

§19. Coherent Magnetic Fluctuations Observed During Neutral Beam Injection

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Global modes such as toroidicity-induced Alfvén eigenmode (TAE) and global Alfvén eigenmode (GAE) destabilized by energetic particles have received increasing attention, because they may seriously degrade confinement of alpha particles in a fusion device.

In CHS we study possibility of excitation of TAE and GAE in NBI heated plasmas, modifying the rotational transform profile by the net plasma current in NBI heated plasmas. We have analyzed magnetic fluctuations, detected with a movable magnetic probe array [1] in NBI heated low-beta plasmas at the relatively low toroidal field of $B_t=0.7-1.2\text{T}$. In these plasmas the ratio of injected neutral hydrogen beam velocity to Alfvén velocity is in $v_b/v_A=0.15-0.5$. Figure 1 shows power spectral density of poloidal magnetic fluctuations detected at $\langle r \rangle / \langle a \rangle \sim 0.93$, and the coherence with fluctuations detected at $\langle r \rangle / \langle a \rangle \sim 1.08$. In the frequency range of 80-110kHz coherent magnetic fluctuations are clearly observed. The lower frequency components ($\leq 80\text{kHz}$) are thought to be usual pressure driven modes [1]. The frequency of the coherent mode is decreased with the increase in electron density during the discharge. It is very interesting to investigate how the fluctuation amplitude of the coherent mode behaves after switching NBI pulse off. Figure 2 shows time behavior of the coherent mode amplitude in the range of $f=70-120\text{kHz}$ together with usual pressure driven modes observed in $f=10-60\text{kHz}$. The coherent mode is rapidly suppressed less than 0.5ms after switch-off of NBI, where the global energy confinement time is about 2ms. The usual pressure driven modes persist for $\sim 3\text{ms}$. Excitation of the coherent modes seems to be closely related to the presence of energetic particles. We have studied the dependence of the observed frequency on electron density and toroidal magnetic field as shown in Fig. 3. The frequency exhibits the same dependence on the Alfvén velocity.

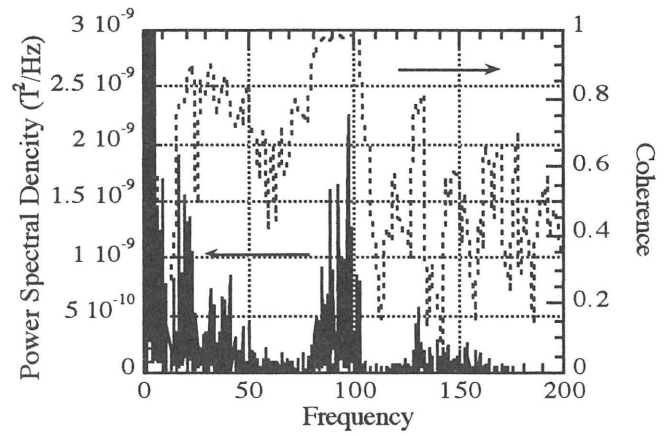


Fig. 1 Frequency spectrum of poloidal field fluctuations and its coherence in a deuterium plasma heated by co-injected NBI, where $B_t=0.9\text{T}$ and $\bar{n}_e = 1.7 \times 10^{19} \text{m}^{-3}$

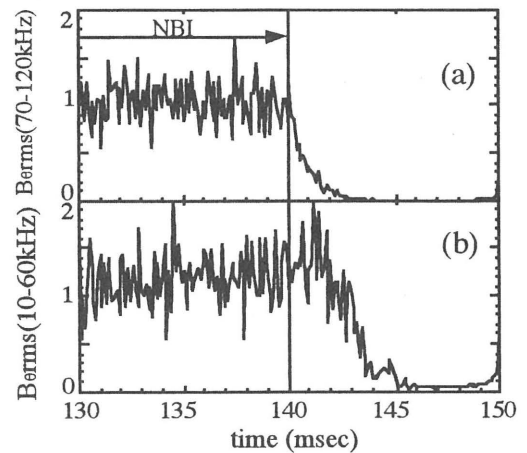


Fig. 2. Time behavior of rms. amplitude of the coherent mode (a) and usual pressure driven modes (b) after switching NBI off, where the amplitudes are averaged over 0.1ms.

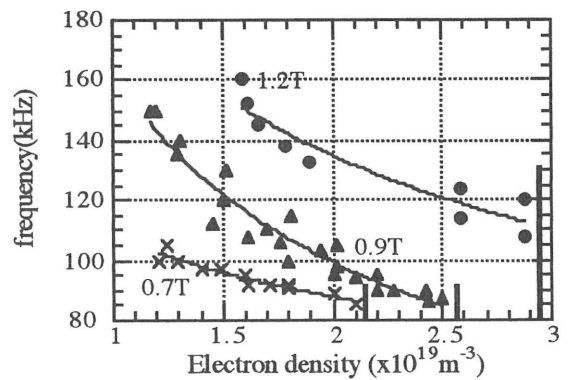


Fig. 3 Dependence of the observed frequency on electron density and toroidal magnetic field. In the density above the vertical line for each toroidal field the coherent mode is suppressed.

[1] T. Oike et al., this issue.