§ 63. Measurement of Fine Spectral Profiles of Hα in LHD Plasmas

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In order to understand behavior of neutral hydrogen atoms at edge and divertor regions, fine spectral profiles of Hα were measured with a high-resolution spectroscopic system in LHD plasmas.

The spectroscopic system consists of a collecting optics, optical fibers, visible spectrometer with an echelle grating and a CCD detector. The absolute wavelength and the dispersion were calibrated in detail by a hollow discharge in the magnetic field strength of 1.13 T. The reciprocal dispersion was obtained as 0.1 nm/mm (0.0024 nm/pixel). The estimated minimum detectable velocity for this system is 10^3 m/s. (The calibration was performed at Kyoto university.)

To obtain poloidal and toroidal distribution of Hα emission in same discharge, 2-D imaging optical fiber array was installed. Figure 1 shows the schematic drawing of 2-D imaging fiber array.

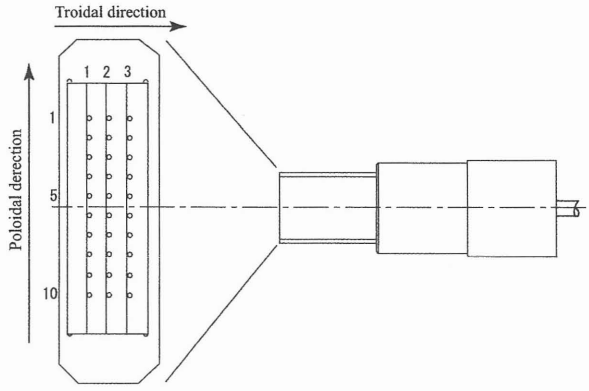

Figure 1. The schematic drawing of 2-D imaging fiber array. This optics enables to obtain poloidal and toroidal distributions of Hα emission in same discharge.

Lines of sight view a rectangular region (880 mm in toroidal direction×176 mm in poloidal direction) at near the divertor plate.

Figure 2 shows a dependence of the Hα line intensity on the averaged electron density for several sight lines. Plasmas were heated by NBI, and magnetic axis and pulse duration were 3.6 m and 4 s, respectively. Measurements were carried out in steady state phase. In fig. 2, line intensities increase with the averaged electron density. Sight line #2-10, which views around the strike point of inner divertor flux, has greatest increasing rate. On the other hand, sight line #1-10 is increasing slightly. The estimated spatial distribution of Hα line intensities is consistent with the divertor flux distribution qualitatively.

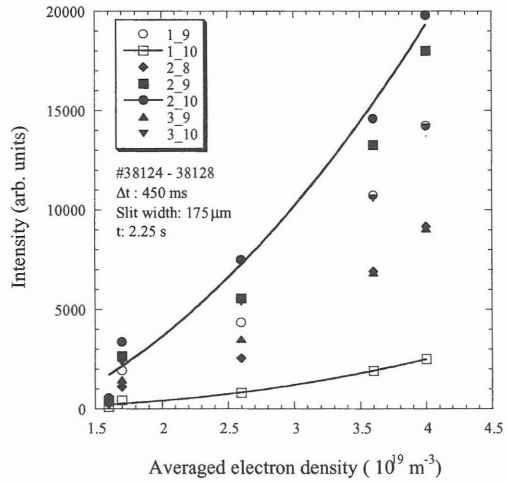

Figure 2. Dependence of the Hα line intensity on the averaged electron density for several sight lines.

Asymmetric Hα profiles were observed in the magnetic configuration of Rax=3.6 m. Figure 3 shows an asymmetric spectral profile of Hα. The profile is fitted to a sum of two

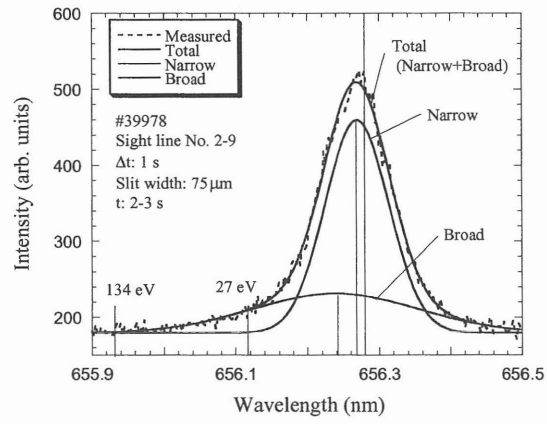

Figure 3. The asymmetric profile of Hα. The profile is fitted to a sum of two Gaussian components, narrow and broad. The shoulder in the blue wing is clearly distinguished.

Gaussian components, narrow and broad. Central wavelength of two components shifts toward the bleu side. Velocities corresponding to shift of the narrow and broad components are 4.6 km/s (0.1 eV) and 18 km/s (1.7 eV), respectively. The shoulder in the blue wing is clearly distinguished from 655.92 nm to 656.18 nm. The corresponding energy region is from 27 eV to 134 eV. As one of possibilities, the broad component is due to the emission from dissociated atoms and the narrow component is corresponding to the emission from charge exchange and reflected atoms. Especially, relation between energy range of distinguished blue wing and inner divertor flux was observed. More detailed investigation will be performed in future work.