§20. Fluctuation Behavior in High Ti Mode

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High ion temperature was achieved by positive and negative ion based NB heating with carbon pellet injection [1]. Figure 1 shows time trace of line averaged density, central T_e, T_i, fluctuation level and phase velocity of fluctuation of high T_i discharge. Carbon pellet was injected at t= 1.8s and T_i increased during decay of density. The central Ti exceed Te due to increase of deposition power to ion and improvement of ion confinement. Fluctuations are measured by two dimensional phase contrast imaging (2D PCI) [2]. The 2D PCI can measure local fluctuation profile using magnetic shear technique. The measured k was poloidally dominated and its range was $k_{perp}\rho_i$=0.1-0.3, where k_{perp} is perpendicular wavenumber, is ion Larmor radius. The measured k region is expected to be unstable region of ion temperature gradient mode.

Figure 2 shows T_e, T_i and n_e profiles at low T_i (2.0s) and high T_i (2.4s) timing. As shown in Fig.2 (a), The gradient of T_i gradient increased for ρ<0.6 at t=2.4s suggesting ion transport was improved and internal transport barrier (ITB) was formed. Fluctuation amplitude and phase velocities are shown in Fig.3. The measured phase velocities were in the laboratory frame. The positive and negative velocity indicates electron and ion diamagnetic direction in laboratory frame respectively. As shown in Fig.3, fluctuation profiles are clearly changed between low and high T_i timing. When low T_i was low, two peaks are seen. One is a core component at ρ=0.2-0.8 and its phase velocity is around 0.5 km/s in the i-dia. direction. The other is an edge component at ρ=1.0 and its phase velocity is 1-4km/s e-dia. direction as shown in Fig,3(a). The core components shifted to outer region (ρ=0.45-0.8) at high T_i timing as shown in Fig.3(b). The main part of core components propagated from position inside ITB to that outside ITB and swapped velocity direction.

Temporal behavior of turbulence are shown in Fig1 (b) and (c) for the inside of ITB (ρ=0.425), ITB foot point (ρ=0.625) and outside of ITB (ρ=0.825). Since back ground density decreased after carbon pellet injection, fluctuation level, which was the amplitude normalized by plasma density was analyzed. As shown in Fig.1 (c), fluctuation level inside ITB stayed almost constant, while, fluctuation level at ITB foot point and outside ITB increased. As shown in Fig.1 (c), phase velocity increased in the i-dia. direction with increase of T_i. The difference of phase velocity between positions inside and outside ITB increased. Because of lack of rotation measurements, it is not clear if the observed change of the phase velocity is due to change of rotation or phase velocity of turbulence. Nevertheless, the velocity shear between inside and outside ITB might improve ion energy confinement.

1) Nagaoka, K., et al., Plasma Fusion Res. **3** (2008) S1013
2) Tanaka, K., et al., Rev. Sci. Instrum. 79, 10E702 (2008)

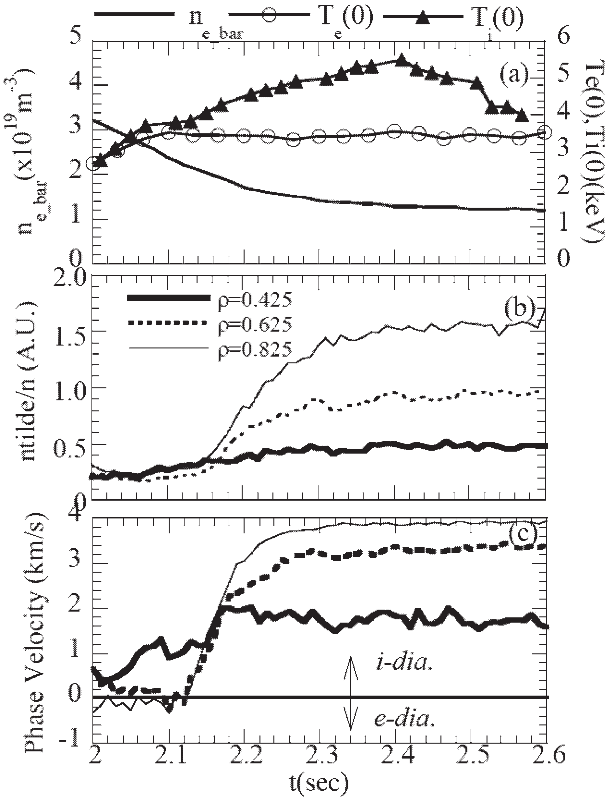

Fig.1 Time trace of (a) line averaged density, central T_e, T_i, (b) fluctuation level and (c) phase velocity

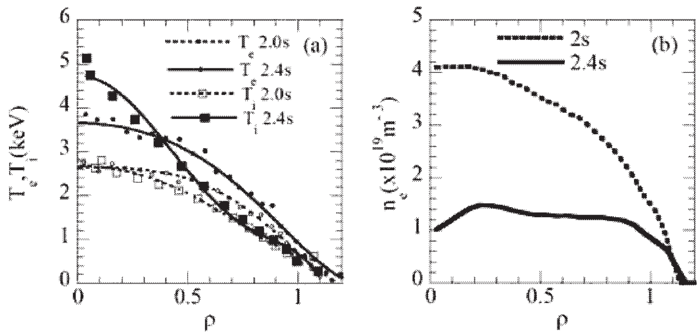

Fig.2 (a) T_e,T_i and (b) ne profile at low (2.0s) and high (2.4s) T_i timing

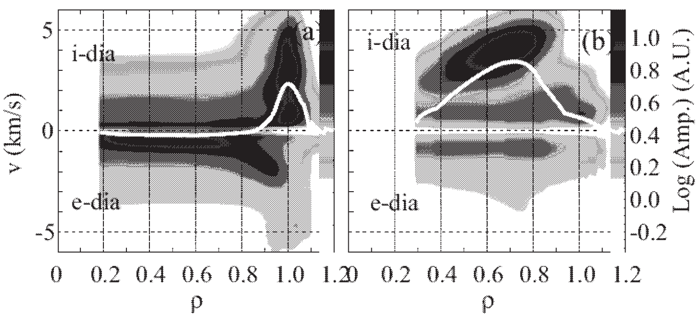

Fig.3 Fluctuation amplitude profile at (a) low T_i (2.0s) and (b) high T_i (2.4s). Positive and negative velocity indicates electron and ion diamagnetic direction in laboratory frame. White lines indicate the averaged phase velocity.