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ON THE STARK BROADENING OF Ti 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 4 Ti XI multiplets, for perturber densities 10^{18}– 10^{22} cm^{-3} and temperatures T = 500,000 – 5,000,000 K.

1. INTRODUCTION

Stark broadening of spectral lines for titanium ion in various ionisation stages is of interest for the investigation and modeling of stellar plasma, since this element is present in stars. E.G. Rogerson and Ewell (1985) have found 7 Ti IV lines in the τ Sco spectrum. Stark broadening parameters for 10 Titanium IV multiplets, have been calculated within the semiclassical perturbation approach by Dimitrijević and Sahal - Bréchot (1992). Such data for higher ionization stages are of interest for the consideration of subphotospheric layers (Seaton, 1987), as well as e.g. for fusion plasma research and for investigations of systematic trends along isoelectronic sequences. Conjointly with Ti IV Stark broadening parameters, Dimitrijević and Sahal - Bréchot (1992) have determined also Stark broadening parameters for 10 scandium III multiplets, belonging to the same isoelectronic sequence. Moreover, Stark broadening parameters for 27 titanium XII multiplets have been determined recently (Dimitrijević and Sahal - Bréchot (1998ab)).

By using the semiclassical-perturbation formalism (Sahal-Bréchot 1969ab), we have calculated electron-, proton-, and He III-impact line widths and shifts for 4 titanium XI multiplets. The used semiclassical perturbation formalism has been discussed and reviewed e.g. in Dimitrijević *et al.* (1991) and Dimitrijević and Sahal - Bréchot (1996).

2. RESULTS AND DISCUSSION

Energy levels for titanium XI lines have been taken from Wiese and Musgrove (1989). All other details of calculations are given in Dimitrijević and Sahal-Bréchot (1998a).

Table 1

This Table shows electron- and proton-impact broadening full half-widths (FWHM) and shifts for Ti 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 linewidth we obtain an estimate of 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)
Ti XI3S 3P	500000.	0.129E-01	-0.142E-03	0.258E-03	-0.140E-03
386.1 A	750000.	0.107E-01	-0.155E-03	0.401E-03	-0.204E-03
C=0.39E+22	1000000.	0.943E-02	-0.179E-03	0.518E-03	-0.258E-03
	2000000.	0.704E-02	-0.174E-03	0.802E-03	-0.400E-03
	3000000.	0.601E-02	-0.171E-03	0.986E-03	-0.486E-03
	5000000.	0.500E-02	-0.162E-03	0.113E-02	-0.589E-03
Ti XI3P 4S	500000.	0.213E-02	0.161E-03	0.113E-03	0.211E-03
123.9 A	750000.	0.181E-02	0.165E-03	0.171E-03	0.258E-03
C=0.11E+21	1000000.	0.162E-02	0.159E-03	0.218E-03	0.297E-03
	2000000.	0.126E-02	0.154E-03	0.352E-03	0.373E-03
	3000000.	0.110E-02	0.149E-03	0.423E-03	0.416E-03
	5000000.	0.932E-03	0.131E-03	0.515E-03	0.473E-03
Ti XI3P 5S	500000.	0.177E-02	0.245E-03	0.245E-03	0.352E-03
81.1 A	750000.	0.153E-02	0.243E-03	0.351E-03	0.417E-03
C=0.25E+20	1000000.	0.139E-02	0.239E-03	0.405E-03	0.447E-03
	2000000.	0.111E-02	0.230E-03	0.541E-03	0.540E-03
	3000000.	0.985E-03	0.208E-03	0.633E-03	0.600E-03
	5000000.	0.843E-03	0.177E-03	0.776E-03	0.667E-03
Ti XI3P 3D	500000.	0.104E-01	-0.560E-04	0.325E-03	-0.509E-04
327.2 A	750000.	0.858E-02	-0.450E-04	0.476E-03	-0.757E-04
C=0.28E+22	1000000.	0.753E-02	-0.568E-04	0.595E-03	-0.978E-04
	2000000.	0.560E-02	-0.614E-04	0.859E-03	-0.164E-03
	3000000.	0.478E-02	-0.531E-04	0.985E-03	-0.200E-03
	5000000.	0.398E-02	-0.532E-04	0.109E-02	-0.256E-03

Our results for electron-, proton-, and He III-impact line widths and shifts for 4 titanium 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 will show here in Table 1, data for perturber density of 10^{19} cm^{-3}, while the complete results will be published in Dimitrijević and Sahal-Bréchot (1998ab). We also specify the parameter C (Dimitrijević and S.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.

The results shown here are the first Stark broadening data concerning titanium XI spectral lines. Such data are of interest for astrophysical and laboratory plasma research, as well as for the theoretical considerations of systematic trends along isoelectronic sequences and development and rafinement of the Stark broadening theory for multiply charged ion lines. Such data are of interest also for fusion plasma research and for the consideration of laser produced plasmas. Experimental Stark broadening data for titanium XI spectral lines will be of course very interesting also for the above mentioned topics as well as for the further checking of the semiclassical perturbation method.

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