§80. Measurement of Ion Cyclotron Emissions Excited by Perpendicular Neutral Beam in LHD

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Ion cyclotron emissions (ICEs) are excited when the distribution function of ions increases with the perpendicular velocity, and the frequencies are close to multiples of the ion cyclotron frequency at the excitation point [1]. In LHD during the injection of perpendicular neutral beam, ion cyclotron emissions (ICEs) with the frequency corresponding to the ion cyclotron frequency at the plasma edge were detected, by using of spare ICRF heating antennas [2] or high-frequency magnetic probes [3]. The signals are originated from magnetic perturbation since the phase difference of signals measured by a pair of probes with the different turn direction was 180°. The frequency and the short decay time after turn-off of NBI show that the excitation point is in the peripheral region of plasma. However, the toroidal position of the excitation point was not clear.

To investigate the excitation position, the ICEs excited by two beams injected from the different toroidal position (5-O port and 10-O port) were measured with the two high-frequency magnetic probes in different toroidal position (5.5-U port and 6.5-U port) as shown in Fig. 1. Figure 2 shows power of NBIs and plasma parameters. The tangential neutral beams (hydrogen of 180 keV) were also injected to the plasma, but only at the timing of perpendicular neutral beam (hydrogen of 40 keV), ICEs were observed as shown in Fig. 3-(a). The magnetic field strength on the magnetic axis of 3.75 m is 2.64 T, and the peak fundamental ICE frequency of 23.3 MHz corresponds to the ion cyclotron frequency of hydrogen at the plasma edge on the mid-plane in the horizontally elongated plasma cross-section in front of the perpendicular NBI port. The signal of ICEs excited with the perpendicular neutral beam injection from the 1-O port, which is the opposite side in torus with magnetic probes, were small compared to those excited with the neutral beam injection from the 5-O port, as shown in Figs. 3-(a) and (b), where the neutral beam power from each port was 5 MW. The comparison of signal intensity between the 5.5-U and 6.5-U probes revealed that the intensity decreases with the distance from NBI at the 5-O port, as shown in Figs. 3-(a) and (c). The signal decreases with the distance between probe and NBI port. The result means that the excitation position is localized near the ports of perpendicular NBIs.

1) Dendy, R.O. et al.: Phys. Plasmas **1** (1994) 1918.
2) Saito, K. et al.: Fusion Eng. Des. **84** (2009) 1676.
3) Saito, K. et al.: submitted to Plasma Sci. Technol.

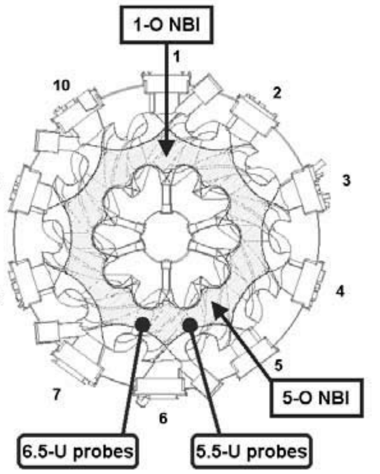

Fig. 1 Location of probes and perpendicular NBIs.

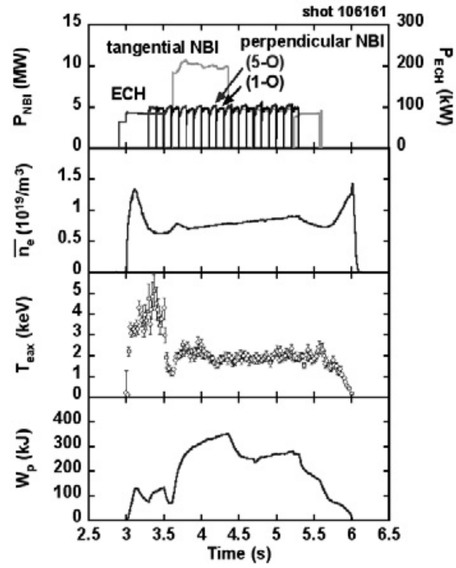

Fig. 2 A discharge with two perpendicular neutral beam.

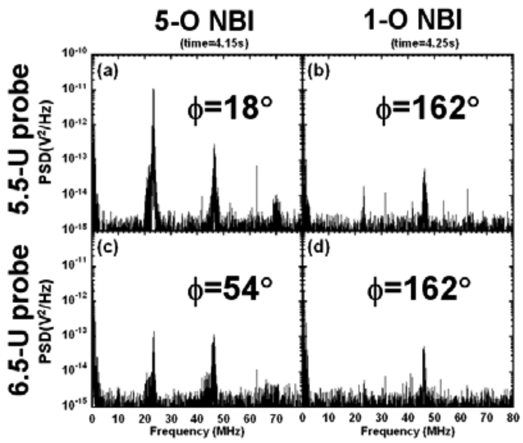

Fig. 3 Power spectral density (PSD) of ICEs measured in the timing of perpendicular NBIs.ϕ is the troidal angle between probe and perpendicular neutral beam port.