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ON THE STARK BROADENING OF Sc XI LINES

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Abstract. Using a semiclassical approach, we have calculated electron-, proton-, and doubly charged helium-impact line widths and shifts for 10 Sc XI multiplets, for perturber densities 10^{18}– 10^{22} cm^{-3} and temperatures T = 500,000 – 5,000,000 K.

1. INTRODUCTION

The various atomic data concerning scandium element, including Stark broadening parameters of its spectral lines for various ionization stages are of interest for astrophysical plasma research and modeling, since this element is present in stellar plasma. Stark broadening data for higher ionization stages are additionaly of interest for the modelling and theoretical considerations of subphotospheric layers (Seaton, 1997), as well as for investigations of systematic trends along isoelectronic sequences.

By using the semiclassical-perturbation formalism (Sahal-Bréchot 1969ab), we have calculated electron-, proton-, and He III-impact line widths and shifts for 10 scandium XI multiplets. A short review of the formalism is given e.g. in Dimitrijević *et al.* (1991) and Dimitrijević and Sahal - Bréchot (1996).

2. RESULTS AND DISCUSSION

Energy levels for scandium XI lines have been taken from Bashkin and Stoner (1978). All other details of calculations are given in Dimitrijević and Sahal-Bréchot (1998). Our results for electron-, proton-, and He III-impact line widths and shifts for 10 scandium XI multiplets, for perturber densities 10^{18}– 10^{22} cm^{-3} and temperatures T = 500,000 – 5,000,000 K, will be published elsewhere (Dimitrijević and Sahal-Bréchot, 1998). We present here, in Table 1, only data for perturber density of 10^{19} cm^{-3}. We also specify the parameter C (Dimitrijević and Sahal-Bréchot, 1984), which gives an estimate of the maximum perturber density for which the line may be treated as isolated when divided by the corresponding full width at half maximum.

Table 1

This Table shows electron- and proton-impact broadening full half- widths (FWHM) and shifts for Sc XI for a perturber density of 10^{19} cm^{-3} and temperatures from 500,000 up to 5,000,000 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+19cm-3

PERTURBERS ARE:		ELECTRONS		PROTONS	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
ScXI 3S-3P	500000.	0.247E-01	-0.340E-03	0.526E-03	-0.406E-03
510.9 A	750000.	0.205E-01	-0.413E-03	0.816E-03	-0.579E-03
C=0.51E+22	1000000.	0.181E-01	-0.439E-03	0.106E-02	-0.711E-03
	2000000.	0.136E-01	-0.413E-03	0.165E-02	-0.105E-02
	3000000.	0.116E-01	-0.400E-03	0.202E-02	-0.128E-02
	5000000.	0.966E-02	-0.389E-03	0.237E-02	-0.147E-02
ScXI 3S-4P	500000.	0.215E-02	0.174E-04	0.150E-03	0.216E-04
95.0 A	750000.	0.181E-02	0.205E-04	0.185E-03	0.299E-04
C=0.68E+20	1000000.	0.161E-02	0.173E-04	0.215E-03	0.367E-04
	2000000.	0.125E-02	0.176E-04	0.259E-03	0.523E-04
	3000000.	0.109E-02	0.166E-04	0.282E-03	0.617E-04
	5000000.	0.930E-03	0.156E-04	0.315E-03	0.707E-04
ScXI 4S-4P	500000.	0.511	-0.142E-01	0.321E-01	-0.207E-01
1327.8 A	750000.	0.435	-0.137E-01	0.404E-01	-0.256E-01
C=0.13E+23	1000000.	0.390	-0.133E-01	0.475E-01	-0.296E-01
	2000000.	0.306	-0.129E-01	0.601E-01	-0.374E-01
	3000000.	0.268	-0.126E-01	0.674E-01	-0.419E-01
	5000000.	0.230	-0.107E-01	0.790E-01	-0.476E-01
ScXI 3P-4S	500000.	0.240E-02	0.184E-03	0.130E-03	0.236E-03
127.9 A	750000.	0.204E-02	0.190E-03	0.192E-03	0.288E-03
C=0.12E+21	1000000.	0.183E-02	0.182E-03	0.246E-03	0.332E-03
	2000000.	0.142E-02	0.177E-03	0.391E-03	0.415E-03
	3000000.	0.124E-02	0.172E-03	0.470E-03	0.461E-03
	5000000.	0.105E-02	0.152E-03	0.575E-03	0.523E-03
ScXI 3P-3D	500000.	0.146E-01	-0.714E-04	0.477E-03	-0.729E-04
378.7 A	750000.	0.121E-01	-0.609E-04	0.692E-03	-0.108E-03
C=0.28E+22	1000000.	0.107E-01	-0.870E-04	0.861E-03	-0.140E-03
	2000000.	0.795E-02	-0.831E-04	0.123E-02	-0.233E-03
	3000000.	0.679E-02	-0.750E-04	0.140E-02	-0.283E-03
	5000000.	0.566E-02	-0.726E-04	0.155E-02	-0.361E-03

Table 1 continued

PERTURBER DENSITY = 1.E+19cm-3

PERTURBERS ARE:		ELECTRONS		PROTONS	
TRANSITION	T(K)	WIDTH(Å)	SHIFT(Å)	WIDTH(Å)	SHIFT(Å)
ScXI 3P-4D	500000.	0.261E-02	0.374E-04	0.186E-03	0.116E-03
104.9 A	750000.	0.220E-02	0.315E-04	0.234E-03	0.145E-03
C=0.37E+20	1000000.	0.196E-02	0.333E-04	0.279E-03	0.167E-03
	2000000.	0.152E-02	0.345E-04	0.365E-03	0.214E-03
	3000000.	0.133E-02	0.282E-04	0.419E-03	0.239E-03
	5000000.	0.113E-02	0.224E-04	0.498E-03	0.272E-03
ScXI 3P-5D	500000.	0.335E-02	0.867E-04	0.430E-03	0.319E-03
78.8 A	750000.	0.288E-02	0.935E-04	0.521E-03	0.379E-03
C=0.11E+20	1000000.	0.260E-02	0.941E-04	0.574E-03	0.406E-03
	2000000.	0.207E-02	0.787E-04	0.720E-03	0.489E-03
	3000000.	0.183E-02	0.668E-04	0.830E-03	0.541E-03
	5000000.	0.159E-02	0.574E-04	0.968E-03	0.603E-03
ScXI 4P-4D	500000.	0.364	0.190E-03	0.296E-01	0.813E-02
1042.3 A	750000.	0.310	-0.108E-02	0.367E-01	0.106E-01
C=0.37E+22	1000000.	0.278	-0.620E-03	0.415E-01	0.121E-01
	2000000.	0.218	-0.432E-03	0.495E-01	0.162E-01
	3000000.	0.192	-0.880E-03	0.550E-01	0.181E-01
	5000000.	0.165	-0.129E-02	0.636E-01	0.205E-01
ScXI 4P-5D	500000.	0.361E-01	0.633E-03	0.445E-02	0.293E-02
242.7 A	750000.	0.311E-01	0.660E-03	0.525E-02	0.349E-02
C=0.10E+21	1000000.	0.281E-01	0.681E-03	0.577E-02	0.373E-02
	2000000.	0.225E-01	0.539E-03	0.717E-02	0.449E-02
	3000000.	0.200E-01	0.435E-03	0.818E-02	0.498E-02
	5000000.	0.174E-01	0.355E-03	0.946E-02	0.549E-02
ScXI 3D-4P	500000.	0.672E-02	0.106E-03	0.512E-03	0.120E-03
168.6 A	750000.	0.566E-02	0.122E-03	0.631E-03	0.162E-03
C=0.21E+21	1000000.	0.504E-02	0.120E-03	0.731E-03	0.192E-03
	2000000.	0.389E-02	0.117E-03	0.875E-03	0.264E-03
	3000000.	0.340E-02	0.111E-03	0.954E-03	0.297E-03
	5000000.	0.291E-02	0.106E-03	0.106E-02	0.341E-03

There is no experimental data or results of other calculations, concerning scandium XI Stark broadening parameters. We hope that presented data will be of interest for astrophysical and laboratory plasma research, as well as for the theoretical considerations of systematic trends along isoelectronic sequences. The corresponding experimental data will be of interest for checking and rafinement of the Stark broadening theory for multicharged ion lines.

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