

§13. Construction of Zeeman Effect Polarimeter using Hell 4686A Line

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We have constructed a Zeeman Effect polarimeter to measure the poloidal magnetic field profile near the plasma edge in the JIPP T-IIU plasmas. This polarimeter is designed to detect the polarization of HeII(4685.7A) line emitted from He-doped tokamak plasmas. The spectral line is left-hand and right-hand circular polarized. When the line is observed from the direction perpendicular to the toroidal magnetic field, the maximum of the polarization modulation for wavelength is expressed by the following equation:

$$\begin{aligned} \text{Max}_{\lambda} \left( \frac{I_L - I_R}{I_0} \right) &= 2\sqrt{2} \cos \gamma \frac{\Delta \lambda_B}{\Delta \lambda_D} \\ &\sim B_0 \cos \gamma \left( \frac{\lambda}{\lambda_0} \right)^{1/2} \end{aligned}$$

where  $I_L, I_R, I_0, \gamma, \lambda_0, \Delta \lambda_B, \Delta \lambda_D$  are the left-hand and right-hand circular polarized line intensity, the maximum of the unpolarized line profile, the angle between the direction of observation and the total magnetic field, the center wavelength of the line, the Zeeman shift, and the Doppler width(FWHM) of the line, respectively. The quantity  $B_0 \cos \gamma$  corresponds to the poloidal magnetic field.

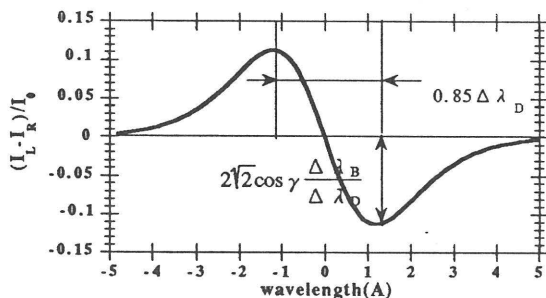


Fig.1 Modulation profile of circular polarized line.

The schematic diagram of this polarimeter is shown in Fig.2. This is composed with the photoelastic modulator (PEM), polarized beam splitter (PBS), interference filter (IF), the scanning Fabry-Perot interferometer (F-P), and photomultipliers (PMTs) as a detector.

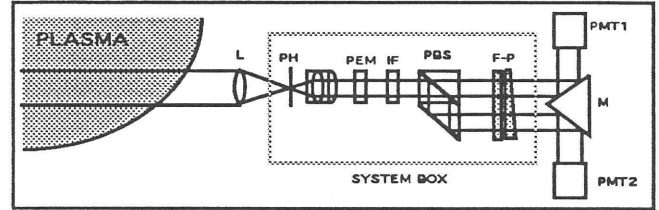


Fig.2 Schematic of a polarimeter on JIPP T-IIU.

For assumed radial profiles of ion temperature, magnetic field, intensity of spectral line, we have calculated expected output signals of this polarimeter and polarization modulation, as shown in Fig.3.

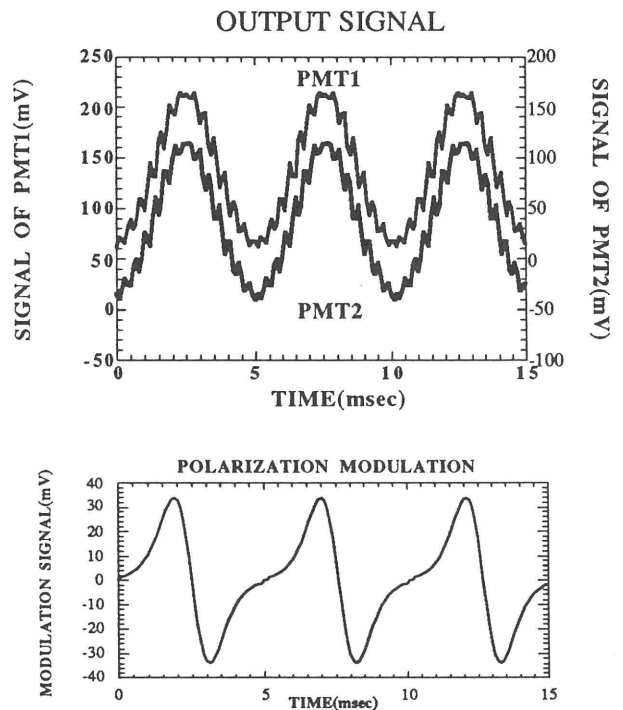


Fig.3 Expected output signal from detector1 (PMT1) and detector2 (PMT2) of the polarimeter and polarization modulation signal.

Reference

- 1) U. Feldman et al, J. Appl. Phys, 56(9), 2512 (1984)