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THE H_β ASYMMETRY IN THE PRESENCE OF A DC MAGNETIC FIELD

S. DJUROVIĆ, Z. MIJATOVIĆ, M. PAVLOV, B. VUJIČIĆ,
R. KOBILAROV and D. NIKOLIĆ
Institute of Physics, Faculty of Science, University of Novi Sad,
Trg Dositeja Obradovića 4, 21000 Novi Sad, Yugoslavia

1. INTRODUCTION

It is well known that H_β spectral line emited from plasmas is asymmetric and red shifted. Theoretical calculations of hydrogen line profiles (Keple and Griem, 1968; Vidal *et al.*, 1973) give symmetrical and unshifted profiles. However, many experiments have shown that H_β line has asymmetrical profile, especially in the intensity difference between blue and red peaks (Helbig and Nick, 1981; Mijatović *et al.*, 1987, Halenka, 1988). The asymmetry results from inhomogeneities of the ion produced electric field (ion - atom quadrupole interactions) and from non-negligible second order alterations arising from the homogeneous term of the ionic field (Halenka *et al.*, 1989).

Here we present experimental results of the H_β asymmetry in presence of the low DC magnetic field. The results are compared with our measurements obtained in absence of the magnetic field.

2. EXPERIMENT

The plasma source was a small magnetically driven shock tube of T-shape with a reflector. The tube was energized by a $1\mu F$ capacitor bank. The capacitor bank was charged to 20 kV. The discharge circuit was critically damped. The filling gas was hydrogen at a pressure of 300 Pa. Magnetic field was produced by an electromagnet and was perpendicular to the T-tube axis that is to the direction of the shock front propagation. The magnetic line density between poles measured in a free air was 0.5 T. Spectroscopic plasma observations were made by 1m monochromator along magnetic field through a hole in an electromagnet pole. The point of observation was 15 mm in front of the reflector. The photomultiplier signals were recorded by an oscilloscope equipped with a 35 mm camera.

The H_β profiles were scanned at close intervals by using successive discharges over the wavelength range ± 30 nm from the line center. Electron densities in range from $2 \times 10^{23} m^{-3}$ to $8 \times 10^{23} m^{-3}$ were determined from the H_β line halfwidth (Vidal *et al.*, 1973). Electron temperatures in range from 19000 K to 27000 K were determined from the line-to-continuum intensity ratios of the H_β line (Griem, 1964).

3. RESULTS AND CONCLUSIONS

In this paper we analized asymmetry of the whole H_β profile in such a way as is illustrated in Fig. 1. We measured the center of the line on 0.8, 0.6, 0.5, 0.4, 0.2 and 0.1 of the maximum H_β profile (I/I_{max}). Line drawn through obtained central points is not straight line. This line illustrates the asymmetry of the H_β profile.

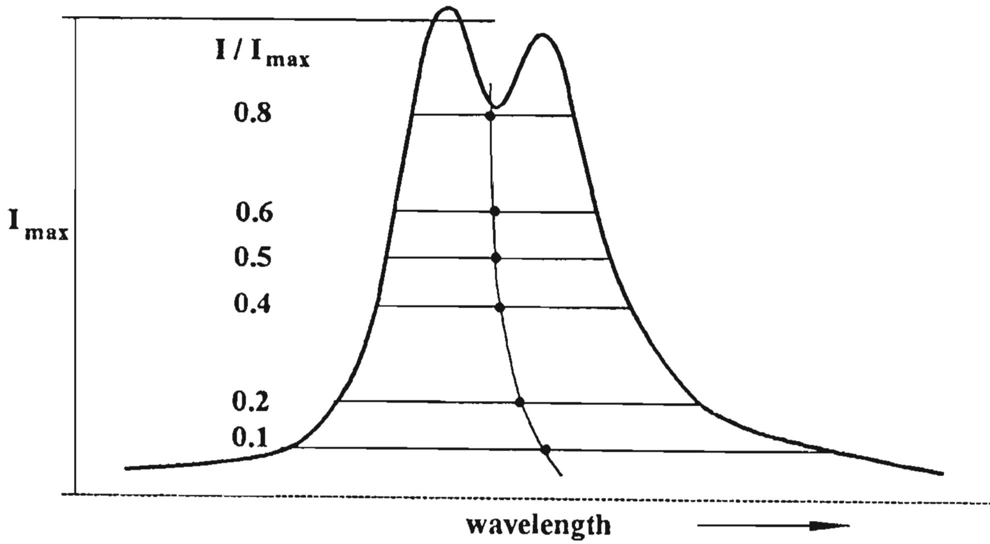

Fig. 1.

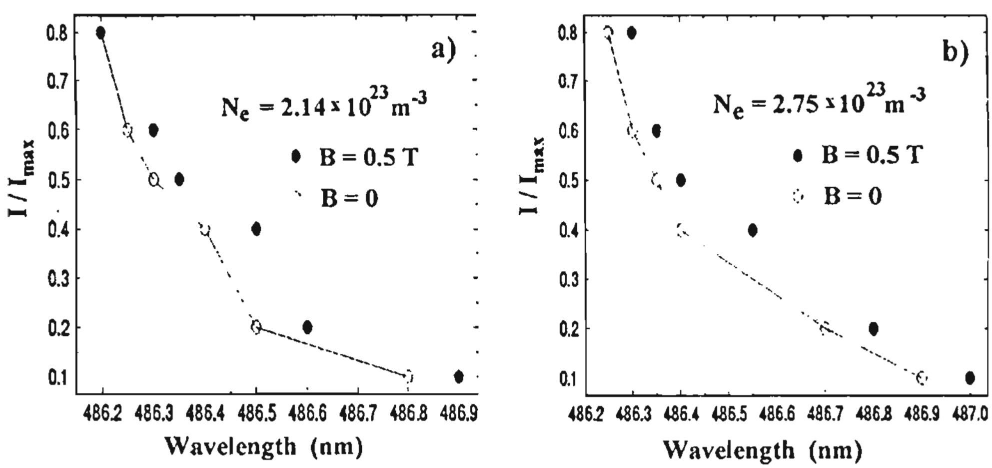

Fig. 2.

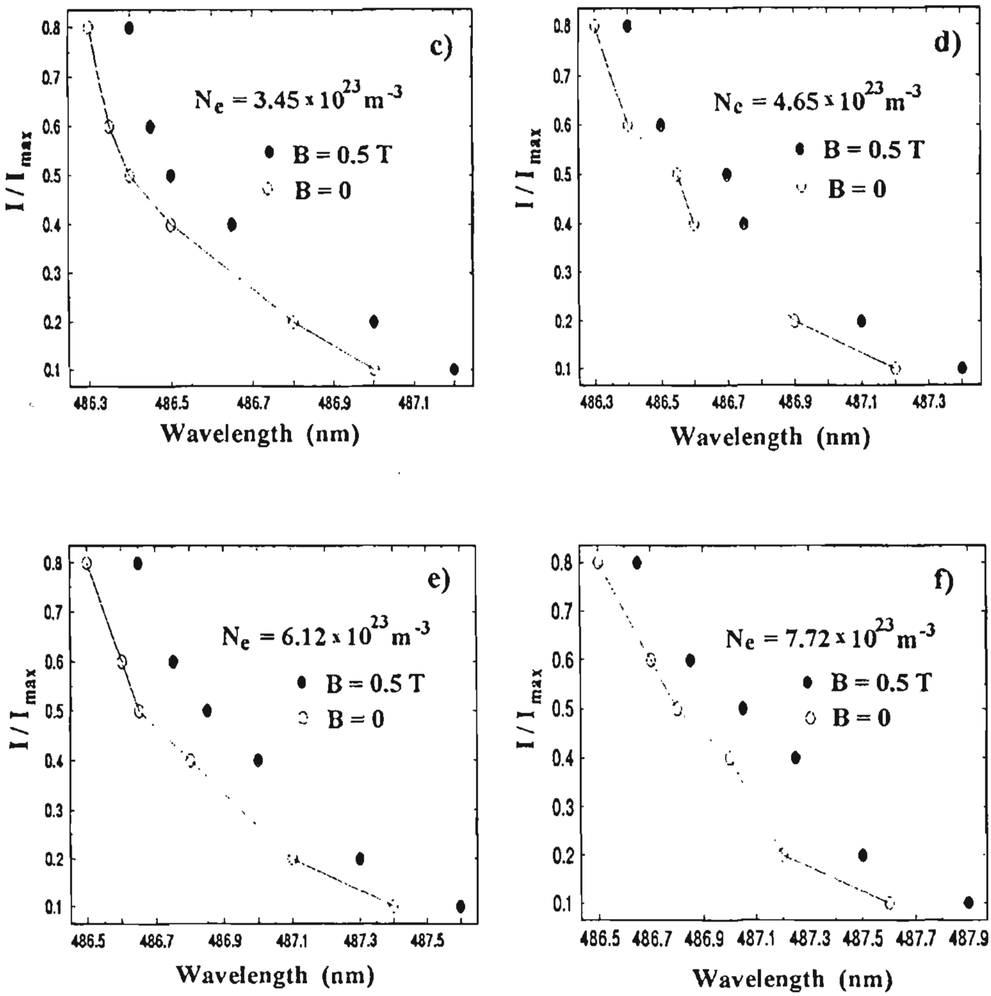

Fig. 2. continued.

The H_β spectral line asymmetry obtained by above described procedure in the presence and in the absence of a magnetic field are shown in Fig. 2(a-f). The open circles represent asymmetry in the absence of a magnetic field, while full circles represent asymmetry in the presence of a magnetic field.

One can notice that the line asymmetries with and without magnetic field behave in the same manner, so one can conclude that the presence of the low DC magnetic field has no influence on asymmetry of the H_β profile. The magnetic field causes only a small additional red shift of the whole H_β profile as much as the asymmetry lines with and without magnetic field are shifted one relative to the other. It is in agreement with our previous results (Pavlov *et al.*, 1988; Mijatović *et al.*, 1995) where we found small additional shift of H_β profile, in the presence of a magnetic field, measured in halfwidth position.

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