§24. Anomalous Transport Study of Fast Ions Using Hybrid Directional Langmuir Probe in Heliotron J

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Anomalous transport of fast ions induced by fast-ion-driven MHD activities is a crucial issues in burning plasma experiments such as ITER, and is intensively studied in tokamak and helical devices. Recently, response of fast ions to bursting Alfven eigenmodes was observed using a hybrid directional Langmuir probe (HDLP) in Compact Helical System (CHS)[1)] and Heliotron J [2)]. In order to identify the interaction between fast ions and the Alfven eigenmode, a Mirnov coil has been installed on the HDLP [1)]. However, the sensitivity is not enough to observe the magnetic fluctuations, so far. In fiscal year of 2010, we replaced the Mirnov coil on the HDLP in Heliotron J. The position of the Mirnov coil is located at the center of ch 3, 4, 5 and 6, which is shown in Fig. 1. The Alfven eigenmodes are observed at almost same position as fast ion measurement. The fluctuation of poloidal component of magnetic field was measured at the out side of the last closed flux surface (LCFS).

In fiscal year of 2011, the systematic experiment to observe the interactions between fast ions and the MHD modes was carried out. Figure 2 shows a power spectrum of fast-ion-driven bursting mode observed by a Mirnov coil on vacuum vessel, wave form of Mirnov coil on HDLP and co-directed fast ion flux. The observed mode in this experiment was weaker and the frequency chirping was smaller than those observed in 2010. The fast ion flux was observed to response to the bursting mode, however, the mode was not observed by the Mirnov signal on the HDLP. This result indicates the sensitivity of the Mirnov coil on the HDLP is not enough yet to observe detailed behaviors of the mode frequency. Moreover, the some channels of the HDLP could not work, and the ctr-directed fast ion flux was not obtained in this experiment.

Therefore, it was decided to change the probe the head structure of the HDLP. The probe head was fixed in the original design, and the probe head can be replaced easily in the new design. When the purpose of the probe changes, the probe head can be changed day by day. The first removable probe head will be designed for fast ion measurement with a Mirnov coil and a kind of thermal probe. The construction of the new probe will be completed in 2012, then the investigation of fast ion transport will be restarted in Heliotron J.

1) K. Nagaoka, M. Isobe, et al., Phys. Rev. Lett., 100, 065005 (2008).

2) S. Kobayashi, K. Nagaoka, S. Yamamoto, T. Mizuuchi et al., Contrib. Plasma Physics, **50**, 534-539 (2010).

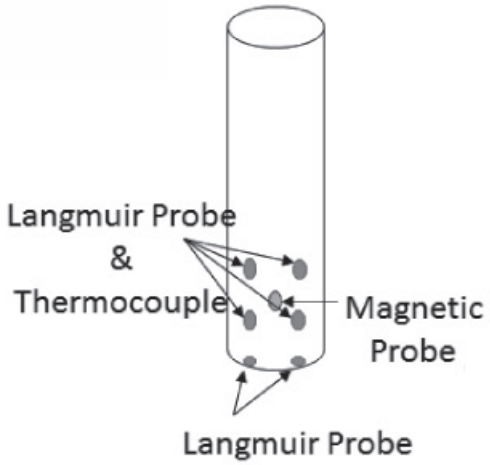

Fig. 1: Schematic of channel arrangement on HDLP.

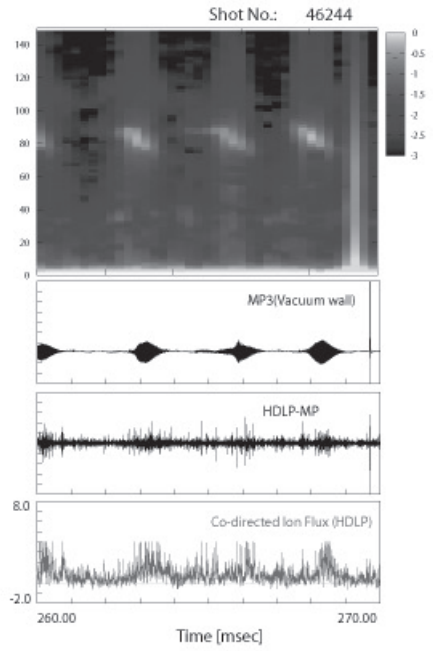

Fig. 2: Time evolution of frequency spectrum and wave form of Mirnov signal on the chamber wall. The wave form of Mirnov signal on the HDLP and the fast ion flux.