§8. Excitation of RF Waves in GAMMA 10 and in the Local Magnetic Mirror Configuration on LHD

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In magnetically confined plasmas, fluctuations in the ion cyclotron range of frequency (ICRF) will be driven by the presence of non-thermal ion energy distribution. In a typical discharge on the GAMMA 10 tandem mirror, Alfvén-ion-cyclotron (AIC) modes are spontaneously excited due to strong temperature anisotropy [1]. On the while, in fusion-oriented devices with a toroidal configuration, the neutral beam (NB) injection and high power ICRF are commonly used to create high performance plasmas. Resultant high-energy ions are trapped in the local mirror configuration and will form the velocity distribution with the strong anisotropy. Especially in burning plasma experiments on JET and TFTR, fusion-product (FP) ions will form the non-thermal ion energy distribution in the bulk plasma and the ion cyclotron emissions (ICEs) have been observed [2,3]. To study the relation among the AIC-modes, beam-driven electrostatic instabilities and ICEs in the magnetically confined plasmas with non-thermal energy distribution is the main purpose of this work. In LHD, the measurement of fluctuations in the ion cyclotron frequency range has been started in the high power ICRF and the perpendicular NB injection experiments.

In GAMMA 10, plasmas with a strong temperature anisotropy are produced when the strong ICRF heating is applied. The temperature anisotropy is measured by using a diamagnetic loop array installed in the axial direction. Spontaneously excited modes in the fundamental ion cyclotron frequency and higher harmonic frequency range have been measured with magnetic probes. The AIC modes are excited as eigenmodes in the axial direction. Figure 1 shows the temporal evolution of the frequency spectrum of excited AIC-modes. The amplitude is represented by the brightness. The plasma parameters are indicated in Fig.2. It is clearly observed the frequency moves depending on the plasma parameters.

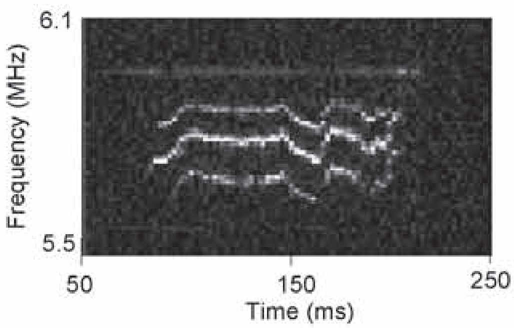

Fig.1 Temporal evolution of AIC-modes. The amplitude is represented by the brightness.

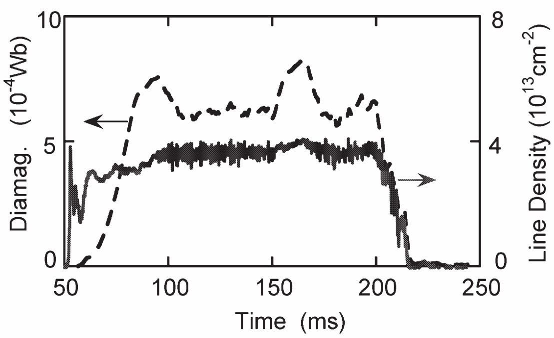

Fig.2 Temporal evolution of line density and diamagnetic signals on the same discharge in Fig.1.

To evaluate the excitation of the higher harmonic waves, the dispersion relation of the electromagnetic waves in hot plasmas with the temperature anisotropy has been solved. It is verified the waves in the fast Alfvén wave branch become unstable due to the temperature anisotropy. Figure 3 shows the growth rate of the slow and fast Alfvén waves in plasmas with the temperature anisotropy. The growth rate is represented by the brightness. Near higher harmonic resonance layers, the fast Alfvén waves are destabilized in large perpendicular wave numbers and small parallel wave numbers. It is clearly shown the amplitude of the fundamental AIC-modes is extremely large compared with that of higher harmonic modes.

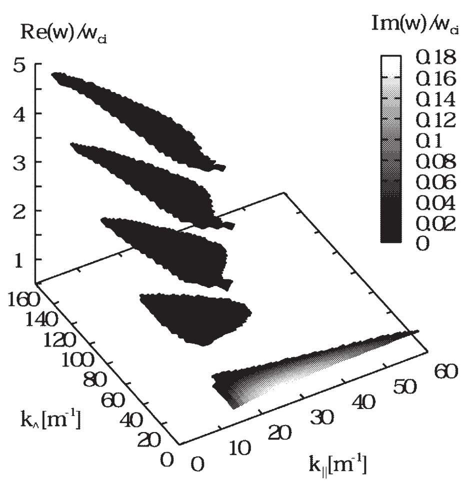

Fig.3 The growth rate of slow and fast Alfvén waves in the plasma with the temperature anisotropy.

REFERENCES

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