§74. Measurement of the Emission from the Super Dense Core Plasma in the Second Harmonic Frequency Range with Use of the Transmission Line for ECH

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Electron Bernstein wave (EBW) heating in the second harmonic frequency range is attractive for the central heating in the super dense core (SDC) plasma in the LHD. Since the plasma cutoff and the upper hybrid resonance (UHR) layer are located near the core region, the EBW excited via the ordinary-extraordinary-EBW (O-X-B) mode conversion process is expected to be absorbed in the core region as the previous numerical examination suggested[1]. The thermally emitted EBW in the core region propagates and comes out to the outside of the plasma via the reversed path of heating if the detection angle of the antenna is set to obtain high O-X-B (B-X-O) mode conversion rate. With use of the transmission line for ECH that connects to an antenna installed in the 2-O horizontal port in the LHD, measurement of the emission originated from the EBW has been tried since 14th experimental campaign.

In the 15th experimental campaign, a double side band radiometer with use of a harmonic mixer was newly installed in one of the transmission line for ECH. The local signal of 15.3 GHz was input to the harmonic mixer. The emitted wave was input to the harmonic mixer through a high-pass filter (>140GHz). The range of the intermediate frequency (IF) f_{IF} of the harmonic mixer is DC < f_{IF} < 2.5GHz. The IF of 1< f_{IF} < 0.3GHz is amplified.

During the long time sustainment of the SDC plasma with a continuous hydrogen pellet injection, the emission of 153GHz wave was measured. Fig. 1 shows time changes of the electron density, electron temperature and measured emission signal. Just after the electron density exceeded the cutoff density for the first time, the level of the emission signal decreased to the thermal noise level. Without this moment, when the electron density near the plasma centre is higher than the cutoff density of 154GHz, the signal intensity was comparable to that when the electron temperature was similar and density was less than the cutoff density.

Fig.2 shows profiles of the electron temperature and the electron density. The electron density was higher than the cutoff density of 154GHz in only very narrow region in the central part. Fig.3 provides the projection of the cross section along the line of sight of the measurement to the R-Z plane, where R is the radial and Z is the vertical direction. If the width of the "over-dense" region where the electron density is higher than the cutoff density is narrow and considering the refraction of the wave, emission from the second electron cyclotron resonance (ECR) layer can be directly measured. For the target plasma SDC of higher central density is appropriate for measurement of the emission originated from the EBW.

1) Igami, H. et al.: Plasma Sci. Technol. **13** (2011) 405

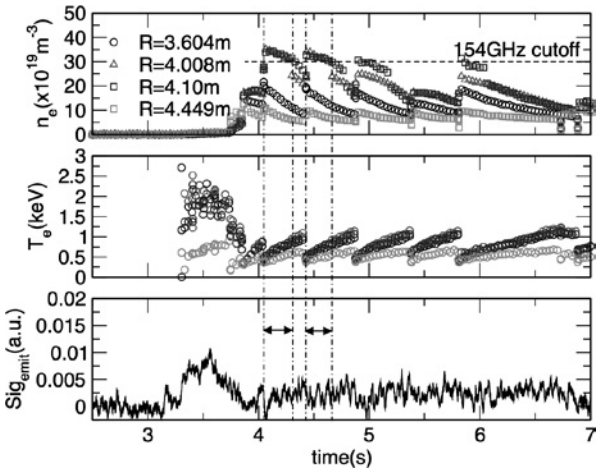

Fig.1. (From the top) Time changes of the electron density, electron temperature and the emission signal measured by double sideband radiometer

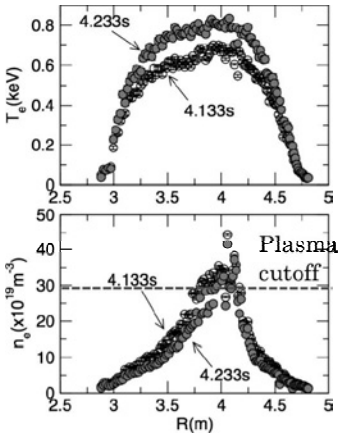

Fig. 2. Profiles of the electron temperature and electron density at t=4.133s and 4.233s.

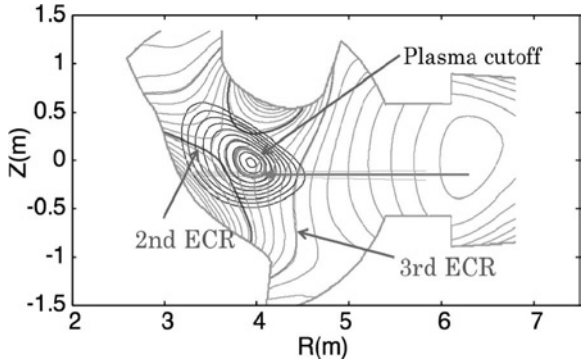

Fig. 3. Plasma cross section along the line of sight of the measurement projected to the R-Z plane.