Journal of Research in Physics Vol. 28, No. 3, 267-269 (1999)

THE ASYMMETRY OF THE H_β LINE PROFILE

I. SAVIĆ, S. DJUROVIĆ, B. VUJIČIĆ, R. KOBILAROV
Institute of Physics, Trg Dositeja Obradovića 4, 21000 Novi Sad

1. INTRODUCTION

The profile of the Balmer H_β line is very important for plasma diagnostic purposes. It is well known that H_β spectral line profile emited from plasmas is asymmetric and red shifted (Wiese et al., 1972). Many experiments showed 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). Other experiments treated line widths (Wiese et al., 1972) or line wings (Bengtson and Chester, 1976) separately. The experimental results (Wiese et al., 1972; Mijatović et al., 1991) showed that H_β line has a red shift also. The most of theoretical calculations, see for example Kepple and Griem, (1968) and Vidal et al., (1973), give symmetrical and unshifted hydrogen line profiles. However, theoretical calculations developed by Demura (1974), give asymmetrical hydrogen line profiles.

In this work comparison between theoretical and experimental H_β line profile is given.

2. EXPERIMENT

The details of the experiment are given elsewhere (Mijatović, 1995). Briefly, the plasma source was magnetically driven T-tube 27 mm in diameter and supplied with a reflector. The T-tube was energized by using a 4 μF capacitor bank charged up to 20 kV. The filling gas was hydrogen at a pressure of 300 Pa. Spectroscopic observations of the plasma were made by 1m monochromator. The point of observation was 4 mm in front of the reflector. The photomultiplier signals were recorded by an oscilloscope equipped with a 35 mm camera. The H_β profiles was scanned at close intervals by using successive discharges over the wavelength range ± 30 nm from the line center.

The electron density of $2.92\ 10^{23}\ m^{-3}$ was determined from H_β halfwidth using Kepple and Griem, (1974) theory. Electron temperature of 21300 K was determined from line-to-continuum intensity ratio of the H_β line (Griem, 1964).

3. RESULTS AND DISCUSSION

Here we analyzed asymmetry of the Balmer H_β spectral line profile and compared the profile with theoretical ones (Griem, 1974; Demura, 1974) (Fig. 1). The experimental profiles are always asymmetrical what is illustrated in Fig. 1 on the 0.8, 0.7, 0.6, 0.5, 0.4, 0.3, 0.2 and 0.1 of the maximum of the H_β profile. Theoretical calculations performed by Griem, (1974) and Vidal et al., (1973) which were usually used for plasma diagnostic purposes give symmetrical profiles. These theoretical profiles are also considerable deeper

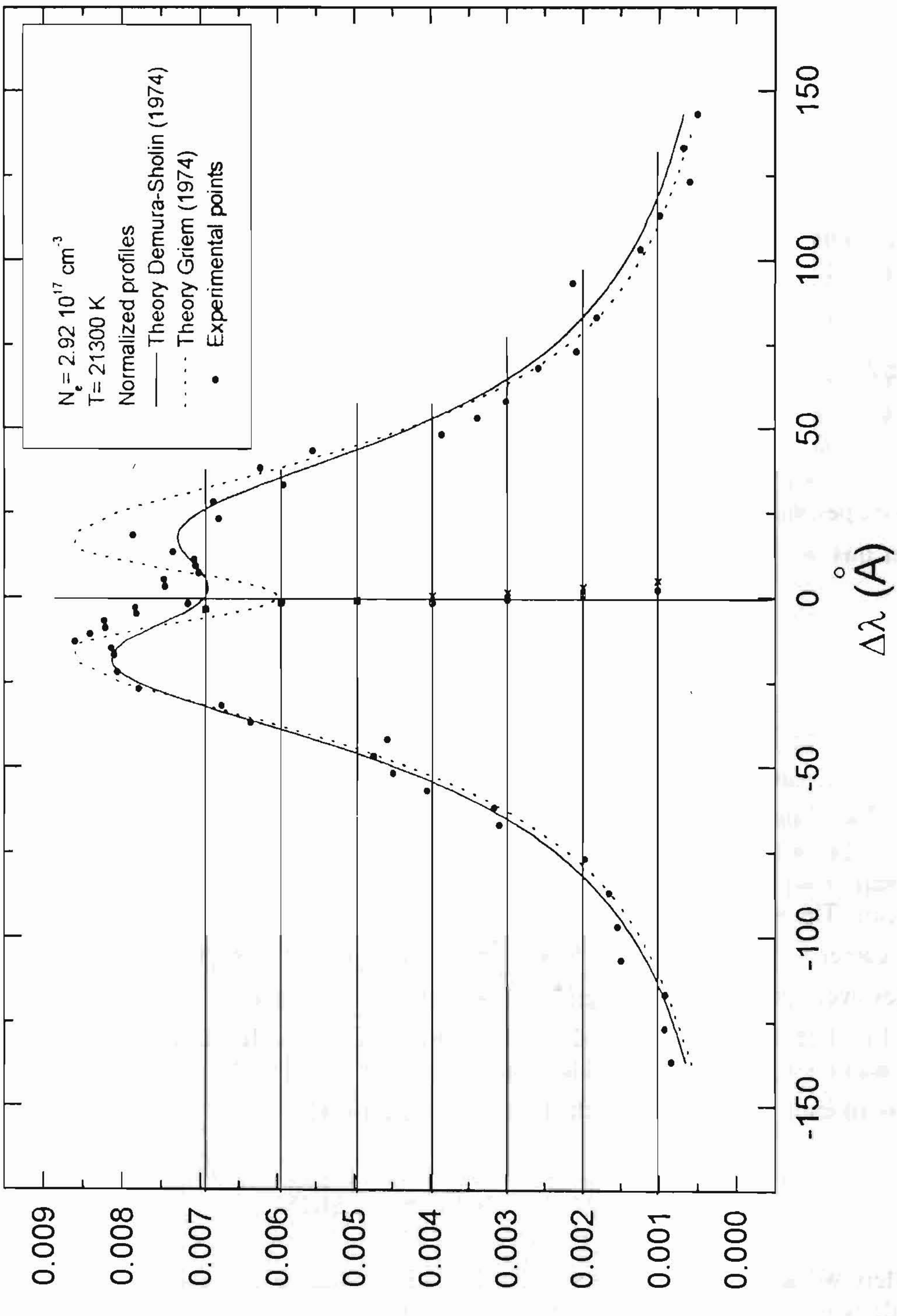

Figure 1. H_β Spectral line profile: theoretical (Griem 1974), (Demura 1974) and experimental profile.

on the line center then experimental profiles. The electron concentration is determined from the H_β halfwidth i. e. from comparison of experimental and theoretical (Griem, 1974; Vidal et al., 1973) halfwidths. In that case determination of the continuum level is very important, but it is difficult to perform it precisely. Uncertainty in continuum determination influences uncertainty in halfwidth determination. The better way for electron density determination should be halfwidth determination from fitting procedure. This is attempt to improve electron density determination.

Comparison of experimental and theoretical profiles calculated by Demura, (1974) shows better agreement then comparison with other theoretical profiles (Griem, 1974; Vidal et al., 1973). Theoretical profile (Demura, 1974) is asymmetrical and better describes peak intensities (Fig. 1).

From Fig. 1 one can see that line centers of the line width, measured on the different intensity positions, change the sign in halfwidth region in comparing with symmetrical line center (Griem, 1974; Vidal et al., 1973).

References

Bengtson, R. D. and Chester, G. R.: 1976, *Phys. Rev. A* **13**, 1762.

Demura, A. V. and Sholin, G. V.: 1974, *J. Quant. Spectrosc. Radiat. Transfer* **15**, 881.

Halenka, J.: 1988, *J. Quant. Spectrosc. Radiat. Transfer* **39**, 347.

Helbig, V. and Nick, K. P.: 1981, *J. Phys. B* **14**, 3573.

Griem, H. R.: 1964, *Plasma Spectroscopy*, McGraw-Hill, New York.

Griem, H. R.: 1974, *Spectral Line Broadening by Plasmas*, Academic Press, New York and London.

Kepple, P. and Griem, H. R.: 1968, *Phys. Rev.* **173**, 317.

Mijatović, Z., Pavlov, M. and Djurović, S.: 1987, *J. Quant. Spectrosc. Radiat. Transfer* **38**, 209.

Mijatović, Z., Pavlov, M. and Djurović, S.: 1991, *Phys. Rev. A* **43**, 6095.

Mijatović, Z., Djurović, S., Pavlov, M., Kobilarov, R. and Vujičić, B. T.: 1995, *Contrib. Plasma Phys.* **35**, 453.

Vidal, C. R., Cooper, J. and Smith, E. W.: 1973, *Astrophys. J. Suppl. Ser.* **25**, 37.

Wiese, W. L., Kelleher, D. E. and Paquette, D. R.: 1972, *Phys. Rev. A* **6**, 1132.