§12. ECH Power Modulation Experiments

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One of the most important features of the ECH is the controllability and locality of the power deposition profile. The antenna system for LHD is designed to fully utilize this feature. The microwave beam from the antenna system installed on LHD is focused so as the waist size to be 15 mm on the mid-plane of LHD. Total power absorbed in the plasma is the key parameter in the global plasma confinement discussion. Furthermore, it is important to deduce the power deposition profile experimentally for the transport analysis. One of the gyrotrons (CPI#2R) is modulated in square wave mainly to deduce power deposition profile. The responses of the local electron temperature are measured by the second harmonic electron cyclotron emission, 32-channel ECE radiometer. .Fig.1 shows one of the examples of modulated ECE intensities. Here, the input power is square wave modulated with the frequency of 50 Hz. Some channels suffer from the spike noise from spurious modes excited in the gyrotron during the turning on and off phase.

The effect of diffusion smears out the power deposition profile for such analysis. In principle, the difference of the time derivative of the local electron temperature between just before and after one of the turn on phase gives the local deposited power. The estimation interval of the time derivative of the electron temperature is the critical parameter to reject the diffusion effect on the estimation of the power deposition profile. In Fig.2 is shown the three cases of interval of the estimation of the time derivative. It is clearly seen that the time interval of 2 ms is too long for the correct estimation of the power deposition profile. The data points start to be scattered when the interval is less than 0.5 ms. Three cases for the different focal positions are analyzed with the interval of 0.5 ms.. Fig.3 shows the example of deduced power deposition profile. ECE signals corresponding to the central region within the normalized minor radius $\rho<0.15$ is blocked due to the direct stray from the gyrotron. Although the absorbed power in the central region is ambiguous, it is clear that the power deposition profile is changed by varying the focal position of injected beam, especially in the case where no one path absorption is expected (R_f=3.80m).

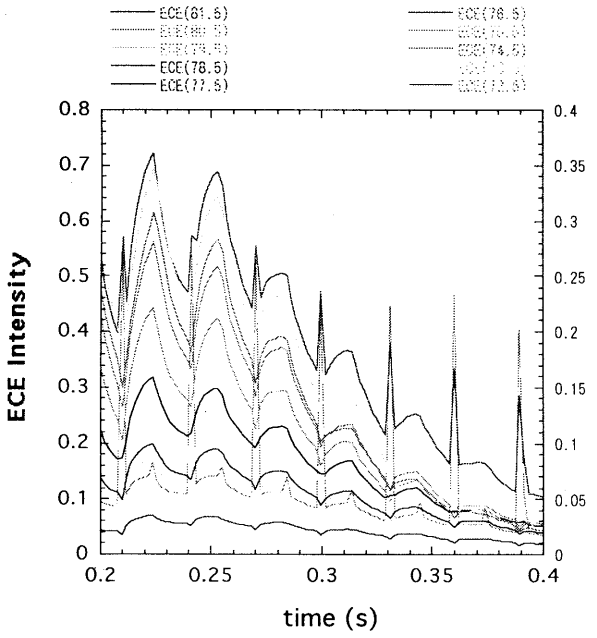

Fig.1 Modulated ECE intensity during ECH power modulation experiment.

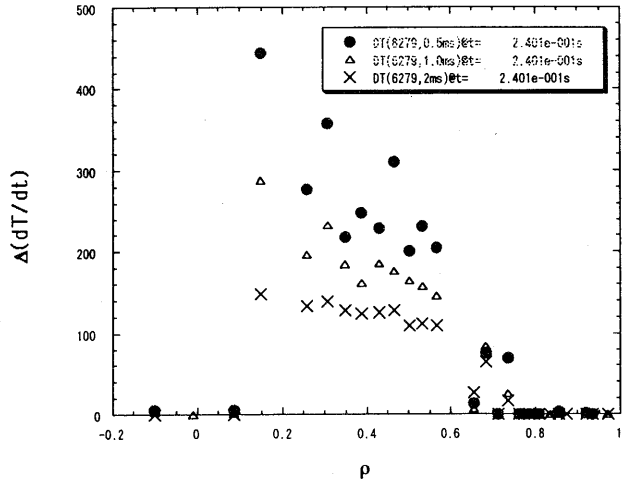

Fig. 2 The effect of diffusion on the analysis of power deposition profile. Closed circles, open triangles and crosses correspond to the cases of time interval for the analysis 0.5,1.0 and 2.0 ms, respectively.

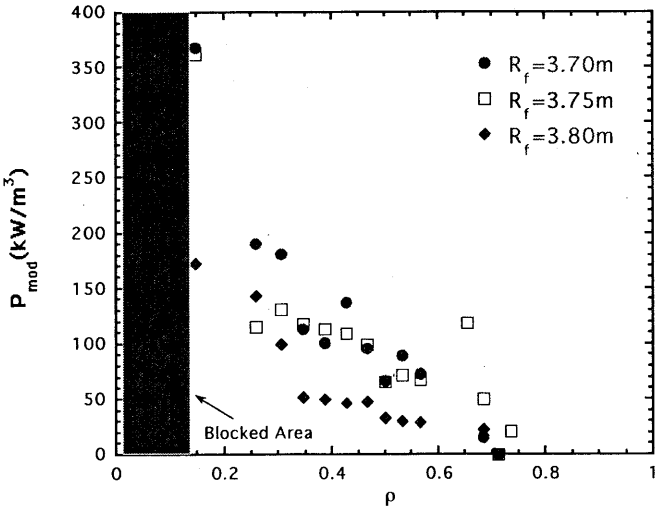

Fig. 3 Deduced power deposition profile for different focal positions.