§1. Excitation Experiments of Electron Bernstein Waves on the Internal Coil Torus Device

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1. Introduction

The internal coil device Mini-RT has been constructed to confine high beta plasma with planetary magnetic field, which is made by magnetically levitated superconducting magnet coil. This device enables overdense plasma production for electron cyclotron heating[1], which is thought to be caused by electron cyclotron harmonics heating with electron Bernstein waves (EBW) that have no cutoff density and are mode-converted from electromagnetic waves.

We have detected electrostatic waves with short wavelength that is a feature of EBW[2,3]. In addition, by using magnetic loop antennas, electromagnetic mode waves have been measured, in order to investigate characteristic of propagation and mode conversion of electromagnetic waves.

2. Equipments for wave measurements

In the Mini-RT device, electric field has been measured by interferometry with monopole antennas. In addition, electromagnetic field has been measured with magnetic loop antennas. Three orthogonal oriented loop antennas were set in order to measure three components of magnetic field (radial, toroidal and poloidal field). Measurements were carried out with moving antennas in radial way. Figure 1 shows measurement systems.

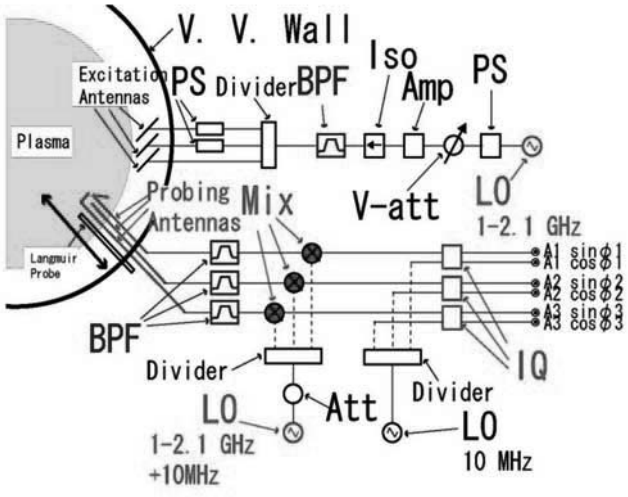

Fig. 1 Block diagram to measure wave characteristics by means of interferometry

3. Experimental results

Figure 2(a), (b), and (c) shows plasma density profile, electrostatic mode profile measured with a monopole antenna, and electromagnetic mode profile measured with a loop antenna, respectively. In Fig.2 (b), electrostatic mode with short wavelength is shown in higher density area than UHR area, which is suggested EBW mode-converted from electromagnetic waves. On the other hand, in Fig.2(c), where measurement results with loop antenna (red and blue lines are sine and cosine elements of amplitude) are shown, long wavelength mode is observed in the lower density area than UHR region, and this mode is electromagnetic wave mode (slow X mode) excited by antennas on the outside of plasmas.

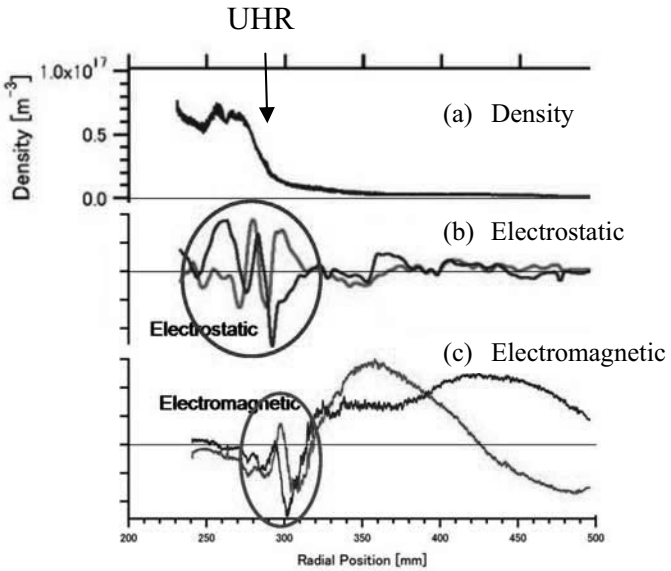

Fig. 2 Direct measurements of electrostatic and electromagnetic wave fields

Furthermore short wavelength mode is also shown near UHR. Then both EBW and X mode wave which is reflected at L-Cutoff exist near UHR. Dispersion relation at this area is shown in Fig.3 and it shows X mode wave exist at UHR on the eve of mode conversion. Therefore the short wavelength mode in Fig.2(c) can be identified with this X mode wave.

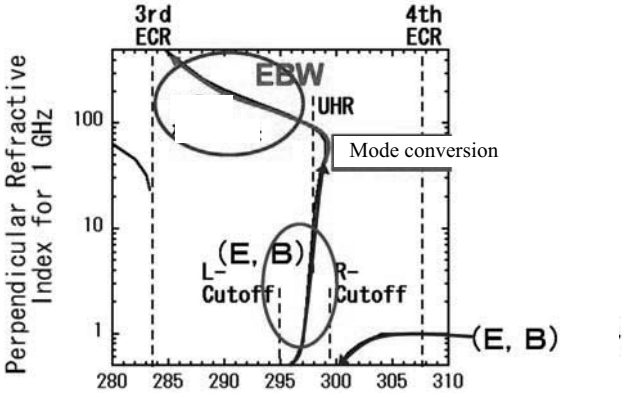

Fig. 3 Dispersion relation of electromagnetic X- and O-modes, and electrostatic EBW mode.

[1] T. Goto, *et al*., Jpn. J. Apl. Phys., **45**, 5197 (2006).
[2] E. Yatsuka, *et al*., Rev. Sci. Instrum. **80**, 023505 (2009).
[3] E. Yatsuka *et al*., Plasma Fus. Res. **3**, 013(2008).