Fluctuation Measurements of NBI-ECH Plasma with HIBP on CHS


The researches of anomalous transport caused by fluctuations are very important for magnetic confinement plasmas. The subject of this study is to clarify the feature of the fluctuations of plasma using Heavy Ion Beam Probe (HIBP). The HIBP is a very powerful tool for fluctuation measurements in interior of high temperature plasmas, because of the capability of measuring potential and density fluctuations simultaneously with high spatial and temporal resolution.

In the CHS-HIBP, singly charged cesium particles Cs\(^+\) are injected to plasma and the particles are ionized to doubly charged cesium Cs\(^{2+}\) through electron impact collisions. Some of particles are detected with energy analyzer outside the plasma. The plasma potential at the ionization point is determined from difference between the detected and injected beam energy, while the density fluctuations are estimated from slight variation of the detected beam currents.

We carried out the fluctuation measurements in the plasmas heated with ECH and NBI \((n_s \approx 5 \times 10^{19} \text{m}^{-3}, T_e \approx 1 \text{keV})\) on CHS. Figure 1(a) shows time evolution of the plasma potential at \(\rho = 0.0\) and \(\rho = 0.5\) obtained using the HIBP. The dynamic events of quasi-periodic negative pulses, which is termed the electric pulsations, occurred in plasma core region [1]. As is seen in the box-A of Fig.1(b) (an expanded view of Fig.1(a)), coherent oscillations are seen in the position of \(\rho = 0.5\) usually just after the negative pulses. In Fig. 2 the dotted lines show the power spectra, the clear peak around frequency of \(\sim 180\text{kHz}\) is found to have high coherence with magnetic fluctuations of Mirnov coils. This electromagnetic oscillation has been supposed to be a sort of Alven Eigenmodes (AE).

On the other hand, solid lines in Fig.2 indicate the spectra of electrostatic fluctuations in periods without the electromagnetic fluctuations (indicated by the box-B of Fig.1(a)). Figure 3 shows radial profiles of the normalized amplitudes obtained from the spectra of the electrostatic fluctuation. Obviously, both the amplitudes of the density and potential fluctuations increased toward the plasma edge, this feature agrees with other torus devices. The normalized amplitudes of the density fluctuation are about 2 times larger than one of the potential fluctuations in central plasma region. However, the estimated value could be larger than the actual value because the detected beam fluctuations can contain the fluctuations along the beam orbit.

In future, under various conditions of experiments we will study the relation between fluctuation and parameters such as radial profiles, heating methods, input power, and etc. [1] A. Fujisawa et al., Phys. Rev. Lett., 81(1998)221