5s^25p^4\ ^3P_2$	$5p^3(^2P^\circ)5d\ ^3P^\circ_1$	95TAU/JOS
508.734	0.005	196 566.5	48		$5s^25p^4\ ^3P_1$	$5p^3(^2D^\circ)5d\ ^3P^\circ_1$	95TAU/JOS
508.831	0.005	196 528.8	45		$5s^25p^4\ ^1D_2$	$5p^3(^2P^\circ)5d\ ^3D^\circ_1$	95TAU/JOS
509.612	0.005	196 227.9	55		$5s^25p^4\ ^1S_0$	$5p^3(^2P^\circ)5d\ ^1P^\circ_1$	95TAU/JOS
512.415	0.005	195 154.2	2		$5s^25p^4\ ^3P_1$	$5p^3(^4S^\circ)6s\ ^5S^\circ_2$	95TAU/JOS
513.069	0.005	194 905.5	55		$5s^25p^4\ ^1D_2$	$5p^3(^2P^\circ)5d\ ^3D^\circ_2$	95TAU/JOS
514.467	0.005	194 375.9	52		$5s^25p^4\ ^3P_2$	$5p^3(^2P^\circ)5d\ ^1D^\circ_2$	95TAU/JOS
516.283	0.005	193 692.4	58		$5s^25p^4\ ^1D_2$	$5p^3(^4S^\circ)6s\ ^3S^\circ_1$	95TAU/JOS
518.660	0.005	192 804.6	8		$5s^25p^4\ ^3P_1$	$5p^3(^2D^\circ)5d\ ^3S^\circ_1$	95TAU/JOS
520.763	0.005	192 026.1	28		$5s^25p^4\ ^3P_1$	$5p^3(^2D^\circ)5d\ ^3P^\circ_2$	95TAU/JOS
527.492	0.005	189 576.2	12		$5s^25p^4\ ^1D_2$	$5p^3(^2P^\circ)5d\ ^3P^\circ_2$	95TAU/JOS
528.096	0.005	189 359.6	5		$5s^25p^4\ ^3P_2$	$5p^3(^2D^\circ)5d\ ^3D^\circ_1$	95TAU/JOS
531.133	0.005	188 276.6	55		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)5d\ ^3P^\circ_1$	95TAU/JOS
533.783	0.005	187 342.1	28		$5s^25p^4\ ^3P_1$	$5p^3(^2P^\circ)5d\ ^3F^\circ_2$	95TAU/JOS
535.153	0.005	186 862.4	8		$5s^25p^4\ ^1D_2$	$5p^3(^4S^\circ)6s\ ^5S^\circ_2$	95TAU/JOS
535.536	0.005	186 728.8	35		$5s^25p^4\ ^1D_2$	$5p^3(^2P^\circ)5d\ ^3D^\circ_3$	95TAU/JOS
537.564	0.005	186 024.3	6		$5s^25p^4\ ^3P_0$	$5p^3(^2P^\circ)5d\ ^3P^\circ_1$	95TAU/JOS
541.963	0.005	184 514.5	30		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)5d\ ^3S^\circ_1$	95TAU/JOS
544.262	0.005	183 735.2	42		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)5d\ ^3P^\circ_2$	95TAU/JOS
545.472	0.005	183 327.3	50		$5s^25p^4\ ^3P_1$	$5p^3(^4S^\circ)5d\ ^3D^\circ_2$	95TAU/JOS
550.224	0.005	181 744.2	22		$5s^25p^4\ ^3P_1$	$5p^3(^2P^\circ)5d\ ^3P^\circ_0$	95TAU/JOS
552.810	0.005	180 894.0	50		$5s^25p^4\ ^3P_1$	$5p^3(^2P^\circ)5d\ ^3P^\circ_1$	95TAU/JOS
552.860	0.005	180 877.7	60		$5s^25p^4\ ^3P_2$	$5p^3(^2D^\circ)5d\ ^3G^\circ_3$	95TAU/JOS
556.293	0.005	179 761.3	15		$5s^25p^4\ ^1D_2$	$5p^3(^2P^\circ)5d\ ^3F^\circ_3$	95TAU/JOS
558.499	0.005	179 051.3	26		$5s^25p^4\ ^1D_2$	$5p^3(^2P^\circ)5d\ ^3F^\circ_2$	95TAU/JOS
558.791	0.005	178 957.9	50		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)5d\ ^3D^\circ_3$	95TAU/JOS
559.208	0.005	178 824.3	42		$5s^25p^4\ ^3P_2$	$5p^3(^2D^\circ)5d\ ^3F^\circ_3$	95TAU/JOS
561.614	0.005	178 058.3	52		$5s^25p^4\ ^3P_0$	$5p^3(^2D^\circ)5d\ ^3D^\circ_1$	95TAU/JOS
561.952	0.005	177 951.0	22		$5s^25p^4\ ^3P_1$	$5p^3(^2P^\circ)5d\ ^1D^\circ_2$	95TAU/JOS
566.133	0.005	176 637.0	55		$5s^25p^4\ ^3P_2$	$5p^3(^2D^\circ)5d\ ^3F^\circ_2$	95TAU/JOS
572.683	0.005	174 616.8	12		$5s^25p^4\ ^3P_2$	$5p^3(^4S^\circ)5d\ ^3D^\circ_1$	95TAU/JOS
576.586	0.005	173 434.8	40		$5s^25p^4\ ^3P_2$	$5p^3(^4S^\circ)5d\ ^3D^\circ_3$	95TAU/JOS
578.273	0.005	172 928.8	5		$5s^25p^4\ ^3P_1$	$5p^3(^2D^\circ)5d\ ^3D^\circ_1$	95TAU/JOS
579.351	0.005	172 606.9	20		$5s^25p^4\ ^1D_2$	$5p^3(^2P^\circ)5d\ ^3P^\circ_1$	95TAU/JOS
588.001	0.005	170 067.7	5		$5s^25p^4\ ^1S_0$	$5p^3(^2P^\circ)5d\ ^3D^\circ_1$	95TAU/JOS
589.425	0.005	169 656.9	20		$5s^25p^4\ ^1D_2$	$5p^3(^2P^\circ)5d\ ^1D^\circ_2$	95TAU/JOS
601.400	0.005	166 278.6	55		$5s^25p^4\ ^3P_2$	$5p^3(^2D^\circ)5d\ ^3D^\circ_2$	95TAU/JOS
607.386	0.005	164 640.0	16		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)5d\ ^3D^\circ_1$	95TAU/JOS

TABLE 6. Observed spectral lines of Ba V—Continued

λ (Å)	Unc. (Å)	σ (cm⁻¹)	Int.	Line Code	Lower Level	Upper Level	λ Ref.
612.318	0.005	163 313.8	25		$5s^25p^4\ ^3P_0$	$5p^3(^4S^\circ)5d\ ^3D^\circ_1$	95TAU/JOS
612.549	0.005	163 252.2	24		$5s^25p^4\ ^3P_2$	$5s(^2S)5p^5\ ^1P^\circ_1$	83REA
617.621	0.005	161 911.5	2		$5s^25p^4\ ^3P_1$	$5p^3(^2D^\circ)5d\ ^1S^\circ_0$	95TAU/JOS
622.961	0.005	160 523.6	45		$5s^25p^4\ ^3P_2$	$5p^3(^4S^\circ)5d\ ^5D^\circ_1$	95TAU/JOS
624.188	0.005	160 208.1	2		$5s^25p^4\ ^3P_1$	$5p^3(^2D^\circ)5d\ ^3F^\circ_2$	95TAU/JOS
626.981	0.005	159 494.5	50		$5s^25p^4\ ^3P_2$	$5p^3(^4S^\circ)5d\ ^5D^\circ_2$	95TAU/JOS
627.057	0.005	159 475.1	50		$5s^25p^4\ ^3P_2$	$5p^3(^4S^\circ)5d\ ^5D^\circ_3$	95TAU/JOS
632.167	0.005	158 186.1	8		$5s^25p^4\ ^3P_1$	$5p^3(^4S^\circ)5d\ ^3D^\circ_1$	95TAU/JOS
632.705	0.005	158 051.6	2		$5s^25p^4\ ^1S_0$	$5p^3(^2D^\circ)5d\ ^3S^\circ_1$	95TAU/JOS
640.382	0.005	156 156.8	20		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)5d\ ^3G^\circ_3$	95TAU/JOS
648.925	0.005	154 101.1	46		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)5d\ ^3F^\circ_3$	95TAU/JOS
658.111	0.005	151 950.1	4		$5s^25p^4\ ^3P_0$	$5s(^2S)5p^5\ ^1P^\circ_1$	83REA
658.260	0.005	151 915.6	14		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)5d\ ^3F^\circ_2$	95TAU/JOS
667.123	0.005	149 897.5	3		$5s^25p^4\ ^1D_2$	$5p^3(^4S^\circ)5d\ ^3D^\circ_1$	95TAU/JOS
670.138	0.005	149 222.9	9		$5s^25p^4\ ^3P_0$	$5p^3(^4S^\circ)5d\ ^5D^\circ_1$	95TAU/JOS
681.094	0.005	146 822.6	3		$5s^25p^4\ ^3P_1$	$5s(^2S)5p^5\ ^1P^\circ_1$	83REA
693.988	0.005	144 094.7	25		$5s^25p^4\ ^3P_1$	$5p^3(^4S^\circ)5d\ ^5D^\circ_1$	95TAU/JOS
696.467	0.005	143 581.9	9		$5s^25p^4\ ^3P_1$	$5p^3(^4S^\circ)5d\ ^5D^\circ_0$	95TAU/JOS
698.987	0.005	143 064.1	8		$5s^25p^4\ ^3P_1$	$5p^3(^4S^\circ)5d\ ^5D^\circ_2$	95TAU/JOS
706.420	0.005	141 558.8	5		$5s^25p^4\ ^1D_2$	$5p^3(^2D^\circ)5d\ ^3D^\circ_2$	95TAU/JOS
719.858	0.005	138 916.3	55		$5s^25p^4\ ^3P_2$	$5s(^2S)5p^5\ ^3P^\circ_1$	83REA
721.849	0.005	138 533.1	55		$5s^25p^4\ ^1D_2$	$5s(^2S)5p^5\ ^1P^\circ_1$	83REA
723.705	0.005	138 177.8	2		$5s^25p^4\ ^1S_0$	$5p^3(^2D^\circ)5d\ ^3D^\circ_1$	95TAU/JOS
736.365	0.005	135 802.2	12		$5s^25p^4\ ^1D_2$	$5p^3(^4S^\circ)5d\ ^5D^\circ_1$	95TAU/JOS
741.989	0.005	134 772.8	3		$5s^25p^4\ ^1D_2$	$5p^3(^4S^\circ)5d\ ^5D^\circ_2$	95TAU/JOS
760.449	0.005	131 501.3	55		$5s^25p^4\ ^3P_1$	$5s(^2S)5p^5\ ^3P^\circ_0$	83REA
766.867	0.005	130 400.7	75		$5s^25p^4\ ^3P_2$	$5s(^2S)5p^5\ ^3P^\circ_2$	83REA
783.609	0.005	127 614.7	55		$5s^25p^4\ ^3P_0$	$5s(^2S)5p^5\ ^3P^\circ_1$	83REA
816.412	0.005	122 487.2	60		$5s^25p^4\ ^3P_1$	$5s(^2S)5p^5\ ^3P^\circ_1$	83REA
875.690	0.005	114 195.7	50		$5s^25p^4\ ^1D_2$	$5s(^2S)5p^5\ ^3P^\circ_1$	83REA
877.410	0.005	113 971.8	65		$5s^25p^4\ ^3P_1$	$5s(^2S)5p^5\ ^3P^\circ_2$	83REA
892.285	0.005	112 071.8	25		$5s^25p^4\ ^1S_0$	$5s(^2S)5p^5\ ^1P^\circ_1$	83REA
946.255	0.005	105 679.8	55		$5s^25p^4\ ^1D_2$	$5s(^2S)5p^5\ ^3P^\circ_2$	83REA
1 139.797	0.005	87 734.9	25		$5s^25p^4\ ^1S_0$	$5s(^2S)5p^5\ ^3P^\circ_1$	95TAU/JOS

TABLE 7. Energy levels of Ba V

Configuration	Term	J	Energy (cm⁻¹)	Unc. (cm⁻¹)	Leading percentages	Reference
$5s^25p^4$	^3P	2	0.0		85% + 15% $5s^25p^4\ ^1D$	83REA
	^3P	0	11 301.9	0.9	71% + 29% $5s^25p^4\ ^1S$	83REA
	^3P	1	16 429.1	0.9	100%	83REA
$5s^25p^4$	^1D	2	24 720.5	0.9	85% + 15% $5s^25p^4\ ^3P$	83REA
$5s^25p^4$	^1S	0	51 180.7	0.9	71% + 29% $5s^25p^4\ ^3P$	83REA
$5s(^2S)5p^5$	$^3P^\circ$	2	130 401.0	0.9	81% + 12% $5p^3(^2D^\circ)5d\ ^3P^\circ$ + 6% $5p^3(^2P^\circ)5d\ ^3P^\circ$	95TAU/JOS
	$^3P^\circ$	1	138 916.0	0.9	68% + 12% $5p^3(^2D^\circ)5d\ ^3P^\circ$ + 8% $5s(^2S)5p^5\ ^1P^\circ$	95TAU/JOS
	$^3P^\circ$	0	147 932.0	0.9	75% + 14% $5p^3(^2D^\circ)5d\ ^3P^\circ$ + 6% $5p^3(^2P^\circ)5d\ ^3P^\circ$	95TAU/JOS
$5p^3(^4S^\circ)5d$	$^5D^\circ$	3	159 475.	1	72% + 8% $5p^3(^2P^\circ)5d\ ^3F^\circ$ + 7% $5p^3(^2P^\circ)5d\ ^3D^\circ$	95TAU/JOS
	$^5D^\circ$	2	159 494.	1	67% + 8% $5p^3(^2P^\circ)5d\ ^3D^\circ$ + 8% $5p^3(^2D^\circ)5d\ ^3F^\circ$	95TAU/JOS
	$^5D^\circ$	0	160 011.	1	81% + 8% $5p^3(^2P^\circ)5d\ ^3P^\circ$ + 4% $5s(^2S)5p^5\ ^3P^\circ$	95TAU/JOS
	$^5D^\circ$	1	160 524.	1	80% + 5% $5s(^2S)5p^5\ ^3P^\circ$ + 5% $5p^3(^2P^\circ)5d\ ^3P^\circ$	95TAU/JOS
$5s(^2S)5p^5$	$^1P^\circ$	1	163 254.	1	42% + 34% $5p^3(^2D^\circ)5d\ ^1P^\circ$ + 8% $5p^3(^4S^\circ)5d\ ^5D^\circ$	95TAU/JOS

TABLE 7. Energy levels of Ba V—Continued

Configuration	Term	J	Energy (cm^{-1})	Unc. (cm^{-1})	Leading percentages	Reference
$5p^3(^4S^\circ)5d$	$^3D^\circ$	3	173 435.	2	26%+23% $5p^3(^2D^\circ)5d$ $^3D^\circ$ $5p^3(^4S^\circ)5d$ $^5D^\circ$	95TAU/JOS
	$^3D^\circ$	1	174 616.	2	48%+40% $5p^3(^2D^\circ)5d$ $^3D^\circ$+5% $5p^3(^2P^\circ)5d$ $^3P^\circ$	95TAU/JOS
	$^3D^\circ$	2	199 756.	2	19%+35% $5p^3(^2P^\circ)5d$ $^3D^\circ$+17% $5p^3(^2D^\circ)5d$ $^3D^\circ$	95TAU/JOS
$5p^3(^2D^\circ)5d$	$^3F^\circ$	2	176 637.	2	47%+25% $5p^3(^2D^\circ)5d$ $^3D^\circ$+15% $5p^3(^4S^\circ)5d$ $^3D^\circ$	95TAU/JOS
	$^3F^\circ$	3	178 823.	2	62%+14% $5p^3(^2D^\circ)5d$ $^3D^\circ$+11% $5p^3(^4S^\circ)5d$ $^3D^\circ$	95TAU/JOS
$5p^3(^2D^\circ)5d$	$^1S^\circ$	0	178 341.	2	81%+9% $5p^3(^2P^\circ)5d$ $^3P^\circ$+7% $5p^3(^4S^\circ)5d$ $^5D^\circ$	95TAU/JOS
$5p^3(^2D^\circ)5d$	$^3G^\circ$	3	180 878.	2	59%+16% $5p^3(^2D^\circ)5d$ $^3F^\circ$+10% $5p^3(^2D^\circ)5d$ $^3D^\circ$	95TAU/JOS
$5p^3(^2D^\circ)5d$	$^3D^\circ$	2	166 279.	2	18%+22% $5p^3(^4S^\circ)5d$ $^5D^\circ$+19% $5p^3(^4S^\circ)5d$ $^3D^\circ$	95TAU/JOS
	$^3D^\circ$	1	189 360.	2	40%+37% $5p^3(^2P^\circ)5d$ $^3D^\circ$+11% $5p^3(^4S^\circ)5d$ $^3D^\circ$	95TAU/JOS
	$^3D^\circ$	3	203 679.	2	26%+32% $5p^3(^2P^\circ)5d$ $^3F^\circ$+17% $5p^3(^2D^\circ)5d$ $^3G^\circ$	95TAU/JOS
$5p^3(^2P^\circ)5d$	$^1D^\circ$	2	194 378.	2	29%+21% $5p^3(^2D^\circ)5d$ $^1D^\circ$+20% $5p^3(^2P^\circ)5d$ $^3F^\circ$	95TAU/JOS
$5p^3(^2P^\circ)5d$	$^3P^\circ$	1	197 326.	2	42%+24% $5p^3(^2D^\circ)5d$ $^3S^\circ$+13% $5p^3(^2D^\circ)5d$ $^3P^\circ$	95TAU/JOS
	$^3P^\circ$	0	198 174.	2	42%+34% $5p^3(^2D^\circ)5d$ $^3P^\circ$+15% $5p^3(^2D^\circ)5d$ $^1S^\circ$	95TAU/JOS
	$^3P^\circ$	2	214 297.	2	37%+22% $5p^3(^2D^\circ)5d$ $^3P^\circ$+14% $5p^3(^2D^\circ)5d$ $^1D^\circ$	95TAU/JOS
$5p^3(^2P^\circ)5d$	$^3D^\circ$	3	211 450.	2	33%+31% $5p^3(^2D^\circ)5d$ $^1F^\circ$+20% $5p^3(^4S^\circ)5d$ $^3D^\circ$	95TAU/JOS
	$^3D^\circ$	2	219 629.	2	25%+20% $5p^3(^2D^\circ)5d$ $^3P^\circ$+14% $5p^3(^2D^\circ)5d$ $^1D^\circ$	95TAU/JOS
	$^3D^\circ$	1	221 250.	2	28%+17% $5p^3(^2P^\circ)5d$ $^1P^\circ$+14% $5p^3(^4S^\circ)5d$ $^3D^\circ$	95TAU/JOS
$5p^3(^2P^\circ)5d$	$^3F^\circ$	2	203 772.	2	53%+19% $5p^3(^2D^\circ)5d$ $^3F^\circ$+15% $5p^3(^2P^\circ)5d$ $^3P^\circ$	95TAU/JOS
	$^3F^\circ$	3	204 482.	2	34%+21% $5p^3(^2P^\circ)5d$ $^3D^\circ$+16% $5p^3(^2D^\circ)5d$ $^3D^\circ$	95TAU/JOS
$5p^3(^2D^\circ)5d$	$^3P^\circ$	2	208 457.	3	38%+18% $5p^3(^2P^\circ)5d$ $^3P^\circ$+15% $5p^3(^2D^\circ)5d$ $^3D^\circ$	95TAU/JOS
	$^3P^\circ$	1	212 997.	3	18%+21% $5p^3(^2D^\circ)5d$ $^1P^\circ$+19% $5s(^2S)5p^5$ $^1P^\circ$	95TAU/JOS
	$^3P^\circ$	0	225 046.	3	44%+35% $5p^3(^2P^\circ)5d$ $^3P^\circ$+17% $5s(^2S)5p^5$ $^3P^\circ$	95TAU/JOS
$5p^3(^2D^\circ)5d$	$^3S^\circ$	1	209 234.	3	54%+30% $5p^3(^2D^\circ)5d$ $^3P^\circ$+5% $5p^3(^2P^\circ)5d$ $^3P^\circ$	95TAU/JOS
$5p^3(^4S^\circ)6s$	$^5S^\circ$	2	211 583.	3	68%+16% $5p^3(^2P^\circ)6s$ $^3P^\circ$+4% $5p^3(^2P^\circ)5d$ $^3P^\circ$	95TAU/JOS
$5p^3(^4S^\circ)6s$	$^3S^\circ$	1	218 414.	3	44%+15% $5p^3(^2D^\circ)6s$ $^3D^\circ$+11% $5p^3(^2P^\circ)6s$ $^1P^\circ$	95TAU/JOS
$5p^3(^2P^\circ)5d$	$^1F^\circ$	3	222 586.	3	32%+25% $5p^3(^2P^\circ)5d$ $^3D^\circ$+21% $5p^3(^2D^\circ)5d$ $^1F^\circ$	95TAU/JOS
$5p^3(^2D^\circ)5d$	$^1P^\circ$	1	226 615.	3	17%+20% $5p^3(^2P^\circ)5d$ $^3D^\circ$+15% $5p^3(^2P^\circ)5d$ $^3P^\circ$	95TAU/JOS
$5p^3(^2D^\circ)6s$	$^3D^\circ$	2	229 671.	3	48%+15% $5p^3(^4S^\circ)6s$ $^5S^\circ$+12% $5p^3(^2D^\circ)6s$ $^1D^\circ$	95TAU/JOS
	$^3D^\circ$	1	231 253.	3	61%+33% $5p^3(^4S^\circ)6s$ $^3S^\circ$	95TAU/JOS
	$^3D^\circ$	3	235 832.	3	97%	95TAU/JOS
$5p^3(^2D^\circ)5d$	$^1D^\circ$	2	231 190.	3	33%+20% $5p^3(^2P^\circ)5d$ $^3D^\circ$+16% $5p^3(^2P^\circ)5d$ $^1D^\circ$	95TAU/JOS
$5p^3(^2D^\circ)5d$	$^1F^\circ$	3	234 036.	3	39%+39% $5p^3(^2P^\circ)5d$ $^1F^\circ$+8% $5p^3(^4S^\circ)5d$ $^3D^\circ$	95TAU/JOS
$5p^3(^2D^\circ)6s$	$^1D^\circ$	2	238 468.	3	72%+25% $5p^3(^2D^\circ)6s$ $^3D^\circ$	95TAU/JOS
$5p^3(^2P^\circ)5d$	$^1P^\circ$	1	247 412.	3	34%+34% $5p^3(^2P^\circ)6s$ $^3P^\circ$+16% $5p^3(^2P^\circ)6s$ $^1P^\circ$	95TAU/JOS
$5p^3(^2P^\circ)6s$	$^3P^\circ$	0	247 832.	3	99%	95TAU/JOS
	$^3P^\circ$	1	250 440.	3	38%+35% $5p^3(^2P^\circ)5d$ $^1P^\circ$+10% $5p^3(^2P^\circ)6s$ $^1P^\circ$	95TAU/JOS
	$^3P^\circ$	2	261 176.	3	67%+14% $5p^3(^2D^\circ)6s$ $^3D^\circ$+13% $5p^3(^2D^\circ)6s$ $^1D^\circ$	95TAU/JOS
$5p^3(^2P^\circ)6s$	$^1P^\circ$	1	263 593.	3	55%+20% $5p^3(^2D^\circ)6s$ $^3D^\circ$+15% $5p^3(^2P^\circ)6s$ $^3P^\circ$	95TAU/JOS
Ba VI ($5p^3$ $^4S^\circ_{3/2}$)	*Limit*	—	468 000			04ROD/IND

6.4. Ba VI

Sb isoelectronic sequence
Ground state
$1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^25p^3\ ^4S^\circ_{3/2}$
Ionization energy (573 000 cm^{-1}); (71 eV)

The Ba VI spectrum was first measured by Tauheed and Joshi [94TAU/JOS], who photographed the 300–1240 Å region using a triggered spark as the source. The 128 spectral lines observed (see Table 8) enabled them to locate all five levels of the ground configuration and 42 out of 44 levels of the $5s5p^4$, $5s^25p^25d$, and $5s^25p^26s$ configurations. The two J=9/2 levels were calculated by Tauheed and Joshi [94TAU/JOS] using the Hartree–Fock technique. As can be easily observed from the leading percentages in Table 9, configuration mixing is severe for the levels of Ba VI. It should be noted that in order to assign unique names to the levels, some of the designations given in Table 9 have names which do not correspond to the largest component.

Recently the EUV photoabsorption spectrum of Ba VI was recorded by Murphy *et al.* [06MUR/NIG]. They observed several unresolved spectral features which they assigned to transitions from the ground configuration to levels in which a $4d$ electron is promoted into the $5p$ shell. No experimental uncertainties are given in the [06MUR/NIG] paper; however, they do state that the resolving power of their spectrograph is between 1300 and 1900. Since the resolution of the experiment was not sufficient to separate the individual transitions (resulting in up to eight classifications assigned to a spectral feature), and since the internal consistency of the level values obtained using the Murphy *et al.* [06MUR/NIG] classifications is not good, the designations and level values are not included in this compilation. All level values reported here are from [94TAU/JOS], except the calculated ionization energy, which is quoted from Rodrigues *et al.* [04ROD/IND] who did not provide an estimate of its uncertainty.

6.4.1. References for Ba VI

94TAU/JOS A. Tauheed and Y. N. Joshi, Phys. Scr. **49**, 335 (1994).

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

06MUR/NIG N. Murphy, P. Niga, A. Cummings, P. Dunne, and G. O'Sullivan, J. Phys. B **39**, 365 (2006).

TABLE 8. Observed spectral lines of Ba VI

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	Lower Level	Upper Level	λ Ref.
Vacuum							
149.6		668 600		b			06MUR/NIG
150.3		665 200					06MUR/NIG
150.8		663 300					06MUR/NIG
151.5		659 900					06MUR/NIG
151.9		658 300					06MUR/NIG
152.7		654 900		b			06MUR/NIG
153.5		651 500		b			06MUR/NIG
154.4		647 800					06MUR/NIG
154.9		645 600		b			06MUR/NIG
156.6		638 700					06MUR/NIG
157.4		635 500		b			06MUR/NIG
344.680	0.005	290 124.4	4		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^1S)6s\ ^2S_{1/2}$	94TAU/JOS
368.594	0.005	271 301.4	18		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^1D)6s\ ^2D_{5/2}$	94TAU/JOS
368.689	0.005	271 231.1	12		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^1S)6s\ ^2S_{1/2}$	94TAU/JOS
368.890	0.005	271 083.6	6		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)6s\ ^2P_{3/2}$	94TAU/JOS
373.625	0.005	267 648.2	55		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)6s\ ^4P_{5/2}$	94TAU/JOS
377.333	0.005	265 017.8	15		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^1D)6s\ ^2D_{5/2}$	94TAU/JOS
382.318	0.005	261 562.5	35		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)6s\ ^4P_{3/2}$	94TAU/JOS
387.947	0.005	257 767.5	7		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^1S)6s\ ^2S_{1/2}$	94TAU/JOS
393.974	0.005	253 823.6	18		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)6s\ ^2P_{3/2}$	94TAU/JOS
402.587	0.005	248 393.7	35		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)6s\ ^2P_{1/2}$	94TAU/JOS
403.672	0.005	247 725.7	34		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)6s\ ^4P_{1/2}$	94TAU/JOS
403.982	0.005	247 535.5	34		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)6s\ ^2P_{3/2}$	94TAU/JOS
409.322	0.005	244 306.5	18		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)6s\ ^4P_{3/2}$	94TAU/JOS
409.658	0.005	244 106.0	34		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)6s\ ^4P_{5/2}$	94TAU/JOS
414.452	0.005	241 282.6	40		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^1D)6s\ ^2D_{3/2}$	94TAU/JOS
416.595	0.005	240 041.3	10		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^2F_{5/2}$	94TAU/JOS
418.504	0.005	238 946.1	22		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^1D)6s\ ^2D_{5/2}$	94TAU/JOS
420.137	0.005	238 017.8	20		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)6s\ ^4P_{3/2}$	94TAU/JOS
422.577	0.005	236 643.3	5		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^1D)5d\ ^2D_{5/2}$	94TAU/JOS

TABLE 8. Observed spectral lines of Ba VI—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	Lower Level	Upper Level	λ Ref.
425.666	0.005	234 925.8	40		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^3P)6s\ ^2P_{3/2}$	94TAU/JOS
426.781	0.005	234 312.0	20	b	$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^1D)5d\ ^2P_{1/2}$	94TAU/JOS
427.807	0.005	233 750.4	30	*	$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^1D)5d\ ^2S_{1/2}$	94TAU/JOS
427.807	0.005	233 750.4	30	*	$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^2F_{5/2}$	94TAU/JOS
428.763	0.005	233 228.9	5		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^1S)5d\ ^2D_{3/2}$	94TAU/JOS
433.910	0.005	230 462.5	40		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)6s\ ^4P_{1/2}$	94TAU/JOS
435.735	0.005	229 497.3	30		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^3P)6s\ ^2P_{1/2}$	94TAU/JOS
436.121	0.005	229 294.3	10		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^2P_{1/2}$	94TAU/JOS
436.227	0.005	229 238.5	5		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^1D)5d\ ^2P_{3/2}$	94TAU/JOS
437.956	0.005	228 333.3	48		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^2D_{5/2}$	94TAU/JOS
442.785	0.005	225 843.0	6		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^1S)5d\ ^2D_{5/2}$	94TAU/JOS
446.238	0.005	224 095.7	50		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^2D_{3/2}$	94TAU/JOS
448.530	0.005	222 950.4	15		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^1D)5d\ ^2P_{3/2}$	94TAU/JOS
451.543	0.005	221 463.0	12		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)6s\ ^2P_{3/2}$	94TAU/JOS
453.268	0.005	220 620.2	45		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^1S)5d\ ^2D_{3/2}$	94TAU/JOS
455.462	0.005	219 557.1	30		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^1S)5d\ ^2D_{5/2}$	94TAU/JOS
455.828	0.005	219 381.1	50		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^1D)5d\ ^2D_{5/2}$	94TAU/JOS
457.264	0.005	218 692.0	50		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4P_{1/2}$	94TAU/JOS
457.436	0.005	218 610.0	52		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^2F_{7/2}$	94TAU/JOS
457.544	0.005	218 558.3	50		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^1D)5d\ ^2D_{3/2}$	94TAU/JOS
458.658	0.005	218 027.2	10		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)6s\ ^4P_{5/2}$	94TAU/JOS
460.094	0.005	217 346.7	60	b	$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4P_{3/2}$	94TAU/JOS
460.709	0.005	217 056.8	16	a	$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^1D)5d\ ^2P_{1/2}$	94TAU/JOS
465.395	0.005	214 871.1	55		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4P_{5/2}$	94TAU/JOS
469.277	0.005	213 093.7	60		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^1D)5d\ ^2D_{5/2}$	94TAU/JOS
469.385	0.005	213 044.6	55		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s(^2S)5p^4(^3P)\ ^2P_{3/2}$	94TAU/JOS
471.092	0.005	212 272.8	50		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^1D)5d\ ^2D_{3/2}$	94TAU/JOS
471.626	0.005	212 032.6	50		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^2P_{1/2}$	94TAU/JOS
471.830	0.005	211 940.7	18		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)6s\ ^4P_{3/2}$	94TAU/JOS
472.653	0.005	211 571.7	18		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^3P)6s\ ^4P_{1/2}$	94TAU/JOS
473.769	0.005	211 073.3	50		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^2D_{5/2}$	94TAU/JOS
475.423	0.005	210 339.0	45		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^1D)5d\ ^2P_{3/2}$	94TAU/JOS
481.517	0.005	207 677.1	50		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^2F_{5/2}$	94TAU/JOS
482.737	0.005	207 152.2	48		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^1S)5d\ ^2D_{3/2}$	94TAU/JOS
488.321	0.005	204 783.5	55		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^2D_{5/2}$	94TAU/JOS
495.404	0.005	201 855.6	63		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4D_{5/2}$	94TAU/JOS
496.557	0.005	201 386.7	58		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^1D)5d\ ^2S_{1/2}$	94TAU/JOS
498.638	0.005	200 546.4	28		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^2D_{3/2}$	94TAU/JOS
499.785	0.005	200 086.2	45		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4P_{3/2}$	94TAU/JOS
500.847	0.005	199 661.8	50		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^1D)5d\ ^2D_{3/2}$	94TAU/JOS
504.648	0.005	198 158.0	58		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^1D)5d\ ^2P_{1/2}$	94TAU/JOS
506.049	0.005	197 609.2	30		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4P_{5/2}$	94TAU/JOS
506.959	0.005	197 254.8	40		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4D_{3/2}$	94TAU/JOS
507.939	0.005	196 874.0	48		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^1D)5d\ ^2P_{3/2}$	94TAU/JOS
510.777	0.005	195 780.3	52	b	$5s^25p^3\ ^2D^\circ_{3/2}$	$5s(^2S)5p^4(^3P)\ ^2P_{3/2}$	94TAU/JOS
513.529	0.005	194 730.8	48		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^1D)5d\ ^2F_{7/2}$	94TAU/JOS
515.999	0.005	193 799.0	48		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^4P_{3/2}$	94TAU/JOS
516.844	0.005	193 481.9	20		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^1S)5d\ ^2D_{5/2}$	94TAU/JOS
522.510	0.005	191 383.8	28		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^1D)5d\ ^2F_{5/2}$	94TAU/JOS
522.672	0.005	191 324.4	45		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^4P_{5/2}$	94TAU/JOS
527.717	0.005	189 495.5	55		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s(^2S)5p^4(^3P)\ ^2P_{3/2}$	94TAU/JOS
530.050	0.005	188 661.4	50		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^1D)5d\ ^2G_{7/2}$	94TAU/JOS
532.094	0.005	187 936.8	35		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^3P)5d\ ^2D_{3/2}$	94TAU/JOS
534.709	0.005	187 017.5	18		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^1D)5d\ ^2D_{5/2}$	94TAU/JOS
541.445	0.005	184 691.1	6		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^1D)5d\ ^2P_{1/2}$	94TAU/JOS
541.719	0.005	184 597.6	28		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4D_{5/2}$	94TAU/JOS
544.417	0.005	183 682.8	30	b	$5s^25p^3\ ^2D^\circ_{3/2}$	$5s(^2S)5p^4(^1S)\ ^2S_{1/2}$	94TAU/JOS

TABLE 8. Observed spectral lines of Ba VI—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	Lower Level	Upper Level	λ Ref.
544.807	0.005	183 551.3	50		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4F_{5/2}$	94TAU/JOS
547.827	0.005	182 539.5	5		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^3P)5d\ ^4P_{1/2}$	94TAU/JOS
554.659	0.005	180 290.9	20		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4F_{3/2}$	94TAU/JOS
555.564	0.005	179 997.4	12		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4D_{3/2}$	94TAU/JOS
556.571	0.005	179 671.7	18		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^2P_{1/2}$	94TAU/JOS
558.416	0.005	179 078.0	10		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s(^2S)5p^4(^3P)\ ^2P_{1/2}$	94TAU/JOS
559.573	0.005	178 707.6	5		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^2D_{5/2}$	94TAU/JOS
560.815	0.005	178 312.0	25		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^4D_{5/2}$	94TAU/JOS
565.329	0.005	176 888.3	6		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s(^2S)5p^4(^3P)\ ^2P_{3/2}$	94TAU/JOS
566.576	0.005	176 498.7	5		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^2P_{3/2}$	94TAU/JOS
575.686	0.005	173 705.9	30		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^4D_{3/2}$	94TAU/JOS
579.431	0.005	172 583.0	5		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^4D_{7/2}$	94TAU/JOS
591.463	0.005	169 072.4	5		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4P_{1/2}$	94TAU/JOS
591.667	0.005	169 014.0	6		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^4F_{7/2}$	94TAU/JOS
595.827	0.005	167 834.0	5		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^1D)5d\ ^2F_{5/2}$	94TAU/JOS
606.869	0.005	164 780.1	5		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s(^2S)5p^4(^1S)\ ^2S_{1/2}$	94TAU/JOS
611.377	0.005	163 565.2	5		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s(^2S)5p^4(^1D)\ ^2D_{5/2}$	94TAU/JOS
611.914	0.005	163 421.6	6		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s(^2S)5p^4(^3P)\ ^2P_{3/2}$	94TAU/JOS
613.381	0.005	163 030.8	18		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4F_{3/2}$	94TAU/JOS
617.987	0.005	161 815.6	50		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s(^2S)5p^4(^3P)\ ^2P_{1/2}$	94TAU/JOS
620.735	0.005	161 099.3	9		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^3P)5d\ ^4D_{3/2}$	94TAU/JOS
624.978	0.005	160 005.6	7		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^4F_{5/2}$	94TAU/JOS
627.992	0.005	159 237.8	9		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^2P_{3/2}$	94TAU/JOS
632.273	0.005	158 159.5	15	u	$5s^25p^3\ ^4S^\circ_{3/2}$	$5s(^2S)5p^4(^1D)\ ^2D_{3/2}$	94TAU/JOS
634.010	0.005	157 726.3	50	b	$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^3P)5d\ ^4D_{1/2}$	94TAU/JOS
637.983	0.005	156 744.1	48		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^4F_{3/2}$	94TAU/JOS
653.803	0.005	152 951.2	50		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s^25p^2(^3P)5d\ ^2P_{3/2}$	94TAU/JOS
656.880	0.005	152 234.7	5		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4D_{5/2}$	94TAU/JOS
660.860	0.005	151 317.9	27		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s(^2S)5p^4(^1S)\ ^2S_{1/2}$	94TAU/JOS
677.346	0.005	147 635.1	6		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4D_{3/2}$	94TAU/JOS
693.187	0.005	144 261.2	6		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4D_{1/2}$	94TAU/JOS
699.690	0.005	142 920.5	32		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s(^2S)5p^4(^3P)\ ^2P_{1/2}$	94TAU/JOS
700.027	0.005	142 851.7	48		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s(^2S)5p^4(^3P)\ ^4P_{1/2}$	94TAU/JOS
709.733	0.005	140 898.1	60		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s(^2S)5p^4(^1D)\ ^2D_{3/2}$	94TAU/JOS
712.544	0.005	140 342.2	16		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s^25p^2(^3P)5d\ ^2P_{3/2}$	94TAU/JOS
714.190	0.005	140 018.8	55		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s(^2S)5p^4(^1D)\ ^2D_{5/2}$	94TAU/JOS
714.697	0.005	139 919.4	55		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s(^2S)5p^4(^3P)\ ^4P_{3/2}$	94TAU/JOS
742.881	0.005	134 611.0	15		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s(^2S)5p^4(^1D)\ ^2D_{3/2}$	94TAU/JOS
746.652	0.005	133 931.2	3		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4F_{5/2}$	94TAU/JOS
765.261	0.005	130 674.4	10	u	$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^4F_{3/2}$	94TAU/JOS
778.595	0.005	128 436.4	65		$5s^25p^3\ ^4S^\circ_{3/2}$	$5s(^2S)5p^4(^3P)\ ^4P_{5/2}$	94TAU/JOS
788.168	0.005	126 876.5	28		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s^25p^2(^3P)5d\ ^2P_{3/2}$	94TAU/JOS
796.240	0.005	125 590.3	10		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s(^2S)5p^4(^3P)\ ^4P_{1/2}$	94TAU/JOS
819.656	0.005	122 002.4	20		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s(^2S)5p^4(^1D)\ ^2D_{3/2}$	94TAU/JOS
859.306	0.005	116 373.0	22		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s(^2S)5p^4(^3P)\ ^4P_{3/2}$	94TAU/JOS
877.611	0.005	113 945.7	52		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s(^2S)5p^4(^1D)\ ^2D_{5/2}$	94TAU/JOS
899.479	0.005	111 175.5	60		$5s^25p^3\ ^2D^\circ_{3/2}$	$5s(^2S)5p^4(^3P)\ ^4P_{5/2}$	94TAU/JOS
937.235	0.005	106 696.8	15		$5s^25p^3\ ^2P^\circ_{1/2}$	$5s(^2S)5p^4(^3P)\ ^4P_{1/2}$	94TAU/JOS
953.387	0.005	104 889.2	36		$5s^25p^3\ ^2D^\circ_{5/2}$	$5s(^2S)5p^4(^3P)\ ^4P_{5/2}$	94TAU/JOS
1 072.606	0.005	93 230.9	4		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s(^2S)5p^4(^3P)\ ^4P_{1/2}$	94TAU/JOS
1 107.428	0.005	90 299.3	15		$5s^25p^3\ ^2P^\circ_{3/2}$	$5s(^2S)5p^4(^3P)\ ^4P_{3/2}$	94TAU/JOS

TABLE 9. Energy levels of Ba VI

Configuration	Term	J	Energy (cm^{-1})	Unc. (cm^{-1})	Leading percentages	Reference
$5s^25p^3$	$^4S°$	3/2	0.0		72%+20% $5s^25p^3$ $^2P°$+8% $5s^25p^3$ $^2D°$	94TAU/JOS
$5s^25p^3$	$^2D°$	3/2	17 260.6	0.5	68%+21% $5s^25p^3$ $^4S°$+11% $5s^25p^3$ $^2P°$	94TAU/JOS
	$^2D°$	5/2	23 547.2	0.5	100%	94TAU/JOS
$5s^25p^3$	$^2P°$	1/2	36 155.7	0.5	100%	94TAU/JOS
	$^2P°$	3/2	49 621.0	0.5	69%+24% $5s^25p^3$ $^2D°$+7% $5s^25p^3$ $^4S°$	94TAU/JOS
$5s(^2S)5p^4(^3P)$	^4P	5/2	128 436.3	0.5	81%+10% $5s(^2S)5p^4(^1S)$ ^2S+8% $5s^25p^2(^3P)5d$ ^4P	94TAU/JOS
	^4P	3/2	139 920.1	0.5	83%+8% $5s^25p^2(^3P)5d$ ^4P+5% $5s(^2S)5p^4(^1D)$ ^2D	94TAU/JOS
	^4P	1/2	142 851.9	0.5	86%+7% $5s(^2S)5p^4(^1D)$ ^2D+7% $5s^25p^2(^3P)5d$ ^4P	94TAU/JOS
$5s(^2S)5p^4(^1D)$	^2D	3/2	158 158.4	1.	61%+12% $5s^25p^2(^1D)5d$ ^2D+8% $5s(^2S)5p^4(^3P)$ ^4P	94TAU/JOS
	^2D	5/2	163 566.3	1.	75%+15% $5s^25p^2(^1D)5d$ ^2D+7% $5s(^2S)5p^4(^3P)$ ^4P	94TAU/JOS
$5s^25p^2(^3P)5d$	^2P	3/2	176 498.0	1.	29%+19% $5s(^2S)5p^4(^3P)$ ^2P+17% $5s^25p^2(^3P)5d$ ^4F	94TAU/JOS
	^2P	1/2	229 293.1	1.	29%+32% $5s(^2S)5p^4(^3P)$ ^2P+16% $5s^25p^2(^1D)5d$ ^2P	94TAU/JOS
$5s(^2S)5p^4(^3P)$	^2P	1/2	179 076.6	1.	34%+29% $5s(^2S)5p^4(^1S)$ ^2S+23% $5s^25p^2(^3P)5d$ ^2P	94TAU/JOS
	^2P	3/2	213 042.9	1.	37%+27% $5s^25p^2(^3P)5d$ ^2P+9% $5s^25p^25d$ $(^1D)^2P$	94TAU/JOS
$5s^25p^2(^3P)5d$	^4F	3/2	180 293.1	1.	61%+19% $5s(^2S)5p^4(^3P)$ ^2P+10% $5s^25p^2(^3P)5d$ ^2P	94TAU/JOS
	^4F	5/2	183 552.2	1.	62%+23% $5s^25p^2(^3P)5d$ ^4D+6% $5s^25p^2(^1S)5d$ ^2D	94TAU/JOS
	^4F	7/2	192 561.2	1.	84%+12% $5s^25p^2(^3P)5d$ ^4D	94TAU/JOS
	^4F	9/2	(199 080.5)		78%+22% $5s^25p^2(^1D)5d$ ^2G	94TAU/JOS
$5s^25p^2(^1D)5d$	^2F	5/2	191 382.2	2.	39%+29% $5s^25p^2(^3P)5d$ ^2F+21% $5s^25p^2(^3P)5d$ ^4F	94TAU/JOS
	^2F	7/2	218 278.0		34%+39% $5s^25p^2(^1D)5d$ ^2G+20% $5s^25p^2(^3P)5d$ ^4D	94TAU/JOS
$5s^25p^2(^3P)5d$	^4D	1/2	193 882.1	2.	64%+19% $5s(^2S)5p^4(^1S)$ ^2S+7% $5s^25p^2(^3P)5d$ ^2P	94TAU/JOS
	^4D	7/2	196 130.2	2.	75%+11% $5s^25p^2(^3P)5d$ ^4F+6% $5s(^2S)5p^4(^3P)$ ^2P	94TAU/JOS
	^4D	3/2	197 255.4	2.	49%+14% $5s^25p^2(^3P)5d$ ^2F+13% $5s^25p^2(^3P)5d$ ^4F	94TAU/JOS
	^4D	5/2	201 857.0	2.	39%+34% $5s^25p^2(^1D)5d$ ^2F+18% $5s^25p^2(^3P)5d$ ^2F	94TAU/JOS
$5s(^2S)5p^4(^1S)$	^2S	1/2	200 937.6	2.	25%+28% $5s^25p^2(^3P)5d$ ^4D+19% $5s^25p^2(^3P)5d$ ^2P	94TAU/JOS
$5s^25p^2(^1D)5d$	^2G	7/2	212 208.6	2.	45%+29% $5s^25p^2(^3P)5d$ ^4D+13% $5s^25p^2(^3P)5d$ ^2F	94TAU/JOS
	^2G	9/2	(222 542.2)		78%+22% $5s^25p^2(^3P)5d$ ^4F	94TAU/JOS
$5s^25p^2(^3P)5d$	^4P	5/2	214 870.8	2.	68%+11% $5s^25p^2(^3P)5d$ ^4D+9% $5s^25p^2(^1D)5d$ ^2D	94TAU/JOS
	^4P	3/2	217 346.5	2.	61%+23% $5s^25p^2(^1D)5d$ ^2P+6% $5s(^2S)5p^4(^3P)$ ^4P	94TAU/JOS
	^4P	1/2	218 693.8	2.	64%+17% $5s^25p^2(^1D)5d$ ^2P+11% $5s^25p^2(^1D)5d$ ^2S	94TAU/JOS
$5s^25p^2(^3P)5d$	^2D	3/2	224 093.2	2.	44%+21% $5s^25p^2(^1S)5d$ ^2D+10% $5s^25p^2(^3P)5d$ ^4P	94TAU/JOS
	^2D	5/2	228 330.9	2.	52%+17% $5s^25p^2(^1D)5d$ ^2D+16% $5s^25p^2(^3P)5d$ ^2F	94TAU/JOS
$5s^25p^2(^1D)5d$	^2P	1/2	234 313.6	2.	63%+12% $5s^25p^2(^3P)5d$ ^2P+11% $5s^25p^2(^1D)5d$ ^2S	94TAU/JOS
	^2P	3/2	246 496.2	2.	43%+24% $5s^25p^2(^3P)5d$ ^2P+10% $5s^25p^2(^1S)5d$ ^2D	94TAU/JOS
$5s^25p^2(^1D)5d$	^2D	3/2	235 818.7	2.	63%+12% $5s(^2S)5p^4(^1D)$ ^2D+11% $5s^25p^2(^3P)5d$ ^4P	94TAU/JOS
	^2D	5/2	236 640.5	2.	24%+24% $5s^25p^2(^1D)5d$ ^2F+18% $5s^25p^2(^3P)5d$ ^2F	94TAU/JOS
$5s^25p^2(^3P)5d$	^2F	7/2	242 157.2	2.	62%+30% $5s^25p^2(^1D)5d$ ^2F+6% $5s^25p^2(^1D)5d$ ^2G	94TAU/JOS
	^2F	5/2	257 298.9	2.	18%+31% $5s^25p^2(^1S)5d$ ^2D+29% $5s^25p^2(^3P)5d$ ^2D	94TAU/JOS
$5s^25p^2(^1S)5d$	^2D	5/2	243 103.4	2.	45%+29% $5s^25p^2(^1D)5d$ ^2D+16% $5s^25p^2(^3P)5d$ ^2D	94TAU/JOS
	^2D	3/2	256 774.8	2.	50%+43% $5s^25p^2(^3P)5d$ ^2D	94TAU/JOS
$5s^25p^2(^3P)6s$	^4P	1/2	247 725.6	3.	71%+14% $5s^25p^2(^3P)6s$ ^2P+12% $5s^25p^2(^1S)6s$ ^2S	94TAU/JOS
	^4P	3/2	261 563.8	3.	93%+5% $5s^25p^2(^3P)6s$ ^2P	94TAU/JOS
	^4P	5/2	267 649.7	3.	64%+35% $5s^25p^2(^1D)6s$ ^2D	94TAU/JOS

TABLE 9. Energy levels of Ba VI—Continued

Configuration	Term	J	Energy (cm^{-1})	Unc. (cm^{-1})	Leading percentages	Reference
$5s^25p^2(^1D)5d$	^2S	1/2	251 008.8	3.	59%+15% $5s(^2S)5p^4(^1S)$ ^2S+9% $5s^25p^2(^3P)5d$ ^4P	94TAU/JOS
$5s^25p^2(^3P)6s$	^2P	1/2	265 653.5	3.	78%+20% $5s^25p^2(^3P)6s$ ^4P	94TAU/JOS
	^2P	3/2	271 083.2	3.	49%+48% $5s^25p^2(^1D)6s$ ^2D	94TAU/JOS
$5s^25p^2(^1D)6s$	^2D	3/2	290 903.6	4.	51%+44% $5s^25p^2(^3P)6s$ ^2P+5% $5s^25p^2(^3P)6s$ ^4P	94TAU/JOS
	^2D	5/2	288 565.1	4.	64%+36% $5s^25p^2(^3P)6s$ ^4P	94TAU/JOS
$5s^25p^2(^1S)6s$	^2S	1/2	307 387.0	4.	86%+8% $5s^25p^2(^3P)6s$ ^4P+5% $5s^25p^2(^3P)6s$ ^2P	94TAU/JOS
Ba VII ($5p^2$ $^3P_0$)	*Limit*	—	573 000			04ROD/IND

6.5. Ba VII

Sn isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^25p^2$ $^3P_0$
Ionization energy (694 000 cm^{-1}); (86 eV)

Tauheed and Joshi [92TAU/JOS] are the only group so far to measure the Ba VII spectrum. They used a triggered-spark source to measure the 70 lines listed in Table 10 in the 300–1220 Å region. The 25 experimentally observed levels in Table 11 include all five levels of the $5s^25p^2$ ground configuration and all but one $J=4$ level of the $5s5p^3$, $5s^25p5d$, and $5s^25p6s$ configurations. The $5s^25p5d$ $^3F^\circ_4$ level was calculated by Tauheed and Joshi [92TAU/JOS] using the Hartree–Fock technique. As can be easily observed from the leading percentages in Table 11, configuration mixing is somewhat of an issue for a few levels of Ba VII. In order for the $5s^25p5d$ $^3D^\circ_2$ and $^1D^\circ_2$ levels to have unique names, the designations assigned do not correspond to the components with the highest leading percentages. The ionization energy is obtained from Rodrigues *et al.* [04ROD/IND] who used the Dirac–Fock approximation to calculate the total atomic energies for all ionization stages.

6.5.1. References for Ba VII

92TAU/JOS A. Tauheed and Y. N. Joshi, Phys. Scr. **46**, 403 (1992).

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

TABLE 10. Observed spectral lines of Ba VII

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	Lower Level	Upper Level	λ Ref.
Vacuum							
332.633	0.005	300 632.	4		$5s^25p^2$ $^3P_1$	$5s^25p6s$ $^3P^\circ_2$	92TAU/JOS
335.506	0.005	298 057.	2		$5s^25p^2$ $^3P_2$	$5s^25p6s$ $^1P^\circ_1$	92TAU/JOS
339.116	0.005	294 884.	12		$5s^25p^2$ $^3P_0$	$5s^25p6s$ $^3P^\circ_1$	92TAU/JOS
339.394	0.005	294 643.	14		$5s^25p^2$ $^3P_2$	$5s^25p6s$ $^3P^\circ_2$	92TAU/JOS
357.940	0.005	279 377.	12		$5s^25p^2$ $^3P_1$	$5s^25p6s$ $^3P^\circ_1$	92TAU/JOS
359.650	0.005	278 048.	28		$5s^25p^2$ $^3P_1$	$5s^25p6s$ $^3P^\circ_0$	92TAU/JOS
360.952	0.005	277 045.	38		$5s^25p^2$ $^1D_2$	$5s^25p6s$ $^1P^\circ_1$	92TAU/JOS
365.466	0.005	273 623.	40		$5s^25p^2$ $^1D_2$	$5s^25p6s$ $^3P^\circ_2$	92TAU/JOS
365.783	0.005	273 386.	40		$5s^25p^2$ $^3P_2$	$5s^25p6s$ $^3P^\circ_1$	92TAU/JOS
386.883	0.005	258 476.	12		$5s^25p^2$ $^1S_0$	$5s^25p6s$ $^1P^\circ_1$	92TAU/JOS
422.107	0.005	236 907.	55	b	$5s^25p^2$ $^3P_2$	$5s^25p5d$ $^1F^\circ_3$	92TAU/JOS
427.711	0.005	233 803.	5		$5s^25p^2$ $^1S_0$	$5s^25p6s$ $^3P^\circ_1$	92TAU/JOS
433.792	0.005	230 525.	28		$5s^25p^2$ $^3P_1$	$5s^25p5d$ $^3P^\circ_2$	92TAU/JOS
437.778	0.005	228 427.	50		$5s^25p^2$ $^3P_1$	$5s^25p5d$ $^3P^\circ_1$	92TAU/JOS
440.208	0.005	227 165.	45		$5s^25p^2$ $^3P_1$	$5s^25p5d$ $^3P^\circ_0$	92TAU/JOS
442.086	0.005	226 200.	55		$5s^25p^2$ $^3P_0$	$5s^25p5d$ $^3D^\circ_1$	92TAU/JOS
445.375	0.005	224 530.	50		$5s^25p^2$ $^3P_2$	$5s^25p5d$ $^3P^\circ_2$	92TAU/JOS
448.588	0.005	222 922.	55		$5s^25p^2$ $^3P_1$	$5s^25p5d$ $^1D^\circ_2$	92TAU/JOS
449.570	0.005	222 435.	38		$5s^25p^2$ $^3P_2$	$5s^25p5d$ $^3P^\circ_1$	92TAU/JOS
450.263	0.005	222 093.	5		$5s^25p^2$ $^1D_2$	$5s^25p5d$ $^1P^\circ_1$	92TAU/JOS
454.723	0.005	219 914.	60	b	$5s^25p^2$ $^3P_2$	$5s^25p5d$ $^3D^\circ_3$	92TAU/JOS
455.520	0.005	219 529.	30		$5s^25p^2$ $^3P_0$	$5s5p^3$ $^1P^\circ_1$	92TAU/JOS
460.982	0.005	216 928.	60	b	$5s^25p^2$ $^3P_2$	$5s^25p5d$ $^1D^\circ_2$	92TAU/JOS
463.202	0.005	215 888.	60	b	$5s^25p^2$ $^1D_2$	$5s^25p5d$ $^1F^\circ_3$	92TAU/JOS

TABLE 10. Observed spectral lines of Ba VII—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	Lower Level	Upper Level	λ Ref.
474.622	0.005	210 694.	40		$5s^25p^2\ ^3P_1$	$5s^25p5d\ ^3D^\circ_1$	92TAU/JOS
480.045	0.005	208 314.	55		$5s^25p^2\ ^3P_1$	$5s^25p5d\ ^3D^\circ_2$	92TAU/JOS
488.529	0.005	204 696.	15		$5s^25p^2\ ^3P_2$	$5s^25p5d\ ^3D^\circ_1$	92TAU/JOS
490.148	0.005	204 020.	38		$5s^25p^2\ ^3P_1$	$5s5p^3\ ^1P^\circ_1$	92TAU/JOS
491.341	0.005	203 525.	45		$5s^25p^2\ ^1S_0$	$5s^25p5d\ ^1P^\circ_1$	92TAU/JOS
491.364	0.005	203 515.	60	*	$5s^25p^2\ ^1D_2$	$5s^25p5d\ ^3P^\circ_2$	92TAU/JOS
494.268	0.005	202 319.	60	*	$5s^25p^2\ ^3P_2$	$5s^25p5d\ ^3D^\circ_2$	92TAU/JOS
496.481	0.005	201 418.	38		$5s^25p^2\ ^1D_2$	$5s^25p5d\ ^3P^\circ_1$	92TAU/JOS
502.776	0.005	198 895.8	45		$5s^25p^2\ ^1D_2$	$5s^25p5d\ ^3D^\circ_3$	92TAU/JOS
509.477	0.005	196 279.8	45		$5s^25p^2\ ^3P_0$	$5s5p^3\ ^3S^\circ_1$	92TAU/JOS
510.426	0.005	195 914.9	50		$5s^25p^2\ ^1D_2$	$5s^25p5d\ ^1D^\circ_2$	92TAU/JOS
520.256	0.005	192 213.0	55		$5s^25p^2\ ^3P_2$	$5s^25p5d\ ^3F^\circ_3$	92TAU/JOS
523.123	0.005	191 159.6	30		$5s^25p^2\ ^3P_1$	$5s^25p5d\ ^3F^\circ_2$	92TAU/JOS
540.043	0.005	185 170.4	40		$5s^25p^2\ ^3P_2$	$5s^25p5d\ ^3F^\circ_2$	92TAU/JOS
544.417	0.005	183 682.8	30		$5s^25p^2\ ^1D_2$	$5s^25p5d\ ^3D^\circ_1$	92TAU/JOS
546.899	0.005	182 849.1	5		$5s^25p^2\ ^1S_0$	$5s^25p5d\ ^3P^\circ_1$	92TAU/JOS
551.553	0.005	181 306.3	25		$5s^25p^2\ ^1D_2$	$5s^25p5d\ ^3D^\circ_2$	92TAU/JOS
553.174	0.005	180 775.0	40		$5s^25p^2\ ^3P_1$	$5s5p^3\ ^3S^\circ_1$	92TAU/JOS
564.925	0.005	177 014.5	45		$5s^25p^2\ ^1D_2$	$5s5p^3\ ^1P^\circ_1$	92TAU/JOS
565.729	0.005	176 763.1	7		$5s^25p^2\ ^3P_1$	$5s5p^3\ ^1D^\circ_2$	92TAU/JOS
572.143	0.005	174 781.5	60	b	$5s^25p^2\ ^3P_2$	$5s5p^3\ ^3S^\circ_1$	92TAU/JOS
573.114	0.005	174 485.3	25		$5s^25p^2\ ^3P_0$	$5s5p^3\ ^3P^\circ_1$	92TAU/JOS
584.120	0.005	171 197.7	6		$5s^25p^2\ ^1D_2$	$5s^25p5d\ ^3F^\circ_3$	92TAU/JOS
605.637	0.005	165 115.4	5		$5s^25p^2\ ^1S_0$	$5s^25p5d\ ^3D^\circ_1$	92TAU/JOS
609.186	0.005	164 153.6	28		$5s^25p^2\ ^1D_2$	$5s^25p5d\ ^3F^\circ_2$	92TAU/JOS
625.267	0.005	159 931.7	5		$5s^25p^2\ ^3P_1$	$5s5p^3\ ^3P^\circ_2$	92TAU/JOS
629.016	0.005	158 978.6	50		$5s^25p^2\ ^3P_1$	$5s5p^3\ ^3P^\circ_1$	92TAU/JOS
631.130	0.005	158 445.9	25		$5s^25p^2\ ^1S_0$	$5s5p^3\ ^1P^\circ_1$	92TAU/JOS
637.064	0.005	156 970.1	40		$5s^25p^2\ ^3P_1$	$5s5p^3\ ^3P^\circ_0$	92TAU/JOS
649.596	0.005	153 941.8	62		$5s^25p^2\ ^3P_2$	$5s5p^3\ ^3P^\circ_2$	92TAU/JOS
650.339	0.005	153 766.0	8		$5s^25p^2\ ^1D_2$	$5s5p^3\ ^3S^\circ_1$	92TAU/JOS
653.676	0.005	152 981.1	15		$5s^25p^2\ ^3P_2$	$5s5p^3\ ^3P^\circ_1$	92TAU/JOS
667.749	0.005	149 756.9	60		$5s^25p^2\ ^1D_2$	$5s5p^3\ ^1D^\circ_2$	92TAU/JOS
673.187	0.005	148 547.1	60		$5s^25p^2\ ^3P_0$	$5s5p^3\ ^3D^\circ_1$	92TAU/JOS
739.049	0.005	135 309.1	60		$5s^25p^2\ ^3P_2$	$5s5p^3\ ^3D^\circ_3$	92TAU/JOS
740.038	0.005	135 128.2	62		$5s^25p^2\ ^3P_1$	$5s5p^3\ ^3D^\circ_2$	92TAU/JOS
751.651	0.005	133 040.5	2		$5s^25p^2\ ^3P_1$	$5s5p^3\ ^3D^\circ_1$	92TAU/JOS
752.305	0.005	132 924.8	25		$5s^25p^2\ ^1D_2$	$5s5p^3\ ^3P^\circ_2$	92TAU/JOS
774.386	0.005	129 134.6	5		$5s^25p^2\ ^3P_2$	$5s5p^3\ ^3D^\circ_2$	92TAU/JOS
787.102	0.005	127 048.3	25		$5s^25p^2\ ^3P_2$	$5s5p^3\ ^3D^\circ_1$	92TAU/JOS
874.940	0.005	114 293.5	50		$5s^25p^2\ ^1D_2$	$5s5p^3\ ^3D^\circ_3$	92TAU/JOS
881.833	0.005	113 400.2	5		$5s^25p^2\ ^1S_0$	$5s5p^3\ ^3P^\circ_1$	92TAU/JOS
924.902	0.005	108 119.6	8		$5s^25p^2\ ^1D_2$	$5s5p^3\ ^3D^\circ_2$	92TAU/JOS
937.590	0.005	106 656.4	40		$5s^25p^2\ ^3P_1$	$5s5p^3\ ^5S^\circ_2$	92TAU/JOS
943.096	0.005	106 033.7	10		$5s^25p^2\ ^1D_2$	$5s5p^3\ ^3D^\circ_1$	92TAU/JOS
993.416	0.005	100 662.8	40		$5s^25p^2\ ^3P_2$	$5s5p^3\ ^5S^\circ_2$	92TAU/JOS

TABLE 11. Energy levels of Ba VII

Configuration	Term	J	Energy (cm^{-1})	Unc. (cm^{-1})	Leading percentages	Reference
$5s^25p^2$	^3P	0	0.0		87% $5s^25p^2$ ^3P+13% $5s^25p^2$ ^1S	92TAU/JOS
	^3P	1	15 506.6	0.8	100% $5s^25p^2$ ^3P	92TAU/JOS
	^3P	2	21 499.2	0.8	59% $5s^25p^2$ ^3P+41% $5s^25p^2$ ^1D	92TAU/JOS
$5s^25p^2$	^1D	2	42 514.2	0.8	59% $5s^25p^2$ ^1D+41% $5s^25p^2$ ^3P	92TAU/JOS
$5s^25p^2$	^1S	0	61 082.5	0.8	87% $5s^25p^2$ ^1S+13% $5s^25p^2$ ^3P	92TAU/JOS
$5s5p^3$	$^3P^\circ$	0	172 476.7	0.8	94% $5s5p^3$ $^3P^\circ$+6% $5s^25p5d$ $^3P^\circ$	92TAU/JOS
$5s5p^3$	$^5S^\circ$	2	122 162.5	0.8	88% $5s5p^3$ $^5S^\circ$+10% $5s5p^3$ $^3P^\circ$	92TAU/JOS
$5s5p^3$	$^3D^\circ$	1	148 547.3	0.8	72% $5s5p^3$ $^3D^\circ$+15% $5s5p^3$ $^3P^\circ$+6% $5s^25p5d$ $^3D^\circ$	92TAU/JOS
	$^3D^\circ$	3	156 808.0	0.8	93% $5s5p^3$ $^3D^\circ$+7% $5s^25p5d$ $^3D^\circ$	92TAU/JOS
$5s5p^3$	$^3P^\circ$	1	174 483.4	0.8	73% $5s5p^3$ $^3P^\circ$+15% $5s5p^3$ $^3D^\circ$+6% $5s5p^3$ $^3S^\circ$	92TAU/JOS
	$^3P^\circ$	2	175 439.5	0.8	37% $5s5p^3$ $^3P^\circ$+27% $5s5p^3$ $^1D^\circ$+16% $5s5p^3$ $^3D^\circ$	92TAU/JOS
$5s5p^3$	$^1D^\circ$	2	192 270.5	1.	33% $5s5p^3$ $^1D^\circ$+31% $5s5p^3$ $^3P^\circ$+24% $5s^25p5d$ $^1D^\circ$	92TAU/JOS
$5s5p^3$	$^3S^\circ$	1	196 280.5	1.	60% $5s5p^3$ $^3S^\circ$+31% $5s5p^3$ $^1P^\circ$+5% $5s5p^3$ $^3P^\circ$	92TAU/JOS
$5s^25p5d$	$^3F^\circ$	2	206 668.	2.	87% $5s^25p5d$ $^3F^\circ$+9% $5s5p^3$ $^1D^\circ$	92TAU/JOS
	$^3F^\circ$	3	213 712.	2.	90% $5s^25p5d$ $^3F^\circ$+5% $5s^25p5d$ $^3D^\circ$	92TAU/JOS
	$^3F^\circ$	4	(228 093.)	2.	100% $5s^25p5d$ $^3F^\circ$	92TAU/JOS
$5s5p^3$	$^1P^\circ$	1	219 528.	2.	46% $5s5p^3$ $^1P^\circ$+29% $5s5p^3$ $^3S^\circ$+14% $5s^25p5d$ $^1P^\circ$	92TAU/JOS
$5s^25p5d$	$^3D^\circ$	2	223 820.	2.	22%+45% $5s^25p5d$ $^3P^\circ$+18% $5s^25p5d$ $^1D^\circ$	92TAU/JOS
	$^3D^\circ$	1	226 198.	2.	64%+16% $5s^25p5d$ $^3P^\circ$+6% $5s5p^3$ $^1P^\circ$	92TAU/JOS
	$^3D^\circ$	3	241 412.	2.	78%+9% $5s^25p5d$ $^3F^\circ$+7% $5s^25p5d$ $^1F^\circ$	92TAU/JOS
$5s^25p5d$	$^1D^\circ$	2	238 428.	2.	37%+39% $5s^25p5d$ $^3D^\circ$+13% $5s5p^3$ $^1D^\circ$	92TAU/JOS
$5s^25p5d$	$^3P^\circ$	0	242 672.	2.	94%+6% $5s5p^3$ $^3P^\circ$	92TAU/JOS
	$^3P^\circ$	1	243 933.	2.	70%+21% $5s^25p5d$ $^3D^\circ$+5% $5s5p^3$ $^3P^\circ$	92TAU/JOS
	$^3P^\circ$	2	246 030.	2.	47%+28% $5s^25p5d$ $^3D^\circ$+12% $5s^25p5d$ $^1D^\circ$	92TAU/JOS
$5s^25p5d$	$^1F^\circ$	3	258 404.	3.	89%+9% $5s^25p5d$ $^3D^\circ$	92TAU/JOS
$5s^25p5d$	$^1P^\circ$	1	264 607.	3.	78%+10% $5s5p^3$ $^1P^\circ$+7% $5s^25p5d$ $^3D^\circ$	92TAU/JOS
$5s^25p6s$	$^3P^\circ$	0	293 555.	4.	100%	92TAU/JOS
	$^3P^\circ$	1	294 884.	4.	75%+25% $5s^25p6s$ $^1P^\circ$	92TAU/JOS
	$^3P^\circ$	2	316 139.	4.	100%	92TAU/JOS
$5s^25p6s$	$^1P^\circ$	1	319 558.	4.	75%+25% $5s^25p6s$ $^3P^\circ$	92TAU/JOS
Ba VIII ($5s^25p$ $^2P^\circ_{1/2}$)	*Limit*	—	694 000			04ROD/IND

6.6. Ba VIII

In isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^25p$ $^2P^\circ_{1/2}$
Ionization energy (815 000 cm^{-1}); (101 eV)

The Ba VIII spectrum was first observed by Kaufman and Sugar [87KAU/SUG], who classified 12 lines between 300 and 760 Å. Tauheed *et al.* [92TAU/JOS2] reported four intercombination lines involving the $5s5p^2$ ^4P levels. Churilov *et al.* [01CHU/JOS] remeasured the spectrum, extending the range to 1120 Å. They did a complete reanalysis and reported 139 classified lines and 74 levels. The line reported at 952.6 Å by Tauheed *et al.* [92TAU/JOS2] and several of the lines observed by Kaufman and Sugar [87KAU/SUG] were not confirmed by Churilov *et al.* [01CHU/JOS], who indicated that they most likely belong to other ionization stages. All the wavelength and energy level data in Tables 12 and 13 are taken from Churilov *et al.* [01CHU/JOS]. The ionization energy reported above was calculated by Rodrigues *et al.* [04ROD/IND] using the Dirac–Fock approximation.

The transition probabilities given were calculated by Churilov *et al.* [01CHU/JOS] using the method described by Cowan [81COW]. Calculations of the energy levels produced the leading percentages given in Table 13. There is considerable configuration mixing within the $5p^3$, the $5s5p(^3P^\circ)4f$, and the $5s5p(^3P^\circ)5d$ configurations. In order to have unique names for all levels, names had to be assigned to a few of them which do not correspond to the largest component.

6.6.1. References for Ba VIII

81COW R. D. Cowan, *The Theory of Atomic Structure and Spectra* (University California, Berkeley, CA, 1981).

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TABLE 12. Observed spectral lines of Ba VIII

λ (Å)	Unc. (Å)	σ (cm⁻¹)	Int.	Line Code	A_{ki} (s⁻¹)	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
Vacuum									
304.507	0.005	328 400	50		1.22E+10	$5s5p^2\ ^4P_{5/2}$	$5s5p(^3P^\circ)6s\ ^4P^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
306.407	0.005	326 363	70		1.27E+10	$5s^25p\ ^2P^\circ_{1/2}$	$5s^26s\ ^2S_{1/2}$	01CHU/JOS	01CHU/JOS
318.690	0.005	313 785	25		1.58E+10	$5s5p^2\ ^4P_{3/2}$	$5s5p(^3P^\circ)6s\ ^4P^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
320.750	0.005	311 769	60		1.20E+9	$5s^25p\ ^2P^\circ_{1/2}$	$5s5p(^1P^\circ)4f\ ^2D_{3/2}$	01CHU/JOS	01CHU/JOS
322.197	0.005	310 369	30		1.03E+10	$5s5p^2\ ^4P_{5/2}$	$5s5p(^3P^\circ)6s\ ^4P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
323.843	0.005	308 791	50		2.08E+10	$5s5p^2\ ^2D_{5/2}$	$5s5p(^3P^\circ)6s\ ^2P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
330.287	0.005	302 767	109		2.04E+10	$5s^25p\ ^2P^\circ_{3/2}$	$5s^26s\ ^2S_{1/2}$	01CHU/JOS	01CHU/JOS
344.676	0.005	290 127	56		2.07E+9	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p(^1P^\circ)4f\ ^2D_{5/2}$	01CHU/JOS	01CHU/JOS
345.799	0.005	289 185	58		1.30E+9	$5s^25p\ ^2P^\circ_{1/2}$	$5s5p(^3P^\circ)4f\ ^2D_{3/2}$	01CHU/JOS	01CHU/JOS
363.856	0.005	274 834	50		7.5E+7	$5s^25p\ ^2P^\circ_{1/2}$	$5s5p(^3P^\circ)4f\ ^4D_{3/2}$	01CHU/JOS	01CHU/JOS
376.517	0.005	265 592	52		3.2E+8	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p(^3P^\circ)4f\ ^2D_{3/2}$	01CHU/JOS	01CHU/JOS
388.308	0.005	257 527	184		6.5E+8	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p(^3P^\circ)4f\ ^2D_{5/2}$	01CHU/JOS	01CHU/JOS
399.366	0.005	250 397	299		1.48E+9	$5s^25p\ ^2P^\circ_{1/2}$	$5s5p(^3P^\circ)4f\ ^4F_{3/2}$	01CHU/JOS	01CHU/JOS
402.180	0.005	248 645	138		2.0E+8	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p(^3P^\circ)4f\ ^4D_{5/2}$	01CHU/JOS	01CHU/JOS
409.358	0.005	244 285	151		2.00E+9	$5s5p^2\ ^4P_{5/2}$	$5s5p(^3P^\circ)5d\ ^2F^\circ_{7/2}$	01CHU/JOS	01CHU/JOS
417.185	0.005	239 702	137		2.42E+10	$5s5p^2\ ^2D_{3/2}$	$5s5p(^1P^\circ)5d\ ^2F^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
419.816	0.005	238 200	266		1.60E+10	$5s5p^2\ ^4P_{3/2}$	$5s5p(^3P^\circ)5d\ ^4P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
421.444	0.005	237 280	232		2.80E+10	$5s5p^2\ ^4P_{3/2}$	$5s5p(^3P^\circ)5d\ ^4P^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
427.114	0.005	234 129	379		4.5E+8	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p(^3P^\circ)4f\ ^2F_{5/2}$	01CHU/JOS	01CHU/JOS
428.852	0.005	233 181	267		4.03E+10	$5s5p^2\ ^4P_{1/2}$	$5s5p(^3P^\circ)5d\ ^4D^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
430.811	0.005	232 120	384		2.53E+10	$5s5p^2\ ^4P_{1/2}$	$5s5p(^3P^\circ)5d\ ^4D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
433.334	0.005	230 769	300		1.96E+10	$5s5p^2\ ^2D_{5/2}$	$5s5p(^1P^\circ)5d\ ^2F^\circ_{7/2}$	01CHU/JOS	01CHU/JOS
433.993	0.005	230 418	755		2.62E+10	$5s^25p\ ^2P^\circ_{1/2}$	$5s^25d\ ^2D_{3/2}$	01CHU/JOS	01CHU/JOS
434.649	0.005	230 071	183		3.73E+9	$5s5p^2\ ^4P_{3/2}$	$5s5p(^3P^\circ)5d\ ^2F^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
436.670	0.005	229 006	43		8.75E+9	$5s5p^2\ ^4P_{5/2}$	$5s5p(^3P^\circ)5d\ ^4P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
437.253	0.005	228 701	360		1.84E+10	$5s5p^2\ ^2P_{1/2}$	$5s5p(^1P^\circ)5d\ ^2P^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
439.984	0.005	227 281	239		9.33E+8	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p(^3P^\circ)4f\ ^4F_{5/2}$	01CHU/JOS	01CHU/JOS
440.130	0.005	227 206	615		2.15E+10	$5s5p^2\ ^4P_{5/2}$	$5s5p(^3P^\circ)5d\ ^4D^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
440.901	0.005	226 808	75		3.5E+8	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p(^3P^\circ)4f\ ^4F_{3/2}$	01CHU/JOS	01CHU/JOS
441.558	0.005	226 471	264		3.31E+10	$5s5p^2\ ^4P_{5/2}$	$5s5p(^3P^\circ)5d\ ^4D^\circ_{7/2}$	01CHU/JOS	01CHU/JOS
453.009	0.005	220 746	146		2.2E+9	$5s5p^2\ ^2D_{3/2}$	$5s^26p\ ^2P^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
453.414	0.005	220 549	46		1.2E+9	$5s5p^2\ ^4P_{3/2}$	$5s5p(^3P^\circ)5d\ ^4D^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
454.457	0.005	220 043	212		3.7E+8	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p(^3P^\circ)4f\ ^4G_{5/2}$	01CHU/JOS	01CHU/JOS
455.603	0.005	219 489	262		6.05E+9	$5s5p^2\ ^4P_{3/2}$	$5s5p(^3P^\circ)5d\ ^4D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
459.629	0.005	217 567	803	b	1.88E+10	$5s5p^2\ ^4P_{3/2}$	$5s5p(^3P^\circ)5d\ ^4P^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
462.441	0.005	216 244	174		8.89E+9	$5s5p^2\ ^2D_{5/2}$	$5s5p(^3P^\circ)5d\ ^2F^\circ_{7/2}$	01CHU/JOS	01CHU/JOS
466.732	0.005	214 256	423		1.35E+10	$5s5p^2\ ^2P_{1/2}$	$5s^26p\ ^2P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
474.202	0.005	210 881	339		1.48E+10	$5s5p^2\ ^2P_{1/2}$	$5s5p(^3P^\circ)5d\ ^2P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
475.122	0.005	210 472	850		2.56E+10	$5s^25p\ ^2P^\circ_{3/2}$	$5s^25d\ ^2D_{5/2}$	01CHU/JOS	01CHU/JOS
475.507	0.005	210 302	108		4.8E+8	$5s5p^2\ ^4P_{5/2}$	$5s5p(^3P^\circ)5d\ ^4D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
478.844	0.005	208 836	203		3.97E+10	$5s^25d\ ^2D_{3/2}$	$5s^25f\ ^2F^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
479.519	0.005	208 542	263		1.10E+10	$5s5p^2\ ^2S_{1/2}$	$5s5p(^1P^\circ)5d\ ^2P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
479.909	0.005	208 373	267		3.68E+9	$5s5p^2\ ^4P_{5/2}$	$5s5p(^3P^\circ)5d\ ^4P^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
483.505	0.005	206 823	368	m	6.18E+9	$5s^25p\ ^2P^\circ_{3/2}$	$5s^25d\ ^2D_{3/2}$	01CHU/JOS	01CHU/JOS

TABLE 12. Observed spectral lines of Ba VIII—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
486.475	0.005	205 560	156		1.84E+10	$5s5p^2\ ^2D_{5/2}$	$5s5p(^3P^\circ)5d\ ^2D^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
487.122	0.005	205 287	357		4.05E+10	$5s^25d\ ^2D_{5/2}$	$5s^25f\ ^2F^\circ_{7/2}$	01CHU/JOS	01CHU/JOS
487.358	0.005	205 188	72		2.98E+9	$5s^25d\ ^2D_{5/2}$	$5s^25f\ ^2F^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
491.347	0.005	203 522	779		1.46E+10	$5s5p^2\ ^2D_{3/2}$	$5s5p(^3P^\circ)5d\ ^2D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
492.030	0.005	203 240	287		1.28E+10	$5s5p^2\ ^2P_{3/2}$	$5s5p(^1P^\circ)5d\ ^2D^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
492.499	0.005	203 046	98		8.00E+9	$5s5p^2\ ^2P_{3/2}$	$5s5p(^1P^\circ)5d\ ^2P^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
494.123	0.005	202 379	272		1.12E+10	$5s5p^2\ ^2S_{1/2}$	$5s5p(^1P^\circ)5d\ ^2D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
494.258	0.005	202 323	611	b	9.2E+8	$5s5p^2\ ^4P_{3/2}$	$5s5p(^3P^\circ)5d\ ^4F^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
497.267	0.005	201 099	259		2.94E+9	$5s5p^2\ ^4P_{5/2}$	$5s5p(^3P^\circ)5d\ ^4F^\circ_{7/2}$	01CHU/JOS	01CHU/JOS
497.761	0.005	200 900	292		1.06E+10	$5s5p^2\ ^2D_{3/2}$	$5s5p(^3P^\circ)5d\ ^2F^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
499.452	0.005	200 220	575		4.93E+9	$5s^25p\ ^2P^\circ_{1/2}$	$5s5p^2\ ^2P_{3/2}$	01CHU/JOS	01CHU/JOS
502.467	0.005	199 018	258		1.1E+9	$5s^25p\ ^2P^\circ_{1/2}$	$5s5p^2\ ^2S_{1/2}$	01CHU/JOS	01CHU/JOS
502.986	0.005	198 813	305		2.17E+10	$5s5p^2\ ^2S_{1/2}$	$5s5p(^3P^\circ)5d\ ^2P^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
503.949	0.005	198 433	462	b	1.98E+9	$5s5p^2\ ^2D_{5/2}$	$5s5p(^3P^\circ)5d\ ^4D^\circ_{7/2}$	01CHU/JOS	01CHU/JOS
504.496	0.005	198 218	198		6.0E+8	$5s5p^2\ ^4P_{3/2}$	$5s5p(^3P^\circ)5d\ ^4F^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
517.766	0.005	193 138	382		9.7E+8	$5s5p^2\ ^4P_{5/2}$	$5s5p(^3P)5d\ ^4F^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
525.436	0.005	190 318	157		2.08E+9	$5s5p^2\ ^2D_{3/2}$	$5s5p(^3P^\circ)5d\ ^4D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
530.818	0.005	188 388	186		3.8E+8	$5s5p^2\ ^2D_{3/2}$	$5s5p(^3P^\circ)5d\ ^4P^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
534.925	0.005	186 942	138		2.18E+9	$5s5p^2\ ^4P_{1/2}$	$5p^3\ ^4S^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
535.648	0.005	186 690	295		4.68E+9	$5s5p^2\ ^2P_{1/2}$	$5s5p(^3P^\circ)5d\ ^2D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
554.521	0.005	180 336	868	b	1.82E+9	$5s5p^2\ ^2D_{5/2}$	$5s5p(^3P^\circ)5d\ ^4P^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
557.375	0.005	179 412	255		1.74E+10	$5s^26s\ ^2S_{1/2}$	$5s5p(^1P^\circ)6s\ ^2P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
559.562	0.005	178 711	245		1.74E+10	$5s^26s\ ^2S_{1/2}$	$5s5p(^1P^\circ)6s\ ^2P^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
566.162	0.005	176 628	732		1.87E+10	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p^2\ ^2P_{3/2}$	01CHU/JOS	01CHU/JOS
567.106	0.005	176 334	146		6.8E+8	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^1P^\circ)4f\ ^2D_{5/2}$	01CHU/JOS	01CHU/JOS
570.058	0.005	175 421	604		1.19E+10	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p^2\ ^2S_{1/2}$	01CHU/JOS	01CHU/JOS
571.289	0.005	175 043	552		1.45E+10	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^1P^\circ)4f\ ^2D_{5/2}$	01CHU/JOS	01CHU/JOS
572.864	0.005	174 562	668		1.66E+10	$5s^25p\ ^2P^\circ_{1/2}$	$5s5p^2\ ^2P_{1/2}$	01CHU/JOS	01CHU/JOS
573.438	0.005	174 387	482		1.50E+10	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^1P^\circ)4f\ ^2D_{3/2}$	01CHU/JOS	01CHU/JOS
573.686	0.005	174 312	192		5.20E+9	$5s5p^2\ ^4P_{3/2}$	$5p^3\ ^4S^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
576.379	0.005	173 497	305		1.38E+10	$5s^25d\ ^2D_{5/2}$	$5s5p(^1P^\circ)5d\ ^2P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
578.287	0.005	172 925	370	b	2.45E+9	$5s5p^2\ ^4P_{1/2}$	$5p^3\ ^2D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
578.526	0.005	172 853	118		1.41E+10	$5s^25d\ ^2D_{3/2}$	$5s5p(^1P^\circ)5d\ ^2P^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
578.615	0.005	172 827	247		5.10E+9	$5s5p^2\ ^2D_{5/2}$	$5p^3\ ^2P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
584.874	0.005	170 977	71		6.85E+9	$5s^25d\ ^2D_{3/2}$	$5s5p(^1P^\circ)5d\ ^2D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
590.314	0.005	169 401	118		5.33E+9	$5s^25d\ ^2D_{5/2}$	$5s5p(^1P^\circ)5d\ ^2D^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
591.568	0.005	169 042	138		5.8E+8	$5s5p^2\ ^2D_{3/2}$	$5s5p(^3P^\circ)5d\ ^4F^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
592.510	0.005	168 773	582		9.00E+9	$5s5p^2\ ^2D_{3/2}$	$5p^3\ ^2P^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
596.219	0.005	167 724	691		9.29E+9	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^1P^\circ)4f\ ^2G_{7/2}$	01CHU/JOS	01CHU/JOS
598.733	0.005	167 019	278		5.12E+9	$5s^25d\ ^2D_{3/2}$	$5s5p(^1P^\circ)5d\ ^2F^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
600.720	0.005	166 467	180		7.7E+8	$5s5p^2\ ^4P_{5/2}$	$5p^3\ ^2D^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
600.825	0.005	166 438	310	b	1.35E+9	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^1P^\circ)4f\ ^2G_{7/2}$	01CHU/JOS	01CHU/JOS
602.666	0.005	165 929	410		1.11E+10	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^1P^\circ)4f\ ^2G_{9/2}$	01CHU/JOS	01CHU/JOS
605.617	0.005	165 121	238		3.73E+9	$5s5p^2\ ^4P_{5/2}$	$5p^3\ ^4S^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
612.456	0.005	163 277	300		1.56E+9	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^1P^\circ)4f\ ^2F_{7/2}$	01CHU/JOS	01CHU/JOS
617.322	0.005	161 990	631	*	1.01E+10	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^1P^\circ)4f\ ^2F_{5/2}$	01CHU/JOS	01CHU/JOS
617.322	0.005	161 990	631	*	9.34E+9	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^1P^\circ)4f\ ^2F_{7/2}$	01CHU/JOS	01CHU/JOS
622.258	0.005	160 705	122		4.0E+8	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^1P^\circ)4f\ ^2F_{5/2}$	01CHU/JOS	01CHU/JOS
623.859	0.005	160 293	245		2.23E+9	$5s5p^2\ ^4P_{3/2}$	$5p^3\ ^2D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
634.008	0.005	157 727	690	b	3.15E+9	$5s^25p\ ^2P^\circ_{1/2}$	$5s5p^2\ ^2D_{3/2}$	01CHU/JOS	01CHU/JOS
645.037	0.005	155 030	57		2.00E+9	$5s^25d\ ^2D_{3/2}$	$5s5p(^3P^\circ)5d\ ^2P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
646.174	0.005	154 757	78		4.50E+9	$5s^25d\ ^2D_{5/2}$	$5s^26p\ ^2P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
661.790	0.005	151 105	402		5.03E+9	$5s5p^2\ ^4P_{5/2}$	$5p^3\ ^2D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
662.366	0.005	150 974	281		7.5E+8	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p^2\ ^2P_{1/2}$	01CHU/JOS	01CHU/JOS
675.428	0.005	148 054	273		3.6E+9	$5s^25d\ ^2D_{3/2}$	$5s^26p\ ^2P^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
675.853	0.005	147 961	79		1.30E+9	$5s^25d\ ^2D_{5/2}$	$5s5p(^3P^\circ)5d\ ^2F^\circ_{7/2}$	01CHU/JOS	01CHU/JOS
682.008	0.005	146 626	166		5.9E+8	$5s5p(^3P^\circ)4f\ ^4D_{7/2}$	$5s5p(^1P^\circ)5d\ ^2F^\circ_{7/2}$	01CHU/JOS	01CHU/JOS

TABLE 12. Observed spectral lines of Ba VIII—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
687.951	0.005	145 359	133		1.0E+7	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^3P^\circ)4f\ ^2G_{9/2}$	01CHU/JOS	01CHU/JOS
695.738	0.005	143 732	191		5.5E+8	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^3P^\circ)4f\ ^2D_{5/2}$	01CHU/JOS	01CHU/JOS
703.301	0.005	142 187	656		1.27E+9	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p^2\ ^2D_{5/2}$	01CHU/JOS	01CHU/JOS
722.392	0.005	138 429	276		2.28E+9	$5s5p^2\ ^2D_{5/2}$	$5p^3\ ^2D^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
722.633	0.005	138 383	237		3.15E+9	$5s5p^2\ ^2P_{3/2}$	$5p^3\ ^2P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
724.480	0.005	138 030	48		7.5E+7	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^3P^\circ)4f\ ^2G_{7/2}$	01CHU/JOS	01CHU/JOS
727.516	0.005	137 454	65		2.5E+7	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^3P^\circ)4f\ ^4D_{3/2}$	01CHU/JOS	01CHU/JOS
729.466	0.005	137 087	154		1.35E+9	$5s5p^2\ ^2D_{5/2}$	$5p^3\ ^4S^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
731.296	0.005	136 744	227		2.2E+8	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^3P^\circ)4f\ ^2G_{7/2}$	01CHU/JOS	01CHU/JOS
741.557	0.005	134 851	80		1.0E+8	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^3P^\circ)4f\ ^4D_{5/2}$	01CHU/JOS	01CHU/JOS
745.513	0.005	134 136	107		7.5E+7	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p^2\ ^2D_{3/2}$	01CHU/JOS	01CHU/JOS
757.683	0.005	131 981	49		1.2E+7	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^3P^\circ)4f\ ^4F_{7/2}$	01CHU/JOS	01CHU/JOS
762.676	0.005	131 117	132		8.0E+8	$5s5p^2\ ^2D_{3/2}$	$5p^3\ ^2D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
765.143	0.005	130 695	560		1.5E+8	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^3P^\circ)4f\ ^4F_{7/2}$	01CHU/JOS	01CHU/JOS
784.405	0.005	127 485	193		2.6E+9	$5s5p^2\ ^2S_{1/2}$	$5p^3\ ^2P^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
812.556	0.005	123 068	38		2.2E+8	$5s5p^2\ ^2D_{5/2}$	$5p^3\ ^2D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
817.317	0.005	122 352	94		1.0E+8	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^3P^\circ)4f\ ^2F_{7/2}$	01CHU/JOS	01CHU/JOS
826.026	0.005	121 062	152		1.6E+8	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^3P^\circ)4f\ ^2F_{7/2}$	01CHU/JOS	01CHU/JOS
840.010	0.005	119 046	39		5.E+7	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^3P^\circ)4f\ ^2F_{5/2}$	01CHU/JOS	01CHU/JOS
862.647	0.005	115 922	249		2.5E+8	$5s^25p\ ^2P^\circ_{1/2}$	$5s5p^2\ ^4P_{1/2}$	01CHU/JOS	01CHU/JOS
875.020	0.005	114 283	314		7.0E+8	$5s5p^2\ ^2P_{1/2}$	$5p^3\ ^2D^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
876.055	0.005	114 148	428		2.2E+8	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p^2\ ^4P_{5/2}$	01CHU/JOS	01CHU/JOS
881.176	0.005	113 485	92		1.5E+8	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^3P^\circ)4f\ ^4F_{5/2}$	01CHU/JOS	01CHU/JOS
884.845	0.005	113 014	121		2.0E+8	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^3P^\circ)4f\ ^4F_{3/2}$	01CHU/JOS	01CHU/JOS
888.622	0.005	112 534	118		1.1E+8	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^3P^\circ)4f\ ^4D_{7/2}$	01CHU/JOS	01CHU/JOS
890.994	0.005	112 234	63		1.3E+8	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^3P^\circ)4f\ ^4G_{9/2}$	01CHU/JOS	01CHU/JOS
891.294	0.005	112 196	103		1.2E+8	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^3P^\circ)4f\ ^4F_{5/2}$	01CHU/JOS	01CHU/JOS
898.970	0.005	111 238	615	b	1.2E+8	$5s^24f\ ^2F^\circ_{7/2}$	$5s5p(^3P^\circ)4f\ ^4D_{7/2}$	01CHU/JOS	01CHU/JOS
921.758	0.005	108 488	365		5.0E+7	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^3P^\circ)4f\ ^4G_{7/2}$	01CHU/JOS	01CHU/JOS
941.156	0.005	106 252	100		5.0E+7	$5s^24f\ ^2F^\circ_{5/2}$	$5s5p(^3P^\circ)4f\ ^4G_{5/2}$	01CHU/JOS	01CHU/JOS
952.758	0.005	104 958	89		2.5E+7	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p^2\ ^4P_{3/2}$	01CHU/JOS	01CHU/JOS
961.646	0.005	103 988	195		6.8E+8	$5s5p^2\ ^2P_{3/2}$	$5p^3\ ^2D^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
997.587	0.005	100 242	30		1.0E+8	$5s5p(^3P^\circ)4f\ ^4G_{7/2}$	$5s5p(^3P^\circ)5d\ ^4P^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
1013.120	0.005	98 705	90		6.0E+8	$5s5p(^3P^\circ)4f\ ^4F_{3/2}$	$5s5p(^3P^\circ)5d\ ^4D^\circ_{1/2}$	01CHU/JOS	01CHU/JOS
1039.553	0.005	96 195	37		3.0E+8	$5s5p(^3P^\circ)4f\ ^4D_{7/2}$	$5s5p(^3P^\circ)5d\ ^4P^\circ_{5/2}$	01CHU/JOS	01CHU/JOS
1048.343	0.005	95 389	86		2.0E+8	$5s^24f\ ^2F^\circ_{7/2}$	$5s^25d\ ^2D_{5/2}$	01CHU/JOS	01CHU/JOS
1074.920	0.005	93 030	128		1.5E+8	$5s^24f\ ^2F^\circ_{5/2}$	$5s^25d\ ^2D_{3/2}$	01CHU/JOS	01CHU/JOS
1083.068	0.005	92 330	27		5.0E+7	$5s^25p\ ^2P^\circ_{3/2}$	$5s5p^2\ ^4P_{1/2}$	01CHU/JOS	01CHU/JOS
1101.855	0.005	90 756	24		5.0E+7	$5s5p(^3P^\circ)4f\ ^4D_{1/2}$	$5s5p(^3P^\circ)5d\ ^4P^\circ_{3/2}$	01CHU/JOS	01CHU/JOS
1113.144	0.005	89 836	152		3.0E+8	$5s5p(^3P^\circ)4f\ ^4D_{1/2}$	$5s5p(^3P^\circ)5d\ ^4P^\circ_{1/2}$	01CHU/JOS	01CHU/JOS

TABLE 13. Energy levels of Ba VIII

Configuration	Term	J	Energy (cm^{-1})	Unc. (cm^{-1})	Leading percentages	Reference
$5s^25p$	$^2P^\circ$	1/2	0		99%	01CHU/JOS
	$^2P^\circ$	3/2	23 592	1.0	99%	01CHU/JOS
$5s5p^2$	^4P	1/2	115 922	1.5	91%+7% $5s5p^2\ ^2S$	01CHU/JOS
	^4P	3/2	128 550	1.5	98%	01CHU/JOS
	^4P	5/2	137 739	1.5	81%+18% $5s5p^2\ ^2D$	01CHU/JOS
$5s^24f$	$^2F^\circ$	5/2	137 385	1.5	98%	01CHU/JOS
	$^2F^\circ$	7/2	138 675	1.5	98%	01CHU/JOS

Table 13. Energy levels of Ba VIII—Continued

Configuration	Term	J	Energy (cm^{-1})	Unc. (cm^{-1})	Leading percentages	Reference
$5s5p^2$	^2D	3/2	157 727	1.5	85%+7% $5s5p^2$ ^2P+6% $5s^25d$ ^2D	01CHU/JOS
	^2D	5/2	165 778	1.5	74%+18% $5s5p^2$ ^4P+6% $5s^25d$ ^2D	01CHU/JOS
$5s5p^2$	^2P	1/2	174 563	1.5	67%+27% $5s5p^2$ ^2S+6% $5s5p^2$ ^4P	01CHU/JOS
	^2P	3/2	200 220	1.5	92%+5% $5s5p^2$ ^2D	01CHU/JOS
$5s5p^2$	^2S	1/2	199 015	1.5	65%+32% $5s5p^2$ ^2P	01CHU/JOS
$5s^25d$	^2D	3/2	230 416	1.5	84%+7% $5s5p(^1P°)4f$ ^2D+6% $5s5p^2$ ^2D	01CHU/JOS
	^2D	5/2	234 064	1.5	85%+6% $5s5p(^1P°)4f$ ^2D+5% ^2D+5% ^2D	01CHU/JOS
$5s5p(^3P°)4f$	^4G	5/2	243 636	1.5	70%+16% $5s5p(^3P°)4f$ ^4F+7% $5s5p(^1P°)4f$ ^2F	01CHU/JOS
	^4G	7/2	245 873	1.5	50%+40% $5s5p(^3P°)4f$ ^4F+7% $5s5p(^3P°)4f$ ^4D	01CHU/JOS
	^4G	9/2	(268 188)	1.5	51%+49% $5s5p(^3P°)4f$ ^4F	01CHU/JOS
	^4G	11/2	(270 087)	1.5	100%	01CHU/JOS
$5s5p(^3P°)4f$	^4D	7/2	249 919	1.5	29%+24% $5s5p(^1P°)4f$ ^2F +18% $5s5p(^3P°)4f$ ^2F	01CHU/JOS
	^4D	5/2	272 237	1.5	61%+27% $5s5p(^3P°)4f$ ^4F	01CHU/JOS
	^4D	3/2	274 837	1.5	88%+10% $5s5p(^3P°)4f$ ^4F	01CHU/JOS
	^4D	1/2	275 994	1.5	100%	01CHU/JOS
$5s5p(^3P°)4f$	^4F	3/2	250 399	1.5	84%+7% $5s5p(^3P°)4f$ ^4D	01CHU/JOS
	^4F	9/2	250 909	1.5	47%+45% $5s5p(^3P°)4f$ ^4G+8% $5s5p(^1P°)4f$ ^2G	01CHU/JOS
	^4F	5/2	250 871	1.5	51%+20% $5s5p(^3P°)4f$ ^4D+11% $5s5p(^1P°)4f$ ^2F	01CHU/JOS
	^4F	7/2	269 368	1.5	40%+27% $5s5p(^3P°)4f$ ^4D+18% $5s5p(^3P°)4f$ ^4G	01CHU/JOS
$5s5p(^3P°)4f$	^2F	5/2	257 721	1.5	51%+19% $5s5p(^3P°)4f$ ^2D+17% $5s5p(^3P°)4f$ ^4G	01CHU/JOS
	^2F	7/2	259 737	1.5	26%+38% $5s5p(^3P°)4f$ ^2G+13% $5s5p(^3P°)4f$ ^4G	01CHU/JOS
$5s5p(^3P°)4f$	^2G	7/2	275 417	1.5	35%+22% $5s5p(^3P°)4f$ ^4D+17% $5s5p(^3P°)4f$ ^2F	01CHU/JOS
	^2G	9/2	284 034	1.5	72%+24% $5s5p(^1P°)4f$ ^2G	01CHU/JOS
$5s5p(^3P°)4f$	^2D	5/2	281 118	1.5	50%+20% $5s5p(^1P°)4f$ ^2F+14% $5s5p(^3P°)4f$ ^4D	01CHU/JOS
	^2D	3/2	289 185	1.5	66%+26% $5s5p(^1P°)4f$ ^2D	01CHU/JOS
$5p^3$	$^2D°$	3/2	288 845	1.5	30%+36% $5p^3$ $^4S°$+25% $5p^3$ $^2P°$	01CHU/JOS
	$^2D°$	5/2	304 207	1.5	79%+19% $5s5p(^3P°)5d$ $^2D°$	01CHU/JOS
$5s5p(^1P°)4f$	^2F	5/2	299 380	1.5	53%+33% $5s5p(^3P°)4f$ ^2F+10% $5s5p(^3P°)4f$ ^2D	01CHU/JOS
	^2F	7/2	300 662	1.5	51%+38% $5s5p(^3P°)4f$ ^2F+6% $5s5p(^3P°)4f$ ^2G	01CHU/JOS
$5p^3$	$^4S°$	3/2	302 663	1.5	52%+37% $5p^3$ $^2D°$+10% $5s5p(^3P°)5d$ $^2D°$	01CHU/JOS
$5s5p(^1P°)4f$	^2G	9/2	305 192	1.5	68%+28% $5s5p(^3P°)4f$ ^2G	01CHU/JOS
	^2G	7/2	305 109	1.5	89%+6% $5s5p(^3P°)4f$ ^2G	01CHU/JOS
$5s5p(^1P°)4f$	^2D	3/2	311 771	1.5	62%+32% $5s5p(^3P°)4f$ ^2D	01CHU/JOS
	^2D	5/2	313 718	1.5	79%+14% $5s5p(^3P°)4f$ ^2D	01CHU/JOS
$5s^26s$	^2S	1/2	326 361	1.5	99%	01CHU/JOS
$5p^3$	$^2P°$	1/2	326 500	1.5	89%+8% $5s5p(^3P°)5d$ $^2P°$	01CHU/JOS
	$^2P°$	3/2	338 604	1.5	57%+11% $5p^3$ ^4S+10% $5p^3$ $^2D°$	01CHU/JOS
$5s5p(^3P°)5d$	$^4F°$	3/2	326 769	1.5	91%	01CHU/JOS
	$^4F°$	5/2	330 877	1.5	89%	01CHU/JOS
	$^4F°$	7/2	338 839	1.5	87%+8% $5s5p(^3P°)5d$ $^4D°$	01CHU/JOS
	$^4F°$	9/2	(352 530)	1.5	99%	01CHU/JOS
$5s5p(^3P°)5d$	$^4P°$	5/2	346 114	1.5	52%+24% $5s5p(^3P°)5d$ $^4D°$+11% $5s5p(^3P°)5d$ $^2D°$	01CHU/JOS
	$^4P°$	1/2	365 830	1.5	90%+9% $5s5p(^3P°)5d$ $^4D°$	01CHU/JOS
	$^4P°$	3/2	366 749	1.5	65%+28% $5s5p(^3P°)5d$ $^4D°$	01CHU/JOS
$5s5p(^3P°)5d$	$^4D°$	3/2	348 042	1.5	57%+29% $5s5p(^3P°)5d$ $^4P°$	01CHU/JOS
	$^4D°$	1/2	349 103	1.5	83%+8% $5s5p(^3P°)5d$ $^4P°$	01CHU/JOS
	$^4D°$	7/2	364 211	1.5	85%+10% $5s5p(^3P°)5d$ $^4F°$	01CHU/JOS
	$^4D°$	5/2	364 946	1.5	54%+15% $5s5p(^3P°)5d$ $^4P°$+12% $5s5p(^3P°)5d$ $^2F°$	01CHU/JOS

TABLE 13. Energy levels of Ba VIII—Continued

Configuration	Term	J	Energy (cm^{-1})	Unc. (cm^{-1})	Leading percentages	Reference
$5s5p(^3P°)5d$	$^2F°$	5/2	358 624	1.5	34%+20% $5s5p(^1P°)5d$ $^2F°$+15% $5s5p(^3P°)5d$ $^2D°$	01CHU/JOS
	$^2F°$	7/2	382 024	1.5	54%+35% $5s5p(^1P°)5d$ $^2F°$+6% $4f5p^2$ $^2F°$	01CHU/JOS
$5s5p(^3P°)5d$	$^2D°$	3/2	361 250	1.5	54%+11% $5p^3$ $^2D°$+8% $5s5p(^3P°)5d$ $^4D°$	01CHU/JOS
	$^2D°$	5/2	371 338	1.5	29%+28% $5s5p(^3P°)5d$ $^4P°$+12% $5s5p(^3P°)5d$ $^2F°$	01CHU/JOS
$5s^26p$	$^2P°$	1/2	378 471	1.5	97%	01CHU/JOS
	$^2P°$	3/2	388 820	1.5	63%+15% $5s5p(^1P°)5d$ $^2D°$+13% $5s5p(^3P°)5d$ $^2P°$	01CHU/JOS
$5s5p(^3P°)5d$	$^2P°$	3/2	385 445	1.5	28%+33% $5s^26p$ $^2P°$+23% $5s5p(^1P°)5d$ $^2D°$	01CHU/JOS
	$^2P°$	1/2	397 828	1.5	72%+10% $5s5p(^1P°)5d$ $^2P°$+5% $5s4f5d$ $^2P°$	01CHU/JOS
$5s5p(^1P°)5d$	$^2F°$	7/2	396 547	1.5	40%+24% $5s5p(^3P°)5d$ $^2F°$+9% $5s^25f$ $^2F°$	01CHU/JOS
	$^2F°$	5/2	397 433	1.5	40%+18% $5s5p(^3P°)5d$ $^2F°$+14% $4f5p^2$ $^4G°$	01CHU/JOS
$5s5p(^1P°)5d$	$^2D°$	3/2	401 393	1.5	29%+24% $5s5p(^3P°)5d$ $^2P°$+14% $4f5p^2$ $^2D°$	01CHU/JOS
	$^2D°$	5/2	403 463	1.5	27%+22% $4f5p^2$ 4G°+14% $4f5p^2$ $^2D°$	01CHU/JOS
$5s5p(^1P°)5d$	$^2P°$	1/2	403 267	1.5	68%+17% $4f5p^2$ $^2P°$	01CHU/JOS
	$^2P°$	3/2	407 558	1.5	76%+10% $4f5p^2$ $^2P°$	01CHU/JOS
$5s^25f$	$^2F°$	5/2	439 252	1.5	84%+11% $5s5p(^1P°)5d$ $^2F°$	01CHU/JOS
	$^2F°$	7/2	439 351	1.5	86%+10% $5s5p(^1P°)5d$ $^2F°$	01CHU/JOS
$5s5p(^3P°)6s$	$^4P°$	1/2	442 336	1.5	94%+5% $5s5p(^3P°)6s$ $^2P°$	01CHU/JOS
	$^4P°$	3/2	448 109	1.5	86%+8% $5s5p(^3P°)6s$ $^2P°$	01CHU/JOS
	$^4P°$	5/2	466 140	1.5	98%	01CHU/JOS
$5s5p(^3P°)6s$	$^2P°$	1/2	(455 913)	1.5	91%	01CHU/JOS
	$^2P°$	3/2	474 569	1.5	87%+9% $5s5p(^3P°)6s$ $^4P°$	01CHU/JOS
$5s5p(^1P°)6s$	$^2P°$	1/2	505 072	1.5	83%+7% $5s4f5d$ $^2P°$	01CHU/JOS
	$^2P°$	3/2	505 773	1.5	87%	01CHU/JOS
Ba IX ($5s^2$ $^1S_0$)	*Limit*	—	(851 000)			04ROD/IND

6.7. Ba IX

Cd isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^2$ $^1S_0$
Ionization energy 1 052 800(5200) cm^{-1}; 130.5(6) eV

The Ba IX spectrum was first observed by Kaufman and Sugar [87KAU/SUG2], who classified 26 lines between 100 and 900 Å. Churilov and Joshi [00CHU/JOS] remeasured the spectrum and did a complete reanalysis, also incorporating the earlier data, and reported a total of 110 classified lines and 54 levels. All the wavelength and energy level data in Tables 14 and 15 are taken from [00CHU/JOS]. Since Churilov and Joshi did not calculate the ionization energy, the value reported above is from [87KAU/SUG2], who used values for the $5s5p$ and $5s6p$ levels and a value for the change in the effective quantum number ($\Delta n^*=1.0635$) determined by relativistic Hartree–Fock calculations.

Transition probabilities for the $5s^2$ $^1S_0-5s5p$ $^3P_1^\circ$ and $^1P_1^\circ$ transitions have been calculated by many groups. Values before the year 2000 are summarized in Biémont *et al.* [00BIE/FRO] along with their relativistic Hartree–Fock and their multiconfiguration Dirac–Fock (MCDF) calculations. Curtis *et al.* [00CUR/MAT] used multiconfiguration Dirac–Hartree–Fock calculations and also combined the *ab initio* values with isoelectronic fitting of the singlet-triplet mixing angle to produce semiempirical results. The most recent values are from Glowacki and Migdalek [03GLO/MIG], who used a relativistic configuration-interaction method with Dirac–Fock wavefunctions. The spread in values approaches ±20% and it is difficult to determine which of the results is better. We retain here the [00CUR/MAT] multiconfiguration Dirac–Hartree–Fock values for these transitions. Churilov and Joshi [00CHU/JOS] used relativistic Hartree–Fock calculations to obtain transition probabilities listed for the other transitions, but gave no estimate of the uncertainty.

6.7.1. References for Ba IX

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TABLE 14. Observed spectral lines of Ba IX

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
134.405	0.005	744 020	10		2.32E+10	$5s^2\ ^1S_0$	$4d^95s^25p\ ^3D^\circ_1$	00CHU/JOS	00CHU/JOS
137.651	0.005	726 475	30		1.37E+11	$5s^2\ ^1S_0$	$4d^95s^25p\ ^1P^\circ_1$	00CHU/JOS	00CHU/JOS
181.353	0.005	551 411	40		8.27E+9	$5s^2\ ^1S_0$	$5s6p\ ^1P^\circ_1$	00CHU/JOS	00CHU/JOS
184.502	0.005	542 000	30		3.60E+9	$5s^2\ ^1S_0$	$5s6p\ ^3P^\circ_1$	00CHU/JOS	00CHU/JOS
274.397	0.005	364 435	34		5.07E+9	$5s5p\ ^3P^\circ_0$	$5s6s\ ^3S_1$	00CHU/JOS	00CHU/JOS
278.851	0.005	358 614	52		1.36E+10	$5s5p\ ^3P^\circ_1$	$5s6s\ ^3S_1$	00CHU/JOS	00CHU/JOS
295.320	0.005	338 616	70		2.03E+10	$5s5p\ ^3P^\circ_2$	$5s6s\ ^3S_1$	00CHU/JOS	00CHU/JOS
318.607	0.005	313 866	60		3.28E+10	$5s5p\ ^1P^\circ_1$	$5s6s\ ^1S_0$	00CHU/JOS	00CHU/JOS
360.342	0.005	277 514	86		1.34E+9	$5s5p\ ^3P^\circ_1$	$4f5p\ ^3D_2$	00CHU/JOS	00CHU/JOS
387.523	0.005	258 049	128		1.52E+9	$5s5p\ ^3P^\circ_1$	$5s5d\ ^1D_2$	00CHU/JOS	00CHU/JOS
390.979	0.005	255 768	89		9.43E+8	$5s5p\ ^3P^\circ_2$	$4f5p\ ^3D_3$	00CHU/JOS	00CHU/JOS
396.081	0.005	252 473	90		1.26E+10	$5p^2\ ^1D_2$	$5p5d\ ^1F^\circ_3$	00CHU/JOS	00CHU/JOS
411.379	0.005	243 085	399		1.46E+10	$5s5p\ ^1P^\circ_1$	$4f5p\ ^1D_2$	00CHU/JOS	00CHU/JOS
412.910	0.005	242 184	475		1.61E+10	$5s5p\ ^3P^\circ_0$	$5s5d\ ^3D_1$	00CHU/JOS	00CHU/JOS
414.456	0.005	241 280	582	b	3.42E+9	$5p^2\ ^3P_1$	$5p5d\ ^3P^\circ_2$	00CHU/JOS	00CHU/JOS
417.560	0.005	239 487	71		1.95E+10	$5p^2\ ^3P_1$	$5p5d\ ^3P^\circ_1$	00CHU/JOS	00CHU/JOS
417.848	0.005	239 322	85		2.65E+10	$5p^2\ ^3P_1$	$5p5d\ ^3P^\circ_0$	00CHU/JOS	00CHU/JOS
418.080	0.005	239 189	54		5.96E+9	$5p^2\ ^1D_2$	$5p5d\ ^3P^\circ_2$	00CHU/JOS	00CHU/JOS
421.229	0.005	237 400	29		4.50E+9	$5p^2\ ^1D_2$	$5p5d\ ^3P^\circ_1$	00CHU/JOS	00CHU/JOS
422.107	0.005	236 907	787	b	1.82E+10	$5s5p\ ^3P^\circ_1$	$5s5d\ ^3D_2$	00CHU/JOS	00CHU/JOS
422.507	0.005	236 683	201		3.41E+10	$5p^2\ ^3P_0$	$5p5d\ ^3D^\circ_1$	00CHU/JOS	00CHU/JOS
423.075	0.005	236 365	414		1.05E+10	$5s5p\ ^3P^\circ_1$	$5s5d\ ^3D_1$	00CHU/JOS	00CHU/JOS
424.198	0.005	235 739	489		2.44E+10	$5p^2\ ^1D_2$	$5p5d\ ^3D^\circ_3$	00CHU/JOS	00CHU/JOS
428.530	0.005	233 356	33		3.44E+9	$5s5d\ ^3D_2$	$5s5f\ ^1F^\circ_3$	00CHU/JOS	00CHU/JOS
432.115	0.005	231 420	200	p	1.80E+10	$5p^2\ ^3P_1$	$5p5d\ ^3D^\circ_2$	00CHU/JOS	00CHU/JOS
434.479	0.005	230 161	391		4.41E+9	$5s5p\ ^3P^\circ_2$	$4f5p\ ^3F_3$	00CHU/JOS	00CHU/JOS
436.054	0.005	229 329	491		6.80E+9	$5p^2\ ^1D_2$	$5p5d\ ^3D^\circ_2$	00CHU/JOS	00CHU/JOS
436.696	0.005	228 992	198		2.31E+10	$5p^2\ ^3P_2$	$5p5d\ ^1F^\circ_3$	00CHU/JOS	00CHU/JOS
437.515	0.005	228 564	186		2.93E+10	$5s5d\ ^3D_1$	$5s5f\ ^3F^\circ_2$	00CHU/JOS	00CHU/JOS
437.871	0.005	228 378	235		2.63E+10	$5s5d\ ^3D_2$	$5s5f\ ^3F^\circ_3$	00CHU/JOS	00CHU/JOS
441.174	0.005	226 668	281		2.67E+10	$5s5d\ ^3D_3$	$5s5f\ ^3F^\circ_4$	00CHU/JOS	00CHU/JOS
445.218	0.005	224 609	103		6.20E+8	$5s5p\ ^1P^\circ_1$	$4f5p\ ^3D_2$	00CHU/JOS	00CHU/JOS
445.790	0.005	224 321	141		1.23E+10	$4f5p\ ^3F_2$	$5s5f\ ^1F^\circ_3$	00CHU/JOS	00CHU/JOS
455.913	0.005	219 340	52		5.37E+9	$4f5p\ ^3F_2$	$5s5f\ ^3F^\circ_3$	00CHU/JOS	00CHU/JOS
456.361	0.005	219 125	839		1.69E+10	$5s5p\ ^3P^\circ_2$	$5s5d\ ^3D_3$	00CHU/JOS	00CHU/JOS
461.010	0.005	216 915	200	p	4.42E+9	$5s5p\ ^3P^\circ_2$	$5s5d\ ^3D_2$	00CHU/JOS	00CHU/JOS
463.606	0.005	215 700	220		1.90E+10	$5p^2\ ^3P_2$	$5p5d\ ^3P^\circ_2$	00CHU/JOS	00CHU/JOS
463.750	0.005	215 633	82		7.83E+9	$4f5p\ ^3F_3$	$5s5f\ ^3F^\circ_4$	00CHU/JOS	00CHU/JOS
465.990	0.005	214 597	299		1.29E+10	$5p^2\ ^3P_1$	$5p5d\ ^1D^\circ_2$	00CHU/JOS	00CHU/JOS
467.475	0.005	213 915	123		5.37E+9	$5p^2\ ^3P_2$	$5p5d\ ^3P^\circ_1$	00CHU/JOS	00CHU/JOS
470.565	0.005	212 511	186		7.02E+9	$5p^2\ ^1D_2$	$5p5d\ ^1D^\circ_2$	00CHU/JOS	00CHU/JOS
471.132	0.005	212 255	150	p	1.02E+10	$5p^2\ ^3P_2$	$5p5d\ ^3D^\circ_3$	00CHU/JOS	00CHU/JOS
471.204	0.005	212 222	113		1.09E+10	$5s5d\ ^1D_2$	$5s5f\ ^1F^\circ_3$	00CHU/JOS	00CHU/JOS
476.710	0.005	209 771	163		2.23E+10	$5p^2\ ^1S_0$	$5p5d\ ^1P^\circ_1$	00CHU/JOS	00CHU/JOS
479.069	0.005	208 738	237		3.73E+9	$5p^2\ ^1D_2$	$5p5d\ ^3F^\circ_3$	00CHU/JOS	00CHU/JOS
487.455	0.005	205 147	483		1.35E+10	$5s5p\ ^1P^\circ_1$	$5s5d\ ^1D_2$	00CHU/JOS	00CHU/JOS
505.593	0.005	197 787	338		2.72E+9	$5p^2\ ^1D_2$	$5p5d\ ^3F^\circ_2$	00CHU/JOS	00CHU/JOS
517.997	0.005	193 051	156		5.76E+9	$5s5p\ ^1P^\circ_1$	$4f5p\ ^3F_2$	00CHU/JOS	00CHU/JOS
524.224	0.005	190 758	327		1.68E+9	$5s5p\ ^3P^\circ_1$	$5p^2\ ^3P_2$	00CHU/JOS	00CHU/JOS
526.510	0.005	189 930	100	p	8.16E+9	$5s5d\ ^3D_3$	$5s6p\ ^3P^\circ_2$	00CHU/JOS	00CHU/JOS
547.049	0.005	182 799	97		1.37E+10	$5s5d\ ^3D_1$	$5s6p\ ^3P^\circ_0$	00CHU/JOS	00CHU/JOS
557.976	0.005	179 219	62		4.03E+9	$4f5p\ ^3F_2$	$5p5d\ ^1P^\circ_1$	00CHU/JOS	00CHU/JOS
558.990	0.005	178 894	120		2.10E+9	$4f5p\ ^3F_3$	$5s6p\ ^3P^\circ_2$	00CHU/JOS	00CHU/JOS
569.113	0.005	175 712	831		1.05E+10	$5s^2\ ^1S_0$	$5s5p\ ^1P^\circ_1$	00CHU/JOS	00CUR/MAT
573.781	0.005	174 283	113		2.97E+9	$4f5p\ ^1D_2$	$5s5f\ ^1F^\circ_3$	00CHU/JOS	00CHU/JOS

TABLE 14. Observed spectral lines of Ba IX—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
576.023	0.005	173 604	366		9.40E+9	4f5s $^1F^°_3$	4f5p $^1D_2$	00CHU/JOS	00CHU/JOS
584.773	0.005	171 007	530		4.83E+9	5s5p $^3P^°_0$	5p^2 $^3P_1$	00CHU/JOS	00CHU/JOS
585.624	0.005	170 758	638		6.76E+9	5s5p $^3P^°_2$	5p^2 $^3P_2$	00CHU/JOS	00CHU/JOS
589.793	0.005	169 551	62		3.16E+9	5s5d $^3D_2$	5p5d $^3P^°_2$	00CHU/JOS	00CHU/JOS
594.149	0.005	168 308	238		3.87E+9	5s5d $^3D_1$	5p5d $^3P^°_1$	00CHU/JOS	00CHU/JOS
597.815	0.005	167 276	845	b	2.66E+9	5s5p $^3P^°_1$	5p^2 $^1D_2$	00CHU/JOS	00CHU/JOS
600.825	0.005	166 438	310	b	7.89E+8	4f5s $^3F^°_3$	4f5p $^1G_4$	00CHU/JOS	00CHU/JOS
602.041	0.005	166 102	105		2.13E+9	5s5d $^3D_2$	5p5d $^3D^°_3$	00CHU/JOS	00CHU/JOS
603.543	0.005	165 688	355		8.63E+9	4f5s $^3F^°_2$	4f5p $^3F^°_2$	00CHU/JOS	00CHU/JOS
603.925	0.005	165 584	132		6.67E+8	4f5s $^3F^°_4$	4f5p $^1G_4$	00CHU/JOS	00CHU/JOS
605.380	0.005	165 186	512		3.07E+9	5s5p $^3P^°_1$	5p^2 $^3P_1$	00CHU/JOS	00CHU/JOS
610.137	0.005	163 898	541	b	2.99E+9	5s5d $^3D_3$	5p5d $^3D^°_3$	00CHU/JOS	00CHU/JOS
612.913	0.005	163 155	303		3.22E+9	4f5s $^3F^°_2$	4f5p $^3D_2$	00CHU/JOS	00CHU/JOS
614.872	0.005	162 635	446		4.76E+9	4f5s $^3F^°_3$	4f5p $^3D_2$	00CHU/JOS	00CHU/JOS
615.401	0.005	162 496	181		1.35E+10	5s5p $^1P^°_1$	5p^2 $^1S_0$	00CHU/JOS	00CHU/JOS
618.402	0.005	161 707	114		2.36E+9	5s5d $^1D_2$	5p5d $^1F^°_3$	00CHU/JOS	00CHU/JOS
621.526	0.005	160 894	367		2.56E+9	4f5s $^3F^°_3$	4f5p $^3D_3$	00CHU/JOS	00CHU/JOS
624.857	0.005	160 037	381		4.06E+9	4f5s $^3F^°_4$	4f5p $^3D_3$	00CHU/JOS	00CHU/JOS
629.190	0.005	158 934	463		4.62E+9	4f5s $^1F^°_3$	4f5p $^1G_4$	00CHU/JOS	00CHU/JOS
634.744	0.005	157 544	515		6.13E+9	4f5s $^3F^°_4$	4f5p $^3G_5$	00CHU/JOS	00CHU/JOS
634.987	0.005	157 484	113		1.00E+9	5s5d $^3D_3$	5p5d $^3D^°_2$	00CHU/JOS	00CHU/JOS
644.256	0.005	155 218	515		4.04E+9	4f5s $^3F^°_3$	4f5p $^3F_4$	00CHU/JOS	00CHU/JOS
647.822	0.005	154 363	377		1.87E+9	4f5s $^3F^°_4$	4f5p $^3F_4$	00CHU/JOS	00CHU/JOS
650.000	0.005	153 846	383		2.96E+9	5s5d $^3D_3$	5p5d $^3F^°_4$	00CHU/JOS	00CHU/JOS
651.756	0.005	153 432	356		2.99E+9	4f5s $^3F^°_2$	4f5p $^1F_3$	00CHU/JOS	00CHU/JOS
651.923	0.005	153 392	183		9.00E+8	4f5s $^1F^°_3$	4f5p $^3D_3$	00CHU/JOS	00CHU/JOS
653.987	0.005	152 908	218		8.00E+8	4f5s $^3F^°_3$	4f5p $^1F_3$	00CHU/JOS	00CHU/JOS
677.494	0.005	147 603	505		9.20E+9	5s5p $^3P^°_1$	5p^2 $^3P_0$	00CHU/JOS	00CHU/JOS
678.997	0.005	147 276	501		2.48E+9	5s5p $^3P^°_2$	5p^2 $^1D_2$	00CHU/JOS	00CHU/JOS
687.715	0.005	145 409	249		1.69E+9	4f5s $^1F^°_3$	4f5p $^1F_3$	00CHU/JOS	00CHU/JOS
688.771	0.005	145 186	439		3.63E+9	5s5p $^3P^°_2$	5p^2 $^3P_1$	00CHU/JOS	00CHU/JOS
695.944	0.005	143 690	188		1.54E+9	4f5s $^3F^°_2$	5s5d $^1D_2$	00CHU/JOS	00CHU/JOS
698.488	0.005	143 166	88		7.20E+8	4f5s $^3F^°_3$	5s5d $^1D_2$	00CHU/JOS	00CHU/JOS
710.944	0.005	140 658	107		6.00E+8	5s5d $^3D_3$	5p5d $^1D^°_2$	00CHU/JOS	00CHU/JOS
718.903	0.005	139 101	116		1.19E+9	5s5d $^3D_2$	5p5d $^3F^°_3$	00CHU/JOS	00CHU/JOS
725.371	0.005	137 861	281		1.84E+9	5s5p $^1P^°_1$	5p^2 $^3P_2$	00CHU/JOS	00CHU/JOS
730.533	0.005	136 826	46		7.71E+8	5s5d $^3D_3$	5p5d $^3F^°_3$	00CHU/JOS	00CHU/JOS
739.202	0.005	135 281	152		6.14E+8	4f5s $^3F^°_3$	4f5p $^3F_3$	00CHU/JOS	00CHU/JOS
739.589	0.005	135 210	208		7.44E+8	4f5s $^3F^°_3$	4f5p $^3G_4$	00CHU/JOS	00CHU/JOS
743.906	0.005	134 426	313		2.83E+9	4f5s $^3F^°_4$	4f5p $^3F_3$	00CHU/JOS	00CHU/JOS
744.298	0.005	134 355	357		2.40E+9	4f5s $^3F^°_4$	4f5p $^3G_4$	00CHU/JOS	00CHU/JOS
762.940	0.005	131 072	45		1.60E+9	4f5s $^3F^°_3$	4f5p $^3F_2$	00CHU/JOS	00CHU/JOS
764.730	0.005	130 765	244		1.51E+9	4f5s $^3F^°_2$	4f5p $^3G_3$	00CHU/JOS	00CHU/JOS
767.792	0.005	130 244	228		1.20E+9	4f5s $^3F^°_3$	4f5p $^3G_3$	00CHU/JOS	00CHU/JOS
771.448	0.005	129 626	121		2.32E+9	4f5p $^3F_3$	5p5d $^1D^°_2$	00CHU/JOS	00CHU/JOS
777.019	0.005	128 697	102		1.38E+9	5s5d $^3D_1$	5p5d $^3F^°_2$	00CHU/JOS	00CHU/JOS
782.595	0.005	127 780	177		9.29E+8	4f5s $^1F^°_3$	4f5p $^3F_3$	00CHU/JOS	00CHU/JOS
783.023	0.005	127 710	149		5.67E+8	4f5s $^1F^°_3$	4f5p $^3G_4$	00CHU/JOS	00CHU/JOS
792.138	0.005	126 241	58		1.10E+9	5s5d $^1D_2$	5p5d $^3D^°_1$	00CHU/JOS	00CHU/JOS
794.168	0.005	125 921	55		1.10E+9	4f5p $^3G_4$	5p5d $^3F^°_3$	00CHU/JOS	00CHU/JOS
814.253	0.005	122 812	409		1.84E+8	5s^2 $^1S_0$	5s5p $^3P^°_1$	00CHU/JOS	00CUR/MAT
814.707	0.005	122 743	165		7.14E+8	4f5s $^1F^°_3$	4f5p $^3G_3$	00CHU/JOS	00CHU/JOS
815.954	0.005	122 556	142		3.20E+8	4f5s $^3F^°_2$	5s5d $^3D_2$	00CHU/JOS	00CHU/JOS
833.738	0.005	119 942	933	b	1.12E+9	4f5p $^3G_3$	5p5d $^3F^°_2$	00CHU/JOS	00CHU/JOS
874.300	0.005	114 377	296		1.20E+9	5s5p $^1P^°_1$	5p^2 $^1D_2$	00CHU/JOS	00CHU/JOS

TABLE 15. Energy levels of Ba IX

Configuration	Term	J	Energy (cm^{-1})	Unc. (cm^{-1})	Leading percentages	Reference
$5s^2$	^1S	0	0		99%	00CHU/JOS
5s5p	$^3P°$	0	116 992	1	100%	00CHU/JOS
		1	122 812	1	94%+5% 5s5p $^1P°$	00CHU/JOS
		2	142 812	1	100%	00CHU/JOS
5s5p	$^1P°$	1	175 712	2	93%+5% 5s5p $^3P°$+1% 5p5d $^1P°$	00CHU/JOS
4f5s	$^3F°$	2	237 170	2	100%	00CHU/JOS
		3	237 691	2	99%	00CHU/JOS
		4	238 547	2	100%	00CHU/JOS
4f5s	$^1F°$	3	245 192	2	99%	00CHU/JOS
$5p^2$	^3P	0	270 415	4	86%+14% $5p^2$ ^1S	00CHU/JOS
		1	287 998	4	100%	00CHU/JOS
		2	313 571	4	62%+33% $5p^2$ ^1D	00CHU/JOS
$5p^2$	^1D	2	290 088	4	58%+37% $5p^2$ ^3P	00CHU/JOS
$5p^2$	^1S	0	338 208	4	84%+14% $5p^2$ ^3P	00CHU/JOS
5s5d	^3D	1	359 175	3	97%	00CHU/JOS
		2	359 724	3	83%+7% 4f5p ^3D	00CHU/JOS
		3	361 937	3	81%+13% 4f5p ^3D	00CHU/JOS
5s5d	^1D	2	380 858	3	42%+43% 4f5p ^3F+7% 4f5p ^1D	00CHU/JOS
4f5p	^3G	3	367 935	3	62%+28% 4f5p ^1F+9% 4f5p ^3F	00CHU/JOS
		4	372 902	3	44%+41% 4f5p ^3F+15% 4f5p ^1G	00CHU/JOS
		5	396 091	3	100%	00CHU/JOS
4f5p	^3F	2	368 763	3	37%+24% 4f5p ^1D+20% 5s5d ^1D	00CHU/JOS
		3	372 972	3	42%+23% 4f5p ^1F+18% 4f5p ^3D	00CHU/JOS
		4	392 910	3	54%+46% 4f5p ^3G	00CHU/JOS
4f5p	^1F	3	390 601	3	35%+36% 4f5p ^3G+29% 4f5p ^3F	00CHU/JOS
4f5p	^3D	3	398 583	4	69%+17% 4f5p ^3F+11% 4f5p ^1F	00CHU/JOS
		2	400 325	4	81%+13% 4f5p ^3F	00CHU/JOS
		1	402 858	4	97%	00CHU/JOS
4f5p	^1G	4	404 128	4	84%+10% 4f5p ^3G+5% 4f5p ^3F	00CHU/JOS
4f5p	^1D	2	418 797	4	63%+24% 5s5d ^1D+5% 4f5p ^3D	00CHU/JOS
5s6s	^3S	1	481 427	5	100%	00CHU/JOS
5p5d	$^3F°$	2	487 874	4	79%+18% 5p5d $^1D°$	00CHU/JOS
		3	498 824	4	85%+9% 5p5d $^3D°$	00CHU/JOS
		4	515 783	4	98%+2% 5s5f $^3F°$	00CHU/JOS
5s6s	^1S	0	489 578	5	99%	00CHU/JOS
5p5d	$^1D°$	2	502 597	4	38%+33% 5p5d $^3P°$+21% 5p5d $^3D°$	00CHU/JOS
5p5d	$^3D°$	1	507 098	4	85%+9% 5p5d $^3P°$+11% 5p5d $^1P°$	00CHU/JOS
		2	519 418	4	36%+39% 5p5d $^1D°$+12% 5p5d $^3P°$	00CHU/JOS
		3	525 827	4	79%+12% 5p5d $^3F°$+7% 5p5d $^1F°$	00CHU/JOS
5p5d	$^3P°$	0	527 320	4	96%+3% 5s6p $^3P°$	00CHU/JOS
		1	527 486	4	72%+24% 5p5d $^3D°$	00CHU/JOS
		2	528 700	4	53%+40% 5p5d $^3D°$+5% 5p5d $^1D°$	00CHU/JOS

TABLE 15. Energy levels of Ba IX—Continued

Configuration	Term	J	Energy (cm^{-1})	Unc. (cm^{-1})	Leading percentages	Reference
5p5d	^{1}F°	3	542 564	4	74%+10% 5p5d ^{3}D°+10% 5s5f ^{1}F°	00CHU/JOS
5p5d	^{1}P°	1	547 980	4	76%+8% 4f5d ^{1}P°+6% 5p5d ^{3}D°	00CHU/JOS
5s6p	^{3}P°	0	541 975	4	96%	00CHU/JOS
		1	542 000	4	63%+32% 5s6p ^{1}P°	00CHU/JOS
		2	551 867	4	99%	00CHU/JOS
5s6p	^{1}P°	1	551 411	15	64%+31% 5s6p ^{3}P°	00CHU/JOS
5s5f	^{3}F°	2	587 740	5	96%	00CHU/JOS
		3	588 102	5	96%	00CHU/JOS
		4	588 605	5	96%	00CHU/JOS
5s5f	^{1}F°	3	593 082	5	70%+22% 4f5d ^{1}F°	00CHU/JOS
4d^{9}5s^{2}5p	^{1}P°	1	726 475	30	86%+9% 4d^{9}5s^{2}5p ^{3}D°	00CHU/JOS
4d^{9}5s^{2}5p	^{3}D°	1	744 020	30	64%+22% 4d^{9}5s^{2}5p ^{3}P°+14% 4d^{9}5s^{2}5p ^{1}P°	00CHU/JOS
Ba X (5s ^{2}S$_{1/2}$)	*Limit*	—	1 052 800	5200		87KAU/SUG2

6.8. Ba X

Ag isoelectronic sequence
Ground state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s\ ^2S_{1/2}$
Ionization energy 1 181 800(1000) cm^{-1}; 146.52(12) eV

The Ba X spectrum was first observed by Sugar [77SUG], who identified $5s-5p$, $5p-5d$, and $4f-5g$ transitions. Additional measurements allowed Kaufman and Sugar [81KAU/SUG] to improve the level values reported in [77SUG] and locate levels of $6s$, $7s$, $6p$, $5f$, and $5g$. Kaufman and Sugar [84KAU/SUG] reported five transitions to $4d^9 5s5p$ levels. Gayasov and Joshi [98GAY/JOS] extended the analysis of the spectrum by locating two $4d^9 5s(^3D)4f\ ^2P$ levels. Churilov and Joshi [00CHU/JOS] remeasured the entire spectrum and classified eight lines as $4f-5d$, $5d-5f$, $5p-5d$, and $5s-4d^9 5s5p$. The wavelengths and energy levels given in Tables 16 and 17 are from [00CHU/JOS] and the ionization energy is taken from [81KAU/SUG]. The level at 761 700 cm^{-1} was calculated by Churilov and Joshi using the relativistic Hartree–Fock method.

Transition probabilities for the Ba X spectrum have been calculated by several groups. Most recently Safronova *et al.* [03SAF/SAV] used third-order relativistic many-body calculations to obtain oscillator strengths for the $5s-5p$, $5p-5d$, $4f-5d$, and $4f-5g$ transitions. Migdalek and Garmulewicz [00MIG/GAR] compared several methods of calculating oscillator strengths in the silver and gold isoelectronic sequences. Their values are used here for the $5p-6s$ transitions, for which they show a consistency of ±10% between the various methods of calculation. The other values were determined by Churilov and Joshi [00CHU/JOS] with relativistic Hartree–Fock calculations. The Churilov and Joshi [00CHU/JOS] transition probabilities agree with those of Safronova *et al.* [03SAF/SAV] within ±10% and with those of Migdalek and Garmulewicz [00MIG/GAR] by ±15%.

6.8.1. References for Ba X

77SUG J. Sugar, J. Opt. Soc. Am. **67**, 1518 (1977).

81KAU/SUG V. Kaufman and J. Sugar, Phys. Scr. **24**, 738 (1981).

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98GAY/JOS R. Gayasov and Y. N. Joshi, J. Phys. B **31**, L705 (1998).

00CHU/JOS S. S. Churilov and Y. N. Joshi, Phys. Scr. **62**, 282 (2000).

00MIG/GAR J. Migdalek and M. Garmulewicz, J. Phys. B **33**, 1735 (2000).

03SAF/SAV U. I. Safronova, I. M. Savukov, M. S. Safronova, and W. R. Johnson, Phys. Rev. A **68**, 062505 (2003).

TABLE 16. Observed spectral lines of Ba X

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
102.886	0.005	971 950	17		2.75E+12	5s ^{2}S$_{1/2}$	4d^{9}5s(^{3}D)4f ^{2}P°$_{3/2}$	00CHU/JOS	00CHU/JOS
102.908	0.005	971 740	13		2.75E+12	5s ^{2}S$_{1/2}$	4d^{9}5s(^{3}D)4f ^{2}P°$_{1/2}$	00CHU/JOS	00CHU/JOS
125.244	0.005	798 440	10		4.04E+10	5s ^{2}S$_{1/2}$	4d^9(^{2}D)5s5p(^{1}P°) (3/2,1)°$_{1/2}$	00CHU/JOS	00CHU/JOS
128.319	0.005	779 310	20		7.27E+10	5s ^{2}S$_{1/2}$	4d^9(^{2}D)5s5p(^{1}P°) (5/2,1)°$_{3/2}$	00CHU/JOS	00CHU/JOS

TABLE 16. Observed spectral lines of Ba X—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
130.117	0.005	768 540	8		7.03E+9	5s $^2S_{1/2}$	$4d^9(^2D)5s5p(^3P^\circ)$ $(3/2,2)^\circ_{3/2}$	00CHU/JOS	00CHU/JOS
132.493	0.005	754 760	20		1.16E+11	5s $^2S_{1/2}$	$4d^9(^2D)5s5p(^3P^\circ)$ $(3/2,1)^\circ_{1/2}$	00CHU/JOS	00CHU/JOS
132.749	0.005	753 300	30		7.06E+10	5s $^2S_{1/2}$	$4d^9(^2D)5s5p(^3P^\circ)$ $(3/2,1)^\circ_{3/2}$	00CHU/JOS	00CHU/JOS
134.183	0.005	745 250	12		1.67E+10	5s $^2S_{1/2}$	$4d^9(^2D)5s5p(^3P^\circ)$ $(3/2,0)^\circ_{3/2}$	00CHU/JOS	00CHU/JOS
134.399	0.005	744 050	5		7.10E+9	5s $^2S_{1/2}$	$4d^9(^2D)5s5p(^3P^\circ)$ $(5/2,2)^\circ_{1/2}$	00CHU/JOS	00CHU/JOS
135.840	0.005	736 160	7		3.18E+9	5s $^2S_{1/2}$	$4d^9(^2D)5s5p(^3P^\circ)$ $(3/2,1)^\circ_{3/2}$	00CHU/JOS	00CHU/JOS
137.975	0.005	724 770	10		5.00E+9	5s $^2S_{1/2}$	$4d^9(^2D)5s5p(^3P^\circ)$ $(5/2,1)^\circ_{3/2}$	00CHU/JOS	00CHU/JOS
154.252	0.005	648 290	25		2.09E+10	4f $^2F^\circ_{5/2}$	6g $^2G_{7/2}$	00CHU/JOS	00CHU/JOS
154.613	0.005	646 776	30		2.19E+10	4f $^2F^\circ_{7/2}$	6g $^2G_{9/2}$	00CHU/JOS	00CHU/JOS
167.663	0.005	596 435	40		7.38E+9	5s $^2S_{1/2}$	6p $^2P^\circ_{3/2}$	00CHU/JOS	00CHU/JOS
168.328	0.005	594 078	7		1.65E+10	5p $^2P^\circ_{3/2}$	7s $^2S_{1/2}$	00CHU/JOS	00CHU/JOS
170.880	0.005	585 206	30		6.85E+9	5s $^2S_{1/2}$	6p $^2P^\circ_{1/2}$	00CHU/JOS	00CHU/JOS
194.938	0.005	512 984	45		4.11E+10	4f $^2F^\circ_{5/2}$	5g $^2G_{7/2}$	00CHU/JOS	03SAF/SAV
195.516	0.005	511 467	60		4.32E+10	4f $^2F^\circ_{7/2}$	5g $^2G_{9/2}$	00CHU/JOS	03SAF/SAV
259.228	0.005	385 761	35		1.51E+10	5p $^2P^\circ_{1/2}$	6s $^2S_{1/2}$	00CHU/JOS	00MIG/GAR
278.748	0.005	358 747	45		3.18E+10	5p $^2P^\circ_{3/2}$	6s $^2S_{1/2}$	00CHU/JOS	00MIG/GAR
412.087	0.005	242 667	57		1.88E+10	5p $^2P^\circ_{1/2}$	5d $^2D_{3/2}$	00CHU/JOS	03SAF/SAV
419.088	0.005	238 613	21		3.58E+10	5d $^2D_{3/2}$	5f $^2F^\circ_{5/2}$	00CHU/JOS	00CHU/JOS
425.959	0.005	234 764	23		3.68E+10	5d $^2D_{5/2}$	5f $^2F^\circ_{7/2}$	00CHU/JOS	00CHU/JOS
427.285	0.005	234 036	5		2.43E+9	5d $^2D_{5/2}$	5f $^2F^\circ_{5/2}$	00CHU/JOS	00CHU/JOS
454.060	0.005	220 235	68		1.81E+10	5p $^2P^\circ_{3/2}$	5d $^2D_{5/2}$	00CHU/JOS	03SAF/SAV
463.707	0.005	215 653	25	p	2.84E+9	5p $^2P^\circ_{3/2}$	5d $^2D_{3/2}$	00CHU/JOS	03SAF/SAV
601.104	0.005	166 361	82		5.05E+9	5s $^2S_{1/2}$	5p $^2P^\circ_{3/2}$	00CHU/JOS	03SAF/SAV
609.620	0.005	164 037	3		1.17E+8	4f $^2F^\circ_{5/2}$	5d $^2D_{5/2}$	00CHU/JOS	03SAF/SAV
615.301	0.005	162 522	36		2.30E+9	4f $^2F^\circ_{7/2}$	5d $^2D_{5/2}$	00CHU/JOS	03SAF/SAV
627.130	0.005	159 457	30		2.29E+9	4f $^2F^\circ_{5/2}$	5d $^2D_{3/2}$	00CHU/JOS	03SAF/SAV
717.626	0.005	139 348	60		2.93E+9	5s $^2S_{1/2}$	5p $^2P^\circ_{1/2}$	00CHU/JOS	03SAF/SAV

TABLE 17. Energy levels of Ba X

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
5s	^2S	1/2	0		
5p	$^2P^\circ$	1/2	139 348	1.0	00CHU/JOS
		3/2	166 361	1.4	00CHU/JOS
4f	$^2F^\circ$	5/2	222 558	3	00CHU/JOS
	$^2F^\circ$	7/2	224 074	3	00CHU/JOS
5d	^2D	3/2	382 015	3	00CHU/JOS
		5/2	386 596	3	00CHU/JOS
6s	^2S	1/2	525 108	8	00CHU/JOS
6p	$^2P^\circ$	1/2	585 206	20	00CHU/JOS
	$^2P^\circ$	3/2	596 435	20	00CHU/JOS
5f	$^2F^\circ$	5/2	620 628	4	00CHU/JOS
	$^2F^\circ$	7/2	621 360	4	00CHU/JOS
$4d^9(^2D)5s5p(^3P^\circ)$	$(5/2,1)^\circ$	3/2	724 769	30	00CHU/JOS
	$(5/2,2)^\circ$	1/2	744 053	30	00CHU/JOS
5g	^2G	7/2	735 542	15	00CHU/JOS
	^2G	9/2	735 541	15	00CHU/JOS

TABLE 17. Energy levels of Ba X—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$4d^9(^2D)5s5p(^3P^\circ)$	$(3/2,1)^\circ$	3/2	736 160	30	00CHU/JOS
	$(3/2,0)^\circ$	3/2	745 250	30	00CHU/JOS
	$(3/2,1)^\circ$	3/2	753 300	30	00CHU/JOS
	$(3/2,1)^\circ$	1/2	754 760	30	00CHU/JOS
	$(3/2,2)^\circ$	1/2	(761 700)	30	00CHU/JOS
	$(3/2,2)^\circ$	3/2	768 540	30	00CHU/JOS
7s	^2S	1/2	760 439	20	00CHU/JOS
$4d^9(^2D)5s5p(^1P^\circ)$	$(5/2,1)^\circ$	3/2	779 308	30	00CHU/JOS
$4d^9(^2D)5s5p(^1P^\circ)$	$(3/2,1)^\circ$	1/2	798 441	30	00CHU/JOS
6g	^2G	7/2	870 848	25	00CHU/JOS
	^2G	9/2	870 850	25	00CHU/JOS
$4d^95s(^3D)4f$	$^2P^\circ$	1/2	971 745	50	00CHU/JOS
	$^2P^\circ$	3/2	971 953	50	00CHU/JOS
Ba XI (5s $^2S_{1/2}$)	*Limit*	—	1 181 800	1000	81KAU/SUG

6.9. Ba XI

Pd isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}\ ^1S_0$
Ionization energy (1 944 000 cm^{-1}); (241 eV)

Transitions in the Ba XI spectrum were first reported by Sugar [77SUG], who measured resonance lines in the 100–130 Å region. Sugar and Kaufman [82SUG/KAU] improved the measurements and extended the number of members of the palladium isoelectronic sequence studied. More recently Churilov *et al.* [02CHU/RYA and 02CHU/RYA2] used a laser-produced plasma to record spectra between 300 and 800 Å and a triggered low-inductance spark to produce lines in the the region between 100 and 130 Å. Incorporating the previously obtained data along with the newer observations and relativistic Hartree–Fock calculations, [02CHU/RYA2] contains the most complete summary of the Ba XI spectroscopic data. The wavelengths, energy levels, leading percentages, and transition probabilities in Tables 18 and 19 are taken from [02CHU/RYA2].

As discussed by Safronova *et al.* [05SAF/COW], calculated values for the transition probabilities for transitions to the ground state from the $4d^95p\ ^3P^\circ_1$ and $^3D^\circ_1$ are extremely sensitive to the amount of configuration mixing with the $^1P^\circ_1$ state. Thus the values obtained may not be as reliable as would otherwise be expected. The same is true for the $4f$ configuration and, since the $4d^94f\ ^3P^\circ_1$ level has very little of the corresponding $^1P^\circ_1$ component, the $4d^{10}\ ^1S_0$-$4d^94f\ ^3P^\circ_1$ transition is expected to have a very small transition probability, which may explain why it has not been detected. The ionization energy is taken from Rodrigues *et al.* [04ROD/IND], who used the Dirac–Fock approximation to calculate total binding energies of isoelectronic series.

6.9.1. References for Ba XI

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TABLE 18. Observed spectral lines of Ba XI

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
101.391	0.003	986 281	70		2.49E+12	$4d^{10}\ ^1S_0$	$4d^94f\ ^1P^\circ_1$	02CHU/RYA2	02CHU/RYA2
122.103	0.003	818 981	70		2.91E+10	$4d^{10}\ ^1S_0$	$4d^95p\ ^3D^\circ_1$	02CHU/RYA2	02CHU/RYA2
124.001	0.003	806 445	50		8.67E+9	$4d^{10}\ ^1S_0$	$4d^94f\ ^3D^\circ_1$	02CHU/RYA2	02CHU/RYA2
125.042	0.003	799 731	100		1.47E+11	$4d^{10}\ ^1S_0$	$4d^95p\ ^1P^\circ_1$	02CHU/RYA2	02CHU/RYA2
126.908	0.003	787 972	30		3.30E+9	$4d^{10}\ ^1S_0$	$4d^95p\ ^3P^\circ_1$	02CHU/RYA2	02CHU/RYA2

TABLE 18. Observed spectral lines of Ba XI—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
340.585	0.007	293 613	64		3.51E+10	$4d^95p\ ^1P^\circ_1$	$4d^95d\ ^1S_0$	02CHU/RYA2	02CHU/RYA2
374.120	0.007	267 294	68		9.42E+9	$4d^95p\ ^3F^\circ_2$	$4d^95d\ ^1D_2$	02CHU/RYA2	02CHU/RYA2
375.166	0.007	266 549	35		2.34E+9	$4d^95p\ ^3F^\circ_3$	$4d^95d\ ^1F_3$	02CHU/RYA2	02CHU/RYA2
375.815	0.007	266 088	150		1.13E+10	$4d^95p\ ^3P^\circ_2$	$4d^95d\ ^3D_3$	02CHU/RYA2	02CHU/RYA2
378.308	0.007	264 335	53		8.22E+9	$4d^95p\ ^3P^\circ_1$	$4d^95d\ ^1D_2$	02CHU/RYA2	02CHU/RYA2
380.044	0.007	263 127	266		2.23E+10	$4d^95p\ ^3P^\circ_2$	$4d^95d\ ^3D_2$	02CHU/RYA2	02CHU/RYA2
381.177	0.007	262 345	222		1.26E+10	$4d^95p\ ^3F^\circ_3$	$4d^95d\ ^3D_3$	02CHU/RYA2	02CHU/RYA2
381.306	0.007	262 257	35		5.92E+9	$4d^95d\ ^3G_4$	$4d^95f\ ^1G^\circ_4$	02CHU/RYA2	02CHU/RYA2
382.360	0.007	261 534	70		3.73E+9	$4d^95d\ ^3G_4$	$4d^95f\ ^3F^\circ_4$	02CHU/RYA2	02CHU/RYA2
384.297	0.007	260 215	458		2.40E+10	$4d^95p\ ^3F^\circ_2$	$4d^95d\ ^3G_3$	02CHU/RYA2	02CHU/RYA2
385.281	0.007	259 551	48		7.40E+9	$4d^95d\ ^3G_5$	$4d^95f\ ^3G^\circ_5$	02CHU/RYA2	02CHU/RYA2
385.542	0.007	259 375	76		4.94E+9	$4d^95p\ ^3F^\circ_3$	$4d^95d\ ^3D_2$	02CHU/RYA2	02CHU/RYA2
387.057	0.007	258 360	71		1.79E+10	$4d^95d\ ^3D_2$	$4d^95f\ ^3F^\circ_3$	02CHU/RYA2	02CHU/RYA2
388.449	0.007	257 434	720		2.94E+10	$4d^95p\ ^3F^\circ_3$	$4d^95d\ ^3G_4$	02CHU/RYA2	02CHU/RYA2
388.558	0.007	257 362	363	*	4.28E+10	$4d^95d\ ^3G_4$	$4d^95f\ ^3H^\circ_5$	02CHU/RYA2	02CHU/RYA2
388.558	0.007	257 362	363	*	4.20E+10	$4d^95d\ ^3G_3$	$4d^95f\ ^3H^\circ_4$	02CHU/RYA2	02CHU/RYA2
388.744	0.007	257 239	24		5.64E+9	$4d^95d\ ^1G_4$	$4d^95f\ ^3G^\circ_4$	02CHU/RYA2	02CHU/RYA2
389.066	0.007	257 026	48		1.81E+10	$4d^95d\ ^3P_1$	$4d^95f\ ^3D^\circ_2$	02CHU/RYA2	02CHU/RYA2
389.667	0.007	256 629	121		2.49E+10	$4d^95d\ ^3D_3$	$4d^95f\ ^3F^\circ_4$	02CHU/RYA2	02CHU/RYA2
390.079	0.007	256 358	56		1.99E+10	$4d^95d\ ^1P_1$	$4d^95f\ ^1D^\circ_2$	02CHU/RYA2	02CHU/RYA2
390.181	0.007	256 291	100		2.38E+10	$4d^95d\ ^3D_1$	$4d^95f\ ^3F^\circ_2$	02CHU/RYA2	02CHU/RYA2
390.820	0.007	255 872	134		1.32E+10	$4d^95p\ ^3P^\circ_1$	$4d^95d\ ^3P_1$	02CHU/RYA2	02CHU/RYA2
390.979	0.007	255 768	154	b	2.70E+10	$4d^95d\ ^1D_2$	$4d^95f\ ^3G^\circ_3$	02CHU/RYA2	02CHU/RYA2
391.547	0.007	255 397	63		1.81E+10	$4d^95d\ ^3D_3$	$4d^95f\ ^3F^\circ_3$	02CHU/RYA2	02CHU/RYA2
393.332	0.007	254 238	47		1.34E+10	$4d^95d\ ^3D_2$	$4d^95f\ ^3P^\circ_2$	02CHU/RYA2	02CHU/RYA2
394.514	0.007	253 476	371	*	4.26E+10	$4d^95d\ ^3G_5$	$4d^95f\ ^3H^\circ_6$	02CHU/RYA2	02CHU/RYA2
394.514	0.007	253 476	371	*	2.74E+10	$4d^95d\ ^3P_2$	$4d^95f\ ^1F^\circ_3$	02CHU/RYA2	02CHU/RYA2
395.049	0.007	253 133	178		3.17E+10	$4d^95d\ ^1F_3$	$4d^95f\ ^1G^\circ_4$	02CHU/RYA2	02CHU/RYA2
395.213	0.007	253 028	314		4.18E+10	$4d^95d\ ^1G_4$	$4d^95f\ ^1H^\circ_5$	02CHU/RYA2	02CHU/RYA2
395.919	0.007	252 577	125		4.34E+9	$4d^95p\ ^1P^\circ_1$	$4d^95d\ ^1D_2$	02CHU/RYA2	02CHU/RYA2
396.078	0.007	252 475	353	b	3.22E+10	$4d^95d\ ^3F_2$	$4d^95f\ ^3D^\circ_3$	02CHU/RYA2	02CHU/RYA2
396.865	0.007	251 975	403		2.49E+10	$4d^95p\ ^3P^\circ_2$	$4d^95d\ ^3S_1$	02CHU/RYA2	02CHU/RYA2
396.948	0.007	251 922	247		3.58E+10	$4d^95d\ ^3F_3$	$4d^95f\ ^3G^\circ_4$	02CHU/RYA2	02CHU/RYA2
397.199	0.007	251 763	270		3.49E+10	$4d^95d\ ^3F_4$	$4d^95f\ ^3G^\circ_5$	02CHU/RYA2	02CHU/RYA2
399.806	0.007	250 122	81		1.09E+10	$4d^95d\ ^3F_4$	$4d^95f\ ^3F^\circ_4$	02CHU/RYA2	02CHU/RYA2
401.361	0.007	249 152	99		2.91E+10	$4d^95p\ ^3P^\circ_1$	$4d^95d\ ^3P_0$	02CHU/RYA2	02CHU/RYA2
402.611	0.007	248 379	84		1.34E+9	$4d^95p\ ^3F^\circ_2$	$4d^95d\ ^3P_2$	02CHU/RYA2	02CHU/RYA2
404.244	0.007	247 375	186		3.94E+9	$4d^95p\ ^3F^\circ_2$	$4d^95d\ ^1F_3$	02CHU/RYA2	02CHU/RYA2
404.930	0.007	246 956	174		1.91E+9	$4d^95p\ ^1D^\circ_2$	$4d^95d\ ^3G_3$	02CHU/RYA2	02CHU/RYA2
405.172	0.007	246 809	191		1.59E+9	$4d^94f\ ^3H^\circ_4$	$4d^95d\ ^3G_3$	02CHU/RYA2	02CHU/RYA2
406.394	0.007	246 067	99		1.14E+10	$4d^95d\ ^3P_2$	$4d^95f\ ^3P^\circ_2$	02CHU/RYA2	02CHU/RYA2
407.460	0.007	245 423	132		3.58E+9	$4d^95p\ ^3P^\circ_1$	$4d^95d\ ^3P_2$	02CHU/RYA2	02CHU/RYA2
409.651	0.007	244 110	113		4.23E+9	$4d^95p\ ^1P^\circ_1$	$4d^95d\ ^3P_1$	02CHU/RYA2	02CHU/RYA2
411.807	0.007	242 832	368		6.80E+9	$4d^95p\ ^3F^\circ_4$	$4d^95d\ ^3F_4$	02CHU/RYA2	02CHU/RYA2
413.654	0.007	241 748	333		5.19E+9	$4d^94f\ ^3H^\circ_6$	$4d^95d\ ^3G_5$	02CHU/RYA2	02CHU/RYA2
414.264	0.007	241 392	213		1.34E+10	$4d^95p\ ^3P^\circ_0$	$4d^95d\ ^3D_1$	02CHU/RYA2	02CHU/RYA2
417.156	0.007	239 718	245		6.19E+9	$4d^95p\ ^1F^\circ_3$	$4d^95d\ ^3F_3$	02CHU/RYA2	02CHU/RYA2
425.319	0.007	235 118	356		1.18E+10	$4d^95p\ ^1D^\circ_2$	$4d^95d\ ^3P_2$	02CHU/RYA2	02CHU/RYA2
425.461	0.007	235 039	780		2.54E+10	$4d^95p\ ^3F^\circ_4$	$4d^95d\ ^3G_5$	02CHU/RYA2	02CHU/RYA2
425.677	0.007	234 929	373		1.73E+10	$4d^95p\ ^3D^\circ_1$	$4d^95d\ ^3F_2$	02CHU/RYA2	02CHU/RYA2
426.504	0.007	234 464	298		4.53E+9	$4d^94f\ ^3H^\circ_5$	$4d^95d\ ^3G_4$	02CHU/RYA2	02CHU/RYA2
426.605	0.007	234 409	720		2.49E+10	$4d^95p\ ^1F^\circ_3$	$4d^95d\ ^1G_4$	02CHU/RYA2	02CHU/RYA2
427.122	0.007	234 125	550	*	7.26E+9	$4d^95p\ ^1D^\circ_2$	$4d^95d\ ^1F_3$	02CHU/RYA2	02CHU/RYA2
427.122	0.007	234 125	550	*	2.38E+9	$4d^94f\ ^3F^\circ_2$	$4d^95d\ ^1D_2$	02CHU/RYA2	02CHU/RYA2
427.659	0.007	233 831	472	*	1.84E+10	$4d^95p\ ^3D^\circ_2$	$4d^95d\ ^3F_3$	02CHU/RYA2	02CHU/RYA2
427.659	0.007	233 831	472	*	2.22E+9	$4d^94f\ ^3F^\circ_4$	$4d^95d\ ^3F_4$	02CHU/RYA2	02CHU/RYA2
427.975	0.007	233 659	453	p	5.24E+9	$4d^95p\ ^1P^\circ_1$	$4d^95d\ ^3P_2$	02CHU/RYA2	02CHU/RYA2

TABLE 18. Observed spectral lines of Ba XI—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
428.311	0.007	233 475	145		3.20E+9	$4d^94f\ ^3D^\circ_2$	$4d^95d\ ^3P_1$	02CHU/RYA2	02CHU/RYA2
429.300	0.007	232 937	616		1.59E+10	$4d^95p\ ^3D^\circ_3$	$4d^95d\ ^3F_4$	02CHU/RYA2	02CHU/RYA2
431.742	0.007	231 620	451		4.37E+9	$4d^94f\ ^3G^\circ_5$	$4d^95d\ ^1G_4$	02CHU/RYA2	02CHU/RYA2
431.904	0.007	231 533	172		2.11E+9	$4d^94f\ ^3F^\circ_4$	$4d^95d\ ^1F_3$	02CHU/RYA2	02CHU/RYA2
432.510	0.007	231 208	154		4.64E+9	$4d^95p\ ^3D^\circ_2$	$4d^95d\ ^3F_2$	02CHU/RYA2	02CHU/RYA2
433.449	0.007	230 708	284		3.47E+9	$4d^94f\ ^3F^\circ_2$	$4d^95d\ ^3D_1$	02CHU/RYA2	02CHU/RYA2
433.591	0.007	230 632	255		6.71E+9	$4d^95p\ ^3D^\circ_3$	$4d^95d\ ^1F_3$	02CHU/RYA2	02CHU/RYA2
434.305	0.007	230 253	211		3.50E+9	$4d^94f\ ^1G^\circ_4$	$4d^95d\ ^3G_3$	02CHU/RYA2	02CHU/RYA2
434.970	0.007	229 901	122		7.23E+9	$4d^95p\ ^3D^\circ_1$	$4d^95d\ ^3D_1$	02CHU/RYA2	02CHU/RYA2
435.201	0.007	229 779	63		1.59E+9	$4d^94f\ ^3H^\circ_4$	$4d^95d\ ^3D_3$	02CHU/RYA2	02CHU/RYA2
435.525	0.007	229 608	131		6.12E+9	$4d^95p\ ^3D^\circ_2$	$4d^95d\ ^1D_2$	02CHU/RYA2	02CHU/RYA2
436.073	0.007	229 319	129		5.97E+9	$4d^94f\ ^1D^\circ_2$	$4d^95d\ ^1P_1$	02CHU/RYA2	02CHU/RYA2
439.078	0.007	227 750	238		3.79E+9	$4d^94f\ ^1H^\circ_5$	$4d^95d\ ^3F_4$	02CHU/RYA2	02CHU/RYA2
439.412	0.007	227 557	215		3.42E+9	$4d^94f\ ^3F^\circ_3$	$4d^95d\ ^3D_2$	02CHU/RYA2	02CHU/RYA2
439.695	0.007	227 430	79		4.30E+9	$4d^94f\ ^3G^\circ_3$	$4d^95d\ ^3F_2$	02CHU/RYA2	02CHU/RYA2
440.437	0.007	227 047	325		1.10E+10	$4d^95p\ ^1P^\circ_1$	$4d^95d\ ^1P_1$	02CHU/RYA2	02CHU/RYA2
440.786	0.007	226 867	175		4.34E+9	$4d^94f\ ^3G^\circ_4$	$4d^95d\ ^3F_3$	02CHU/RYA2	02CHU/RYA2
447.505	0.007	223 461	132		2.84E+9	$4d^95p\ ^3D^\circ_3$	$4d^95d\ ^3D_2$	02CHU/RYA2	02CHU/RYA2
447.850	0.007	223 289	147		2.52E+9	$4d^94f\ ^3D^\circ_3$	$4d^95d\ ^3P_2$	02CHU/RYA2	02CHU/RYA2
449.865	0.007	222 289	86		1.27E+9	$4d^94f\ ^3D^\circ_3$	$4d^95d\ ^1F_3$	02CHU/RYA2	02CHU/RYA2
452.201	0.007	221 141	61		3.73E+9	$4d^95p\ ^3D^\circ_2$	$4d^95d\ ^3P_1$	02CHU/RYA2	02CHU/RYA2
467.408	0.007	213 946	152		2.66E+9	$4d^94f\ ^1F^\circ_3$	$4d^95d\ ^1D_2$	02CHU/RYA2	02CHU/RYA2
512.573	0.007	195 094	79		3.14E+8	$4d^95s\ ^3D_2$	$4d^95p\ ^1F^\circ_3$	02CHU/RYA2	02CHU/RYA2
543.493	0.007	183 995	749		5.01E+9	$4d^95s\ ^3D_3$	$4d^95p\ ^3D^\circ_3$	02CHU/RYA2	02CHU/RYA2
546.276	0.007	183 058	490		3.28E+9	$4d^95s\ ^3D_1$	$4d^95p\ ^3D^\circ_2$	02CHU/RYA2	02CHU/RYA2
555.396	0.007	180 052	482		2.56E+9	$4d^95s\ ^3D_2$	$4d^95p\ ^3D^\circ_3$	02CHU/RYA2	02CHU/RYA2
557.345	0.007	179 422	497		4.48E+9	$4d^95s\ ^1D_2$	$4d^95p\ ^3D^\circ_2$	02CHU/RYA2	02CHU/RYA2
557.590	0.007	179 343	517		6.70E+9	$4d^95s\ ^3D_1$	$4d^95p\ ^3D^\circ_1$	02CHU/RYA2	02CHU/RYA2
561.757	0.007	178 013	387		4.23E+9	$4d^95s\ ^3D_2$	$4d^95p\ ^1P^\circ_1$	02CHU/RYA2	02CHU/RYA2
566.383	0.007	176 559	705		3.74E+9	$4d^95s\ ^3D_2$	$4d^95p\ ^1D^\circ_2$	02CHU/RYA2	02CHU/RYA2
569.021	0.007	175 740	491	p	2.38E+9	$4d^95s\ ^3D_2$	$4d^94f\ ^1D^\circ_2$	02CHU/RYA2	02CHU/RYA2
574.369	0.007	174 104	570		7.30E+9	$4d^95s\ ^3D_3$	$4d^95p\ ^3F^\circ_4$	02CHU/RYA2	02CHU/RYA2
576.268	0.007	173 530	796		6.94E+9	$4d^95s\ ^1D_2$	$4d^95p\ ^1F^\circ_3$	02CHU/RYA2	02CHU/RYA2
595.809	0.007	167 839	232		6.70E+9	$4d^95s\ ^3D_1$	$4d^95p\ ^3P^\circ_0$	02CHU/RYA2	02CHU/RYA2
601.478	0.007	166 257	395		2.73E+9	$4d^95s\ ^3D_2$	$4d^95p\ ^3P^\circ_1$	02CHU/RYA2	02CHU/RYA2
630.983	0.007	158 483	79		1.00E+8	$4d^95s\ ^1D_2$	$4d^95p\ ^3D^\circ_3$	02CHU/RYA2	02CHU/RYA2
639.187	0.007	156 449	146		1.73E+9	$4d^95s\ ^1D_2$	$4d^95p\ ^1P^\circ_1$	02CHU/RYA2	02CHU/RYA2
675.341	0.007	148 073	131		1.60E+9	$4d^95s\ ^3D_3$	$4d^95p\ ^3F^\circ_3$	02CHU/RYA2	02CHU/RYA2
687.891	0.007	145 372	78		2.38E+9	$4d^95s\ ^3D_1$	$4d^95p\ ^3F^\circ_2$	02CHU/RYA2	02CHU/RYA2
691.126	0.007	144 691	44		2.50E+9	$4d^95s\ ^1D_2$	$4d^95p\ ^3P^\circ_1$	02CHU/RYA2	02CHU/RYA2
692.857	0.007	144 330	110		4.02E+9	$4d^95s\ ^3D_3$	$4d^95p\ ^3P^\circ_2$	02CHU/RYA2	02CHU/RYA2
693.858	0.007	144 122	102		2.67E+9	$4d^95s\ ^3D_2$	$4d^95p\ ^3F^\circ_3$	02CHU/RYA2	02CHU/RYA2

TABLE 19. Energy levels of Ba XI

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Leading percentages	Reference
$4d^{10}$	^1S	0	0	20		
$4d^95s$	^3D	3	617 769	5	100%	02CHU/RYA2
		2	621 717	5	57%+43% $4d^95s$ ^1D	02CHU/RYA2
		1	639 642	5	100%	02CHU/RYA2
$4d^95s$	^1D	2	643 279	5	57%+43% $4d^95s$ ^3D	02CHU/RYA2
$4d^95p$	$^3P^\circ$	2	762 099	5	71%+20% $4d^95p$ $^3D^\circ$+6% $4d^95p$ $^1D^\circ$	02CHU/RYA2
		1	787 972	5	67%+31% $4d^95p$ $^3D^\circ$	02CHU/RYA2
		0	807 481	5	100%	02CHU/RYA2
$4d^94f$	$^3P^\circ$	0	(764 244)	5	100%	02CHU/RYA2
		1	767 861?	5	97%	02CHU/RYA2
		2	(775 147)	5	90%+7% $4d^94f$ $^3D^\circ$	02CHU/RYA2
$4d^95p$	$^3F^\circ$	3	765 841	5	52%+34% $4d^95p$ $^1F^\circ$+15% $4d^95p$ $^3D^\circ$	02CHU/RYA2
		2	785 014	5	85%+5% $4d^95p$ $^3D^\circ$+5% $4d^95p$ $^3P^\circ$	02CHU/RYA2
		4	791 873	5	96%	02CHU/RYA2
$4d^94f$	$^3H^\circ$	6	785 164	5	100%	02CHU/RYA2
		5	788 813	5	79%+20% $4d^94f$ $^1H^\circ$	02CHU/RYA2
		4	798 415	5	75%+13% $4d^94f$ $^3G^\circ$+9% $4d^94f$ $4d^94f$ $^1G^\circ$	02CHU/RYA2
$4d^94f$	$^1D^\circ$	2	797 456	5	24%+26% $4d^94f$ $^3F^\circ$+22% $4d^95p$ $^1D^\circ$	02CHU/RYA2
$4d^94f$	$^3F^\circ$	3	797 647	5	50%+44% $4d^94f$ $^3D^\circ$	02CHU/RYA2
		4	800 864	5	82%+7% $4d^94f$ $^1G^\circ$	02CHU/RYA2
		2	818 170	5	58%+22% $4d^94f$ $^1D^\circ$+18% $4d^94f$ $^3D^\circ$	02CHU/RYA2
$4d^95p$	$^1D^\circ$	2	798 275	5	41%+14% $4d^95p$ $^3P^\circ$+14% $4d^94f$ $^3F^\circ$	02CHU/RYA2
$4d^95p$	$^1P^\circ$	1	799 729	5	81%+11% $4d^95p$ $^3P^\circ$+7% $4d^95p$ $^3D^\circ$	02CHU/RYA2
$4d^95p$	$^3D^\circ$	3	801 764	5	71%+24% $4d^95p$ $^1F^\circ$	02CHU/RYA2
		1	818 983	5	62%+21% $4d^95p$ $^3P^\circ$+16% $4d^95p$ $^1P^\circ$	02CHU/RYA2
		2	822 700	5	56%+26% $4d^95p$ $^1D^\circ$+12% $4d^95p$ $^3F^\circ$	02CHU/RYA2
$4d^94f$	$^3D^\circ$	1	806 445	5	96%	02CHU/RYA2
		3	810 106	5	44%+25% $4d^94f$ $^3F^\circ$+14% $4d^94f$ $^1F^\circ$	02CHU/RYA2
		2	810 368	5	49%+41% $4d^94f$ $^1D^\circ$+10% $4d^94f$ $^3P^\circ$	02CHU/RYA2
$4d^94f$	$^1H^\circ$	5	806 953	5	45%+49% $4d^94f$ $^3G^\circ$+6% $4d^94f$ $^3H^\circ$	02CHU/RYA2
$4d^94f$	$^1G^\circ$	4	814 978	5	45%+33% $4d^94f$ $^3G^\circ$+22% $4d^94f$ $^3H^\circ$	02CHU/RYA2
$4d^95p$	$^1F^\circ$	3	816 810	5	40%+47% $4d^95p$ $^3F^\circ$+12% $4d^95p$ $^3D^\circ$	02CHU/RYA2
$4d^94f$	$^3G^\circ$	5	819 599	5	50%+35% $4d^94f$ $^1H^\circ$+15% $4d^94f$ $^3H^\circ$	02CHU/RYA2
		3	826 477	5	67%+19% $4d^94f$ $^3F^\circ$+7% $4d^94f$ $^3D^\circ$	02CHU/RYA2
		4	829 664	5	50%+39% $4d^94f$ $^1G^\circ$+11% $4d^94f$ $^3F^\circ$	02CHU/RYA2
$4d^94f$	$^1F^\circ$	3	838 362	5	80%+14% $4d^94f$ $^3G^\circ$	02CHU/RYA2
$4d^94f$	$^1P^\circ$	1	986 281	5	96%	02CHU/RYA2
$4d^95d$	^3S	1	1 014 074	5	79%+20% $4d^95d$ ^3P	02CHU/RYA2
$4d^95d$	^3G	4	1 023 277	5	56%+42% $4d^95d$ ^1G	02CHU/RYA2
		5	1 026 912	5	100%	02CHU/RYA2
		3	1 045 231	5	74%+21% $4d^95d$ ^1F	02CHU/RYA2
$4d^95d$	^3D	2	1 025 224	5	44%+51% $4d^95d$ ^3P	02CHU/RYA2
		3	1 028 187	5	46%+37% $4d^95d$ ^3F	02CHU/RYA2
		1	1 048 878	5	57%+37% $4d^95d$ ^3P	02CHU/RYA2

TABLE 19. Energy levels of Ba XI—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Leading percentages	Reference
$4d^95d$	^1P	1	1 026 776	5	51%+25% $4d^95d$ ^3D	02CHU/RYA2
$4d^95d$	^1F	3	1 032 397	5	39%+41% $4d^95d$ ^3D	02CHU/RYA2
$4d^95d$	^3P	2	1 033 393	5	29%+46% $4d^95d$ ^1D	02CHU/RYA2
		0	1 037 124	5	98%	02CHU/RYA2
		1	1 043 843	5	24%+47% $4d^95d$ ^1P	02CHU/RYA2
$4d^95d$	^3F	4	1 034 703	5	78%+19% $4d^95d$ ^1G	02CHU/RYA2
		2	1 053 907	5	46%+38% $4d^95d$ ^3D	02CHU/RYA2
		3	1 056 532	5	52%+33% $4d^95d$ ^1F	02CHU/RYA2
$4d^95d$	^1G	4	1 051 219	5	39%+41% $4d^95d$ ^3G	02CHU/RYA2
$4d^95d$	^1D	2	1 052 308	5	49%+36% $4d^95d$ ^3F	02CHU/RYA2
$4d^95d$	^1S	0	1 093 342	5	96%	02CHU/RYA2
$4d^95f$	$^3P^\circ$	0	(1 274 651)	5	100%	02CHU/RYA2
		1	(1 276 464)	5	72%+9% $4d^95f$ $^3D^\circ$	02CHU/RYA2
		2	1 279 461	5	54%+28% $4d^95f$ $^3D^\circ$	02CHU/RYA2
$4d^95f$	$^3H^\circ$	6	1 280 388	5	100%	02CHU/RYA2
		5	1 280 639	5	54%+45% $4d^95f$ $^1H^\circ$	02CHU/RYA2
		4	1 302 593	5	78%+13% $4d^95f$ $^1G^\circ$	02CHU/RYA2
$4d^95f$	$^1D^\circ$	2	1 283 134	5	41%+38% $4d^95f$ $^3F^\circ$	02CHU/RYA2
$4d^95f$	$^3F^\circ$	3	1 283 584	5	47%+49% $4d^95f$ $^3D^\circ$	02CHU/RYA2
		4	1 284 817	5	67%+29% $4d^95f$ $^3G^\circ$	02CHU/RYA2
		2	1 305 169	5	62%+20% $4d^95f$ $^1D^\circ$	02CHU/RYA2
$4d^95f$	$^1G^\circ$	4	1 285 532	5	52%+19% $4d^95f$ $^1D^\circ$	02CHU/RYA2
$4d^95f$	$^3G^\circ$	5	1 286 465	5	79%+15% $4d^95f$ $^1H^\circ$	02CHU/RYA2
		3	1 308 076	5	64%+31% $4d^95f$ $^1F^\circ$	02CHU/RYA2
		4	1 308 456	5	45%+34% $4d^95f$ $^1G^\circ$	02CHU/RYA2
$4d^95f$	$^1F^\circ$	3	1 286 869	5	52%+19% $4d^95f$ $^3G^\circ$	02CHU/RYA2
$4d^95f$	$^3D^\circ$	1	(1 290 708)	5	72%+13% $4d^95f$ $^1P^\circ$	02CHU/RYA2
		2	1 300 869	5	27%+33% $4d^95f$ $^3P^\circ$	02CHU/RYA2
		3	1 306 382?	5	30%+42% $4d^95f$ $^3F^\circ$	02CHU/RYA2
$4d^95f$	$^1H^\circ$	5	1 304 247	5	40%+40% $4d^95f$ $^3H^\circ$	02CHU/RYA2
$4d^95f$	$^1P^\circ$	1	(1 319 774)	5	81%+12% $4d^95f$ $^3D^\circ$	02CHU/RYA2
Ba XII ($4d^9$ $^2D_{5/2}$)	*Limit*	—	(1 944 000)			04ROD/IND

6.10. Ba XII

Rh isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^9$ $^2D_{5/2}$
Ionization energy (2 150 000 cm^{-1}); (267 eV)

There are only three papers reporting measurements of the Ba XII spectrum. Using a high voltage, triggered spark to excite the spectrum, Sugar *et al.* [83SUG/TEC] photographed 39 transitions in the 100–125 Å region, involving the $4p^64d^9$ ^2D ground configuration and levels of the $4p^64d^85p$ configuration, on a grazing incidence spectrograph. By extending the spectral observations down to 95 Å, Gayasov and Joshi [98GAY/JOS] located six transitions to levels of the $4p^64d^84f$ configuration. A new analysis based on measurements from 90 to 165 Å by Churilov and Joshi [06CHU/JOS] brought the total number of classified lines to 80 and the number of observed levels to 63. Churilov and Joshi [06CHU/JOS] also reported the first observed transitions to the $4p^54d^{10}$ configuration, which are listed in Table 20.

Churilov and Joshi [06CHU/JOS] noted that *LS* coupling does not describe the odd levels of Ba XII well. However, they indicate that *jj* and J_1j coupling also are not satisfactory choices for the coupling scheme. As a result we first give the ground configuration in Table 21, then arrange the remaining levels by J value, sorted by energy level within each J. In Table 20 the upper levels are designated by the J value and both the configuration of the largest component and the level value to avoid confusion. Predictions for additional energy levels can also be found in Churilov and Joshi [06CHU/JOS].

The transition probabilities were calculated by Churilov and Joshi using the computer code of Cowan [81COW] with relativistic corrections. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.10.1. References for Ba XII

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83SUG/TEC J. Sugar, J. L. Tech, and V. Kaufman, J. Opt. Soc. Am. **73**, 1077 (1983).

98GAY/JOS R. Gayasov and Y. N. Joshi, J. Phys. B **31**, L705 (1998).

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

06CHU/JOS S. S. Churilov and Y. N. Joshi, Phys. Scr. **73**, 188 (2006).

TABLE 20. Observed spectral lines of Ba XII

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
96.924	0.003	1 031 736	38		2.55E+12	$4d^9\ ^2D_{3/2}$	$4p^54d^{10}\ ^2P^\circ$ 1 053 786(1/2)	06CHU/JOS	06CHU/JOS
97.058	0.003	1 030 315	10		1.73E+10	$4d^9\ ^2D_{5/2}$	$4d^84f^\circ$ 1 030 303(5/2)	06CHU/JOS	06CHU/JOS
99.155	0.003	1 008 525	60		2.45E+12	$4d^9\ ^2D_{5/2}$	$4d^84f^\circ$ 1 008 525(7/2)	06CHU/JOS	06CHU/JOS
99.183	0.003	1 008 242	52		2.42E+12	$4d^9\ ^2D_{3/2}$	$4d^84f^\circ$ 1 030 303(5/2)	06CHU/JOS	06CHU/JOS
99.330	0.003	1 006 749	51		2.35E+12	$4d^9\ ^2D_{5/2}$	$4d^84f^\circ$ 1 006 749(3/2)	06CHU/JOS	06CHU/JOS
99.828	0.003	1 001 724	57		2.21E+12	$4d^9\ ^2D_{5/2}$	$4d^84f^\circ$ 1 001 724(5/2)	06CHU/JOS	06CHU/JOS
100.130	0.003	998 700	50		2.20E+12	$4d^9\ ^2D_{3/2}$	$4d^84f^\circ$ 1 020 750(3/2)	06CHU/JOS	06CHU/JOS
104.182	0.003	959 859	50	b	1.20E+10	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 959 832(3/2)	06CHU/JOS	06CHU/JOS
106.635	0.003	937 782	16		4.0E+9	$4d^9\ ^2D_{3/2}$	$4d^85p^\circ$ 959 832(3/2)	06CHU/JOS	06CHU/JOS
109.430	0.003	913 827	26		4.0E+9	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 913 827(7/2)	06CHU/JOS	06CHU/JOS
109.581	0.003	912 565	5		1.7E+9	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 912 562(5/2)	06CHU/JOS	06CHU/JOS
109.898	0.003	909 938	30		5.8E+9	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 909 938(7/2)	06CHU/JOS	06CHU/JOS
110.170	0.003	907 688	7	m	7.E+8	$4d^9\ ^2D_{5/2}$	$4d^84f^\circ$ 907 670(5/2)	06CHU/JOS	06CHU/JOS
110.347	0.003	906 231	18		8.0E+9	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 906 231(3/2)	06CHU/JOS	06CHU/JOS
110.875	0.003	901 918	8		1.3E+9	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 901 920(5/2)	06CHU/JOS	06CHU/JOS
111.280	0.003	898 634	8		1.2E+9	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 898 630(5/2)	06CHU/JOS	06CHU/JOS
111.413	0.003	897 563	26		1.20E+10	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 897 565(3/2)	06CHU/JOS	06CHU/JOS
111.774	0.003	894 664	35		3.58E+10	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 894 680(3/2)	06CHU/JOS	06CHU/JOS
111.922	0.003	893 479	50		2.02E+11	$4d^9\ ^2D_{3/2}$	$4d^85p^\circ$ 915 529(1/2)	06CHU/JOS	06CHU/JOS
112.204	0.003	891 232	16		1.9E+9	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 891 232(7/2)	06CHU/JOS	06CHU/JOS
112.295	0.003	890 509	40		4.58E+10	$4d^9\ ^2D_{3/2}$	$4d^85p^\circ$ 912 562(5/2)	06CHU/JOS	06CHU/JOS
112.437	0.003	889 385	28		7.0E+9	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 889 390(5/2)	06CHU/JOS	06CHU/JOS
112.606	0.003	888 051	19		2.05E+10	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 888 052(3/2)	06CHU/JOS	06CHU/JOS
112.676	0.003	887 503	8		1.2E+9	$4d^9\ ^2D_{3/2}$	$4d^85p^\circ$ 909 553(3/2)	06CHU/JOS	06CHU/JOS
112.916	0.003	885 615	32		6.0E+9	$4d^9\ ^2D_{3/2}$	$4d^84f^\circ$ 907 670(5/2)	06CHU/JOS	06CHU/JOS
113.531	0.003	880 817	15		1.0E+10	$4d^9\ ^2D_{3/2}$	$4d^85p^\circ$ 902 867(1/2)	06CHU/JOS	06CHU/JOS
113.552	0.003	880 653	52		8.28E+10	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 880 653(3/2)	06CHU/JOS	06CHU/JOS
113.651	0.003	879 884	60	d	3.63E+10	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 879 884(7/2)	06CHU/JOS	06CHU/JOS
113.651	0.003	879 884	60	d	1.20E+10	$4d^9\ ^2D_{3/2}$	$4d^85p^\circ$ 901 920(5/2)	06CHU/JOS	06CHU/JOS
113.698	0.003	879 521	43		2.42E+10	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 879 517(5/2)	06CHU/JOS	06CHU/JOS
113.986	0.003	877 303	21		8.2E+9	$4d^9\ ^2D_{5/2}$	$4d^84f^\circ$ 877 303(3/2)	06CHU/JOS	06CHU/JOS
114.080	0.003	876 580	52		5.63E+10	$4d^9\ ^2D_{3/2}$	$4d^85p^\circ$ 898 630(5/2)	06CHU/JOS	06CHU/JOS
114.153	0.003	876 017	47		4.65E+10	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 876 020(3/2)	06CHU/JOS	06CHU/JOS
114.173	0.003	875 868	48		1.20E+10	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 875 868(7/2)	06CHU/JOS	06CHU/JOS
114.218	0.003	875 518	10		2.0E+9	$4d^9\ ^2D_{3/2}$	$4d^85p^\circ$ 897 565(3/2)	06CHU/JOS	06CHU/JOS
114.458	0.003	873 680	52		4.07E+10	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 873 680(5/2)	06CHU/JOS	06CHU/JOS
114.594	0.003	872 645	45		8.70E+10	$4d^9\ ^2D_{3/2}$	$4d^85p^\circ$ 894 680(3/2)	06CHU/JOS	06CHU/JOS
114.765	0.003	871 350	45		2.18E+10	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 871 345(5/2)	06CHU/JOS	06CHU/JOS
114.806	0.003	871 035	59		3.15E+10	$4d^9\ ^2D_{5/2}$	$4d^85p^\circ$ 871 035(7/2)	06CHU/JOS	06CHU/JOS
115.000	0.003	869 568	41		4.03E+10	$4d^9\ ^2D_{5/2}$	$4d^84f^\circ$ 869 568(7/2)	06CHU/JOS	06CHU/JOS
115.071	0.003	869 029	43		1.67E+10	$4d^9\ ^2D_{5/2}$	$4d^84f^\circ$ 869 029(5/2)	06CHU/JOS	06CHU/JOS
115.295	0.003	867 344	35		1.40E+10	$4d^9\ ^2D_{3/2}$	$4d^85p^\circ$ 889 390(5/2)	06CHU/JOS	06CHU/JOS

TABLE 20. Observed spectral lines of Ba XII—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
115.429	0.003	866 331	24		2.0E+10	$4d^9\ ^2D_{3/2}$	$4d^85p°$ 888 382(1/2)	06CHU/JOS	06CHU/JOS
115.473	0.003	866 003	53		1.19E+11	$4d^9\ ^2D_{3/2}$	$4d^85p°$ 888 052(3/2)	06CHU/JOS	06CHU/JOS
115.632	0.003	864 814	60		6.97E+10	$4d^9\ ^2D_{5/2}$	$4d^85p°$ 864 820(5/2)	06CHU/JOS	06CHU/JOS
115.994	0.003	862 112	25		9.0E+9	$4d^9\ ^2D_{5/2}$	$4d^85p°$ 862 100(3/2)	06CHU/JOS	06CHU/JOS
116.038	0.003	861 784	14		7.5E+8	$4d^9\ ^2D_{5/2}$	$4d^84f°$ 861 784(7/2)	06CHU/JOS	06CHU/JOS
116.372	0.003	859 313	53		1.55E+10	$4d^9\ ^2D_{5/2}$	$4d^85p°$ 859 313(7/2)	06CHU/JOS	06CHU/JOS
116.470	0.003	858 590	10	m	7.5E+8	$4d^9\ ^2D_{3/2}$	$4d^85p°$ 880 653(3/2)	06CHU/JOS	06CHU/JOS
116.590	0.003	857 706	12		7.5E+9	$4d^9\ ^2D_{3/2}$	$4d^85p°$ 879 756(1/2)	06CHU/JOS	06CHU/JOS
116.623	0.003	857 463	37		1.60E+10	$4d^9\ ^2D_{3/2}$	$4d^85p°$ 879 517(5/2)	06CHU/JOS	06CHU/JOS
116.659	0.003	857 202	6		1.E+8	$4d^9\ ^2D_{5/2}$	$4d^84f°$ 857 202(7/2)	06CHU/JOS	06CHU/JOS
116.794	0.003	856 210	54		2.02E+10	$4d^9\ ^2D_{5/2}$	$4d^85p°$ 856 210(5/2)	06CHU/JOS	06CHU/JOS
117.100	0.003	853 973	8		3.2E+9	$4d^9\ ^2D_{3/2}$	$4d^85p°$ 876 020(3/2)	06CHU/JOS	06CHU/JOS
117.310	0.003	852 442	14		2.5E+9	$4d^9\ ^2D_{5/2}$	$4d^85p°$ 852 433(3/2)	06CHU/JOS	06CHU/JOS
117.746	0.003	849 289	11		2.2E+9	$4d^9\ ^2D_{3/2}$	$4d^85p°$ 871 345(5/2)	06CHU/JOS	06CHU/JOS
118.236	0.003	845 767	18		7.E+8	$4d^9\ ^2D_{5/2}$	$4d^84f°$ 845 767(5/2)	06CHU/JOS	06CHU/JOS
118.585	0.003	843 280	25		9.E+8	$4d^9\ ^2D_{5/2}$	$4d^85p°$ 843 280(7/2)	06CHU/JOS	06CHU/JOS
118.656	0.003	842 774	16		3.2E+9	$4d^9\ ^2D_{3/2}$	$4d^85p°$ 864 820(5/2)	06CHU/JOS	06CHU/JOS
118.713	0.003	842 366	29		5.8E+9	$4d^9\ ^2D_{5/2}$	$4d^85p°$ 842 367(5/2)	06CHU/JOS	06CHU/JOS
119.042	0.003	840 037	23		4.2E+9	$4d^9\ ^2D_{3/2}$	$4d^85p°$ 862 100(3/2)	06CHU/JOS	06CHU/JOS
119.105	0.003	839 596	9		5.E+8	$4d^9\ ^2D_{5/2}$	$4d^84f°$ 839 600(3/2)	06CHU/JOS	06CHU/JOS
119.611	0.003	836 044	10		2.E+8	$4d^9\ ^2D_{5/2}$	$4d^85p°$ 836 044(5/2)	06CHU/JOS	06CHU/JOS
120.184	0.003	832 056	16		1.E+9	$4d^9\ ^2D_{3/2}$	$4d^85p°$ 854 106(1/2)	06CHU/JOS	06CHU/JOS
120.428	0.003	830 373	19		2.2E+9	$4d^9\ ^2D_{3/2}$	$4d^85p°$ 852 433(3/2)	06CHU/JOS	06CHU/JOS
121.070	0.003	825 969	14		2.5E+8	$4d^9\ ^2D_{5/2}$	$4d^84f°$ 825 969(7/2)	06CHU/JOS	06CHU/JOS
121.854	0.003	820 656	10		4.E+8	$4d^9\ ^2D_{5/2}$	$4d^85p°$ 820 656(7/2)	06CHU/JOS	06CHU/JOS
121.924	0.003	820 181	12		2.5E+9	$4d^9\ ^2D_{3/2}$	$4d^84f°$ 842 231(1/2)	06CHU/JOS	06CHU/JOS
122.179	0.003	818 472	15		1.0E+9	$4d^9\ ^2D_{5/2}$	$4d^84f°$ 818 475(5/2)	06CHU/JOS	06CHU/JOS
122.317	0.003	817 551	16		5.E+8	$4d^9\ ^2D_{3/2}$	$4d^84f°$ 839 600(3/2)	06CHU/JOS	06CHU/JOS
122.725	0.003	814 833	11		1.5E+9	$4d^9\ ^2D_{3/2}$	$4d^85p°$ 836 883(3/2)	06CHU/JOS	06CHU/JOS
123.036	0.003	812 769	17		9.E+8	$4d^9\ ^2D_{5/2}$	$4d^84f°$ 812 769(7/2)	06CHU/JOS	06CHU/JOS
123.590	0.003	809 125	16		9.E+8	$4d^9\ ^2D_{5/2}$	$4d^84f°$ 809 125(7/2)	06CHU/JOS	06CHU/JOS
125.560	0.003	796 430	18		1.0E+9	$4d^9\ ^2D_{3/2}$	$4d^84f°$ 818 475(5/2)	06CHU/JOS	06CHU/JOS
126.009	0.003	793 594	10		3.E+8	$4d^9\ ^2D_{3/2}$	$4d^84f°$ 815 644(5/2)	06CHU/JOS	06CHU/JOS
128.537	0.003	777 984	8		3.E+8	$4d^9\ ^2D_{3/2}$	$4d^84f°$ 800 034(5/2)	06CHU/JOS	06CHU/JOS
129.104	0.003	774 571	6		5.E+8	$4d^9\ ^2D_{3/2}$	$4d^84f°$ 796 621(1/2)	06CHU/JOS	06CHU/JOS
131.812	0.003	758 656	11		1.0E+9	$4d^9\ ^2D_{3/2}$	$4d^84f°$ 780 706(1/2)	06CHU/JOS	06CHU/JOS
139.916	0.003	714 715	15		9.8E+9	$4d^9\ ^2D_{5/2}$	$4p^54d^{10}\ ^2P°$ 714 715(3/2)	06CHU/JOS	06CHU/JOS
144.370	0.003	692 665	7		1.0E+9	$4d^9\ ^2D_{3/2}$	$4p^54d^{10}\ ^2P°$ 714 715(3/2)	06CHU/JOS	06CHU/JOS

TABLE 21. Energy levels of Ba XII

J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Leading percentages	Reference
5/2	0	–	100% $4d^9\ ^2D_{5/2}$	06CHU/JOS
3/2	22 050	15	100% $4d^9\ ^2D_{3/2}$	06CHU/JOS
1/2	780 706	30	50% $4d^8(^1G)4f\ ^2P°$+15% $4p^54d^{10}\ ^2P°$+15% $4d^8(^3F)4f\ ^2P°$	06CHU/JOS
	796 621	30	70% $4d^8(^3F)4f\ ^4D°$+11% $4d^8(^3F)4f\ ^4P°$+7% $4p^54d^{10}\ ^2P°$	06CHU/JOS
	842 231	30	34% $4d^8(^3P)4f\ ^4D°$+32% $4d^8(^3F)4f\ ^2P°$+22% $4p^54d^{10}\ ^2P°$	06CHU/JOS
	854 106	30	33% $4d^8(^3P)5p\ ^4D°$+15% $4d^8(^3P)5p\ ^2P°$+14% $4d^8(^3F)5p\ ^4D°$	06CHU/JOS
	879 756	30	36% $4d^8(^1D)5p\ ^2P°$+25% $4d^8(^3P)5p\ ^4D°$+22% $4d^8(^3F)5p\ ^4D°$	06CHU/JOS
	888 382	30	43% $4d^8(^3F)5p\ ^4D°$+36% $4d^8(^3P)5p\ ^2P°$+6% $4d^8(^1D)5p\ ^2P°$	06CHU/JOS
	902 867	30	59% $4d^8(^3P)5p\ ^2S°$+13% $4d^8(^3P)5p\ ^4P°$+11% $4d^8(^3P)5p\ ^4D°$	06CHU/JOS
	915 529	30	37% $4d^8(^3P)5p\ ^2P°$+31% $4d^8(^1D)5p\ ^2P°$+17% $4d^8(^1S)5p\ ^2P°$	06CHU/JOS
	1 053 786	30	38% $4p^54d^{10}\ ^2P°$+33% $4d^8(^1G)4f\ ^2P°$+25% $4d^8(^3F)4f\ ^2P°$	06CHU/JOS

TABLE 21. Energy levels of Ba XII—Continued

J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Leading percentages	Reference
3/2	714 715	30	74% $4p^54d^{10}\ ^2P^\circ$+20% $4d^8(^1G)4f\ ^2P^\circ$+5% $4d^8(^1D)4f\ ^2P^\circ$	06CHU/JOS
	799 430	30	28% $4d^8(^3F)4f\ ^4P^\circ$+18% $4d^8(^1G)4f\ ^2D^\circ$+12% $4d^8(^1D)4f\ ^2D^\circ$	06CHU/JOS
	836 883	30	28% $4d^8(^1D)5p\ ^2D^\circ$+19% $4d^8(^1D)5p\ ^2P^\circ$+19% $4d^8(^3P)5p\ ^4P^\circ$	06CHU/JOS
	839 600	30	66% $4d^8(^3P)4f\ ^4D^\circ$+10% $4d^8(^1D)4f\ ^2P^\circ$+5% $4d^8(^3F)4f\ ^4F^\circ$	06CHU/JOS
	852 433	30	26% $4d^8(^3P)5p\ ^4D^\circ$+24% $4d^8(^3F)5p\ ^4D^\circ$+20% $4d^8(^3P)5p\ ^4P^\circ$	06CHU/JOS
	862 100	30	19% $4d^8(^3P)5p\ ^4P^\circ$+19% $4d^8(^3P)5p\ ^4D^\circ$+12% $4d^8(^3F)5p\ ^4D^\circ$	06CHU/JOS
	876 020	30	25% $4d^8(^3F)5p\ ^4D^\circ$+23% $4d^8(^3P)5p\ ^2P^\circ$+17% $4d^8(^1D)5p\ ^2D^\circ$	06CHU/JOS
	877 303	30	51% $4d^8(^3P)4f\ ^2D^\circ$+23% $4d^8(^1D)4f\ ^2P^\circ$+10% $4d^8(^3F)4f\ ^2D^\circ$	06CHU/JOS
	880 653	30	42% $4d^8(^1D)5p\ ^2P^\circ$+37% $4d^8(^3F)5p\ ^4F^\circ$+11% $4d^8(^3P)5p\ ^2P^\circ$	06CHU/JOS
	888 052	30	59% $4d^8(^3F)5p\ ^2D^\circ$+15% $4d^8(^1D)5p\ ^2D^\circ$+11% $4d^8(^3F)5p\ ^4D^\circ$	06CHU/JOS
	894 680	30	29% $4d^8(^3P)5p\ ^2P^\circ$+24% $4d^8(^3P)5p\ ^2D^\circ$+13% $4d^8(^3F)5p\ ^4D^\circ$	06CHU/JOS
	897 565	30	23% $4d^8(^3P)5p\ ^4S^\circ$+18% $4d^8(^3P)5p\ ^2D^\circ$+16% $4d^8(^3P)5p\ ^4D^\circ$	06CHU/JOS
	906 231	30	42% $4d^8(^3P)5p\ ^2D^\circ$+19% $4d^8(^3P)5p\ ^4S^\circ$+7% $4d^8(^3F)5p\ ^4F^\circ$	06CHU/JOS
	909 553	30	39% $4d^8(^3P)5p\ ^4S^\circ$+17% $4d^8(^1D)5p\ ^2P^\circ$+16% $4d^8(^1D)5p\ ^2D^\circ$	06CHU/JOS
	959 832	30	83% $4d^8(^1S)5p\ ^2P^\circ$+5% $4d^8(^3P)5p\ ^2D^\circ$	06CHU/JOS
	1 006 749	30	37% $4d^8(^1G)4f\ ^2P^\circ$+29% $4d^8(^3F)4f\ ^2P^\circ$+17% $4p^54d^{10}\ ^2P^\circ$	06CHU/JOS
	1 020 750	30	52% $4d^8(^3F)4f\ ^2D^\circ$+18% $4d^8(^1G)4f\ ^2D^\circ$+10% $4d^8(^1D)4f\ ^2D^\circ$	06CHU/JOS
5/2	800 034	30	31% $4d^8(^1D)4f\ ^2F^\circ$+13% $4d^8(^3F)4f\ ^4P^\circ$+10% $4d^8(^3F)4f\ ^4F^\circ$	06CHU/JOS
	815 644	30	40% $4d^8(^1G)4f\ ^2D^\circ$+16% $4d^8(^3F)4f\ ^4D^\circ$+15% $4d^8(^3F)4f\ ^2D^\circ$	06CHU/JOS
	818 475	30	37% $4d^8(^3F)4f\ ^4G^\circ$+31% $4d^8(^3P)4f\ ^4G^\circ$+12% $4d^8(^3P)4f\ ^4F^\circ$	06CHU/JOS
	836 044	30	23% $4d^8(^1D)5p\ ^2F^\circ$+14% $4d^8(^3P)5p\ ^4D^\circ$+13% $4d^8(^3F)5p\ ^4D^\circ$	06CHU/JOS
	842 367	30	35% $4d^8(^3F)5p\ ^4D^\circ$+31% $4d^8(^3F)5p\ ^4F^\circ$+18% $4d^8(^3F)5p\ ^4G^\circ$	06CHU/JOS
	845 767	30	34% $4d^8(^1G)4f\ ^2F^\circ$+28% $4d^8(^3P)4f\ ^4D^\circ$+9% $4d^8(^1D)4f\ ^2F^\circ$	06CHU/JOS
	856 210	30	27% $4d^8(^3F)5p\ ^4G^\circ$+14% $4d^8(^3P)5p\ ^4P^\circ$+11% $4d^8(^3F)5p\ ^2D^\circ$	06CHU/JOS
	864 820	30	60% $4d^8(^3F)5p\ ^2D^\circ$+13% $4d^8(^3F)5p\ ^4D^\circ$+7% $4d^8(^3P)5p\ ^4P^\circ$	06CHU/JOS
	869 029	30	49% $4d^8(^3P)4f\ ^2D^\circ$+9% $4d^8(^3F)4f\ ^2D^\circ$+7% $4d^8(^3P)5p\ ^4P^\circ$	06CHU/JOS
	871 345	30	26% $4d^8(^1D)5p\ ^2F^\circ$+17% $4d^8(^3P)4f\ ^2D^\circ$+12% $4d^8(^3F)5p\ ^4F^\circ$	06CHU/JOS
	873 680	30	30% $4d^8(^1D)5p\ ^2D^\circ$+18% $4d^8(^3F)5p\ ^2F^\circ$+14% $4d^8(^3P)5p\ ^2D^\circ$	06CHU/JOS
	879 517	30	18% $4d^8(^3F)5p\ ^4F^\circ$+16% $4d^8(^3P)5p\ ^4P^\circ$+14% $4d^8(^3F)5p\ ^2F^\circ$	06CHU/JOS
	889 390	30	34% $4d^8(^3F)5p\ ^2F^\circ$+21% $4d^8(^3P)5p\ ^4P^\circ$+10% $4d^8(^3P)5p\ ^4D^\circ$	06CHU/JOS
	898 630	30	65% $4d^8(^1G)5p\ ^2F^\circ$+11% $4d^8(^1D)5p\ ^2D^\circ$+10% $4d^8(^3F)5p\ ^4F^\circ$	06CHU/JOS
	901 920	30	47% $4d^8(^3P)5p\ ^4D^\circ$+34% $4d^8(^3P)5p\ ^2D^\circ$+6% $4d^8(^3F)5p\ ^4D^\circ$	06CHU/JOS
	907 670	30	63% $4d^8(^1S)4f\ ^2F^\circ$+12% $4d^8(^1D)4f\ ^2F^\circ$+7% $4d^8(^3P)4f\ ^2D^\circ$	06CHU/JOS
	912 562	30	26% $4d^8(^1D)5p\ ^2D^\circ$+17% $4d^8(^3F)5p\ ^2F^\circ$+15% $4d^8(^1G)5p\ ^2F^\circ$	06CHU/JOS
	1 001 724	30	57% $4d^8(^3F)4f\ ^2D^\circ$+22% $4d^8(^1G)4f\ ^2D^\circ$+9% $4d^8(^1D)4f\ ^2D^\circ$	06CHU/JOS
	1 030 303	30	37% $4d^8(^3F)4f\ ^2F^\circ$+31% $4d^8(^3P)4f\ ^2F^\circ$+15% $4d^8(^1D)4f\ ^2F^\circ$	06CHU/JOS
7/2	809 125	30	36% $4d^8(^3F)4f\ ^4G^\circ$+26% $4d^8(^3P)4f\ ^4G^\circ$+16% $4d^8(^1D)4f\ ^2G^\circ$	06CHU/JOS
	812 769	30	23% $4d^8(^1D)4f\ ^2F^\circ$+21% $4d^8(^3F)4f\ ^2G^\circ$+10% $4d^8(^3P)4f\ ^4F^\circ$	06CHU/JOS
	820 656	30	64% $4d^8(^3F)5p\ ^4D^\circ$+18% $4d^8(^3F)5p\ ^4F^\circ$+9% $4d^8(^3F)5p\ ^2F^\circ$	06CHU/JOS
	825 969	30	32% $4d^8(^3P)4f\ ^4F^\circ$+31% $4d^8(^3F)4f\ ^4F^\circ$+16% $4d^8(^3F)4f\ ^4H^\circ$	06CHU/JOS
	843 280	30	59% $4d^8(^3F)5p\ ^4G^\circ$+15% $4d^8(^3F)5p\ ^2G^\circ$+10% $4d^8(^3F)5p\ ^4F^\circ$	06CHU/JOS
	857 202	30	28% $4d^8(^3F)4f\ ^4G^\circ$+24% $4d^8(^3P)4f\ ^4G^\circ$+18% $4d^8(^1G)4f\ ^2G^\circ$	06CHU/JOS
	859 313	30	52% $4d^8(^3F)5p\ ^2F^\circ$+21% $4d^8(^3F)5p\ ^4D^\circ$+10% $4d^8(^3F)5p\ ^4F^\circ$	06CHU/JOS
	861 784	30	28% $4d^8(^1G)4f\ ^2F^\circ$+19% $4d^8(^3F)4f\ ^2F^\circ$+19% $4d^8(^3P)4f\ ^2F^\circ$	06CHU/JOS
	869 568	30	26% $4d^8(^1G)5p\ ^2F^\circ$+16% $4d^8(^1G)4f\ ^2G^\circ$+14% $4d^8(^1D)5p\ ^2F^\circ$	06CHU/JOS
	871 035	30	27% $4d^8(^1G)4f\ ^2G^\circ$+22% $4d^8(^3P)4f\ ^2G^\circ$+21% $4d^8(^1G)5p\ ^2F^\circ$	06CHU/JOS
	875 868	30	24% $4d^8(^1D)5p\ ^2F^\circ$+20% $4d^8(^1G)5p\ ^2F^\circ$+19% $4d^8(^3F)5p\ ^4F^\circ$	06CHU/JOS
	879 884	30	38% $4d^8(^3F)5p\ ^4F^\circ$+26% $4d^8(^3F)5p\ ^2F^\circ$+22% $4d^8(^3F)5p\ ^2G^\circ$	06CHU/JOS
	891 232	30	51% $4d^8(^3P)5p\ ^4D^\circ$+32% $4d^8(^3F)5p\ ^2G^\circ$+12% $4d^8(^3F)5p\ ^4G^\circ$	06CHU/JOS
	909 938	30	59% $4d^8(^1G)5p\ ^2G^\circ$+10% $4d^8(^1G)5p\ ^2F^\circ$+9% $4d^8(^1S)4f\ ^2F^\circ$	06CHU/JOS
	913 827	30	39% $4d^8(^1D)5p\ ^2F^\circ$+15% $4d^8(^1G)5p\ ^2G^\circ$+15% $4d^8(^3P)5p\ ^4D^\circ$	06CHU/JOS
	1 008 525	30	38% $4d^8(^3F)4f\ ^2F^\circ$+33% $4d^8(^3P)4f\ ^2F^\circ$+14% $4d^8(^1D)4f\ ^2F^\circ$	06CHU/JOS
	(2 150 000)	Ba XIII ($4d^8\ ^3F_4$)	*Limit*	04ROD/IND

6.11. Ba XIII

Ru isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^8\ ^3F_4$
Ionization energy (2 390 000 cm^{-1}); (296 eV)

There have been no experimental observations of the Ba XIII spectrum. The ground state is assigned by analogy with Xe XI, which has been measured by Churilov *et al.* [04CHU/JOS]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.11.1. References for Ba XIII

04CHU/JOS S. S. Churilov, Y. N. Joshi, J. Reader, and R. R. Kildiyarova, Phys. Scr. **70**, 126 (2004).
04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

6.12. Ba XIV

Tc isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^7\ ^4F_{9/2}$
Ionization energy (2 620 000 cm^{-1}); (325 eV)

No energy levels or wavelengths have been measured for the Ba XIV spectrum. The ground state has been assigned by analogy with Xe XII, as calculated by Saloman [04SAL]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.12.1. References for Ba XIV

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
04SAL E. B. Saloman J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.13. Ba XV

Mo isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^6\ ^5D_4$
Ionization energy (2 860 000 cm^{-1}); (354 eV)

No measurements of energy levels or wavelengths of the Ba XV spectrum have been published. The ground state has been assigned by analogy with Xe XIII, as calculated by Saloman [04SAL]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.13.1. References for Ba XV

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
04SAL E. B. Saloman, J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.14. Ba XVI

Nb isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^5\ ^6S_{5/2}$
Ionization energy (3 150 000 cm^{-1}); (390 eV)

No measurements of energy levels or wavelengths of the Ba XVI spectrum have been published. The ground state has been assigned by analogy with Xe XIV, as calculated by Saloman [04SAL]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.14.1. References for Ba XVI

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
04SAL E. B. Saloman, J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.15. Ba XVII

Zr isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^4\ ^5D_0$
Ionization energy (3 400 000 cm^{-1}); (422 eV)

No measurements of energy levels or wavelengths of the Ba XVII spectrum have been published. The ground state has been assigned by analogy with Xe XV, as calculated by Saloman [04SAL]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.15.1. References for Ba XVII

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
04SAL E. B. Saloman, J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.16. Ba XVIII

Y isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^3\ ^4F_{3/2}$
Ionization energy (3 670 000 cm^{-1}); (455 eV)

No energy levels or wavelengths have been measured for the Ba XVIII spectrum. The ground state has been assigned by analogy with Xe XVI, as calculated by Saloman [04SAL]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.16.1. References for Ba XVIII

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

04SAL E. B. Saloman, J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.17. Ba XIX

Sr isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^2\ ^3F_2$
Ionization energy (3 940 000 cm^{-1}); (488 eV)

The spectrum of Ba XIX has not been experimentally observed. The ground state given here has been assigned by analogy with Xe XVII, as calculated by Saloman [04SAL]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.17.1. References for Ba XIX

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

04SAL E. B. Saloman, J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.18. Ba XX

Rb isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d\ ^2D_{3/2}$
Ionization energy (4 190 000 cm^{-1}); (520 eV)

Wavelengths of three $4p^64d$-$4p^54d^2$ transitions of ten members of the Rb I isoelectronic series from Pd (Z=46) to Nd (Z=60) were measured by Sugar *et al.* [92SUG/KAU] using radiation from the TEXT tokamak photographed on a grazing-incidence spectrograph. These wavelengths were used to calculate fitted values for corresponding transitions in the Ba XX spectrum, which are listed in Table 22. The ground state given here has been assigned by analogy with Xe XVIII, as calculated by Saloman [04SAL]. Although the lack of a measurement of the splitting of the $4p^64d\ ^2D$ ground configuration precludes a calculation of the other energy level values, the $4p^54d^2(^1G^\circ)\ ^2F^\circ_{5/2}$ level is determined to lie at $1\,000\,520 \pm 50$ cm^{-1}. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.18.1. References for Ba XX

92SUG/KAU J. Sugar, V. Kaufman, and W. L. Rowan, J. Opt. Soc. Am. B **9**, 1959 (1992).

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

04SAL E. B. Saloman J. Phys. Chem. Ref. Data **33**, 765 (2004).

TABLE 22. Spectral lines of Ba XX

λ (Å)	Unc. (Å)	σ (cm^{-1})	Lower Level	Upper Level	λ Ref.
[97.522]	0.005	1 025 410	$4p^64d\ ^2D_{5/2}$	$4p^54d^2(^1G^\circ)\ ^2F^\circ_{7/2}$	92SUG/KAU
[98.301]	0.005	1 017 280	$4p^64d\ ^2D_{5/2}$	$4p^54d^2(^3F^\circ)\ ^2D^\circ_{5/2}$	92SUG/KAU
[99.948]	0.005	1 000 520	$4p^64d\ ^2D_{3/2}$	$4p^54d^2(^1G^\circ)\ ^2F^\circ_{5/2}$	92SUG/KAU

6.19. Ba XXI

Kr isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^6\ ^1S_0$
Ionization energy (5 210 000 cm^{-1}); (646 eV)

Two resonance transitions from the $4p^54d$ configuration in the Kr isoelectronic sequence from Pd XI to Cs XX have been measured by Sugar *et al.* [91SUG/KAU] using radiation from the TEXT tokamak photographed on a grazing-incidence spectrograph. In addition, Sugar *et al.* [91SUG/KAU] observed the $4p^6\ ^1S_0$-$4p^54d\ ^1P^\circ_1$ transition in Nd XXV. These wavelengths were combined with values for Mo VII from Reader *et al.* [72REA/EPS] and for Ru IX and Rh X from Even-Zohar and Fraenkel [72EVE/FRA] to obtain fitted wavelengths for the transitions of the Ba XXI spectrum listed in Table 23 and the energy levels in Table 24. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.19.1. References for Ba XXI

72EVE/FRA M. Even-Zohar and B. S. Fraenkel, J. Phys. B **5**, 1596 (1972).

72REA/EPS J. Reader, G. L. Epstein, and J. O. Ekberg, J. Opt. Soc. Am. **62**, 273 (1972).

91SUG/KAU J. Sugar, V. Kaufman, and W. L. Rowan, J. Opt. Soc. Am. B **8**, 2026 (1991).

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

TABLE 23. Spectral lines of Ba XXI

λ (Å)	Unc. (Å)	σ (cm^{-1})	Lower Level	Upper Level	λ Ref.
[98.666]	0.01	1 013 520	$4p^6\ ^1S_0$	$4p^54d\ ^1P^\circ_1$	91SUG/KAU
[120.183]	0.01	827 610	$4p^6\ ^1S_0$	$4p^54d\ ^3D^\circ_1$	91SUG/KAU

TABLE 24. Energy levels of Ba XXI

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$4p^6$	^1S	0	0		91SUG/KAU
$4d^54d$	$^3D^\circ$	1	[827 610]	70	91SUG/KAU
$4d^54d$	$^1P^\circ$	1	[1 013 520]	100	91SUG/KAU
Ba XXII ($4p^5\ ^2P_{3/2}$)	*Limit*	—	(5 210 000)		04ROD/IND

6.20. Ba XXII

Br isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^5\ ^2P^\circ_{3/2}$
Ionization energy (5 480 000 cm^{-1}); (679 eV)

No energy levels or wavelengths have been measured for the Ba XXII spectrum. The ground state has been assigned by analogy with Xe XX, as calculated by Saloman [04SAL]. A semiempirical value of the splitting of the ground configuration has been obtained by Curtis [87CUR] using the Dirac–Fock method combined with observed splittings for lower Z members of the Br isoelectronic sequence. The $4p^5$ $^2P^\circ_{3/2}$-$^2P^\circ_{3/2}$ splitting obtained was 156 260 cm^{-1}. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.20.1. References for Ba XXII

87CUR L. J. Curtis, Phys. Rev. A **35**, 2089 (1987).
04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
04SAL E. B. Saloman J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.21. Ba XXIII

Se isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^4\ ^3P_2$
Ionization energy (5 780 000 cm^{-1}); (717 eV)

No energy levels or wavelengths have been measured for the Ba XXIII spectrum. The ground state has been assigned by analogy with Xe XXI, as calculated by Saloman [04SAL]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.21.1. References for Ba XXIII

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
04SAL E. B. Saloman J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.22. Ba XXIV

As isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^3\ ^4S^\circ_{3/2}$
Ionization energy (6 070 000 cm^{-1}); (752 eV)

No energy levels or wavelengths have been measured for the Ba XXIV spectrum; however, Charro and Martín [98CHA/MAR] have calculated the energy levels of a few low-lying states and the oscillator strengths for three resonance transitions. The wavelengths and energy levels are listed in Tables 25 and 26. There is no estimate of the uncertainty of their MCDF calculations, but a comparison of experimental and theoretical energy levels for the isoelectronic ions Y VII, Zr VIII, Nb IX, and Mo X indicates that the [98CHA/MAR] values are systematically too high, with an average deviation of about 4000 cm^{-1}. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.22.1. References for Ba XXIV

98CHA/MAR E. Charro and I. Martín, Astron. Astrophys. Suppl. Ser. **131**, 523 (1998).
04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

TABLE 25. Spectral lines of Ba XXIV

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(40.29)	(2 482 000)	2.56E+11	$4p^3\ ^4S^\circ_{3/2}$	$4p^25s\ ^4P_{5/2}$	98CHA/MAR	98CHA/MAR
(40.50)	(2 469 000)	1.78E+11	$4p^3\ ^4S^\circ_{3/2}$	$4p^25s\ ^4P_{3/2}$	98CHA/MAR	98CHA/MAR
(42.86)	(2 333 000)	7.53E+11	$4p^3\ ^4S^\circ_{3/2}$	$4p^25s\ ^4P_{1/2}$	98CHA/MAR	98CHA/MAR

TABLE 26. Energy levels of Ba XXIV

Configuration	Term	J	Energy (cm^{-1})	Reference
$4p^3$	$^4S^\circ$	3/2	(0)	98CHA/MAR
$4p^3$	$^2D^\circ$	3/2	(137 000)	98CHA/MAR
$4p^3$	$^2D^\circ$	5/2	(168 000)	98CHA/MAR
$4p^3$	$^2P^\circ$	1/2	(200 000)	98CHA/MAR
$4p^3$	$^2P^\circ$	3/2	(339 000)	98CHA/MAR
$4p^25s$	^4P	1/2	(2 333 000)	98CHA/MAR
$4p^25s$	^4P	3/2	(2 469 000)	98CHA/MAR
$4p^25s$	^4P	5/2	(2 482 000)	98CHA/MAR
$4p^25s$	^2P	1/2	(2 495 000)	98CHA/MAR
$4p^25s$	^2P	3/2	(2 504 000)	98CHA/MAR
$4p^25s$	^2D	5/2	(2 653 000)	98CHA/MAR
$4p^25s$	^2D	3/2	(2 664 000)	98CHA/MAR
$4p^25s$	^2S	1/2	(2 714 000)	98CHA/MAR
Ba XXV ($4p^2\ ^3P_0$)	*Limit*	—	(6 070 000)	04ROD/IND

6.23. Ba XXV

Ge isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p^2\ ^3P_0$
Ionization energy (6 530 000 cm^{-1}); (809 eV)

Doron *et al.* [98DOR/FRA] have identified four transitions in the x-ray spectrum of Ba XXV. As indicated in Table 27, two of the transitions were blended with lines of other Ba ionization stages and two are arrays of transitions from the ground configuration to $3d^94s^24p^2nf$ levels, where n=5 or 6. The oscillator strengths for these transitions are calculated by Doron *et al.* [98DOR/FRA] using the RELAC computer code [77KLA/SCH]. Charro and Martín [02CHA/MAR] calculated some oscillator strengths for transitions between the ground configuration and the $4s^24p5s$ configuration, but no wavelengths or energy level values for those transitions are reported. The ground state given above has been assigned by analogy with Xe XXIII, as calculated by Saloman [04SAL]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.23.1. References for Ba XXV

77KLA/SCH M. Klapisch, J. L. Schwob, B. S. Fraenkel, and J. Oreg, J. Opt. Soc. Am. **61**, 148 (1977).
98DOR/FRA R. Doron, M. Fraenkel, P. Mandelbaum, A. Zigler, and J. L. Schwob, Phys. Scr. **58**, 19 (1998).
02CHA/MAR E. Charro and I. Martín, Astron. Astrophys. **395**, 719 (2002).
04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
04SAL E. B. Saloman J. Phys. Chem. Ref. Data **33**, 765 (2004).

TABLE 27. Observed spectral lines of Ba XXV

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	*gf*	Lower Level	Upper Level	λ Ref.	*gf* Ref.
9.786	0.005	10 219 000	11	b	6.0	$3d^{10}4s^24p^2$	$3d^9_{3/2}4s^24p^26f^\circ_{5/2}$	98DOR/FRA	98DOR/FRA
9.928	0.005	10 073 000	6		4.5	$3d^{10}4s^24p^2$	$3d^9_{5/2}4s^24p^26f^\circ_{7/2}$	98DOR/FRA	98DOR/FRA
10.757	0.005	9 296 000	15	b	17.	$3d^{10}4s^24p^2$	$3d^9_{3/2}4s^24p^25f^\circ_{5/2}$	98DOR/FRA	98DOR/FRA
10.910	0.005	9 166 000	3		7.0	$3d^{10}4s^24p^2$	$3d^9_{5/2}4s^24p^25f^\circ_{7/2}$	98DOR/FRA	98DOR/FRA

6.24. Ba XXVI

Ga isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^24p\ ^2P^\circ_{1/2}$
Ionization energy (6 820 000 cm^{-1}); (846 eV)

Doron *et al.* [98DOR/FRA, 98DOR/BEH] have identified seven transitions in the x-ray spectrum of Ba XXVI. Their analysis of the spectral feature at 9.1901 Å [98DOR/BEH] indicates that it consists of a combination of transitions from the ground state to $3d^94s^24p7f$ levels and two $3d^{10}4s4p^2$-$3d^94s4p^27f$ transitions. By combining experimental values for ions in the Ga isoelectronic sequence with Z between 31 and 49 and Dirac–Fock calculations, Curtis [84CUR, 87CUR] arrived at a value of 171 181 cm^{-1} for the fine-structure splitting of the two levels of the ground configuration. Ali [97ALI] used the MCDF method and isoelectronic fitting to calculate the splitting to be 171 846 cm^{-1}. Safronova *et al.* [06SAF/COW] confirmed the Ali result, using a relativistic many-body approach to obtain a value just 2 cm^{-1} higher.

The oscillator strengths in Table 28 are calculated by Doron *et al.* [98DOR/FRA] using the RELAC computer code [77KLA/SCH]. Ali [97ALI] reported values of the magnetic dipole and electric quadrupole transition probabilities for the forbidden transition between the levels of the ground configuration to be $A_{M1}=4.46\times10^{+4}$ and $A_{E2}=5.72\times10^{+2}$ s^{-1}, respectively. These values would produce an expected lifetime for the $3d^{10}4s^24p\ ^2P^\circ_{3/2}$ level within 3% of the 2.17 $\times10^{-5}$ s obtained by Safronova *et al.* [06SAF/COW]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.24.1. References for Ba XXVI

84CUR L. J. Curtis, Phys. Rev. A **29**, 2284 (1984).
87CUR L. J. Curtis, Phys. Rev. A **35**, 2089 (1987).
97ALI M. A. Ali, Phys. Scr. **55**, 159 (1997).
98DOR/BEH R. Doron, E. Behar, M. Fraenkel, P. Mandelbaum, A. Zigler, J. L. Schwob, Ya. Faenov, and T. A. Pikuz, Phys. Rev. A **58**, 1859 (1998).
98DOR/FRA R. Doron, M. Fraenkel, P. Mandelbaum, A. Zigler, and J. L. Schwob, Phys. Scr. **58**, 19 (1998).
04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
06SAF/COW U. I. Safronova, T. E. Cowan, and M. S. Safronova, Phys. Lett. A **348**, 293 (2006).

TABLE 28. Observed spectral lines of Ba XXVI

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	*gf*	Lower Level	Upper Level	λ Ref.	*gf* Ref.
9.089	0.005	11 002 000	1.5		1.2	$3d^{10}4s^24p\ ^2P^\circ$	$3d^9_{3/2}4s^24p7f_{5/2}$	98DOR/FRA	98DOR/FRA
9.1845	0.0009	10 887 900	1.0	*		$3d^{10}4s^24p\ ^2P^\circ_{3/2}$	$[(3d^9_{5/2}4s^24p_{3/2})7f_{7/2}]_{5/2}$	98DOR/BEH	
9.1901	0.0009	10 073 000	1.0	c*				98DOR/BEH	
9.572	0.005	11 002 000	13.	b	2.5	$3d^{10}4s^24p\ ^2P^\circ$	$3d^9_{3/2}4s^24p6f_{5/2}$	98DOR/FRA	98DOR/FRA
10.571	0.005	9 460 000	25.		7.3	$3d^{10}4s^24p\ ^2P^\circ$	$3d^9_{3/2}4s^24p5f_{5/2}$	98DOR/FRA	98DOR/FRA
10.720	0.005	9 328 000	3.5		2.8	$3d^{10}4s^24p\ ^2P^\circ$	$3d^9_{5/2}4s^24p5f_{7/2}$	98DOR/FRA	98DOR/FRA
13.097	0.005	7 635 300	4.		32.	$3d^{10}4s^24p\ ^2P^\circ$	$3d^9_{3/2}4s^24p5f_{5/2}$	98DOR/FRA	98DOR/FRA

6.25. Ba XXVII

Zn isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^{10}4s^2\ ^1S_0$
Ionization energy (7 370 000 cm^{-1}); (914 eV)

Several lines of the Ba XXVII spectrum have been observed experimentally and are given in Table 29. Reader and Luther [80REA/LUT] measured the $4s^2\ ^1S_0$-$4s4p\ (1/2,3/2)^\circ_1$ transition. Subsequently Acquista and Reader [84ACQ/REA] remeasured that transition and Sugar *et al.* [91SUG/KAU3] reported a value for the $4s^2\ ^1S_0$-$4s4p\ (1/2,1/2)^\circ_1$ line based on an isoelectronic fit of observed data for other ions. Doron *et al.* [98DOR/BEH, 98DOR/FRA] investigated the 8–13.5 Å region and observed several transitions involving configurations in which one of the 3*d* electrons has been promoted. Biémont [89BIE] used the MCDF technique to calculate energy levels for many of the low-lying configurations and the wavelengths and transition probabilities for transitions between them. Brown *et al.* [94BRO/SEE] combined all the available experimental data for isoelectronic ions from Sn XXI to U LXIII with theoretical calculations to obtain predicted values for most of the $4s4p$, $4p^2$, and $4s4d$ levels. It should be noted that, while the data from Doron *et al.* [98DOR/BEH] are identified using levels specified in *jj* coupling, the papers of Biémont [89BIE] and Brown *et al.* [94BRO/SEE] use *LS* coupling for the $4p^2$ levels. Thus the energies of the $4p^2$ levels indicated in the two classifications of the observed feature at 9.3428 Å cannot be unambiguously matched with the energies in Table 30. For the levels with a $3d^{10}$ core we have included in Table 30 only the $4s^2$, $4s4p$, $4p^2$, and $4s4d$ energies and have used Biémont's notation for the level designations. As mentioned in Sec. 1, the energy and wavelength values in parentheses are calculated, those in square brackets are from isoelectronic fits, and those not enclosed are experimental values.

Transition probabilities for many of the Ba XXVII lines were determined by Biémont [89BIE]. For the transitions to the ground state from the $4s4p\ (1/2,1/2)^\circ_1$ and $4s4p\ (1/2,3/2)^\circ_1$ states, probabilities were also calculated by Curtis [92CUR], Cheng and Huang [92CHE/HUA], and Chou *et al.* [94CHO/CHI]. All the results lie within 10% of each other and we retain the [89BIE] values in Table 29. Doron *et al.* provided transition probabilities for the lines they observed by using the HULLAC [98DOR/BEH] and RELAC [98DOR/FRA] computer codes. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.25.1. References for Ba XXVII

80REA/LUT J. Reader and G. Luther, Phys. Rev. Lett. **45**, 609 (1980).

84ACQ/REA N. Acquista and J. Reader, J. Opt. Soc. B **1**, 649 (1984).

89BIE E. Biémont, At. Data Nucl. Data Tables **43**, 163 (1989).

91SUG/KAUC J. Sugar, V. Kaufman, D. H. Baik, Y.-K. Kim, and W. L. Rowan, J. Opt. Soc. B **8**, 1795 (1991).

92CUR L. J. Curtis, J. Opt. Soc. B **9**, 5 (1992).

92CHE/HUA T.-C. Cheng and K.-N. Huang, Phys. Rev. A **45**, 4367 (1992).

94BRO/SEE C. M. Brown, J. F. Seely, D. R. Kania, B. A. Hammel, C. A. Back, R. W. Lee, A. Bar-Shalom, and W. E. Behring, At. Data Nucl. Data Tables **58**, 203 (1994).

94CHO/CHI H.-S. Chou, H.-C. Chi, and K.-N. Huang, Phys. Rev. A **49**, 2394 (1994).

98DOR/BEH R. Doron, E. Behar, M. Fraenkel, P. Mandelbaum, A. Zigler, J. L. Schwob, Ya. Faenov, and T. A. Pikuz, Phys. Rev. A **58**, 1859 (1998).

98DOR/FRA R. Doron, M. Fraenkel, P. Mandelbaum, A. Zigler, and J. L. Schwob, Phys. Scr. **58**, 19 (1998).

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

TABLE 29. Spectral lines of Ba XXVII

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
8.543	0.005	11 715 000	2.	b	6.09E+13	$4s^2\ ^1S_0$	$(3d^94s^2)8f\ (3/2,5/2)^\circ_1$	98DOR/FRA	98DOR/FRA
8.627	0.005	11 592 000	5.	b	1.49E+14	$4s^2\ ^1S_0$	$(3d^94s^2)8f\ (5/2,7/2)^\circ_1$	98DOR/FRA	98DOR/FRA
8.837	0.005	11 316 000	9.		2.56E+14	$4s^2\ ^1S_0$	$(3d^94s^2)7f\ (3/2,5/2)^\circ_1$	98DOR/FRA	98DOR/FRA
8.953	0.005	11 169 400	11.	b	3.05E+14	$4s^2\ ^1S_0$	$(3d^94s^2)7f\ (5/2,7/2)^\circ_1$	98DOR/FRA	98DOR/FRA
9.3295	0.0009	10 718 700			7.52E+12	$4s4p\ (1/2,3/2)^\circ_1$	$[(3d^9_{3/2}4s)_24p_{3/2}]6f\ (3/2,5/2)_2$	98DOR/BEH	98DOR/BEH
9.3345	0.0009	10 712 900			1.00E+13	$4s4p\ (1/2,3/2)^\circ_1$	$[(3d^9_{3/2}4s)_24p_{3/2}]6f\ (3/2,5/2)_1$	98DOR/BEH	98DOR/BEH
9.3428	0.0009	10 703 400		*	8.10E+12	$4p^2\ (3/2,3/2)_2$	$[3d^9_{3/2}(4p^2_{3/2})_2]6f\ (5/2,5/2)^\circ_3$	98DOR/BEH	98DOR/BEH
9.3428	0.0009	10 703 400		*	7.36E+12	$4p^2\ (1/2,3/2)_2$	$[(3d^9_{3/2}4p_{1/2})_1(4p_{3/2})_2]6f\ (3/2,5/2)^\circ_3$	98DOR/BEH	98DOR/BEH
9.3509	0.0009	10 694 200		*	1.08E+13	$4s4p\ (1/2,3/2)^\circ_2$	$[(3d^9_{3/2}4s)_24p_{3/2}]6f\ (7/2,5/2)_1$	98DOR/BEH	98DOR/BEH
9.3509	0.0009	10 694 200		*	9.43E+12	$4s4p\ (1/2,3/2)^\circ_2$	$[(3d^9_{3/2}4s)_24p_{3/2}]6f\ (5/2,5/2)_3$	98DOR/BEH	98DOR/BEH
9.3509	0.0009	10 694 200		*	9.72E+12	$4s4p\ (1/2,3/2)^\circ_2$	$[(3d^9_{3/2}4s)_24p_{3/2}]6f\ (5/2,5/2)_2$	98DOR/BEH	98DOR/BEH
9.357	0.005	10 687 200	18.		4.57E+14	$4s^2\ ^1S_0$	$(3d^94s^2)6f\ (3/2,5/2)^\circ_1$	98DOR/FRA	98DOR/FRA
9.474	0.005	10 555 200	8.		1.98E+14	$4s^2\ ^1S_0$	$(3d^94s^2)6f\ (5/2,7/2)^\circ_1$	98DOR/FRA	98DOR/FRA
10.371	0.005	9 642 300	15.		3.10E+14	$4s^2\ ^1S_0$	$(3d^94s^2)5f\ (3/2,5/2)^\circ_1$	98DOR/FRA	98DOR/FRA
10.518	0.005	9 507 500	25.	b	5.02E+14	$4s^2\ ^1S_0$	$(3d^94s^2)5f\ (5/2,7/2)^\circ_1$	98DOR/FRA	98DOR/FRA
11.312	0.005	8 840 200	4.		6.95E+13	$4s^2\ ^1S_0$	$(3p^54s^2)4d\ (3/2,5/2)^\circ_1$	98DOR/FRA	98DOR/FRA
12.968	0.005	7 711 300	120		1.59E+15	$4s^2\ ^1S_0$	$(3d^94s^2)4f\ (3/2,5/2)^\circ_1$	98DOR/FRA	98DOR/FRA
[104.396]	0.02	[957 890]			1.41E+11	$4s4p\ (1/2,1/2)^\circ_0$	$4s4d\ (1/2,3/2)_1$	94BRO/SEE	89BIE
[107.488]	0.02	[930 340]			8.50E+10	$4s4p\ (1/2,1/2)^\circ_1$	$4s4d\ (1/2,3/2)_1$	94BRO/SEE	89BIE
[122.201]	0.02	[818 320]			2.21E+10	$4s4p\ (1/2,1/2)^\circ_1$	$4p^2\ ^3P_2$	94BRO/SEE	89BIE
[122.535]	0.02	[816 090]			1.60E+11	$4s4p\ (1/2,3/2)^\circ_2$	$4s4d\ (1/2,5/2)_3$	94BRO/SEE	89BIE
[125.733]	0.02	[795 340]			2.49E+11	$4s4p\ (1/2,3/2)^\circ_1$	$4s4d\ (1/2,5/2)_2$	94BRO/SEE	89BIE
[143.786]	0.02	[695 480]			6.40E+8	$4s4p\ (1/2,3/2)^\circ_1$	$4s4d\ (1/2,3/2)_2$	94BRO/SEE	89BIE
147.972	0.01	675 800			1.22E+11	$4s^2\ ^1S_0$	$4s4p\ (1/2,3/2)^\circ_1$	84ACQ/REA	89BIE
[148.828]	0.02	[671 920]			4.89E+10	$4s4p\ (1/2,1/2)^\circ_0$	$4p^2\ ^3P_1$	94BRO/SEE	89BIE
[149.668]	0.02	[668 140]			6.70E+10	$4s4p\ (1/2,3/2)^\circ_2$	$4p^2\ ^3P_2$	94BRO/SEE	89BIE
[153.215]	0.02	[652 680]			3.06E+10	$4s4p\ (1/2,1/2)^\circ_1$	$4p^2\ ^1D_2$	94BRO/SEE	89BIE
[155.038]	0.02	[645 000]			1.32E+11	$4s4p\ (1/2,3/2)^\circ_1$	$4p^2\ ^1S_0$	94BRO/SEE	89BIE
[233.015]	0.01	[429 160]			3.81E+9	$4s^2\ ^1S_0$	$4s4p\ (1/2,1/2)^\circ_1$	91SUG/KAU3	89BIE

TABLE 30. Energy levels of Ba XXVII

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$4s^2$	^1S	0	0		
4s4p	$(1/2,1/2)^\circ$	0	[401 670]		94BRO/SEE
		1	[429 160]	20	91SUG/KAU3
4s4p	$(1/2,3/2)^\circ$	2	[579 410]		94BRO/SEE
		1	675 800	50	84ACQ/REA
$4p^2$	^3P	0	(929 940)		89BIE
		1	[1 073 590]		94BRO/SEE
		2	[1 247 550]		94BRO/SEE
$4p^2$	^1D	2	[1 081 910]		94BRO/SEE
$4p^2$	^1S	0	[1 320 830]		94BRO/SEE
4s4d	(1/2,3/2)	1	[1 359 560]		94BRO/SEE
		2	[1 371 310]		94BRO/SEE
4s4d	(1/2,5/2)	3	[1 395 500]		94BRO/SEE
		2	[1 471 170]		94BRO/SEE
Ba XXVIII ($4s\ ^2S_{1/2}$)	*Limit*	—	(7 370 000)		04ROD/IND

TABLE 30. Energy levels of Ba XXVII—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
(3d^{9}4s^2)4f	(3/2,5/2)°	1	7 711 300	3000	98DOR/FRA
(3p^{5}4s^2)4d	(3/2,5/2)°	1	8 840 200	4000	98DOR/FRA
(3d^{9}4s^2)5f	(5/2,7/2)°	1	9 507 500	4500	98DOR/FRA
	(3/2,5/2)°	1	9 642 300	5000	98DOR/FRA
(3d^{9}4s^2)6f	(5/2,7/2)°	1	10 555 200	6000	98DOR/FRA
	(3/2,5/2)°	1	10 687 200	6000	98DOR/FRA
(3d^{9}4s^2)7f	(5/2,7/2)°	1	11 169 400	6500	98DOR/FRA
	(3/2,5/2)°	1	11 316 000	6500	98DOR/FRA
(3d^{9}4s^2)8f	(5/2,7/2)°	1	11 592 000	7000	98DOR/FRA
	(3/2,5/2)°	1	11 715 000	7000	98DOR/FRA
[(3d$^9_{3/2}$4s)$_2$4p$_{3/2}$]6f	(7/2,5/2)	1	11 273 600	1000	98DOR/BEH
[(3d$^9_{3/2}$4s)$_2$4p$_{3/2}$]6f	(5/2,5/2)	3	11 273 600	1000	98DOR/BEH
		2	11 273 600	1000	98DOR/BEH
[(3d$^9_{3/2}$4s)$_2$4p$_{3/2}$]6f	(3/2,5/2)	1	11 388 700	1000	98DOR/BEH
		2	11 394 500	1000	98DOR/BEH

6.26. Ba XXVIII

Cu isoelectronic sequence
Ground state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s\ ^2S_{1/2}$
Ionization energy 7 877 000(1000) cm^{-1}; 976.6(1) eV

There are two substantial sets of experimental measurements of the Ba XXVIII spectrum. Reader and Luther [81REA/LUT] used a laser-produced plasma to observe transitions in the region 25–155 Å between levels with a $3d^{10}$ core having a valence electron with $n \leq 6$. Doron *et al.* [98DOR/BEH, 98DOR/FRA] also used laser-produced plasmas, but investigated the 8–13 Å region. The transitions they observed were between $n=4$ levels with a $3d^{10}$ core and levels with either a $3d^9$ or $3p^5$ core. These transitions are summarized in Table 31. Reader and Luther provided a table of their observed energy levels. Levels in Table 32 ascribed to Doron *et al.* [98DOR/BEH, 98DOR/FRA] are obtained by adding their transition energies to the [81REA/LUT] lower level values. The wavelength of the $4s\ ^2S_{1/2}$-$4p\ ^2P_{1/2}$ transition is a Ritz value (denoted by an *R*) because it has been calculated from the energy levels. The ionization energy cited above is taken from Reader and Luther [81REA/LUT], who combined the observed 6*h* energy level with a 6*h* binding energy calculated using the DESCLAUX code [75DES].

For Ba XXVIII transitions between levels with a $3d^{10}$ core, Cheng and Kim [78CHE/KIM] produced the most comprehensive set of transition probabilities, which they calculated using the DESCLAUX code [75DES]. Biémont [88BIE] used the MCDF technique to calculate oscillator strengths and energy levels for the $3d^{10}4s$, $4p$, $4d$, and $4f$ configurations. Curtis and Theodosiou [89CUR/THE] also reported calculations of oscillator strengths for the $4s-4p$ and $4p-4d$ transitions. In general, the agreement between the [78CHE/KIM], [88BIE], and [89CUR/THE] transition probabilities is within 5%. For transitions involving levels with a $3d^9$ or $3p^5$ core, oscillator strengths were given by Doron *et al.*, who used the HULLAC [98DOR/BEH] and RELAC [98DOR/FRA] computer codes, but did not estimate the accuracy of the calculations. Because the *J* values of many of the higher levels have not been established, Table 31 lists the weighted transition probabilities $g_k A_{ki}$ (where *k* indicates the upper level), since this can be obtained from the weighted oscillator strengths given.

6.26.1. References for Ba XXVIII

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TABLE 31. Observed spectral lines of Ba XXVIII

λ (Å)	Unc. (Å)	σ (cm⁻¹)	Int.	Line Code	g_kA_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
8.116	0.005	12 321 000	2	b	1.42E+13	$4s\ ^2S_{1/2}$	$(3d^9_{3/2}4s)9f^\circ_{5/2}$	98DOR/FRA	98DOR/FRA
8.204	0.005	12 189 000	1	b	1.78E+13	$4s\ ^2S_{1/2}$	$(3d^9_{5/2}4s)9f^\circ_{7/2}$	98DOR/FRA	98DOR/FRA
8.322	0.005	12 016 000	1	b	2.22E+13	$4s\ ^2S_{1/2}$	$(3d^9_{3/2}4s)8f^\circ_{5/2}$	98DOR/FRA	98DOR/FRA
8.422	0.005	11 874 000	4	b	2.35E+13	$4s\ ^2S_{1/2}$	$(3d^9_{5/2}4s)8f^\circ_{7/2}$	98DOR/FRA	98DOR/FRA
8.627	0.005	11 592 000	5	b	3.58E+13	$4s\ ^2S_{1/2}$	$(3d^9_{3/2}4s)7f^\circ_{5/2}$	98DOR/FRA	98DOR/FRA
8.723	0.005	11 464 000	6	b	3.33E+13	$4s\ ^2S_{1/2}$	$(3d^9_{5/2}4s)7f^\circ_{7/2}$	98DOR/FRA	98DOR/FRA
9.1428	0.0009	10 937 600		*	5.84E+13	$4p\ ^2P^\circ_{3/2}$	$(3d^9_{3/2}4p_{3/2})6f\ (1,5/2)_{5/2}$	98DOR/BEH	98DOR/BEH
9.1428	0.0009	10 937 600		*	3.78E+13	$4p\ ^2P^\circ_{3/2}$	$(3d^9_{3/2}4p_{3/2})6f\ (2,5/2)_{3/2}$	98DOR/BEH	98DOR/BEH
9.1428	0.0009	10 937 600		*	7.79E+13	$4d\ ^2D_{5/2}$	$(3d^9_{3/2}4d_{5/2})6f\ (3,5/2)^\circ_{7/2}$	98DOR/BEH	98DOR/BEH
9.1491	0.0009	10 930 000		*	2.44E+13	$4s\ ^2S_{1/2}$	$(3d^9_{3/2}4s)6f\ (2,5/2)^\circ_{1/2}$	98DOR/BEH	98DOR/BEH
9.1491	0.0009	10 930 000		*	3.90E+13	$4p\ ^2P^\circ_{1/2}$	$(3d^9_{3/2}4p_{1/2})6f\ (1,5/2)_{3/2}$	98DOR/BEH	98DOR/BEH
9.1518	0.0009	10 926 800			4.72E+13	$4s\ ^2S_{1/2}$	$(3d^9_{3/2}4s)6f\ (2,5/2)^\circ_{3/2}$	98DOR/BEH	98DOR/BEH
9.1578	0.0009	10 919 700			2.36E+13	$4p\ ^2P^\circ_{1/2}$	$(3d^9_{3/2}4p_{1/2})6f\ (2,5/2)_{1/2}$	98DOR/BEH	98DOR/BEH
9.1622	0.0009	10 914 400			2.55E+13	$4d\ ^2D_{3/2}$	$(3d^9_{3/2}4d_{3/2})6f\ (3,5/2)^\circ_{5/2}$	98DOR/BEH	98DOR/BEH
9.1749	0.0009	10 899 300		*	7.32E+12	$4p\ ^2P^\circ_{3/2}$	$(3p^5_{3/2}4p_{3/2})5s\ (3,1/2)_{5/2}$	98DOR/BEH	98DOR/BEH
9.1749	0.0009	10 899 300		*	5.16E+12	$4p\ ^2P^\circ_{1/2}$	$(3p^5_{3/2}4p_{1/2})5s\ (2,1/2)_{3/2}$	98DOR/BEH	98DOR/BEH
9.1749	0.0009	10 899 300		*	2.64E+12	$4s\ ^2S_{1/2}$	$(3p^5_{3/2}4s)5s\ (1,1/2)^\circ_{1/2}$	98DOR/BEH	98DOR/BEH
9.2472	0.0009	10 814 100			3.88E+13	$4p\ ^2P^\circ_{3/2}$	$(3d^9_{5/2}4p_{3/2})6f\ (3,7/2)_{5/2}$	98DOR/BEH	98DOR/BEH
9.2554	0.0009	10 804 500		*	2.08E+13	$4p\ ^2P^\circ_{3/2}$	$(3d^9_{5/2}4p_{3/2})6f\ (3,7/2)_{3/2}$	98DOR/BEH	98DOR/BEH
9.2554	0.0009	10 804 500		*	3.62E+13	$4d\ ^2D_{5/2}$	$(3d^9_{5/2}4d_{5/2})6f\ (4,7/2)^\circ_{7/2}$	98DOR/BEH	98DOR/BEH
9.2601	0.0009	10 799 000			3.20E+13	$4s\ ^2S_{1/2}$	$(3d^9_{5/2}4s)6f\ (2,7/2)^\circ_{3/2}$	98DOR/BEH	98DOR/BEH
9.2640	0.0009	10 794 500		*	3.26E+13	$4p\ ^2P^\circ_{1/2}$	$(3d^9_{5/2}4p_{1/2})6f\ (2,7/2)_{3/2}$	98DOR/BEH	98DOR/BEH
9.2640	0.0009	10 794 500		*	1.62E+13	$4s\ ^2S_{1/2}$	$(3d^9_{5/2}4s)6f\ (3,7/2)^\circ_{1/2}$	98DOR/BEH	98DOR/BEH
10.182	0.005	9 821 300	35		5.79E+13	$4s\ ^2S_{1/2}$	$(3d^9_{3/2}4s)5f^\circ_{5/2}$	98DOR/FRA	98DOR/FRA
10.327	0.005	9 683 400	18		2.38E+13	$4s\ ^2S_{1/2}$	$(3d^9_{5/2}4s)5f^\circ_{7/2}$	98DOR/FRA	98DOR/FRA
10.518	0.005	9 507 500	25	b*	1.63E+13	$4s\ ^2S_{1/2}$	$(3p^5_{1/2}4s)4d\ (1,3/2)^\circ_{3/2}$	98DOR/FRA	98DOR/FRA
10.518	0.005	9 507 500	25	b*	5.49E+13	$4s\ ^2S_{1/2}$	$(3p^5_{1/2}4s)4d\ (1,3/2)^\circ_{1/2}$	98DOR/FRA	98DOR/FRA
11.173	0.005	8 950 100	18		1.60E+13	$4s\ ^2S_{1/2}$	$(3p^5_{3/2}4s)4d\ (1,5/2)^\circ_{3/2}$	98DOR/FRA	98DOR/FRA
11.223	0.005	8 910 300	4		1.11E+14	$4s\ ^2S_{1/2}$	$(3p^5_{3/2}4s)4d\ (1,3/2)^\circ_{1/2}$	98DOR/FRA	98DOR/FRA
12.607	0.005	7 932 100	3		1.68E+14	$4p\ ^2P^\circ_{3/2}$	$(3d^9_{3/2}4d_{3/2})4d\ (0,5/2)_{5/2}$	98DOR/FRA	98DOR/FRA
12.741	0.005	7 848 700	16		2.67E+14	$4s\ ^2S_{1/2}$	$(3d^9_{3/2}4s)4f\ (1,5/2)^\circ_{3/2}$	98DOR/FRA	98DOR/FRA
12.844	0.005	7 785 700	180		8.37E+12	$4s\ ^2S_{1/2}$	$(3d^9_{3/2}4s)4f_{5/2}$	98DOR/FRA	98DOR/FRA
25.222	0.015	3 964 800	2			$4d\ ^2D_{5/2}$	$6f\ ^2F^\circ_{7/2}$	81REA/LUT	
28.094	0.015	3 559 500	5		1.61E+12	$4s\ ^2S_{1/2}$	$5p\ ^2P^\circ_{3/2}$	81REA/LUT	78CHE/KIM
28.757	0.015	3 477 400	3		1.19E+12	$4s\ ^2S_{1/2}$	$5p\ ^2P^\circ_{1/2}$	81REA/LUT	78CHE/KIM
29.035	0.015	3 444 100	5		1.85E+12	$4p\ ^2P^\circ_{1/2}$	$5d\ ^2D_{3/2}$	81REA/LUT	78CHE/KIM
30.476	0.015	3 281 300	15		4.13E+12	$4p\ ^2P^\circ_{3/2}$	$5d\ ^2D_{5/2}$	81REA/LUT	78CHE/KIM
34.653	0.015	2 885 800	25		7.29E+12	$4d\ ^2D_{3/2}$	$5f\ ^2F^\circ_{5/2}$	81REA/LUT	78CHE/KIM
35.050	0.015	2 853 100	35		1.06E+13	$4d\ ^2D_{5/2}$	$5f\ ^2F^\circ_{7/2}$	81REA/LUT	78CHE/KIM
35.684	0.015	2 802 400	3		9.26E+11	$4p\ ^2P^\circ_{1/2}$	$5s\ ^2S_{1/2}$	81REA/LUT	78CHE/KIM
38.146	0.015	2 621 500	3		2.16E+12	$4p\ ^2P^\circ_{3/2}$	$5s\ ^2S_{1/2}$	81REA/LUT	78CHE/KIM
45.436	0.015	2 200 900	5		2.30E+13	$4f\ ^2F^\circ_{5/2}$	$5g\ ^2G_{7/2}$	81REA/LUT	78CHE/KIM
45.523	0.015	2 196 700	30	p	2.97E+13	$4f\ ^2F^\circ_{7/2}$	$5g\ ^2G_{9/2}$	81REA/LUT	78CHE/KIM
93.824	0.015	1 065 820	2	h*		$5g\ ^2G_{7/2}$	$5h\ ^2H^\circ_{9/2}$	81REA/LUT	
93.824	0.015	1 065 820	2	h*		$5g\ ^2G_{9/2}$	$5h\ ^2H^\circ_{11/2}$	81REA/LUT	
108.001	0.015	925 920	15		7.68E+11	$4p\ ^2P^\circ_{1/2}$	$4d\ ^2D_{3/2}$	81REA/LUT	78CHE/KIM
120.274	0.015	831 440	4		8.67E+11	$4d\ ^2D_{3/2}$	$4f\ ^2F^\circ_{5/2}$	81REA/LUT	78CHE/KIM
124.876	0.015	800 790	5		1.11E+12	$4d\ ^2D_{5/2}$	$4f\ ^2F^\circ_{7/2}$	81REA/LUT	78CHE/KIM
127.984	0.015	781 350	10		8.59E+11	$4p\ ^2P^\circ_{3/2}$	$4d\ ^2D_{5/2}$	81REA/LUT	78CHE/KIM
155.770	0.015	641 970	5		2.62E+11	$4s\ ^2S_{1/2}$	$4p\ ^2P^\circ_{3/2}$	81REA/LUT	78CHE/KIM
216.892*R*		461 060			4.79E+10	$4s\ ^2S_{1/2}$	$4p\ ^2P^\circ_{1/2}$	81REA/LUT	78CHE/KIM

TABLE 32. Energy levels of Ba XXVIII

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
4s	^2S	1/2	0		81REA/LUT
4p	$^2P^\circ$	1/2	461 060	200	81REA/LUT
	$^2P^\circ$	3/2	641 970	100	81REA/LUT
4d	^2D	3/2	1 386 980	160	81REA/LUT
	^2D	5/2	1 423 320	110	81REA/LUT
4f	$^2F^\circ$	5/2	2 218 410	190	81REA/LUT
	$^2F^\circ$	7/2	2 224 110	150	81REA/LUT
5s	^2S	1/2	3 263 500	800	81REA/LUT
5p	$^2P^\circ$	1/2	3 477 400	1800	81REA/LUT
	$^2P^\circ$	3/2	3 559 400	1900	81REA/LUT
5d	^2D	3/2	3 905 200	1800	81REA/LUT
	^2D	5/2	3 923 200	1600	81REA/LUT
5f	$^2F^\circ$	5/2	4 272 700	1300	81REA/LUT
	$^2F^\circ$	7/2	4 276 400	1200	81REA/LUT
5g	^2G	7/2	4 419 300	700	81REA/LUT
	^2G	9/2	4 420 800	1400	81REA/LUT
6f	$^2F^\circ$	7/2	5 388 200	2400	81REA/LUT
6h	$^2H^\circ$	9/2,11/2	5 485 900	800	81REA/LUT
$(3d^9_{3/2}4s)4f_{5/2}$	$^\circ$		7 785 700	3000	98DOR/FRA
	$(1,5/2)^\circ$	3/2	7 848 700	3000	98DOR/FRA
Ba XXIX ($3d^{10}\ ^1S_0$)	*Limit*	—	7 877 000	1000	81REA/LUT
$(3d^9_{3/2}4d_{3/2})4d$	(0,5/2)	5/2	8 574 100	3000	98DOR/FRA
$(3p^5_{3/2}4s)4d$	$(1,3/2)^\circ$	1/2	8 910 300	4000	98DOR/FRA
	$(1,5/2)^\circ$	3/2	8 950 100	4000	98DOR/FRA
$(3p^5_{1/2}4s)4d$	$(1,3/2)^\circ$	3/2	9 507 500	4500	98DOR/FRA
	$(1,3/2)^\circ$	1/2	9 507 500	4500	98DOR/FRA
$(3d^9_{5/2}4s)5f_{7/2}$	$^\circ$		9 683 400	5000	98DOR/FRA
$(3d^9_{3/2}4s)5f_{5/2}$	$^\circ$		9 821 300	5000	98DOR/FRA
$(3d^9_{5/2}4s)6f$	$(3,7/2)^\circ$	1/2	10 794 500	1100	98DOR/BEH
	$(2,7/2)^\circ$	3/2	10 799 000	1100	98DOR/BEH
$(3p^5_{3/2}4s)5s$	$(1,1/2)^\circ$	1/2	10 899 300	1100	98DOR/BEH
$(3p^5_{3/2}4s)5s$	$(2,5/2)^\circ$	3/2	10 926 800	1100	98DOR/BEH
	$(2,5/2)^\circ$	1/2	10 930 000	1100	98DOR/BEH
$(3d^9_{5/2}4p_{1/2})6f$	(2,7/2)	3/2	11 255 500	1100	98DOR/BEH
$(3p^5_{3/2}4p_{1/2})5s$	(2,1/2)	3/2	11 360 400	1100	98DOR/BEH
$(3d^9_{3/2}4p_{1/2})6f$	(2,5/2)	1/2	11 380 700	1100	98DOR/BEH
	(1,5/2)	3/2	11 391 100	1100	98DOR/BEH
$(3d^9_{5/2}4p_{3/2})6f$	(3,7/2)	3/2	11 446 500	1100	98DOR/BEH
	(3,7/2)	5/2	11 456 100	1100	98DOR/BEH
$(3d^9_{5/2}4s)7f_{7/2}$	$^\circ$		11 464 000	7000	98DOR/FRA
$(3p^5_{3/2}4p_{3/2})5s$	(3,1/2)	5/2	11 541 300	1100	98DOR/BEH

TABLE 32. Energy levels of Ba XXVIII—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$(3d^9_{3/2}4p_{3/2})6f$	(1,5/2)	5/2	11 579 500	1100	98DOR/BEH
	(2,5/2)	3/2	11 579 500	1100	98DOR/BEH
$(3d^9_{3/2}4s)7f_{5/2}$	°		11 592 000	7000	98DOR/FRA
$(3d^9_{5/2}4s)8f_{7/2}$	°		11 874 000	7000	98DOR/FRA
$(3d^9_{3/2}4s)8f_{5/2}$	°		12 016 000	7000	98DOR/FRA
$(3d^9_{5/2}4s)9f_{7/2}$	°		12 189 000	7000	98DOR/FRA
$(3d^9_{5/2}4d_{5/2})6f$	(4,7/2)°	7/2	12 227 800	1100	98DOR/BEH
$(3d^9_{3/2}4d_{3/2})6f$	(3,5/2)°	5/2	12 301 400	1100	98DOR/BEH
$(3d^9_{3/2}4s)9f_{5/2}$	°		12 321 000	7500	98DOR/FRA
$(3d^9_{3/2}4d_{5/2})6f$	(3,5/2)°	7/2	12 360 900	1100	98DOR/BEH

6.27. Ba XXIX

Ni isoelectronic sequence
Ground state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}\ ^1S_0$
Ionization energy (13 671 000 cm^{-1}); (1695 eV)

A few transitions of the Ba XXIX spectrum have been observed experimentally by Doron *et al.* [98DOR/FRA], who used a laser-produced plasma to obtain spectra in the 8–13.5 Å region. In addition, Träbert *et al.* [06TRA/BEI] observed the resonance transition from the $3d^9 4s\ ^3D_3$ level, but reported only the lifetime of the upper level, not the wavelength of the transition. Schofield and MacGowan [92SCH/MAC] reported MCDF results for wavelengths of transitions between a few levels of the $3d^9 4p$ and $3d^9 4d$ configurations. They then corrected their results using a semiempirical fit along the isoelectronic sequence. Using the MCDF approach, Quinet and Biémont [91QUI/BIE] produced values for transition rates and wavelengths for transitions to the ground state from odd parity levels with $J=1$ in the $3d^9 4p$, $3d^9 4f$, $3p^5 3d^{10} 4s$, and $3p^5 3d^{10} 4d$ configurations for Ni-like ions. Later Safronova *et al.* [00SAF/JOH] recalculated these wavelengths using relativistic many-body perturbation theory and achieved a closer agreement with experimental data for those elements that have been observed. This work was extended in Safronova *et al.* [06SAF/SAF] resulting in more available wavelengths and transition probabilities for some forbidden transitions.

The experimental wavelengths reported in Table 33 and their transition probabilities are from Doron *et al.* [98DOR/FRA], while the fitted values are from Schofield and MacGowan [92SCH/MAC]. Schofield and MacGowan estimated that the uncertainty in the transition energies for their corrected data is about 800 cm^{-1}. The unresolved transition arrays involving $3d^8 4snf$ observed by Doron *et al.* [98DOR/FRA] can be used to approximately locate the upper energy levels. We obtained the values listed by adding the configuration average energy (5 455 000 cm^{-1}) for the $3d^9 4s$ lower configuration to the transition energies. The uncertainty introduced by this procedure is indicated by the $+x$ in Table 34. The theoretical values for the $3d^9 4s$, $3d^9 4p$, and $3d^9 4d$ levels retained in Table 34 (and the wavelengths of the $3d^9 4p$ resonance transitions) are taken from Safronova *et al.* [06SAF/SAF], whose designations were given in *LS* coupling. To consistently present all levels in *jj* coupling in Tables 33 and 34 we have assigned *jj* labels to the [06SAF/SAF] levels based on calculations using the Cowan code [81COW]. Estimated uncertainties are not reported for the [06SAF/SAF] level values. The energy level value for the $3d^9 4d$ $(3/2,3/2)_0$ level is obtained by adding the energies of three [92SCH/MAC] transitions to the [06SAF/SAF] values for the $3d^9 4p$ lower levels and averaging the results. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND]. Ivanova and Tsirekidze [86IVA/TSE] also calculated the ionization energy, obtaining a value of 13 706 000 cm^{-1}.

6.27.1. References for Ba XXIX

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TABLE 33. Spectral lines of Ba XXIX

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	g_kA_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
8.116	0.005	12 321 000	2	b*	1.22E+13	$3d^{10}\ ^1S_0$	$3d^98f\ (3/2,5/2)^\circ_1$	98DOR/FRA	98DOR/FRA
8.204	0.005	12 189 000	1	b*	1.29E+13	$3d^{10}\ ^1S_0$	$3d^98f\ (5/2,7/2)^\circ_1$	98DOR/FRA	98DOR/FRA
8.204	0.005	12 189 000	1	b,c*	1.29E+14	$3d^94s$	$3d^84s7f\ m^\circ$	98DOR/FRA	98DOR/FRA
8.250	0.005	12 121 000	0.5	c	1.57E+14	$3d^94s$	$3d^84s7f\ l^\circ$	98DOR/FRA	98DOR/FRA
8.273	0.005	12 088 000	0.5	c	5.65E+13	$3d^94s$	$3d^84s7f\ k^\circ$	98DOR/FRA	98DOR/FRA
8.322	0.005	12 016 000	1	b,c*	1.06E+14	$3d^94s$	$3d^84s7f\ j^\circ$	98DOR/FRA	98DOR/FRA
8.357	0.005	11 966 000	0.5	c	1.24E+14	$3d^94s$	$3d^84s7f\ i^\circ$	98DOR/FRA	98DOR/FRA
8.422	0.005	11 874 000	4	b*	2.82E+13	$3d^{10}\ ^1S_0$	$3d^97f\ (3/2,5/2)^\circ_1$	98DOR/FRA	98DOR/FRA
8.519	0.005	11 738 000	2.5		2.67E+13	$3d^{10}\ ^1S_0$	$3d^97f\ (5/2,7/2)^\circ_1$	98DOR/FRA	98DOR/FRA
8.723	0.005	11 464 000	6	b,c*	2.72E+14	$3d^94s$	$3d^84s6f\ h^\circ$	98DOR/FRA	98DOR/FRA
8.759	0.005	11 417 000	1.5	c	2.78E+14	$3d^94s$	$3d^84s6f\ g^\circ$	98DOR/FRA	98DOR/FRA
8.953	0.005	11 694 000	11	b*	5.08E+13	$3d^{10}\ ^1S_0$	$3d^96f\ (3/2,5/2)^\circ_1$	98DOR/FRA	98DOR/FRA
9.055	0.005	11 044 000	8		3.25E+13	$3d^{10}\ ^1S_0$	$3d^96f\ (5/2,7/2)^\circ_1$	98DOR/FRA	98DOR/FRA
9.744	0.005	10 263 000	8	c	7.03E+14	$3d^94s$	$3d^84s5f\ f^\circ$	98DOR/FRA	98DOR/FRA
9.786	0.005	10 219 000	11	b,c*	6.55E+14	$3d^94s$	$3d^84s5f\ e^\circ$	98DOR/FRA	98DOR/FRA
9.907	0.005	10 094 000	3.5	c	3.19E+14	$3d^94s$	$3d^84s5f\ d^\circ$	98DOR/FRA	98DOR/FRA
9.948	0.005	10 052 000	6	c	3.77E+14	$3d^94s$	$3d^84s5f\ c^\circ$	98DOR/FRA	98DOR/FRA
9.998	0.005	10 002 000	17		1.07E+14	$3d^{10}\ ^1S_0$	$3d^95f\ (3/2,5/2)^\circ_1$	98DOR/FRA	98DOR/FRA
10.075	0.005	9 925 600	11		9.20E+12	$3d^{10}\ ^1S_0$	$(3s3p^63d^{10})4p\ (1/2,1/2)^\circ_1$	98DOR/FRA	98DOR/FRA
10.138	0.005	9 863 900	12		3.44E+13	$3d^{10}\ ^1S_0$	$3d^95f\ (5/2,7/2)^\circ_1$	98DOR/FRA	98DOR/FRA
10.388	0.005	9 626 500	15		2.73E+13	$3d^{10}\ ^1S_0$	$(3p^53d^{10})4d\ (1/2,3/2)^\circ_1$	98DOR/FRA	98DOR/FRA
11.072	0.005	9 031 800	18		5.22E+13	$3d^{10}\ ^1S_0$	$(3p^53d^{10})4d\ (3/2,5/2)^\circ_1$	98DOR/FRA	98DOR/FRA
12.411	0.005	8 057 400	70	c	4.29E+15	$3d^94s$	$3d^84s4f\ b^\circ$	98DOR/FRA	98DOR/FRA
12.519	0.005	7 987 900	30	c	3.66E+14	$3d^94s$	$3d^84s4f\ a^\circ$	98DOR/FRA	98DOR/FRA
12.721	0.005	7 861 000	100		2.23E+14	$3d^{10}\ ^1S_0$	$3d^94f\ (3/2,5/2)^\circ_1$	98DOR/FRA	98DOR/FRA
13.046	0.005	7 665 200	9		2.08E+13	$3d^{10}\ ^1S_0$	$3d^94f\ (5/2,7/2)^\circ_1$	98DOR/FRA	98DOR/FRA
13.136	0.005	7 612 700	10		2.05E+13	$3d^{10}\ ^1S_0$	$(3p^53d^{10})4s\ (3/2,1/2)^\circ_1$	98DOR/FRA	98DOR/FRA
(16.174)		(6 182 800)			1.24E+12	$3d^{10}\ ^1S_0$	$3d^94p\ (3/2,3/2)^\circ_1$	06SAF/SAF	06SAF/SAF
(16.505)		(6 058 800)			8.91E+12	$3d^{10}\ ^1S_0$	$3d^94p\ (5/2,3/2)^\circ_1$	06SAF/SAF	06SAF/SAF
(16.655)		(6 004 200)			2.05E+12	$3d^{10}\ ^1S_0$	$3d^94p\ (3/2,1/2)^\circ_1$	06SAF/SAF	06SAF/SAF
[87.65]	0.06	[1 140 900]				$3d^94p\ (3/2,1/2)^\circ_1$	$3d^94d\ (3/2,3/2)_0$	92SCH/MAC	
[92.12]	0.07	[1 085 500]				$3d^94p\ (5/2,1/2)^\circ_1$	$3d^94d\ (3/2,3/2)_0$	92SCH/MAC	
[103.87]	0.09	[962 700]				$3d^94p\ (3/2,3/2)^\circ_1$	$3d^94d\ (3/2,3/2)_0$	92SCH/MAC	
[127.82]	0.13	[782 400]				$3d^94p\ (5/2,3/2)^\circ_1$	$3d^94d\ (5/2,5/2)_2$	92SCH/MAC	
[132.92]	0.14	[752 300]				$3d^94p\ (5/2,3/2)^\circ_1$	$3d^94d\ (5/2,5/2)_1$	92SCH/MAC	

TABLE 34. Energy levels of Ba XXIX

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$3d^{10}$	^1S	0	0		
$3d^94s$	(5/2,1/2)	3	(5 398 400)		06SAF/SAF
		2	(5 407 200)		06SAF/SAF
$3d^94s$	(3/2,1/2)	1	(5 530 100)		06SAF/SAF
		2	(5 537 100)		06SAF/SAF
$3d^94p$	$(5/2,1/2)^\circ$	2	(5 855 500)		06SAF/SAF
		3	(5 864 400)		06SAF/SAF

TABLE 34. Energy levels of Ba XXIX—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$3d^9 4p$	$(3/2,1/2)^{\circ}$	2	(5 990 500)		06SAF/SAF
		1	(6 004 200)		06SAF/SAF
$3d^9 4p$	$(5/2,3/2)^{\circ}$	1	(6 058 800)		06SAF/SAF
		2	(6 054 400)		06SAF/SAF
		3	(6 068 000)		06SAF/SAF
$3d^9 4p$	$(3/2,3/2)^{\circ}$	3	(6 182 000)		06SAF/SAF
		1	(6 182 800)		06SAF/SAF
		2	(6 195 400)		06SAF/SAF
$3d^9 4d$	(5/2,3/2)	1	(6 756 800)		06SAF/SAF
		2	(6 791 200)		06SAF/SAF
		3	(6 802 300)		06SAF/SAF
$3d^9 4d$	(5/2,5/2)	1	(6 811 500)		06SAF/SAF
		3	(6 835 300)		06SAF/SAF
		2	(6 842 300)		06SAF/SAF
$3d^9 4d$	(3/2,3/2)	1	(6 911 300)		06SAF/SAF
		3	(6 915 200)		06SAF/SAF
		2	(6 942 500)		06SAF/SAF
		0	(7 145 000)		06SAF/SAF,92SCH/MAC
$3d^9 4d$	(3/2,5/2)	1	(6 943 000)		06SAF/SAF
		2	(6 965 200)		06SAF/SAF
		3	(6 974 500)		06SAF/SAF
$(3p^5 3d^{10})4s$	$(3/2,1/2)^{\circ}$	1	7 612 700	3000	98DOR/FRA
$3d^9 4f$	$(5/2,7/2)^{\circ}$	1	7 665 200	3000	98DOR/FRA
	$(3/2,5/2)^{\circ}$	1	7 861 000	3000	98DOR/FRA
$(3p^5 3d^{10})4d$	$(3/2,5/2)^{\circ}$	1	9 031 800	4000	98DOR/FRA
	$(1/2,3/2)^{\circ}$	1	9 626 500	5000	98DOR/FRA
$3d^9 5f$	$(5/2,7/2)^{\circ}$	1	9 863 900	5000	98DOR/FRA
	$(3/2,5/2)^{\circ}$	1	10 002 000	5000	98DOR/FRA
$(3s3p^6 3d^{10})4p$	$(1/2,1/2)^{\circ}$	1	9 925 600	5000	98DOR/FRA
$3d^9 6f$	$(5/2,7/2)^{\circ}$	1	11 044 000	6000	98DOR/FRA
	$(3/2,5/2)^{\circ}$	1	11 694 000	6000	98DOR/FRA
$3d^9 7f$	$(5/2,7/2)^{\circ}$	1	11 738 000	7000	98DOR/FRA
	$(3/2,5/2)^{\circ}$	1	11 874 000	7000	98DOR/FRA
$3d^9 8f$	$(5/2,7/2)^{\circ}$	1	12 189 000	7000	98DOR/FRA
	$(3/2,5/2)^{\circ}$	1	12 321 000	8000	98DOR/FRA
$3d^8 4s4f$	a°		13 442 900+x	3000	98DOR/FRA
	b°		13 512 400+x	3000	98DOR/FRA
Ba XXX ($3d^9$ $^2D_{5/2}$)	*Limit*	—	13 671 000		04ROD/IND
$3d^8 4s5f$	c°		15 507 000+x	5000	98DOR/FRA
	d°		15 549 000+x	5000	98DOR/FRA
	e°		15 674 000+x	5000	98DOR/FRA
	f°		15 718 000+x	5000	98DOR/FRA
$3d^8 4s6f$	g°		16 872 000+x	7000	98DOR/FRA
	h°		16 919 000+x	7000	98DOR/FRA
$3d^8 4s7f$	i°		17 421 000+x	7000	98DOR/FRA

TABLE 34. Energy levels of Ba XXIX—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
	$j°$		17 471 000+x	7000	98DOR/FRA
	$k°$		17 543 000+x	7000	98DOR/FRA
	$l°$		17 576 000+x	7000	98DOR/FRA
	$m°$		17 644 000+x	7000	98DOR/FRA

6.28. Ba XXX

Co isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^9$ $^2D_{5/2}$
Ionization energy (14 324 000 cm^{-1}); (1776 eV)

Wavelengths and energy levels of the Ba XXX spectrum have been experimentally observed by two research groups. Reader [83REA2] observed the three allowed $3p^63d^9-3p^53d^{10}$ transitions. Ekberg *et al.* [87EKB/FEL] included these data, along with MCDF calculations of wavelengths in an isoelectronic fit to obtain the more certain values for the energy levels of the $3p^63d^9$ and $3p^53d^{10}$ configurations. The second set of experimental observations were performed by Doron *et al.* [98DOR/FRA], who used a laser-produced plasma to obtain spectra of highly ionized barium in the 8–13.5 Å region. The majority of transitions observed involve promotion of one of the $3d$ electrons, although a few involve the $3p$ electrons. Doron *et al.* [98DOR/FRA] assigned two of the transitions to an unresolved transition array between the $3d^84s$ and $3d^74s4f$ configurations. It should be noted that the configurations in Ba XXX are very mixed. We have retained the intermediate coupling used by Doron *et al.* [98DOR/FRA] in order to have unique names for each level, even though in a few cases the leading percentage is very small. As indicated by the ?s in Tables 35 and 36, the designations of the $3d^87f$ levels are tentative.

Data on transition probabilities for Ba XXX are very limited. Biémont and Hansen [89BIE/HAN] reported magnetic dipole (M1) and electric quadrupole (E2) transition probabilities for the forbidden transition between the $^2D_{3/2}$ and $^2D_{5/2}$ levels of the ground configuration. The M1 probability is much larger than the E2 so the A_{ki} cited below is the M1 value. In addition, Doron *et al.* [98DOR/FRA] provided oscillator strengths for the transitions they observed. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.28.1. References for Ba XXX

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TABLE 35. Spectral lines of Ba XXX

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
8.033	0.005	12 448 649	0.5	b*	3.10E+12	$3d^9$ $^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]7f$ $(4,5/2)°_{5/2}$?	98DOR/FRA	98DOR/FRA
8.033	0.005	12 448 649	0.5	b*	4.39E+12	$3d^9$ $^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]7f$ $(4,5/2)°_{3/2}$?	98DOR/FRA	98DOR/FRA
8.054	0.005	12 416 191	1.0		5.48E+12	$3d^9$ $^2D_{3/2}$	$[3d^2_{3/2}3d^6_{5/2}]7f$ $(2,5/2)°_{5/2}$?	98DOR/FRA	98DOR/FRA
8.155	0.005	12 262 416	0.5		3.68E+12	$3d^9$ $^2D_{5/2}$	$[3d^4_{3/2}3d^4_{5/2}]7f$ $(4,7/2)°_{5/2}$?	98DOR/FRA	98DOR/FRA
8.543	0.005	11 705 490	2.0	c*	2.13E+12	$3d^9$ $^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]6f$ $(4,5/2)°_{5/2}$	98DOR/FRA	98DOR/FRA
8.543	0.005	11 705 490	2.0	c*	5.37E+12	$3d^9$ $^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]6f$ $(4,5/2)°_{7/2}$	98DOR/FRA	98DOR/FRA
8.543	0.005	11 705 490	2.0	c*	6.09E+12	$3d^9$ $^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]6f$ $(4,7/2)°_{5/2}$	98DOR/FRA	98DOR/FRA
8.543	0.005	11 705 490	2.0	c*	7.77E+12	$3d^9$ $^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]6f$ $(4,5/2)°_{3/2}$	98DOR/FRA	98DOR/FRA
8.572	0.005	11 665 889	3.5	c*	4.20E+12	$3d^9$ $^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]6f$ $(2,5/2)°_{7/2}$	98DOR/FRA	98DOR/FRA
8.572	0.005	11 665 889	3.5	c*	1.09E+13	$3d^9$ $^2D_{3/2}$	$[3d^2_{3/2}3d^6_{5/2}]6f$ $(2,5/2)°_{5/2}$	98DOR/FRA	98DOR/FRA
8.572	0.005	11 665 889	3.5	c*	1.02E+13	$3d^9$ $^2D_{3/2}$	$[3d^2_{3/2}3d^6_{5/2}]6f$ $(2,5/2)°_{3/2}$	98DOR/FRA	98DOR/FRA
8.700	0.005	11 494 253	3.0	c*	5.40E+12	$3d^9$ $^2D_{5/2}$	$[3d^4_{3/2}3d^4_{5/2}]6f$ $(2,7/2)°_{7/2}$	98DOR/FRA	98DOR/FRA
8.700	0.005	11 494 253	3.0	c*	3.08E+12	$3d^9$ $^2D_{5/2}$	$[3d^4_{3/2}3d^4_{5/2}]6f$ $(2,7/2)°_{5/2}$	98DOR/FRA	98DOR/FRA
8.700	0.005	11 494 253	3.0	c*	4.70E+12	$3d^9$ $^2D_{5/2}$	$[3d^4_{3/2}3d^4_{5/2}]6f$ $(4,7/2)°_{5/2}$	98DOR/FRA	98DOR/FRA
8.700	0.005	11 494 253	3.0	c*	2.31E+12	$3d^9$ $^2D_{5/2}$	$[3d^4_{3/2}3d^4_{5/2}]6f$ $(4,7/2)°_{7/2}$	98DOR/FRA	98DOR/FRA
9.572	0.005	10 447 137	13.	b*	2.18E+13	$3d^9$ $^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]5f$ $(4,5/2)°_{5/2}$	98DOR/FRA	98DOR/FRA
9.572	0.005	10 447 137	13.	b*	2.27E+13	$3d^9$ $^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]5f$ $(4,5/2)°_{7/2}$	98DOR/FRA	98DOR/FRA
9.605	0.005	10 411 244	10.	b*	2.53E+13	$3d^9$ $^2D_{3/2}$	$[3d^2_{3/2}3d^6_{5/2}]5f$ $(2,5/2)°_{5/2}$	98DOR/FRA	98DOR/FRA

TABLE 35. Spectral lines of Ba XXX—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
9.605	0.005	10 411 244	10.	b*	2.71E+13	$3d^9\ ^2D_{3/2}$	$[3d^2_{3/2}3d^6_{5/2}]5f\ (2,5/2)^\circ_{3/2}$	98DOR/FRA	98DOR/FRA
9.683	0.005	10 327 378	3.0		1.67E+13	$3d^9\ ^2D_{3/2}$	$[3d^3_{3/2}3d^5_{5/2}]5f\ (4,7/2)^\circ_{1/2}$	98DOR/FRA	98DOR/FRA
9.684	0.005	10 326 311	2.0	b*	6.93E+12	$3d^9\ ^2D_{5/2}$	$[3d^4_{3/2}3d^4_{5/2}]5f\ (2,7/2)^\circ_{7/2}$	98DOR/FRA	98DOR/FRA
10.757	0.005	9 296 272	15.	b*	2.59E+12	$3d^9\ ^2D_{3/2}$	$[3p^5_{3/2}3d^9_{3/2}]4d\ (3,5/2)^\circ_{3/2}$	98DOR/FRA	98DOR/FRA
10.757	0.005	9 296 272	15.	b*	1.30E+12	$3d^9\ ^2D_{5/2}$	$[3p^5_{3/2}3d^9_{5/2}]4d\ (3,5/2)^\circ_{7/2}$	98DOR/FRA	98DOR/FRA
10.805	0.005	9 254 975	3.0	c*	9.28E+12	$3d^9\ ^2D_{5/2}$	$[3p^5_{3/2}3d^9_{5/2}]4d\ (3,3/2)^\circ_{3/2}$	98DOR/FRA	98DOR/FRA
10.805	0.005	9 254 975	3.0	c*	6.00E+12	$3d^9\ ^2D_{3/2}$	$[3p^5_{3/2}3d^9_{3/2}]4d\ (2,5/2)^\circ_{5/2}$	98DOR/FRA	98DOR/FRA
10.805	0.005	9 254 975	3.0	c*	6.43E+12	$3d^9\ ^2D_{5/2}$	$[3p^5_{3/2}3d^9_{5/2}]4d\ (2,5/2)^\circ_{7/2}$	98DOR/FRA	98DOR/FRA
10.893	0.005	9 180 207	7.		5.06E+12	$3d^9\ ^2D_{5/2}$	$[3p^5_{3/2}3d^9_{5/2}]4d\ (2,3/2)^\circ_{5/2}$	98DOR/FRA	98DOR/FRA
12.004	0.005	8 330 556	20.	*		$3d^84s$	$3d^74s4f^\circ$	98DOR/FRA	
12.072	0.005	8 283 632	20.	*		$3d^84s$	$3d^74s4f^\circ$	98DOR/FRA	
12.158	0.005	8 225 037	5.		5.19E+13	$3d^9\ ^2D_{3/2}$	$[3d^2_{3/2}3d^6_{5/2}]4f\ (0,5/2)^\circ_{5/2}$	98DOR/FRA	98DOR/FRA
12.236	0.005	8 172 605	9.	b*	7.80E+13	$3d^9\ ^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]4f\ (2,5/2)^\circ_{7/2}$	98DOR/FRA	98DOR/FRA
12.236	0.005	8 172 605	9.	b*	7.28E+13	$3d^9\ ^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]4f\ (4,5/2)^\circ_{5/2}$	98DOR/FRA	98DOR/FRA
12.279	0.005	8 143 986	20.	b*	7.41E+13	$3d^9\ ^2D_{3/2}$	$[3d^2_{3/2}3d^6_{5/2}]4f\ (2,5/2)^\circ_{3/2}$	98DOR/FRA	98DOR/FRA
12.279	0.005	8 143 986	20.	b*	5.20E+13	$3d^9\ ^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]4f\ (4,5/2)^\circ_{3/2}$	98DOR/FRA	98DOR/FRA
12.317	0.005	8 118 860	16.		3.37E+13	$3d^9\ ^2D_{3/2}$	$[3d^2_{3/2}3d^6_{5/2}]4f\ (2,5/2)^\circ_{5/2}$	98DOR/FRA	98DOR/FRA
12.344	0.005	8 101 102	2.5		3.50E+12	$3d^9\ ^2D_{5/2}$	$[3d^3_{3/2}3d^5_{5/2}]4f\ (4,7/2)^\circ_{3/2}$	98DOR/FRA	98DOR/FRA
12.372	0.005	8 082 768	2.0		5.66E+13	$3d^9\ ^2D_{3/2}$	$[3d^2_{3/2}3d^6_{5/2}]4f\ (2,5/2)^\circ_{1/2}$	98DOR/FRA	98DOR/FRA
	0.006	[2 684 200]				$3d^9\ ^2D_{3/2}$	$3p^53d^{10}\ ^2P^\circ_{1/2}$	87EKB/FEL	
[45.674]	0.006	[2 189 430]				$3d^9\ ^2D_{5/2}$	$3p^53d^{10}\ ^2P^\circ_{3/2}$	87EKB/FEL	
	0.006	[2 077 030]				$3d^9\ ^2D_{3/2}$	$3p^53d^{10}\ ^2P^\circ_{3/2}$	87EKB/FEL	
[755.3]	0.7	[120 450]			3.78E+4	$3d^9\ ^2D_{5/2}$	$3d^9\ ^2D_{3/2}$	87EKB/FEL	89BIE/HAN

TABLE 36. Energy levels of Ba XXX

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$3d^9$	^2D	5/2	[0]		87EKB/FEL
		3/2	[132 400]	130	87EKB/FEL
$3p^53d^{10}$	$^2P^\circ$	3/2	[2 189 430]	240	87EKB/FEL
		1/2	[2 816 600]	400	87EKB/FEL
$[3d^3_{3/2}3d^5_{5/2}]4f$	$(4,7/2)^\circ$	3/2	8 101 000	3000	98DOR/FRA
$[3d^3_{3/2}3d^5_{5/2}]4f$	$(4,5/2)^\circ$	3/2	8 144 000	3000	98DOR/FRA
		5/2	8 173 000	3000	98DOR/FRA
$[3d^3_{3/2}3d^5_{5/2}]4f$	$(2,5/2)^\circ$	7/2	8 173 000	3000	98DOR/FRA
$[3d^2_{3/2}3d^6_{5/2}]4f$	$(2,5/2)^\circ$	1/2	8 215 000	3000	98DOR/FRA
		5/2	8 251 000	3000	98DOR/FRA
		3/2	8 276 000	3000	98DOR/FRA
$[3d^2_{3/2}3d^6_{5/2}]4f$	$(0,5/2)^\circ$	5/2	8 357 000	3000	98DOR/FRA
$[3p^5_{3/2}3d^9_{5/2}]4d$	$(2,3/2)^\circ$	5/2	9 180 000	4000	98DOR/FRA
$[3p^5_{3/2}3d^9_{5/2}]4d$	$(3,3/2)^\circ$	3/2	9 255 000	4000	98DOR/FRA
$[3p^5_{3/2}3d^9_{5/2}]4d$	$(2,5/2)^\circ$	7/2	9 255 000	4000	98DOR/FRA
		5/2	9 387 000	4000	98DOR/FRA
$[3p^5_{3/2}3d^9_{5/2}]4d$	$(3,5/2)^\circ$	7/2	9 296 000	4000	98DOR/FRA
		3/2	9 429 000	4000	98DOR/FRA
$[3d^4_{3/2}3d^4_{5/2}]5f$	$(2,7/2)^\circ$	7/2	10 326 000	5000	98DOR/FRA
$[3d^3_{3/2}3d^5_{5/2}]5f$	$(4,5/2)^\circ$	5/2,7/2	10 447 000	5000	98DOR/FRA

TABLE 36. Energy levels of Ba XXX—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$[3d^3_{3/2}3d^5_{5/2}]5f$	$(4,7/2)^\circ$	1/2	10 460 000	5000	98DOR/FRA
$[3d^2_{3/2}3d^6_{5/2}]5f$	$(2,5/2)^\circ$	3/2,5/2	10 544 000	5000	98DOR/FRA
$[3d^4_{3/2}3d^4_{5/2}]6f$	$(2,7/2)^\circ$	5/2,7/2	11 494 000	7000	98DOR/FRA
$[3d^4_{3/2}3d^4_{5/2}]6f$	$(4,7/2)^\circ$	5/2,7/2	11 494 000	7000	98DOR/FRA
$[3d^3_{3/2}3d^5_{5/2}]6f$	$(2,5/2)^\circ$	7/2	11 666 000	7000	98DOR/FRA
$[3d^3_{3/2}3d^5_{5/2}]6f$	$(4,5/2)^\circ$	3/2,5/2,7/2	11 705 000	7000	98DOR/FRA
$[3d^3_{3/2}3d^5_{5/2}]6f$	$(4,7/2)^\circ$	5/2	11 705 000	7000	98DOR/FRA
$[3d^2_{3/2}3d^6_{5/2}]6f$	$(2,5/2)^\circ$	3/2,5/2	11 798 000	7000	98DOR/FRA
$[3d^4_{3/2}3d^4_{5/2}]7f?$	$(4,7/2)^\circ$	5/2	12 262 000	8000	98DOR/FRA
$[3d^3_{3/2}3d^5_{5/2}]7f?$	$(4,5/2)^\circ$	3/2,5/2	12 449 000	8000	98DOR/FRA
$[3d^2_{3/2}3d^6_{5/2}]7f?$	$(2,5/2)^\circ$	5/2	12 549 000	8000	98DOR/FRA
Ba XXXI ($3d^8$ $^3F_4$)	*Limit*	—	14 324 000		04ROD/IND

6.29. Ba XXXI

Fe isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^6[3d^4_{3/2}3d^4_{5/2}]\ (0,4)_4$
Ionization energy (15 034 000 cm^{-1}); (1864 eV)

Eighteen lines in the Ba XXXI spectrum between 36 and 49 Å were measured by Ekberg *et al.* [88EKB/FEL], who classified them as transitions between levels in the $3p^63d^8$ and $3p^53d^9$ configurations (see Table 37). For the ground configuration levels not connected to the ground state Ekberg *et al.* [88EKB/FEL] obtained values by isoelectronic fitting, and indicated the possible error in the values by adding "$+x$," "$+y$," or "$+z$." The $3p^53d^9$ levels in Table 38 followed by letters were determined by adding the wave number of the transition to the energy of the ground configuration level. Since any error in the ground state fitting would propagate to the upper level, the amount of the potential error is again indicated by $+x$, $+y$, or $+z$. The square brackets around other level values mean that those values were obtained by isoelectronic fitting. In addition to the Ekberg *et al.* [88EKB/FEL] measurements, Doron *et al.* [98DOR/FRA] observed an unresolved transition array near 11 Å, which they assigned to resonance transitions from the $3d^74f$ configuration. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.29.1. References for Ba XXXI

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98DOR/FRA R. Doron, M. Fraenkel, P. Mandelbaum, A. Zigler, and J. L. Schwob, Phys. Scr. **58**, 19 (1998).

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TABLE 37. Observed spectral lines of Ba XXXI

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	Lower Level	Upper Level	λ Ref.
11.839	0.005	8 446 659	4	*c	$3d^8$	$3d^74f^\circ$	98DOR/FRA
11.875	0.005	8 421 053	4	*c	$3d^8$	$3d^74f^\circ$	98DOR/FRA
11.900	0.005	8 403 361	6	*c	$3d^8$	$3d^74f^\circ$	98DOR/FRA
36.368	0.015	2 749 670	2	w	$3p^6[3d^3_{3/2}3d^5_{5/2}]\ (0,3)_3$	$3p^53d^9\ (1/2,5/2)^\circ_3$	88EKB/FEL
36.512	0.015	2 738 826	2		$3p^6[3d^2_{3/2}3d^6_{5/2}]\ (0,2)_2$	$3p^53d^9\ (1/2,3/2)^\circ_1$	88EKB/FEL
36.998	0.015	2 702 849	3	w	$3p^6[3d^3_{3/2}3d^5_{5/2}]\ (0,2)_2$	$3p^53d^9\ (1/2,5/2)^\circ_3$	88EKB/FEL
37.258	0.015	2 683 987		b	$3p^6[3d^3_{3/2}3d^5_{5/2}]\ (0,3)_3$	$3p^53d^9\ (1/2,5/2)^\circ_2$	88EKB/FEL
37.549	0.015	2 663 187	15		$3p^6[3d^3_{3/2}3d^5_{5/2}]\ (0,4)_4$	$3p^53d^9\ (1/2,5/2)^\circ_3$	88EKB/FEL
37.928	0.015	2 636 575		b	$3p^6[3d^3_{3/2}3d^5_{5/2}]\ (0,2)_2$	$3p^53d^9\ (1/2,5/2)^\circ_2$	88EKB/FEL
38.324	0.015	2 609 331	2		$3p^6[3d^3_{3/2}3d^5_{5/2}]\ (0,1)_1$	$3p^53d^9\ (1/2,5/2)^\circ_2$	88EKB/FEL
42.684	0.015	2 342 798	4		$3p^6[3d^4_{3/2}3d^4_{5/2}]\ (0,4)_4$	$3p^53d^9\ (3/2,3/2)^\circ_3$	88EKB/FEL

TABLE 37. Observed spectral lines of Ba XXXI—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Int.	Line Code	Lower Level	Upper Level	λ Ref.
45.083	0.015	2 218 131	3		$3p^6[3d^3_{3/2}3d^5_{5/2}]$ $(0,3)_3$	$3p^53d^9$ $(3/2,3/2)^\circ_3$	88EKB/FEL
45.137	0.015	2 215 477	3		$3p^6[3d^4_{3/2}3d^4_{5/2}]$ $(0,2)_2$	$3p^53d^9$ $(3/2,5/2)^\circ_1$	88EKB/FEL
45.523	0.015	2 196 692	30		$3p^6[3d^4_{3/2}3d^4_{5/2}]$ $(0,4)_4$	$3p^53d^9$ $(3/2,5/2)^\circ_3$	88EKB/FEL
46.008	0.015	2 173 535	4		$3p^6[3d^3_{3/2}3d^5_{5/2}]$ $(0,2)_2$	$3p^53d^9$ $(3/2,3/2)^\circ_1$	88EKB/FEL
46.173	0.015	2 165 768	5		$3p^6[3d^3_{3/2}3d^5_{5/2}]$ $(0,3)_3$	$3p^53d^9$ $(3/2,3/2)^\circ_2$	88EKB/FEL
46.574	0.015	2 147 121	3	*	$3p^6[3d^4_{3/2}3d^4_{5/2}]$ $(0,2)_2$	$3p^53d^9$ $(3/2,5/2)^\circ_3$	88EKB/FEL
46.574	0.015	2 147 121	3	*	$3p^6[3d^3_{3/2}3d^5_{5/2}]$ $(0,1)_1$	$3p^53d^9$ $(3/2,3/2)^\circ_1$	88EKB/FEL
46.904	0.015	2 132 014	3		$3p^6[3d^3_{3/2}3d^5_{5/2}]$ $(0,4)_4$	$3p^53d^9$ $(3/2,3/2)^\circ_3$	88EKB/FEL
47.204	0.015	2 118 465	2		$3p^6[3d^3_{3/2}3d^5_{5/2}]$ $(0,2)_2$	$3p^53d^9$ $(3/2,3/2)^\circ_2$	88EKB/FEL
47.990	0.015	2 083 767	4		$3p^6[3d^4_{3/2}3d^4_{5/2}]$ $(0,4)_4$	$3p^53d^9$ $(3/2,5/2)^\circ_4$	88EKB/FEL
48.147	0.015	2 076 973	3		$3p^6[3d^4_{3/2}3d^4_{5/2}]$ $(0,2)_2$	$3p^53d^9$ $(3/2,5/2)^\circ_2$	88EKB/FEL

TABLE 38. Energy levels of Ba XXXI

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$3p^6[3d^4_{3/2}3d^4_{5/2}]$	(0,4)	4	0		88EKB/FEL
	(0,2)	2	49 020+x	500	88EKB/FEL
	(0,0)	0	[138 560]	500	88EKB/FEL
$3p^6[3d^3_{3/2}3d^5_{5/2}]$	(0,3)	3	124 570	500	88EKB/FEL
	(0,2)	2	171 670	500	88EKB/FEL
	(0,1)	1	199 770+y	500	88EKB/FEL
	(0,4)	4	210 870	500	88EKB/FEL
$3p^6[3d^2_{3/2}3d^6_{5/2}]$	(0,2)	2	287 540+z	500	88EKB/FEL
	(0,0)	0	[428 350]	500	88EKB/FEL
$3p^53d^9$	$(3/2,5/2)^\circ$	4	2 083 770	500	88EKB/FEL
	$(3/2,5/2)^\circ$	2	2 125 990+x	500	88EKB/FEL
	$(3/2,5/2)^\circ$	3	2 196 690	500	88EKB/FEL
	$(3/2,5/2)^\circ$	1	2 264 500+x	500	88EKB/FEL
$3p^53d^9$	$(3/2,3/2)^\circ$	2	2 290 230	500	88EKB/FEL
	$(3/2,3/2)^\circ$	0	[2 322 630]	500	88EKB/FEL
	$(3/2,3/2)^\circ$	3	2 342 800	500	88EKB/FEL
	$(3/2,3/2)^\circ$	1	2 345 210	500	88EKB/FEL
$3p^53d^9$	$(1/2,5/2)^\circ$	2	2 809 100+y	500	88EKB/FEL
	$(1/2,5/2)^\circ$	3	2 874 270	500	88EKB/FEL
$3p^53d^9$	$(1/2,3/2)^\circ$	2	[2 860 060]	500	88EKB/FEL
	$(1/2,3/2)^\circ$	1	3 026 370+z	500	88EKB/FEL
Ba XXXII ($3d^7$ $^4F_{9/2}$)	Limit		(15 034 000)		04ROD/IND

6.30. Ba XXXII

Mn isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^7$ $^4F_{9/2}$
Ionization energy (15 792 000 cm^{-1}); (1958 eV)

Only one line of the Ba XXXII spectrum has been observed. The forbidden transition $3d^7$ $^4F_{5/2}$-$^2P_{3/2}$ was measured at 4873(6) Å by Crespo López-Urrutia *et al.* [02CRE/BEI] using an electron beam ion trap (EBIT). Crespo López-Urrutia *et al.* [02CRE/BEI] also calculated the transition probability of this transition (using the HULLAC [88BAR/KLA] computer code) to be A_{ki}=15 s^{-1}. The ground state given above has been assigned by analogy with Xe XXIII, as calculated by Saloman [04SAL]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.30.1. References for Ba XXXII

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02CRE/BEI J. R. Crespo López-Urrutia, P. Beiersdorfer, K. Widmann, and V. Decaux, Can. J. Phys. **80**, 1687 (2002).

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

04SAL E. B. Saloman, J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.31. Ba XXXIII

Cr isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^6$ $^5D_4$
Ionization energy (16 510 000 cm^{-1}); (2047 eV)

Only one line of the Ba XXXIII spectrum has been classified. The forbidden transition $3d^6$ $^3D_2$-$^5F_3$ was measured at 5681(8) Å by Crespo López-Urrutia *et al.* [02CRE/BEI] using an EBIT. Its transition probability was calculated (using the HULLAC [88BAR/KLA] computer code) to be A_{ki} =119 s^{-1}. A second line was observed at 4515(5) Å, but Crespo López-Urrutia *et al.* [02CRE/BEI] were not able to determine the levels involved. The ground state given above has been assigned by analogy with Xe XXIII, as calculated by Saloman [04SAL]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.31.1. References for Ba XXXIII

88BAR/KLA A. Bar-Shalom, M. Klapisch, and J. Oreg, Phys. Rev. A **38**, 1773 (1988).

02CRE/BEI J. R. Crespo López-Urrutia, P. Beiersdorfer, K. Widmann, and V. Decaux, Can. J. Phys. **80**, 1687 (2002).

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

04SAL E. B. Saloman J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.32. Ba XXXIV

V isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^5\ ^6S_{5/2}$
Ionization energy (17 276 000 cm^{-1}); (2142 eV)

Two lines of the Ba XXXIV spectrum have been observed and classified using EBITs. The forbidden transition $3d^5\ ^2G_{7/2}$-$^4G_{9/2}$ was measured first by Morgan *et al.* [95MOR/SER], then with improved accuracy by Bieber *et al.* [97BIE/MAR], who obtained a wavelength of 3435.22(5) Å. Morgan *et al.* [95MOR/SER] used the Cowan code [81COW] to calculate a transition probability of 425 s^{-1} for the line. The $3d^5\ ^4G_{9/2}$-$^4G_{11/2}$ transition was measured by Crespo López-Urrutia *et al.* [02CRE/BEI] at 5078(7) Å. Its transition probability was calculated (using the HULLAC [88BAR/KLA] computer code) to be A_{ki}=67 s^{-1}. Another line was observed at 4932(7) Å, but Crespo López-Urrutia *et al.* [02CRE/BEI] were not able to determine the levels involved. The ground state given above has been assigned by analogy with Xe XXIII, as calculated by Saloman [04SAL]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.32.1. References for Ba XXXIV

81COW R. D. Cowan, *The Theory of Atomic Structure and Spectra* (University of California, Berkeley, CA, 1981).

88BAR/KLA A. Bar-Shalom, M. Klapisch, and J. Oreg, Phys. Rev. A **38**, 1773 (1988).

95MOR/SER C. A. Morgan, F. G. Serpa, E. Takács, E. S. Meyer, J. D. Gillaspy, J. Sugar, and J. R. Roberts, Phys. Rev. Lett. **74**, 1716 (1995).

97BIE/MAR D. J. Bieber, H. S. Margolis, P. K. Oxley, and J. D. Silver, Phys. Scr., T **T73**, 64 (1997).

02CRE/BEI J. R. Crespo López-Urrutia, P. Beiersdorfer, K. Widmann, and V. Decaux, Can. J. Phys. **80**, 1687 (2002).

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

04SAL E. B. Saloman J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.33. Ba XXXV

Ti isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^63d^4\ ^5D_0$
Ionization energy (18 196 000 cm^{-1}); (2256 eV)

The $J=3-J=2$ magnetic dipole transition within the ground configuration of Ba XXXV has been the subject of intense interest. The first measurement of the transition was reported by Morgan *et al.* [95MOR/SER], who used an EBIT. They also calculated the energies of all the levels of the ground configuration and transition probability for the observed spectral line using the relativistic Hartree–Fock method of Cowan [81COW]. This was followed by several experimental papers [95ADL/MEY, 97BIE/MAR, 99CRE/BEI, 02CRE/BEI, 01KAT/TON, 99KAT/YAM, 01WAT/CRO, 01WAT/CUR] published on the transition. Interest in this spectral line was echoed in the theoretical literature, with wavelengths and transition probabilities being calculated by Froese Fischer and Fritzsche [01FRO/FRI] (using the multiconfiguration Dirac–Hartree–Fock technique) and Biémont *et al.* [01BIE/TRA] (using the relativistic Hartree–Fock code of Cowan [81COW]). We adopt here the Bieber *et al.* [97BIE/MAR] experimental value for the $J=3$—$J=2$ wavelength—3932.39(8) Å and the calculated value of the transition probability from Biémont *et al.* [01BIE/TRA]-A_{ki} =409 s^{-1}. A second line was observed at 5002(6) Å by Crespo López-Urrutia *et al.* [02CRE/BEI], but they were unable to definitively assign it a Ba XXXV classification. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.33.1. References for Ba XXXV

81COW R. D. Cowan, *The Theory of Atomic Structure and Spectra* (University of California, Berkeley, CA, 1981).

95ADL/MEY H. Adler, E. S. Meyer, F. G. Serpa, E. Takács, J. D. Gillaspy, C. M. Brown, and U. Feldman, Nucl. Instrum. Methods Phys. Res. B **98**, 581 (1995).

95MOR/SER C. A. Morgan, F. G. Serpa, E. Takács, E. S. Meyer, J. D. Gillaspy, J. Sugar, and J. R. Roberts, Phys. Rev. Lett. **74**, 1716 (1995).

97BIE/MAR D. J. Bieber, H. S. Margolis, P. K. Oxley, and J. D. Silver, Phys. Scr., T **T73**, 64 (1997).

99CRE/BEI J. R. Crespo López-Urrutia, P. Beiersdorfer, K. Widmann, and V. Decaux, Phys. Scr., T **T80**, 488 (1999).

99KAT/YAM D. Kato, C. Yamada, T. Fukami, I. Ikuta, H. Watanabe, K. Okazaki, S. Tsurubuchi, K. Mohohashi, and S. Ohtani, Phys. Scr., T **T80**, 446 (1999).

01BIE/TRA E. Biémont, E. Träbert, and C. J. Zeippen, Phys. Scr., T **T80**, 446 (1999).

01FRO/FRI C. Frose Fischer and S. Fritzsche, J. Phys. B **34**, L767 (2001).

01KAT/TON D. Kato, X.-M. Tong, H. Watanabe, T. Fukami, T. Kinugawa, C. Yamada, S. Ohtani, and T. Watanabe, J. Chin. Chem.

Soc. (Taipei) **48**, 525 (2001).
01WAT/CRO H. Watanabe, D. Crosby, F. J. Currell, T. Fukami, D. Kato, S. Ohtani, J. D. Silver, and C. Yamada, Phys. Rev. A **63**, 042513 (2001).
01WAT/CUR H. Watanabe, F. J. Currell, T. Fukami, D. Kato, S. Ohtani, and C. Yamada, Phys. Scr., T **T92**, 122 (2001).
02CRE/BEI J. R. Crespo López-Urrutia, P. Beiersdorfer, K. Widmann, and V. Decaux, Can. J. Phys. **80**, 1687 (2002).
04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

6.34. Ba XXXVI

Sc isoelectronic sequence
Ground state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3\ {}^4F_{3/2}$
Ionization energy (18 950 000 cm^{-1}); (2349 eV)

By using an electron beam ion trap Crespo López-Urrutia *et al.* [02CRE/BEI] measured one line in the Ba XXXVI spectrum. They identified a line at 4019(3) Å as a forbidden transition, but did not specify the upper and lower states. The ground state given above has been assigned by analogy with Xe XXIII, as calculated by Saloman [04SAL]. The calculated ionization energy is taken from Rodrigues *et al.* [04ROD/IND]. It agrees well with that calculated by Zilitis [02ZIL].

6.34.1. References for Ba XXXVI

02CRE/BEI J. R. Crespo López-Urrutia, P. Beiersdorfer, K. Widmann, and V. Decaux, Can. J. Phys. **80**, 1687 (2002).
02ZIL V. A. Zilitis, Opt. Spectrosc. **92**, 353 (2002).
04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
04SAL E. B. Saloman J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.35. Ba XXXVII

Ca isoelectronic sequence
Ground state $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2\ {}^3F_2$
Ionization energy (19 780 000 cm^{-1}); (2452 eV)

One line in the the Ba XXXVII spectrum has been observed by Crespo López-Urrutia *et al.* [02CRE/BEI] in ions trapped in an EBIT. The classification for the line, which lies at 4008(3) Å, was not given. The ground state given above has been assigned by analogy with Xe XXIII, as calculated by Saloman [04SAL]. The ionization energy is obtained from the Dirac–Fock calculations of binding energies of ions by Rodrigues *et al.* [04ROD/IND].

6.35.1. References for Ba XXXVII

02CRE/BEI J. R. Crespo López-Urrutia, P. Beiersdorfer, K. Widmann, and V. Decaux, Can. J. Phys. **80**, 1687 (2002).
04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
04SAL E. B. Saloman J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.36. Ba XXXVIII

K isoelectronic sequence
Ground state $1s^2 2s^2 2p^6 3s^2 3p^6 3d\ {}^2D_{3/2}$
Ionization energy (20 540 000 cm^{-1}); (2547 eV)

The Ba XXXVIII spectrum has not been observed; however, calculations of the ground state splitting and the transition probabilities for the transitions between its levels have been done by Ali and Kim [92ALI/KIM]. Biémont [90BIE] used the MCDF method to calculate values for the $4s$, ${}^2S_{1/2}$, $3d$, ${}^2D$, and $4d\ {}^2D$ levels. Charro *et al.* [02CHA/CUR] used experimental data for isoelectronic ions with values of $18 \leqslant Z \leqslant 42$ to predict the energy of the $3d\ {}^2D_{5/2}$ and $4s\ {}^2S_{1/2}$ levels. They also predicted the ionization energy by extrapolating from data available for isoelectronic ions with $18 \leqslant Z \leqslant 34$. Comparison of [02CHA/CUR] and [91SUG/KAU2] data for ions from Tc XXV to Sn XXXII indicates that the polynomials calculated by [02CHA/CUR] do not accurately predict the values for ions with higher Z. Therefore, we retain in Tables 39 and 40 the [90BIE] calculated values for levels and transition probabilities. The calculated ionization energy cited is taken from Rodrigues *et al.* [04ROD/IND].

6.36.1. References for Ba XXXVIII

90BIE E. Biémont, Bull. Soc. R. Sci. Liège **59**, 319 (1990).
91SUG/KAU2 J. Sugar, V. Kaufman, and W. L. Rowan, J. Opt. Soc. Am. B **8**, 913 (1991).
92ALI/KIM M. A. Ali and Y.-K. Kim, J. Opt. Soc. Am. B **9**, 185 (1992).
02CHA/CUR E. Charro, Z. Curiel, and I. Martín, Astron. Astrophys. **387**, 1146 (2002).
04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

TABLE 39. Spectral lines of Ba XXXVIII

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(12.024)	(8 316 700)	2.79E+9	3d ${}^2D_{3/2}$	4s ${}^2S_{1/2}$	90BIE	90BIE
(12.264)	(8 154 300)	4.22E+9	3d ${}^2D_{5/2}$	4s ${}^2S_{1/2}$	90BIE	90BIE
(615.7)	(162 400)	4.59E+4	3d ${}^2D_{3/2}$	3d ${}^2D_{5/2}$	90BIE	90BIE

TABLE 40. Energy levels of Ba XXXVIII

Configuration	Term	J	Energy (cm^{-1})	Reference
3d	^{2}D	3/2	(0)	90BIE
	^{2}D	5/2	(162 400)	90BIE
4s	^{2}S	5/2	(8 316 700)	90BIE
4d	^{2}D	3/2	(9 645 600)	90BIE
	^{2}D	5/2	(9 707 500)	90BIE
Ba XXXIX (3p^6 ^{1}S$_0$)		*Limit*	(20 540 000)	04ROD/IND

6.37. Ba XXXIX

Ar isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^6$ $^1S_0$
Ionization energy (22 700 000 cm^{-1}); (2814 eV)

There are no observations of the energy levels or wavelengths of the Ba XXXIX spectrum. The ground state has been assigned by analogy with Xe XXXVII, as calculated by Saloman [04SAL]. Rodrigues *et al.* [04ROD/IND] calculated the ionization energy cited above.

6.37.1. References for Ba XXXIX

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

04SAL E. B. Saloman J. Phys. Chem. Ref. Data **33**, 765 (2004).

6.38. Ba XL

Cl isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^5$ $^2P^\circ_{3/2}$
Ionization energy (23 400 000 cm^{-1}); (2901 eV)

The Ba XL spectrum has not been observed, but Huang *et al.* [83HUA/KIM] used the MCDF technique to calculate energy levels and wavefunctions. Electric dipole transition probabilities were calculated for transitions between the ground configuration and excited states in the $3s3p^6$ and $3s^23p^43d^2$ configurations. Electric quadrupole and magnetic dipole transition probabilities were given for the transition between the two levels of the ground configuration. Other than the ground configuration, [83HUA/KIM] did not list configuration designations for the barium energy levels. Therefore, in Tables 41 and 42 we designate the levels by the level value with its *J* value in parentheses. No information regarding the accuracy of the calculated values is available. The calculated ionization energy cited above is taken from Rodrigues *et al.* [04ROD/IND].

6.38.1. References for Ba XL

83HUA/KIM K.-N. Huang, Y.-K. Kim, K. T. Cheng, and J. P. Desclaux, At. Data Nucl. Data Tables **28**, 355 (1983).

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

TABLE 41. Spectral lines of Ba XL

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(32.137)	(3 111 673)	1.02E+9	3s^{2}3p^5 $^2P^\circ_{3/2}$	3 111 673(5/2)	83HUA/KIM	83HUA/KIM
(32.326)	(3 093 486)	2.14E+8	3s^{2}3p^5 $^2P^\circ_{3/2}$	3 093 486(3/2)	83HUA/KIM	83HUA/KIM
(37.875)	(2 640 230)	9.59E+9	3s^{2}3p^5 $^2P^\circ_{3/2}$	2 640 230(1/2)	83HUA/KIM	83HUA/KIM
(39.228)	(2 549 220)	7.54E+10	3s^{2}3p^5 $^2P^\circ_{3/2}$	2 549 220(3/2)	83HUA/KIM	83HUA/KIM
(41.986)	(2 381 753)	1.36E+12	3s^{2}3p^5 $^2P^\circ_{3/2}$	2 381 753(1/2)	83HUA/KIM	83HUA/KIM
(42.003)	(2 380 796)	8.16E+11	3s^{2}3p^5 $^2P^\circ_{3/2}$	2 380 796(5/2)	83HUA/KIM	83HUA/KIM
(42.038)	(2 378 797)	8.21E+11	3s^{2}3p^5 $^2P^\circ_{3/2}$	2 378 797(3/2)	83HUA/KIM	83HUA/KIM
(42.477)	(2 354 239)	7.61E+11	3s^{2}3p^5 $^2P^\circ_{1/2}$	3 093 486(3/2)	83HUA/KIM	83HUA/KIM
(42.586)	(2 348 184)	1.11E+11	3s^{2}3p^5 $^2P^\circ_{3/2}$	2 348 184(5/2)	83HUA/KIM	83HUA/KIM
(43.298)	(2 309 587)	9.82E+8	3s^{2}3p^5 $^2P^\circ_{3/2}$	2 309 587(5/2)	83HUA/KIM	83HUA/KIM
(43.828)	(2 281 658)	1.24E+10	3s^{2}3p^5 $^2P^\circ_{3/2}$	2 281 658(3/2)	83HUA/KIM	83HUA/KIM
(46.512)	(2 149 991)	2.36E+10	3s^{2}3p^5 $^2P^\circ_{3/2}$	2 149 991(5/2)	83HUA/KIM	83HUA/KIM
(47.916)	(2 086 973)	8.12E+6	3s^{2}3p^5 $^2P^\circ_{3/2}$	2 086 973(3/2)	83HUA/KIM	83HUA/KIM
(49.360)	(2 025 913)	4.52E+9	3s^{2}3p^5 $^2P^\circ_{3/2}$	2 025 913(1/2)	83HUA/KIM	83HUA/KIM
(52.604)	(1 900 983)	6.50E+11	3s^{2}3p^5 $^2P^\circ_{1/2}$	2 640 230(1/2)	83HUA/KIM	83HUA/KIM
(54.671)	(1 829 131)	2.39E+11	3s^{2}3p^5 $^2P^\circ_{3/2}$	1 829 131(1/2)	83HUA/KIM	83HUA/KIM
(55.249)	(1 809 973)	2.52E+11	3s^{2}3p^5 $^2P^\circ_{1/2}$	2 549 220(3/2)	83HUA/KIM	83HUA/KIM
(56.773)	(1 761 412)	1.76E+11	3s^{2}3p^5 $^2P^\circ_{3/2}$	1 761 412(5/2)	83HUA/KIM	83HUA/KIM
(57.472)	(1 739 978)	1.34E+11	3s^{2}3p^5 $^2P^\circ_{3/2}$	1 739 978(3/2)	83HUA/KIM	83HUA/KIM
(58.583)	(1 706 969)	8.78E+8	3s^{2}3p^5 $^2P^\circ_{3/2}$	1 706 969(5/2)	83HUA/KIM	83HUA/KIM
(60.883)	(1 642 506)	1.51E+10	3s^{2}3p^5 $^2P^\circ_{1/2}$	2 381 753(1/2)	83HUA/KIM	83HUA/KIM
(60.992)	(1 639 550)	4.78E+9	3s^{2}3p^5 $^2P^\circ_{1/2}$	2 378 797(3/2)	83HUA/KIM	83HUA/KIM
(64.834)	(1 542 411)	4.99E+8	3s^{2}3p^5 $^2P^\circ_{1/2}$	2 281 658(3/2)	83HUA/KIM	83HUA/KIM

TABLE 41. Spectral lines of Ba XL—Continued

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(66.053)	(1 513 941)	1.55E+8	$3s^23p^5\ ^2P^\circ_{3/2}$	1 513 941(3/2)	83HUA/KIM	83HUA/KIM
(65.698)	(1 522 118)	3.75E+8	$3s^23p^5\ ^2P^\circ_{3/2}$	1 522 118(1/2)	83HUA/KIM	83HUA/KIM
(72.942)	(1 370 945)	2.38E+8	$3s^23p^5\ ^2P^\circ_{3/2}$	1 370 945(5/2)	83HUA/KIM	83HUA/KIM
(72.943)	(1 370 928)	1.83E+9	$3s^23p^5\ ^2P^\circ_{3/2}$	1 370 928(1/2)	83HUA/KIM	83HUA/KIM
(74.155)	(1 348 533)	9.12E+8	$3s^23p^5\ ^2P^\circ_{3/2}$	1 348 533(3/2)	83HUA/KIM	83HUA/KIM
(74.199)	(1 347 726)	1.57E+8	$3s^23p^5\ ^2P^\circ_{1/2}$	2 086 973(3/2)	83HUA/KIM	83HUA/KIM
(77.720)	(1 286 666)	6.08E+8	$3s^23p^5\ ^2P^\circ_{1/2}$	2 025 913(1/2)	83HUA/KIM	83HUA/KIM
(91.753)	(1 089 884)	1.59E+10	$3s^23p^5\ ^2P^\circ_{1/2}$	1 829 131(1/2)	83HUA/KIM	83HUA/KIM
(99.927)	(1 000 731)	2.64E+6	$3s^23p^5\ ^2P^\circ_{1/2}$	1 739 978(3/2)	83HUA/KIM	83HUA/KIM
(127.735)	(782 871)	1.17E+9	$3s^23p^5\ ^2P^\circ_{1/2}$	1 522 118(1/2)	83HUA/KIM	83HUA/KIM
(129.083)	(774 694)	1.01E+7	$3s^23p^5\ ^2P^\circ_{1/2}$	1 522 118(1/2)	83HUA/KIM	83HUA/KIM
(135.273)	(739 247)	7.24E+6	$3s^23p^5\ ^2P^\circ_{3/2}$	$3s^23p^5\ ^2P^\circ_{1/2}$	83HUA/KIM	83HUA/KIM
(158.308)	(631 681)	2.61E+8	$3s^23p^5\ ^2P^\circ_{1/2}$	1 370 928(1/2)	83HUA/KIM	83HUA/KIM
(164.126)	(609 286)	7.16E+6	$3s^23p^5\ ^2P^\circ_{1/2}$	1 348 533(3/2)	83HUA/KIM	83HUA/KIM

TABLE 42. Energy levels of Ba XL

Configuration	Term	J	Energy (cm^{-1})	Reference
$3s^23p^5$	$^2P^\circ$	3/2	(0)	83HUA/KIM
	$^2P^\circ$	1/2	(739 247)	83HUA/KIM
1 370 928(1/2)		1/2	(1 370 928)	83HUA/KIM
1 522 118(1/2)		1/2	(1 522 118)	83HUA/KIM
1 829 131(1/2)		1/2	(1 829 131)	83HUA/KIM
2 025 913(1/2)		1/2	(2 025 913)	83HUA/KIM
2 381 753(1/2)		1/2	(2 381 753)	83HUA/KIM
2 640 230(1/2)		1/2	(2 640 230)	83HUA/KIM
1 348 533(3/2)		3/2	(1 348 533)	83HUA/KIM
1 513 941(3/2)		3/2	(1 513 941)	83HUA/KIM
1 739 978(3/2)		3/2	(1 739 978)	83HUA/KIM
2 086 973(3/2)		3/2	(2 086 973)	83HUA/KIM
2 281 658(3/2)		3/2	(2 281 658)	83HUA/KIM
2 378 797(3/2)		3/2	(2 378 797)	83HUA/KIM
2 549 220(3/2)		3/2	(2 549 220)	83HUA/KIM
3 093 486(3/2)		3/2	(3 093 486)	83HUA/KIM
1 370 945(5/2)		5/2	(1 370 945)	83HUA/KIM
1 706 969(5/2)		5/2	(1 706 969)	83HUA/KIM
1 761 412(5/2)		5/2	(1 761 412)	83HUA/KIM
2 149 991(5/2)		5/2	(2 149 991)	83HUA/KIM
2 309 587(5/2)		5/2	(2 309 587)	83HUA/KIM
2 348 184(5/2)		5/2	(2 348 184)	83HUA/KIM
2 380 796(5/2)		5/2	(2 380 796)	83HUA/KIM
3 111 673(5/2)		5/2	(3 111 673)	83HUA/KIM
1 409 696(7/2)		7/2	(1 409 696)	83HUA/KIM
1 529 547(7/2)		7/2	(1 529 547)	83HUA/KIM
2 158 934(7/2)		7/2	(2 158 934)	83HUA/KIM
2 240 413(7/2)		7/2	(2 240 413)	83HUA/KIM
2 404 811(7/2)		7/2	(2 404 811)	83HUA/KIM
1 548 756(9/2)		9/2	(1 548 756)	83HUA/KIM
2 318 207(9/2)		9/2	(2 318 207)	83HUA/KIM
Ba XLI ($3p^4\ ^3P_2$)		*Limit*	(23 400 000)	04ROD/IND

6.39. Ba XLI

S isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^4\ ^3P_2$
Ionization energy (24 150 000 cm^{-1}); (2994 eV)

Although the Ba XLI spectrum has not been experimentally observed, there are two theoretical papers that report values for energy levels and transition probabilities. Saloman and Kim [89SAL/KIM] used the MCDF technique to determine energy levels of the ground-state configuration and magnetic dipole (M1) and electric quadrupole (E2) probabilities for transitions between them. Chou *et al.* [96CHO/CHA] repeated the [89SAL/KIM] calculations with more configurations and also reported values for levels of the $3s3p^5$ and $3s^23p^33d$ configurations and probabilities for transitions from them to levels in the ground configuration. Except for the levels in the ground configuration the configuration designations are uncertain, so in the tables, excited levels are referred to by energy level and J value. The transition probabilities given for lines in which [96CHO/CHA] calculated both M1 and E2 probabilities are the sum of the two. Although no comparison of experimental and theoretical results is possible for Ba XLI, [96CHO/CHA] show such comparisons for Ca V through Ni XIII. These tables indicate agreement with experimental levels within a few percent. The number of significant digits given in the Tables 43 and 44 are those reported in [96CHO/CHA] and are not an indication of the accuracy of the data. The calculated ionization energy cited above is taken from Rodrigues *et al.* [04ROD/IND].

6.39.1. References for Ba XLI

89SAL/KIM E. B. Saloman and Y.-K. Kim, At. Data Nucl. Data Tables **41**, 339 (1989).

96CHO/CHA H.-S. Chou, J.-Y. Chang, Y.-H. Chang, and K.-N. Huang, At. Data Nucl. Data Tables **62**, 77 (1996).

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).

TABLE 43. Spectral lines of Ba XLI

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
Vacuum						
(29.6754)	(3 369 799)	4.57E+7	$3s^23p^4\ ^3P_2$	3 369 799(1)°	96CHO/CHA	96CHO/CHA
(30.6619)	(3 261 375)	2.95E+9	$3s^23p^4\ ^3P_0$	3 369 799(1)°	96CHO/CHA	96CHO/CHA
(31.9868)	(3 126 293)	8.84E+8	$3s^23p^4\ ^3P_2$	3 126 293(3)°	96CHO/CHA	96CHO/CHA
(32.5432)	(3 072 834)	1.66E+6	$3s^23p^4\ ^3P_2$	3 072 834(2)°	96CHO/CHA	96CHO/CHA
(32.8194)	(3 046 980)	2.37E+6	$3s^23p^4\ ^3P_2$	3 046 980(3)°	96CHO/CHA	96CHO/CHA
(32.8723)	(3 042 074)	1.01E+9	$3s^23p^4\ ^3P_2$	3 042 074(2)°	96CHO/CHA	96CHO/CHA
(33.1026)	(3 020 915)	5.77E+8	$3s^23p^4\ ^3P_2$	3 020 915(1)°	96CHO/CHA	96CHO/CHA
(34.3349)	(2 912 491)	8.81E+7	$3s^23p^4\ ^3P_0$	3 020 915(1)°	96CHO/CHA	96CHO/CHA
(37.4299)	(2 671 662)	6.41E+7	$3s^23p^4\ ^3P_2$	2 671 662(1)°	96CHO/CHA	96CHO/CHA
(37.8596)	(2 641 341)	1.12E+10	$3s^23p^4\ ^3P_1$	3 369 799(1)°	96CHO/CHA	96CHO/CHA
(38.7305)	(2 581 945)	3.86E+8	$3s^23p^4\ ^1D_2$	3 369 799(1)°	96CHO/CHA	96CHO/CHA
(39.0132)	(2 563 238)	1.02E+9	$3s^23p^4\ ^3P_0$	2 671 662(1)°	96CHO/CHA	96CHO/CHA
(39.1641)	(2 553 360)	9.36E+9	$3s^23p^4\ ^3P_2$	2 553 360(2)°	96CHO/CHA	96CHO/CHA
(40.0999)	(2 493 771)	2.76E+10	$3s^23p^4\ ^3P_2$	2 493 771(3)°	96CHO/CHA	96CHO/CHA
(40.1809)	(2 488 746)	2.40E+10	$3s^23p^4\ ^3P_2$	2 488 746(1)°	96CHO/CHA	96CHO/CHA
(40.8104)	(2 450 353)	3.43E+10	$3s^23p^4\ ^3P_2$	2 450 353(2)°	96CHO/CHA	96CHO/CHA
(41.1653)	(2 429 228)	6.80E+8	$3s^23p^4\ ^3P_2$	2 429 228(3)°	96CHO/CHA	96CHO/CHA
(41.6023)	(2 403 713)	1.33E+11	$3s^23p^4\ ^3P_2$	2 403 713(1)°	96CHO/CHA	96CHO/CHA
(41.9607)	(2 383 180)	8.64E+9	$3s^23p^4\ ^3P_2$	2 383 180(2)°	96CHO/CHA	96CHO/CHA
(42.0111)	(2 380 322)	2.42E+11	$3s^23p^4\ ^3P_0$	2 488 746(1)°	96CHO/CHA	96CHO/CHA
(42.6553)	(2 344 376)	1.34E+11	$3s^23p^4\ ^3P_1$	3 072 834(2)°	96CHO/CHA	96CHO/CHA
(42.7636)	(2 338 439)	2.23E+9	$3s^23p^4\ ^1D_2$	3 126 293(3)°	96CHO/CHA	96CHO/CHA
(43.0829)	(2 321 106)	9.17E+11	$3s^23p^4\ ^3P_2$	2 321 106(1)°	96CHO/CHA	96CHO/CHA
(43.2224)	(2 313 616)	1.39E+11	$3s^23p^4\ ^3P_1$	3 042 074(2)°	96CHO/CHA	96CHO/CHA
(43.4022)	(2 304 029)	8.80E+11	$3s^23p^4\ ^3P_2$	2 304 029(2)°	96CHO/CHA	96CHO/CHA
(43.5675)	(2 295 289)	6.42E+11	$3s^23p^4\ ^3P_0$	2 403 713(1)°	96CHO/CHA	96CHO/CHA
(43.5713)	(2 295 089)	7.33E+11	$3s^23p^4\ ^3P_2$	2 295 089(3)°	96CHO/CHA	96CHO/CHA
(43.6213)	(2 292 457)	5.28E+11	$3s^23p^4\ ^3P_1$	3 020 915(1)°	96CHO/CHA	96CHO/CHA
(43.7641)	(2 284 980)	1.74E+11	$3s^23p^4\ ^1D_2$	3 072 834(2)°	96CHO/CHA	96CHO/CHA
(43.9865)	(2 273 423)	1.03E+12	$3s^23p^4\ ^3P_1$	3 001 881(0)°	96CHO/CHA	96CHO/CHA
(44.2649)	(2 259 126)	6.32E+11	$3s^23p^4\ ^1D_2$	3 046 980(3)°	96CHO/CHA	96CHO/CHA
(44.3612)	(2 254 220)	1.34E+11	$3s^23p^4\ ^1D_2$	3 042 074(2)°	96CHO/CHA	96CHO/CHA
(44.7816)	(2 233 061)	3.24E+11	$3s^23p^4\ ^1D_2$	3 020 915(1)°	96CHO/CHA	96CHO/CHA
(44.8963)	(2 227 354)	9.02E+9	$3s^23p^4\ ^3P_2$	2 227 354(1)°	96CHO/CHA	96CHO/CHA
(45.1940)	(2 212 682)	1.71E+9	$3s^23p^4\ ^3P_0$	2 321 106(1)°	96CHO/CHA	96CHO/CHA
(45.7497)	(2 185 807)	5.56E+10	$3s^23p^4\ ^3P_2$	2 185 807(2)°	96CHO/CHA	96CHO/CHA
(45.9702)	(2 175 324)	1.26E+10	$3s^23p^4\ ^3P_2$	2 175 324(3)°	96CHO/CHA	96CHO/CHA
(47.1936)	(2 118 930)	5.41E+8	$3s^23p^4\ ^3P_0$	2 227 354(1)°	96CHO/CHA	96CHO/CHA
(48.6689)	(2 054 699)	6.48E+9	$3s^23p^4\ ^3P_2$	2 054 699(3)°	96CHO/CHA	96CHO/CHA
(49.6846)	(2 012 696)	2.06E+10	$3s^23p^4\ ^3P_2$	2 012 696(1)°	96CHO/CHA	96CHO/CHA
(49.7254)	(2 011 044)	4.59E+9	$3s^23p^4\ ^3P_2$	2 011 044(2)°	96CHO/CHA	96CHO/CHA
(51.4614)	(1 943 204)	3.33E+9	$3s^23p^4\ ^3P_1$	2 671 662(1)°	96CHO/CHA	96CHO/CHA
(52.5135)	(1 904 272)	1.85E+10	$3s^23p^4\ ^3P_0$	2 012 696(1)°	96CHO/CHA	96CHO/CHA
(53.0840)	(1 883 808)	5.82E+11	$3s^23p^4\ ^1D_2$	2 671 662(1)°	96CHO/CHA	96CHO/CHA
(54.0291)	(1 850 854)	7.84E+10	$3s^23p^4\ ^3P_2$	1 850 854(1)°	96CHO/CHA	96CHO/CHA
(54.7975)	(1 824 902)	2.66E+11	$3s^23p^4\ ^3P_1$	2 553 360(2)°	96CHO/CHA	96CHO/CHA
(55.1518)	(1 813 178)	5.09E+11	$3s^23p^4\ ^1S_0$	3 369 799(1)°	96CHO/CHA	96CHO/CHA
(56.0031)	(1 785 616)	2.31E+11	$3s^23p^4\ ^3P_1$	2 514 074(0)°	96CHO/CHA	96CHO/CHA
(56.6410)	(1 765 506)	2.00E+11	$3s^23p^4\ ^1D_2$	2 553 360(2)°	96CHO/CHA	96CHO/CHA
(56.8089)	(1 760 288)	1.71E+11	$3s^23p^4\ ^3P_1$	2 488 746(1)°	96CHO/CHA	96CHO/CHA
(57.3911)	(1 742 430)	1.01E+11	$3s^23p^4\ ^3P_0$	1 850 854(1)°	96CHO/CHA	96CHO/CHA
(57.4264)	(1 741 358)	1.47E+11	$3s^23p^4\ ^3P_2$	1 741 358(2)°	96CHO/CHA	96CHO/CHA
(58.0756)	(1 721 895)	1.01E+11	$3s^23p^4\ ^3P_1$	2 450 353(2)°	96CHO/CHA	96CHO/CHA
(58.6195)	(1 705 917)	1.87E+11	$3s^23p^4\ ^1D_2$	2 493 771(3)°	96CHO/CHA	96CHO/CHA
(58.6290)	(1 705 640)	5.54E+10	$3s^23p^4\ ^3P_2$	1 705 640(1)°	96CHO/CHA	96CHO/CHA

TABLE 43. Spectral lines of Ba XLI—Continued

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(58.7927)	(1 700 892)	5.55E+9	$3s^23p^4\ ^1D_2$	2 488 746(1)°	96CHO/CHA	96CHO/CHA
(59.6924)	(1 675 255)	4.45E+10	$3s^23p^4\ ^3P_1$	2 403 713(1)°	96CHO/CHA	96CHO/CHA
(59.7827)	(1 672 725)	1.32E+10	$3s^23p^4\ ^3P_2$	1 672 725(3)°	96CHO/CHA	96CHO/CHA
(60.1504)	(1 662 499)	6.00E+10	$3s^23p^4\ ^1D_2$	2 450 353(2)°	96CHO/CHA	96CHO/CHA
(60.4331)	(1 654 722)	6.30E+9	$3s^23p^4\ ^3P_1$	2 383 180(2)°	96CHO/CHA	96CHO/CHA
(60.9246)	(1 641 374)	5.40E+7	$3s^23p^4\ ^1D_2$	2 429 228(3)°	96CHO/CHA	96CHO/CHA
(61.8866)	(1 615 859)	8.01E+9	$3s^23p^4\ ^1D_2$	2 403 713(1)°	96CHO/CHA	96CHO/CHA
(62.6089)	(1 597 216)	2.92E+10	$3s^23p^4\ ^3P_0$	1 705 640(1)°	96CHO/CHA	96CHO/CHA
(62.6831)	(1 595 326)	9.44E+8	$3s^23p^4\ ^1D_2$	2 383 180(2)°	96CHO/CHA	96CHO/CHA
(62.7885)	(1 592 648)	1.05E+9	$3s^23p^4\ ^3P_1$	2 321 106(1)°	96CHO/CHA	96CHO/CHA
(63.4691)	(1 575 571)	8.71E+9	$3s^23p^4\ ^3P_1$	2 304 029(2)°	96CHO/CHA	96CHO/CHA
(64.2417)	(1 556 621)	2.95E+2	$3s^23p^4\ ^3P_2$	$3s^23p^4\ ^1S_0$	96CHO/CHA	96CHO/CHA
(65.2209)	(1 533 252)	4.97E+8	$3s^23p^4\ ^1D_2$	2 321 106(1)°	96CHO/CHA	96CHO/CHA
(65.9554)	(1 516 175)	2.96E+9	$3s^23p^4\ ^1D_2$	2 304 029(2)°	96CHO/CHA	96CHO/CHA
(66.3467)	(1 507 235)	1.14E+9	$3s^23p^4\ ^1D_2$	2 295 089(3)°	96CHO/CHA	96CHO/CHA
(66.5184)	(1 503 344)	1.66E+9	$3s^23p^4\ ^3P_2$	1 503 344(2)°	96CHO/CHA	96CHO/CHA
(66.7158)	(1 498 896)	1.05E+9	$3s^23p^4\ ^3P_1$	2 227 354(1)°	96CHO/CHA	96CHO/CHA
(66.7863)	(1 497 314)	3.61E+8	$3s^23p^4\ ^3P_1$	2 225 772(0)°	96CHO/CHA	96CHO/CHA
(68.2923)	(1 464 294)	5.01E+9	$3s^23p^4\ ^1S_0$	3 020 915(1)°	96CHO/CHA	96CHO/CHA
(68.6177)	(1 457 349)	4.93E+8	$3s^23p^4\ ^3P_1$	2 185 807(2)°	96CHO/CHA	96CHO/CHA
(69.4686)	(1 439 500)	9.61E+6	$3s^23p^4\ ^1D_2$	2 227 354(1)°	96CHO/CHA	96CHO/CHA
(71.5332)	(1 397 953)	8.35E+7	$3s^23p^4\ ^1D_2$	2 185 807(2)°	96CHO/CHA	96CHO/CHA
(72.0736)	(1 387 470)	1.80E+8	$3s^23p^4\ ^1D_2$	2 175 324(3)°	96CHO/CHA	96CHO/CHA
(72.6360)	(1 376 728)	1.99E+7	$3s^23p^4\ ^3P_2$	1 376 728(3)°	96CHO/CHA	96CHO/CHA
(73.4954)	(1 360 630)	1.91E+9	$3s^23p^4\ ^3P_2$	1 360 630(1)°	96CHO/CHA	96CHO/CHA
(75.2969)	(1 328 076)	1.83E+9	$3s^23p^4\ ^3P_2$	1 328 076(2)°	96CHO/CHA	96CHO/CHA
(77.8672)	(1 284 238)	1.90E+7	$3s^23p^4\ ^3P_1$	2 012 696(1)°	96CHO/CHA	96CHO/CHA
(77.9675)	(1 282 586)	2.58E+6	$3s^23p^4\ ^3P_1$	2 011 044(2)°	96CHO/CHA	96CHO/CHA
(78.1808)	(1 279 086)	1.37E+9	$3s^23p^4\ ^3P_1$	2 007 544(0)°	96CHO/CHA	96CHO/CHA
(78.9363)	(1 266 845)	1.49E+8	$3s^23p^4\ ^1D_2$	2 054 699(3)°	96CHO/CHA	96CHO/CHA
(79.8591)	(1 252 206)	6.42E+8	$3s^23p^4\ ^3P_0$	1 360 630(1)°	96CHO/CHA	96CHO/CHA
(81.6432)	(1 224 842)	2.73E+9	$3s^23p^4\ ^1D_2$	2 012 696(1)°	96CHO/CHA	96CHO/CHA
(81.7534)	(1 223 190)	3.24E+8	$3s^23p^4\ ^1D_2$	2 011 044(2)°	96CHO/CHA	96CHO/CHA
(89.0951)	(1 122 396)	4.54E+9	$3s^23p^4\ ^3P_1$	1 850 854(1)°	96CHO/CHA	96CHO/CHA
(89.6828)	(1 115 041)	9.19E+9	$3s^23p^4\ ^1S_0$	2 671 662(1)°	96CHO/CHA	96CHO/CHA
(94.0734)	(1 063 000)	1.18E+10	$3s^23p^4\ ^1D_2$	1 850 854(1)°	96CHO/CHA	96CHO/CHA
(98.7264)	(1 012 900)	6.84E+9	$3s^23p^4\ ^3P_1$	1 741 358(2)°	96CHO/CHA	96CHO/CHA
(102.3351)	(977 182)	4.30E+8	$3s^23p^4\ ^3P_1$	1 705 640(1)°	96CHO/CHA	96CHO/CHA
(104.8763)	(953 504)	4.76E+9	$3s^23p^4\ ^1D_2$	1 741 358(2)°	96CHO/CHA	96CHO/CHA
(107.2817)	(932 125)	2.41E+8	$3s^23p^4\ ^1S_0$	2 488 746(1)°	96CHO/CHA	96CHO/CHA
(108.9579)	(917 786)	1.48E+9	$3s^23p^4\ ^1D_2$	1 705 640(1)°	96CHO/CHA	96CHO/CHA
(113.0108)	(884 871)	8.42E+5	$3s^23p^4\ ^1D_2$	1 672 725(3)°	96CHO/CHA	96CHO/CHA
(118.0509)	(847 092)	1.69E+8	$3s^23p^4\ ^1S_0$	2 403 713(1)°	96CHO/CHA	96CHO/CHA
(120.7492)	(828 163)	1.80E+7	$3s^23p^4\ ^3P_1$	$3s^23p^4\ ^1S_0$	96CHO/CHA	96CHO/CHA
(126.9271)	(787 854)	3.84E+6	$3s^23p^4\ ^3P_2$	$3s^23p^4\ ^1D_2$	96CHO/CHA	96CHO/CHA
(129.0512)	(774 886)	7.62E+8	$3s^23p^4\ ^3P_1$	1 503 344(2)°	96CHO/CHA	96CHO/CHA
(130.0784)	(768 767)	2.91E+4	$3s^23p^4\ ^1D_2$	$3s^23p^4\ ^1S_0$	96CHO/CHA	96CHO/CHA
(130.8070)	(764 485)	2.92E+8	$3s^23p^4\ ^1S_0$	2 321 106(1)°	96CHO/CHA	96CHO/CHA
(137.2763)	(728 458)	6.10E+6	$3s^23p^4\ ^3P_2$	$3s^23p^4\ ^3P_1$	96CHO/CHA	96CHO/CHA
(139.7644)	(715 490)	5.23E+8	$3s^23p^4\ ^1D_2$	1 503 344(2)°	96CHO/CHA	96CHO/CHA
(147.1822)	(679 430)	3.45E+4	$3s^23p^4\ ^3P_0$	$3s^23p^4\ ^1D_2$	96CHO/CHA	96CHO/CHA
(149.0906)	(670 733)	2.20E+8	$3s^23p^4\ ^1S_0$	2 227 354(1)°	96CHO/CHA	96CHO/CHA
(155.0628)	(644 900)	3.40E+7	$3s^23p^4\ ^3P_1$	1 373 358(0)°	96CHO/CHA	96CHO/CHA
(158.1848)	(632 172)	2.97E+7	$3s^23p^4\ ^3P_1$	1 360 630(1)°	96CHO/CHA	96CHO/CHA
(161.2815)	(620 034)	1.68E+6	$3s^23p^4\ ^3P_0$	$3s^23p^4\ ^3P_1$	96CHO/CHA	96CHO/CHA
(166.7728)	(599 618)	1.40E+7	$3s^23p^4\ ^3P_1$	1 328 076(2)°	96CHO/CHA	96CHO/CHA
(169.8156)	(588 874)	2.13E+6	$3s^23p^4\ ^1D_2$	1 376 728(3)°	96CHO/CHA	96CHO/CHA

TABLE 43. Spectral lines of Ba XLI—Continued

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(174.5883)	(572 776)	1.71E+8	$3s^23p^4\ ^1D_2$	1 360 630(1)°	96CHO/CHA	96CHO/CHA
(185.1091)	(540 222)	3.54E+7	$3s^23p^4\ ^1D_2$	1 328 076(2)°	96CHO/CHA	96CHO/CHA
(219.2622)	(456 075)	1.92E+7	$3s^23p^4\ ^1S_0$	2 012 696(1)°	96CHO/CHA	96CHO/CHA
(264.8558)	(377 564)	1.83E+4	1 328 076(2)°	1 705 640(1)°	96CHO/CHA	96CHO/CHA
(289.8467)	(345 010)	1.47E+5	1 360 630(1)°	1 705 640(1)°	96CHO/CHA	96CHO/CHA
(300.9492)	(332 282)	2.61E+5	1 373 358(0)°	1 705 640(1)°	96CHO/CHA	96CHO/CHA
(339.8667)	(294 233)	8.60E+6	$3s^23p^4\ ^1S_0$	1 850 854(1)°	96CHO/CHA	96CHO/CHA
(510.2275)	(195 991)	3.23E+5	1 360 630(1)°	$3s^23p^4\ ^1S_0$	96CHO/CHA	96CHO/CHA
(671.0554)	(149 019)	2.02E+5	$3s^23p^4\ ^1S_0$	1 705 640(1)°	96CHO/CHA	96CHO/CHA
(922.3050)	(108 424)	1.50E+0	$3s^23p^4\ ^3P_2$	$3s^23p^4\ ^3P_0$	96CHO/CHA	96CHO/CHA
(1683.6151)	(59 396)	8.12E+2	$3s^23p^4\ ^3P_1$	$3s^23p^4\ ^1D_2$	96CHO/CHA	96CHO/CHA
Air						
(2207.6945)	(45 282)	5.78E−2	1 328 076(2)°	1 373 358(0)°	96CHO/CHA	96CHO/CHA
(3070.9268)	(32 554)	5.43E+2	1 328 076(2)°	1 360 630(1)°	96CHO/CHA	96CHO/CHA
(7854.5329)	(12 728)	8.99E+1	1 360 630(1)°	1 373 358(0)°	96CHO/CHA	96CHO/CHA

TABLE 44. Energy levels of Ba XLI

Configuration	Term	J	Energy (cm^{-1})	Reference
$3s^23p^4$	^3P	2	(0)	96CHO/CHA
	^3P	0	(108 424)	96CHO/CHA
	^3P	1	(728 458)	96CHO/CHA
	^1D	2	(787 854)	96CHO/CHA
	^1S	0	(1 556 621)	96CHO/CHA
1 373 358(0)°		0	(1 373 358)	96CHO/CHA
2 007 544(0)°		0	(2 007 544)	96CHO/CHA
2 225 772(0)°		0	(2 225 772)	96CHO/CHA
2 514 074(0)°		0	(2 514 074)	96CHO/CHA
3 001 881(0)°		0	(3 001 881)	96CHO/CHA
1 360 630(1)°		1	(1 360 630)	96CHO/CHA
1 705 640(1)°		1	(1 705 640)	96CHO/CHA
1 850 854(1)°		1	(1 850 854)	96CHO/CHA
2 012 696(1)°		1	(2 012 696)	96CHO/CHA
2 227 354(1)°		1	(2 227 354)	96CHO/CHA
2 321 106(1)°		1	(2 321 106)	96CHO/CHA
2 403 713(1)°		1	(2 403 713)	96CHO/CHA
2 488 746(1)°		1	(2 488 746)	96CHO/CHA
2 671 662(1)°		1	(2 671 662)	96CHO/CHA
3 020 915(1)°		1	(3 020 915)	96CHO/CHA
3 369 799(1)°		1	(3 369 799)	96CHO/CHA
1 328 076(2)°		2	(1 328 076)	96CHO/CHA
1 503 344(2)°		2	(1 503 344)	96CHO/CHA
1 741 358(2)°		2	(1 741 358)	96CHO/CHA
2 011 044(2)°		2	(2 011 044)	96CHO/CHA
2 185 807(2)°		2	(2 185 807)	96CHO/CHA
2 304 029(2)°		2	(2 304 029)	96CHO/CHA
2 383 180(2)°		2	(2 383 180)	96CHO/CHA
2 450 353(2)°		2	(2 450 353)	96CHO/CHA
2 553 360(2)°		2	(2 553 360)	96CHO/CHA
3 042 074(2)°		2	(3 042 074)	96CHO/CHA
3 072 834(2)°		2	(3 072 834)	96CHO/CHA
1 376 728(3)°		3	(1 376 728)	96CHO/CHA
1 672 725(3)°		3	(1 672 725)	96CHO/CHA
2 054 699(3)°		3	(2 054 699)	96CHO/CHA
2 175 324(3)°		3	(2 175 324)	96CHO/CHA
2 295 089(3)°		3	(2 295 089)	96CHO/CHA
2 429 228(3)°		3	(2 429 228)	96CHO/CHA
2 493 771(3)°		3	(2 493 771)	96CHO/CHA
3 046 980(3)°		3	(3 046 980)	96CHO/CHA
3 126 293(3)°		3	(3 126 293)	96CHO/CHA
1 529 234(4)°		4	(1 529 234)	96CHO/CHA
2 114 793(4)°		4	(2 114 793)	96CHO/CHA
2 191 935(4)°		4	(2 191 935)	96CHO/CHA
2 260 160(4)°		4	(2 260 160)	96CHO/CHA
3 030 273(4)°		4	(3 030 273)	96CHO/CHA
2 284 413(5)°		5	(2 284 413)	96CHO/CHA
Ba XLII ($3p^3\ ^4S^\circ_{3/2}$)		*Limit*	(24 150 000)	04ROD/IND

6.40. Ba XLII

P isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^3\ ^4S^\circ_{3/2}$
Ionization energy (24 850 000 cm^{-1}); (3081 eV)

The only experimental information on the Ba XLII spectrum is an observation of cascading x-ray emissions from the dielectronic recombination of electrons and Ba XLIII ions. Biedermann *et al.* [97BIE/RAD] published plots of the x-ray spectra and a discussion of the energy levels involved. Huang [84HUA] used the MCDF technique to calculate energy levels and wavefunctions. Electric dipole transition probabilities were calculated for transitions between the ground configuration and excited states in the $3s3p^4$ and $3s^23p^23d$ configurations. Electric quadrupole and magnetic dipole transition probabilities were given for transitions between the five levels of the ground configuration. Charro *et al.* [00CHA/MAR] also reported values for transition probabilities for transitions from the ground state to the $3s^2 3p^2(^3P)3d\ ^4P$ states. There is considerable disagreement between [84HUA] and [00CHA/MAR] in both the energy levels and the transition probabilities. The [00CHA/MAR] calculations are based on extrapolations from polynomials fitted to data for $15 \leqslant Z \leqslant 36$, for which significant deviations can be expected. Since the resolution of the [97BIE/RAD] data is limited we report the [84HUA] results in Tables 45 and 46. Because neither *LS* nor *jj* coupling provides high-purity descriptions of the Ba XLII energy levels, we concatenate the level value with the *J* value in parentheses to designate each level. No information regarding the accuracy of the calculated values is available. The calculated ionization energy cited above is taken from Rodrigues *et al.* [04ROD/IND].

6.40.1. References for Ba XLII

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TABLE 45. Spectral lines of Ba XLII

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(28.849)	(3 466 345)	2.11E+8	0(3/2)°	3 466 345(1/2)	84HUA	84HUA
(30.673)	(3 260 198)	9.22E+8	0(3/2)°	3 260 198(5/2)	84HUA	84HUA
(31.007)	(3 225 081)	1.48E+9	0(3/2)°	3 225 081(3/2)	84HUA	84HUA
(31.979)	(3 127 072)	7.55E+8	0(3/2)°	3 127 072(5/2)	84HUA	84HUA
(32.632)	(3 064 508)	7.62E+8	0(3/2)°	3 064 508(3/2)	84HUA	84HUA
(33.754)	(2 962 578)	1.16E+9	0(3/2)°	2 962 578(1/2)	84HUA	84HUA
(34.044)	(2 937 407)	1.15E+8	0(3/2)°	2 937 407(3/2)	84HUA	84HUA
(34.108)	(2 931 888)	7.70E+7	0(3/2)°	2 931 888(1/2)	84HUA	84HUA
(34.132)	(2 929 776)	7.39E+2	0(3/2)°	2 929 776(5/2)	84HUA	84HUA
(35.977)	(2 779 556)	4.62E+6	686 789(3/2)°	3 466 345(1/2)	84HUA	84HUA
(37.787)	(2 646 383)	3.04E+9	0(3/2)°	2 646 383(1/2)	84HUA	84HUA
(37.854)	(2 641 758)	2.93E+8	0(3/2)°	2 641 758(3/2)	84HUA	84HUA
(38.116)	(2 623 574)	4.62E+9	842 771(1/2)°	3 466 345(1/2)	84HUA	84HUA
(38.859)	(2 573 409)	5.42E+9	686 789(3/2)°	3 260 198(5/2)	84HUA	84HUA
(39.397)	(2 538 292)	1.44E+7	686 789(3/2)°	3 225 081(3/2)	84HUA	84HUA
(39.640)	(2 522 674)	1.00E+9	0(3/2)°	2 522 674(5/2)	84HUA	84HUA
(39.992)	(2 500 483)	1.67E+9	759 715(5/2)°	3 260 198(5/2)	84HUA	84HUA
(40.562)	(2 465 366)	1.00E+10	759 715(5/2)°	3 225 081(3/2)	84HUA	84HUA
(40.651)	(2 459 955)	1.20E+10	0(3/2)°	2 459 955(3/2)	84HUA	84HUA
(40.979)	(2 440 283)	1.26E+8	686 789(3/2)°	3 127 072(5/2)	84HUA	84HUA
(41.602)	(2 403 729)	3.56E+10	0(3/2)°	2 403 729(1/2)	84HUA	84HUA
(41.922)	(2 385 386)	1.74E+10	0(3/2)°	2 385 386(3/2)	84HUA	84HUA
(41.933)	(2 384 773)	6.82E+10	0(3/2)°	2 384 773(5/2)	84HUA	84HUA
(41.976)	(2 382 310)	1.95E+10	842 771(1/2)°	3 225 081(3/2)	84HUA	84HUA
(42.057)	(2 377 719)	3.64E+9	686 789(3/2)°	3 064 508(3/2)	84HUA	84HUA
(42.241)	(2 367 357)	2.41E+8	759 715(5/2)°	3 127 072(5/2)	84HUA	84HUA
(43.388)	(2 304 793)	1.60E+10	759 715(5/2)°	3 064 508(3/2)	84HUA	84HUA
(43.941)	(2 275 789)	1.24E+11	686 789(3/2)°	2 962 578(1/2)	84HUA	84HUA
(44.269)	(2 258 892)	9.84E+11	0(3/2)°	2 258 892(3/2)	84HUA	84HUA
(44.273)	(2 258 726)	7.30E+11	0(3/2)°	2 258 726(1/2)	84HUA	84HUA
(44.432)	(2 250 618)	5.00E+11	686 789(3/2)°	2 937 407(3/2)	84HUA	84HUA
(44.541)	(2 245 099)	6.46E+11	686 789(3/2)°	2 931 888(1/2)	84HUA	84HUA
(44.583)	(2 242 987)	2.17E+11	686 789(3/2)°	2 929 776(5/2)	84HUA	84HUA
(44.951)	(2 224 666)	4.54E+11	0(3/2)°	2 224 666(5/2)	84HUA	84HUA
(45.010)	(2 221 737)	5.59E+11	842 771(1/2)°	3 064 508(3/2)	84HUA	84HUA
(45.403)	(2 202 492)	3.69E+11	759 715(5/2)°	2 962 207(7/2)	84HUA	84HUA
(45.558)	(2 195 022)	1.53E+11	0(3/2)°	2 195 022(5/2)	84HUA	84HUA
(45.920)	(2 177 692)	2.58E+11	759 715(5/2)°	2 937 407(3/2)	84HUA	84HUA
(46.082)	(2 170 061)	4.19E+11	759 715(5/2)°	2 929 776(5/2)	84HUA	84HUA
(46.227)	(2 163 215)	1.41E+11	759 715(5/2)°	2 922 930(7/2)	84HUA	84HUA

TABLE 45. Spectral lines of Ba XLII—Continued

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(46.436)	(2 153 505)	3.21E+7	0(3/2)°	2 153 505(3/2)	84HUA	84HUA
(47.174)	(2 119 807)	1.45E+10	842 771(1/2)°	2 962 578(1/2)	84HUA	84HUA
(47.741)	(2 094 636)	5.34E+10	842 771(1/2)°	2 937 407(3/2)	84HUA	84HUA
(47.867)	(2 089 117)	3.04E+10	842 771(1/2)°	2 931 888(1/2)	84HUA	84HUA
(50.350)	(1 986 091)	2.77E+9	0(3/2)°	1 986 091(1/2)	84HUA	84HUA
(50.420)	(1 983 323)	2.92E+10	0(3/2)°	1 983 323(3/2)	84HUA	84HUA
(50.544)	(1 978 489)	1.09E+9	0(3/2)°	1 978 489(5/2)	84HUA	84HUA
(51.031)	(1 959 594)	9.77E+10	686 789(3/2)°	2 646 383(1/2)	84HUA	84HUA
(51.152)	(1 954 969)	7.50E+10	686 789(3/2)°	2 641 758(3/2)	84HUA	84HUA
(51.917)	(1 926 152)	8.27E+11	1 540 193(3/2)°	3 466 345(1/2)	84HUA	84HUA
(53.134)	(1 882 043)	3.72E+11	759 715(5/2)°	2 641 758(3/2)	84HUA	84HUA
(54.470)	(1 835 885)	2.51E+10	686 789(3/2)°	2 522 674(5/2)	84HUA	84HUA
(55.444)	(1 803 612)	3.86E+11	842 771(1/2)°	2 646 383(1/2)	84HUA	84HUA
(55.587)	(1 798 987)	6.68E+10	842 771(1/2)°	2 641 758(3/2)	84HUA	84HUA
(55.931)	(1 787 921)	1.46E+11	0(3/2)°	1 787 921(3/2)	84HUA	84HUA
(56.180)	(1 779 984)	9.13E+10	0(3/2)°	1 779 984(1/2)	84HUA	84HUA
(56.396)	(1 773 166)	1.33E+11	686 789(3/2)°	2 459 955(3/2)	84HUA	84HUA
(56.723)	(1 762 959)	2.50E+11	759 715(5/2)°	2 522 674(5/2)	84HUA	84HUA
(58.139)	(1 720 005)	3.93E+11	1 540 193(3/2)°	3 260 198(5/2)	84HUA	84HUA
(58.243)	(1 716 940)	9.35E+10	686 789(3/2)°	2 403 729(1/2)	84HUA	84HUA
(58.815)	(1 700 240)	4.11E+10	759 715(5/2)°	2 459 955(3/2)	84HUA	84HUA
(58.872)	(1 698 597)	7.95E+10	686 789(3/2)°	2 385 386(3/2)	84HUA	84HUA
(58.893)	(1 697 984)	2.47E+11	686 789(3/2)°	2 384 773(5/2)	84HUA	84HUA
(59.351)	(1 684 888)	2.90E+11	1 540 193(3/2)°	3 225 081(3/2)	84HUA	84HUA
(60.579)	(1 650 746)	9.41E+10	0(3/2)°	1 650 746(5/2)	84HUA	84HUA
(61.513)	(1 625 671)	1.47E+10	759 715(5/2)°	2 385 386(3/2)	84HUA	84HUA
(61.536)	(1 625 058)	4.43E+9	759 715(5/2)°	2 384 773(5/2)	84HUA	84HUA
(61.836)	(1 617 184)	5.55E+10	842 771(1/2)°	2 459 955(3/2)	84HUA	84HUA
(62.112)	(1 609 995)	1.36E+11	759 715(5/2)°	2 369 710(7/2)	84HUA	84HUA
(63.017)	(1 586 879)	1.10E+9	1 540 193(3/2)°	3 127 072(5/2)	84HUA	84HUA
(63.609)	(1 572 103)	7.65E+8	686 789(3/2)°	2 258 892(3/2)	84HUA	84HUA
(63.616)	(1 571 937)	2.23E+8	686 789(3/2)°	2 258 726(1/2)	84HUA	84HUA
(64.063)	(1 560 958)	4.71E+10	842 771(1/2)°	2 403 729(1/2)	84HUA	84HUA
(64.825)	(1 542 615)	2.10E+10	842 771(1/2)°	2 385 386(3/2)	84HUA	84HUA
(64.927)	(1 540 193)	4.01E+2	0(3/2)°	1 540 193(3/2)°	84HUA	84HUA
(65.025)	(1 537 877)	3.91E+9	686 789(3/2)°	2 224 666(5/2)	84HUA	84HUA
(65.603)	(1 524 315)	8.70E+9	1 540 193(3/2)°	3 064 508(3/2)	84HUA	84HUA
(66.303)	(1 508 233)	1.10E+10	686 789(3/2)°	2 195 022(5/2)	84HUA	84HUA
(66.703)	(1 499 177)	1.30E+9	759 715(5/2)°	2 258 892(3/2)	84HUA	84HUA
(67.081)	(1 490 733)	1.02E+10	0(3/2)°	1 490 733(5/2)	84HUA	84HUA
(68.180)	(1 466 716)	2.67E+9	686 789(3/2)°	2 153 505(3/2)	84HUA	84HUA
(68.262)	(1 464 951)	6.44E+9	759 715(5/2)°	2 224 666(5/2)	84HUA	84HUA
(69.672)	(1 435 307)	8.07E+8	759 715(5/2)°	2 195 022(5/2)	84HUA	84HUA
(70.304)	(1 422 385)	2.71E+8	1 540 193(3/2)°	2 962 578(1/2)	84HUA	84HUA
(70.615)	(1 416 121)	4.45E+6	842 771(1/2)°	2 258 892(3/2)	84HUA	84HUA
(70.624)	(1 415 955)	1.52E+9	842 771(1/2)°	2 258 726(1/2)	84HUA	84HUA
(71.571)	(1 397 214)	1.36E+8	1 540 193(3/2)°	2 937 407(3/2)	84HUA	84HUA
(71.747)	(1 393 790)	1.82E+7	759 715(5/2)°	2 153 505(3/2)	84HUA	84HUA
(71.783)	(1 393 085)	2.25E+8	759 715(5/2)°	2 152 800(7/2)	84HUA	84HUA
(71.855)	(1 391 695)	1.35E+9	1 540 193(3/2)°	2 931 888(1/2)	84HUA	84HUA
(71.964)	(1 389 583)	3.04E+9	1 540 193(3/2)°	2 929 776(5/2)	84HUA	84HUA
(76.293)	(1 310 734)	1.55E+8	842 771(1/2)°	2 153 505(3/2)	84HUA	84HUA
(76.964)	(1 299 302)	6.41E+8	686 789(3/2)°	1 986 091(1/2)	84HUA	84HUA
(77.129)	(1 296 534)	1.69E+8	686 789(3/2)°	1 983 323(3/2)	84HUA	84HUA
(77.142)	(1 296 318)	2.64E+9	0(3/2)°	1 296 318(3/2)	84HUA	84HUA
(77.417)	(1 291 700)	7.36E+7	686 789(3/2)°	1 978 489(5/2)	84HUA	84HUA
(77.462)	(1 290 957)	5.92E+6	759 715(5/2)°	2 050 672(7/2)	84HUA	84HUA

TABLE 45. Spectral lines of Ba XLII—Continued

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(81.726)	(1 223 608)	2.64E+9	759 715(5/2)°	1 983 323(3/2)	84HUA	84HUA
(82.050)	(1 218 774)	1.25E+9	759 715(5/2)°	1 978 489(5/2)	84HUA	84HUA
(87.465)	(1 143 320)	2.63E+8	842 771(1/2)°	1 986 091(1/2)	84HUA	84HUA
(87.677)	(1 140 552)	3.17E+8	842 771(1/2)°	1 983 323(3/2)	84HUA	84HUA
(90.400)	(1 106 190)	9.50E+9	1 540 193(3/2)°	2 646 383(1/2)	84HUA	84HUA
(90.780)	(1 101 565)	1.15E+10	1 540 193(3/2)°	2 641 758(3/2)	84HUA	84HUA
(90.816)	(1 101 132)	6.44E+9	686 789(3/2)°	1 787 921(3/2)	84HUA	84HUA
(91.475)	(1 093 195)	2.31E+6	1 787 921(3/2)	1 779 984(1/2)	84HUA	84HUA
(97.257)	(1 028 206)	1.47E+10	759 715(5/2)°	1 787 921(3/2)	84HUA	84HUA
(101.783)	(982 481)	6.74E+9	1 540 193(3/2)°	2 522 674(5/2)	84HUA	84HUA
(103.739)	(963 957)	5.49E+9	686 789(3/2)°	1 650 746(5/2)	84HUA	84HUA
(105.803)	(945 150)	1.52E+7	842 771(1/2)°	1 787 921(3/2)	84HUA	84HUA
(106.699)	(937 213)	1.36E+10	842 771(1/2)°	1 779 984(1/2)	84HUA	84HUA
(108.724)	(919 762)	1.05E+8	1 779 984(1/2)	1 779 984(1/2)	84HUA	84HUA
(112.230)	(891 031)	3.12E+9	759 715(5/2)°	1 650 746(5/2)	84HUA	84HUA
(115.803)	(863 536)	1.21E+9	1 540 193(3/2)°	2 403 729(1/2)	84HUA	84HUA
(117.178)	(853 404)	9.61E+6	686 789(3/2)°	1 540 193(3/2)°	84HUA	84HUA
(118.316)	(845 193)	2.85E+6	1 540 193(3/2)°	2 385 386(3/2)	84HUA	84HUA
(118.402)	(844 580)	4.12E+8	1 540 193(3/2)°	2 384 773(5/2)	84HUA	84HUA
(118.656)	(842 771)	4.81E+6	0(3/2)°	842 771(1/2)°	84HUA	84HUA
(124.387)	(803 944)	1.44E+9	686 789(3/2)°	1 490 733(5/2)	84HUA	84HUA
(128.127)	(780 478)	2.27E+6	759 715(5/2)°	1 540 193(3/2)°	84HUA	84HUA
(131.628)	(759 715)	1.22E+6	0(3/2)°	759 715(5/2)°	84HUA	84HUA
(136.796)	(731 018)	8.47E+8	759 715(5/2)°	1 490 733(5/2)	84HUA	84HUA
(139.140)	(718 699)	2.03E+7	1 540 193(3/2)°	2 258 892(3/2)	84HUA	84HUA
(139.172)	(718 533)	2.72E+8	1 540 193(3/2)°	2 258 726(1/2)	84HUA	84HUA
(143.385)	(697 422)	1.65E+6	842 771(1/2)°	1 540 193(3/2)°	84HUA	84HUA
(145.605)	(686 789)	6.39E+6	0(3/2)°	686 789(3/2)°	84HUA	84HUA
(146.098)	(684 473)	3.23E+8	1 540 193(3/2)°	2 224 666(5/2)	84HUA	84HUA
(152.712)	(654 829)	1.17E+8	1 540 193(3/2)°	2 195 022(5/2)	84HUA	84HUA
(163.049)	(613 312)	1.38E+8	1 540 193(3/2)°	2 153 505(3/2)	84HUA	84HUA
(164.061)	(609 529)	6.25E+6	686 789(3/2)°	1 296 318(3/2)	84HUA	84HUA
(186.358)	(536 603)	9.94E+7	759 715(5/2)°	1 296 318(3/2)	84HUA	84HUA
(220.484)	(453 547)	2.64E+3	842 771(1/2)°	1 296 318(3/2)	84HUA	84HUA
(224.267)	(445 898)	1.08E+7	1 540 193(3/2)°	1 986 091(1/2)	84HUA	84HUA
(225.667)	(443 130)	1.34E+7	1 540 193(3/2)°	1 983 323(3/2)	84HUA	84HUA
(228.156)	(438 296)	3.11E+6	1 540 193(3/2)°	1 978 489(5/2)	84HUA	84HUA
(403.669)	(247 728)	1.07E+7	1 540 193(3/2)°	1 787 921(3/2)	84HUA	84HUA
(410.046)	(243 875)	1.77E+5	1 296 318(3/2)	1 540 193(3/2)°	84HUA	84HUA
(417.030)	(239 791)	6.17E+6	1 540 193(3/2)°	1 779 984(1/2)	84HUA	84HUA
(641.100)	(155 982)	5.16E+2	686 789(3/2)°	842 771(1/2)°	84HUA	84HUA
(904.544)	(110 553)	3.72E+4	1 540 193(3/2)°	1 650 746(5/2)	84HUA	84HUA
(1204.01)	(83 056)	1.23E+0	759 715(5/2)°	842 771(1/2)°	84HUA	84HUA
(1371.25)	(72 926)	1.93E+3	686 789(3/2)°	759 715(5/2)°	84HUA	84HUA
(2021.84)	(49 460)	2.08E+3	1 490 733(5/2)	1 540 193(3/2)°	84HUA	84HUA

TABLE 46. Energy levels of Ba XLII

Configuration	Designation	J	Energy (cm^{-1})	Reference
$3s^23p^3$	0(3/2)°	3/2	(0)	84HUA
	686 789(3/2)°	3/2	(686 789)	84HUA
	759 715(5/2)°	5/2	(759 715)	84HUA
	842 771(1/2)°	1/2	(842 771)	84HUA
	1 540 193(3/2)°	3/2	(1 540 193)	84HUA
$3s3p^4$	1 779 984(1/2)	1/2	(1 779 984)	84HUA

TABLE 46. Energy levels of Ba XLII—Continued

Configuration	Designation	J	Energy (cm^{-1})	Reference
	2 403 729(1/2)	1/2	(2 403 729)	84HUA
	2 931 888(1/2)	1/2	(2 931 888)	84HUA
	1 296 318(3/2)	3/2	(1 296 318)	84HUA
	1 787 921(3/2)	3/2	(1 787 921)	84HUA
	2 641 758(3/2)	3/2	(2 641 758)	84HUA

TABLE 46. Energy levels of Ba XLII—Continued

Configuration	Designation	J	Energy (cm^{-1})	Reference
	1 490 733(5/2)	5/2	(1 490 733)	84HUA
	1 650 746(5/2)	5/2	(1 650 746)	84HUA
$3s^23p^23d$	1 986 091(1/2)	1/2	(1 986 091)	84HUA
	2 258 726(1/2)	1/2	(2 258 726)	84HUA
	2 646 383(1/2)	1/2	(2 646 383)	84HUA
	2 962 578(1/2)	1/2	(2 962 578)	84HUA
	3 466 345(1/2)	1/2	(3 466 345)	84HUA
	1 983 323(3/2)	3/2	(1 983 323)	84HUA
	2 153 505(3/2)	3/2	(2 153 505)	84HUA
	2 258 892(3/2)	3/2	(2 258 892)	84HUA
	2 385 386(3/2)	3/2	(2 385 386)	84HUA
	2 459 955(3/2)	3/2	(2 459 955)	84HUA
	2 937 407(3/2)	3/2	(2 937 407)	84HUA
	3 064 508(3/2)	3/2	(3 064 508)	84HUA
	3 225 081(3/2)	3/2	(3 225 081)	84HUA
	1 978 489(5/2)	5/2	(1 978 489)	84HUA
	2 195 022(5/2)	5/2	(2 195 022)	84HUA
	2 224 666(5/2)	5/2	(2 224 666)	84HUA
	2 384 773(5/2)	5/2	(2 384 773)	84HUA
	2 522 674(5/2)	5/2	(2 522 674)	84HUA
	2 929 776(5/2)	5/2	(2 929 776)	84HUA
	3 127 072(5/2)	5/2	(3 127 072)	84HUA
	3 260 198(5/2)	5/2	(3 260 198)	84HUA
	2 050 672(7/2)	7/2	(2 050 672)	84HUA
	2 152 800(7/2)	7/2	(2 152 800)	84HUA
	2 369 710(7/2)	7/2	(2 369 710)	84HUA
	2 922 930(7/2)	7/2	(2 922 930)	84HUA
	2 962 207(7/2)	7/2	(2 962 207)	84HUA
	2 233 378(9/2)	9/2	(2 233 378)	84HUA
	2 955 367(9/2)	9/2	(2 955 367)	84HUA
Ba XLIII ($3p^2\ ^3P_0$)		*Limit*	(24 850 000)	04ROD/IND

6.41. Ba XLIII

Si isoelectronic sequence
Ground state $1s^22s^22p^63s^23p^2\ ^3P_0$
Ionization energy (26 340 000 cm^{-1}); (3266 eV)

There have been no experimental observations of the Ba XLIII spectrum, but Huang [85HUA] used the MCDF technique to calculate energy levels and wavefunctions. Electric dipole transition probabilities were calculated for transitions between the ground configuration and excited states in the $3s3p^3$ and $3s^23p3d$ configurations. Electric quadrupole and magnetic dipole transition probabilities were given for transitions between the five levels of the ground configuration. Because neither *LS* nor *jj* coupling provides high-purity descriptions of the Ba XLIII energy levels, the designation for each level in Tables 47 and 48 consists of the level value with the *J* value in parentheses. No information regarding the accuracy of the calculated values is available. The calculated ionization energy cited above is taken from Rodrigues *et al.* [04ROD/IND].

6.41.1. References for Ba XLIII

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TABLE 47. Spectral lines of Ba XLIII

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(28.761)	(3 476 934)	2.53E+8	0(0)	3 476 934(1)°	85HUA	85HUA
(31.522)	(3 172 364)	2.26E+9	0(0)	3 172 364(1)°	85HUA	85HUA
(34.458)	(2 902 078)	1.78E+8	0(0)	2 902 078(1)°	85HUA	85HUA
(36.175)	(2 764 365)	1.43E+8	712 569(1)	3 476 934(1)°	85HUA	85HUA
(36.921)	(2 708 451)	7.20E+8	768 483(2)	3 476 934(1)°	85HUA	85HUA
(38.190)	(2 618 492)	4.44E+8	0(0)	2 618 492(1)°	85HUA	85HUA
(38.413)	(2 603 291)	1.18E+9	712 569(1)	3 315 860(2)°	85HUA	85HUA
(39.256)	(2 547 377)	2.54E+9	768 483(2)	3 315 860(2)°	85HUA	85HUA
(39.549)	(2 528 500)	8.64E+9	0(0)	2 528 500(1)°	85HUA	85HUA
(40.654)	(2 459 795)	2.27E+9	712 569(1)	3 172 364(1)°	85HUA	85HUA
(41.599)	(2 403 881)	1.02E+10	768 483(2)	3 172 364(1)°	85HUA	85HUA
(42.202)	(2 369 530)	1.17E+10	768 483(2)	3 138 013(3)°	85HUA	85HUA
(45.143)	(2 215 196)	1.09E+9	712 569(1)	2 927 765(2)°	85HUA	85HUA
(45.458)	(2 199 820)	5.31E+11	712 569(1)	2 912 389(0)°	85HUA	85HUA
(45.568)	(2 194 539)	7.44E+11	0(0)	2 194 539(1)°	85HUA	85HUA
(45.672)	(2 189 509)	5.44E+11	712 569(1)	2 902 078(1)°	85HUA	85HUA

TABLE 47. Spectral lines of Ba XLIII—Continued

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(45.724)	(2 187 045)	2.53E+11	712 569(1)	2 899 614(2)°	85HUA	85HUA
(46.312)	(2 159 282)	8.30E+8	768 483(2)	2 927 765(2)°	85HUA	85HUA
(46.869)	(2 133 595)	6.79E+10	768 483(2)	2 902 078(1)°	85HUA	85HUA
(46.923)	(2 131 131)	5.05E+11	768 483(2)	2 899 614(2)°	85HUA	85HUA
(46.939)	(2 130 413)	4.46E+11	768 483(2)	2 898 896(3)°	85HUA	85HUA
(51.059)	(1 958 507)	4.73E+11	1 518 427(2)	3 476 934(1)°	85HUA	85HUA
(52.468)	(1 905 923)	1.65E+11	712 569(1)	2 618 492(1)°	85HUA	85HUA
(54.054)	(1 850 009)	3.76E+11	768 483(2)	2 618 492(1)°	85HUA	85HUA
(54.241)	(1 843 623)	2.08E+10	712 569(1)	2 556 192(2)°	85HUA	85HUA
(54.376)	(1 839 042)	3.07E+11	1 637 892(0)	3 476 934(1)°	85HUA	85HUA
(55.068)	(1 815 931)	1.48E+11	712 569(1)	2 528 500(1)°	85HUA	85HUA
(55.635)	(1 797 433)	4.42E+11	1 518 427(2)	3 315 860(2)°	85HUA	85HUA
(55.938)	(1 787 709)	2.51E+11	768 483(2)	2 556 192(2)°	85HUA	85HUA
(56.757)	(1 761 890)	1.05E+11	0(0)	1 761 890(1)°	85HUA	85HUA
(56.818)	(1 760 017)	8.09E+9	768 483(2)	2 528 500(1)°	85HUA	85HUA
(57.296)	(1 745 324)	9.95E+10	712 569(1)	2 457 893(0)°	85HUA	85HUA
(60.462)	(1 653 937)	8.85E+10	1 518 427(2)	3 172 364(1)°	85HUA	85HUA
(60.571)	(1 650 950)	1.95E+11	712 569(1)	2 363 519(2)°	85HUA	85HUA
(60.984)	(1 639 777)	8.64E+10	768 483(2)	2 408 260(3)°	85HUA	85HUA
(61.744)	(1 619 586)	2.75E+11	1 518 427(2)	3 138 013(3)°	85HUA	85HUA
(62.695)	(1 595 036)	6.22E+9	768 483(2)	2 363 519(2)°	85HUA	85HUA
(65.169)	(1 534 472)	9.00E+10	1 637 892(0)	3 172 364(1)°	85HUA	85HUA
(65.858)	(1 518 427)	1.42E+1	0(0)	1 518 427(2)	85HUA	85HUA
(67.478)	(1 481 970)	5.60E+7	712 569(1)	2 194 539(1)°	85HUA	85HUA
(68.929)	(1 450 759)	8.80E+9	712 569(1)	2 163 328(2)°	85HUA	85HUA
(69.429)	(1 440 324)	2.27E+10	768 483(2)	2 208 807(3)°	85HUA	85HUA
(70.123)	(1 426 056)	3.16E+9	768 483(2)	2 194 539(1)°	85HUA	85HUA
(70.955)	(1 409 338)	9.97E+9	1 518 427(2)	2 927 765(2)°	85HUA	85HUA
(71.693)	(1 394 845)	1.79E+9	768 483(2)	2 163 328(2)°	85HUA	85HUA
(72.273)	(1 383 651)	2.17E+7	1 518 427(2)	2 902 078(1)°	85HUA	85HUA
(72.401)	(1 381 187)	3.98E+8	1 518 427(2)	2 899 614(2)°	85HUA	85HUA
(72.439)	(1 380 469)	3.61E+9	1 518 427(2)	2 898 896(3)°	85HUA	85HUA
(79.102)	(1 264 186)	1.20E+8	1 637 892(0)	2 902 078(1)°	85HUA	85HUA
(80.111)	(1 248 269)	9.95E+7	712 569(1)	1 960 838(2)°	85HUA	85HUA
(83.868)	(1 192 355)	2.08E+9	768 483(2)	1 960 838(2)°	85HUA	85HUA
(90.904)	(1 100 065)	9.00E+9	1 518 427(2)	2 618 492(1)°	85HUA	85HUA
(95.300)	(1 049 321)	4.72E+9	712 569(1)	1 761 890(1)°	85HUA	85HUA
(96.361)	(1 037 765)	1.11E+10	1 518 427(2)	2 556 192(2)°	85HUA	85HUA
(99.003)	(1 010 073)	4.76E+9	1 518 427(2)	2 528 500(1)°	85HUA	85HUA
(100.664)	(993 407)	1.74E+10	768 483(2)	1 761 890(1)°	85HUA	85HUA
(101.978)	(980 600)	4.02E+9	1 637 892(0)	2 618 492(1)°	85HUA	85HUA
(108.070)	(925 323)	1.16E+7	712 569(1)	1 637 892(0)	85HUA	85HUA
(112.283)	(890 608)	4.23E+9	1 637 892(0)	2 528 500(1)°	85HUA	85HUA
(112.381)	(889 833)	5.65E+9	1 518 427(2)	2 408 260(3)°	85HUA	85HUA
(113.745)	(879 157)	6.05E+9	712 569(1)	1 591 726(2)°	85HUA	85HUA
(115.021)	(869 409)	1.17E+5	768 483(2)	1 637 892(0)	85HUA	85HUA
(118.330)	(845 092)	9.31E+7	1 518 427(2)	2 363 519(2)°	85HUA	85HUA
(121.471)	(823 243)	4.41E+9	768 483(2)	1 591 726(2)°	85HUA	85HUA
(124.091)	(805 858)	4.28E+6	712 569(1)	1 518 427(2)	85HUA	85HUA
(130.126)	(768 483)	2.36E+4	0(0)	768 483(2)	85HUA	85HUA
(133.343)	(749 944)	4.02E+6	768 483(2)	1 518 427(2)	85HUA	85HUA
(140.337)	(712 569)	4.62E+6	0(0)	712 569(1)	85HUA	85HUA
(144.848)	(690 380)	5.11E+8	1 518 427(2)	2 208 807(3)°	85HUA	85HUA
(147.904)	(676 112)	1.00E+8	1 518 427(2)	2 194 539(1)°	85HUA	85HUA
(155.063)	(644 901)	3.50E+8	1 518 427(2)	2 163 328(2)°	85HUA	85HUA
(179.647)	(556 647)	1.40E+7	1 637 892(0)	2 194 539(1)°	85HUA	85HUA
(226.034)	(442 411)	9.40E+6	1 518 427(2)	1 960 838(2)°	85HUA	85HUA

TABLE 47. Spectral lines of Ba XLIII—Continued

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(410.740)	(243 463)	1.28E+7	1 518 427(2)	1 761 890(1)°	85HUA	85HUA
(806.465)	(123 998)	2.89E+5	1 637 892(0)	1 761 890(1)°	85HUA	85HUA
(837.065)	(119 465)	1.33E+1	1 518 427(2)	1 637 892(0)	85HUA	85HUA
(1364.275)	(73 299)	7.35E+4	1 518 427(2)	1 591 726(2)°	85HUA	85HUA
(1788.461)	(55 914)	9.17E+2	712 569(1)	768 483(2)	85HUA	85HUA

TABLE 48. Energy levels of Ba XLIII

Configuration	Designation	J	Energy (cm^{-1})	Reference
$3s^23p^2$	0(0)	0	(0)	85HUA
	712 569(1)	1	(712 569)	85HUA
	768 483(2)	2	(768 483)	85HUA
	1 518 427(2)	2	(1 518 427)	85HUA
	1 637 892(0)	0	(1 637 892)	85HUA
$3s3p^3$	2 457 893(0)°	0	(2 457 893)	85HUA
	1 761 890(1)°	1	(1 761 890)	85HUA
	2 194 539(1)°	1	(2 194 539)	85HUA
	2 528 500(1)°	1	(2 528 500)	85HUA
	2 618 492(1)°	1	(2 618 492)	85HUA
	1 591 726(2)°	2	(1 591 726)	85HUA
	1 960 838(2)°	2	(1 960 838)	85HUA
	2 163 328(2)°	2	(2 163 328)	85HUA
	3 315 860(2)°	2	(3 315 860)	85HUA
	2 208 807(3)°	3	(2 208 807)	85HUA
$3s^23p3d$	2 912 389(0)°	0	(2 912 389)	85HUA
	2 902 078(1)°	1	(2 902 078)	85HUA
	3 172 364(1)°	1	(3 172 364)	85HUA
	3 476 934(1)°	1	(3 476 934)	85HUA
	2 363 519(2)°	2	(2 363 519)	85HUA
	2 556 192(2)°	2	(2 556 192)	85HUA
	2 899 614(2)°	2	(2 899 614)	85HUA
	2 927 765(2)°	2	(2 927 765)	85HUA
	2 408 260(3)°	3	(2 408 260)	85HUA
	2 898 896(3)°	3	(2 898 896)	85HUA
	3 138 013(3)°	3	(3 138 013)	85HUA
	2 923 894(4)°	4	(2 923 894)	85HUA
Ba XLIV ($3p\ ^2P^{\circ}_{1/2}$)		*Limit*	(26 340 000)	04ROD/IND

6.42. Ba XLIV

Al isoelectronic sequence
Ground state $1s^22s^22p^63s^23p\ ^2P^{\circ}_{1/2}$
Ionization energy (27 120 000 cm^{-1}); (3363 eV)

The Ba XLIV spectrum has not been observed, but Huang [86HUA] used the MCDF technique to calculate energy levels and wavelengths. Electric dipole transition probabilities were calculated for transitions between the ground configuration and excited states in the $3s3p^2$ and $3s^23d$ configurations, as well as between the $3s3p^2$ and $3s^23d$ levels and odd-parity levels of the $3p^3$ and $3s3p3d$ configurations with $J \geqslant 5/2$. Electric quadrupole and magnetic dipole transition probabilities were given for transitions between the first five levels of the ion. Charro *et al.* [03CHA/LOP] obtained values within 10% of Huang [86HUA] for the forbidden transition in the ground state, using the relativistic quantum defect orbital method. Lavin *et al.* [97LAV/ALV] and Gebarowski *et al.* [94GEB/MIG] reported transition probabilities for transitions from the ground configuration to the $3s^23d\ ^2D$ states and Safronova *et al.* [03SAF/SAT] calculated probabilities for transitions with lower levels in the $3s^23p$, $3s3p^2$, and $3s^23d$ configurations. Although the transition probabilities of [03SAF/SAT] and [86HUA] generally agree to within 10%, there is considerable disagreement between them and [97LAV/ALV]. In order to give a consistent set of wavelengths, energy levels, and transition probabilities, Tables 49 and 50 include the [86HUA] results, where available. For transitions in [03SAF/SAT], but not in [86HUA], the levels given by [86HUA] are used to calculate the wavelengths, and [03SAF/SAT] transition probabilities are retained.

Because neither *LS* nor *jj* coupling provides high-purity descriptions of the Ba XLIV energy levels, we use the level value with the *J* value in parentheses to designate each level. Despite the impurity of the coupling, Table 50 also gives the *jj* configuration names given by Huang [86HUA]. No information regarding the accuracy of the calculated values is available. The calculated ionization energy cited is taken from Rodrigues *et al.* [00ROD/OUR, 04ROD/IND]. It is within 2% of the value obtained by Clark *et al.* [86CLA/COW].

6.42.1. References for Ba XLIV

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TABLE 49. Spectral lines of Ba XLIV

λ (Å)	σ (cm⁻¹)	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(37.826)	(2 643 657)	1.93E+6	0(1/2)°	2 643 657(3/2)	86HUA	86HUA
(38.299)	(2 611 065)	4.89E+9	1 509 973(3/2)	4 121 038(5/2)°	86HUA	86HUA
(38.455)	(2 600 474)	5.20E+9	0(1/2)°	2 600 474(1/2)	86HUA	86HUA
(39.786)	(2 513 475)	8.16E+9	1 607 563(5/2)	4 121 038(5/2)°	86HUA	86HUA
(41.723)	(2 396 788)	2.07E+6	1 509 973(3/2)	3 906 761(5/2)°	86HUA	86HUA
(41.973)	(2 382 498)	7.49E+9	1 738 540(3/2)	4 121 038(5/2)°	86HUA	86HUA
(42.025)	(2 379 545)	1.78E+8	1 607 563(5/2)	3 987 108(7/2)°	86HUA	86HUA
(43.493)	(2 299 198)	1.31E+10	1 607 563(5/2)	3 906 761(5/2)°	86HUA	86HUA
(43.517)	(2 297 956)	1.35E+9	1 509 973(3/2)	3 807 929(5/2)°	86HUA	86HUA
(43.863)	(2 279 843)	6.38E+10	1 607 563(5/2)	3 887 406(7/2)°	86HUA	86HUA
(45.447)	(2 200 366)	1.72E+10	1 607 563(5/2)	3 807 929(5/2)°	86HUA	86HUA
(46.121)	(2 168 221)	1.74E+11	1 738 540(3/2)	3 906 761(5/2)°	86HUA	86HUA
(47.306)	(2 113 914)	2.71E+11	1 808 760(1/2)	3 922 674(1/2)°	86HUA	03SAF/SAT
(47.409)	(2 109 289)	5.45E+11	0(1/2)°	2 109 289(3/2)	86HUA	86HUA
(47.463)	(2 106 918)	2.64E+11	1 509 973(3/2)	3 616 891(1/2)°	86HUA	03SAF/SAT
(47.471)	(2 106 569)	1.24E+11	1 509 973(3/2)	3 616 542(5/2)°	86HUA	86HUA
(47.608)	(2 100 505)	2.63E+11	1 509 973(3/2)	3 610 478(3/2)°	86HUA	03SAF/SAT
(47.870)	(2 088 980)	3.83E+11	875 360(1/2)	2 964 340(3/2)°	86HUA	03SAF/SAT
(48.149)	(2 076 899)	3.83E+11	875 360(1/2)	2 952 259(1/2)°	86HUA	03SAF/SAT
(48.259)	(2 072 140)	1.36E+11	1 808 760(1/2)	3 880 900(3/2)°	86HUA	03SAF/SAT
(48.323)	(2 069 389)	2.87E+9	1 738 540(3/2)	3 807 929(5/2)°	86HUA	86HUA
(49.331)	(2 027 121)	2.59E+11	1 607 563(5/2)	3 634 684(7/2)°	86HUA	86HUA
(49.359)	(2 025 979)	1.29E+11	1 738 540(3/2)	3 764 519(3/2)°	86HUA	03SAF/SAT
(49.708)	(2 011 749)	1.28E+10	2 109 289(3/2)	4 121 038(5/2)°	86HUA	86HUA
(49.777)	(2 008 979)	2.73E+11	1 607 563(5/2)	3 616 542(5/2)°	86HUA	86HUA
(49.927)	(2 002 915)	5.24E+10	1 607 563(5/2)	3 610 478(3/2)°	86HUA	03SAF/SAT
(51.108)	(1 956 629)	8.22E+10	2 435 915(5/2)	4 392 544(3/2)°	86HUA	03SAF/SAT
(51.131)	(1 955 759)	1.08E+11	1 808 760(1/2)	3 764 519(3/2)°	86HUA	03SAF/SAT
(51.395)	(1 945 706)	1.39E+11	1 509 973(3/2)	3 455 679(3/2)°	86HUA	03SAF/SAT
(51.447)	(1 943 750)	8.18E+10	2 109 289(3/2)	4 053 039(1/2)°	86HUA	03SAF/SAT
(51.980)	(1 923 824)	1.87E+11	2 197 214(5/2)	4 121 038(5/2)°	86HUA	86HUA
(52.423)	(1 907 565)	2.51E+11	2 197 214(5/2)	4 104 779(3/2)°	86HUA	03SAF/SAT
(52.693)	(1 897 775)	8.09E+9	1 509 973(3/2)	3 407 748(5/2)°	86HUA	86HUA
(53.238)	(1 878 351)	1.51E+10	1 738 540(3/2)	3 616 891(1/2)°	86HUA	03SAF/SAT
(53.248)	(1 878 002)	1.70E+10	1 738 540(3/2)	3 616 542(5/2)°	86HUA	86HUA
(53.818)	(1 858 124)	2.48E+10	875 360(1/2)	2 733 484(3/2)°	86HUA	03SAF/SAT
(53.865)	(1 856 492)	5.96E+11	787 165(3/2)°	2 643 657(3/2)	86HUA	86HUA
(54.109)	(1 848 116)	2.08E+10	1 607 563(5/2)	3 455 679(3/2)°	86HUA	03SAF/SAT
(55.145)	(1 813 385)	4.07E+11	2 109 289(3/2)	3 922 674(1/2)°	86HUA	03SAF/SAT
(55.148)	(1 813 309)	2.92E+11	787 165(3/2)°	2 600 474(1/2)	86HUA	86HUA
(55.286)	(1 808 760)	4.12E+11	0(1/2)°	1 808 760(1/2)	86HUA	86HUA
(55.550)	(1 800 185)	5.67E+10	1 607 563(5/2)	3 407 748(5/2)°	86HUA	86HUA
(55.634)	(1 797 472)	5.40E+11	2 109 289(3/2)	3 906 761(5/2)°	86HUA	86HUA
(55.801)	(1 792 070)	1.40E+11	2 600 474(1/2)	4 392 544(3/2)°	86HUA	03SAF/SAT
(55.869)	(1 789 894)	8.65E+10	2 197 214(5/2)	3 987 108(7/2)°	86HUA	86HUA
(56.446)	(1 771 611)	8.88E+10	2 109 289(3/2)	3 880 900(3/2)°	86HUA	03SAF/SAT
(56.719)	(1 763 092)	2.42E+11	1 738 540(3/2)	3 501 632(1/2)°	86HUA	03SAF/SAT
(56.982)	(1 754 932)	5.79E+10	875 360(1/2)	2 630 292(3/2)°	86HUA	03SAF/SAT
(57.179)	(1 748 887)	5.66E+11	2 643 657(3/2)	4 392 544(3/2)°	86HUA	03SAF/SAT
(57.520)	(1 738 540)	1.13E+11	0(1/2)°	1 738 540(3/2)	86HUA	86HUA
(58.236)	(1 717 139)	9.05E+10	1 738 540(3/2)	3 455 679(3/2)°	86HUA	03SAF/SAT
(58.495)	(1 709 547)	1.35E+7	2 197 214(5/2)	3 906 761(5/2)°	86HUA	86HUA

TABLE 49. Spectral lines of Ba XLIV—Continued

λ (Å)	σ (cm⁻¹)	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(58.871)	(1 698 640)	9.52E+8	2 109 289(3/2)	3 807 929(5/2)°	86HUA	86HUA
(59.165)	(1 690 192)	1.02E+11	2 197 214(5/2)	3 887 406(7/2)°	86HUA	86HUA
(59.343)	(1 685 123)	1.32E+11	2 435 915(5/2)	4 121 038(5/2)°	86HUA	86HUA
(59.909)	(1 669 208)	1.55E+11	1 738 540(3/2)	3 407 748(5/2)°	86HUA	86HUA
(59.921)	(1 668 864)	1.12E+11	2 435 915(5/2)	4 104 779(3/2)°	86HUA	03SAF/SAT
(60.415)	(1 655 230)	8.19E+10	2 109 289(3/2)	3 764 519(3/2)°	86HUA	03SAF/SAT
(60.652)	(1 648 750)	2.13E+11	787 165(3/2)°	2 435 915(5/2)	86HUA	86HUA
(60.719)	(1 646 919)	2.17E+11	1 808 760(1/2)	3 455 679(3/2)°	86HUA	03SAF/SAT
(61.634)	(1 622 485)	5.89E+10	1 509 973(3/2)	3 132 458(3/2)°	86HUA	03SAF/SAT
(62.084)	(1 610 715)	1.47E+11	2 197 214(5/2)	3 807 929(5/2)°	86HUA	86HUA
(62.387)	(1 602 898)	1.15E+10	1 509 973(3/2)	3 112 871(5/2)°	86HUA	86HUA
(63.804)	(1 567 305)	3.55E+10	2 197 214(5/2)	3 764 519(3/2)°	86HUA	03SAF/SAT
(64.467)	(1 551 193)	2.79E+11	2 435 915(5/2)	3 987 108(7/2)°	86HUA	86HUA
(66.226)	(1 509 973)	7.84E+8	0(1/2)°	1 509 973(3/2)	86HUA	86HUA
(66.346)	(1 507 253)	1.51E+9	2 109 289(3/2)	3 616 542(5/2)°	86HUA	86HUA
(66.432)	(1 505 308)	4.33E+10	1 607 563(5/2)	3 112 871(5/2)°	86HUA	86HUA
(66.476)	(1 504 305)	1.06E+11	2 600 474(1/2)	4 104 779(3/2)°	86HUA	03SAF/SAT
(67.561)	(1 480 152)	9.36E+10	1 509 973(3/2)	2 990 125(5/2)°	86HUA	86HUA
(67.687)	(1 477 381)	2.29E+11	2 643 657(3/2)	4 121 038(5/2)°	86HUA	86HUA
(67.988)	(1 470 846)	1.20E+8	2 435 915(5/2)	3 906 761(5/2)°	86HUA	86HUA
(68.844)	(1 452 565)	1.56E+11	2 600 474(1/2)	4 053 039(1/2)°	86HUA	03SAF/SAT
(68.895)	(1 451 491)	3.67E+10	2 435 915(5/2)	3 887 406(7/2)°	86HUA	86HUA
(69.475)	(1 439 367)	4.88E+10	1 607 563(5/2)	3 046 930(7/2)°	86HUA	86HUA
(69.567)	(1 437 470)	1.45E+10	2 197 214(5/2)	3 634 684(7/2)°	86HUA	86HUA
(70.456)	(1 419 328)	2.04E+8	2 197 214(5/2)	3 616 542(5/2)°	86HUA	86HUA
(70.920)	(1 410 049)	2.95E+10	787 165(3/2)°	2 197 214(5/2)	86HUA	86HUA
(72.329)	(1 382 562)	1.79E+9	1 607 563(5/2)	2 990 125(5/2)°	86HUA	86HUA
(72.763)	(1 374 331)	2.70E+10	1 738 540(3/2)	3 112 871(5/2)°	86HUA	86HUA
(72.886)	(1 372 014)	2.71E+10	2 435 915(5/2)	3 807 929(5/2)°	86HUA	86HUA
(75.636)	(1 322 124)	5.18E+7	787 165(3/2)°	2 109 289(3/2)	86HUA	86HUA
(77.014)	(1 298 459)	3.41E+7	2 109 289(3/2)	3 407 748(5/2)°	86HUA	86HUA
(77.486)	(1 290 560)	5.06E+8	1 509 973(3/2)	2 800 533(5/2)°	86HUA	86HUA
(79.170)	(1 263 104)	1.36E+9	2 643 657(3/2)	3 906 761(5/2)°	86HUA	86HUA
(79.899)	(1 251 585)	6.66E+8	1 738 540(3/2)	2 990 125(5/2)°	86HUA	86HUA
(82.608)	(1 210 534)	3.00E+9	2 197 214(5/2)	3 407 748(5/2)°	86HUA	86HUA
(83.419)	(1 198 769)	1.60E+8	2 435 915(5/2)	3 634 684(7/2)°	86HUA	86HUA
(83.824)	(1 192 970)	5.08E+9	1 607 563(5/2)	2 800 533(5/2)°	86HUA	86HUA
(84.701)	(1 180 627)	1.02E+9	2 435 915(5/2)	3 616 542(5/2)°	86HUA	86HUA
(85.891)	(1 164 272)	1.75E+9	2 643 657(3/2)	3 807 929(5/2)°	86HUA	86HUA
(94.163)	(1 061 993)	1.38E+9	1 738 540(3/2)	2 800 533(5/2)°	86HUA	86HUA
(97.886)	(1 021 595)	1.54E+10	787 165(3/2)°	1 808 760(1/2)	86HUA	86HUA
(99.643)	(1 003 582)	1.02E+8	2 109 289(3/2)	3 112 871(5/2)°	86HUA	86HUA
(102.787)	(972 885)	9.18E+8	2 643 657(3/2)	3 616 542(5/2)°	86HUA	86HUA
(102.898)	(971 833)	1.20E+10	2 435 915(5/2)	3 407 748(5/2)°	86HUA	86HUA
(105.111)	(951 375)	9.19E+9	787 165(3/2)°	1 738 540(3/2)	86HUA	86HUA
(109.211)	(915 657)	8.76E+9	2 197 214(5/2)	3 112 871(5/2)°	86HUA	86HUA
(113.529)	(880 836)	4.70E+7	2 109 289(3/2)	2 990 125(5/2)°	86HUA	86HUA
(114.239)	(875 360)	1.43E+10	0(1/2)°	875 360(1/2)	86HUA	86HUA
(117.686)	(849 716)	8.30E+9	2 197 214(5/2)	3 046 930(7/2)°	86HUA	86HUA
(121.892)	(820 398)	5.95E+9	787 165(3/2)°	1 607 563(5/2)	86HUA	86HUA
(126.118)	(792 911)	2.92E+8	2 197 214(5/2)	2 990 125(5/2)°	86HUA	86HUA
(127.038)	(787 165)	4.35E+6	0(1/2)°	787 165(3/2)°	86HUA	86HUA
(130.874)	(764 091)	4.39E+9	2 643 657(3/2)	3 407 748(5/2)°	86HUA	86HUA
(136.574)	(732 203)	2.03E+4	875 360(1/2)	1 607 563(5/2)	86HUA	86HUA
(138.349)	(722 808)	8.71E+8	787 165(3/2)°	1 509 973(3/2)	86HUA	86HUA
(144.667)	(691 244)	3.85E+9	2 109 289(3/2)	2 800 533(5/2)°	86HUA	86HUA
(147.720)	(676 956)	1.40E+8	2 435 915(5/2)	3 112 871(5/2)°	86HUA	86HUA

TABLE 49. Spectral lines of Ba XLIV—Continued

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(157.576)	(634 613)	3.59E+6	875 360(1/2)	1 509 973(3/2)	86HUA	86HUA
(163.662)	(611 015)	7.39E+8	2 435 915(5/2)	3 046 930(7/2)°	86HUA	86HUA
(165.750)	(603 319)	2.28E+6	2 197 214(5/2)	2 800 533(5/2)°	86HUA	86HUA
(180.437)	(554 210)	1.69E+8	2 435 915(5/2)	2 990 125(5/2)°	86HUA	86HUA
(213.122)	(469 214)	5.82E+7	2 643 657(3/2)	3 112 871(5/2)°	86HUA	86HUA
(274.260)	(364 618)	1.08E+7	2 435 915(5/2)	2 800 533(5/2)°	86HUA	86HUA
(288.627)	(346 468)	4.30E+6	2 643 657(3/2)	2 990 125(5/2)°	86HUA	86HUA
(637.446)	(156 876)	1.94E+4	2 643 657(3/2)	2 800 533(5/2)°	86HUA	86HUA
(1024.695)	(97 590)	9.43E+3	1 509 973(3/2)	1 607 563(5/2)	86HUA	86HUA
(1133.851)	(88 195)	3.93E+5	787 165(3/2)°	875 360(1/2)	86HUA	86HUA

TABLE 50. Energy levels of Ba XLIV

Designation	Configuration	J	Energy (cm^{-1})	Reference
0(1/2)°	$[(3s^2)_0 3p_{1/2}]°$	1/2	(0)	86HUA
787 165(3/2)°		3/2	(787 165)	86HUA
875 360(1/2)	$[3s(3p^2_{1/2})_0]°$	1/2	(875 360)	86HUA
1 509 973(3/2)	$[3s(3p_{1/2}3p_{3/2})_2]$	3/2	(1 509 973)	86HUA
1 607 563(5/2)		5/2	(1 607 563)	86HUA
1 738 540(3/2)	$[3s(3p_{1/2}3p_{3/2})_1]$	3/2	(1 738 540)	86HUA
1 808 760(1/2)		1/2	(1 808 760)	86HUA
2 109 289(3/2)	$[(3s^2)_0 3d_{3/2}]°$	3/2	(2 109 289)	86HUA
2 197 214(5/2)		5/2	(2 197 214)	86HUA
2 435 915(5/2)	$[(3p^2_{1/2})_0 3d_{5/2}]$	5/2	(2 435 915)	86HUA
2 643 657(3/2)		3/2	(2 643 657)	86HUA
2 600 474(1/2)	$[3s(3p^2_{3/2})_0]°$	1/2	(2 600 474)	86HUA
2 630 292(3/2)°	$[(3s3p_{1/2})_0 3d_{3/2}]°$	3/2	(2 630 292)	86HUA
2 733 484(3/2)°	$[(3p^2_{1/2})_0 3p_{3/2}]°$	3/2	(2 733 484)	86HUA
2 800 533(5/2)°	$[(3s3p_{1/2})_1 3d_{3/2}]°$	5/2	(2 800 533)	86HUA
2 952 259(1/2)°		1/2	(2 952 259)	86HUA
2 964 340(3/2)°		3/2	(2 964 340)	86HUA
2 990 125(5/2)°	$[(3s3p_{1/2})_0 3d_{5/2}]°$	5/2	(2 990 125)	86HUA
3 046930(7/2)°	$[(3s3p_{1/2})_1 3d_{5/2}]°$	7/2	(3 046 930)	86HUA
3 112 871(5/2)°		5/2	(3 112 871)	86HUA
3 132 458(3/2)°		3/2	(3 132 458)	86HUA
3 407 748(5/2)°	$[3p_{1/2}(3p^2_{3/2})_2]°$	5/2	(3 407 748)	86HUA
3 455679(3/2)°		3/2	(3 455 679)	86HUA
3 501 632(1/2)°	$[(3s3p_{3/2})_2 3d_{3/2}]°$	1/2	(3 501 632)	86HUA
3 610 478(3/2)°		3/2	(3 610 478)	86HUA
3 616 542(5/2)°		5/2	(3 616 542)	86HUA
3 616 891(1/2)°	$[3p_{1/2}(3p^2_{3/2})_0]°$	1/2	(3 616 891)	86HUA
3 634 684(7/2)°	$[(3s3p_{3/2})_2 3d_{3/2}]°$	7/2	(3 634 684)	86HUA
3 666 065(9/2)°	$[(3s3p_{3/2})_2 3d_{5/2}]°$	9/2	(3 666 065)	86HUA
3 880 900(3/2)°		3/2	(3 880 900)	86HUA
3 887 406(7/2)°		7/2	(3 887 406)	86HUA
3 906 761(5/2)°		5/2	(3 906 761)	86HUA
4 053 039(1/2)°		1/2	(4 053 039)	86HUA
3 764 519(3/2)°	$[(3s3p_{3/2})_1 3d_{3/2}]°$	3/2	(3 764 519)	86HUA
3 807 929(5/2)°		5/2	(3 807 929)	86HUA
3 922 674(1/2)°		1/2	(3 922 674)	86HUA
3 987 108(7/2)°	$[(3s3p_{3/2})_1 3d_{5/2}]°$	7/2	(3 987 108)	86HUA
4 104 779(3/2)°		3/2	(4 104 779)	86HUA
4 121 038(5/2)°		5/2	(4 121 038)	86HUA
4 392 544(3/2)°	$[3p_{1/2}(3d^2_{3/2})_2]°$	3/2	(4 392 544)	86HUA
Ba XLV ($3s^2$ $^1S_0$)		*Limit*	(27 120 000)	04ROD/IND

6.43. Ba XLV

Mg isoelectronic sequence
Ground state $1s^2 2s^2 2p^6 3s^2$ $^1S_0$
Ionization energy (28 600 000 cm^{-1}); (3546 eV)

No experimental data are available for the Ba XLV spectrum; however, Ekberg *et al.* [91EKB/FEL] used experimental data for other ions along the Mg isoelectronic sequence to produce fitted values for the energy levels. In Tables 51 and 52 we report fitted values for the energy levels and the wavelengths and wave numbers calculated from them. The ions used to determine the fit which produced the barium energy levels extend from Mo XXXI (Z=42) through Cs XLIV (Z=55), thus the values in Table 52 are extrapolated. Although no estimate of the accuracy of the barium levels is given by [91EKB/FEL], their cesium levels are expected to be accurate within ±500 cm^{-1}. The calculated ionization energy cited above is taken from Rodrigues *et al.* [04ROD/IND].

Transition probabilities have been calculated by Wang *et al.* [06WAN/CHE] for many transitions involving the $3s^2$, $3s3p$, $3s3d$, $3s4s$, $3s4p$, $3s4d$, $3p^2$, $3p3d$, $3p4s$, $3p4p$, $3p4d$, $3d^2$, $3d4s$, $3d4p$, and $3d4d$ configurations. Those which correspond to the transitions fitted by [91EKB/FEL] are included in Table 51. Wang *et al.* [06WAN/CHE] used the MCDF method.

6.43.1. References for Ba XLV

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TABLE 51. Spectral lines of Ba XLV

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
[49.106]	[2 036 400]	2.43+11	$3p3d(1/2,3/2)^{\circ}_{2}$	$3d^2(3/2,3/2)_2$	91EKB/FEL	06WAN/CHE
[49.675]	[2 013 100]	2.26+11	$3p3d(1/2,5/2)^{\circ}_{2}$	$3d^2(3/2,5/2)_1$	91EKB/FEL	06WAN/CHE
[50.030]	[1 998 800]	1.26+11	$3p^2(1/2,3/2)_2$	$3p3d(3/2,3/2)^{\circ}_{3}$	91EKB/FEL	06WAN/CHE
[50.176]	[1 993 000]	3.32+11	$3s3p(1/2,1/2)^{\circ}_{1}$	$3s3d(1/2,3/2)_2$	91EKB/FEL	06WAN/CHE
[50.533]	[1 978 900]	3.37+11	$3p^2(1/2,1/2)_0$	$3p3d(1/2,3/2)^{\circ}_{1}$	91EKB/FEL	06WAN/CHE
[51.592]	[1 938 300]	1.94+11	$3p^2(1/2,3/2)_2$	$3p3d(3/2,3/2)^{\circ}_{2}$	91EKB/FEL	06WAN/CHE
[51.768]	[1 931 700]	1.27+11	$3p^2(1/2,3/2)_1$	$3p3d(3/2,3/2)^{\circ}_{2}$	91EKB/FEL	06WAN/CHE
[52.301]	[1 912 000]	1.53+11	$3p3d(1/2,5/2)^{\circ}_{3}$	$3d^2(3/2,5/2)_3$	91EKB/FEL	06WAN/CHE
[54.007]	[1 851 600]	2.26+11	$3p3d(1/2,3/2)^{\circ}_{1}$	$3d^2(3/2,3/2)_2$	91EKB/FEL	06WAN/CHE
[54.277]	[1 842 400]	1.79+11	$3s3p(1/2,3/2)^{\circ}_{2}$	$3p^2(3/2,3/2)_2$	91EKB/FEL	06WAN/CHE
[56.699]	[1 763 700]	1.56+11	$3s3p(1/2,1/2)^{\circ}_{0}$	$3p^2(1/2,3/2)_1$	91EKB/FEL	06WAN/CHE
[56.770]	[1 761 500]	3.56+11	$3s^2(1/2,1/2)_0$	$3s3p(1/2,3/2)^{\circ}_{1}$	91EKB/FEL	06WAN/CHE
[57.703]	[1 733 000]	1.70+11	$3s3d(1/2,3/2)_1$	$3p3d(3/2,3/2)^{\circ}_{1}$	91EKB/FEL	06WAN/CHE
[58.720]	[1 703 000]	4.27+11	$3s3p(1/2,3/2)^{\circ}_{1}$	$3p^2(3/2,3/2)_0$	91EKB/FEL	06WAN/CHE
[59.266]	[1 687 300]	2.77+11	$3s3d(1/2,3/2)_2$	$3p3d(3/2,3/2)^{\circ}_{3}$	91EKB/FEL	06WAN/CHE
[59.238]	[1 688 100]		$3s3p(1/2,1/2)^{\circ}_{1}$	$3p^2(1/2,3/2)_1$	91EKB/FEL	06WAN/CHE
[59.471]	[1 681 500]		$3s3p(1/2,1/2)^{\circ}_{1}$	$3p^2(1/2,3/2)_2$	91EKB/FEL	06WAN/CHE
[61.523]	[1 625 400]	3.25+11	$3s3p(1/2,3/2)^{\circ}_{1}$	$3p^2(3/2,3/2)_2$	91EKB/FEL	06WAN/CHE
[62.305]	[1 605 000]	2.03+11	$3s3d(1/2,5/2)_3$	$3p3d(3/2,5/2)^{\circ}_{4}$	91EKB/FEL	06WAN/CHE
[62.637]	[1 596 500]	1.86+11	$3s3d(1/2,5/2)_2$	$3p3d(3/2,5/2)^{\circ}_{2}$	91EKB/FEL	06WAN/CHE
[67.308]	[1 485 700]		$3s3p(1/2,3/2)^{\circ}_{2}$	$3s3d(1/2,5/2)_2$	91EKB/FEL	06WAN/CHE
[71.352]	[1 401 500]	1.04+11	$3s3p(1/2,3/2)^{\circ}_{2}$	$3s3d(1/2,5/2)_3$	91EKB/FEL	06WAN/CHE
[73.421]	[1 362 000]	2.44+11	$3p^2(3/2,3/2)_2$	$3p3d(3/2,5/2)^{\circ}_{3}$	91EKB/FEL	06WAN/CHE
[73.981]	[1 351 700]		$3p^2(1/2,3/2)_2$	$3p3d(1/2,5/2)^{\circ}_{3}$	91EKB/FEL	06WAN/CHE
[74.145]	[1 348 700]	1.02+11	$3p^2(3/2,3/2)_0$	$3p3d(3/2,5/2)^{\circ}_{1}$	91EKB/FEL	06WAN/CHE
[74.488]	[1 342 500]		$3p^2(1/2,3/2)_1$	$3p3d(1/2,5/2)^{\circ}_{2}$	91EKB/FEL	06WAN/CHE
[74.873]	[1 335 600]	1.29+11	$3p3d(3/2,3/2)^{\circ}_{3}$	$3d^2(3/2,5/2)_4$	91EKB/FEL	06WAN/CHE
[81.453]	[1 009 400]	1.47+11	$3p3d(3/2,5/2)^{\circ}_{3}$	$3d^2(5/2,5/2)_4$	91EKB/FEL	06WAN/CHE
[122.986]	[813 100]		$3s^2(1/2,1/2)_0$	$3s3p(1/2,1/2)^{\circ}_{1}$	91EKB/FEL	06WAN/CHE

TABLE 52. Energy levels of Ba XLV

Configuration	Term	J	Energy (cm^{-1})	Reference
$3s^2$	(1/2,1/2)	0	[0]	91EKB/FEL
3s3p	$(1/2,1/2)^{\circ}$	0	[737 500]	91EKB/FEL
	$(1/2,1/2)^{\circ}$	1	[813 100]	91EKB/FEL
3s3p	$(1/2,3/2)^{\circ}$	2	[1 544 500]	91EKB/FEL
	$(1/2,3/2)^{\circ}$	1	[1 761 500]	91EKB/FEL
$3p^2$	(1/2,1/2)	0	[1 768 900]	91EKB/FEL
$3p^2$	(1/2,3/2)	2	[2 494 600]	91EKB/FEL
	(1/2,3/2)	1	[2 501 200]	91EKB/FEL
3s3d	(1/2,3/2)	1	[2 764 400]	91EKB/FEL
	(1/2,3/2)	2	[2 806 100]	91EKB/FEL
3s3d	(1/2,5/2)	3	[2 946 000]	91EKB/FEL
	(1/2,5/2)	2	[3 030 200]	91EKB/FEL
$3p^2$	(3/2,3/2)	2	[3 386 900]	91EKB/FEL
	(3/2,3/2)	0	[3 464 500]	91EKB/FEL
3p3d	$(1/2,3/2)^{\circ}$	2	[3 563 000]	91EKB/FEL
	$(1/2,3/2)^{\circ}$	1	[3 747 800]	91EKB/FEL
3p3d	$(1/2,5/2)^{\circ}$	2	[3 843 700]	91EKB/FEL
	$(1/2,5/2)^{\circ}$	3	[3 846 300]	91EKB/FEL
3p3d	$(3/2,3/2)^{\circ}$	2	[4 432 900]	91EKB/FEL
	$(3/2,3/2)^{\circ}$	3	[4 493 400]	91EKB/FEL
	$(3/2,3/2)^{\circ}$	0	[4 496 300]	91EKB/FEL
	$(3/2,3/2)^{\circ}$	1	[4 497 400]	91EKB/FEL

TABLE 52. Energy levels of Ba XLV—Continued

Configuration	Term	J	Energy (cm^{-1})	Reference
3p3d	$(3/2,5/2)^{\circ}$	4	[4 551 000]	91EKB/FEL
	$(3/2,5/2)^{\circ}$	2	[4 626 700]	91EKB/FEL
	$(3/2,5/2)^{\circ}$	3	[4 748 900]	91EKB/FEL
	$(3/2,5/2)^{\circ}$	1	[4 813 200]	91EKB/FEL
$3d^2$	(3/2,3/2)	2	[5 599 400]	91EKB/FEL
	(3/2,3/2)	0	[5 736 900]	91EKB/FEL
$3d^2$	(3/2,5/2)	3	[5 758 300]	91EKB/FEL
	(3/2,5/2)	4	[5 829 000]	91EKB/FEL
	(3/2,5/2)	2	[5 831 000]	91EKB/FEL
	(3/2,5/2)	1	[5 856 800]	91EKB/FEL
$3d^2$	(5/2,5/2)	4	[5 976 600]	91EKB/FEL
	(5/2,5/2)	2	[6 026 400]	91EKB/FEL
Ba XLVI (3s $^2S_{1/2}$)		*Limit*	(28 600 000)	04ROD/IND

6.44. Ba XLVI

Na isoelectronic sequence
Ground state $1s^22s^22p^63s\ ^2S_{1/2}$
Ionization energy [29 375 000 cm^{-1}]; [3642 eV]

Transitions in the Ba XLVI spectrum have been reported by two teams of researchers using electron beam ion traps to contain the highly ionized atoms. Although they gave no quantitative value for the wavelengths, Chantler *et al.* [97CHA/PAT] showed recorded spectra with the $3s\ ^2S_{1/2}-2p^5(^2P_{3/2})3s3d(^2D_{5/2})^{\circ}_{1/2,3/2}$ transitions identified. Kato *et al.* [06KAT/NAK] measured one transition of the Ba XLVI spectrum on the Tokyo EBIT, yielding a value for the $3s\ ^2S_{1/2}-2p^5(^2P_{3/2})3s3d(^2D_{5/2})^{\circ}_{3/2}$ wavelength. Other research groups have determined values for other transitions and energy levels by using fitting along the Na isoelectronic sequence. Seely and Wagner [90SEE/WAG] used data for 15 ions with $39\leqslant Z\leqslant 55$ to locate the $3s-3p$ transitions. Matsushima *et al.* [91MAT/GEI] observed sodiumlike Cd, In, Sb, and Te in the region between 5 and 9.2 Å and fitted the isoelectronic sequence using a polynomial to obtain data for $\Delta n\geqslant 1$. Seely *et al.* [91SEE/BRO] measured the spectrum of Na-like Cd, In, Sn, and Gd in the 23–150 Å range, then combined these values with observations of other elements by Reader *et al.* [87REA/KAU, 90REA/EKB], Hinnov *et al.* [86HIN/BOO], Burkhalter *et al.* [77BUR/REA], Mansfield *et al.* [78MAN/PEA], and Seely *et al.* [88SEE/FEL]. Seely *et al.* [91SEE/BRO] then calculated isoelectronically fitted values for Ba XLVI energy levels by comparison with MCDF predictions. The wavelengths in Table 53 are calculated from the energy levels. The ionization energy and the $n=3$ energy level values in Table 54 are from [91SEE/BRO], while levels with $n>3$ are taken from [91MAT/GEI].

Where available the transition probabilities in Table 53 are taken from Johnson *et al.* [96JOH/LIU], who used third-order many-body perturbation theory. Otherwise the reported values are from Sampson *et al.* [90SAM/ZHA] who used a fully relativistic distorted wave approach. The values of [96JOH/LIU] and [90SAM/ZHA] differ by less than 5% for the transitions calculated in both papers. Additional calculations of transition probabilities by Baik *et al.* [91BAI/OHR] give values within 9% of those listed here.

6.44.1. References for Ba XLVI

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TABLE 53. Spectral lines of Ba XLVI

λ (Å)	Unc. (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
2.5225	0.0003	39 643 000		3s $^2S_{1/2}$	$2p^5(^2P_{3/2})3s3d(^2D_{5/2})^\circ_{3/2}$	06KAT/NAK	
[7.106]	0.005	[14 073 000]	1.21E+13	3s $^2S_{1/2}$	4p $^2P^\circ_{3/2}$	91SEE/BRO	90SAM/ZHA
[7.280]	0.005	[13 736 000]	1.55E+13	3s $^2S_{1/2}$	4p $^2P^\circ_{1/2}$	91SEE/BRO	90SAM/ZHA
[7.340]	0.005	[13 624 000]	2.53E+13	3p $^2P^\circ_{1/2}$	4d $^2D_{3/2}$	91SEE/BRO	90SAM/ZHA
[7.760]	0.005	[12 887 000]	3.15E+13	3p $^2P^\circ_{3/2}$	4d $^2D_{5/2}$	91SEE/BRO	90SAM/ZHA
[7.808]	0.002	[12 807 790]	5.39E+12	3p $^2P^\circ_{3/2}$	4d $^2D_{3/2}$	91SEE/BRO, 91MAT/GEI	90SAM/ZHA
[7.977]	0.003	[12 535 510]	4.69E+12	3p $^2P^\circ_{1/2}$	4s $^2S_{1/2}$	91SEE/BRO, 91MAT/GEI	96JOH/LIU
[8.312]	0.005	[12 030 700]	5.59E+13	3d $^2D_{3/2}$	4f $^2F^\circ_{5/2}$	91SEE/BRO, 91MAT/GEI	90SAM/ZHA
[8.418]	0.005	[11 880 000]	5.93E+13	3d $^2D_{5/2}$	4f $^2F^\circ_{7/2}$	91SEE/BRO, 91MAT/GEI	90SAM/ZHA
[8.537]	0.005	[11 713 990]	1.16E+13	3p $^2P^\circ_{3/2}$	4s $^2S_{1/2}$	91SEE/BRO, 91MAT/GEI	96JOH/LIU
[16.286]	0.005	[6 140 400]		4p $^2P^\circ_{1/2}$	5d $^2D_{3/2}$	91MAT/GEI	
[17.100]	0.005	[5 848 100]		4p $^2P^\circ_{3/2}$	5d $^2D_{5/2}$	91MAT/GEI	
[18.027]	0.005	[5 547 200]		4d $^2D_{3/2}$	5f $^2F^\circ_{5/2}$	91MAT/GEI	
[18.233]	0.005	[5 484 600]		4d $^2D_{5/2}$	5f $^2F^\circ_{7/2}$	91MAT/GEI	
[18.912]	0.005	[5 287 700]		4f $^2F^\circ_{5/2}$	5g $^2G_{7/2}$	91MAT/GEI	
[18.999]	0.005	[5 263 400]		4f $^2F^\circ_{7/2}$	5g $^2G_{9/2}$	91MAT/GEI	
[52.873]	0.005	[1 891 310]	2.06E+11	3p $^2P^\circ_{1/2}$	3d $^2D_{3/2}$	91SEE/BRO	90SAM/ZHA
[59.826]	0.005	[1 671 510]	1.99E+11	3s $^2S_{1/2}$	3p $^2P^\circ_{3/2}$	91SEE/BRO	96JOH/LIU
[79.662]	0.005	[1 255 290]	7.34E+10	3p $^2P^\circ_{3/2}$	3d $^2D_{5/2}$	91SEE/BRO	90SAM/ZHA
[93.476]	0.005	[1 069 790]	7.41E+9	3p $^2P^\circ_{3/2}$	3d $^2D_{3/2}$	91SEE/BRO	90SAM/ZHA
[117.649]	0.005	[849 990]	2.50E+10	3s $^2S_{1/2}$	3p $^2P^\circ_{1/2}$	91SEE/BRO	96JOH/LIU

TABLE 54. Energy levels of Ba XLVI

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
3s	^2S	1/2	[0]		91SEE/BRO
3p	$^2P^\circ$	1/2	[849 990]	40	91SEE/BRO
	$^2P^\circ$	3/2	[1 671 510]	140	91SEE/BRO
3d	^2D	3/2	[2 741 300]	200	91SEE/BRO
	^2D	5/2	[2 926 800]	200	91SEE/BRO
4s	^2S	1/2	[13 385 500]	1300	91MAT/GEI
4p	$^2P^\circ$	1/2	[13 740 000]	1300	91MAT/GEI
	$^2P^\circ$	3/2	[14 073 800]	1300	91MAT/GEI
4d	^2D	3/2	[14 479 300]	1300	91MAT/GEI
	^2D	5/2	[14 559 600]	1300	91MAT/GEI
4f	$^2F^\circ$	5/2	[14 772 000]	1300	91MAT/GEI
	$^2F^\circ$	7/2	[14 806 800]	1300	91MAT/GEI
5s	^2S	1/2	[19 336 500]	2500	91MAT/GEI
5p	$^2P^\circ$	1/2	[19 514 300]	2500	91MAT/GEI
	$^2P^\circ$	3/2	[19 682 300]	2500	91MAT/GEI
5d	^2D	3/2	[19 880 400]	2500	91MAT/GEI
	^2D	5/2	[19 921 900]	2500	91MAT/GEI
5f	$^2F^\circ$	5/2	[20 026 500]	2500	91MAT/GEI
	$^2F^\circ$	7/2	[20 044 200]	2500	91MAT/GEI
5g	^2G	7/2	[20 059 700]	2500	91MAT/GEI
	^2G	9/2	[20 070 200]	2500	91MAT/GEI
6s	^2S	1/2	[22 484 000]	5000	91MAT/GEI
6p	$^2P^\circ$	1/2	[22 585 000]	5000	91MAT/GEI
	$^2P^\circ$	3/2	[22 681 000]	5000	91MAT/GEI
6d	^2D	3/2	[22 794 000]	5000	91MAT/GEI
	^2D	5/2	[22 818 000]	5000	91MAT/GEI
6f	$^2F^\circ$	5/2	[22 879 000]	5000	91MAT/GEI
	$^2F^\circ$	7/2	[22 890 000]	5000	91MAT/GEI
Ba XLVII ($2p^6$ $^1S_0$)	*Limit*		[29 375 000]		91SEE/BRO
$2p^5(^2P_{3/2})3s3d(^2D_{5/2})^\circ$		3/2	39 643 000	4700	06KAT/NAK

6.45. Ba XLVII

Ne isoelectronic sequence
Ground state $1s^22s^22p^6$ $^1S_0$
Ionization energy (67 150 000 cm^{-1}); (8326 eV)

Because Ba XLVII is in the neon isoelectronic sequence, its spectrum has been a subject of interest for many research groups. Theoretical calculations of the energy levels, wavelengths, and transition probabilities were performed by Zhang and Sampson [89ZHA/SAM], Sampson *et al.* [89SAM/ZHA], and Ivanova and Gulov [91IVA/GUL], while Nilsen *et al.* [96NIL/BEI] and Safronova *et al.* [94SAF/SAF] calculated values for $n=4$ levels with $J=1$. Level values for the $2p^53s$ configuration have also been calculated by Avgoustoglou *et al.* [95AVG/JOH]. Safronova *et al.* [05SAF/COW2] calculated lifetimes for the $2p3s$ $^1P_1$ and $^3P_1$ levels and Quinet *et al.* [91QUI/GOR] reported transition probabilities for other transitions with upper levels having $n=3$. In Table 55 theoretical wavelengths are indicated by being enclosed in parentheses.

The spectrum has also been observed experimentally. Aglitskii *et al.* [84AGL/ANT, 89AGL/IVA] used a low-inductance vacuum spark to measure seven resonance lines from $J=1$ levels in the $2p^53s$, $2p^53s$, and $2s2p^63p$ configurations and compared them with theoretical values. As Electron Beam Ion Traps (EBITs) were being developed, scans of the Ba XLVII spectrum were reported by Biederman *et al.* [97BIE/FOR], Chantler *et al.* [97CHA/PAT], Gillaspy [97GIL], and Aglitskii *et al.* [98AGL/SER]. Nilsen *et al.* [96NIL/BEI] measured the resonance transition from the $2p^54d\ (3/2,5/2)_1$ level. Several additional wavelength measurements have been performed on the Tokyo EBIT by Ohtani and his research group [99NAK/KAT, 00NAK/KAT, 01KAT/NAK, and 06KAT/NAK].

In order to present a consistent set of energy level values in Table 56, we report the [91IVA/GUL] values, which match the experimental and most recent calculated values most closely. Although Ivanova and Gulov [91IVA/GUL] do not estimate the uncertainty of their values, comparison with the experimental data for levels with $n=3$ indicates agreement with an average deviation of 12 000 cm^{-1}. For levels with $n=4$ the only indication of accuracy of the [91IVA/GUL] data is a comparison with the MCDF calculations of [96NIL/BEI]. [96NIL/BEI] reported agreement within 10 000 cm^{-1} with experimental values from several nearby ions in the neon sequence. The agreement between the [91IVA/GUL] and [96NIL/BEI] values is within 22 000 cm^{-1}, which is the uncertainty we assign to the [91IVA/GUL] energy levels for $n=4$. Comparison with [94SAF/SAF] $n=4$ energy levels gives similar results.

The wavelengths reported are from [06KAT/NAK], [96NIL/BEI], or [89AGL/IVA], where available and otherwise calculated from the [91IVA/GUL] levels. Transition probabilities are mostly from [91QUI/GOR] and from [91IVA/GUL] where there are no [91QUI/GOR] values. The calculated ionization energy cited above is taken from Huang *et al.* [06HUA/JIA], which agrees with Rodrigues *et al.* [04ROD/IND], is 11 000 cm^{-1} less than calculations by Gu [05GU], and is 64 000 cm^{-1} less than the value calculated by Ivanova and Gulov [91IVA/GUL].

6.45.1. References for Ba XLVII

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TABLE 55. Spectral lines of Ba XLVII

λ (Å)	Unc. (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(1.7527)		(57 055 800)	8.2E+13	$2p^6\ ^1S_0$	$2s2p^64p\ (1/2,3/2)^\circ_1$	91IVA/GUL	91IVA/GUL
(1.7636)		(56 700 800)	4.0E+13	$2p^6\ ^1S_0$	$2s2p^64p\ (1/2,1/2)^\circ_1$	91IVA/GUL	91IVA/GUL
(1.8592)		(53 786 600)	5.9E+12	$2p^6\ ^1S_0$	$2p^54s\ (1/2,1/2)^\circ_1$	91IVA/GUL	91IVA/GUL
1.93028	0.000 10	51 806 000		$2p^6\ ^1S_0$	$2p^54d\ (3/2,5/2)^\circ_1$	96NIL/BEI	
(1.9755)		(50 619 600)	1.2E+13	$2p^6\ ^1S_0$	$2p^54s\ (3/2,1/2)^\circ_1$	91IVA/GUL	91IVA/GUL
2.259	0.001	44 268 000	1.3E+14	$2p^6\ ^1S_0$	$2s2p^63p\ (1/2,3/2)^\circ_1$	84AGL/ANT	91IVA/GUL
2.306	0.001	43 365 000	4.6E+13	$2p^6\ ^1S_0$	$2s2p^63p\ (1/2,1/2)^\circ_1$	84AGL/ANT	91IVA/GUL
2.342	0.001	42 699 000	5.8E+14	$2p^6\ ^1S_0$	$2p^53d\ (1/2,3/2)^\circ_1$	84AGL/ANT	91IVA/GUL
2.4995	0.000 3	40 008 000	2.95E+12	$2p^6\ ^1S_0$	$2p^53s\ (1/2,1/2)^\circ_1$	06KAT/NAK	05SAF/COWb
2.5111	0.000 3	39 823 000	8.0E+14	$2p^6\ ^1S_0$	$2p^53d\ (3/2,5/2)^\circ_1$	06KAT/NAK	91IVA/GUL
2.5398	0.000 3	39 373 000	3.3E+12	$2p^6\ ^1S_0$	$2p^53d\ (3/2,3/2)^\circ_1$	06KAT/NAK	91IVA/GUL
2.5976	0.000 3	38 497 000	1.54E+11	$2p^6\ ^1S_0$	$2p^53p\ (3/2,3/2)_2$	06KAT/NAK	91QUI/GOR
2.6588	0.000 5	37 611 000	1.93E+11	$2p^6\ ^1S_0$	$2p^53p\ (3/2,1/2)_2$	06KAT/NAK	91QUI/GOR
2.7153	0.001 3	36 828 000	4.12E+13	$2p^6\ ^1S_0$	$2p^53s\ (3/2,1/2)^\circ_1$	89AGL/IVA	05SAF/COWb

TABLE 56. Energy levels of Ba XLVII

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$2p^6$	^1S	0	(0)	4 000	91IVA/GUL
$2p^53s$	$(3/2,1/2)^\circ$	2	(36 803 400)	4 000	91IVA/GUL
	$(3/2,1/2)^\circ$	1	(36 850 500)	4 000	91IVA/GUL
	$(1/2,1/2)^\circ$	0	(39 973 900)	4 000	91IVA/GUL
	$(1/2,1/2)^\circ$	1	(40 011 300)	4 000	91IVA/GUL
$2p^53p$	$(3/2,1/2)$	1	(37 589 300)	4 000	91IVA/GUL
	$(3/2,1/2)$	2	(37 608 300)	4 000	91IVA/GUL
	$(3/2,3/2)$	3	(38 426 200)	4 000	91IVA/GUL
	$(3/2,3/2)$	1	(38 426 700)	4 000	91IVA/GUL
	$(3/2,3/2)$	2	(38 496 500)	4 000	91IVA/GUL
	$(3/2,3/2)$	0	(38 805 100)	4 000	91IVA/GUL
	$(1/2,1/2)$	1	(40 753 300)	4 000	91IVA/GUL
	$(1/2,1/2)$	0	(41 022 700)	4 000	91IVA/GUL
	$(1/2,3/2)$	1	(41 599 400)	4 000	91IVA/GUL
	$(1/2,3/2)$	2	(41 624 100)	4 000	91IVA/GUL
$2p^53d$	$(3/2,3/2)^\circ$	0	(39 328 900)	4 000	91IVA/GUL
	$(3/2,3/2)^\circ$	1	(39 379 900)	4 000	91IVA/GUL
	$(3/2,3/2)^\circ$	3	(39 406 800)	4 000	91IVA/GUL
	$(3/2,5/2)^\circ$	2	(39 442 900)	4 000	91IVA/GUL
	$(3/2,5/2)^\circ$	4	(39 579 400)	4 000	91IVA/GUL
	$(3/2,3/2)^\circ$	2	(39 615 100)	4 000	91IVA/GUL
	$(3/2,5/2)^\circ$	3	(39 673 300)	4 000	91IVA/GUL
	$(3/2,5/2)^\circ$	1	(39 831 600)	4 000	91IVA/GUL
	$(1/2,3/2)^\circ$	2	(42 569 000)	4 000	91IVA/GUL
	$(1/2,3/2)^\circ$	1	(42 713 200)	4 000	91IVA/GUL
	$(1/2,5/2)^\circ$	2	(42 778 000)	4 000	91IVA/GUL
	$(1/2,5/2)^\circ$	3	(42 801 100)	4 000	91IVA/GUL
$2s2p^63s$	$(1/2,1/2)$	1	(42 606 500)	4 000	91IVA/GUL
	$(1/2,1/2)$	0	(42 768 100)	4 000	91IVA/GUL
$2s2p^63p$	$(1/2,1/2)^\circ$	0	(43 393 100)	4 000	91IVA/GUL
	$(1/2,1/2)^\circ$	1	(43 410 100)	4 000	91IVA/GUL
	$(1/2,3/2)^\circ$	2	(44 235 900)	4 000	91IVA/GUL
	$(1/2,3/2)^\circ$	1	(44 270 600)	4 000	91IVA/GUL
$2s2p^63d$	$(1/2,3/2)$	1	(45 176 500)	4 000	91IVA/GUL
	$(1/2,3/2)$	2	(45 205 600)	4 000	91IVA/GUL
	$(1/2,5/2)$	3	(45 376 500)	4 000	91IVA/GUL
	$(1/2,5/2)$	2	(45 474 700)	4 000	91IVA/GUL
$2p^54s$	$(3/2,1/2)^\circ$	2	(50 604 500)	20 000	91IVA/GUL
	$(3/2,1/2)^\circ$	1	(50 619 600)	20 000	91IVA/GUL
	$(1/2,1/2)^\circ$	0	(53 780 100)	20 000	91IVA/GUL
	$(1/2,1/2)^\circ$	1	(53 786 600)	20 000	91IVA/GUL
$2p^54p$	$(3/2,1/2)$	1	(50 925 100)	20 000	91IVA/GUL
	$(3/2,1/2)$	2	(50 930 400)	20 000	91IVA/GUL
	$(3/2,3/2)$	1	(51 270 300)	20 000	91IVA/GUL
	$(3/2,3/2)$	3	(51 268 900)	20 000	91IVA/GUL
	$(3/2,3/2)$	2	(51 293 700)	20 000	91IVA/GUL
	$(3/2,3/2)$	0	(51 392 500)	20 000	91IVA/GUL
	$(1/2,1/2)$	1	(54 097 500)	20 000	91IVA/GUL
	$(1/2,1/2)$	0	(54 175 600)	20 000	91IVA/GUL
	$(1/2,3/2)$	1	(54 448 900)	20 000	91IVA/GUL
	$(1/2,3/2)$	2	(54 453 600)	20 000	91IVA/GUL
$2p^54d$	$(3/2,3/2)^\circ$	0	(51 619 300)	20 000	91IVA/GUL
	$(3/2,3/2)^\circ$	1	(51 637 400)	20 000	91IVA/GUL
	$(3/2,3/2)^\circ$	3	(51 644 400)	20 000	91IVA/GUL
	$(3/2,3/2)^\circ$	2	(51 657 300)	20 000	91IVA/GUL
	$(3/2,5/2)^\circ$	4	(51 724 100)	20 000	91IVA/GUL
	$(3/2,5/2)^\circ$	2	(51 736 800)	20 000	91IVA/GUL
	$(3/2,5/2)^\circ$	3	(51 756 400)	20 000	91IVA/GUL
	$(3/2,5/2)^\circ$	1	(51 815 100)	20 000	91IVA/GUL
	$(1/2,3/2)^\circ$	2	(54 816 700)	20 000	91IVA/GUL
	$(1/2,3/2)^\circ$	1	(54 866 000)	20 000	91IVA/GUL
	$(1/2,5/2)^\circ$	2	(54 909 900)	20 000	91IVA/GUL
	$(1/2,5/2)^\circ$	3	(54 917 000)	20 000	91IVA/GUL
$2s2p^64s$	$(1/2,1/2)$	1	(56 373 100)	20 000	91IVA/GUL
	$(1/2,1/2)$	0	(56 426 100)	20 000	91IVA/GUL

TABLE 56. Energy levels of Ba XLVII—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$2s2p^64p$	$(1/2,1/2)^\circ$	0	(56 697 200)	20 000	91IVA/GUL
	$(1/2,1/2)^\circ$	1	(56 700 800)	20 000	91IVA/GUL
	$(1/2,3/2)^\circ$	2	(57 044 300)	20 000	91IVA/GUL
	$(1/2,3/2)^\circ$	1	(57 055 800)	20 000	91IVA/GUL
$2s2p^64d$	$(1/2,3/2)$	1	(57 408 100)	20 000	91IVA/GUL
	$(1/2,3/2)$	2	(57 418 400)	20 000	91IVA/GUL
	$(1/2,5/2)$	3	(57 497 300)	20 000	91IVA/GUL
	$(1/2,5/2)$	2	(57 527 500)	20 000	91IVA/GUL
Ba XLVIII ($2p^5\ ^2P^\circ_{3/2}$)	*Limit*		(67 150 000)		06HUA/JIA

6.46. Ba XLVIII

F isoelectronic sequence
Ground state $1s^22s^22p^5\ ^2P^\circ_{3/2}$
Ionization energy (69 080 000 cm^{-1}); (8565 eV)

Several transitions of the Ba XLVIII spectrum have been observed by Hutton *et al.* [91HUT/BEI] by trapping ions in an electron beam ion trap and exciting them with a 10 keV electron beam. In addition, Feldman *et al.* [91FEL/EKB] measured transitions from the $2s2p^6\ ^2S_{1/2}$ level to the two ground configuration levels in isoelectronic ions of Mo, Cd, In, and Sn. These wavelengths were combined with measurements of other isoelectronic ions to produce extrapolated values for the Ba XLVIII transitions and the ground configuration splitting based on data for ions with $Z \leqslant 51$. Sampson *et al.* [91SAM/ZHA] used the relativistic distorted wave method to calculate probabilities for transitions between levels of the $2s^22p^5$, $2s2p^6$, $2s^22p^43l$, and $2s2p^53l$ configurations, which are given in Table 57. Ivanova and Gulov [91IVA/GUL] used the relativistic perturbation theory with a model potential to calculate the three lowest energy levels, with results within 2000 cm^{-1} of the values obtained by Feldman *et al.* [91FEL/EKB]. Table 58 includes the Feldman *et al.* result for the ground configuration splitting, which is also within 2000 cm^{-1} of the isoelectronic fitted value obtained by Kim and Huang [82KIM/HUA] using ions with $Z \leqslant 39$.

Since the line classifications in the experimental paper of Hutton *et al.* [91HUT/BEI] do not include the *J* value of the core, it is impossible to identify the term for all the levels. For those which can be uniquely identified we give the levels in *jj* coupling. For the others we specify as much information as possible about the electron configuration. The calculated ionization energy cited is taken from Huang *et al.* [06HUA/JIA] and is within $\pm 10\ 000$ cm^{-1} of calculations by Gu [05GU] and Rodrigues *et al.* [04ROD/IND].

6.46.1. References for Ba XLVIII

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06HUA/JIA J. Huang, G. Jiang, and Q. Zhao, Chin. Phys. Lett. **23**, 69 (2006).

TABLE 57. Spectral lines of Ba XLVIII

λ (Å)	Unc. (Å)	σ (cm^{-1})	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
2.231 55	0.0004	44 811 900	b		$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$[(2s2p^2_{1/2}2p^3_{3/2})3p_{3/2}]_{5/2}$	91HUT/BEI	
2.293 29	0.0004	43 605 500	b		$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$[(2s^22p_{1/2}2p^3_{3/2})3d_{3/2}]_{3/2}$	91HUT/BEI	
2.303 67	0.0004	43 409 000			$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$[(2s^22p_{1/2}2p^3_{3/2})3d_{3/2}]_{5/2}$	91HUT/BEI	
2.449 89	0.0003	40 818 200			$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$(2s^22p^2_{1/2}2p^2_{3/2})3d\ (0,5/2)_{5/2}$	91HUT/BEI	
2.453 77	0.0003	40 753 600		2.33E+12	$2s^22p^5\ (0,1/2)^\circ_{1/2}$	$[(2s^22p_{1/2}2p^3_{3/2})3d_{5/2}]_{1/2}$	91HUT/BEI	91SAM/ZHA
2.460 69	0.0003	40 639 000			$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$[(2s^22p^2_{1/2}2p^2_{3/2})3d_{3/2}]_{3/2}$	91HUT/BEI	
2.462 79	0.0003	40 604 400			$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$(2s^22p^2_{1/2}2p^2_{3/2})3d\ (2,5/2)_{5/2}$	91HUT/BEI	
2.470 48	0.0004	40 478 000	b	9.84E+12	$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$(2s^22p^2_{1/2}2p^2_{3/2})3d\ (2,5/2)_{1/2}$	91HUT/BEI	91SAM/ZHA
2.474 03	0.0004	40 419 900			$2s^22p^5\ (0,1/2)^\circ_{1/2}$	$[(2s^22p_{1/2}2p^3_{3/2})3d_{5/2}]_{3/2}$	91HUT/BEI	
2.525 25	0.0004	39 600 000			$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$[(2s^22p^2_{1/2}2p^2_{3/2})3p_{3/2}]^\circ_{3/2}$	91HUT/BEI	
2.600 00	0.0003	38 461 500			$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$[(2s^22p^2_{1/2}2p^2_{3/2})3p_{1/2}]^\circ_{5/2}$	91HUT/BEI	
2.626 66	0.0003	38 071 200		3.00E+13	$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$(2s^22p^2_{1/2}2p^2_{3/2})3s\ (0,1/2)_{1/2}$	91HUT/BEI	91SAM/ZHA
2.646 22	0.0003	37 789 800		5.88E+13	$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$(2s^22p^2_{1/2}2p^2_{3/2})3s\ (2,1/2)_{3/2}$	91HUT/BEI	91SAM/ZHA
2.650 63	0.0003	37 726 900		9.24E+12	$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$(2s^22p^2_{1/2}2p^2_{3/2})3s\ (2,1/2)_{5/2}$	91HUT/BEI	91SAM/ZHA
2.665 07	0.0003	37 522 500			$2s2p^6\ (1/2,0)_{1/2}$	$[(2s2p^2_{1/2}2p^3_{3/2})3s_{1/2}]^\circ_{3/2}$	91HUT/BEI	
2.761 35	0.0004	36 214 200			$2s2p^6\ (1/2,0)_{1/2}$	$[(2s^22p_{1/2}2p^3_{3/2})3p_{1/2}]^\circ_{3/2}$	91HUT/BEI	

TABLE 57. Spectral lines of Ba XLVIII—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
[17.374]	>0.005	[5 755 700]		2.41E+12	$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$2s2p^6\ (1/2,0)_{1/2}$	91FEL/EKB	91SAM/ZHA
[31.44]	>0.02	[3 180 700]			$2s^22p^5\ (0,3/2)^\circ_{3/2}$	$2s^22p^5\ (0,1/2)^\circ_{1/2}$	91FEL/EKB	
[38.829]	>0.005	[2 575 400]		1.03E+11	$2s^22p^5\ (0,1/2)^\circ_{1/2}$	$2s2p^6\ (1/2,0)_{1/2}$	91FEL/EKB	91SAM/ZHA

TABLE 58. Energy levels of Ba XLVIII

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$2s^22p^5$	$(0,3/2)^\circ$	3/2	[0]		
	$(0,1/2)^\circ$	1/2	[3 180 700]	>2000	91FEL/EKB
$2s2p^6$	$(1/2,0)$	1/2	[5 755 700]	>2000	91FEL/EKB
$(2s^22p^2_{1/2}2p^2_{3/2})3s$	$(2,1/2)$	5/2	37 726 900	5000	91HUT/BEI
	$(2,1/2)$	3/2	37 789 800	5000	91HUT/BEI
	$(0,1/2)$	1/2	38 071 200	5000	91HUT/BEI
$(2s^22p^2_{1/2}2p^2_{3/2})3p_{1/2}$	$^\circ$	5/2	38 461 500	5000	91HUT/BEI
$(2s^22p^2_{1/2}2p^2_{3/2})3p_{3/2}$	$^\circ$	3/2	39 600 000	6000	91HUT/BEI
$(2s^22p^2_{1/2}2p^2_{3/2})3d$	$(2,5/2)$	1/2	40 478 000	6000	91HUT/BEI
	$(2,5/2)$	5/2	40 604 400	5000	91HUT/BEI
	$(0,5/2)$	5/2	40 818 200	5000	91HUT/BEI
$(2s^22p^2_{1/2}2p^2_{3/2})3d_{3/2}$		3/2	40 639 000	5000	91HUT/BEI
$(2s^22p_{1/2}2p^3_{3/2})3p_{1/2}$	$^\circ$	3/2	41 969 900	7000	91HUT/BEI
$(2s2p^2_{1/2}2p^3_{3/2})3s_{1/2}$	$^\circ$	3/2	43 278 200	8000	91HUT/BEI
$(2s^22p_{1/2}2p^3_{3/2})3d$	$(1,3/2)$	5/2	43 409 000	5000	91HUT/BEI
$(2s^22p_{1/2}2p^3_{3/2})3d_{5/2}$		3/2	43 600 600	8000	91HUT/BEI
		1/2	43 934 300	8000	91HUT/BEI
$(2s^22p_{1/2}2p^3_{3/2})3d_{3/2}$		3/2	43 605 500	8000	91HUT/BEI
$(2s2p^2_{1/2}2p^3_{3/2})3p_{3/2}$		5/2	44 811 900	8000	91HUT/BEI
Ba XLIX $(2p^2_{1/2}2p^2_{3/2}\ (0,2)_2)$		*Limit*	(69 080 000)		06HUA/JIA

6.47. Ba XLIX

O isoelectronic sequence
Ground state $1s^22s^2(2p^2_{1/2}2p^2_{3/2})\ (0,2)_2$
Ionization energy (71 220 000 cm^{-1}); (8830 eV)

Several transitions of the Ba XLIX spectrum with wavelengths between 2 and 3 Å have been observed by Hutton *et al.* [91HUT/BEI], who trapped ions in an electron beam ion trap and excited them with a 10 keV electron beam. Zhang and Sampson [02ZHA/SAM] used the MCDF method to calculate transition probabilities for 16 transitions between the $2s^22p^4$, $2s2p^5$, and $2p^6$ configurations, as well as the energies of the transitions (see Tables 59 and 60). The energies for levels with $n=3$ are obtained by adding the transition energies from Hutton *et al.* [91HUT/BEI] to the energies of the $n=2$ levels calculated by Zhang and Sampson [02ZHA/SAM]. Since the uncertainties in the Zhang and Sampson [02ZHA/SAM] calculations are unknown, the uncertainties in the level values in Table 60 are based on those for the transitions to $n=2$ levels, as reported by Hutton *et al.* [91HUT/BEI].

Since the line classifications in the experimental paper of Hutton *et al.* [91HUT/BEI] do not include the *J* value of the core, it is impossible to identify the term for all the levels. For those which can be uniquely identified we give the levels in *jj* coupling. For the others we specify as much information as possible about the electron configuration. The calculated ionization energy cited is taken from Huang *et al.*

[06HUA/JIA] and is within ±2600 cm^{-1} of calculations by Gu [05GU] and Rodrigues *et al.* [04ROD/IND].

6.47.1. References for Ba XLIX

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TABLE 59. Spectral lines of Ba XLIX

λ (Å)	Unc. (Å)	σ (cm^{-1})	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
2.174 42	0.0004	45 989 300			$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$[2s(2p_{1/2}^2 2p_{3/2}^2)3p_{3/2}]^\circ_3$	91HUT/BEI	
2.192 36	0.0004	45 612 900			$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$[2s(2p_{1/2}^2 2p_{3/2}^2)3p_{3/2}]^\circ_2$	91HUT/BEI	
2.244 43		44 554 700	b		$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$[2s(2p_{1/2}^2 2p_{3/2}^2)3p_{1/2}]^\circ_3$	91HUT/BEI	
2.247 20		44 499 800	b		$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$[2s^2(2p_{1/2} 2p_{3/2}^2)3d_{3/2}]^\circ_1$	91HUT/BEI	
2.251 15		44 421 700	b		$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$[2s^2(2p_{1/2} 2p_{3/2}^2)3d_{5/2}]^\circ_3$	91HUT/BEI	
2.259 15		44 264 400	b		$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$[2s^2(2p_{1/2} 2p_{3/2}^2)3d_{3/2}]^\circ_3$	91HUT/BEI	
2.406 96	0.0003	41 546 200			$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$2s^2(2p_{1/2}^2 2p_{3/2})3d\ (3/2,5/2)^\circ_3$	91HUT/BEI	
2.412 76	0.0003	41 446 300			$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$2s^2(2p_{1/2}^2 2p_{3/2})3d\ (3/2,5/2)^\circ_2$	91HUT/BEI	
2.422 39	0.0003	41 281 500			$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,0)_0$	$2s^2(2p_{1/2}^2 2p_{3/2})3d\ (3/2,5/2)^\circ_1$	91HUT/BEI	
2.474 03	0.0004	40 419 900			$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$2s^2(2p_{1/2}^2 2p_{3/2})3p\ (3/2,3/2)_3$	91HUT/BEI	
2.530 78		39 513 500	b		$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$2s^2(2p_{1/2}^2 2p_{3/2})3p\ (3/2,1/2)_2$	91HUT/BEI	
2.569 60	0.0010	38 916 600			$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$2s^2(2p_{1/2}^2 2p_{3/2})3s\ (3/2,1/2)^\circ_1$	91HUT/BEI	
2.575 66	0.0009	38 825 000			$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$2s^2(2p_{1/2}^2 2p_{3/2})3s\ (3/2,1/2)^\circ_2$	91HUT/BEI	
2.580 14	0.0009	38 757 600			$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_1$	$[2s(2p_{1/2}^2 2p_{3/2}^2)3s]_0$	91HUT/BEI	
2.589 23		38 621 500	b		$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_2$	$[2s(2p_{1/2}^2 2p_{3/2}^2)3s]_2$	91HUT/BEI	
2.593 24	0.0009	38 561 800			$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_2$	$[2s^2(2p_{1/2} 2p_{3/2}^2)3p_{3/2}]_2$	91HUT/BEI	
2.662 58	0.0003	37 557 600			$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_2$	$[2s^2(2p_{1/2} 2p_{3/2}^2)3p_{1/2}]_2$	91HUT/BEI	
2.694 91	0.0003	37 107 000			$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_1$	$[2s^2(2p_{1/2} 2p_{3/2}^2)3p_{1/2}]_2$	91HUT/BEI	
(11.244)		(8 893 600)		4.24E+10	$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$2s(2p_{1/2} 2p_{3/2}^4)\ (1/2,1/2)^\circ_1$	02ZHA/SAM	02ZHA/SAM
(11.665)		(8 572 300)		1.14E+9	$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,0)_0$	$2s(2p_{1/2} 2p_{3/2}^4)\ (1/2,1/2)^\circ_1$	02ZHA/SAM	02ZHA/SAM
(17.100)		(5 847 800)		1.98E+12	$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_1$	02ZHA/SAM	02ZHA/SAM
(17.479)		(5 721 000)		3.27E+11	$2s^2(2p_{1/2} 2p_{3/2}^3)\ (0,1)_1$	$2s(2p_{1/2} 2p_{3/2}^4)\ (1/2,1/2)^\circ_1$	02ZHA/SAM	02ZHA/SAM
(17.657)		(5 663 400)		7.33E+12	$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_1$	$2p_{1/2}^2 2p_{3/2}^4\ (0,0)_0$	02ZHA/SAM	02ZHA/SAM
(17.913)		(5 582 500)		2.10E+12	$2s^2(2p_{1/2} 2p_{3/2}^3)\ (0,2)_2$	$2s(2p_{1/2} 2p_{3/2}^4)\ (1/2,1/2)^\circ_1$	02ZHA/SAM	02ZHA/SAM
(18.095)		(5 526 500)		6.19E+11	$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,0)_0$	$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_1$	02ZHA/SAM	02ZHA/SAM
(18.336)		(5 453 700)		2.04E+12	$2s^2(2p_{1/2} 2p_{3/2}^3)\ (0,1)_1$	$2s(2p_{1/2} 2p_{3/2}^4)\ (1/2,1/2)^\circ_0$	02ZHA/SAM	02ZHA/SAM
(18.563)		(5 387 200)		1.03E+12	$2s^2(2p_{1/2}^2 2p_{3/2}^2)\ (0,2)_2$	$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_2$	02ZHA/SAM	02ZHA/SAM
(37.380)		(2 675 200)		2.49E+10	$2s^2(2p_{1/2} 2p_{3/2}^3)\ (0,1)_1$	$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_1$	02ZHA/SAM	02ZHA/SAM
(38.203)		(2 617 600)		3.18E+11	$2s(2p_{1/2} 2p_{3/2}^4)\ (1/2,1/2)^\circ_1$	$2p_{1/2}^2 2p_{3/2}^4\ (0,0)_0$	02ZHA/SAM	02ZHA/SAM
(39.421)		(2 536 700)		6.04E+10	$2s^2(2p_{1/2} 2p_{3/2}^3)\ (0,2)_2$	$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_1$	02ZHA/SAM	02ZHA/SAM
(43.600)		(2 293 600)		3.80E+10	$2s^2 2p_{3/2}^4\ (0,0)_0$	$2s(2p_{1/2} 2p_{3/2}^4)\ (1/2,1/2)^\circ_1$	02ZHA/SAM	02ZHA/SAM
(45.155)		(2 214 600)		3.14E+10	$2s^2(2p_{1/2} 2p_{3/2}^3)\ (0,1)_1$	$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_2$	02ZHA/SAM	02ZHA/SAM
(48.167)		(2 076 100)		2.32E+10	$2s^2(2p_{1/2} 2p_{3/2}^3)\ (0,2)_2$	$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_2$	02ZHA/SAM	02ZHA/SAM
(132.94)		(752 200)		1.56E+8	$2s(2p_{1/2}^2 2p_{3/2}^3)\ (1/2,3/2)^\circ_1$	$2s^2 2p_{3/2}^4\ (0,0)_0$	02ZHA/SAM	02ZHA/SAM

TABLE 60. Energy levels of Ba XLIX

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$2s^2(2p_{1/2}^2 2p_{3/2}^2)$	(0,2)	2	(0)		02ZHA/SAM
	(0,0)	0	(321300)		02ZHA/SAM
$2s^2(2p_{1/2} 2p_{3/2}^3)$	(0,1)	1	(3 172 600)		02ZHA/SAM
	(0,2)	2	(3 311 100)		02ZHA/SAM
$2s(2p_{1/2}^2 2p_{3/2}^3)$	$(1/2,3/2)^\circ$	2	(5 387 200)		02ZHA/SAM

TABLE 60. Energy levels of Ba XLIX—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
	$(1/2,3/2)^{\circ}$	1	(5 847 800)		02ZHA/SAM
$2s^22p^4_{3/2}$	(0,0)	0	(6 600 000)		02ZHA/SAM
$2s(2p_{1/2}2p^4_{3/2})$	$(1/2,1/2)^{\circ}$	0	(8 626 300)		02ZHA/SAM
	$(1/2,1/2)^{\circ}$	1	(8 893 600)		02ZHA/SAM
$2p^2_{1/2}2p^4_{3/2}$	(0,0)	0	(11 511 200)		02ZHA/SAM
$2s^2(2p^2_{1/2}2p_{3/2})3s$	$(3/2,1/2)^{\circ}$	2	38 825 000	13 000	91HUT/BEI
	$(3/2,1/2)^{\circ}$	1	38 916 600	14 000	91HUT/BEI
$2s^2(2p^2_{1/2}2p_{3/2})3p$	(3/2,1/2)	2	39 513 500		91HUT/BEI
	(3/2,3/2)	3	40 419 900	6 500	91HUT/BEI
$2s^2(2p^2_{1/2}2p_{3/2})3d$	$(3/2,5/2)^{\circ}$	2	41 446 300	5 000	91HUT/BEI
	$(3/2,5/2)^{\circ}$	3	41 546 200	5 000	91HUT/BEI
	$(3/2,5/2)^{\circ}$	1	41 602 800	5 000	91HUT/BEI, 02ZHA/SAM
$(2s^22p_{1/2}2p^2_{3/2})3p_{1/2}$		2	42 949 800	5 000	91HUT/BEI, 02ZHA/SAM
$(2s^22p_{1/2}2p^2_{3/2})3p_{3/2}$		2	43 949 000	13 000	91HUT/BEI, 02ZHA/SAM
$2s(2p^2_{1/2}2p^2_{3/2})3s$		2	44 008 700		91HUT/BEI, 02ZHA/SAM
		0	44 605 400	13 000	91HUT/BEI, 02ZHA/SAM
$2s^2(2p_{1/2}2p^2_{3/2})3d_{3/2}$	$^{\circ}$	3	44 264 400		91HUT/BEI
	$^{\circ}$	1	44 499 800		91HUT/BEI
$2s^2(2p_{1/2}2p^2_{3/2})3d_{5/2}$	$^{\circ}$	3	44 421 700		91HUT/BEI
$(2s2p^2_{1/2}2p^2_{3/2})3p_{1/2}$	$^{\circ}$	3	44 554 700		91HUT/BEI
$(2s2p^2_{1/2}2p^2_{3/2})3p_{3/2}$	$^{\circ}$	2	45 612 900	8 000	91HUT/BEI
	$^{\circ}$	3	45 989 300	8 000	91HUT/BEI
Ba L $(2p^2_{1/2}2p_{3/2})^{\circ}_{3/2}$		*Limit*	(71 220 000)		06HUA/JIA

6.48. Ba L

N isoelectronic sequence
Ground state $1s^22s^22p^2_{1/2}2p_{3/2}$ $(0,3/2)^{\circ}_{3/2}$
Ionization energy (73 216 000 cm^{-1}); (9078 eV)

Hutton *et al.* [91HUT/BEI] report wavelengths for several transitions of the Ba L spectrum with wavelengths between 2 and 3 Å. The ions were trapped in an electron beam ion trap and excited with a 10 keV electron beam. Zhang and Sampson [02ZHA/SAM] used the MCDF method to calculate transition probabilities for 16 transitions between the $2s^22p^3$, $2s2p^4$, and $2p^5$ configurations, as well as the energies of the transitions (see Tables 61 and 62). The energies for levels with $n=3$ are obtained by adding the transition energies from Hutton *et al.* [91HUT/BEI] to the energies of the $n=2$ levels calculated by Zhang and Sampson [02ZHA/SAM]. Since the uncertainties in the Zhang and Sampson [02ZHA/SAM] calculations are unknown, the uncertainties in the level values in Table 62 are based on those for the transitions to $n=2$ levels, as reported by Hutton *et al.* [91HUT/BEI].

Since the line classifications in the experimental paper of Hutton *et al.* [91HUT/BEI] do not include the J value of the core, it is impossible to identify the term for all the levels. For those which can be uniquely identified we give the levels in jj coupling. For the others we specify as much information as possible about the electron configuration. The ionization energy cited is the average of those calculated by Gu [05GU], Rodrigues *et al.* [04ROD/IND], and Huang *et al.* [06HUA/JIA]. The three ionization energies are within ± 5000 cm^{-1} of the average.

6.48.1. References for Ba L

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TABLE 61. Spectral lines of Ba L

λ (Å)	Unc. (Å)	σ (cm⁻¹)	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
2.160 61		46 283 200	b		$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$[(2s2p_{1/2}^22p_{3/2})3p_{3/2}]_{5/2}$	91HUT/BEI	
2.201 74	0.0004	45 418 600			$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$[2s^2(2p_{1/2}2p_{3/2})3d_{3/2}]_{1/2}$	91HUT/BEI	
2.204 11		45 369 800	b		$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$[2s^2(2p_{1/2}2p_{3/2})3d_{3/2}]_{3/2}$	91HUT/BEI	
2.212 16		45 204 700	b		$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2}^22p_{3/2})3p\ (2,1/2)_{5/2}$	91HUT/BEI	
2.216 25		45 121 200	b		$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$[2s^2(2p_{1/2}2p_{3/2})3d_{3/2}]_{3/2}$	91HUT/BEI	
2.363 00	0.0003	42 319 100			$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s^22p_{1/2}^23d\ (0,5/2)_{5/2}$	91HUT/BEI	
2.374 08		42 121 600	b		$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,0)_{1/2}$	$[(2s2p_{1/2}^22p_{3/2})3d_{5/2}]^\circ_{3/2}$	91HUT/BEI	
2.381 37	0.0003	41 992 600			$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s^22p_{1/2}^23d\ (0,3/2)_{3/2}$	91HUT/BEI	
2.507 19	0.0004	39 885 300			$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,2)_{5/2}$	$[(2s2p_{1/2}^22p_{3/2})3s_{1/2}]^\circ_{3/2}$	91HUT/BEI	
2.509 34	0.0004	39 851 100			$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s^22p_{1/2}^23s\ (0,1/2)_{1/2}$	91HUT/BEI	
2.522 20	0.0004	39 648 000			$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,2)_{3/2}$	$[(2s2p_{1/2}^22p_{3/2})3s_{1/2}]^\circ_{3/2}$	91HUT/BEI	
2.541 70	0.0004	39 343 700			$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,0)_{1/2}$	$[(2s2p_{1/2}^22p_{3/2})3s_{1/2}]^\circ_{3/2}$	91HUT/BEI	
2.565 63	0.0010	38 976 800			$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,2)_{5/2}$	$[2s^2(2p_{1/2}2p_{3/2})3p_{1/2}]^\circ_{3/2}$	91HUT/BEI	
(8.347)		(11 980 500)		2.10E+7	$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s2p_{3/2}^4\ (1/2,0)_{1/2}$	99ZHA/SAM	99ZHA/SAM
(11.230)		(8 904 500)		1.07E+11	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,2)^\circ_{3/2}$	$2s2p_{3/2}^4\ (1/2,0)_{1/2}$	99ZHA/SAM	99ZHA/SAM
(11.286)		(8 860 700)		2.38E+10	$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(11.403)		(8 769 300)		7.47E+10	$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{1/2}$	99ZHA/SAM	99ZHA/SAM
(11.555)		(8 654 200)		1.46E+9	$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,0)_{1/2}$	$2p_{1/2}2p_{3/2}^4\ (1/2,0)^\circ_{1/2}$	99ZHA/SAM	99ZHA/SAM
(11.579)		(8 636 200)		9.25E+10	$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,2)_{3/2}$	$2p_{1/2}2p_{3/2}^4\ (1/2,0)^\circ_{1/2}$	99ZHA/SAM	99ZHA/SAM
(11.802)		(8 473 400)		1.02E+9	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,0)^\circ_{1/2}$	$2s2p_{3/2}^4\ (1/2,0)_{1/2}$	99ZHA/SAM	99ZHA/SAM
(11.837)		(8 448 200)		3.87E+8	$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{5/2}$	99ZHA/SAM	99ZHA/SAM
(12.238)		(8 171 400)		5.83E+10	$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (0,3/2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(16.664)		(6 000 800)		1.68E+11	$(2s2p_{1/2})2p_{3/2}^3\ (0,3/2)_{3/2}$	$2p_{1/2}2p_{3/2}^4\ (1/2,0)^\circ_{1/2}$	99ZHA/SAM	99ZHA/SAM
(16.686)		(5 993 100)		8.19E+11	$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,2)_{5/2}$	$2p_{1/2}^22p_{3/2}^3\ (0,3/2)^\circ_{3/2}$	99ZHA/SAM	99ZHA/SAM
(17.287)		(5 784 700)		5.20E+10	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(17.565)		(5 693 300)		3.61E+12	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{1/2}$	99ZHA/SAM	99ZHA/SAM
(17.803)		(5 617 100)		2.86E+12	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,2)^\circ_{5/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(18.064)		(5 536 000)		1.89E+12	$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(18.123)		(5 518 000)		2.19E+12	$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,0)_{1/2}$	99ZHA/SAM	99ZHA/SAM
(18.504)		(5 404 300)		1.87E+11	$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,0)_{1/2}$	$2p_{1/2}^22p_{3/2}^3\ (0,3/2)^\circ_{3/2}$	99ZHA/SAM	99ZHA/SAM
(18.509)		(5 402 900)		1.10E+12	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{1/2}$	$2p_{1/2}2p_{3/2}^4\ (1/2,0)^\circ_{1/2}$	99ZHA/SAM	99ZHA/SAM
(18.563)		(5 387 000)		4.33E+12	$2s^22p_{3/2}^3\ (0,3/2)^\circ_{3/2}$	$2s2p_{3/2}^4\ (1/2,0)_{1/2}$	99ZHA/SAM	99ZHA/SAM
(18.566)		(5 386 300)		1.76E+12	$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,2)_{3/2}$	$2p_{1/2}^22p_{3/2}^3\ (0,3/2)^\circ_{3/2}$	99ZHA/SAM	99ZHA/SAM
(18.614)		(5 372 200)		3.23E+10	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{5/2}$	99ZHA/SAM	99ZHA/SAM
(18.679)		(5 353 600)		2.65E+11	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,0)^\circ_{1/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(18.827)		(5 311 500)		5.16E+12	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{3/2}$	$2p_{1/2}2p_{3/2}^4\ (1/2,0)^\circ_{1/2}$	99ZHA/SAM	99ZHA/SAM
(19.003)		(5 262 200)		6.56E+11	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,0)^\circ_{1/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{1/2}$	99ZHA/SAM	99ZHA/SAM
(19.214)		(5 204 600)		9.02E+11	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,2)^\circ_{5/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{5/2}$	99ZHA/SAM	99ZHA/SAM
(19.626)		(5 095 400)		9.06E+11	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (0,3/2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(20.287)		(4 929 200)		1.72E+11	$2s^22p_{1/2}^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,2)_{5/2}$	99ZHA/SAM	99ZHA/SAM
(20.293)		(4 927 800)		5.07E+10	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,2)^\circ_{5/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (0,3/2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(21.439)		(4 664 300)		3.95E+9	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,0)^\circ_{1/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (0,3/2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(36.352)		(2 750 900)		3.93E+10	$(2s2p_{1/2})2p_{3/2}^3\ (0,3/2)_{3/2}$	$2p_{1/2}^22p_{3/2}^3\ (0,3/2)^\circ_{3/2}$	99ZHA/SAM	99ZHA/SAM
(40.419)		(2 474 100)		1.68E+11	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{5/2}$	$2p_{1/2}^22p_{3/2}^3\ (0,3/2)^\circ_{3/2}$	99ZHA/SAM	99ZHA/SAM
(40.650)		(2 460 000)		1.51E+10	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,2)^\circ_{3/2}$	$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(40.950)		(2 442 000)		1.08E+9	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,2)^\circ_{3/2}$	$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,0)_{1/2}$	99ZHA/SAM	99ZHA/SAM
(43.622)		(2 292 400)		6.10E+10	$2s^22p_{1/2}(2p_{3/2}^2)\ (1/2,2)^\circ_{5/2}$	$2s2p_{1/2}^2(2p_{3/2}^2)\ (1/2,2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(44.107)		(2 267 200)		2.77E+10	$2s^22p_{3/2}^3\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(45.627)		(2 191 700)		7.88E+10	$2s2p_{3/2}^4\ (1/2,0)_{1/2}$	$2p_{1/2}2p_{3/2}^4\ (1/2,0)^\circ_{1/2}$	99ZHA/SAM	99ZHA/SAM
(45.960)		(2 175 800)		4.05E+10	$2s^22p_{3/2}^3\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}^3\ (1,3/2)_{1/2}$	99ZHA/SAM	99ZHA/SAM

TABLE 61. Spectral lines of Ba L—Continued

λ (Å)	Unc. (Å)	σ (cm^{-1})	Line Code	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(46.447)		(2 153 000)		1.31E+10	$(2s2p_{1/2})2p^3_{3/2}\ (1,3/2)_{1/2}$	$2p^2_{1/2}2p^3_{3/2}\ (0,3/2)^\circ_{3/2}$	99ZHA/SAM	99ZHA/SAM
(48.506)		(2 061 600)		3.91E+10	$(2s2p_{1/2})2p^3_{3/2}\ (1,3/2)_{3/2}$	$2p^2_{1/2}2p^3_{3/2}\ (0,3/2)^\circ_{3/2}$	99ZHA/SAM	99ZHA/SAM
(49.288)		(2 028 900)		6.05E+7	$2s^22p_{1/2}(2p^2_{3/2})\ (1/2,0)^\circ_{1/2}$	$2s2p^2_{1/2}(2p^2_{3/2})\ (1/2,2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(49.729)		(2 010 900)		3.86E+10	$2s^22p_{1/2}(2p^2_{3/2})\ (1/2,0)^\circ_{1/2}$	$2s2p^2_{1/2}(2p^2_{3/2})\ (1/2,0)_{1/2}$	99ZHA/SAM	99ZHA/SAM
(53.917)		(1 854 700)		1.28E+10	$2s^22p^3_{3/2}\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2})2p^3_{3/2}\ (1,3/2)_{5/2}$	99ZHA/SAM	99ZHA/SAM
(53.961)		(1 853 200)		1.27E+10	$2s^22p_{1/2}(2p^2_{3/2})\ (1/2,2)^\circ_{3/2}$	$2s2p^2_{1/2}(2p^2_{3/2})\ (1/2,2)_{5/2}$	99ZHA/SAM	99ZHA/SAM
(59.326)		(1 685 600)		9.70E+9	$2s^22p_{1/2}(2p^2_{3/2})\ (1/2,2)^\circ_{5/2}$	$2s2p^2_{1/2}(2p^2_{3/2})\ (1/2,2)_{5/2}$	99ZHA/SAM	99ZHA/SAM
(60.085)		(1 664 300)		2.94E+8	$2s2p^2_{1/2}(2p^2_{3/2})\ (1/2,2)_{5/2}$	$2s^22p^3_{3/2}\ (0,3/2)^\circ_{3/2}$	99ZHA/SAM	99ZHA/SAM
(63.375)		(1 577 900)		2.18E+9	$2s^22p^3_{3/2}\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2})2p^3_{3/2}\ (0,3/2)_{3/2}$	99ZHA/SAM	99ZHA/SAM
(92.980)		(1 075 500)		2.41E+7	$2s2p^2_{1/2}(2p^2_{3/2})\ (1/2,0)_{1/2}$	$2s^22p^3_{3/2}\ (0,3/2)^\circ_{3/2}$	99ZHA/SAM	99ZHA/SAM
(94.500)		(1 058 200)		5.29E+8	$2p^2_{1/2}2p^3_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s2p^4_{3/2}\ (1/2,0)_{1/2}$	99ZHA/SAM	99ZHA/SAM
(94.563)		(1 057 500)		2.37E+8	$2s2p^2_{1/2}(2p^2_{3/2})\ (1/2,2)_{3/2}$	$2s^22p^3_{3/2}\ (0,3/2)^\circ_{3/2}$	99ZHA/SAM	99ZHA/SAM

TABLE 62. Energy levels of Ba L

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
$2s^22p^2_{1/2}2p_{3/2}$	$(0,3/2)^\circ$	3/2	(0)		99ZHA/SAM
$2s^22p_{1/2}(2p^2_{3/2})$	$(1/2,2)^\circ$	3/2	(3 076 000)		99ZHA/SAM
	$(1/2,2)^\circ$	5/2	(3 243 600)		99ZHA/SAM
	$(1/2,0)^\circ$	1/2	(3 507 100)		99ZHA/SAM
$2s2p^2_{1/2}(2p^2_{3/2})$	$(1/2,2)$	5/2	(4 929 200)		99ZHA/SAM
	$(1/2,0)$	1/2	(5 518 000)		99ZHA/SAM
	$(1/2,2)$	3/2	(5 536 000)		99ZHA/SAM
$2s^22p^3_{3/2}$	$(0,3/2)^\circ$	3/2	(6 593 500)		99ZHA/SAM
$(2s2p_{1/2})2p^3_{3/2}$	$(0,3/2)$	3/2	(8 171 400)		99ZHA/SAM
	$(1,3/2)$	5/2	(8 448 200)		99ZHA/SAM
	$(1,3/2)$	1/2	(8 769 300)		99ZHA/SAM
	$(1,3/2)$	3/2	(8 860 700)		99ZHA/SAM
$2p^2_{1/2}2p^3_{3/2}$	$(0,3/2)^\circ$	3/2	(10 922 300)		99ZHA/SAM
$2s2p^4_{3/2}$	$(1/2,0)$	1/2	(11 980 500)		99ZHA/SAM
$2p_{1/2}2p^4_{3/2}$	$(1/2,0)^\circ$	1/2	(14 172 200)		99ZHA/SAM
$2s^22p^2_{1/2}3s$	$(0,1/2)$	1/2	39 851 100	6400	91HUT/BEI
$2s^22p^2_{1/2}3d$	$(0,5/2)$	5/2	41 992 600	5000	91HUT/BEI
$2s^22p^2_{1/2}3d$	$(0,3/2)$	3/2	42 319 100	5000	91HUT/BEI
$2s^2(2p_{1/2}2p_{3/2})3p_{1/2}$	$^\circ$	3/2	42 220 400	14000	91HUT/BEI, 99ZHA/SAM
$(2s2p^2_{1/2}2p_{3/2})3s_{1/2}$	$^\circ$	3/2	42 724 000	6400	91HUT/BEI, 99ZHA/SAM
$(2s2p^2_{1/2}2p_{3/2})3s_{1/2}$	$^\circ$	3/2	42 850 800	6400	91HUT/BEI, 99ZHA/SAM
$(2s2p^2_{1/2}2p_{3/2})3s_{1/2}$	$^\circ$	3/2	43 128 900	6400	91HUT/BEI, 99ZHA/SAM
$2s^2(2p_{1/2}2p_{3/2})3d_{3/2}$		3/2	45 121 200		91HUT/BEI
$2s^2(2p_{1/2}2p_{3/2})3d_{3/2}$		3/2	45 369 800		91HUT/BEI
$2s^2(2p_{1/2}2p_{3/2})3d_{3/2}$		1/2	45 418 600	8000	91HUT/BEI
$(2s2p^2_{1/2}2p_{3/2})3p$	$(2,1/2)$	5/2	45 204 700		91HUT/BEI
$(2s2p^2_{1/2}2p_{3/2})3p_{3/2}$		5/2	46 283 200		91HUT/BEI
$(2s2p^2_{1/2}2p_{3/2})3d_{5/2}$	$^\circ$	3/2	47 639 600		91HUT/BEI, 99ZHA/SAM

TABLE 62. Energy levels of Ba L—Continued

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
Ba LI ($2p^2$ $^3P_0$)		*Limit*	(73 216 000)		04ROD/IND, 05GU, 06HUA/JIA

6.49. Ba LI

C isoelectronic sequence
Ground state $1s^22s^22p^2$ $^3P_0$
Ionization energy (78 552 000 cm^{-1}); (9739 eV)

There are no observations of the energy levels or wavelengths of the Ba LI spectrum. The ground state has been assigned by analogy with Xe XLIX, as calculated by Saloman [04SAL]. The calculated ionization energy cited is the average of those calculated by Huang *et al.* [06HUA/JIA], Rodrigues *et al.* [04ROD/IND], and Gu [05GU]. The three values are within ±6000 cm^{-1} of the average.

6.49.1. References for Ba LI

04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
04SAL E. B. Saloman J. Phys. Chem. Ref. Data **33**, 765 (2004).
05GU M. F. Gu, At. Data Nucl. Data Tables **89**, 267 (2005).
06HUA/JIA J. Huang, G. Jiang, and Q. Zhao, Chin. Phys. Lett. **23**, 69 (2006).

6.50. Ba LII

B isoelectronic sequence
Ground state $1s^22s^22p$ $(0,1/2)^\circ_{1/2}$
Ionization energy (80 840 000 cm^{-1}); (10 023 eV)

There are no observations of the energy levels or wavelengths of the Ba LII spectrum. Zhang and Sampson [94ZHA/SAM] calculated energies and oscillator strengths for transitions between the $2s^22p$ and $2p^3$ configurations and $2s2p^2$ using the relativistic Dirac–Fock method. Koc [05KOC] also reported energies for the $2s^22p_{3/2}$ and $2s2p^2_{1/2}$ states using the Dirac–Coulomb–Breit formulation with quantum electrodynamic (QED) corrections. The results are within ±5000 cm^{-1} of the [94ZHA/SAM] values. To have a consistent set of levels, we retain the [94ZHA/SAM] values in Tables 63 and 64. A value for the transition probability of the forbidden $2s^22p_{1/2}$-$2s^22p_{3/2}$ transition was obtained by Charro *et al.* [01CHA/LOP] using the relativistic quantum defect orbital method.

The calculated ionization energy cited is taken from Huang *et al.* [06HUA/JIA]. Rodrigues *et al.* [04ROD/IND] obtained the same value to the number of significant figures given. Gu [05GU] calculated an ionization energy of 39 000 cm^{-1} lower.

6.50.1. References for Ba LII

94ZHA/SAM H. L. Zhang and D. H. Sampson, At. Data Nucl. Data Tables **56**, 41 (1994).
01CHA/LOP E. Charro, S. López, and I. Martín, J. Phys. B **34**, 4243 (2001).
04ROD/IND G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
05GU M. F. Gu, At. Data Nucl. Data Tables **89**, 267 (2005).
05KOC K. Koc, Nucl. Instrum. Methods Phys. Res. B **235**, 46 (2005).
06HUA/JIA J. Huang, G. Jiang, and Q. Zhao, Chin. Phys. Lett. **23**, 69 (2006).

TABLE 63. Spectral lines of Ba LII

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(8.381)	(11 931 600)	1.49E+6	$2s2p^2_{1/2}$ $(1/2,0)_{1/2}$	$2p^3_{3/2}$ $(0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(11.149)	(8 969 300)	4.30E+9	$(2s2p_{1/2})2p_{3/2}$ $(0,3/2)_{3/2}$	$2p^3_{3/2}$ $(0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(11.415)	(8 760 200)	4.31E+8	$2s2p^2_{1/2}$ $(1/2,0)_{1/2}$	$2p_{1/2}2p^2_{3/2}$ $(1/2,0)^\circ_{1/2}$	94ZHA/SAM	94ZHA/SAM
(11.496)	(8 698 600)	1.57E+9	$(2s2p_{1/2})2p_{3/2}$ $(1,3/2)_{5/2}$	$2p^3_{3/2}$ $(0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(11.711)	(8 539 300)	9.71E+9	$2s^22p_{1/2}$ $(0,1/2)^\circ_{1/2}$	$2s2p^2_{3/2}$ $(1/2,2)_{3/2}$	94ZHA/SAM	94ZHA/SAM
(11.730)	(8 525 300)	3.69E+10	$2s^22p_{1/2}$ $(0,1/2)^\circ_{1/2}$	$2s2p^2_{3/2}$ $(1/2,0)_{1/2}$	94ZHA/SAM	94ZHA/SAM
(12.086)	(8 274 100)	8.08E+9	$2s2p^2_{1/2}$ $(1/2,0)_{1/2}$	$2p_{1/2}2p^2_{3/2}$ $(1/2,2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(12.090)	(8 271 200)	6.78E+9	$(2s2p_{1/2})2p_{3/2}$ $(1,3/2)_{1/2}$	$2p^3_{3/2}$ $(0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(12.094)	(8 268 700)	1.64E+10	$(2s2p_{1/2})2p_{3/2}$ $(1,3/2)_{3/2}$	$2p^3_{3/2}$ $(0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(17.248)	(5 797 900)	2.83E+10	$(2s2p_{1/2})2p_{3/2}$ $(0,3/2)_{3/2}$	$2p_{1/2}2p^2_{3/2}$ $(1/2,0)^\circ_{1/2}$	94ZHA/SAM	94ZHA/SAM
(18.275)	(5 472 000)	9.76E+9	$(2s2p_{1/2})2p_{3/2}$ $(0,3/2)_{3/2}$	$2p_{1/2}2p^2_{3/2}$ $(1/2,2)^\circ_{5/2}$	94ZHA/SAM	94ZHA/SAM
(18.419)	(5 429 300)	7.21E+11	$2s2p^2_{3/2}$ $(1/2,2)_{5/2}$	$2p^3_{3/2}$ $(0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM

TABLE 63. Spectral lines of Ba LII—Continued

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(18.826)	(5 311 800)	7.79E+11	$(2s2p_{1/2})2p_{3/2}\ (0,3/2)_{3/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(19.226)	(5 201 300)	6.88E+11	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{5/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,2)^\circ_{5/2}$	94ZHA/SAM	94ZHA/SAM
(19.415)	(5 150 600)	3.47E+11	$2s2p^2_{1/2}\ (1/2,0)_{1/2}$	$2p^2_{1/2}2p_{3/2}\ (0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(19.420)	(5 149 300)	1.63E+12	$2s^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s2p^2_{3/2}\ (1/2,2)_{3/2}$	94ZHA/SAM	94ZHA/SAM
(19.473)	(5 135 300)	1.92E+12	$2s^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s2p^2_{3/2}\ (1/2,0)_{1/2}$	94ZHA/SAM	94ZHA/SAM
(19.609)	(5 099 800)	5.10E+11	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{1/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,0)^\circ_{1/2}$	94ZHA/SAM	94ZHA/SAM
(19.618)	(5 097 300)	2.41E+12	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{3/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,0)^\circ_{1/2}$	94ZHA/SAM	94ZHA/SAM
(19.769)	(5 058 500)	4.74E+11	$2s^22p_{1/2}\ (0,1/2)^\circ_{1/2}$	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{3/2}$	94ZHA/SAM	94ZHA/SAM
(19.778)	(5 056 000)	1.16E+12	$2s^22p_{1/2}\ (0,1/2)^\circ_{1/2}$	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{1/2}$	94ZHA/SAM	94ZHA/SAM
(19.837)	(5 041 100)	1.38E+11	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{5/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(20.825)	(4 801 900)	1.51E+11	$2s2p^2_{3/2}\ (1/2,0)_{1/2}$	$2p^3_{3/2}\ (0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(20.886)	(4 787 900)	1.45E+12	$2s2p^2_{3/2}\ (1/2,2)_{3/2}$	$2p^3_{3/2}\ (0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(20.958)	(4 771 400)	4.06E+11	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{3/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,2)^\circ_{5/2}$	94ZHA/SAM	94ZHA/SAM
(21.675)	(4 613 700)	2.58E+11	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{1/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(21.686)	(4 611 200)	8.72E+10	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{3/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(22.183)	(4 507 900)	1.39E+11	$2s^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s2p^2_{3/2}\ (1/2,2)_{5/2}$	94ZHA/SAM	94ZHA/SAM
(22.947)	(4 357 900)	2.41E+9	$2s^22p_{1/2}\ (0,1/2)^\circ_{1/2}$	$(2s2p_{1/2})2p_{3/2}\ (0,3/2)_{3/2}$	94ZHA/SAM	94ZHA/SAM
(29.499)	(3 390 000)	1.78E+8	$2s^22p_{1/2}\ (0,1/2)^\circ_{1/2}$	$2s^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	94ZHA/SAM	01CHA/LOP
(45.698)	(2 188 300)	1.58E+10	$(2s2p_{1/2})2p_{3/2}\ (0,3/2)_{3/2}$	$2p^2_{1/2}2p_{3/2}\ (0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(50.140)	(1 994 400)	4.38E+8	$2s2p^2_{1/2}\ (1/2,0)_{1/2}$	$2s^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(50.173)	(1 993 100)	1.89E+9	$2p^2_{1/2}2p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s2p^2_{3/2}\ (1/2,2)_{3/2}$	94ZHA/SAM	94ZHA/SAM
(50.528)	(1 979 100)	2.34E+9	$2p^2_{1/2}2p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s2p^2_{3/2}\ (1/2,0)_{1/2}$	94ZHA/SAM	94ZHA/SAM
(51.760)	(1 932 000)	2.38E+10	$2s2p^2_{3/2}\ (1/2,2)_{5/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,2)^\circ_{5/2}$	94ZHA/SAM	94ZHA/SAM
(52.149)	(1 917 600)	7.23E+10	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{5/2}$	$2p^2_{1/2}2p_{3/2}\ (0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(56.440)	(1 771 800)	3.66E+10	$2s2p^2_{3/2}\ (1/2,2)_{5/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(59.934)	(1 668 500)	6.50E+9	$2s^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{3/2}$	94ZHA/SAM	94ZHA/SAM
(60.024)	(1 666 000)	1.91E+10	$2s^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{1/2}$	94ZHA/SAM	94ZHA/SAM
(61.331)	(1 630 500)	2.73E+10	$2s2p^2_{3/2}\ (1/2,0)_{1/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,0)^\circ_{1/2}$	94ZHA/SAM	94ZHA/SAM
(61.862)	(1 616 500)	3.30E+8	$2s2p^2_{3/2}\ (1/2,2)_{3/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,0)^\circ_{1/2}$	94ZHA/SAM	94ZHA/SAM
(67.105)	(1 490 200)	4.59E+9	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{1/2}$	$2p^2_{1/2}2p_{3/2}\ (0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(67.218)	(1 487 700)	9.68E+9	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{3/2}$	$2p^2_{1/2}2p_{3/2}\ (0,3/2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(71.654)	(1 395 600)	1.08E+10	$2s^22p_{1/2}\ (0,1/2)^\circ_{1/2}$	$2s2p^2_{1/2}\ (1/2,0)_{1/2}$	94ZHA/SAM	94ZHA/SAM
(73.981)	(1 351 700)	7.95E+7	$2p^2_{1/2}2p_{3/2}\ (0,3/2)^\circ_{3/2}$	$2s2p^2_{3/2}\ (1/2,2)_{5/2}$	94ZHA/SAM	94ZHA/SAM
(77.483)	(1 290 600)	5.23E+9	$2s2p^2_{3/2}\ (1/2,2)_{3/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,2)^\circ_{5/2}$	94ZHA/SAM	94ZHA/SAM
(80.736)	(1 238 600)	3.08E+9	$2s^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}\ (1,3/2)_{5/2}$	94ZHA/SAM	94ZHA/SAM
(87.382)	(1 144 400)	1.32E+7	$2s2p^2_{3/2}\ (1/2,0)_{1/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(88.464)	(1 130 400)	1.44E+9	$2s2p^2_{3/2}\ (1/2,2)_{3/2}$	$2p_{1/2}2p^2_{3/2}\ (1/2,2)^\circ_{3/2}$	94ZHA/SAM	94ZHA/SAM
(103.316)	(967 900)	4.31E+8	$2s^22p_{3/2}\ (0,3/2)^\circ_{3/2}$	$(2s2p_{1/2})2p_{3/2}\ (0,3/2)_{3/2}$	94ZHA/SAM	94ZHA/SAM

TABLE 64. Energy levels of Ba LII

Configuration	Term	J	Energy (cm^{-1})	Reference
$2s^22p_{1/2}$	$(0,1/2)^\circ$	1/2	(0)	94ZHA/SAM
$2s2p^2_{1/2}$	(1/2,0)	1/2	(1 395 600)	94ZHA/SAM
$2s^22p_{3/2}$	$(0,3/2)^\circ$	3/2	(3 390 000)	94ZHA/SAM
$(2s2p_{1/2})2p_{3/2}$	(0,3/2)	3/2	(4 357 900)	94ZHA/SAM
	(1,3/2)	5/2	(4 628 600)	94ZHA/SAM
	(1,3/2)	1/2	(5 056 000)	94ZHA/SAM
	(1,3/2)	3/2	(5 058 500)	94ZHA/SAM
$2p^2_{1/2}2p_{3/2}$	$(0,3/2)^\circ$	3/2	(6 546 200)	94ZHA/SAM
$2s2p^2_{3/2}$	(1/2,2)	5/2	(7 897 900)	94ZHA/SAM
	(1/2,0)	1/2	(8 525 300)	94ZHA/SAM
	(1/2,2)	3/2	(8 539 300)	94ZHA/SAM
$2p_{1/2}(2p^2_{3/2})$	$(1/2,2)^\circ$	3/2	(9 669 700)	94ZHA/SAM
	$(1/2,2)^\circ$	5/2	(9 829 900)	94ZHA/SAM
	$(1/2,0)^\circ$	1/2	(10 155 800)	94ZHA/SAM
$2p^3_{3/2}$	$(0,3/2)^\circ$	3/2	(13 327 200)	94ZHA/SAM
Ba LIII ($2s^2\ ^1S_0$)		*Limit*	(80 840 000)	06HUA/JIA

6.51. Ba LIII

Be isoelectronic sequence
Ground state $1s^22s^2\ ^1S_0$

Ionization energy (83 695 000 cm^{-1}); (10 376 eV)

The Ba LIII spectrum has not been observed experimentally, but Zhang and Sampson [92ZHA/SAM] used the relativistic Dirac–Fock method to calculate transition energies and oscillator strengths for transitions between the $2s^2$, $2p^2$, and $2s2p$ configurations. Cheng *et al.* [08CHE/CHE] calculated the four $2s2p$ energy levels using the relativistic configuration interaction method and obtained probabilities for the four $2s^2$-$2s2p$ transitions. In papers discussing the hyperfine quenching of transition rates, Marques *et al.* [93MAR/PAR] gave lifetimes for the $2s2p$ $(1/2,1/2)^{\circ}_{01}$ levels. Cheng *et al.* [08CHE/CHE] also discussed the effect of hyperfine structure on the transition rates of $2s^2$-$2s2p$ $(1/2,1/2)^{\circ}_0$ in isotopes with nonzero nuclear spin, obtaining A_{ki}=3.08 $\times 10^2$ s^{-1} for ^{135}Ba and A_{ki}=3.85$\times 10^2$ s^{-1} for ^{137}Ba. In Tables 65 and 66 we include the [92ZHA/SAM] energy level and wavelength values. We retain the [08CHE/CHE] transition probabilities for the $2s^2$-$2s2p$ transitions, which agree with the [92ZHA/SAM] values to within 1%, and otherwise cite the [92ZHA/SAM] results.

The calculated ionization energy cited is taken from Huang *et al.* [06HUA/JIA]. Rodrigues *et al.* [04ROD/IND] obtained nearly the same value. Gu [05GU] calculated an ionization of energy of 90 000 cm^{-1} higher.

6.51.1. References for Ba LIII

92ZHA/SAM	H. L. Zhang and D. H. Sampson, At. Data Nucl. Data Tables **52**, 143 (1992).
93MAR/PAR	J. P. Marques, F. Parente, and P. Indelicato, Phys. Rev. A **47**, 929 (1993).
04ROD/IND	G. C. Rodrigues, P. Indelicato, J. P. Santos, P. Patté, and F. Parente, At. Data Nucl. Data Tables **86**, 117 (2004).
05GU	M. F. Gu, At. Data Nucl. Data Tables **89**, 267 (2005).
06HUA/JIA	J. Huang, G. Jiang, and Q. Zhao, Chin. Phys. Lett. **23**, 69 (2006).
08CHE/CHE	K. T. Cheng, M. H. Chen, and W. R. Johnson, Phys. Rev. A **77**, 052504 (2008).

TABLE 65. Spectral lines of Ba LIII

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(12.175)	8 213 600)	1.08E+10	$2s2p_{1/2}$ $(1/2,1/2)^{\circ}_1$	$2p^2_{3/2}$ $(3/2,3/2)_2$	92ZHA/SAM	92ZHA/SAM
(20.154)	(4 961 900)	6.88E+11	$2s2p_{3/2}$ $(1/2,3/2)^{\circ}_2$	$2p^2_{3/2}$ $(3/2,3/2)_2$	92ZHA/SAM	92ZHA/SAM
(20.467)	(4 885 800)	4.60E+11	$2s2p_{1/2}$ $(1/2,1/2)^{\circ}_0$	$2p_{1/2}2p_{3/2}$ $(1/2,3/2)_1$	92ZHA/SAM	92ZHA/SAM
(20.488)	(4 880 800)	9.14E+11	$2s^2$ $^1S_0$	$2s2p_{3/2}$ $(1/2,3/2)^{\circ}_1$	92ZHA/SAM	08CHE/CHE
(20.700)	(4 830 900)	1.56E+12	$2s2p_{3/2}$ $(1/2,3/2)^{\circ}_1$	$2p^2_{3/2}$ $(3/2,3/2)_0$	92ZHA/SAM	92ZHA/SAM
(20.740)	(4 821 500)	5.81E+11	$2s2p_{1/2}$ $(1/2,1/2)^{\circ}_1$	$2p_{1/2}2p_{3/2}$ $(1/2,3/2)_2$	92ZHA/SAM	92ZHA/SAM
(21.329)	(4 688 500)	2.27E+11	2.27E+11 $(1/2,1/2)^{\circ}_1$	$2p_{1/2}2p_{3/2}$ $(1/2,3/2)_1$	92ZHA/SAM	92ZHA/SAM
(22.622)	(4 420 400)	5.33E+11	$2s2p_{3/2}$ $(1/2,3/2)^{\circ}_1$	$2p^2_{3/2}$ $(3/2,3/2)_2$	92ZHA/SAM	92ZHA/SAM
(23.045)	(4 339 300)	8.37E+4	$2s^2$ $^1S_0$	$2s2p_{3/2}$ $(1/2,3/2)^{\circ}_2$	92ZHA/SAM	08CHE/CHE
(43.361)	(2 306 200)	9.11E+8	$2p^2_{1/2}$ $(1/2,1/2)_0$	$2s2p_{3/2}$ $(1/2,3/2)^{\circ}_1$	92ZHA/SAM	92ZHA/SAM
(63.702)	(1 569 800)	1.17E+10	$2s2p_{3/2}$ $(1/2,3/2)^{\circ}_2$	$2p_{1/2}2p_{3/2}$ $(1/2,3/2)_2$	92ZHA/SAM	92ZHA/SAM
(67.249)	(1 487 000)	4.38E+10	$2s2p_{1/2}$ $(1/2,1/2)^{\circ}_1$	$2p^2_{1/2}$ $(1/2,1/2)_0$	92ZHA/SAM	92ZHA/SAM
(69.599)	(1 436 800)	1.35E+10	$2s2p_{3/2}$ $(1/2,3/2)^{\circ}_2$	$2p_{1/2}2p_{3/2}$ $(1/2,3/2)_1$	92ZHA/SAM	92ZHA/SAM
(91.946)	(1 087 600)	2.41E+9	$2s^2$ $^1S_0$	$2s2p_{1/2}$ $(1/2,1/2)^{\circ}_1$	92ZHA/SAM	08CHE/CHE
(97.248)	(1 028 300)	3.47E+9	$2s2p_{3/2}$ $(1/2,3/2)^{\circ}_1$	$2p_{1/2}2p_{3/2}$ $(1/2,3/2)_2$	92ZHA/SAM	92ZHA/SAM
(111.694)	(895 300)	4.81E+8	$2s2p_{3/2}$ $(1/2,3/2)^{\circ}_1$	$2p_{1/2}2p_{3/2}$ $(1/2,3/2)_1$	92ZHA/SAM	92ZHA/SAM
(112.322)	(890 300)		$2s^2$ $^1S_0$	$2s2p_{1/2}$ $(1/2,1/2)^{\circ}_0$	92ZHA/SAM	

TABLE 66. Energy levels of Ba LIII

Configuration	Term	J	Energy (cm^{-1})	Reference
$2s^2$	^1S	0	(0)	
$2s2p_{1/2}$	$(1/2,1/2)^{\circ}$	0	(890 300)	92ZHA/SAM
	$(1/2,1/2)^{\circ}$	1	(1 087 600)	92ZHA/SAM
$2p^2_{1/2}$	$(1/2,1/2)$	0	(2 574 600)	92ZHA/SAM
$2s2p_{3/2}$	$(1/2,3/2)^{\circ}$	2	(4 339 300)	92ZHA/SAM
	$(1/2,3/2)^{\circ}$	1	(4 880 800)	92ZHA/SAM
$2p_{1/2}2p_{3/2}$	$(1/2,3/2)$	1	(5 776 100)	92ZHA/SAM
	$(1/2,3/2)$	2	(5 909 100)	92ZHA/SAM
$2p^2_{3/2}$	$(3/2,3/2)$	2	(9 301 200)	92ZHA/SAM
	$(3/2,3/2)$	0	(9 711 700)	92ZHA/SAM
Ba LIV (2s $^2S_{1/2}$)		*Limit*	(83 695 000)	06HUA/JIA

6.52. Ba LIV

Li isoelectronic sequence
Ground state $1s^22s$ $^2S_{1/2}$
Ionization energy (85 637 000 cm^{-1}); (10 618 eV)

No experimental observations of the Ba LIV spectrum have been made; however, theoretical interest in the Li-like ion has been considerable. Zhang *et al.* [90ZHA/SAM] used the relativistic Dirac–Fock method to calculate energies for levels with $2 \leqslant n \leqslant 5$ and oscillator strengths for transitions to the ground state and levels in the $2p\ ^2P^\circ$ configuration. Johnson *et al.* [96JOH/LIU] used third-order many-body perturbation theory to calculate transition probabilities for the $2p-2s$ and $3s-2p$ transitions. In addition, the semiempirical Coulomb approximation was used by Theodosiou *et al.* [91THE/CUR] to obtain values for the $2p$ levels, lifetimes for them, and the ionization potential. The $2p$ level values were also calculated by Kim *et al.* [91KIM/BAI], using Dirac–Fock energies with QED corrections, and Yerokhin *et al.* [07YER/ART], who combined a local model potential with a QED corrections and also performed an estimate of the errors in their calculations. For the energy levels, agreement between [90ZHA/SAM], [91THE/CUR], [91KIM/BAI], and [96JOH/LIU] is within ± 3500 cm^{-1}. The [07YER/ART] levels are around 50 000 cm^{-1} higher than the other three despite their error estimate of ± 20 cm^{-1}. The agreement between [90ZHA/SAM] and [96JOH/LIU] transition probabilities is within 1%; [91THE/CUR] and [90ZHA/SAM] agree within 2%.

The wavelengths reported in Table 67 are calculated from the energy levels of Table 68, which are taken from [90ZHA/SAM] in order to have a consistent set of level values. The [96JOH/LIU] probabilities are retained for those transitions for which they are available and [90ZHA/SAM] kept otherwise. Boucard and Indelicato [00BOU/IND] calculated hyperfine splittings for the ground state of ^{135}Ba and ^{137}Ba, obtaining $\Delta E = 283.35$ and 316.94 cm^{-1}, respectively. Theodosiou *et al.* [91THE/CUR], Huang *et al.* [06HUA/JIA], Gu [05GU], and Yerokhin *et al.* [07YER/ART] have all calculated ionization energies for Ba LIII. We have given the average of the first three, since all are within $\pm 16\,000$ cm^{-1} of that value. Yerokhin *et al.* [07YER/ART] produced a value of 48 000 cm^{-1} higher.

6.52.1. References for Ba LIV

90ZHA/SAM	H. L. Zhang, D. H. Sampson, and C. J. Fontes, At. Data Nucl. Data Tables **44**, 31 (1990).
91KIM/BAI	Y.-K. Kim, D. H. Baik, P. Indelicato, and J. P. Desclaux, Phys. Rev. A **44**, 148 (1991).
91THE/CUR	C. E. Theodosiou, L. J. Curtis, and M. El-Mekki, Phys. Rev. A **44**, 7144 (1991).
96JOH/LIU	W. R. Johnson, Z. W. Liu, and J. Sapirstein, At. Data Nucl. Data Tables **64**, 279 (1996).
00BOU/IND	S. Boucard and P. Indelicato, Eur. Phys. J. D **8**, 59 (2000).
07YER/ART	V. A. Yerokhin, A. N. Artemyev, and V. M. Shabaev, Phys. Rev. A **75**, 062501 (2007).

TABLE 67. Spectral lines of Ba LIV

λ (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(1.3740)	(72 777 800)	4.29E+13	2s $^2S_{1/2}$	5p $^2P^\circ_{3/2}$	90ZHA/SAM	90ZHA/SAM
(1.3784)	(72 550 400)	4.60E+13	2s $^2S_{1/2}$	5p $^2P^\circ_{1/2}$	90ZHA/SAM	90ZHA/SAM
(1.3931)	(71 782 400)	7.70E+13	2p $^2P^\circ_{1/2}$	5d $^2D_{3/2}$	90ZHA/SAM	90ZHA/SAM
(1.3991)	(71 475 100)	4.43E+12	2p $^2P^\circ_{1/2}$	5s $^2S_{1/2}$	90ZHA/SAM	90ZHA/SAM
(1.4634)	(68 333 400)	8.35E+13	2p $^2P^\circ_{3/2}$	5d $^2D_{5/2}$	90ZHA/SAM	90ZHA/SAM
(1.4649)	(68 264 800)	1.27E+13	2p $^2P^\circ_{3/2}$	5d $^2D_{3/2}$	90ZHA/SAM	90ZHA/SAM
(1.4715)	(67 957 500)	1.11E+13	2p $^2P^\circ_{3/2}$	5s $^2S_{1/2}$	90ZHA/SAM	90ZHA/SAM
(1.5279)	(65 451 100)	8.26E+13	2s $^2S_{1/2}$	4p $^2P^\circ_{3/2}$	90ZHA/SAM	90ZHA/SAM
(1.5383)	(65 005 100)	9.08E+13	2s $^2S_{1/2}$	4p $^2P^\circ_{1/2}$	90ZHA/SAM	90ZHA/SAM
(1.5510)	(64 476 600)	1.66E+14	2p $^2P^\circ_{1/2}$	4d $^2D_{3/2}$	90ZHA/SAM	90ZHA/SAM
(1.5656)	(63 871 700)	8.98E+12	2p $^2P^\circ_{1/2}$	4s $^2S_{1/2}$	90ZHA/SAM	90ZHA/SAM
(1.6369)	(61 092 900)	1.82E+14	2p $^2P^\circ_{3/2}$	4d $^2D_{5/2}$	90ZHA/SAM	90ZHA/SAM
(1.6404)	(60 959 000)	2.83E+13	2p $^2P^\circ_{3/2}$	4d $^2D_{3/2}$	90ZHA/SAM	90ZHA/SAM
(1.6569)	(60 354 100)	2.33E+13	2p $^2P^\circ_{3/2}$	4s $^2S_{1/2}$	90ZHA/SAM	90ZHA/SAM
(2.0155)	(49 614 400)	1.82E+14	2s $^2S_{1/2}$	3p $^2P^\circ_{3/2}$	90ZHA/SAM	90ZHA/SAM
(2.0535)	(48 697 200)	4.91E+14	2p $^2P^\circ_{1/2}$	3d $^2D_{3/2}$	90ZHA/SAM	90ZHA/SAM
(2.0596)	(48 552 200)	2.14E+14	2s $^2S_{1/2}$	3p $^2P^\circ_{1/2}$	90ZHA/SAM	90ZHA/SAM
(2.1164)	(47 250 200)	2.25E+13	2p $^2P^\circ_{1/2}$	3s $^2S_{1/2}$	90ZHA/SAM	96JOH/LIU
(2.1980)	(45 495 800)	5.58E+14	2p $^2P^\circ_{3/2}$	3d $^2D_{5/2}$	90ZHA/SAM	90ZHA/SAM
(2.2134)	(45 179 600)	8.47E+13	2p $^2P^\circ_{3/2}$	3d $^2D_{3/2}$	90ZHA/SAM	90ZHA/SAM
(2.2866)	(43 732 600)	5.92E+13	2p $^2P^\circ_{3/2}$	3s $^2S_{1/2}$	90ZHA/SAM	96JOH/LIU
(22.056)	(4 534 000)	5.43E+11	2s $^2S_{1/2}$	2p $^2P^\circ_{3/2}$	90ZHA/SAM	96JOH/LIU
(98.386)	(1 016 400)	5.64E+9	2s $^2S_{1/2}$	2p $^2P^\circ_{1/2}$	90ZHA/SAM	96JOH/LIU

TABLE 68. Energy levels of Ba LIV

Configuration	Term	J	Energy (cm^{-1})	Reference
2s	^2S	1/2	(0)	
2p	$^2P^\circ$	1/2	(1 016 400)	90ZHA/SAM
	$^2P^\circ$	3/2	(4 534 000)	90ZHA/SAM
3s	^2S	1/2	(48 266 600)	90ZHA/SAM
3p	$^2P^\circ$	1/2	(48 552 200)	90ZHA/SAM
	$^2P^\circ$	3/2	(49 614 400)	90ZHA/SAM
3d	^2D	3/2	(49 713 600)	90ZHA/SAM
	^2D	5/2	(50 029 800)	90ZHA/SAM
4s	^2S	1/2	(64 888 100)	90ZHA/SAM
4p	$^2P^\circ$	1/2	(65 005 100)	90ZHA/SAM
	$^2P^\circ$	3/2	(65 451 100)	90ZHA/SAM
4d	^2D	3/2	(65 493 000)	90ZHA/SAM
	^2D	5/2	(65 626 900)	90ZHA/SAM
4f	$^2F^\circ$	5/2	(65 629 300)	90ZHA/SAM
	$^2F^\circ$	7/2	(65 694 700)	90ZHA/SAM
5s	^2S	1/2	(72 491 500)	90ZHA/SAM
5p	$^2P^\circ$	1/2	(72 550 400)	90ZHA/SAM
	$^2P^\circ$	3/2	(72 777 800)	90ZHA/SAM
5d	^2D	3/2	(72 798 800)	90ZHA/SAM
	^2D	5/2	(72 867 400)	90ZHA/SAM
5f	$^2F^\circ$	5/2	(72 869 000)	90ZHA/SAM
	$^2F^\circ$	7/2	(72 902 800)	90ZHA/SAM
5g	^2G	7/2	(72 903 700)	90ZHA/SAM
	^2G	9/2	(72 923 000)	90ZHA/SAM
Ba LV ($1s^2\ ^1S_0$)		*Limit*	(85 637 000)	91THE/CUR, 05GU, 06HUA/JIA

6.53. Ba LV

He isoelectronic sequence
Ground state $1s^2\ ^1S_0$
Ionization energy
(350 725 800(1200) cm^{-1}); (43 484.45(15) eV)

No transitions of the Ba LV spectrum have been measured. The wavelength and energies retained in Tables 69 and 70 for singly excited levels are from the theoretical calculations of Drake [88DRA], who determined the energies of the $n=1$ and $n=2$ levels of heliumlike barium and the ionization energy using the unified-theory method. The fine-structure splitting between levels in the $1s2p$ configuration was also calculated by Johnson *et al.* [97JOH/CHE], with agreement within $\pm 3500\ cm^{-1}$. Relativistic all-order many-body calculations by Plante *et al.* [94PLA/JOH] produced energies for the same levels. Kagawa and Safronova [92KAG/SAF] used the relativistic perturbation method to obtain a formula for levels in the $1s^2$, $1s2s$, and $1s2p$ configurations. The [94PLA/JOH] results are within 5000 cm^{-1} of those of Drake [88/DRA], while the Kagawa and Safronova [92KAG/SAF] values have a much greater spread. A formula for calculating doubly excited levels has been published by Safronova *et al.* [94SAF/SAF2] and the $2s^2\ ^1S_0$ level was also calculated by Zhang *et al.* [06ZHA/DON] using the MCDF theory. We list the Zhang *et al.* [06ZHA/DON] value in Table 70 and have used it to calculate transition energies. The Ba LV ionization energy was also determined by Plante *et al.* [94PLA/JOH] with results of 5200 cm^{-1} higher than that of Drake [88DRA].

Johnson *et al.* [95JOH/PLA] used a relativistic, iterative technique to calculate the transition probabilities cited in Table 69 that do not involve the $2s^2\ ^1S_0$ level. The paper also presents a detailed comparison of several methods of calculating transition probabilities for He-like ions. The Johnson *et al.* [95JOH/PLA] values agree to within $\pm 4\%$ with the relativistic random-phase calculations done by Lin *et al.* [77LIN/JOH] for all transitions with rates greater than $10^{10}\ s^{-1}$. Decay rates for the $1s2p\ ^3P^\circ_1$ and $^1P^\circ_1$ levels, calculated by Drake [79DRA] using the unified relativistic theory, agree with the Johnson [95JOH/PLA] results to less than $\pm 0.3\%$. Indelicato *et al.* [89IND/PAR] studied the effect of hyperfine interaction on the lifetimes of the $1s2p\ ^3P^\circ_1$ and $1s2p\ ^3P^\circ_0$ levels and reported less than a 0.1% difference in $1s2p\ ^3P^\circ_1$, but a substantial change in the $1s2p\ ^3P^\circ_0$ lifetime. While the $1s2p\ ^3P^\circ_0$-$1s^2\ ^1S_0$ transition probability for Ba isotopes not affected by hyperfine splitting is calculated to be $A_{ki}=1.90\times 10^9\ s^{-1}$, the corresponding value for ^{135}Ba is $8.80\times 10^{11}\ s^{-1}$ and that of ^{137}Ba is $1.12\times 10^{12}\ s^{-1}$. Similar calculations by Johnson *et al.* [97JOH/CHE] give results within $\pm 8\%$. Two photon effects on the decay of the $1s2p\ ^3P^\circ_0$ were determined by Savukov and Johnson [02SAV/JOH] to be just 0.6% of its transition probability. The only available transition probabilities for decays from the $2s^2\ ^1S_0$ level are presented by Zhang *et al.* [06ZHA/DON], who used the MCDF theory.

6.53.1. References for Ba LV

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TABLE 69. Spectral lines of Ba LV

λ (Å)	Unc. (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(0.373 411)		(267 801 300)	1.38E+12	1s2s $^3S_1$	2s^2 $^1S_0$	88DRA, 06ZHA/DON	06ZHA/DON
(0.374 324)		(267 148 000)	2.26E+15	1s2p $^3P^\circ_1$	2s^2 $^1S_0$	88DRA, 06ZHA/DON	06ZHA/DON
(0.374 643)	0.000 002	(266 921 000)	7.75E+15	1s^2 $^1S_0$	1s2p $^1P^\circ_1$	88DRA	95JOH/PLA
(0.375 065)	0.000 002	(266 620 200)	3.45E+12	1s^2 $^1S_0$	1s2p $^3P^\circ_2$	88DRA	95JOH/PLA
(0.379 538)		(263 478 300)	1.27E+10	1s2p $^3P^\circ_2$	2s^2 $^1S_0$	88DRA, 06ZHA/DON	06ZHA/DON
(0.379 978)		(263 173 400)	3.46E+13	1s2p $^1P^\circ_1$	2s^2 $^1S_0$	88DRA, 06ZHA/DON	06ZHA/DON
(0.380 206)	0.000 002	(263 015 500)		1s^2 $^1S_0$	1s2p $^3P^\circ_0$	88DRA	
(0.380 302)	0.000 002	(262 949 200)	3.56E+15	1s^2 $^1S_0$	1s2p $^3P^\circ_1$	88DRA	95JOH/PLA
(0.381 246)	0.000 002	(262 297 900)	5.62E+11	1s^2 $^1S_0$	1s2s $^3S_1$	88DRA	95JOH/PLA
(21.631)	0.006	(4 623 100)	1.68E+11	1s2s $^3S_1$	1s2p $^1P^\circ_1$	88DRA	95JOH/PLA
(23.136)	0.007	(4 322 300)	4.54E+11	1s2s $^3S_1$	1s2p $^3P^\circ_2$	88DRA	95JOH/PLA
(25.691)	0.008	(3 892 400)	2.34E+11	1s2s $^1S_0$	1s2p $^1P^\circ_1$	88DRA	95JOH/PLA
(139.4)	0.2	(717 600)	1.89E+9	1s2s $^3S_1$	1s2p $^3P^\circ_0$	88DRA	95JOH/PLA
(153.5)	0.3	(651 300)	9.97E+8	1s2s $^3S_1$	1s2p $^3P^\circ_1$	88DRA	95JOH/PLA

TABLE 70. Energy levels of Ba LV

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
1s^2	^{1}S	0	(0)		88DRA
1s2s	^{3}S	1	(262 297 900)	1200	88DRA
1s2p	^{3}P°	1	(262 949 200)	1200	88DRA
	^{3}P°	0	(263 015 500)	1200	88DRA
	^{3}P°	2	(266 620 200)	1200	88DRA
1s2s	^{1}S	0	(263 028 600)	1200	88DRA
1s2p	^{1}P°	1	(266 921 000)	1200	88DRA
Ba LVI (1s^{2}S$_{1/2}$)		*Limit*	(350 725 800)	1200	88DRA
2s^2	^{1}S	0	(530 075 100)		06ZHA/DON

6.54. Ba LVI

H isoelectronic sequence
Ground state 1*s* $^2S_{1/2}$
Ionization energy
(359 412 500(500) cm^{-1}); (44 561.47(6) eV)

No experimental measurements of the Ba LVI spectrum have been made; however Erickson [77ERI] calculated energy levels of barium for levels with $1 \leqslant n \leqslant 3$. Later Johnson and Soff [85JOH/SOF] calculated the $n=1$ and 2 levels with reduced uncertainties. The wavelengths listed in Table 71 are computed using the differences of the levels. The $n=1$ and 2 level values and ionization energy used in Table 72 are taken from Johnson and Soff [85JOH/SOF], corrected for the latest CODATA internationally recommended value of the Rydberg constant, R=109 737.315 685 25(73) cm^{-1}. The $n=3$ levels are obtained by combining the Johnson and Soff [85JOH/SOF] ionization energy with Erickson's binding energies [77ERI]. The uncertainties given are with respect to the ionization limit. The wavelength uncertainties are calculated from those of the energy levels except for transitions between $n=2$ levels, for which Johnson and Soff [85JOH/SOF] give wave number uncertainties. Pal'chikov [98PAL] also calculated the ionization energy for Ba LVI. Although his estimated uncertainty is 160 cm^{-1} and Johnson and Soff's is 500 cm^{-1} [85JOH/SOF], the difference between their values is 4600 cm^{-1}.

The transition probabilities in Table 71 were calculated by Jitrik and Bunge [04JIT/BUN] using point-nucleus Dirac eigenfunctions. Pal'chikov [98PAL] also obtained transition probabilities for the resonance transitions. The results agree with Jitrik and Bunge [04JIT/BUN] to within 0.1%.

6.54.1. References for Ba LVI

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TABLE 71. Spectral lines of ^{138}Ba LVI

λ (Å)	Unc. (Å)	σ (cm^{-1})	A_{ki} (s^{-1})	Lower Level	Upper Level	λ Ref.	A_{ki} Ref.
(0.311 883 5)	0.000 000 6	(320 632 594)	1.615E+15	1s $^2S_{1/2}$	3p $^2P^\circ_{3/2}$	77ERI,85JOH/SOF	04JIT/BUN
(0.313 049 9)	0.000 000 8	(319 437 894)	1.594E+15	1s $^2S_{1/2}$	3p $^2P^\circ_{1/2}$	77ERI,85JOH/SOF	04JIT/BUN
(0.367 014 6)	0.000 000 7	(272 468 700)	5.912E+15	1s $^2S_{1/2}$	2p $^2P^\circ_{3/2}$	85JOH/SOF	04JIT/BUN
(0.372 419 8)	0.000 000 7	(268 514 200)	9.155E+11	1s $^2S_{1/2}$	2s $^2S_{1/2}$	85JOH/SOF	04JIT/BUN
(0.372 510 8)	0.000 000 7	(268 448 600)	6.288E+15	1s $^2S_{1/2}$	2p $^2P^\circ_{1/2}$	85JOH/SOF	04JIT/BUN
(1.916 37)	0.000 02	(52 181 904)	5.684E+14	2p $^2P^\circ_{1/2}$	3d $^2D_{3/2}$	77ERI,85JOH/SOF	04JIT/BUN
(1.918 71)	0.000 02	(52 118 394)	2.084E+14	2s $^2S_{1/2}$	3p $^2P^\circ_{3/2}$	77ERI,85JOH/SOF	04JIT/BUN
(1.960 37)	0.000 04	(51 010 894)	2.314E+13	2p $^2P^\circ_{1/2}$	3s $^2S_{1/2}$	77ERI,85JOH/SOF	04JIT/BUN
(1.963 72)	0.000 03	(50 923 694)	2.490E+14	2s $^2S_{1/2}$	3p $^2P^\circ_{1/2}$	77ERI,85JOH/SOF	04JIT/BUN
(2.060 67)	0.000 02	(48 527 934)	6.315E+14	2p $^2P^\circ_{3/2}$	3d $^2D_{5/2}$	77ERI,85JOH/SOF	04JIT/BUN
(2.076 33)	0.000 02	(48 161 804)	1.048E+14	2p $^2P^\circ_{3/2}$	3d $^2D_{3/2}$	77ERI,85JOH/SOF	04JIT/BUN
(2.128 08)	0.000 05	(46 990 794)	6.310E+13	2p $^2P^\circ_{3/2}$	3s $^2S_{1/2}$	77ERI,85JOH/SOF	04JIT/BUN
(24.87 52)	0.000 2	(4 020 060)	5.659E+8	2p $^2P^\circ_{1/2}$	2p $^2P^\circ_{3/2}$	85JOH/SOF	04JIT/BUN
(25.28 80)	0.000 5	(3 954 450)	3.535E+11	2s $^2S_{1/2}$	2p $^2P^\circ_{3/2}$	85JOH/SOF	04JIT/BUN

TABLE 72. Energy levels of ^{138}Ba LVI

Configuration	Term	J	Energy (cm^{-1})	Uncertainty (cm^{-1})	Reference
1s	^2S	1/2	(0)		
2p	$^2P^\circ$	1/2	(268 448 600)	500	85JOH/SOF
2p	$^2P^\circ$	3/2	(272 468 700)	500	85JOH/SOF
2s	^2S	1/2	(268 514 200)	500	85JOH/SOF
3p	$^2P^\circ$	1/2	(319 437 894)	800	77ERI,85JOH/SOF
3p	$^2P^\circ$	3/2	(320 632 594)	400	77ERI,85JOH/SOF
3s	^2S	1/2	(319 459 494)	1000	77ERI,85JOH/SOF
3d	^2D	3/2	(320 630 504)	20	77ERI,85JOH/SOF
3d	^2D	5/2	(320 996 634)	20	77ERI,85JOH/SOF
		Limit	(359 412 500)	500	85JOH/SOF

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