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Preliminary report

STARK BROADENING PARAMETER TABLES FOR Xe II, Sc II, Y II and Zr II

L. Č. Popović and M. S. Dimitrijević

Astronomical Observatory, Volgina 7, 11000 Belgrade, Yugoslavia

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SUMMARY: Using the modified semiempirical approach, we have calculated Stark broadening parameters for 20 spectral lines of Xe II, 6 Sc II, 6 Y II and 6 Zr II as a function of temperature, for an electron density of 10^{23} m^{-3}.

1. INTRODUCTION

The spectral lines of heavy elements are present in Solar and stellar spectra. For example lines of Xe II have been observed by Aller (1970), Heacox (1979), Dobrichev *et al.* (1990) etc., and lines of Sc II, Y II and Zr II by Adelman *et al.* (1979), Redfors and Cowley (1993), Kupka *et al.* (1994) etc. in spectra of hot stars (as, e.g., in ϕ Her spectrum, Adelman and Lanz 1987), where Stark broadening mechanism is main pressure broadening mechanism. It was shown in Popović and Dimitrijević (1996a) that conditions exist in stellar plasma where Stark width is comparable and even up to one order of magnitude larger than the thermal Doppler width and where Stark broadening may be the principal broadening mechanism influencing line shape formation. In order to provide to astrophysicist the needed Stark broadening data, we have calculated by using the modified semiempirical approach (Dimitrijević and Konjević 1980, Dimitrijević and Kršljanin 1986, for the case of complex heavy ions see also Popović and Dimitrijević 1986b), electron-impact line widths and shifts for 20 Xe II, 6 Sc II, 6 Y II and 6 Zr II lines of for a perturber density of 10^{23} m^{-3} (Popović and Dimitrijević 1996a,c).

2. RESULTS AND DISCUSSION

The analysis of obtained results, details of calculations and the comparison with other theoretical experimental data have been published in Popović and Dimitrijević (1996a,c).

Here, we present only tables of Stark broadening parameters for astrophysical and laboratory plasma diagnostic purposes. These Tables in electronic form can be accessed by ftp at

cdsarc.u-strasb.fr
or on www at
http://cdsweb.u-strasbg.fr/abstract.html,

where they are related to Popović and Dimitrijević 1996a for Sc II, Y II and Zr II, 1996c for Xe II.

Our results for 20 Xe II, 6 Sc II, 6 Y II and 6 Zr II lines/multiplets for a perturber density 10^{23} m^{-3} (Popović and Dimitrijević 1996a,c) are presented in Tables 1 – 4.

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Table 1. Stark full widths (FWHM) and shifts of Xe II multiplets for tempertures 5000 up to 50,000 K. The electron density is $10^{23}m^{-3}$. The averaged wavelength of the multiplet is denoted by $\overline{\lambda}$.

Transition	T (K)	W (nm)	d (nm)
$({}^3P_2)5d[4]-({}^3P_2)6p[3]$	5000.	.134	-.119E-01
	10000.	.922E-01	-.846E-02
	20000.	.640E-01	-.606E-02
	30000.	.532E-01	-.500E-02
$\overline{\lambda} = 753.5$ nm	40000.	.483E-01	-.445E-02
	50000.	.461E-01	-.404E-02
$({}^3P_2)5d[4]-({}^3P_2)5f[5]$	5000.	.559E-01	.329E-01
	10000.	.508E-01	.304E-01
	20000.	.499E-01	.287E-01
	30000.	.510E-01	.272E-01
$\overline{\lambda} = 200.8$ nm	40000.	.502E-01	.252E-01
	50000.	.474E-01	.231E-01
$({}^3P_2)6s[2]-({}^3P_2)6p[1]$	5000.	.564E-01	-.171E-01
	10000.	.390E-01	-.123E-01
	20000.	.272E-01	-.904E-02
	30000.	.227E-01	-.765E-02
$\overline{\lambda} = 457.0$ nm	40000.	.207E-01	-.705E-01
	50000.	.198E-01	-.665E-01
$({}^3P_2)6s[2]-({}^3P_2)6p[2]$	5000.	.810E-01	-.286E-01
	10000.	.561E-01	-.207E-01
	20000.	.391E-01	-.154E-01
	30000.	.326E-01	-.132E-01
$\overline{\lambda} = 552.7$ nm	40000.	.296E-01	-.124E-01
	50000.	.283E-01	-.120E-01
$({}^3P_2)6s[2]-({}^3P_2)6p[3]$	5000.	.728E-01	-.214E-01
	10000.	.504E-01	-.155E-01
	20000.	.351E-01	-.114E-01
	30000.	.293E-01	-.981E-02
$\overline{\lambda} = 506.2$ nm	40000.	.266E-01	-.915E-01
	50000.	.254E-01	-.879E-01
$({}^3P_2)6p[1]-({}^3P_2)6d[1]$	5000.	.110	.296E-01
	10000.	.961E-01	.311E-01
	20000.	.860E-01	.298E-01
	30000.	.818E-01	.278E-01
$\overline{\lambda} = 437.3$ nm	40000.	.802E-01	.261E-01
	50000.	.739E-01	.241E-01
$({}^3P_2)6p[1]-({}^3P_2)6d[2]$	5000.	.115	.201E-01
	10000.	.851E-01	.184E-01
	20000.	.704E-01	.210E-01
	30000.	.677E-01	.232E-01
$\overline{\lambda} = 503.4$ nm	40000.	.664E-01	.231E-01
	50000.	.657E-01	.225E-01

Table 1, continued

Transition	T (K)	*w* (nm)	*d* (nm)
$({}^3P_2)6p[2]-({}^3P_2)6d[1]$	5000.	.806E-01	.234E-01
	10000.	.703E-01	.241E-01
	20000.	.630E-01	.229E-01
	30000.	.599E-01	.214E-01
$\overline{\lambda} = 375.2$ nm	40000.	.588E-01	.202E-01
	50000.	.541E-01	.188E-01
$({}^3P_2)6p[2]-({}^3P_2)6d[2]$	5000.	.807E-01	.163E-01
	10000.	.595E-01	.145E-01
	20000.	.493E-01	.161E-01
	30000.	.474E-01	.175E-01
$\overline{\lambda} = 422.8$ nm	40000.	.465E-01	.175E-01
	50000.	.460E-01	.172E-01
$({}^3P_2)6p[2]-({}^3P_2)6d[3]$	5000.	.783E-01	.193E-01
	10000.	.635E-01	.199E-01
	20000.	.576E-01	.208E-01
	30000.	.540E-01	.203E-01
$\overline{\lambda} = 398.6$ nm	40000.	.527E-01	.194E-01
	50000.	.524E-01	.185E-01
$({}^3P_2)6p[3]-({}^3P_2)6d[2]$	5000.	.973E-01	.168E-01
	10000.	.716E-01	.153E-01
	20000.	.589E-01	.175E-01
	30000.	.564E-01	.192E-01
$\overline{\lambda} = 454.8$ nm	40000.	.552E-01	.192E-01
	50000.	.545E-01	.189E-01
$({}^3P_2)6p[3]-({}^3P_2)6d[3]$	5000.	.932E-01	.204E-01
	10000.	.752E-01	.215E-01
	20000.	.677E-01	.229E-01
	30000.	.633E-01	.223E-01
$\overline{\lambda} = 426.9$ nm	40000.	.617E-01	.213E-01
	50000.	.613E-01	.204E-01
$({}^3P_2)6p[3]-({}^3P_2)6d[4]$	5000.	.936E-01	.174E-01
	10000.	.701E-01	.165E-01
	20000.	.591E-01	.186E-01
	30000.	.569E-01	.200E-01
$\overline{\lambda} = 440.4$ nm	40000.	.553E-01	.197E-01
	50000.	.546E-01	.192E-01
$({}^3P_1)6s[1]-({}^3P_1)6p[0]$	5000.	.103	-.363E-01
	10000.	.713E-01	-.262E-01
	20000.	.501E-01	-.192E-01
	30000.	.425E-01	-.164E-01
$\overline{\lambda} = 587.8$ nm	40000.	.395E-01	-.147E-01
	50000.	.382E-01	-.140E-01
$({}^3P_1)6s[1]-({}^3P_1)6p[1]$	5000.	.742E-01	-.243E-01
	10000.	.513E-01	-.174E-01
	20000.	.362E-01	-.126E-01
	30000.	.308E-01	-.105E-01
$\overline{\lambda} = 494.7$ nm	40000.	.286E-01	-.939E-02
	50000.	.277E-01	-.839E-02

Table 1, continued

Transition	T (K)	w (nm)	d (nm)
$(^3P_1)6s[1] - (^3P_1)6p[2]$ $\overline{\lambda} = 526.3$ nm	5000.	.906E-01	-.316E-01
	10000.	.627E-01	-.227E-01
	20000.	.441E-01	-.166E-01
	30000.	.374E-01	-.141E-01
	40000.	.347E-01	-.129E-01
	50000.	.335E-01	-.118E-01
$(^3P_0)6s[0] - (^3P_0)6p[1]$ $\overline{\lambda} = 498.3$ nm	5000.	.781E-01	-.288E-01
	10000.	.540E-01	-.207E-01
	20000.	.379E-01	-.152E-01
	30000.	.319E-01	-.128E-01
	40000.	.294E-01	-.117E-01
	50000.	.282E-01	-.108E-01
$(^1D_2)6s[2] - (^1D_2)6p[1]$ $\overline{\lambda} = 505.4$ nm	5000.	.806E-01	-.186E-01
	10000.	.563E-01	-.133E-01
	20000.	.402E-01	-.930E-02
	30000.	.341E-01	-.761E-02
	40000.	.313E-01	-.695E-02
	50000.	.298E-01	-.662E-02
$(^1D_2)6s[2] - (^1D_2)6p[2]$ $\overline{\lambda} = 472.0$ nm	5000.	.633E-01	-.154E-01
	10000.	.439E-01	-.111E-01
	20000.	.307E-01	-.810E-02
	30000.	.256E-01	-.683E-02
	40000.	.232E-01	-.628E-02
	50000.	.221E-01	-.588E-02
$(^1D_2)6s[2] - (^1D_2)6p[3]$ $\overline{\lambda} = 536.4$ nm	5000.	.855E-01	-.225E-01
	10000.	.593E-01	-.163E-01
	20000.	.414E-01	-.120E-01
	30000.	.344E-01	-.103E-01
	40000.	.312E-01	-.967E-02
	50000.	.296E-01	-.933E-02

Table 2. Same as in Table 1, but for Sc II multiplets.

Transition	T (K)	W (nm)
Sc II $a^3D - z^3F^0$ $\overline{\lambda} = 362.8$ nm	5000.	.222E-01
	10000.	.155E-01
	20000.	.107E-01
	30000.	.869E-02
	40000.	.759E-02
	50000.	.694E-02
Sc II $a^3D - z^3D^0$ $\overline{\lambda} = 357.6$ nm	5000.	.215E-01
	10000.	.149E-01
	20000.	.103E-01
	30000.	.840E-02
	40000.	.734E-02
	50000.	.671E-02
Sc II $a^3D - z^3P^0$ $\overline{\lambda} = 336.9$	5000.	.195E-01
	10000.	.135E-01
	20000.	.936E-02
	30000.	.761E-02
	40000.	.665E-02
	50000.	.609E-02
Sc II $a^1D_2 - z^1D_2^0$ $\lambda = 424.7$ nm	5000.	.322E-01
	10000.	.224E-01
	20000.	.155E-01
	30000.	.126E-01
	40000.	.111E-01
	50000.	.102E-01
Sc II $a^1D_2 - z^1P_1^0$ $\lambda = 353.6$ nm	5000.	.233E-01
	10000.	.162E-01
	20000.	.112E-01
	30000.	.911E-02
	40000.	.799E-02
	50000.	.733E-02
Sc II $a^1D_2 - z^1F_3^0$ $\lambda = 335.4$ nm	5000.	.216E-01
	10000.	.150E-01
	20000.	.104E-01
	30000.	.846E-02
	40000.	.743E-02
	50000.	.682E-02

Table 3. Same as in Table 1, but for Y II multiplets.

Transition	T (K)	W (nm)
Y II $a^3D - z^3F^0$ $\bar{\lambda}$ = 375.4 nm	5000.	.254E-01
	10000.	.177E-01
	20000.	.122E-01
	30000.	.996E-02
	40000.	.873E-02
	50000.	.801E-02
Y II $a^3D - z^3D^0$ $\bar{\lambda}$ = 360.5 nm	5000.	.245E-01
	10000.	.170E-01
	20000.	.118E-01
	30000.	.961E-02
	40000.	.843E-02
	50000.	.774E-02
Y II $a^3D - z^3P^0$ $\bar{\lambda}$ = 322.4 nm	5000.	.200E-01
	10000.	.139E-01
	20000.	.962E-02
	30000.	.785E-02
	40000.	.691E-02
	50000.	.637E-02
Y II $a^1D_2 - z^1D_2^0$ λ = 437.5 nm	5000.	.315E-01
	10000.	.218E-01
	20000.	.151E-01
	30000.	.123E-01
	40000.	.108E-01
	50000.	.998E-02
Y II $a^1D_2 - z^1P_1^0$ λ = 412.5 nm	5000.	.300E-01
	10000.	.208E-01
	20000.	.144E-01
	30000.	.118E-01
	40000.	.103E-01
	50000.	.952E-02
Y II $a^1D_2 - z^1F_3^0$ λ = 332.8 nm	5000.	.213E-01
	10000.	.148E-01
	20000.	.103E-01
	30000.	.841E-02
	40000.	.742E-02
	50000.	.687E-02

Table 4. Same as in Table 1, but for Zr II multiplets.

Transition	T (K)	W (nm)
Zr II $a^2F - z^2F^0$ $\bar{\lambda}$ = 417.5 nm	5000.	.274E-01
	10000.	.191E-01
	20000.	.132E-01
	30000.	.107E-01
	40000.	.940E-02
	50000.	.861E-02
Zr II $a^3F - z^3D^0$ $\bar{\lambda}$ = 404.7 nm	5000.	.260E-01
	10000.	.181E-01
	20000.	.125E-01
	30000.	.102E-01
	40000.	.890E-02
	50000.	.815E-02
Zr II $a^2F - z^2G^0$ $\bar{\lambda}$ = 347.6 nm	5000.	.196E-01
	10000.	.136E-01
	20000.	.942E-02
	30000.	.766E-02
	40000.	.670E-02
	50000.	.612E-02
Zr II $a^4F - z^4F^0$ $\bar{\lambda}$ = 329.4 nm	5000.	.153E-01
	10000.	.106E-01
	20000.	.734E-02
	30000.	.595E-02
	40000.	.517E-02
	50000.	.470E-02
Zr II $a^4F - z^4G^0$ $\bar{\lambda}$ = 346.2 nm	5000.	.158E-01
	10000.	.110E-01
	20000.	.761E-02
	30000.	.616E-02
	40000.	.536E-02
	50000.	.487E-02
Zr II $a^4F - z^4D^0$ $\bar{\lambda}$ = 314.1 nm	5000.	.142E-01
	10000.	.986E-02
	20000.	.682E-02
	30000.	.553E-02
	40000.	.481E-02
	50000.	.437E-02

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ТАБЕЛЕ ПАРАМЕТАРА ШТАРКОВОГ ШИРЕЊА СПЕКТРАЛНИХ ЛИНИЈА Xe II, Sc II, Y II и Zr II

Л. Ч. Поповић и М. С. Димитријевић

Астрономска опсерваторија, Волгина 7, 11000 Београд, Југославија

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Претходно саопштење

Користећи семиемпиријску апроксимацију, израчунате су ширине и помераји спектралних линија, проузроковани сударима са електронима за 20 спектралних линија Xe II, 6 Sc II, 6 Y II и 6 Zr II. Резултати су дати у функцији температуре за електронску концентрацију од 10^{23} m^{-3}.