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DETERMINATION OF THE BALMER H_β LINE ASYMMETRY PARAMETER

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1. INTRODUCTION

In this paper are presented measurements of the H_β line asymmetry parameter. It is well known that H_β spectral line profile emitted from plasmas is asymmetric and red shifted (Wiese et al., 1972). Theoretical calculations of hydrogen line profiles (Kepple 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 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 parameter defined as:

$$A = \frac{|I_R| - |I_B|}{|I_R| + |I_B|}$$

The results are compared with theoretical ones (Demura and Sholin, 1973). Theoretical calculations developed by Demura and Sholin, (1973), give asymmetrical hydrogen line profiles.

2. EXPERIMENT

The plasma source was a small magnetically driven shock tube of T-shape with a reflector. The T-tube was energized by using a 4 μF capacitor bank. The capacitor bank was charged up to 20 kV. The discharge circuit was critically damped. The filling gas was hydrogen at a pressure of 300 Pa. Spectroscopic observation 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 densities in range from 2.3×10^{23} m^{-3} to 7.3×10^{23} m^{-3} were determined from H_β halfwidth (Griem, 1974). Electron temperature in range from 19400 K to 34000 K were determined from line-to-continuum intensity ratios of the H_β line (Griem, 1964).

3. RESULTS AND DISCUSSION

In this paper we measured asymmetry parameters of the Balmer H_β spectral line profiles and compared them with theoretical ones calculated by Demura and Sholin, (1974). Theoretical calculations developed by Demura and Sholin [8], give asymmetrical hydrogen line profiles. The illustration of the asymmetry parameter measurements is shown in Fig. 1. The asymmetry parameter A is measured at different $\Delta\lambda$ positions which also shown in Fig. 1.

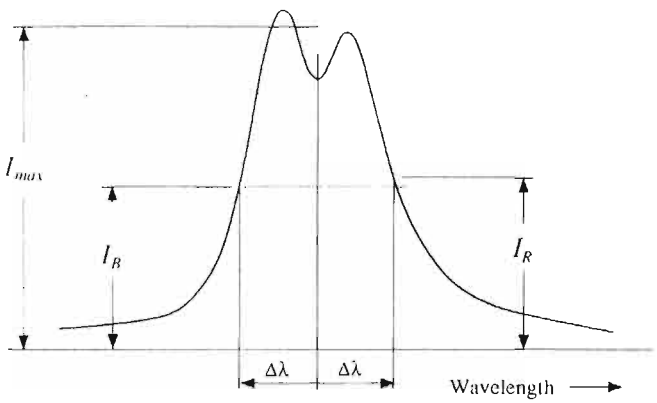

Figure 1 Illustration of the asymmetry parameter measurements

The results of measured and calculated (Demura and Sholin, 1974) parameter A are shown in Fig. 2a - f. The line center is positioned at central point on the intensity half maximum. Obtained experimental results are in agreement with our previous results (Djurović, 1996).

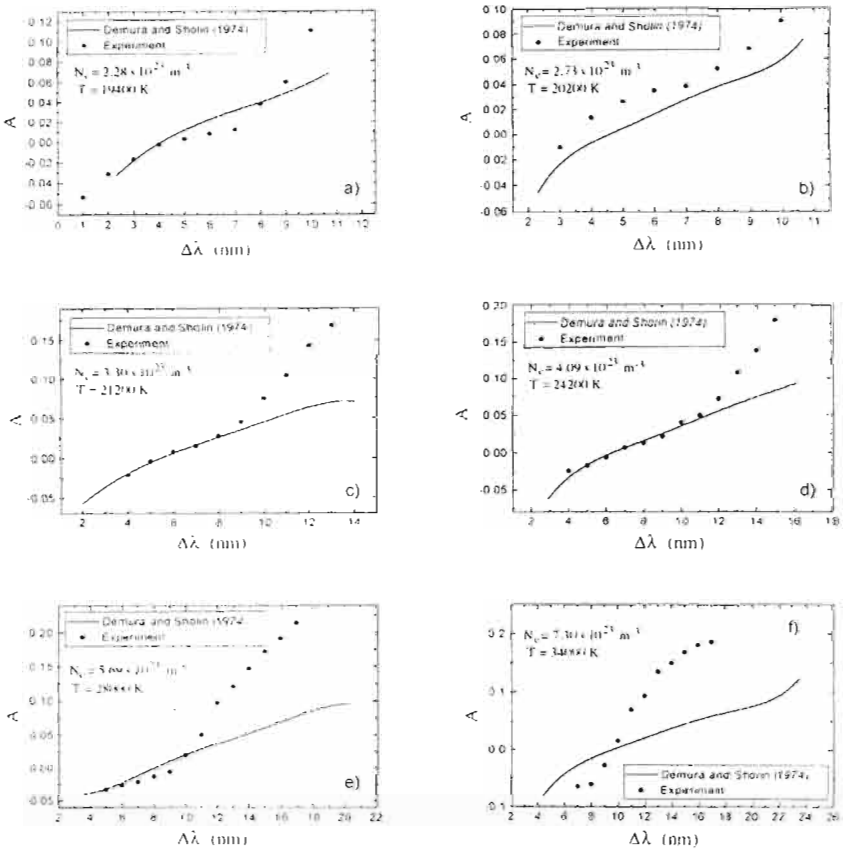

Figure 2 Measured and calculated [8] asymmetry parameter

Both, experimental and theoretical values of parameter A, change the sign. Experimental results show good agreement with theoretical ones (Demura and Sholin, 1974) for lower electron densities and temperatures. For higher electron densities and temperatures, experimental values are considerably higher. General conclusion is that more theoretical and experimental work are needed to obtain better agreement. The better agreement of the experimental and theoretical profile of the H_β line is necessary for using this theory (Demura and Sholin, 1974) for diagnostics purposes.

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