Publ. Obs. Astron. Belgrade No. 44 (1993), 59-63

STARK BROADENING PARAMETERS FOR Be II SPECTRAL LINES

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ABSTRACT Using a semiclassical approach, we have calculated electron-, proton-, and ionized helium-impact line widths and shifts for 30 Be II multiplets. The resulting data have been compared with existing experimental and theoretical values.

INTRODUCTION

Besides the interest for plasma spectroscopy (Platiša et al, 1971; Puric and Konjevic, 1972; Hadziomerspahic et al, 1973; Sanchez et al, 1973) the Be II Stark broadening parameters are important to astrophysicists since the surface content (abundance) of light elements, especially Li and Be, involves problems correlated with nucleogenesis, mixing between the atmosphera and the interior, stellar structure and evolution (Boesgaard, 1988). Moreover, Be II profiles are of importance for opacity calculations as well (Seaton, 1983).

The present paper concerns singly ionized beryllium: In order to provide reliable data for

Be II lines broadened by collisions with charged perturbers in stellar and laboratory plasmas, we have calculated electron-, proton-, and ionized helium-impact line widths and shifts for 30 Be II multiplets, using the semiclassical-perturbation formalism (Sahal-Bréchot, 1969ab). The obtained results for perturber density of 10^{15} cm^{-3}, together with discussion, analysis and comparison with existing experimental and theoretical data will be published in Dimitrijević and Sahal-Bréchot, 1992a). Since data are not linear with perturber density (N), due to the Debye screening effect, which is often important at high densities of interest for subphotospheric layers, Be II Stark broadening data tables for $N = 10^{16} - 10^{19}$ cm^{-3} together with the data for $N = 10^{13}$ cm^{-3} of special interest for stellar atmospheres, will be published in Dimitrijević and Sahal-Bréchot, 1992b. All details of the calculation procedure has been described in Dimitrijević, Sahal-Bréchot, Bommier (1991).

RESULTS AND DISCUSSION

In Tables I and II, the present results are compared with experimental data, (a-Sanchez et al, 1973; b-Hadziomerspahić et al, 1973; c-Platiša et al, 1971;) with other semiclassical (Jones et al, 1971, also in Griem, 1974), with quantum-mechanical strong-coupling (Sanchez et al, 1973; Seaton, 1983) and with semiempirical calculations (Dimitrijević and Konjević, 1981) . We see that the widths fall within the error bars of both methods. However, for the shifts disagreement is larger. It should be noted that the shifts values are of lesser accuracy for semiclassical calculations than the widths (Griem and Shen, 1962; Roberts, 1968; Dimitrijević et al, 1981)

TABLE I Comparison between the experimental Stark full widths at half maximum of Be II lines (W_m) (a-Sanchez et al, 1973; b-Hadžiomerspahić et al, 1973; c-Platiša et al, 1971;) within $2s^2S - 2p^2P^o$ multiplet, with different calculations. Semiclassical calculations: W_{DSB}-present results; W_{JBG} - Jones, Benett and Griem (1971); quantum-mechanical calculations: W_S - Seaton (1988); W_{SBJ} Sanchez, Blaha and Jones (1973); semiempirical calculations: W_{DK} - Dimitrijević and Konjević (1981). The electron density N is equal to 10^{17} cm^{-3}.

λ(A)	T(K)	Wm(A)	Wm/WDSB	Wm/WJBG	Wm/WS	Wm/WSBJ	Wm/ WMSE	Wm/WDK	Ref.
3130.4	19000	0.070	0.80	0.82	2.43	1.69	1.43	1.51	4
	34800	0.04	0.60	0.57	1.49	1.09	1.10	1.01	3
3131.1	19000	0.070	0.80	0.82	2.43	1.69	1.43	1.51	4
	34800	0.06	0.91	0.86	2.23	1.64	1.66	1.51	3

TABLE II As in Table 1 but for the shift (d).

λ(A)	T(K)	dm(A)	dm/dDSB	dm/dJBG	dm/dS	Ref.
3130.4	16800	-0.03	6.1	0.80	2.32	1
	34800	-0.04	10.0	1.41	4.09	3
3131.1	16800	-0.03	6.1	0.80	2.32	1
	34800	-0.03	7.5	1.03	3.07	3

Since the Be II 2s - 2p multiplet has the largest astrophysical importance within the Be II spectrum, the corresponding numerical data are provided in Table III.

TABLE III This table shows electron-, proton-, and ionized helium impact full half widths and shifts for Be II 2s-2p multiplet.

PERTURBER DENSITY = 0.1D+16(cm-3)							
PERTURBERS ARE		ELECTRONS		PROTONS		IONIZED HELIUM	
TRANSITION	T(K)	WIDTH(A)	SHIFT(A)	WIDTH(A)	SHIFT(A)	WIDTH(A)	SHIFT(A)
Be II 2S-2P	2500.	0.126E-02	-0.109E-03	0.374E-05	-0.348E-05	0.637E-05	-0.348E-05
3131.5 A	5000.	0.802E-03	-0.106E-03	0.998E-05	-0.713E-05	0.154E-04	-0.705E-05
C= 0.31E+19	10000.	0.576E-03	-0.472E-04	0.219E-04	-0.134E-04	0.293E-04	-0.127E-04
	20000.	0.444E-03	-0.499E-04	0.366E-04	-0.216E-04	0.433E-04	-0.191E-04
	30000.	0.405E-03	-0.402E-04	0.460E-04	-0.261E-04	0.508E-04	-0.232E-04
	50000.	0.384E-03	-0.477E-04	0.552E-04	-0.326E-04	0.571E-04	-0.275E-04

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