Effect of magnetic configuration on density fluctuation and particle transport in LHD

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The study of fluctuations and particle transport is important issue in heliotron and stellarator devices as well as in tokamaks. A two dimensional phase contrast interferometer (2D PCI) was developed to investigate fluctuation characteristics, which play role in confinement. The current 2D PCI can detect fluctuations for which $0.3<k<1.5mm^{-1}$ and $5<f<500kHz$. With the use of magnetic shear and the 2D detector, the spatial resolution around 20% of averaged minor radius is possible presently. The strongest fluctuations are localized in the plasma edge, where density gradients are negative, but fluctuations also exist in the positive density gradient region of the hollow density profile. The phase velocity of fluctuations in the positive gradient region is close to plasma Er×Bt rotation. On the other hand, fluctuations in the negative density gradient region propagate in the ion diamagnetic direction in the plasma frame and do not follow Er×Bt rotation. This suggests there is a different nature of the fluctuations in the positive and negative density gradient regions.

A particle transport was studied by means of density modulation experiments. The systematic study was done at Rax=3.6m, which is so-called standard configuration [1]. The density profiles vary from peaked to hollow with increasing heating power. It was also found that particle diffusion and convection are functions of electron temperature and its gradient respectively. The magnetic configuration is another parameter, which characterizes particle confinement. At more outward shifted configurations, helical ripple becomes larger and the ergodic region becomes thicker, then neoclassical transport becomes larger. However estimated diffusion coefficients are still around one order of magnitude larger than neoclassical values in edge region, where $\rho = 0.7 \sim 1.0$ and they are larger at more outward configurations. At the same time the convection velocity is found to be comparable with neoclassical prediction at Rax=3.75, 3.9m and Rax=3.6m with low power heating. Fluctuation level becomes larger at more outward configuration suggesting correlation with particle diffusion. A comparison between observed fluctuation power and theoretically computed linear growth rate of drift waves will be presented.

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