§3. ICRF Wave Excitation and Propagation in the GAMMA 10 Tandem Mirror

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The waves in the ion-cyclotron range of frequency (ICRF) are widely used for the plasma production, heating, and the stabilization of the magneto-hydrodynamic (MHD) instabilities. In the present tandem mirror experiments, the operation on the high density plasmas above 10^{19} m^{-3} is one of the most important subjects. Although the high ion temperature above 10 keV has been realized in GAMMA 10, the density is relatively low on such a high performance discharge [1]. The plasma production depends on the wave excitation in the plasma. In the present experimental conditions, the inhomogeneous scale length of the plasma and the magnetic field configuration is in the same order of the wavelength. Then, the wave excitation is strongly affected by the boundary conditions and the eigenmodes are formed in both radial and axial directions. The formation of the eigenmodes in GAMMA 10 has been studied computationally by using a full-wave code [2, 3].

Recently, a wide-band RF probe system is newly constructed in the GAMMA 10 tandem mirror for studying the eigenmode formations of excited waves experimentally [4]. A bar-type antenna is installed in the peripheral region in the anchor cell. The low power RF pulse is applied to the antenna via a wide-band impedance matching network. The applied frequency is swept between 8 and 20 MHz. The current on the antenna and the excited waves in the plasma are measured. The formation of eigenmodes is described by using the antenna-plasma and plasma-probe complex transfer function. The transfer function can be directly obtained from the complex amplitude of the excited wave by dividing that of the current on the antenna. The aim of this work is to establish experimental method for investigating the eigenmode formations, and to confirm the validity of the results from numerical studies.

In the experiment, the first experimental results are presented for the active diagnostic of the eigenmode formation in the minimum-B anchor cell of GAMMA 10. In this frequency range, several discrete peaks are clearly observed, which are indicating the large enhancement of the excited wave fields. To confirm the resonant excitation of the eigenmodes, the real and imaginary parts of the complex transfer function are introduced. The frequency dependence of the real and the imaginary part of the complex transfer function are shown in Fig. 1. As shown in the figure, significant changes can be seen on the frequencies of each peak. In this region, launched waves are thought to be primarily on the fast wave branch in the cold plasma theory.

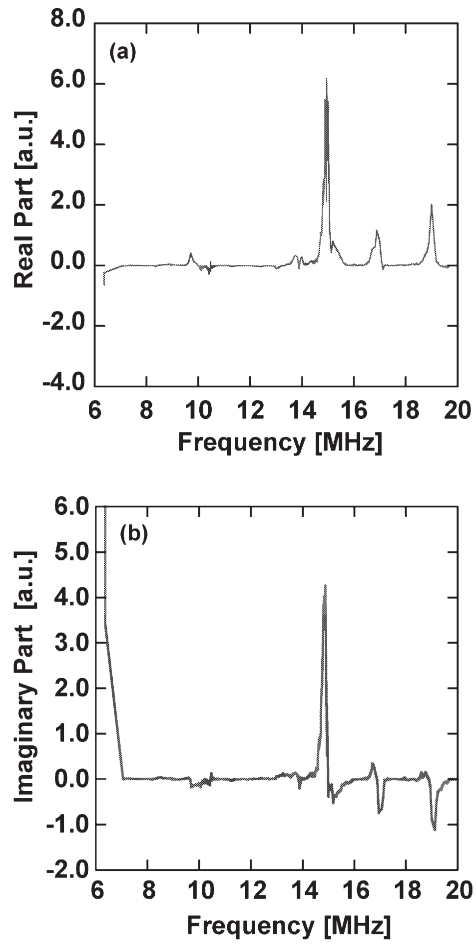

Fig.1 Real (a) and imaginary (b) parts of the complex transfer function between the antenna and the magnetic probe.

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