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STARK SHIFTS FOR SEVERAL Xe II UV LINES

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Abstract. In this paper, new results concerning Stark shifts of six Xe II spectral lines are presented. One of the experimental results is compared with modified semiempirical calculations. In this work, pulsed arc was used as a plasma source.

1. INTRODUCTION

Stark broadening and shift of Xe II UV spectral lines have been a subject of many experimental (Konjević et al. 1984, 1990, 2002 and References therein) and theoretical studies (Popović and Dimitrijević 1996, Di Rocco 1990). Examination of an ionized xenon spectrum is important for laser techniques, light sources, astrophysics etc. The results of Stark shift measurements for six Xe II spectral lines given in this paper, are reported here for the first time. Three of these lines belong to 6p – 6d and two to 6s – 7p transitions. These data can be used for diagnostic purposes, demonstration of regularities and similarities of the line shifts within the multiplets or transition arrays and for theory testing.

2. EXPERIMENTAL

Experimental apparatus and diagnostic methods are described elsewhere (Mar et al. 2000, Djurović et al. 2006). Herein, only minimal details will be given. Excitation unit contains capacitor bank of 20 μF, charged up to 9.2 kV. The mixture of He-Xe at a pressure of $3.0 \cdot 10^3$ Pa continuously flows through the discharge lamp. Plasma electron density $(0.2 - 1.86) \cdot 10^{23}$ m^{-3} was determined by two-wavelength interferometric method, with an error band lower than 10%. The electron temperature (17000 – 29000) K was determined by Boltzmann plot. Estimated error for temperature determination is lower than 15%. Spectra were recorded using a spectrometer equipped with an optical multichannel analyzer detector with 512 channels. Exposure times were usually 5 μs.

3. RESULTS AND DISCUSSION

An example of recorded spectrum containing Xe III 328.126 nm line is shown in Fig. 1. The spectra were fitted to a sum of Lorentzian functions (for spectral lines) and a linear function (for continuum emission).

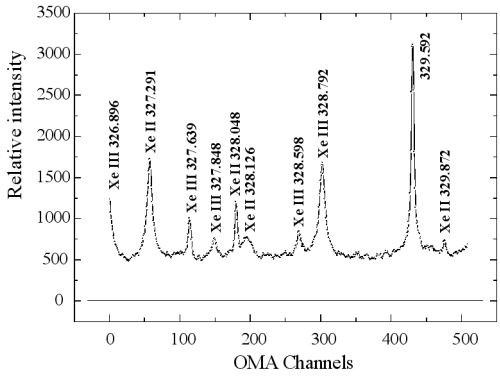

Figure 1: Example of one part of Xe spectrum and its fit.

The measured Stark shift data are given in Table 1. In the first two columns, configurations and Terms of the lines are given. Next two columns contain lines wavelengths and measured Stark shifts. All Stark shift data are new and presented here for the first time. Only one comparison with calculations based on modified semiempirical formula (Dimitrijević and Kršljanin 1986) was made. That was the only case where complete set of perturbing levels necessary for the calculations was available. For semiempirical calculations jK-coupling scheme was used. The agreement is satisfactory.

Table 1: Experimental Stark shifts of Xe II UV lines (d_m) for $T_e = 22000$ K. Estimated accuracy is about 30%. The result for 316.527 nm line is compared with modified semiempirical calculations (Dimitrijević and Kršljanin d_{th}). All data are normalized to electron density of $N_e = 10^{23}$ m^{-3}.

Configurations	Terms	λ (nm)	d_m (pm)	$\frac{d_m}{d_{th}}$
$5p^4$ (^{3}P$_0$) $6s$ – $5p^4$ (^{1}D$_2$) $6p$	$[0]_{1/2}$ - $[1]^\circ_{1/2}$	316.527	- 4.2	0.89
$5p^4$ (^{3}P$_2$) $6p$ – $5p^4$ (^{3}P$_0$) $6d$	$[1]^\circ_{1/2}$ - $[2]_{3/2}$	328.126	26.9	
$5p^4$ (^{1}D$_2$) $6s$ – $5p^4$ (^{3}P$_2$) $7p$	$[2]_{5/2}$ - $[1]^\circ_{3/2}$	337.392	-18.6	
$5p^4$ (^{1}D$_2$) $6s$ – $5p^4$ (^{3}P$_2$) $7p$	$[2]_{5/2}$ - $[3]^\circ_{7/2}$	331.348	-11.4	
$5p^4$ (^{3}P$_2$) $6p$ – $5p^4$ (^{3}P$_2$) $6d$	$[2]^\circ_{3/2}$ - $[3]_{5/2}$	366.170	53.5	
$5p^4$ (^{3}P$_2$) $6p$ – $5p^4$ (^{3}P$_1$) $6d$	$[1]^\circ_{3/2}$ - $[2]_{5/2}$	338.630	28.5	

The estimated errors for Stark shifts given in Table 1 might seem a bit high, but one should bear in mind that we have investigated very low intensity lines.

Stark shift of Xe II 328.126 nm line as a function of electron density is plotted, as an example, in Fig. 2. It is obvious that there is a clear linear trend.

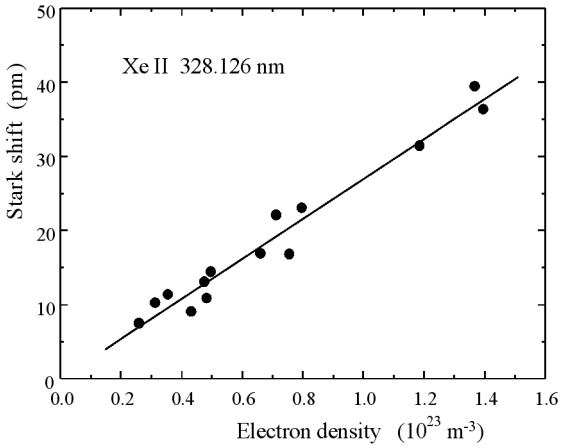

Figure 2: Example of Stark shift vs. electron density and its linear fit.

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