§15. Particle Transport Measurements in the LHD Edge and Divertor Plasma Region

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Particle transport is an essential general issue and of particular importance for the proper functioning of the divertor. Both of plasma flow and ion temperature (T_i) are the key parameters for characterizing the transport in the edge and divertor plasmas. Many sophisticated studies have been done by electron temperature and electron density measurements for the divertor region of the LHD. So far, we have been measured T_i using an Ion Sensitive Probe (ISP) [1] in the divertor leg in LHD during 4^{th}, 5^{th} and 6^{th} experimental cycles. The prototype-ISP for LHD was installed to the fast scanning probe system and the measurement system was established [2]. However, plasma flow and T_i profile in this region are still not enough understood. Recently, the ergodic field line structure has attracted attention from the viewpoint of the Edge Localized Mode (ELM) control in some tokamaks. Though the ergodic layer is equipped intrinsically in the scrape-off layer in the ergodic divertor configuration tokamaks and heliotron-type devices, plasma flow properties in the layer have not been understood well. In this study, we measured plasma flow using Mach probe in the ergodic layer in the Large Helical Device (LHD), to reveal the properties of plasma flow in the layer. Spatial profiles of the plasma flow, electron temperature, electron density and ion temperature were measured simultaneously using a movable multiple functions probe, which consists of Mach probes and an ion sensitive probe as shown in Fig. 1 and 2. Figure 3 shows the spatial profiles of measured ion saturation currents at the upstream and downstream probes and calculated parallel particle flux using the three dimensional plasma and neutral transport code, EMC3-EIRENE. Experimental data suggests that the plasma flow direction in the ergodic layer is inversed at around Z = -0.93 m in Fig. 3, and it is consistent with the result of the calculation.

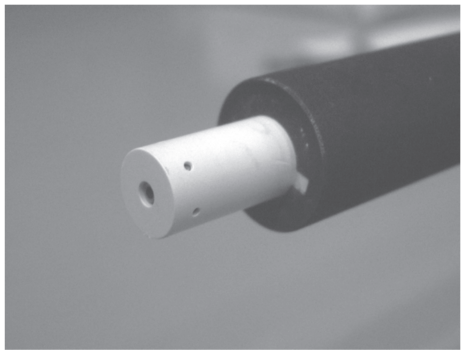

Fig. 1 Photo of the multiple function probe, which consists of Mach probes and ion sensitive probe.

1) Katsumata, I., Contrib. Plasma Phys. **36**, (1996) S, 73.
2) Ezumi. N. et al., J. Nucl. Mater. **313-316**, (2003) 696.

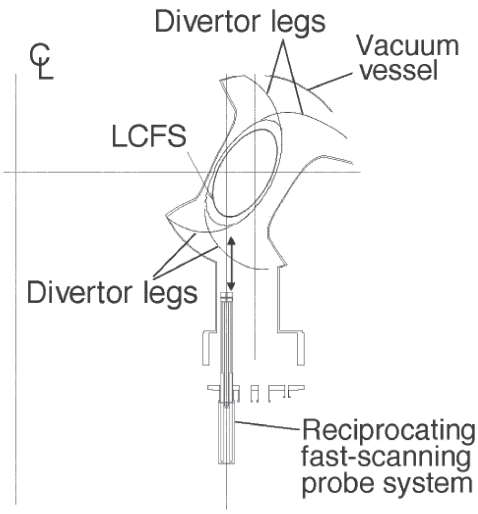

Fig. 2 Configuration of the reciprocating type fast scanning Langmuir probe system installed with the multiple function probe.

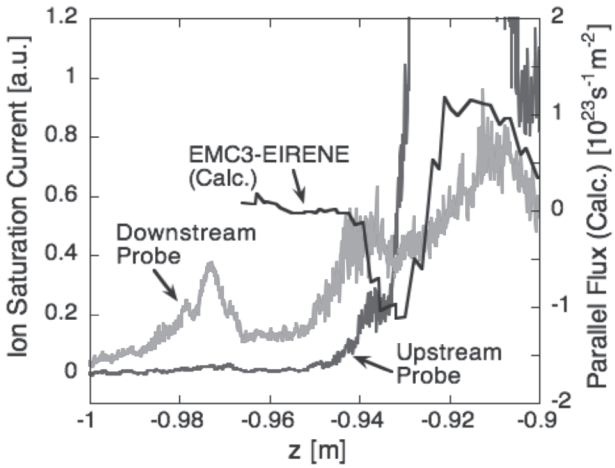

Fig. 3. Comparison of measured ion saturation currents and Calculated particle flux.