§10. HCN Laser Scattering Measurement of ETB-Formed Plasmas in CHS

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Anomalous transport plays a dominant role in plasma confinement in magnetic confinement fusion devices. Hence it is indispensable to understand fluctuations to improve confinement since they are supposed to cause the anomalous transport. An edge transport barrier (ETB), which can improve particle transport in the edge region, has been observed in CHS [1, 2]. The relationship between transport and fluctuations can be made clear in these plasmas with transitions to H-mode. In this research we develop an HCN laser scattering measurement system [3] to examine correlations between electron density fluctuations and confinement. In order to reveal the relation between the transport barrier and fluctuations we have investigated changes in features of turbulences before and after transitions to the improved mode.

The position of the scattering volume is shown in Fig. 1 (a). The position of the magnetic axis is 0.921 m and the magnetic field strength at the magnetic axis is 0.88 T. In this configuration, the dominant wavenumber component of measured fluctuations is the radial one. Figure 1 (b) shows temporal evolutions of operation and plasma parameters and the frequency spectra of fluctuations of an ETB-formed plasma. The positive and negative frequencies correspond to the inward and outward directions of the propagation of fluctuations, respectively. After injections of two NBs, the Hα emission signal decreases spontaneously at t = 0.053 s. Then the density gradient in the plasma edge region becomes steeper and the edge transport barrier is thought to be formed [1, 2]. Frequencies of fluctuations with a wavenumber of 5.4 cm^{-1} increase up to ±200 kHz after NB injections. However, they are suppressed after the transition. When the heating power approaches the threshold for the transition, the delay time of the transition from the start of NB injection becomes longer. The timing of the suppression of fluctuations is confirmed to be late accordingly. These measurement results suggest the improvement of particle confinement with the edge transport barrier. While the beam emission spectroscopy also shows the reduction of density fluctuations, langmuir probes do not. It may suggest the toroidal asymmetry of the confinement improvement. It is under study to determine the causality between the transition and the suppression of fluctuations.

We are designing a modified optical system to install additional two channels (radial wavenumbers of 10 and 20 cm^{-1}).

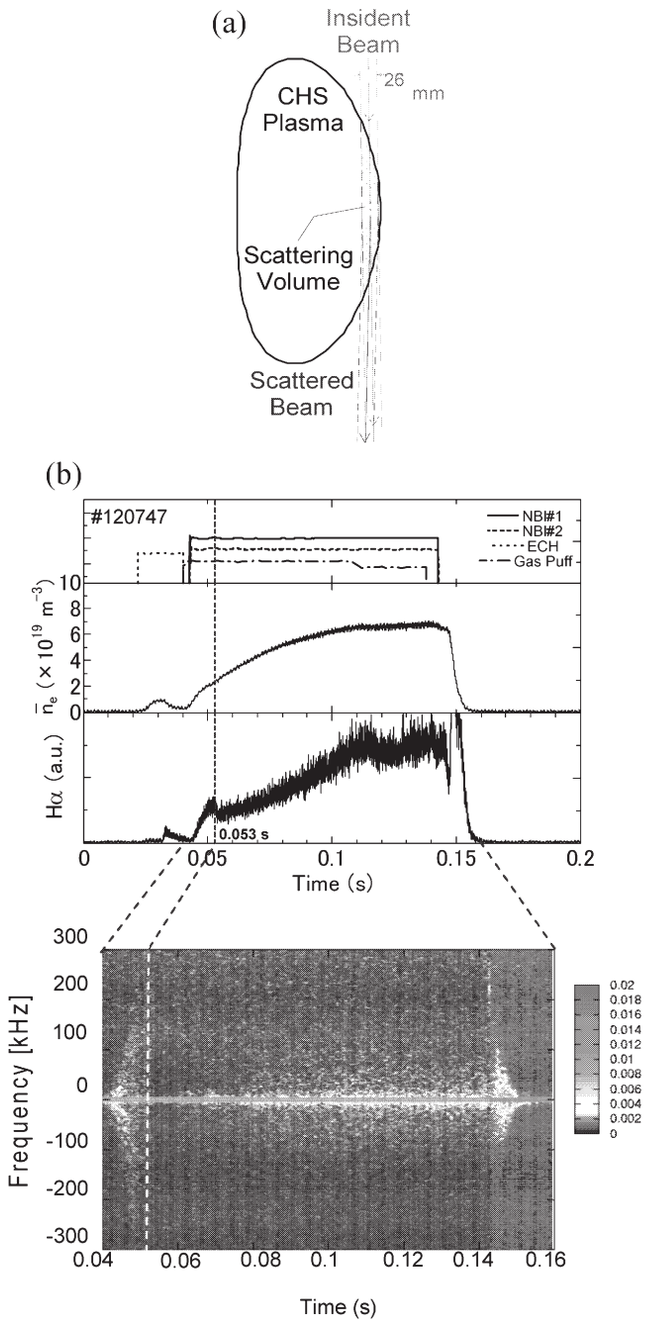

Fig. 1: (a) The location of the scattering volume in a CHS plasma. Here k_r is 5.4 cm^{-1}. (b) Temporal evolutions of operation and plasma parameters and frequency spectra of fluctuations with a wavenumber of 5.4 cm^{-1}. The transition occurs at t = 0.053 s.

References

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2) Okamura, S. *et. al.*, Plasma Phys. Control. Fusion **46** (2004) A113.
3) Akiyama, T. *et. al.*, to be purblished in Journal of the Japan Society of Infrared Science and Technology.