Publ. Astron. Obs. Belgrade No. 57 (1997), 117 - 119 *Contributed paper*

MEASURED STARK WIDTH AND SHIFT OF 220.798 nm NEUTRAL SILICON SPECTRAL LINE

A. Srećković, S. Bukvić and S. Djeniže
Faculty of Physics, University of Belgrade
Belgrade, P.O.B. 368, Serbia, Yugoslavia

Abstract
Stark width and shift of 220.798 nm Si I line was measured at a 28 500 K electron temperature and a 1.9 x 10^{23} m^{-3} electron density in a linear, low-pressure, pulsed arc operated in argon-helium mixture.

1. INTRODUCTION

The aim of this work is to extend the range of the experimental data concerning Stark shift (d) and HWHM (half-width at half intensity maximum, (w) values of the SiI spectral lines. We have measured Stark width and shift of 220.798 nm Si I spectral line of UV 3 multiplet. To the knowledge of the authors this is a first publication of such a data for the UV 3 multiplet (Fuhr and Lesage, 1993).

2. EXPERIMENT

The modified version of the linear, low pressure pulsed arc (Djenize *et al.*, 1991, Djenize *et al., 1992)* has been used as a plasma source. A pulsed discharge has been driven in a quartz glass tube with end-on quartz windows. The investigated plasma region has an effective length of 5.8 cm and inner diameter of 5 mm. Working gas was argon-helium mixture (72% Ar + 28% He) at 70 Pa filling pressure in flowing regime. Silicon atoms have been released by sputtering from a discharge tube glass. Spectroscopic observation of isolated spectral lines were made end-on along the axis of the discharge tube. A capacitor of 8 μF was charged up to 2.8 kV and supplied discharge currents up to 5.9 kA. The line profile was 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. Instrumental HWHM of 0.004 nm was obtained monitoring the narrow spectral lines emitted by the hollow cathode discharge.

Recorded profile of the line has 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). Photomultiplier signal was sampled using digital scope, interfaced to a computer. Measured profile was of the Voigt type due to the convolution of the Lorentzian Stark and Gaussian profiles caused by Doppler and instrumental broadening. The deconvolution procedure (Davies and Vaughan, 1963) was computerized using the least square algorithm (Fig. 1).

Stark widths were measured with ± 15% error. Great care was taken to minimize the influence of selfabsorption on Stark width determinations.

Stark shifts were measured relatively to the unshifted spectral lines emitted by the same plasma (Puric and Konjevic, 1972) .Stark shift data are determined with ± 0.0015 nm errors at given electron temperature (T) and density (N).

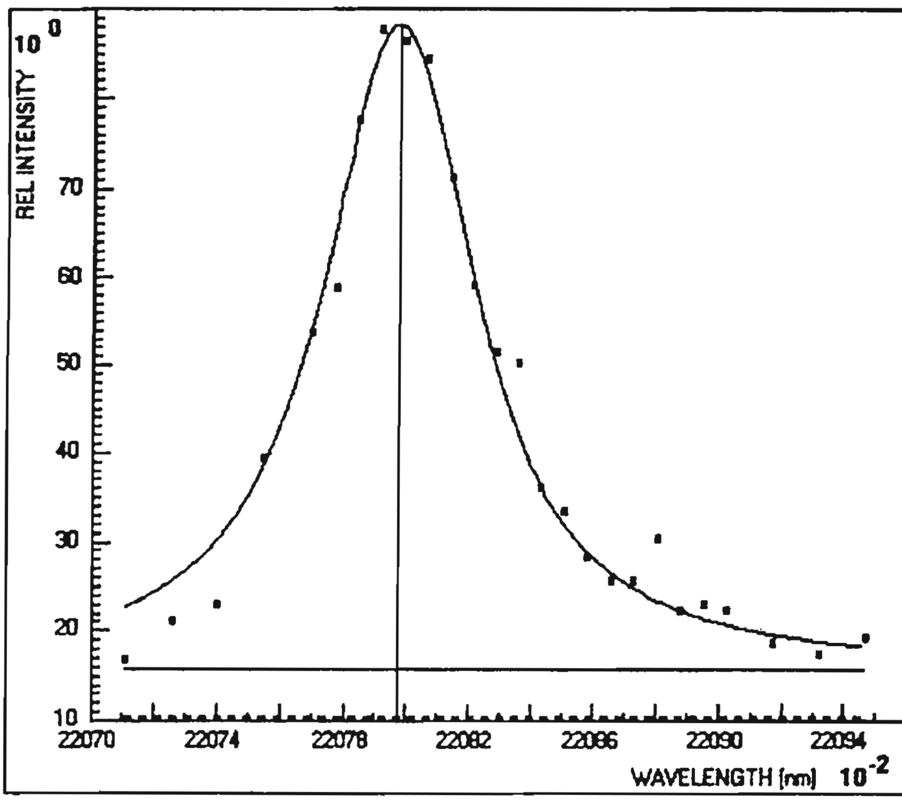

Fig. 1.

The plasma parameters were determined using standard diagnostic methods. The electron temperature was determined from the ratios of the relative intensities of the 333.613 nm, 334.472 nm and 335.849 nm Ar III to 335.093 Ar II spectral lines, assuming the existence of LTE, with an estimated error of ± 14%. All the necessary atomic parameters were taken from (Wiese *at al.*, 1969). The electron density decay was measured using a single wavelength He-Ne laser interferometer (Ashby *et al.*, 1965) for the 632.8 nm transition with an estimated error of ± 7%.

3. RESULTS AND DISCUSION

Our results of the measured w_m (HWHM) and d_m values at given electron temperature (T in 10^4K) and electron density (N in $10^{23}m^{-3}$) are presented in Table 1.

Transition	Multiplet	λ (nm)	N	T	w_m (nm)	d_m (nm)
$3s^23p^2 - 3s3p^3$	$^3P - ^3D^0$ (UV 3)	220.798	1.9	2.85	0.039	0.010

Table 1

To the knowledge of the authors no ader experimental data or calculated Stark HWHM and shift values exist for the spectral line from the UV 3 multiplet, therefore, the comparison of Stark width and shift of relevant 220.798 nm spectral line with theory is omitted.

References

Ashby, D. E. T. F. , Jephcott, D. F., Malein, A. and Raynor, F. A. ; J. Appl. Phys., 36, 29 (1965).

Davies, T. and Vaughan, J. M. ; Ap. J., 137, 1302 (1963).

Djeniže, S., Srećković, A., Labat, J., Konjević, R. and Popović, L. ; Phys. Rev. A44, 410 (1991).

Djeniže, S. Srećković, A., Labat, J. and Platiša, M. ; Physica Scripta 45, 320 (1992)

Fuhr, J.R. and Lesage, A; "Bibliography on Atomic Line Shapes and Shifts" (July 1978 through March 1992) NIST Special Publication 366 Supplement 4 US: DC National Institute of Standards and Technology, Washington (1993).

Purić, J. and Konjević, N. ; Z Phys. 249, 440 (1972).

Wiese, W. L., Smith, M. W. and Miles, B. M. ; "Atomic Transition Probabilities" NSRDS NBS 22 vol. 2 (Washington, DC; US Govt Printing Office, 1969).