§17. Alfven Eigenmodes in the NBI Heated Plasmas of CHS

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Recently, toroidicity-induced Alfven eigenmodes (TAE) are studied in large Tokamaks during NBI or ICRF heating. In turn global Alfven eigenmodes (GAE) are detected in W7-AS characterized by almost no magnetic shear. In CHS having moderate magnetic shear, we are investigating characteristics of Alfven eigenmodes.

In CHS the mode with relatively high frequency (>40kHz) has been observed during NBI heating, where we call " HF modes ". Figure 1 shows comparison of measured frequencies with calculated TAE frequencies ($V_A/4\pi R_0 q$), where q=3 is assumed at the central region of a plasma. By changing the toroidal magnetic field, electron density and mass of the plasma ion species (H or D), the observed frequencies are found to be in proportion to the Alfven velocity $V_A=B_t/(n_i m_i \mu_0)^{1/2}$.

The HF modes decay faster than the usual lower frequency pressure driven modes when the NBI is switched off. Moreover, in ECH plasmas the HF modes have never been observed. This suggests that theHF modes are driven by energetic ions of NBI. Figure 2 shows the power spectrum of magnetic fluctuations of HF modes for different NBI power levels.

We predict the TAE gap for a cylindrical geometry, where we use the electron density profile measured by Thomson scattering and the rotational transform profile calculated with 3D equilibrium VMEC code(Fig.3). The toroidal mode number of the HF modes is identified to be n=2 with magnetic probes arranged in the toroidal direction. The calculated frequency of the TAE mode is close to the observed HF mode frequency, where the gap position is at r/a~0.1. It is confirmed from a soft X-ray detector array that the HF modes are localized near the plasma center(r/a<0.2).

From these experimental results it is concluded that the observed HF modes are TAE mode.

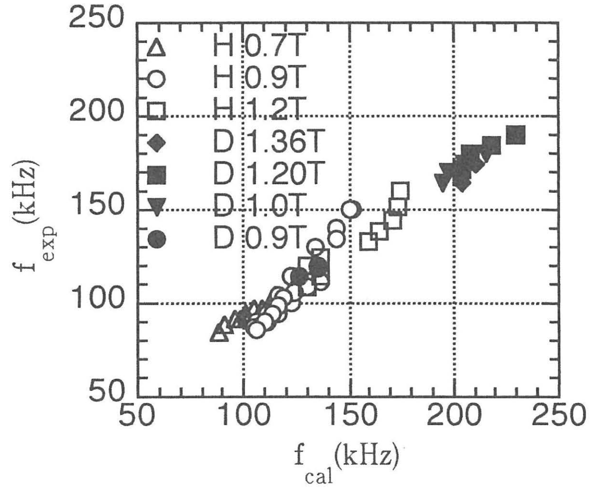

Fig.1 Comparison of observed frequencies f_{exp} with calculated TAE frequencies f_{cal}

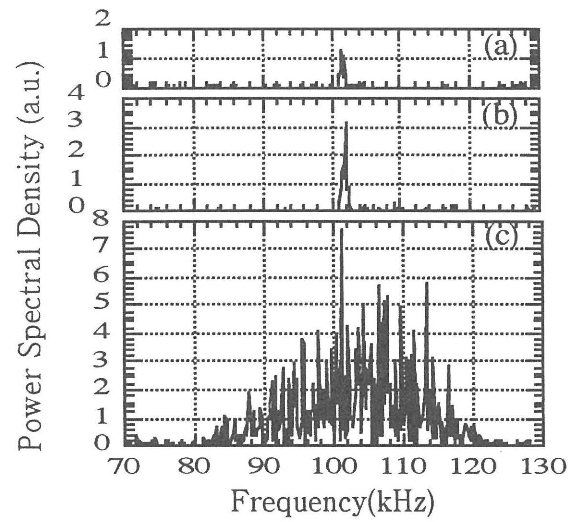

Fig.2 Variation of frequency spectra with NBI power (a) 0.4MW (b) 0.57MW (c) 0.78MW

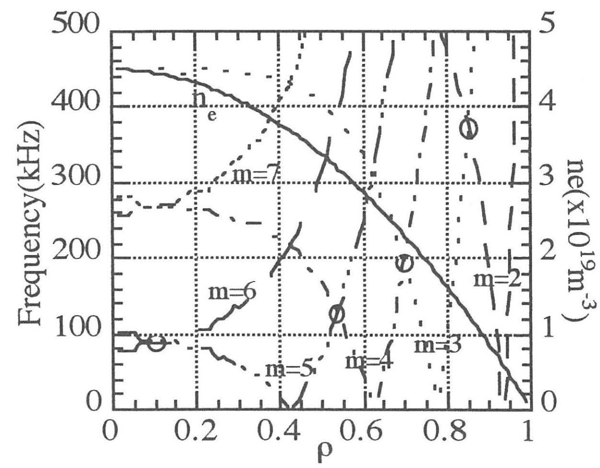

Fig.3 Alfven continua for various poloidal number m, where n=2. Circles denote the TAE gap.