§10. Electron Bernstein Wave Heating in High Dense Plasma and Observation of the Parametric Decay Instability during the Power Injection

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Evidences of the electron cyclotron heating by the electron Bernstein wave (EBW) excited via the ordinary-extraordinary-EBW (O-X-B) mode conversion process have been observed in highly dense plasma generated by hydrogen pellet injection. For both cases of the 77GHz, 1MW electron cyclotron (EC) wave launching toward the vicinity of the theoretically predicted O-X-B mode conversion windows in toroidally-clockwise and toroidally-counter-clockwise directions, increase of the stored energy was observed. Spectrums of the parametric decay waves that indicate the excitation of the EBW were obtained in high (EC) frequency range and low (~1GHz) frequency range during the EC wave injection.

Fig. 1 shows the view from the final mirror of the quasi-optical horizontal launching antenna of the electron cyclotron (EC) wave. There are two theoretically predicted "O-X-B mode conversion (MC) windows" that can be aimed from the antenna in the toroidally-clockwise (CW) and toroidally-conter-clockwise directions. By launching toward the MC window, the excitation of the EBW is expected. In the experiment, the actual O-X-B mode conversion windows were looked for with changing the aiming point around the predicted MC windows shot by shot. Ranges of the aiming point scanning are indicated by dashed line in Fig. 1. Inside the ranges the theoretically predicted contours of the O-X-B mode conversion rate more than 10% are plotted. In Fig. 2, the gradient of the stored energy in the decay trend changed after the EC wave was launched toward the x-mark inside the region "Ⅱ". At that time, the

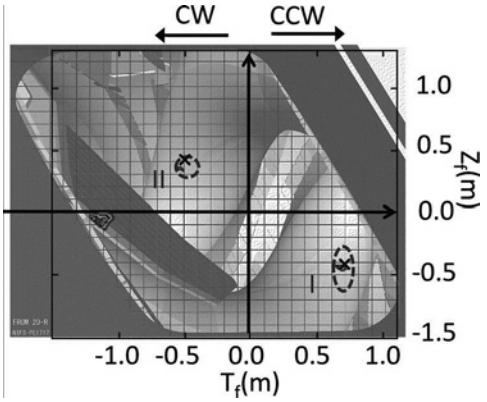

Fig. 1 View from the horizontal antenna, ranges of aiming point scanning (dashed line), contours of the O-X-B mode conversion rate.

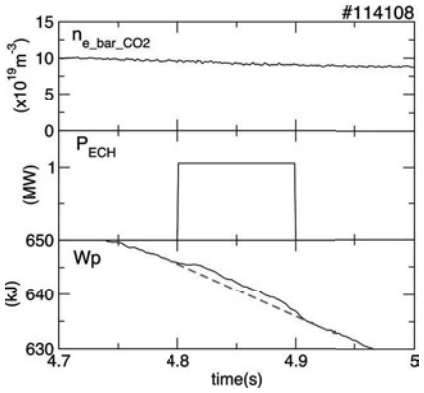

Fig. 2 Time changes of the line averaged density, launched EC wave power, stored energy.

central electron density was 20 x $10^{19}m^{-3}$. When the EC wave was launched toward the x-mark inside the region " I ", gradient of the stored energy also changed similarly.

In the same discharge shown in Fig. 2, EC wave was launched also in the different time window. When the central electron density was 50 x $10^{19}m^{-3}$, high frequency spectrum of the parametric decay wave was observed during the EC wave injection (4.0-4.1s) toward the same aiming point as the case of Fig. 1. In Fig. 3 every several 10MHz, peaks of the spectrum were observed. These several 10MHz frequencies coincide the harmonics of the ion cyclotron frequency range. Low frequency spectrum of the parametric decay wave was also observed in the same time window. In Fig. 4, two peaks were observed in the lower hybrid wave frequency range. These high and low frequency spectrums indicate that the X-mode reaches the upper hybrid resonance layer although clear change of the stored energy was not seen in this time window. In the same time window as shown in Fig. 2, wave spectrums were not measured because of the restriction of the spectrum data acquisition.

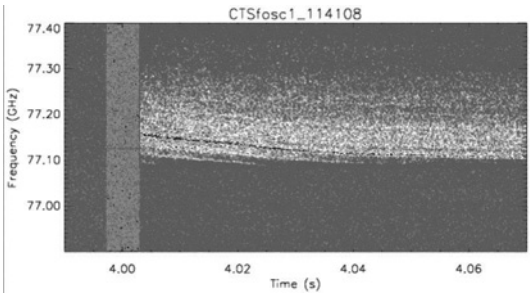

Fig. 3 High frequency spectrum measured by heterodyne radiometer during EC wave injection.

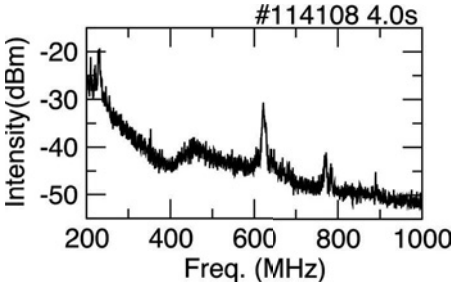

Fig. 4 Low frequency spectrum measured by discone antenna during EC wave injection.