§57. ECE Measurement with the Inner Mirror on LHD

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The LHD has two electron cyclotron resonance regions in the equatorial plane because the magnetic field strength does not change monotonically. The electron cyclotron wave, which is emitted from the electron cyclotron resonance region in the inboard side, is absorbed at the resonance region in the outboard side. Therefore, it is difficult to measure the electron temperature in the inboard region with an ECE diagnostic system installed in the outer port. Therefore, we installed a mirror in the inner port of the LHD in order to measure the emission of the electron cyclotron wave propagating inwards. This mirror is designed, based on the gaussian beam optics, and hence, the concept of the constant phase, proposed by S. Kubo et al.1) This means that the surface of the mirror is determined by the following optical condition; the microwave phase is kept constant, independently of the optical path through the mirror.

Figure 1 shows the ECE diagnostic system in the inner port in the third experimental campaign. The electron temperature in the inboard side was measured with the ECE inner mirror and two heterodyne radiometers. The fundamental ordinal mode of the ECE in the 52-84 GHz range is used for electron temperature measurement in the high magnetic field operation. The second harmonic extraordinary mode is used for the 116-148GHz range measurements. By using these frequency ranges, both modes become optically thick in the high field operation. The ECE mode is chosen with a universal polarization rotator. The ECE is polarized strongly because of the LHD magnetic shear. The degree of the polarization is determined by the angle of the magnetic field line to the equatorial plane at the edge of the plasma.2) Thus, the polarization rotator angle is set by using the magnetic field line calculated in the vacuum, to be matched with the polarization of the mode.

An example of the ECE measurement with the inner mirror is shown in Fig. 2. The closed circles show the data in the inboard side, obtained with the low frequency radiometer. The closed triangles are the data in the outboard side, taken with the GPC . The dotted line shows a fitting curve of the thomson scattering data. The ECE data are calibrated with the thomson scattering data.

By this study, the diagnostic range of the ECE measurement on LHD could be expanded to the inboard side of plasmas.

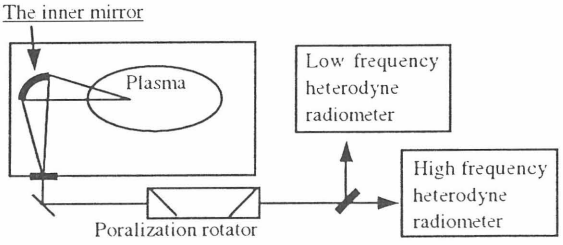

Fig. 1 Schematic diagram of the inner ECE diagnostic system

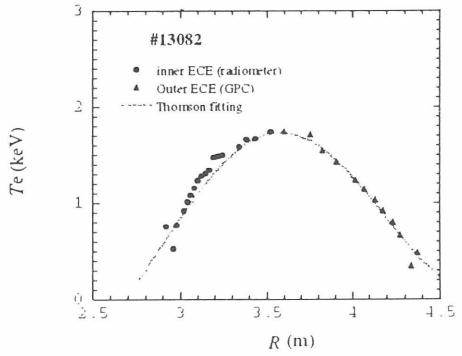

Fig. 2 A example of the ECE measurement with the inner mirror

References

1) S. Kubo et al.: Fusion Eng. Des. **26** (1995) 319.

2) P. C. de Vries et al: to be published in Fus. Eng. Design (2000).