Stark Broadening of Singly Ionized Strontium and Calcium Lines*

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Profiles of five calcium II and six strontium II lines have been measured in an argon plasma behind the reflected shock wave. The plasma was produced in an electromagnetically driven T tube and calcium and strontium were present as impurities. Electron densities were in the range 1.91–3.40 \times 10^{17} \text{ cm}^{-3} and the electron temperatures between 10300 and 14200 \text{ K}. The half halfwidths of the measured profiles of some Ca II and Sr II multiplets show large discrepancies with theoretical predictions.

1. Introduction

The theory of the Stark broadening of isolated spectral lines in plasmas was originally developed by Griem, Baranger, Kolb, and Oertel\textsuperscript{1} for neutral helium. This theory was later extended by Griem\textsuperscript{2,3} to compute broadening parameters of the lines of heavy elements. In general, the agreement with these calculations was very poor for ions, with only a few exceptions. Recently many other calculations of the widths and shifts of isolated ion lines have been performed\textsuperscript{4–9}. However, most of these methods are very laborious and therefore not too practical. Griem's semiempirical approach\textsuperscript{8}, however, gives a simple analytical expressions for shift and width of an ion line. Further, for a number of lines it has been found a good agreement of this theory and experiment.

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what indicated even better accuracy than it could be expected although a large and systematic discrepancies were noticed recently. The aim of this paper is to provide more experimental data on the broadening of Sr II and Ca II lines in plasma and to compare them with the theory. Special attention has been paid to the broadening of Ca II lines since other experimental data varied from experiment to experiment for more than the factor of ten. The plasma source was an electromagnetically driven "T" tube operated in argon with calcium and strontium as an impurity. Electron density was determined by the laser interferometry and temperature from relative intensities of A II lines.

2. Experimental Apparatus

The plasma source, an electromagnetic T tube was designed similar to that described by Ervents and Berg. It was made of Pyrex glass with an expansion tube 34 mm internal diameter. The discharge was driven by 7.5 μF condensor bank charged to 12 kV. During the experiment a continuous flow of argon 0.1 lit/min was sustained at a pressure of 1 Torr. All observations were done at the position 12 mm from reflector, which was placed 12.5 cm apart from electrodes. Strontium and calcium were deposited on the electrodes in the form of thin layer of SrCl₂ and CaCl₂.

The apparatus and experimental procedure were described elsewhere and the only difference was in minimization of the inductance of the circuit and therefore increased velocity of the shock wave for the same input energy.

3. Interferometric Method

Laser interferometry with a plane external mirror was used to determine electron density. The plasma was illuminated by the laser beam perpendicularly to the shock tube axis. Interferometric fringes at 6328 Å (He–Ne laser) were detected in the external cavity by inserting a glass slide which reflects a part of interfering beam into monochro-