

## On the Stark broadening of Te I spectral lines for CP star plasma analysis

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**Abstract.** By using the semiclassical perturbation method, Stark widths and shifts have been calculated for the Te I  $6s\ ^5S^o - 7p\ ^5P$  (5125.2 Å) multiplet, of interest for CP star plasma studies. Results were applied to the investigation of the influence of Stark broadening on CP star spectra. It was found that layers exist in the stellar atmospheres considered where the Stark broadening contribution is comparable to or larger than the Doppler width.

**Key words:** stars: chemically peculiar – stars: atmospheres – line: formation – line: profiles – atomic processes – atomic data

### 1. Introduction

With the development of astronomical observations from space, even elements like tellurium can now be identified in stellar spectra. For example, Yuschenko and Gopka (1996) identified one line of tellurium in the photospheric spectrum of Procyon, and Chayer *et al.* (2005) observed Te I spectral lines in UV spectra of the cool DO white dwarf HD 199499. In order to provide the necessary line broadening data, we have recently calculated Stark broadening parameters for four Te I multiplets for plasma conditions of interest for CP stars. We present here the results for the Te I  $6s\ ^5S^o - 7p\ ^5P$  multiplet and use them for the analysis of the influence of Stark broadening for CP star plasmas by comparing Stark and Doppler widths in model stellar atmospheres.

### 2. Results and discussion

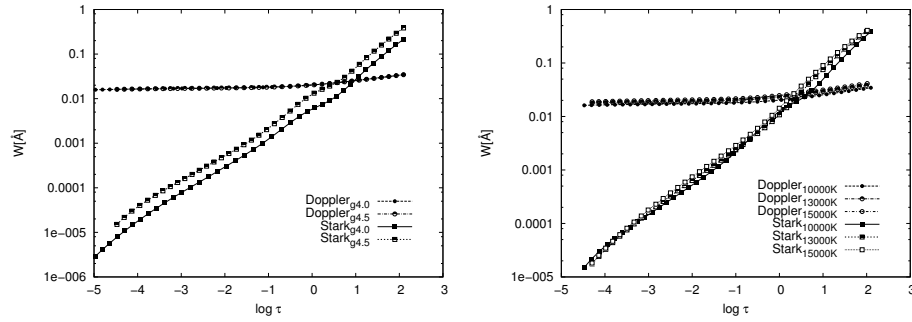
Calculations have been performed within the semiclassical perturbation formalism, developed and discussed by Sahal-Bréchet (1969 a, b). For updates see e.g. Dimitrijević (1996). All details of the calculations will be given by Dimitrijević *et al.* (in preparation). Here, as an example, we present electron- and proton-impact broadening parameters for the Te I  $6s\ ^5S^o - 7p\ ^5P$  (5125.2 Å) multiplet

**Table 1.** Electron ( $e^-$ ) and proton ( $p^+$ ) impact full widths at half maximum ( $W$ ) and shifts ( $d$ ) for the Te I  $6s\ ^5S^o - 7p\ ^5P$  multiplet for an electron density of  $10^{16}\text{cm}^{-3}$ .

TRANSITION	$T$ [K]	$W_e^-$ [Å]	$d_e^-$ [Å]	$W_p^+$ [Å]	$d_p^+$ [Å]
$6s\ ^5S^o - 7p\ ^5P$ 5125.2 Å	5 000	0.146	0.912E-01	0.842E-01	0.215E-01
	10 000	0.170	0.944E-01	0.855E-01	0.251E-01
	20 000	0.196	0.894E-01	0.865E-01	0.288E-01
	50 000	0.230	0.638E-01	0.880E-01	0.341E-01
	100 000	0.244	0.515E-01	0.895E-01	0.387E-01
	150 000	0.243	0.435E-01	0.906E-01	0.414E-01

for a perturber density of  $10^{16}\text{cm}^{-3}$  and temperatures from  $5 \times 10^3$  K to  $1.5 \times 10^5$  K (Table 1).

The Stark widths obtained have been compared with Doppler widths for A-type stellar atmosphere models (Kurucz, 1979; Fig. 1). Our results are presented as a function of Rosseland optical depth. One can see that there exist layers in these atmospheres where Stark broadening is comparable to or even larger than Doppler broadening.



**Figure 1.** Thermal Doppler and Stark widths for the Te I  $6s\ ^5S^o - 7p\ ^5P$  (5125.2 Å) multiplet as a function of optical depth,  $T_{\text{eff}}$  and  $\log g$ , for A type stars. Left:  $T_{\text{eff}} = 10\,000$  K,  $\log g = 4.0 - 4.5$ ; right:  $T_{\text{eff}} = 10\,000 - 15\,000$  K,  $\log g = 4.5$ .

## References

- Chayer, P., Vennes, S., Dupuis, J., Kruk, J.W.: 2005, *Astrophys. J.* **630**, L169  
Dimitrijević, M.S.: 1996, *Zh. Priklad. Spektrosk.* **63**, 810  
Kurucz, R.L.: 1979, *Astrophys. J., Suppl. Ser.* **40**, 1  
Sahal-Bréchet, S.: 1969 a, *Astron. Astrophys.* **1**, 9  
Sahal-Bréchet, S.: 1969 b, *Astron. Astrophys.* **2**, 322  
Yuschenko, A.V., Gopka, V.F.: 1996, *Astron. Astrophys. Transaction* **10**, 307