§ 11. Observation of Coherent Magnetic Fluctuations in the Alfvénic Frequency Range during Intense ECH

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Alfvén eigenmodes (AEs) are paid much attention from a viewpoint that they could be excited by energetic alpha particles and/or energetic ions. In major tokamaks [1] and helical plasmas[2], various types of AEs such as toroidicity induced Alfven eigenmodes (TAEs) are identified. Moreover, stable AEs are excited by externally applied magnetic perturbations in JET plasmas [3] and CHS [4]. Recently, a different type of coherent magnetic fluctuations in the Alfvénic frequency range was detected during the phase of ECH alone in CHS.

A typical waveform of a discharge that the Alfvénic MHD fluctuations are observed is shown in Fig.1, where intense 54 GHz ECH of 150 kW is applied from t=20 ms to 120 ms as the second harmonic X-mode heating in the magnetic axis position of R_{ax}=94.5 cm and co-NBI of about 1 MW is applied from t=62 ms for 40 ms. As seen from Fig.1, strong magnetic fluctuations are excited in the relatively low density regimes (line averaged electron density $\langle n_e \rangle \sim 0.4 \times 10^{19}$ m^{-3}) during ECH alone and suppressed about 4 ms after the turn-on of NBI of which phase $\langle n_e \rangle$ starts to rise. The magnetic fluctuations also exhibit bursting character. Figure 2 shows the contour plot of magnetic fluctuation amplitude in the time and frequency plane. The frequency of the Alfvénic magnetic fluctuations evolves from about 160 kHz to about 120 kHz, having fast frequency chirp-down several times. Note that the TAE gap frequency is about 330 KHz for n=1 and m=2+3 coupling in this phase. Certainly, TAE in the range of f~ 160 kHz is excited during NBI. The magnetic fluctuations in the Alfvénic frequency range are only excited on the condition that ECH power is more than 125 kW and $\langle n_e \rangle$ is less than 0.5×10^{19} m^{-3}. The exciation of the Alfvénic mode may be caused by the generation of an appreciable amount of tail electrons and strong radial electric field. These factors may introduce strong anisotropy of electron distribution function and/or ion tail. The mode activity has similarity to the fishbone like activity observed in DIII-D tokamak during ECH [5]. Further study is required to clarify the excitation mechanisms and impacts to AEs physics.

References

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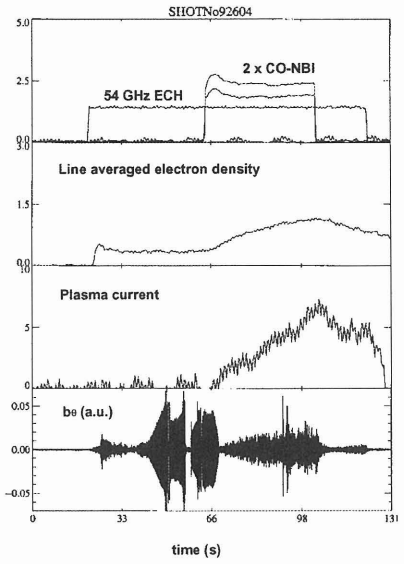

Fig.1 Time evolution of a plasma that coherent magnetic fluctuations in the Alfvénic frequency range are excited during ECH phase, where Bt=0.9T, Rax=94.5cm, ECH power=150 kW. Co-NBI of about 1 MW is applied from t=62 ms.

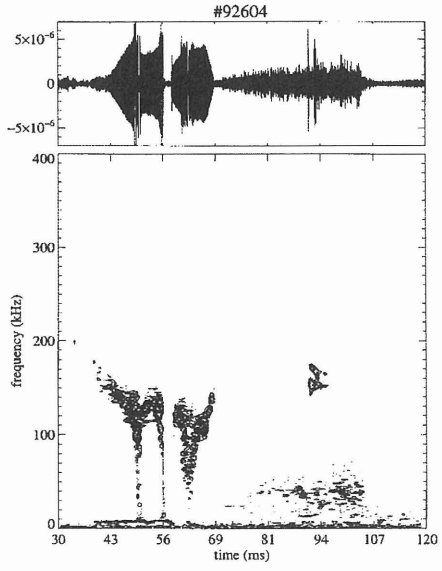

Fig.2 Contour plot of magnetic fluctuations in the time and frequency plane for the shot shown in Fig.1.