§ 22. Electrostatic Fluctuations in a Plasma Produced with 2.45 GHz Electron Cyclotron Waves

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In a toroidal plasma, the particle and energy transport is overwhelmingly larger than predicted by Coulomb collisions. It is thought that the anomalous increase in such transport originates from turbulent fluctuations. In high temperature plasmas, however, basic transport mechanisms are still unclear because of difficulty of fluctuation levels, in particular, the correlation measurements. Although Langmuir probe (LP) is a unique diagnostic tool with high potentiality for the correlation measurements, it is restricted in the plasma edge region of high temperature plasmas. Transport characteristics of high temperature and high density plasma produced by high heating power may be simulated by those of low temperature and low density plasma if these plasmas have similar dimensionless parameters such as effective collision frequency, normalized gyro-radius, plasma beta value and so on [1]. The LP can be applied to the whole region from the edge to core in thus low temperature and low density plasma.

Characteristics of electrostatic fluctuations were measured with a triple LP in low temperature and low density plasma produced with 2.45 GHz electron cyclotron waves (ECW) at the toroidal field B_t<0.1T. Figure 1 shows a typical time evolution of electron density (n_e) and electron temperature (T_e) at normalized radius ρ =0.7 in 2.45 GHz-ECW-produced hydrogen plasma, where the magnetic axis position is R_{ax}=0.92 m, B_t=0.0875T and launched ECW power is 9kW. Radial profiles of relative fluctuation levels of n_e, T_e and plasma potential (V_s) at t=200ms are shown in Fig.2 together with equilibrium n_e and T_e profiles, where the line averaged electron density is $< n_e >=9\times10^{16} m^{-3}$. All fluctuation levels increase rapidly toward the edge.

Figure 3 shows dependence of the relative levels of n_e and T_e fluctuations on troidal magnetic field with the decrease in B_t. Both n_e and T_e fluctuations considerably increase.

Power spectra of n_e and T_e measured at the plasma core (ρ=0.5) and edge (ρ=0.9) are shown in Fig.4. The density fluctuations in the core region are dominated by low frequency components less than 50 kHz, but those in the edge extend up to 100 kHz. On the other hand, the T_e-fluctuations behave similarly to n_e-fluctuations. The characteristics are similar to those obtained with very low ECW power [1].

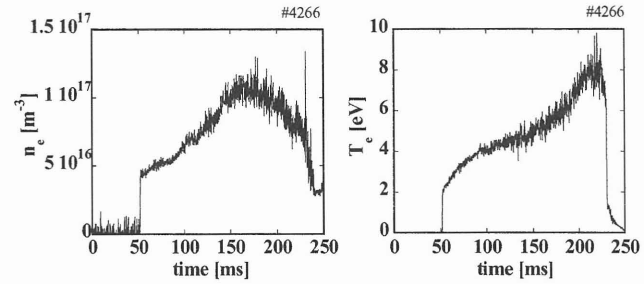

Fig. 1. Typical time evolution of electron density and electron temperature in plasma produced with 9 kW ECW

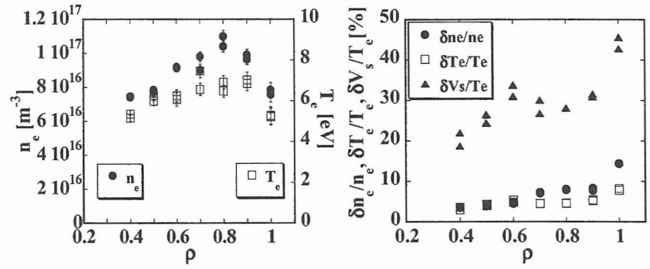

Fig. 2. Radial profiles of relative levels of n_e, T_e and V_s fluctuations together with equilibrium n_e and T_e profiles

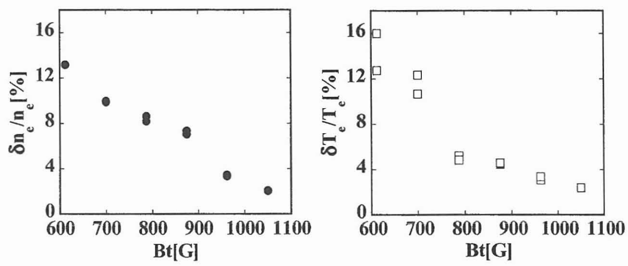

Fig. 3. Relative levels of n_e and T_e fluctuations as a function of B_t

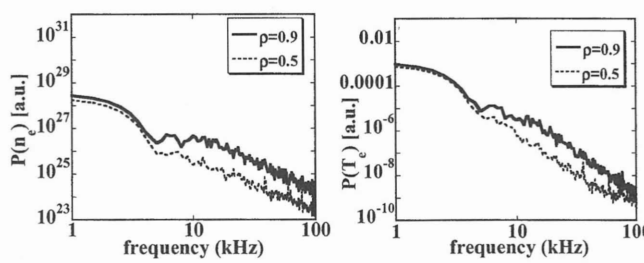

Fig. 4. Power spectra of n_e and T_e fluctuations at the plasma core (ρ=0.5) and edge (ρ=0.9)

Reference

[1] K. Toi et al., 29th EPS Conf. On Plasma Physics and Controlled Fusion, Montreau, 2001, paper No. P4-061.