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EXPERIMENTAL STARK HALFWIDTHS OF SOME Ne II UV LINES

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This work reports new Stark halfwidth data of several Ne II UV spectral lines. Stark effect is the dominant line-broadening mechanism in many laboratory, industrial and astrophysical plasmas, due to the presence of time- and space-varying microfield. The Stark parameters data are usually used for plasma diagnostics purposes.

There are several papers devoted to measurements of the Stark broadening parameters of Ne II lines [1 – 9], but the data for the lines below 300 nm are still missing. In this paper we report Stark halfwidth measurements of eight Ne II lines in UV region between 279 and 291 nm.

Measurements were performed in a pulsed plasma. Pulses were created by discharging a capacitor bank, charged up to 7.5 kV, through a cylindrical Pyrex tube. A mixture of neon (30 %) and helium (70%) was flowing continuously through the tube at a pressure of 3 kPa. The experimental set-up is described in detail in our previous works [10, 11].

The data are given for electron densities, N_e, in the range $1.5 – 1.7 \times 10^{23}$ m^{-3}, measured by a two-wavelength interferometry technique. The electron temperature, T_e, estimated by the Boltzmann plot technique, was in the range 26800 – 31000 K.

Measured Ne II Stark halfwidths are presented in Table 1. In its first three columns, Table 1

Table 1. Experimental Stark halfwidths, w_m, of several Ne II UV lines.

Configuration	Term	Wavelength (nm)	N_e (10^{23} m^{-3}) T_e (K)	w_m (pm)	Acc. (%)	$\frac{w_m}{w_{MSE}}$
$2s^2\,2p^4(^3P)3p – 2s^2\,2p^4(^3P)3d$	$^4P°_{1/2} – ^4F_{3/2}$	291.041	1.55 26800	22.34	30	1.32
	$^4P°_{5/2} – ^2F_{5/2}$	286.996	1.61 26800	21.47	30	1.25
	$^4P°_{5/2} – ^4P_{3/2}$	287.296	1.73 31000	23.62	30	1.38
	$^4P°_{1/2} – ^4P_{3/2}$	290.682	1.62 29400	23.00	30	1.40
	$^4P°_{3/2} – ^4P_{1/2}$	291.006	1.55 26800	21.84	30	1.30
$2s^2\,2p^4(^3P)3p – 2s^2\,2p^4(^3P)4s$	$^4P°_{5/2} – ^4P_{5/2}$	279.202	1.60 26800	38.67	20	1.23
	$^4P°_{1/2} – ^4P_{3/2}$	279.422	1.60 26800	39.48	20	1.21
	$^4P°_{3/2} – ^4P_{5/2}$	280.948	1.58 26800	38.18	20	1.21

contains configurations, terms and wavelengths of the spectral lines. In the next three columns plasma conditions data, measured halfwidths, w_m, and estimated accuracy, Acc., are presented. Last column contains the ratio of measured and calculated data [14], w_m/w_{MSE}.

All the lines were checked to self-absorption effect, using an external mirror [11]. The chosen percentage of neon in neon-helium mixture ensured the plasma conditions, where self-absorption was absent for all lines in consideration.

Apart from taking care of experimental conditions and plasma diagnostics, attention was also paid to the proper fitting [12] and deconvolution procedure [13]. Under these experimental conditions Stark broadening was the dominant broadening mechanism. Two other pressure broadening mechanisms, resonance and van der Waals, were found to be negligible. Therefore, only Gaussian (instrumental + Doppler) and Stark broadening were considered in deconvolution procedure.

All possible errors in the line shape recording, transmittance correction, as well as fitting and deconvolution procedure were included in the final experimental accuracy estimation presented in Table 1.

Since the presented Ne II line halfwidths are new data, there was no possibility to compare them with other author's experimental results. The only possibility is comparing them with theoretically calculated data. For this purpose we used modified semiempirical formula (MSE) [14]. The ratio w_m/w_{MSE} is between 1.2 and 1.4 (see Table 1). It is the usual agreement or disagreement, which we found in case of other Ne II lines [9], as well.

The presented new measured Stark halfwidth data, for eight Ne II UV lines, can be useful for plasma diagnostics purposes for both laboratory and astrophysical plasmas, for comparison with future experimental data, for checking regularities and similarities within multiplets or transition arrays [15], as well as for theory testing.

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