§23. Influence of Oblique Magnetic Field on Probe Measurement in the LHD Edge and Divertor Plasmas

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The stochastic magnetic boundary field line structure has attracted attention from the viewpoint of the Edge Localized Mode (ELM) control in some tokamaks. Though the stochastic magnetic boundary layer is equipped intrinsically in the scrape off layer in the ergodic divertor configuration tokamaks and heliotron-type devices, plasma flow properties and ion dynamics in the layer have not been understood well.

In this study, we analyzed experimental results of plasma flow and temperature measurements obtained by a multiple functions probe in the inner part of a stochastic boundary of LHD. The probe consists of Mach probes and an ion sensitive probe (ISP)[1]. In order to measure the spatial profile of the stochastic layer, the probe was installed on the top of the reciprocating type fast scanning Langmuir probe system. Notice the incident angle of the magnetic field line to each probe is different as shown in Fig. 1. The probes were numbered from #1 to #6. In spite of the angle changes during the movement of the probe head, the angle is almost constant (40 ~ 43 degree) in X-Y plane in the measured stochastic magnetic boundary in this study. Using the pair of probes at the opposite angle position, the difference of the incident angles are compensated because of the absolute angle is same for each probe.

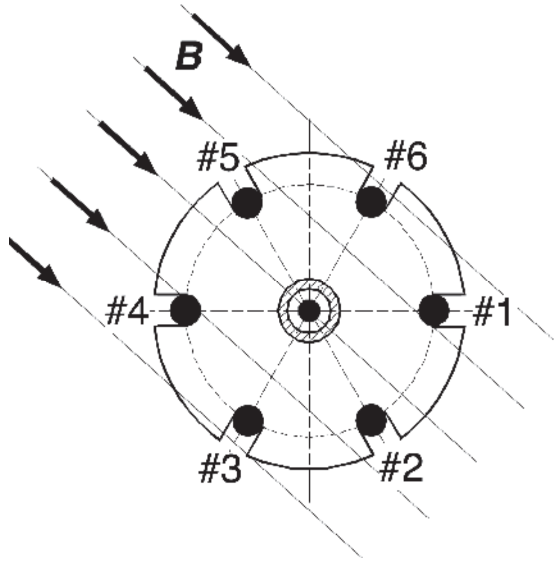

Fig. 1 Top view of the multiple functions probe head designed for the measurement in the LHD divertor and stochastic magnetic boundary.

Figure 2 shows the spatial profiles of measured ion saturation currents (I_{isat}) and calculated parallel particle flux using the three-dimensional plasma and neutral transport code, EMC3-EIRENE. Each of the Fig. 2 a), b) and c) show the I_{isat} measured by the probes of the opposite angle. As shown in Fig. 2 (d), alternations of plasma flow are predicted at around Z = -0.925, -0.895 and -0.820 m by the simulation. Flow alternations are experimentally identified around Z = -0.925 and -0.895 m. It is consistent with the result of the calculation. However, no flow reversal is observed at -0.820 m. The experimental result contradicts the simulation one.

1) Katsumata, I., Contrib. Plasma Phys. **36**, (1996) S, 73.

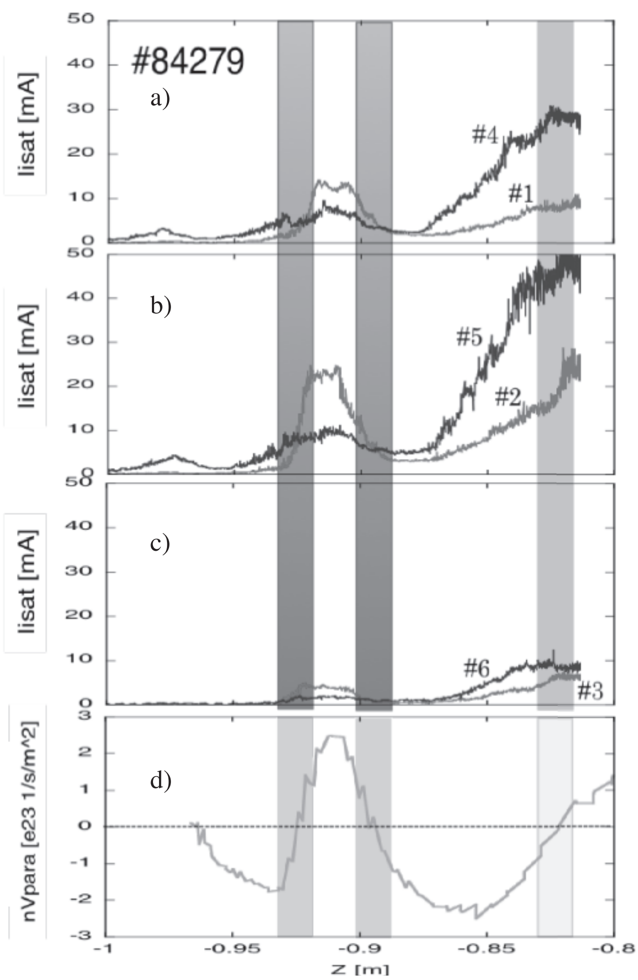

Fig. 2. Comparison of measured ion saturation currents with particle flux calculated by 3D simulation code. The numbers in (a) - (c) correspond to the probe numbers defined in Fig.1.