Publ. Astron. Obs. Belgrade No. 99 (2020), 161 - 164 *Contributed Paper*

COMPARISON OF EXPERIMENTAL AND SEMI-CLASSICAL RESULTS FOR Ar II STARK BROADENING PARAMETERS FOR (^{3}P) 4s ^{2}P – (^{3}P) 4p ^{2}D^o MULTIPLET

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Abstract. Comparison of experimental and calculated data for Stark broadening parameters for the Ar II 4726.87 Å, 4879.86 Å and 4965.08 Å spectral lines from multiplet (^{3}P) 4s ^{2}P – (^{3}P) 4p ^{2}D^o is presented in this work.

1. COMPARISON OF THE EXPERIMENTAL AND THEORETICAL DATA

During the testing new set of semi-classical theoretical results by Blagojević and Konjević 2017, 2020 for singly ionized non-hydrogenic atom lines, we have located set of experimental Stark shift data for Ar II multiplet 14, (the transition (^{3}P)4s ^{2}P - (^{3}P)4p ^{2}D^o) with number of experimental shifts showing similar temperature trend, see Fig.1 (data for some multiplet lines are so close that they are irresolvable in this figure). The reported shifts in Fig.1 were measured by various groups of authors using different plasma sources and plasma diagnostic techniques. The measured experimental line shifts indicate different low electron temperature trend and much smaller absolute shift values, see Fig 1. As expected, two sets of semi-classical results Blagojević and Konjević 2017 and Jones et al. 1971 for line shift and widths, see Figs.1 and 2 and Table 1, agree very well, because present calculations (in figures and Table 1 denoted with Tw) are essentially identical with Jones et al. 1971. The exception is improved numerical procedure used by Blagojević and Konjević 2017, 2020 in comparison with Jones et al. 1971. Another difference between Blagojević and Konjević 2017, 2020 and Jones et al. 1971: the energy level data are taken mainly from Moore 1971 while transition probabilities (TP) were calculated using Coulomb approximation Bates and Damgaard 1949 method. For our calculations, Tw in Figs 1 and 2 and Table 1, both, the energy levels data and TP were taken from NIST data base using small program for automatic data acquisition.

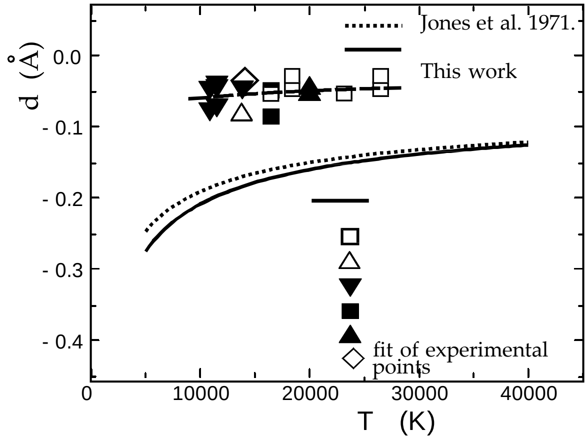

Figure 1: Stark shifts at electron density $N_e = 10^{17}$ cm^{-3} versus electron temperature.

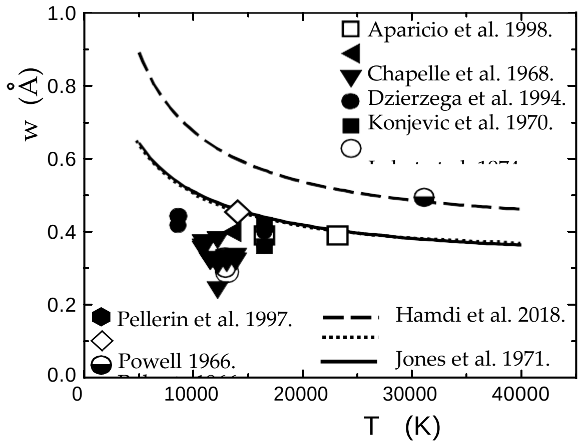

Figure 2: Stark full widths at half maximum (FWHM) at electron density $N_e = 10^{17}$ cm^{-3} versus electron temperature.

The results for Stark widths in Fig. 2 and Table 1 denoted by Hamdi et al. 2018 are calculated by another semi-classical approach while energy levels and TP

Ar II Multiplet (^{3}P) 4s ^{2}P – (^{3}P) 4p ^{2}D^o					
	Jones et al. 1971.		This work		Hamdi et al. 2018
	Mult. 4898 Å		Mult. 4898.6811 Å		Line 4879.86 Å
T (K)	*Halfwidth* (Å)	*Shift* (Å)	*Halfwidth* (Å)	*Shift* (Å)	*Halfwidth* $w_e + w_i$ (Å)
5000	0.644	- 0.243	0.645	- 0.271	0.891
10000	0.502	- 0.188	0.506	- 0.204	0.677
20000	0.416	- 0.148	0.423	- 0.1581	0.535
30000					0.485
40000	0.368	- 0.120	0.362	- 0.1231	0.464
60000			0.310	- 0.1021	0.441

Table 1: Theoretical Stark widths FWHM and shifts for electron density $N_e = 10^{17}$ cm^{-3} and temperatures in the range (5000 – 60000) K.

are calculated as well, see details in Hamdi et al. 2018. Further notes: the theoretical results in figures and table by Jones et al. 1971 and Tw are reported for the average wavelength of the multiplet 14 while results by Hamdi et al. 2018 are for the single line quoted in Table 1. The results for shifts and widths from Jones et al. 1971 and this work are electron impact values while Hamdi et al 2018 data are electron + ion impact Stark widths.

Finally, on the basis of the comparison of experimental and theoretical data for Ar II multiplet 14 one can conclude that this is rather well documented Stark shift case, which offers interesting possibility for theoretical study of electron temperature dependence and magnitude of shift values.

Acknowledgements

Djurović, S. and Konjević N. thanks for financial support of the Ministry of Education, Science and Technological Development of the Republic of Serbia (Grant No. 451-03-68 / 2020-14 / 200125).

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