§1. Experiments on the Excitation of an Electron Bernstein Wave in the Internal Coil Device

Ogawa, Y., Morikawa, J., Uchijima, K., Honda, A., Okabe, K., Makino, W. (Graduate School of Frontier Sciences, Univ. Tokyo)

1. Introduction

The Mini-RT device, which has been constructed to confine high beta plasma with magnetic field like a planet, is an internal coil device. In this device, so-called overdense plasmas have been observed, and study on Electron Bernstein Waves (EBWs), which has no cut-off density, is conducted. In order to examine mode conversion in Mini-RT experiments, we are trying to investigate propagation of waves at Electron Cyclotron Range of Frequencies (ECRF) in overdense plasmas.

In the Mini-RT device, the plasma is produced by Electron Cyclotron Heating (ECH) with continuous X-mode microwaves at 2.45 GHz, 2.5 kW. The plasma confinement region can be changed easily by applying levitation coil current. The diagnostic microwave with a frequency lower than 2.45 GHz is injected to measure propagation of waves in overdense plasmas. In this work, diagnostic wave of X-mode with 1 GHz and 10 W is injected from low field side.

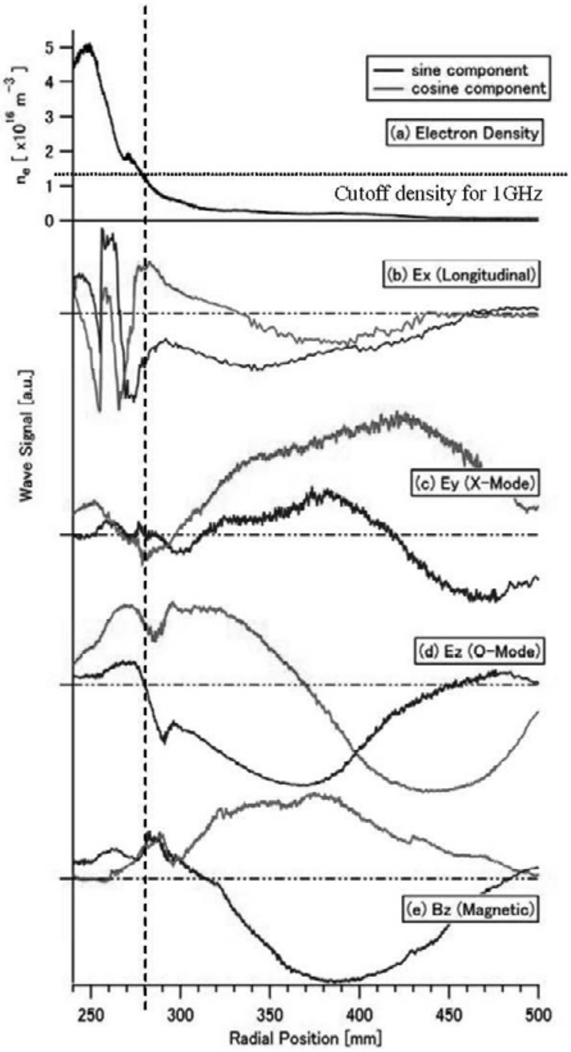

Fig.1Electron density and probe measurements.

2. Experimental results

In order to examine mode conversion of waves from electromagnetic mode to electrostatic one, three kinds of probes are inserted, i.e. pole-antennas (for electric component), loop-antennas (for magnetic component) and triple probe (for density). Interferometry system is introduced to obtain the snapshot of electric or magnetic field. Probing antennas detect the injected diagnostic microwaves and send them to the mixer. They are modulated by IQ demodulators and output as sine and cosine components that have information of the amplitude and the phase of electromagnetic field.

Figure 1 shows density profile measured with triple probe, sine and cosine components of wave signals measured with probing antennas. Cutoff density for 1.0 GHz microwave is 1.24×10^{16} m^{-3}, i.e., inner region than major radius R ～ 280 mm is the evanescent region for diagnostic microwaves, and the Upper Hybrid Resonance (UHR) is located at the outer region of the core plasma (R ～ 290 mm). In electromagnetic field measurements, i.e. (c), (d) and (e), a long wavelength mode is observed in the lower density area than UHR region, and this mode corresponds to an electromagnetic wave mode excited by excitation antennas on the outside of plasmas. Meanwhile, as shown in Fig.1 (b), in radial electric field measurement, short wavelength mode is observed in higher density area than UHR region, i.e. this mode wave is able to propagate in the evanescent region and excited around the UHR region. In this area, electromagnetic mode waves are damped down, which suggests that the short wavelength mode waves shown in Fig.1 (b) are electrostatic mode ones and excited by conversion from electromagnetic mode ones.

Figure 2 shows radial profiles of the phases of Fig.1 (b) and (e). Phase is a function of spatial position and length of transmission lines, and the gradient of the phase gives the wave number vector. As shown in Fig.2, a reversal of the gradient of phase has been confirmed around the UHR in electrostatic mode wave. This suggests a change of the direction of phase velocity, and Figure 2 shows the opposite direction of phase velocity at R<255 mm and 260mm<R<280mm to that at other region, so this electrostatic wave is a backward wave.

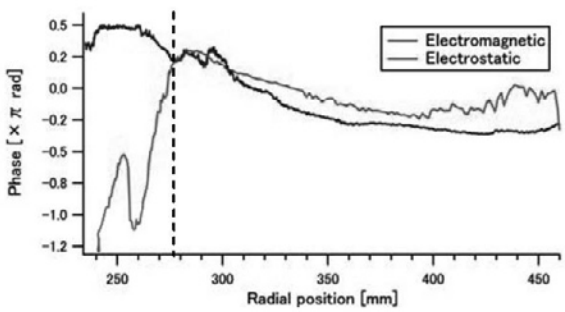

Fig. 2 Phase profiles of electromagnetic and electrostatic components.