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STARK-B DATABASE VIRTUAL ATOMIC AND MOLECULAR DATA CENTER (VAMDC) AND DATA FOR WHITE DWARF ATMOSPHERES ANALYSIS

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Abstract. In a number of papers we have demonstrated the importance of Stark broadening mechanism for the modeling and synthesizing of lines observed in spectra of white dwarf atmospheres. We also determined a number of Stark broadening parameters of interest in particular for DB and DO white dwarf plasmas investigations. Now, work on their inclusion in STARK-B database and in Virtual Atomic and Molecular Data Center, an FP7 european project, as well as in Serbian Virtual Observatory is in progress. We review here the part of this work of interest for white dwarf atmospheres analysis.

1. INTRODUCTION

Virtual Atomic and Molecular Data Center (VAMDC) aims at building an interoperable e-Infrastructure for the exchange of atomic and molecular data. In a number of papers we have demonstrated the importance of Stark broadening mechanism for the modelling and synthesizing of lines observed in spectra of white dwarf atmospheres. We determined Stark broadening parameters for trace element: Te I, Cr II, Mn II, Au II, Cu III, Zn III, Se III, In III and Sn III of interest particularly for DB and DO white dwarf plasmas investigations. Now, work on their inclusion in STARK-B database and in Virtual Atomic and Molecular Data Center, an FP7 european project, as well as in Serbian Virtual Observatory is in progress.

As an example of this work, we will show here Stark broadening parameters for two Mn II lines and their relevance for white dwarf spectra analysis and synthesis.

2. RESULTS AND DISCUSSIONS

Calculations have been performed within the semiclassical perturbation formalism, developed and discussed in detail in Sahal-Breéchot 1969a,b. This formalism, as well as the corresponding computer code, have been optimized and updated several times (Sahal-Breéchot 1974, Dimitrijević and Sahal-Bréchot 1984, Dimitrijević et al. 1991).

Using the semiclassical perturbation method we obtained Stark widths and shifts for six Mn II lines (Popović et al. 2008) for perturber density of $10^{17}cm^{-3}$ and temperatures from 5000 to 100000 K. Here, as an example we will show data for two of them 2594.5 and 2950.1 Å. The needed atomic energy levels were taken from Bashkin and Stoner 1982. The oscillator strengths required were calculated using the Coulomb approximation method described by Bates and Damgaard 1949 and the tables of Oertel and Shomo 1968. For higher levels, the method described by van Regemorter et al. 1979 was applied. As an example of obtained results, Stark widths and shifts for these lines are given in Table 1.

Table 1: Electron-impact broadening parameters (full width at half maximum W and shift d) for Mn II (Popović et al. 2008) for perturber density of 10^{17}cm^{-3} and temperatures from 5000 to 100000 K.

Transition	T(K)	W(Å)	d(Å)
	5000	0.128	0.236E-03
	10000	0.948E-01	-0.996E-03
a ^{7}S - z ^{7}P^o	20000	0.702E-01	-0.116E-02
2594.5Å	30000	0.598E-01	-0.956E-03
	50000	0.507E-01	-0.128E-02
	100000	0.435E-01	-0.118E-02
	5000	0.226	-0.394E-01
	10000	0.165	-0.302E-01
a ^{5}S - z ^{5}P^o	20000	0.121	-0.234E-01
2950.1Å	30000	0.102	-0.193E-01
	50000	0.884E-01	-0.168E-01
	100000	0.800E-01	-0.137E-01

In order to investigate the importance of Stark broadening mechanism in DA and DB white dwarf atmospheres the atmospheric models of Wickramasinghe 1972, with T_{eff} = 15000-25000 K and log g=8, are used. Here, g is the gravitational acceleration on the stellar surface and log g=8 means that $g = 10^8$ m/s. Calculated thermal Doppler and Stark widths as a function of optical depth, for Mn II a ^{5}S - z ^{5}P^o (2950.1 Å), are compared in Figs. 1 and 2. for DA and DB white dwarfs plasma conditions. As in Wickramasinghe 1972, optical depth points at the standard wavelength 5150 Å are used. As one can see, for DB white dwarf atmospheres the Stark broadening mechanism is more important than for the DA white dwarf atmospheres, especially for atmospheric layers with the optical depth larger or approximatively equal to 0.1, where the Stark width is up to one or two orders of magnitude larger than the thermal Doppler width.

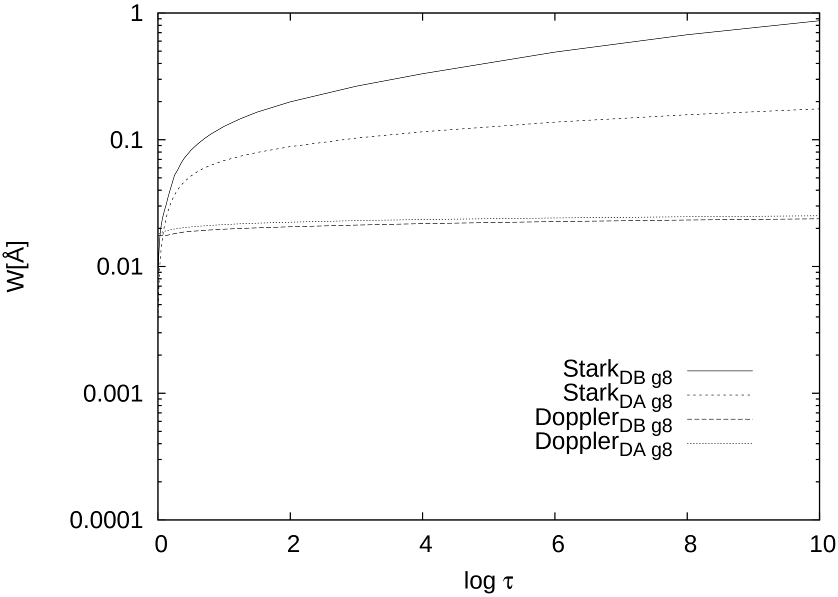

Figure 1. Thermal Doppler and Stark widths for Mn II spectral line a ^{5}S - z ^{5}P^o (2950.1Å) as a function of optical depth for DA and DB white dwarf models with T$_{eff}$=15000 K and log g=8.

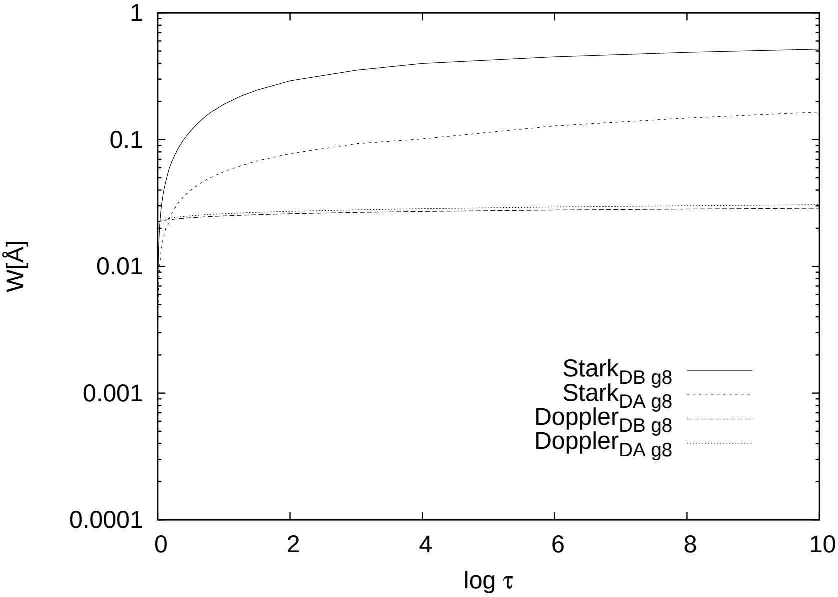

Figure 2. Thermal Doppler and Stark widths for Mn II spectral line a ^{5}S - z ^{5}P^o (2950.1Å) as a function of optical depth for DA and DB white dwarf models with T$_{eff}$=25000 K and log g=8.

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