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ION-BROADENING PARAMETER FOR C I 505.2 nm SPECTRAL LINE

D. NIKOLIĆ, Z. MIJATOVIĆ, S. DJUROVIĆ, R. KOBILAROV AND N. KONJEVIĆ*
Institute of Physics, Trg D. Obradovića 4, 21000 Novi Sad, Yugoslavia
**Faculty of Physics, P.O. Box 368, 11001 Belgrade, Yugoslavia*

1. INTRODUCTION

Usualy measured Stark parameters of plasma broadened neutral atom lines are the halfwidths and the shifts. Third, very important parameter - ion-broadening parameter A has been measured very rarely. There are only a few papers which reported measured values of A for Ar I, N I and C I spectral lines (Jones and Wiese, 1984; Jones et al, 1986 I; Jones et al, 1986 II; Nikolić et al, 1998). The importance of this parameter lies in the fact that it is the meausre of asimetry of the neutral spectral lines, so it's value influences widths and shifts of the lines. Approximate expressions for width and shift (at the peak of the profile) of neutral spectral lines are (Griem, 1974; Konjević and Roberts, 1974):

$$w = 2w_e[1 + 1.75\cdot10^{-4}N_e^{1/4}A(1 - 0.068N_e^{1/6}T_e^{-1/2})]N_e\cdot10^{-16} \quad (1)$$

$$d = [d_e \pm 2.00\cdot10^{-4}N_e^{1/4}Aw_e(1 - 0.068N_e^{1/6}T_e^{-1/2})]N_e\cdot10^{-16} \quad (2)$$

where w_e and d_e are electron impact width and shift, respectively, N_e is the plasma electron density in cm^{-3} and T_e is the electron temperature. Parameter A depends on the electron density like:

$$A = A_N N_e^{1/4}\cdot10^{-4} \ . \quad (3)$$

Experimentaly obtained values for widths and shifts have always been compared to the theoretical ones obtained from Eqs. (1) and (2). Value for A which enters Eqs. (1) and (2) is taken from corresponding theory (Bassalo et al. 1982, and Griem, 1974 for He I lines, and Griem, 1974 for other lines). As it can be seen from (1) and (2) such comparison can give wrong picture since values of A has not been checked. The methods for determination of A used by other authors (see references in Nikolic, 1999) are different. Here we will make comparison with the results obtained by Jones and Wiese (1984). Their method is based on fitting procedure of symetric Lorentzian to the experimental ones. The procedure applied in this work is based on fitting procedure of the theoretical profiles to the experimental ones. It has been applied earlier to several Ar I lines (Nikolić, 1998; Nikolić et al., 1998) while this is an application to the line of other element - carbon.

Pure Stark profile of broadened line is described by $j_{A,R}(x)$ function:

$$j_{A,R}(x) = \frac{1}{\pi}\int_0^\infty \frac{W_R(\beta)}{1+(x - A^{4/3}\beta^2)^2}d\beta \quad (4)$$

where β is reduced electric plasma microfield and $W_R(\beta)$ is it's distribution.

2. EXPERIMENTAL

Spectral profiles of C I 505.2 nm line were recorded from the wall stabilized arc plasma. The detailed experimental procedure is described elsewhere (Mijatović et al., 1995). One example of recorded profile is presented in Fig. 1. As one can see from this example, line profile is very well defined what is of great importance for the accuracy of fitting procedure.

3. FITTING PROCEDURE

This procedure is based on fitting the parameters of theoretical profile to the experimental one. In this case, the theoretical profile is the convolution of $j_{A,R}(x)$ (Eq. (4)) function and Gaussian arrising from Doppler and instrumental broadening. Details of this procedure could be found elsewhere (Nikolić et al., 1999; Nikolić et al., 2000). Solid line in Fig. 1 presents fitted profile. It could be seen that obtained function describes experimental profile satisfactorilly. Certain dissagreements exists at the parts of the line wings of the experimental profile.

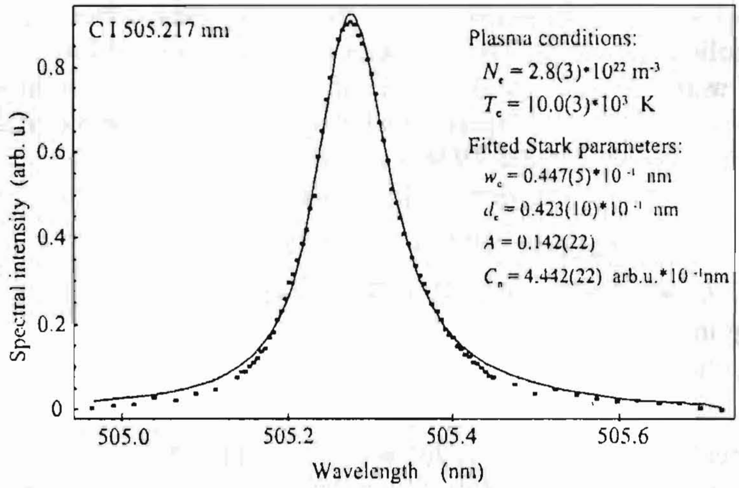

Fig. 1 An example of experimental and fitted profile.

4. RESULTS

One of the fited parameter in above mentioned procedure is the ion-broadening parameter A. Obtained values of A for CI 505.2 nm at two electron densities are given in Table 1 together with the theoretical values A_G (Griem, 1974) and other experimental results A_{JWW} (Jones and Wiese, 1984). Graphically these results are presented in Fig. 2.

Table 1. Measured and theoretica values of A.

T (K)	N_e (10^{22} m^{-3})	$N_e^{1/4}$ (10^5 m$^{-3/4}$)	A	A_G	A_{JWW}
9700(290)	2.2(2)	3.85(9)	0.091(14)	0.07724	0.094(14)
9700(290)	2.2(2)	3.85(9)	0.116(18)	-	-
10000(300)	2.8(3)	4.11(9)	0.142(22)	0.08185	0.100(15)
10000(300)	2.8(3)	4.11(9)	0.158(24)	-	-
10000(300)	2.8(3)	4.11(9)	0.160(24)	-	-
10000	2.56	4	-	0.07617	0.097(15)

*Values were obtained at T=11600 K

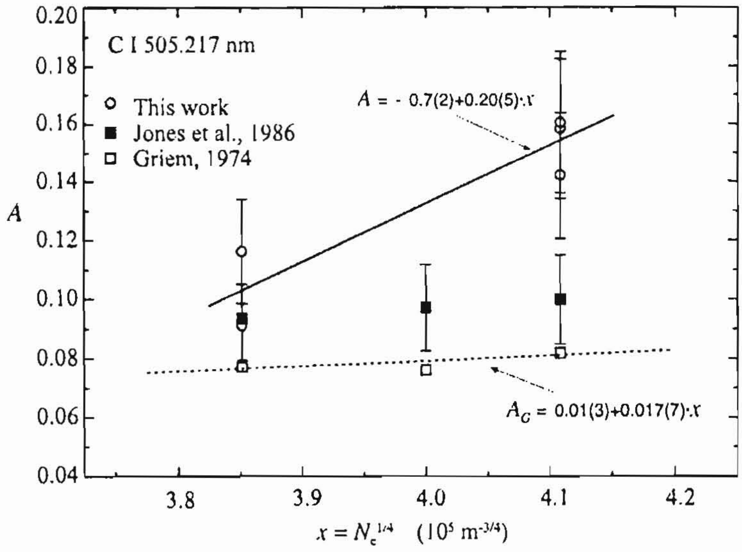

Fig. 2 Obtained values of a parameter A vs $N_e^{1/4}$

As it can be seen resultes obtained in this work are somewhat higher than other experimental and theoretical results. The error of parameter A determination is estimated to be about 15 % (Nikolić et al., 1998). The error is mainly caused by the scattering of the measured points of experimantal profiles. Dissagreement between results obtained in this work and results obtained by Jones end Wiese (1984) is significant (outside error limits).The reason for this could be found in different methods used for for the determinetion of A. In the future work, both methods should be applied to the same experimental profiles and in this way make comparison between them.

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