§22. Particle Transport Study Using a Directional Probe in Heliotron J

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A hybrid directional Langmuir probe (DLP) has been installed since 2007 in Heliotron J, and an anomalous transport of fast ions induced by bursting global Alfven eigenmode was experimentally investigated, so far [1, 2, 3]. In the fiscal year of 2012, a new type of probe was constructed to expand the application of DLP and to improve the signal quality.

Figure 1 shows a picture of the new probe head and five channels of electrode and one pin for position adjustment are arranged around probe body. The body of probe head and electrodes consist of molybdenum to survive and to work well in high heat flux conditions. A thermocouple is mounted in each electrode at 1.5 mm from the top of the electrode to evaluate the heat flux on the probe and to monitor the temperature of the probe head. The collector surface of the electrode becomes larger than that of previous one to improve the signal noise ratio of electrostatic probe measurement. Mirnov coil mounted in new probe head increases the sensitivity to the magnetic fluctuation measurement. Figure 2 shows a picture of pickup coil to measure magnetic field fluctuation. The inductance of the pickup coil is 250uH (250turns), which is 30 times higher than that of previous one.

In order to expand easily the applicability of this DLP, the probe head is removable and the connection of the probe head is unified with other probe system in Heliotron J. Figure 3 show pictures of the connection of probe head. Upper is the probe dead. Co-axial cables are installed in the probe body for electrostatic probe signals and pickup coil signal in order to avoid cross-talk of signal.

Now we have two targets to study using this DLP. One is observation of fast ion responses to the fast ion driven Alfven eigenmodes. The simultaneous measurement of fast ion flux and magnetic fluctuation at the same position reveals the phase relation between them, which includes the information of interaction between them [4]. The other is identification of long-range correlation of fluctuation in the edge region of Heliotron J plasma. The long-range correlation was observed for the first time in TJ-II plasmas, which is slow shear heliac. The experimental identification of the contribution of long-range correlation on confinement improvement in edge region is second target of our plan.

1) K. NAGAOKA, S. KOBAYASHI,et al., Journal of Plasma and Fusion Research SERIES (2009) January vol.8 1100.

2) S. Kobayashi, K. Nagaoka, S. Yamamoto, T. Mizuuchi et al., Proceedings of 17th International Steralator/Heliotron Workshop (invited talk), Oct.12-16, 2009. PPPL.

3) S. Kobayashi, K. Nagaoka, S. Yamamoto, etal., Contribution to Plasma Physics, 50, 6-7, 539-543, 2010.

4) K. Nagaoka, M. Isobe, K. Toi, et al., Phys. Rev. Letters (2008) 100 065005-1.

Fig. 1: A picture of the probe head. The arrangement of electrodes can be seen.

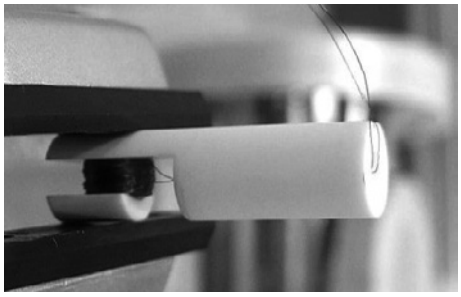

Fig. 2: A picture of magnetic probe unit installed in the DLP.

Fig. 3: Upper is a picture of probe head. Lower is one of cable connection part of the probe body.