§37. First Observation of Parametric Decay Spectrum in Lower Hybrid Wave Frequency Range in an Experimental Configuration for Electron Bernstein Wave Heating

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Excitation of electron Bernstein waves (EBWs) is possible in LHD by extraordinary (X) wave injection from the high magnetic field side (X-B method). If X-waves can reach the upper hybrid resonance (UHR) layer, they can excite EBWs via linear mode conversion process. However, since X-waves propagating obliquely to the external magnetic field are absorbed at the fundamental ECR layer before they reach the UHR layer, if the electron temperature and the electron density are as high as certain levels there. Therefore evidence that X-waves reach the UHR layer is required to certify that EBWs are excited. In the UHR layer, parametric decay instability can be induced via nonlinear coupling process with X-waves since the group velocity of the waves becomes very slow there. Therefore if a parametric decay spectrum is observed, that suggets, that at least, a part of the injected X-waves reaches the UHR layer.

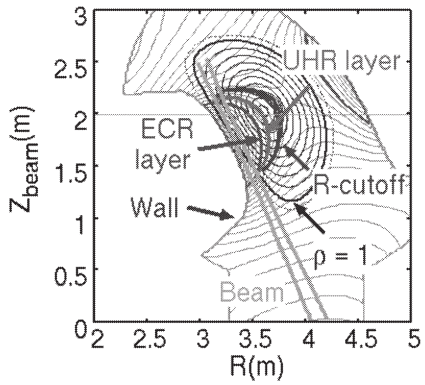

Fig.1: Contours of flux surfaces (ρ = 0.1, 0.2~ 1.0), positions of the UHR layer, the ECR layer, right handed (R) cutoff, beam trajectory.

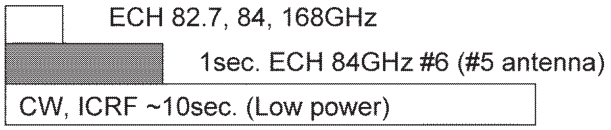

Fig. 2 : Power input pattern of ECH and ICRF heating.

We used a mirror antenna of #5 transmission line for X-B method for the first time. Fig.1 shows the experimental configuration, where the position of the magnetic axis, R_{ax}=3.6m and the magnetic field at the axis B_{ax}=2.75T. Although the injected beam can access the UHR layer from the high field side, the fundamental ECR layer is located in front of the UHR layer. Fig.2 shows the power input pattern of electron cyclotron heating (ECH) and ion cyclotron resonance frequency (ICRF) heating. The target plasma was initiated by ECH and sustained by ICRF heating. About 100kW of ECH power was injected in the manner for 1 sec, as shown in Fig.1. Fig. 3 shows a wave frequency spectrum in the lower hybrid (LH) wave frequency range measured by a loop antenna installed in 2-I port. This type of spectrum was obtained in the case of X wave injection. In the case of ordinary (O) wave injection, this type of spectrum was not observed.

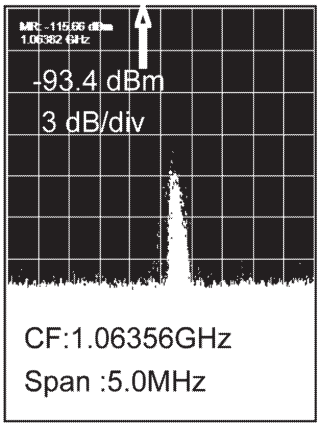

Fig.3:
Wave frequency spectrum around the LH wave frequency range. The center frequency was set at 1.06356GHz.

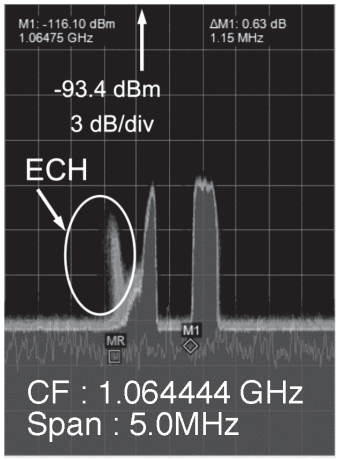

Fig.4:
Wave frequency spectrum around the LH wave frequency range. The center frequency was set at 1.06444GHz. The peak circled appears during ECH power injection.

Fig.4 shows a wave frequency spectrum around the LH wave frequency range when the more ICRF power and neutral beam was injected for 10sec and ECH power injection for 1 sec. Two peaks appeared in the frequency spectrum around the LH wave range frequency during ICRF power injection and NBI. One more peak appeared in addition to these two peaks during ECH power injection in the same manner as shown in Fig.1. These results suggest that parametric decay waves were excited by X wave injection from the high field side and EBWs can be excited in this manner.