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STARK WIDTHS OF THE N V AND O V SPECTRAL LINES

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1. INTRODUCTION

Knowledge of N V and O V spectral lines Stark widths enable them for the spectroscopic diagnostics of hot stars and for the investigation of hot dense plasmas in laboratory. The role of the Stark broadening in astrophysics is explained by Griem (1974) and Dimitrijević (1989). In spite of this, the first measurements of N V and O V Stark FWHM (full-width at half intensity maximum, w) values were performed by Purić *et al.* (1987) and Böttcher *et al.* (1987, 1988) for N V and by Purić *et al.* (1988) for O V spectral lines. Several N V spectral lines have been investigated by Glenzer *et al.* (1992) and Blagojević *et al.* (1996). In meantime Dimitrijević and Sahal-Bréchot (1992) have been refered their calculated Stark FWHM values for the N V spectral lines. The aim of this work is to present the Stark FWHM value of the 455.428 nm O V spectral line, not measured before, to the knowledge of the authors. The Stark FWHM value of the 460.383 nm N V spectral line is also measured at 40 000 K electron temperature where measurements have not been performed up to day. In the case of the N V line our measured w value is compared with existing experimental and calculated data. For 455.428 nm O V spectral line no theoretical calculations exist, to the knowledge of the authors.

2. EXPERIMENT

The modified version of the linear low pressure pulsed arc (Djeniže *et al.* 1990; Milosavljević & Djeniže 1998) has been used as a plasma source. A pulsed discharge driven in a quartz discharge tube of 5 mm i.d. and has an effective plasma length of 5.8 cm. The tube has end-on quartz windows. On the opposite side of the electrodes the glass tube was expanded in order to reduce erosion of the glass wall (see Fig 1. in Djeniže *et al.* 1998) and also sputtering of the electrode material onto the quartz windows. The working gas was nitrogen and oxygen mixture (83% N_2 + 17% O_2) at 70 Pa filling pressure in flowing regime. Spectroscopic observation of isolated spectral lines were made end-on along the axis of the discharge tube. A capacitor of 14 μF was charged up to 3.0 kV and supplied discharge currents up to 7.7 kA. The line profiles were recorded by a shot by-shot technique using a photomultiplier (EMI 9789 QB) and a grating spectrograph (Zeiss PGS-2, reciprocal linear dispersion 0.73 nm/mm in the first order) system. The instrumental FWHM of 0.008 nm was obtained by using of the narrow spectral lines emitted by the hollow cathode discharge. The recorded profile of these lines have been of the Gaussian type within 7% accuracy in the range of the investigated spectral line wavelengths. The exit slit (10 μm) of the spectrograph with the calibrated photomultiplier was micrometrically traversed along the spectral plane in small wavelength steps (0.0073 nm). The photomultiplier signal was digitized using oscilloscope, interfaced to a computer. A sample output, as example, is shown in Fig. 1.

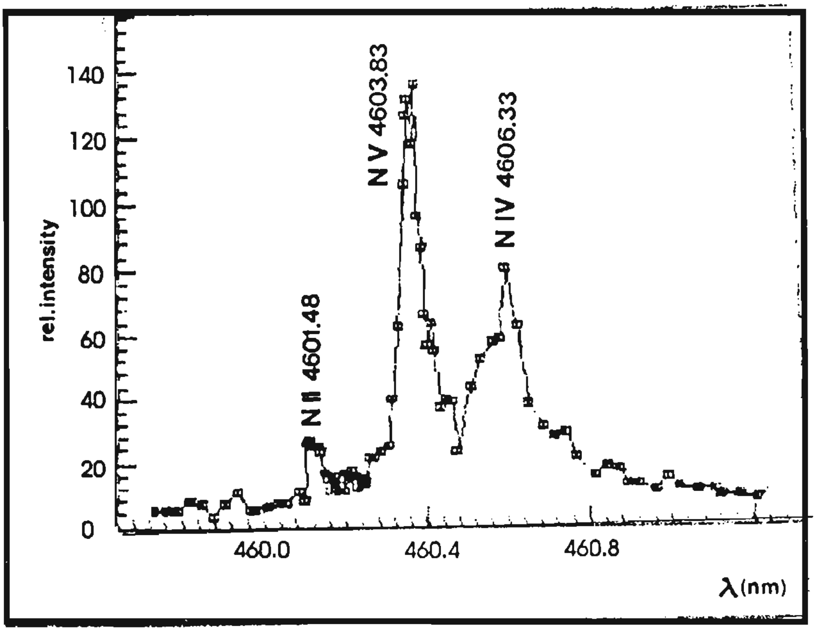

Fig. 1.

3. RECORDED SPECTRUM

The measured profiles were of the Voigt type due to the convolution of the Lorentzian Stark and Gaussian profiles caused by Doppler and instrumental broadening. For electron density and temperature obtained in our experiment the Lorentzian fraction in the Voigt profile was dominant. Van der Waals and resonance broadening were estimated to be smaller by more than an order of magnitude in comparison to Stark, Doppler and instrumental broadening. A standard deconvolution procedure (Davies & Vaughan 1963) was used. The deconvolution procedure was computerized using the least square algorithm. The Stark widths were measured with ±15% error. The selfabsorption was neglibigle becouse the smal concentration of the highly ionized (N V and O V) emitters. The plasma parameters were determined using standard diagnostic methods. The electron temperature was determined from the ratios of the relative intensities of the 348.49 nm N IV to 393.85 nm N III and the previous N III to

399.50 nm N II spectral lines,assuming the existence of LTE, with an estimated error of ±12%. All the necessary atomic parameters were taken from Wiese *et al.* (1966). The electron density decay was measured using a well know single wavelength He-Ne laser interferometer for the 632.8 nm transition with an estimated error of ±7%.

4. RESULTS

Our experimental results of the measured Stark FWHM (w) values at electron temperature (T in 10^4 K) and electron density (N in 10^{23} m^{-3}) are given in Table 1.

Table 1.

Emitter	Transition	Multiplet	λ (nm)	T	N	w_m (nm)
N V	3s - 3p	^{2}S - ^{2}P^0 (1)	460.383	4.0	2.0	0.059
O V	2p3p - 2p3d	^{1}P - ^{1}D^0 (7)	455.428	5.4	2.8	0.032

5. DISCUSSION

The theoretical Stark FWHM dependence on the electron temperature together with the values of the other authors and our experimental results (•) at the electron density $N = 1 \times 10^{23}$ m^{-3} are presented graphically in Fig. 2 assuming the domination of

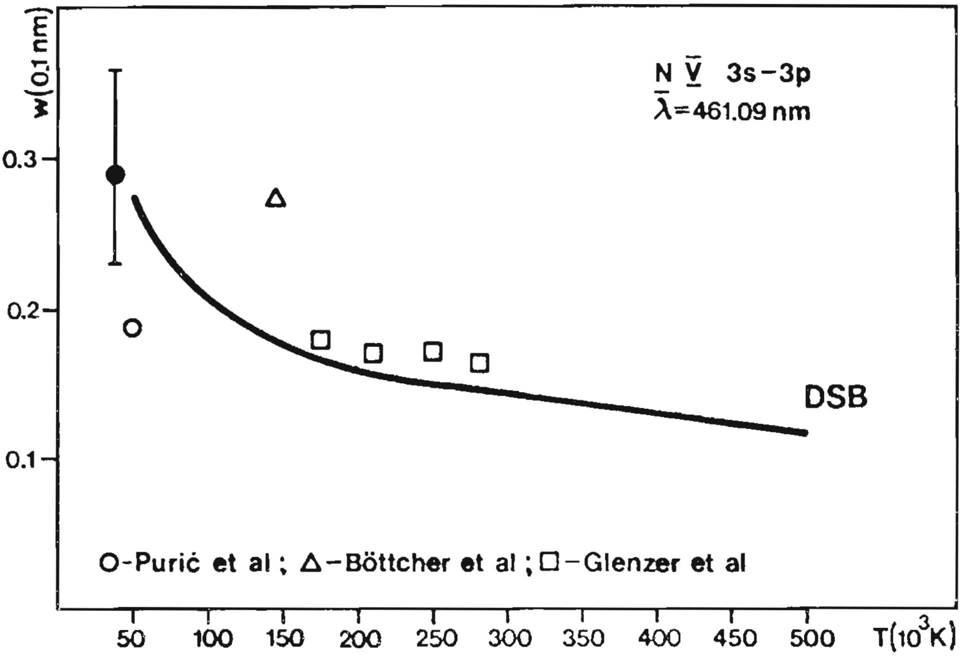

Fig. 2.

the electron impact mechanism to the line broadening. Solid line show the theoretical w values (DSB) calculated on the basis of the semiclassical-perturbation formalism, taked from Dimitrijević and Sahal-Bréchot (1992). $\overline{\lambda}$ is the mean wavelength for the multiplet. The error bar include the uncertainties of the width and electron density measurements.

6. STARK FWHM vs ELECTRON TEMPERATURE

One can conclude that our result, for the N V line, agree well with theoretical predictions (DSB). The same holds, also, for the results from Glenzer *et al.* (1992).

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