§25. Modification of HDLP for Study of Anomalous Transport of Fast Ions 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 Heliotron J [1]. The fast ion current oscillates with the frequency of Alfven eigenmode and the phase relation changes during a burst period. In this previous exprtiment, the Alfven eigenmodes were measured by a couple of Mirnov coils installed on the chamber wall of Heliotron J. In order to identify the interaction between fast ions and the Alfven eigenmode, the fluctuation of magnetic field is necessary to be measured at the same position as that of fast ion measurement. A Mirnov coil was also installed on the HDLP [2], however, it has a poor sensitivity to poloidal component of magnetic fluctuation, 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). Figure 2 shows the comparison between the observation with Mirnov coil on the chamber wall (a) and that on HDLP (b). The fast-ion-driven Alfven eigenmode with the frequency lower than 100 kHz was observed in both signals. However, the intensity of the Alfven eigenmode in the Mirnov coil on HDLP is much smaller than that on the wall. The signal/noise ratio (S/N ratio) is considered to be much improved, when the measurement is performed inside the LCFS. The observation of fast ion response to an Alfven eigenmode and the phase relation between fast ion flux and magnetic field oscillation measured at the same position will be reported in near future.

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

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

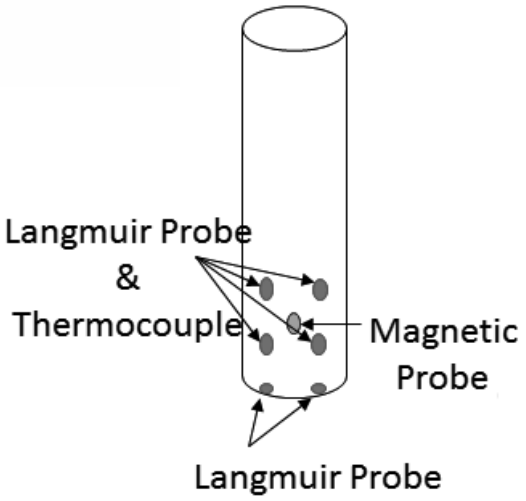

Fig. 1: Poloidal cross section of Heliotron J at the HDLP position.

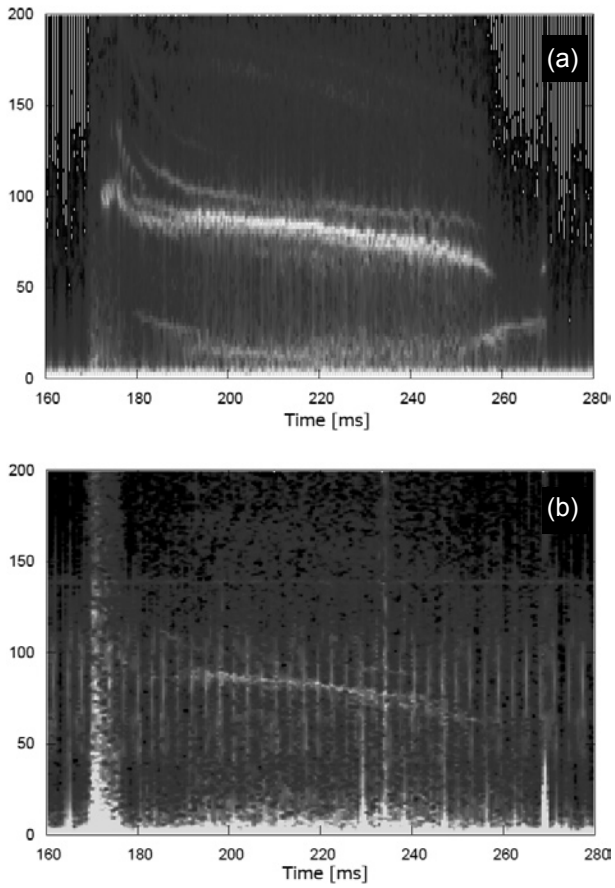

Fig. 2: (a) The Mirnov coil used in this analysis is mounted on the vacuum vessel. (b) Phase difference between them with large coherence.