§43. ECE Measurement in High Density Plasma

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To obtain the ECE intensity two antennas have been used in the 4th experimental campaign on LHD. The ECEs collected by these antennas are transmitted to the 32 channel heterodyne radiometers, the 14 channel grating polychrometerr and the Michelson interferometer. Each detector can detect the fundamental O-mode or the second harmonics of the X-mode. The Michelson interferometer is absolutely calibrated using calibration source and thereby the electron temperature can be easily obtained from the ECE intensity in tenuous plasma.

In LHD plasma, decreases in ECE intensity with increasing density are observed as shown in Fig. 1. Although the density is considerably below the cut-off density the ECE intensities begin to decrease from its black body levels. This is noticeable in the ECE from the edge region (Fig. 1(b)). This tendency is observed in both modes (X and O) and in both antennas (the inboard side and the outboard side). The ECE measurement capabilities are mainly limited by following factors: diamagnetic effect, relativistic frequency broadening, changing in polarization state and dielectric effect. In the density region achieved in LHD the dielectric effect can't be ignored. Refraction is significant in the presence of high-density plasma and spreads the viewing pattern of beam. The optical system of our ECE diagnostic is based on the Gauss beam optics, and thus the spreading of beam will influence ECE intensity. Such effect can destroy the simple relation between ECE intensity and electron temperature. Refraction is depends on the geometric shape of plasma. Hence the heliotron type device has complex magnetic configurations the ECE propagation feature in LHD differs from that in Tokamaks. The ray tracing simulations suggest that the ECE emitted from the edge region in LHD plasma is easy to bend compared with that in Tokamak plasmas as shown in Fig.2.

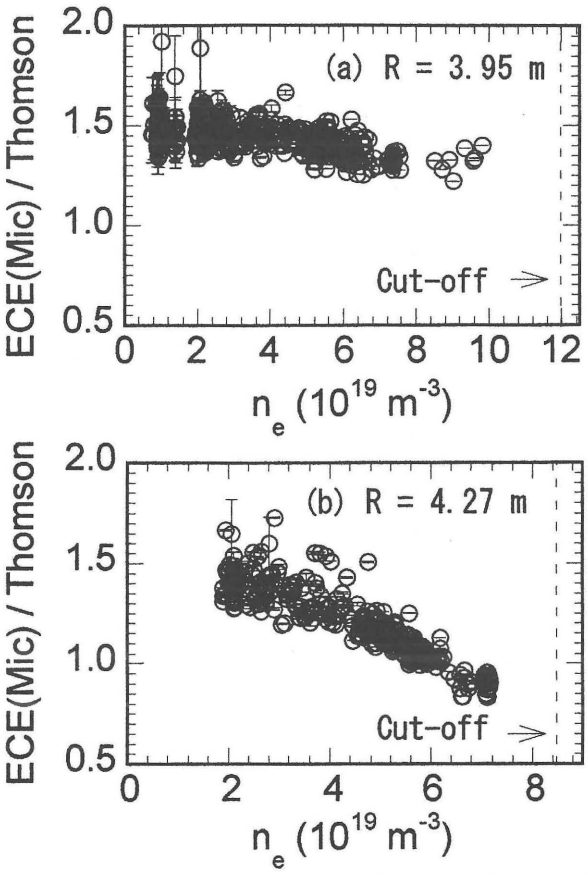

Fig. 1. Density dependence of the ECE intensity emitted from core (a) and edge (b).

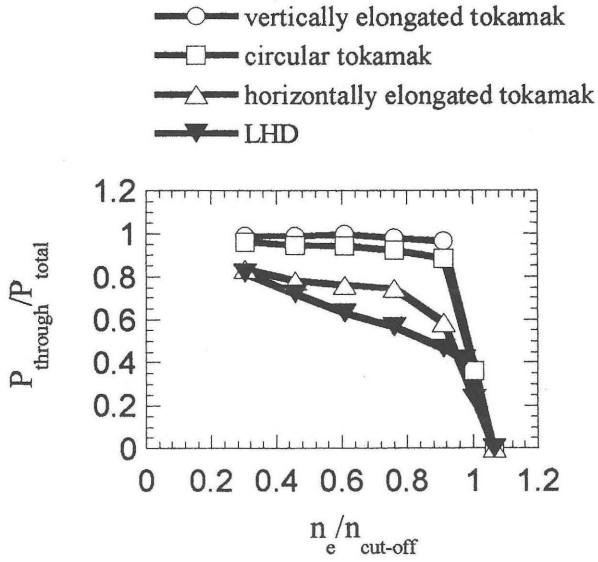

Fig. 2. Comparison of the normalized power detected by antenna in LHD with that in Tokamak.