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Preliminary report

STARK BROADENING PARAMETER TABLES FOR Kr VIII

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SUMMARY: Using a semiclassical approach, we have calculated electron−, proton−, and He III−impact line widths and shifts for 6 Kr VIII multiplets as a function of temperature and perturber density.

1. INTRODUCTION

With the development of space-borne spectroscopy, spectral line parameters even for trace elements become of increasing interest for astrophysics. 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. Recently, Popović and Dimitrijević (1998) calculated Stark widths for 37 Kr II lines from the 5s - 5p transition. 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.

In order to enlarge as much as possible the available set of reliable Stark broadening data needed for the investigation and modeling of astrophysical and laboratory plasmas, as well as plasmas in industry, we have calculated within the semiclassical-perturbation formalism (Sahal−Bréchot 1969ab, see also Sahal−Bréchot, 1974, Fleurier et al, 1977, Dimitrijević and Sahal−Bréchot, 1984,Dimitrijević et al. 1991, Dimitrijević and Sahal−Bréchot, 1995) electron-, proton-, and He III-impact line widths and shifts for 6 Kr VIII multiplets. The used formalism has been reviewed briefly in Dimitrijević and Sahal−Bréchot, 1995.

2. RESULTS AND DISCUSSION

All relevant details concerning the obtained results and the calculation procedure will be published in Dimitrijević and Sahal−Bréchot (1999). Here, we present only tables of Stark broadening parameters.

Atomic energy levels needed for calculations have been taken from Sugar and Musgrove (1991). Our results for 6 Kr VIII multiplets are shown in Table 1, for perturber densities $10^{18} - 10^{22}$ cm^{-3}. Data for perturber density of 10^{17} cm^{-3} will be published in Dimitrijević and Sahal−Bréchot (1999). Stark broadening parameters for densities lower than tabulated, are linear with perturber density. We also specify a parameter C (Dimitrijević and Sahal−Bréchot 1984), which gives an estimate for the maximum perturber density for which the line may be treated

Table 1. This table shows electron-, proton-, and He III-impact broadening parameters for Kr VIII for perturber densities of $10^{18} - 10^{22}$ cm^{-3} and temperatures from 200,000 up to 3,000,000 K. Stark broadening parameters for densities lower than tabulated, are linear with perturber density. Transitions and averaged wavelengths for the multiplet (in $\AA$) are also given in the table. By dividing C by the corresponding full width at half maximum (Dimitrijević et *al.*, 1991), we obtain an estimate for the maximum perturber density for which the line may be treated as isolated and tabulated data may be used. The asterisk identifies cases for which the collision volume multiplied by the perturber density (the condition for validity of the impact approximation) lies between 0.1 and 0.5.

PERTURBERS ARE:		ELECTRONS		PROTONS		He III	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
PERTURBER DENSITY = 1.E+18cm^{-3}							
Kr VIII 4S 4P	200000.	0.992E-02	-0.139E-03	0.240E-03	-0.104E-03	0.474E-03	-0.205E-03
665.7 Å	500000.	0.656E-02	-0.167E-03	0.516E-03	-0.219E-03	0.103E-02	-0.438E-03
C=0.67E+21	1000000.	0.499E-02	-0.155E-03	0.731E-03	-0.315E-03	0.146E-02	-0.632E-03
	1500000.	0.432E-02	-0.156E-03	0.808E-03	-0.376E-03	0.161E-02	-0.756E-03
	2000000.	0.393E-02	-0.152E-03	0.866E-03	-0.405E-03	0.173E-02	-0.814E-03
	3000000.	0.347E-02	-0.145E-03	0.939E-03	-0.451E-03	0.187E-02	-0.907E-03
Kr VIII 4S 5P	200000.	0.175E-02	0.759E-05	0.134E-03	0.318E-05	0.265E-03	0.625E-05
182.1 Å	500000.	0.121E-02	0.115E-04	0.201E-03	0.730E-05	0.401E-03	0.146E-04
C=0.20E+20	1000000.	0.956E-03	0.973E-05	0.228E-03	0.115E-04	0.455E-03	0.230E-04
	1500000.	0.848E-03	0.100E-04	0.243E-03	0.139E-04	0.486E-03	0.279E-04
	2000000.	0.785E-03	0.889E-05	0.254E-03	0.158E-04	0.507E-03	0.317E-04
	3000000.	0.709E-03	0.105E-04	0.265E-03	0.177E-04	0.528E-03	0.355E-04
Kr VIII 5S 5P	200000.	0.185	-0.509E-02	0.121E-01	-0.579E-02	0.240E-01	-0.114E-01
1692.0 Å	500000.	0.131	-0.623E-02	0.187E-01	-0.928E-02	0.373E-01	-0.186E-01
C=0.17E+22	1000000.	0.105	-0.577E-02	0.218E-01	-0.114E-01	0.435E-01	-0.229E-01
	1500000.	0.941E-01	-0.545E-02	0.237E-01	-0.126E-01	0.472E-01	-0.254E-01
	2000000.	0.873E-01	-0.549E-02	0.251E-01	-0.136E-01	0.499E-01	-0.275E-01
	3000000.	0.789E-01	-0.474E-02	0.269E-01	-0.150E-01	0.534E-01	-0.303E-01
Kr VIII 4P 5S	200000.	0.303E-02	0.202E-03	0.112E-03	0.196E-03	0.222E-03	0.384E-03
294.2 Å	500000.	0.211E-02	0.252E-03	0.260E-03	0.309E-03	0.519E-03	0.620E-03
C=0.51E+20	1000000.	0.167E-02	0.230E-03	0.380E-03	0.378E-03	0.761E-03	0.759E-03
	1500000.	0.148E-02	0.222E-03	0.437E-03	0.419E-03	0.876E-03	0.843E-03
	2000000.	0.136E-02	0.219E-03	0.477E-03	0.449E-03	0.956E-03	0.903E-03
	3000000.	0.122E-02	0.199E-03	0.553E-03	0.497E-03	0.109E-02	0.100E-02
Kr VIII 4P 6S	200000.	0.227E-02	0.319E-03	0.195E-03	0.292E-03	0.392E-03	0.568E-03
184.4 Å	500000.	0.166E-02	0.318E-03	0.373E-03	0.400E-03	0.748E-03	0.804E-03
C=0.10E+20	1000000.	0.136E-02	0.297E-03	0.479E-03	0.478E-03	0.956E-03	0.958E-03
	1500000.	0.121E-02	0.285E-03	0.550E-03	0.526E-03	0.110E-02	0.105E-02
	2000000.	0.112E-02	0.263E-03	0.612E-03	0.560E-03	0.121E-02	0.112E-02
	3000000.	0.101E-02	0.231E-03	0.666E-03	0.597E-03	0.131E-02	0.119E-02
Kr VIII 5P 6S	200000.	0.467E-01	0.427E-02	0.358E-02	0.410E-02	0.716E-02	0.799E-02
697.9 Å	500000.	0.341E-01	0.419E-02	0.602E-02	0.565E-02	0.121E-01	0.113E-01
C=0.14E+21	1000000.	0.279E-01	0.394E-02	0.746E-02	0.671E-02	0.150E-01	0.135E-01
	1500000.	0.250E-01	0.377E-02	0.851E-02	0.739E-02	0.171E-01	0.149E-01
	2000000.	0.233E-01	0.346E-02	0.932E-02	0.788E-02	0.184E-01	0.158E-01
	3000000.	0.210E-01	0.299E-02	0.101E-01	0.839E-02	0.198E-01	0.169E-01
PERTURBER DENSITY = 1.E+19cm^{-3}							
Kr VIII 4S 4P	200000.	0.992E-01	-0.141E-02	0.240E-02	-0.101E-02	0.472E-02	-0.191E-02
665.7 Å	500000.	0.656E-01	-0.164E-02	0.516E-02	-0.217E-02	0.103E-01	-0.432E-02
C=0.67E+22	1000000.	0.499E-01	-0.154E-02	0.731E-02	-0.315E-02	0.146E-01	-0.631E-02
	1500000.	0.432E-01	-0.157E-02	0.808E-02	-0.376E-02	0.161E-01	-0.755E-02
	2000000.	0.393E-01	-0.151E-02	0.866E-02	-0.405E-02	0.173E-01	-0.813E-02
	3000000.	0.347E-01	-0.145E-02	0.939E-02	-0.451E-02	0.187E-01	-0.907E-02
Kr VIII 4S 5P	200000.	0.175E-01	0.764E-04	0.133E-02	0.308E-04	0.263E-02	0.582E-04
182.1 Å	500000.	0.121E-01	0.111E-03	0.201E-02	0.726E-04	0.400E-02	0.144E-03
C=0.20E+21	1000000.	0.956E-02	0.970E-04	0.228E-02	0.115E-03	0.454E-02	0.230E-03
	1500000.	0.848E-02	0.996E-04	0.243E-02	0.139E-03	0.486E-02	0.279E-03
	2000000.	0.785E-02	0.889E-04	0.254E-02	0.158E-03	0.507E-02	0.317E-03
	3000000.	0.709E-02	0.105E-03	0.265E-02	0.177E-03	0.528E-02	0.355E-03

PERTURBERS ARE:		ELECTRONS		PROTONS		He III	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
Kr VIII 5S 5P	200000.	1.85	-0.481E-01	0.120	-0.556E-01	*0.238	-0.104
1692.0 Å	500000.	1.31	-0.604E-01	0.187	-0.918E-01	*0.372	-0.182
C=0.17E+23	1000000.	1.05	-0.571E-01	0.218	-0.114	0.435	-0.229
	1500000.	0.941	-0.543E-01	0.237	-0.126	0.472	-0.254
	2000000.	0.873	-0.548E-01	0.251	-0.136	0.499	-0.274
	3000000.	0.789	-0.473E-01	0.269	-0.150	0.534	-0.303
Kr VIII 4P 5S	200000.	0.303E-01	0.194E-02	0.112E-02	0.188E-02	0.222E-02	0.351E-02
294.2 Å	500000.	0.211E-01	0.244E-02	0.260E-02	0.306E-02	0.519E-02	0.606E-02
C=0.51E+21	1000000.	0.167E-01	0.228E-02	0.380E-02	0.377E-02	0.761E-02	0.757E-02
	1500000.	0.148E-01	0.221E-02	0.437E-02	0.418E-02	0.876E-02	0.841E-02
	2000000.	0.136E-01	0.219E-02	0.477E-02	0.449E-02	0.956E-02	0.901E-02
	3000000.	0.122E-01	0.199E-02	0.553E-02	0.497E-02	0.109E-01	0.100E-01
Kr VIII 4P 6S	200000.	0.227E-01	0.302E-02	0.196E-02	0.275E-02	*0.391E-02	*0.499E-02
184.4 Å	500000.	0.166E-01	0.304E-02	0.373E-02	0.393E-02	*0.748E-02	*0.775E-02
C=0.10E+21	1000000.	0.136E-01	0.293E-02	0.479E-02	0.477E-02	*0.956E-02	*0.954E-02
	1500000.	0.121E-01	0.285E-02	0.550E-02	0.524E-02	*0.110E-01	*0.105E-01
	2000000.	0.112E-01	0.262E-02	0.612E-02	0.560E-02	*0.121E-01	*0.112E-01
	3000000.	0.101E-01	0.230E-02	0.666E-02	0.597E-02	*0.131E-01	*0.119E-01
Kr VIII 5P 6S	200000.	0.467	0.403E-01	0.358E-01	0.388E-01	*0.712E-01	*0.703E-01
697.9 Å	500000.	0.341	0.399E-01	0.602E-01	0.554E-01	*0.121	*0.109
C=0.14E+22	1000000.	0.279	0.387E-01	0.746E-01	0.669E-01	*0.150	*0.134
	1500000.	0.250	0.376E-01	0.851E-01	0.737E-01	*0.171	*0.148
	2000000.	0.233	0.346E-01	0.932E-01	0.788E-01	*0.184	*0.158
	3000000.	0.210	0.298E-01	0.101	0.839E-01	*0.198	*0.169
PERTURBER DENSITY = 1.E+20cm^{-3}							
Kr VIII 4S 4P	200000.	0.992	-0.131E-01	0.237E-01	-0.901E-02	0.454E-01	-0.154E-01
665.7 Å	500000.	0.656	-0.159E-01	0.515E-01	-0.211E-01	0.102	-0.400E-01
C=0.67E+23	1000000.	0.499	-0.148E-01	0.731E-01	-0.312E-01	0.146	-0.618E-01
	1500000.	0.432	-0.152E-01	0.808E-01	-0.376E-01	0.161	-0.744E-01
	2000000.	0.393	-0.149E-01	0.866E-01	-0.404E-01	0.173	-0.811E-01
	3000000.	0.347	-0.144E-01	0.939E-01	-0.450E-01	0.187	-0.905E-01
Kr VIII 4S 5P	200000.	0.175	0.740E-03	*0.130E-01	*0.275E-03		
182.1 Å	500000.	0.121	0.113E-02	*0.200E-01	*0.705E-03		
C=0.20E+22	1000000.	0.956E-01	0.948E-03	0.227E-01	0.114E-02		
	1500000.	0.848E-01	0.988E-03	0.243E-01	0.139E-02		
	2000000.	0.785E-01	0.888E-03	0.254E-01	0.158E-02	*0.506E-01	*0.316E-02
	3000000.	0.709E-01	0.103E-02	0.265E-01	0.176E-02	*0.527E-01	*0.354E-02
Kr VIII 5S 5P	200000.	18.5	-0.400	*1.18	-0.484		
1692.0 Å	500000.	13.1	-0.554	*1.86	-0.872		
C=0.17E+24	1000000.	10.5	-0.533	2.18	-1.12		
	1500000.	9.41	-0.512	2.37	-1.26		
	2000000.	8.73	-0.532	2.51	-1.36		
	3000000.	7.89	-0.460	2.69	-1.50	*5.34	-3.01
Kr VIII 4P 5S	200000.	0.303	0.167E-01	0.111E-01	0.163E-01	*0.217E-01	*0.267E-01
294.2 Å	500000.	0.211	0.229E-01	0.260E-01	0.290E-01	*0.518E-01	*0.531E-01
C=0.51E+22	1000000.	0.167	0.215E-01	0.380E-01	0.369E-01	*0.760E-01	*0.726E-01
	1500000.	0.148	0.210E-01	0.437E-01	0.417E-01	*0.876E-01	*0.815E-01
	2000000.	0.136	0.213E-01	0.477E-01	0.448E-01	*0.956E-01	*0.897E-01
	3000000.	0.122	0.194E-01	0.554E-01	0.496E-01	*0.109	*0.995E-01
Kr VIII 4P 6S	200000.	0.227	0.245E-01	*0.195E-01	*0.224E-01		
184.4 Å	500000.	0.166	0.270E-01	*0.370E-01	*0.360E-01		
C=0.10E+22	1000000.	0.136	0.264E-01	*0.479E-01	*0.460E-01		
	1500000.	0.121	0.262E-01	*0.550E-01	*0.522E-01		
	2000000.	0.112	0.250E-01	*0.612E-01	*0.557E-01		
	3000000.	0.101	0.221E-01	*0.666E-01	*0.595E-01		
Kr VIII 5P 6S	200000.	4.67	0.323	*0.354	*0.315		
697.9 Å	500000.	3.41	0.351	*0.597	*0.507		
C=0.14E+23	1000000.	2.79	0.347	*0.746	*0.647		
	1500000.	2.50	0.343	*0.851	*0.734		
	2000000.	2.32	0.329	*0.932	*0.784		
	3000000.	2.10	0.285	*1.01	*0.835		

PERTURBERS ARE:		ELECTRONS		PROTONS		He III	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
PERTURBER DENSITY = 1.E+21cm^{-3}							
Kr VIII 4S 4P	200000.	9.92	-0.898E-01	0.212	-0.628E-01		
665.7 Å	500000.	6.56	-0.135	0.507	-0.188		
C=0.67E+24	1000000.	4.99	-0.131	0.729	-0.297		
	1500000.	4.32	-0.138	0.807	-0.367		
	2000000.	3.93	-0.136	0.865	-0.397		
	3000000.	3.47	-0.134	0.939	-0.449	*1.87	-0.880
Kr VIII 4S 5P	200000.	*1.74	*0.654E-02				
182.1 Å	500000.	1.21	0.108E-01				
C=0.20E+23	1000000.	0.956	0.926E-02				
	1500000.	0.848	0.950E-02				
	2000000.	0.785	0.854E-02				
	3000000.	0.709	0.102E-01	*0.265	*0.176E-01		
Kr VIII 4P 5S	200000.	*3.02	*0.690E-01	*0.105	*0.100		
294.2 Å	500000.	2.11	0.171	*0.257	*0.239		
C=0.51E+23	1000000.	1.67	0.175	*0.377	*0.334		
	1500000.	1.48	0.177	*0.437	*0.397		
	2000000.	1.36	0.182	*0.478	*0.430		
	3000000.	1.21	0.173	*0.553	*0.493		
Kr VIII 4P 6S	200000.	*2.20	*0.294E-01				
184.4 Å	500000.	1.63	0.147				
C=0.10E+23	1000000.	1.33	0.180				
	1500000.	1.19	0.190				
	2000000.	1.11	0.182				
	3000000.	0.994	0.173				
PERTURBER DENSITY = 1.E+22cm^{-3}							
Kr VIII 4S 5P	200000.						
182.1 Å	500000.						
C=0.20E+24	1000000.	*9.37	*0.670E-01				
	1500000.	*8.34	*0.694E-01				
	2000000.	*7.73	*0.676E-01				
	3000000.	7.00	0.864E-01				
Kr VIII 4P 5S	200000.						
294.2 Å	500000.						
C=0.51E+24	1000000.	*15.9	*0.493				
	1500000.	14.2	0.768				
	2000000.	13.1	0.944				
	3000000.	11.7	0.981				
Kr VIII 4P 6S	200000.						
184.4 Å	500000.						
C=0.10E+24	1000000.						
	1500000.	*9.74	*0.399				
	2000000.	*9.19	*0.510				
	3000000.	*8.42	0.594				

as isolated when it is divided by the corresponding 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−Bréchot, 1969ab). Values for NV $>$ 0.5 are not given and values for 0.1 $<$ NV $\leq$ 0.5 are denoted by an asterisk. Stark broadening parameters for densities lower than tabulated, are linear with perturber density. When the impact approximation is not valid, the ion broadening contribution may be estimated by using quasistatic approach (Sahal−Bréchot 1991 or Griem 1974). In the region between where neither of these two approximations is valid, a unified type theory should be used. For example in Barnard et al. (1974), a simple analytical formula for such a case is given. The accuracy of the results obtained decreases when broadening by ion interactions becomes important.

The discussion of obtained results will be published in Dimitrijević and Sahal−Bréchot (1999).

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ТАБЕЛЕ ПАРАМЕТАРА ШТАРКОВОГ ШИРЕЊА СПЕКТРАЛНИХ ЛИНИЈА Kr VIII

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