## §35. Study of Anomalous Particle Transport Driven by Fluctuation Using a Directional Probe


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Anomalous particle transport is driven by fluctuations such as electrostatic turbulence and MHD coherent modes and may affect the performance of magnetically confined fusion plasmas. In order to investigate the characteristics of anomalous particle transport, the hybrid directional Langmuir probe (HDLP) has been upgraded in the previous fiscal year (2012) and started the measurement of the edge plasmas in the Heliotron J device in this fiscal year (2013).

Figure 1 shows a schematic of head structure of the HDLP. Five electrodes mounted around the main body of the probe head with the interval of 60 degrees constituting directional probe. The probe can be rotated around the axis, therefore the area of each electrodes are easily calibrated. The electrodes and the body of plasma head are made by molybdenum in order to survive in heavy heat flux circumstance. The magnetic probe is also mounted in the head of HDLP. A slit perpendicular to the magnetic field was made to penetrate the magnetic perturbations inside the HDLP head.

Figure 2 shows the typical wave forms of low density ECH and NBI heated plasmas in Heliotron J.  Figure 3 shows the typical wave forms of ion saturation current in the co- and ctr-directed channels (1st and 2nd graphs), and signal of magnetic probe mounted on the HDLP (3rd graph). The signal of magnetic probe located on the vacuum vessel is also included in the last graph for comparison. In the NBI heated phase, significant fluctuations of magnetic field are observed in both magnetic probes, and the amplitude of the magnetic fluctuation shows different behaviors each other. The mode profile measurement using beam emission spectroscopy reveals that the magnetic probe on HDLP have a different sensitivity depending on the mode location from that on vacuum vessel.

The fluctuations with high coherence to the magnetic probe signals were observed in the co- and ctr-directed ion saturation currents ($I_S$) measured by the HDLP.  The amplitude of the $I_S$ fluctuation was observed to correlate with the amplitude of magnetic fluctuation. The NBI is injected in the co-direction, and it is however not easy to distinguish fast ion contribution and bulk plasma response in the ion saturation current in this results. Analysis of the radial structure of the $I_S$ fluctuation might be required to distinguish the two components. In near future, a fast ion loss probe will be routinely operated in Heliotron J, then the comparison between the two systems will provide us a progress in anomalous transport study related to Alfven eigenmodes driven by fast ions.

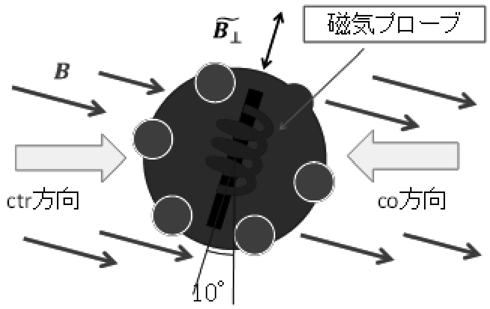


Fig. 1. Schematic of probe head structure of HDLP.

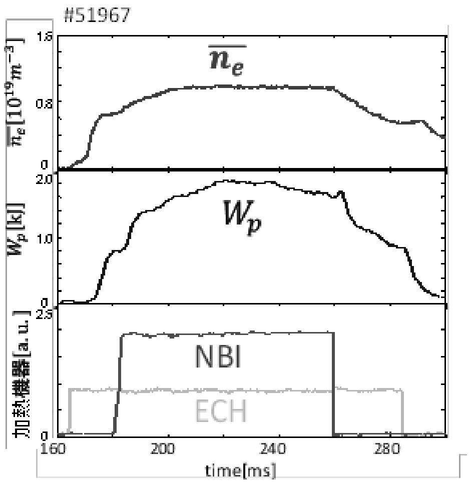


Fig. 2. Typical wave form of Heliotron J plasma with low density ECH and NBI heated plasmas.

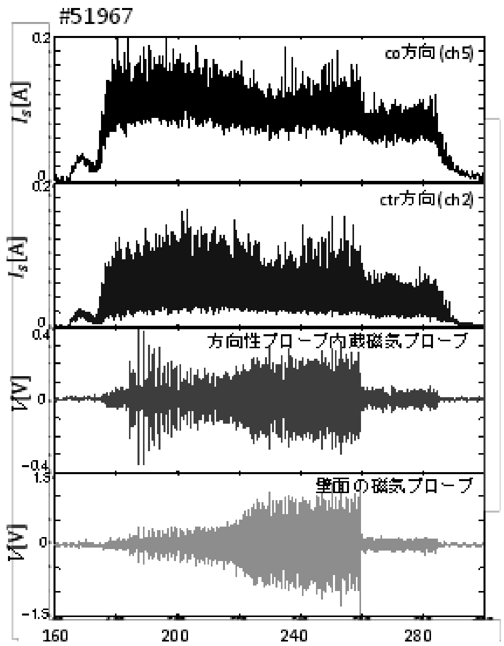


Fig. 3. Signals of ion saturation currents in the co- and ctr-directed channels (1st and 2nd graphs) and magnetic probe ones mounted on HDLP and located on the vacuum vessel (3rd and 4th graphs), respectively.