§4. Emission Locations and Influx of Hydrogen Atoms on the Basis of Zeeman Profile

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In the magnetically confined plasmas oriented nuclear fusion reactor, determination of neutral particle influx from the plasma edge region to the main plasma is important for the purpose of studying H-mode, and the formation of the radial density profile. The Zeeman splitting of the spectral lines in He I is enable to determine the emission locations in the Large Helical Device (LHD)[1]. Polarization resolved Zeeman spectroscopy successfully enable us to deduce the emission location and the influx at a line of sight on the equatorial plane[2].

Ten lines of sight were equipped to cover the poloidal cross section at #1-O port for the polarization revolved observation as shown in Fig. 1. The emission from the plasmas was resolved into orthogonally polarized components with the polarization separation optics (PSO). Two types of the PSO were used. One consisted of a polarization separation Glan-Thompson prism and a pair of lens couplers. The other consisted of two Glan-Taylor prisms and a pair of lens couplers. The each image of the optical fiber cores of 400 μm diameter for the orthogonal polarization components was coaxially overlapped. Each PSO collects the plasma emission within 50 mm diameter cylindrical region.

An example of the polarization separation spectra are shown in Fig. 2. The observed spectra are fitted with assumptions that the emission locations are localized at

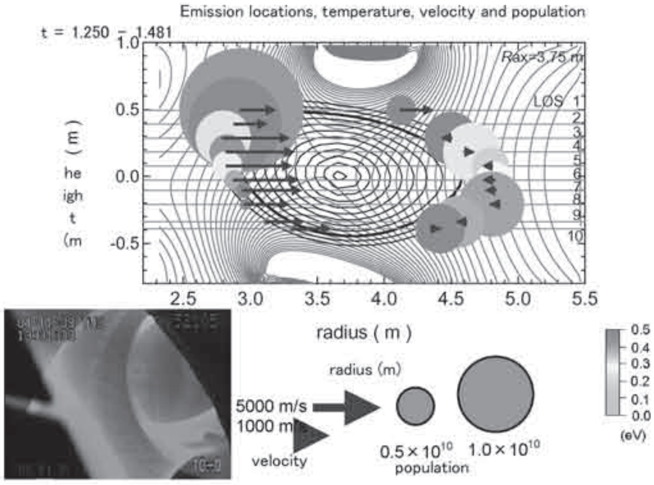

Fig. 0. Ten lines of sight cover the poloidal cross section at #1-O port. The emission locations on the LOS are indicated with the center position of the circles. The radius of circles is proportional to the upper level population $n(p=3)$. The length of the arrow represents the velocity component projected to the LOS. The plasma image taken at #10-O was shown at the left bottom. (#52105). [Tentative analysis]

inner and outer points on a LOS, the magnetic field strength and direction are well represented with a calculated vacuum magnetic field. The orthogonal polarized components are fitted simultaneously and the results are shown in Fig. 2 . The π components are parallel to the magnetic field direction. In the upper panels in Fig. 2, the π component is shifted to the longer wavelength direction and the

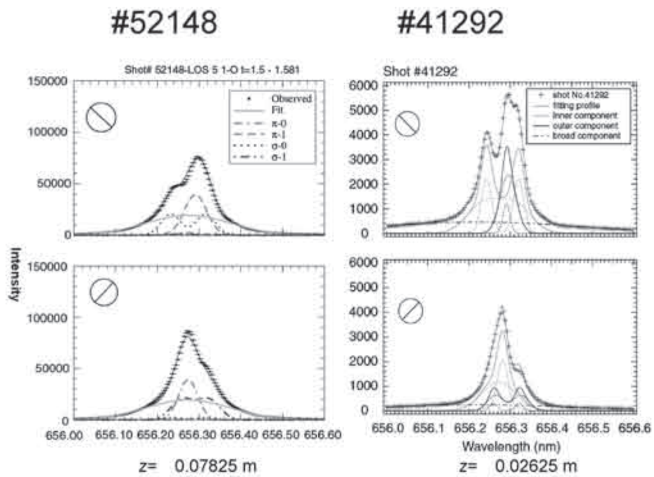

Fig. 2. The polarization separation spectra of hydrogen Balmer α for different discharges at LOS5 of #52105 and #41292. The circle with an oblique line indicates the direction of the polarized component.

π component in the lower panel indicates that the line center shifts to the shorter wavelength direction. The both ensemble of atoms contributed these parts of the spectral line profiles have inward velocity components to the main plasma. The summary of the least-squared fit is shown in Fig. 1. The inward velocity components from the inner side are higher than that from the outer side.

The Doppler width of Hα in the discharge #52148 is broader than that in #41292. The difference in atom velocity distributions may reflect the change of the plasma-wall interaction such as recycling rate or inward neutral velocity driven by the radial neutral pressure gradient.

SNET was laid down to Yoshida campus of Kyoto University. We are able to control the spectrographs and the CCDs in the LHD machine room through KUINS 3 VLAN and SNET from the plasma lab in Kyoto.

[1] M. Goto and S. Morita, Phys. Rev. E **65** 026401 (2002)
[2] A. Iwamae, M. Hayakawa, M. Atake, T. Fujimoto, M Goto and S. Morita, Phys. Plasmas, **12** 042501 (2005)

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