

3.3 Measurements of the Stark broadening parameters of several Cl I lines

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The Stark broadening of isolated neutral atom lines was measured for a number of atoms (Wiese 1965¹) (and favorably compared with existing theory (Griem 1964²)). The extreme exception were near infrared Cl I lines where the experimental half-widths differ for factor of ten from theoretical ones (Bengtson 1968³). The broadening parameters were measured from time-resolved spectra of radiation emitted from an equilibrium plasma consisting of neon with spectroscopic additives of carbon, hydrogen and chlorine behind the reflected shock wave in a pressure driven chock tube. The electron density ($4-9 \times 10^{16} \text{ cm}^{-3}$) was determined by measuring pressure and temperature (10500—12000 K). The difference between calculated and experimental widths has been reduced by factor of six (Roberts 1968⁴) although the theoretical values were systematically lower.

The purpose of this paper is to provide more experimental data and to compare then theory and other experimental results. The plasma source was Z-pinch operated in dichlorodifluoremethane. It consisted of quartz tube (ID 13.5 mm) with distance between electrodes of 20 cm. The discharge was driven by 150 μ F condenser bank charged to 1.0 kV. During the experiment a continuous flow of dichlorodifluoremethane was sustained at a pressure of about 0.1 torr. For determination of axial electron density laser interferometry (Ashby and Jephcott 1963⁵) at one wavelength was employed. Interferometric fringes at 6328 Å were detected by means of a photomultiplier placed behind the laser.

The light from Z-pinch plasma was observed (end on) by the photomultiplier (EMI 9529B S10 photocathode) — grating monochromator (Zeiss SPM2, inverse linear dispersion 40 Å/mm) system, whose output was displayed on a double beam oscilloscope (Tektronix 555) and photographed to analyze. Another photomultiplier (RCA 1P28) was used as a monitor of integrated radiation from the plasma (side on). The observed light intensities were always normalized to the monitor signals. In order to obtain Stark profiles of Cl I lines from experimentally measured the usual deconvolution procedure for instrumental and dispersion profile was used (Davies and Vaughan 1963⁶). The electron temperature was determined from relative intensity ratio of Cl II-4810Å to Cl I-7745Å lines. The transition probabilities for these lines were calculated on the basis of Coulomb approximation and LS coupling (Bates and Damgaard 1949⁷).

Experimentally determined half-widths in Å units and normalized to the electron density of $1 \cdot 10^{17} \text{ cm}^{-3}$ of four Cl I lines are given in Table 1. The axial electron density was $(1.16 \pm 0.06) \cdot 10^{17} \text{ cm}^{-3}$ and electron temperature $8.800 \pm 1.000 \text{ K}$.

The obtained half widths are different from those by Bengtson (1968) and lie between theoretical values given by Griem (1964) and Roberts (1968). Disagree-

ment with other experimental results could not be explained within the limits of the claimed errors.

TABLE 1

Multiplet	Wavelength (Å)	Transition	Griem (1964) (Å)	Roberts (1968) (Å)	Bengtson (1968) (Å)	Present experiment (Å)
2	8585	$4 s^4 P_{3/2} - 4 p^4 D_{5/2}^{\circ}$	0.36	—	—	0.70 ± 0.10
2	8212	$4 s^4 P_{5/2} - 4 p^4 D_{5/2}^{\circ}$	0.33	1.73	3.5 ± 0.5	—
14	8686	$4 s^2 P_{3/2} - 4 p^4 S_{3/2}^{\circ}$	0.38	1.61	1.6 ± 0.5	0.73 ± 0.11
4	7924	$4 s^4 P_{1/2} - 4 p^2 P_{3/2}^{\circ}$	0.34	—	—	1.28 ± 0.19
5	7745	$4 s^4 P_{1/2} - 4 p^2 S_{3/2}^{\circ}$	0.27	1.65	2.8 ± 0.6	1.34 ± 0.20

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3.4 A comparison of calculated and observed transition probabilities of Cu and Ag

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3.5 A study of excitation in a free burning arc from 1 to 14 Å

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