§13. Active and Passive Surveys of the O-X-B Mode Conversion Window in over Dense Plasmas

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In over dense plasmas where the electron density near the electron cyclotron resonance (ECR) layer is higher than the cutoff density of the electron cyclotron (EC) wave, the optimum injection condition to excite the electron Bernstein wave (EBW) via the O-X-B mode conversion process was surveyed actively and passively.

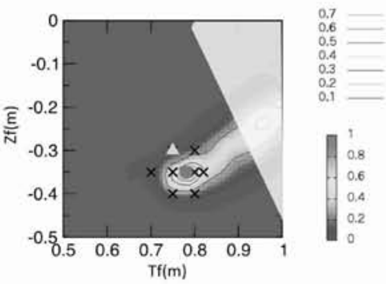


Fig. 1 : Contour plot of the OXB mode conversion rate T_{OXB} and aiming points in the experiment

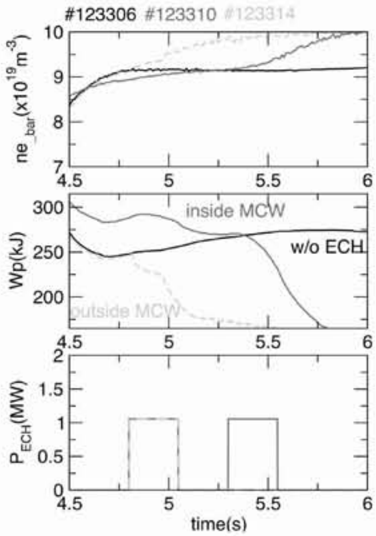


Fig. 2 : Time changes of the line averaged density, stored energy and ECRH power. Increase of the stored energy was observed during EC wave injection toward inside region of the OXB mode conversion window.

In the active survey, with changing the aiming of the EC wave launched from a horizontal port antenna shot by shot in a magnetic configuration $(R_{ax}, B_t) = (3.75\ m, 2.64\ T)$. In Fig. 1, a contour plot of the predicted O-X-B mode conversion rate T_{OXB} and the settings of the aiming in the experiment are shown. For the case of aiming inside the O-X-B mode conversion window where $T_{OXB} > 0$ marked with a circle (●), increase of the stored energy was observed after the start of the ECH pulse as shown in Fig. 2. However, the heating efficiency was only *10 %* that is less than the predicted T_{OXB}. For the case of aiming outside the region $T_{OXB} > 0$ marked with a triangle in Fig. 2 (▲), the stored energy decreased after tuning on the ECH. Moreover increase of the electron density terminates the discharge. The stray EC wave that is reflected at the cutoff without coupling to the EBW may hit the wall and cause the impurity contamination. As possible reasons of the lower heating efficiency than the predicted T_{OXB}, a poor coupling of the incident power to the O-mode because of mode coupling effect in the plasma boundary region and reduce of T_{OXB} by the existence of the density fluctuation at the plasma cutoff can be pointed out.

In the passive survey, the aiming of the lower port antenna to receive the emission from the over dense plasma was changed shot by shot. Fig. 3 shows the change of emission intensity of *77.2 GHz* when the aiming was set at the boundary of the predicted mode conversion window. After the impurity gas puffing at *5.3 s*, the electron temperature obtained by Thomson scattering measurement once increased over wide region then decreased gradually. However the time trend of the emission intensity did not correspond to that of the electron temperature at any locations. Fig. 4 shows the changes of electron temperature and density profiles. Compared to the drastic change of the temperature profile, the density profile did not change significantly. It should be investigated that the change of T_{OXB} with change of the density profile can explain the change of emission intensity. It also should be investigated how the measured region was shifted with the change of the density profile.

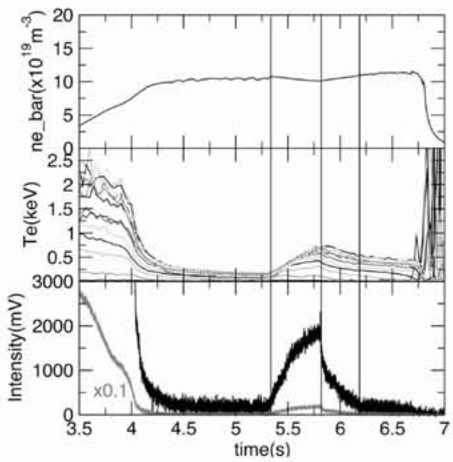
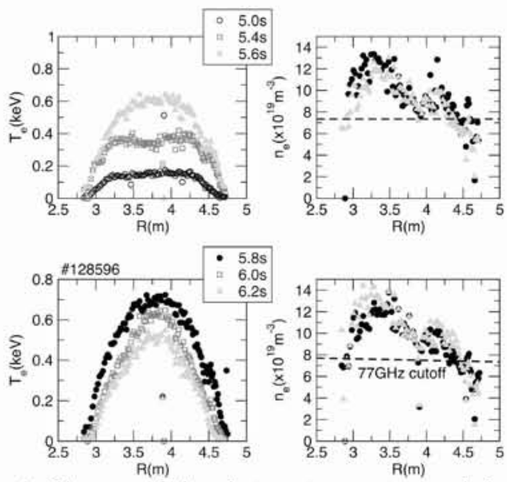


Fig. 3: (From the top) Time changes of the line averaged density, electron temperature for various measured points and emission intensity.



Fog. 4: Changes of the electron temperature and density profiles after *5.0 s*.