

ON THE STARK BROADENING OF Kr VIII LINES

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Abstract. Using a semiclassical approach, we have calculated electron-, proton-, and He III-impact line widths and shifts for 6 Kr VIII multiplets.

1. INTRODUCTION

Spectral line parameters even for trace elements become of increasing interest for astrophysics, due to the development of observations from the space. By using the Goddard High Resolution Spectrograph on Hubble Space Telescope, Cardelli *et al.* (1991) have, for the first time, begun detecting elements such as krypton. Stark broadening data for higher ionization stages, may be of interest for the investigation of subphotospheric layers (Seaton, 1987), as well as for the investigation of regularities and systematic trends along isoelectronic sequences. Griem and Moreno (1990) and Fill and Schöning (1994) pointed out the importance of such results for the development of soft x-ray lasers, where Stark broadening data are needed to calculate gain values, model radiation trapping and to consider photoresonant pumping schemes.

In order to provide Stark broadening data needed for the investigation and modeling of astrophysical and laboratory plasmas, we have calculated within the semiclassical-perturbation formalism (Sahal-Bréchet 1969ab, Dimitrijević and Sahal - Bréchet, 1984, Dimitrijević *et al.* 1991, Dimitrijević and Sahal - Bréchet, 1995) electron-, proton-, and He III-impact line widths and shifts for 6 Kr VIII multiplets.

2. RESULTS AND DISCUSSION

As the continuation of our project to provide to astrophysicists and plasma physicists the needed Stark-broadening parameters (see Dimitrijević 1996, Dimitrijević and Sahal-Bréchet 1995 and references therein), electron-, proton-, and He III-impact line widths and shifts have been calculated for Kr VIII. Energy levels for Kr VIII are taken from Sugar and Musgrove (1991). Our results for 6 Kr VIII multiplets, for perturber densities $10^{17} - 10^{22} \text{ cm}^{-3}$ and temperatures $T = 200,000 - 3,000,000 \text{ K}$ will be published in Dimitrijević and Sahal-Bréchet (1999a,b).

Table 1

This Table shows electron- and proton-impact broadening full half-widths (FWHM) and shifts for Kr VIII for a perturber density of 10^{17} cm^{-3} and temperatures from 200,000 up to 3,000,000 K. By deviding C with the full line width, we obtain an estimate for the maximum perturber density for which the line may be treated as isolated and tabulated data may be used.

PERTURBER DENSITY = 1.E+17cm-3					
PERTURBERS ARE:		ELECTRONS		PROTONS	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
Kr VIII4S 4P 665.7 A C=0.67E+20	200000.	0.991E-03	-0.143E-04	0.240E-04	-0.105E-04
	500000.	0.656E-03	-0.169E-04	0.516E-04	-0.219E-04
	1000000.	0.499E-03	-0.155E-04	0.731E-04	-0.315E-04
	1500000.	0.432E-03	-0.157E-04	0.808E-04	-0.376E-04
	2000000.	0.393E-03	-0.152E-04	0.866E-04	-0.405E-04
	3000000.	0.347E-03	-0.145E-04	0.939E-04	-0.451E-04
Kr VIII4S 5P 182.1 A C=0.20E+19	200000.	0.175E-03	0.751E-06	0.134E-04	0.320E-06
	500000.	0.121E-03	0.113E-05	0.201E-04	0.731E-06
	1000000.	0.956E-04	0.973E-06	0.228E-04	0.115E-05
	1500000.	0.848E-04	0.100E-05	0.243E-04	0.139E-05
	2000000.	0.785E-04	0.890E-06	0.254E-04	0.158E-05
	3000000.	0.709E-04	0.105E-05	0.265E-04	0.177E-05
Kr VIII5S 5P 1692.0 A C=0.17E+21	200000.	0.185E-01	-0.514E-03	0.121E-02	-0.584E-03
	500000.	0.131E-01	-0.623E-03	0.187E-02	-0.929E-03
	1000000.	0.105E-01	-0.578E-03	0.218E-02	-0.114E-02
	1500000.	0.941E-02	-0.546E-03	0.237E-02	-0.126E-02
	2000000.	0.873E-02	-0.550E-03	0.251E-02	-0.136E-02
	3000000.	0.789E-02	-0.474E-03	0.269E-02	-0.150E-02
Kr VIII4P 5S 294.2 A C=0.51E+19	200000.	0.302E-03	0.204E-04	0.112E-04	0.198E-04
	500000.	0.211E-03	0.252E-04	0.260E-04	0.309E-04
	1000000.	0.167E-03	0.231E-04	0.380E-04	0.378E-04
	1500000.	0.148E-03	0.222E-04	0.437E-04	0.419E-04
	2000000.	0.136E-03	0.219E-04	0.477E-04	0.449E-04
	3000000.	0.122E-03	0.199E-04	0.553E-04	0.497E-04
Kr VIII4P 6S 184.4 A C=0.10E+19	200000.	0.227E-03	0.327E-04	0.196E-04	0.295E-04
	500000.	0.166E-03	0.320E-04	0.373E-04	0.401E-04
	1000000.	0.136E-03	0.298E-04	0.479E-04	0.478E-04
	1500000.	0.121E-03	0.286E-04	0.550E-04	0.526E-04
	2000000.	0.112E-03	0.263E-04	0.612E-04	0.560E-04
	3000000.	0.101E-03	0.231E-04	0.666E-04	0.597E-04

Table 1 continued

PERTURBER DENSITY = 1.E+17cm-3					
PERTURBERS ARE:		ELECTRONS		PROTONS	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
Kr VIII5P 6S	200000.	0.467E-02	0.439E-03	0.359E-03	0.416E-03
697.9 A	500000.	0.341E-02	0.421E-03	0.602E-03	0.565E-03
C=0.14E+20	1000000.	0.279E-02	0.395E-03	0.746E-03	0.671E-03
	1500000.	0.250E-02	0.377E-03	0.851E-03	0.739E-03
	2000000.	0.233E-02	0.347E-03	0.932E-03	0.788E-03
	3000000.	0.210E-02	0.299E-03	0.101E-02	0.839E-03

As a part of our results, the Stark broadening widths (FWHM) and shifts due to electron and proton impacts, for a perturber density of 10^{17} cm^{-3} , are shown in Table 1. Parameter C (Dimitrijević and Sahal-Bréchet 1984), given also in Table 1, provides an estimate for the maximum perturber density for which the line may be treated as isolated when divided by the corresponding electron-impact full width at half maximum. For each value given in Table 1, the collision volume (V) multiplied by the perturber density (N) is much less than one and the impact approximation is valid (Sahal-Bréchet, 1969ab). Values for $NV > 0.5$ are not given and values for $0.1 < NV \leq 0.5$ are denoted by an asterisk.

The complete results will be published in Dimitrijević and Sahal-Bréchet (1999ab).

References

- Cardelli, J.A., Savage, B.D., Ebbets, D.C.: 1991, *Astrophys. J.*, **383**, L23.
 Dimitrijević, M.S.: 1996, *Zh. Prikl. Spektrosk.* **63**, 810.
 Dimitrijević, M.S., and Sahal-Bréchet, S.: 1984, *JQSRT* **31**, 301.
 Dimitrijević, M.S. and Sahal-Bréchet, S.: 1995, *Astron. Astrophys. Suppl. Series* **109**, 551.
 Dimitrijević, M.S. and Sahal-Bréchet, S.: 1999a, *Physica Scripta* submitted.
 Dimitrijević, M.S. and Sahal-Bréchet, S.: 1999b, *Serb. Astron. J.* **159**, in press.
 Dimitrijević, M.S., Sahal-Bréchet, S. and Bommier, V.: 1991, *Astron. Astrophys. Suppl. Series* **89**, 581.
 Fill, E.E., Schöning, T.: 1994, *J. Appl. Phys.* **76**, 1423.
 Griem, H.R., Moreno, J.C.: 1990, in: *X-Ray Lasers*, ed. G. Tallents, Institute of Physics, Bristol, 301.
 Sahal-Bréchet, S.: 1969a, *Astron. Astrophys.* **1**, 91.
 Sahal-Bréchet, S.: 1969b, *Astron. Astrophys.* **2**, 322.
 Seaton, M.J.: 1987, *J. Phys. B*, **20**, 6363.
 Sugar, J., Musgrove, A.: 1991, *J. Phys. Chem. Ref. Data*, **20**, 875.