§5. Transport Studies of Dimensionally-Similar Low-Energy-Density Plasmas

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Correlation measurement among plasma fluctuations is crucial to clarify underlying physics mechanisms in turbulent particle and heat transport of a toroidal plasma. However, the correlation measurement is extremely difficult in high temperature plasmas.

Based on the hypothesis of *dimensional similarity in plasmas* [1], we have started a new simulation experiment of high temperature plasma transport using a low energy density plasma obtained at low toroidal field ($B_t \approx 0.0875$) in CHS. Plasma parameters and their fluctuations are measured with a triple probe(LP). Radial profiles of density n_e, electron temperature T_e and plasma potential V_s of the plasma are shown in Fig.1. The density profile is slightly hollow and electron temperature has a very flat profile, where ECR layer is located at the magnetic axis. The hollow density profile is very similar to that of an ECH plasma obtained at high magnetic field ($B_t \geq 0.9$T). In the plasma, the toroidal beta value is still very low (β_t =0.002%), but ν_* and ρ^* are comparable to those in CHS plasmas at $B_t \geq 0.9$T. This plasma is not dimensionally similar to that at high B_t. Nevertheless, it is interesting and important for this new experimental project to investigate characteristics of electrostatic fluctuations in the plasma. In this low energy density plasma, fluctuations were measured even in the plasma core region with LP, as shown in Fig.2. All fluctuations of n_e, T_e and V_s are increased rapidly from ρ~0.7 toward the edge. That is, the n_e-fluctuation level is two time larger than that of T_e. These features are very similar to that of edge turbulence in tokamak and helical plasmas[2]. Note that a reduction in these fluctuations is seen just inside the last closed flux surface(ρ=0.9-1.0). In this edge region, the radial electric field shear is fairly small (Er'~2-3.5 x10^4V/m^2), but the poloidal velocity shear is fairly large (~2.3-4x10^5 s^{-1}) because of low magnetic field(B~0.09T). Turbulence-induced particle flux calculated from measured n_e and poloidal electric field fluctuations is shown in Fig.3. The flux also exhibits the reduction in the edge region.

These preliminary results suggest a possibility of a transport simulation experiment in a high temperature plasma using a low energy density plasma having the same relevant dimensionless parameters as those of high temperature one except for difference of normalized gyro radius ρ*.

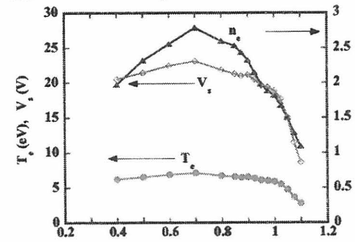

Fig.1 Radial profiles of electron temperature, density and plasma potential in a plasma produced by 0.4 kW ECH at Bt=0.0875T

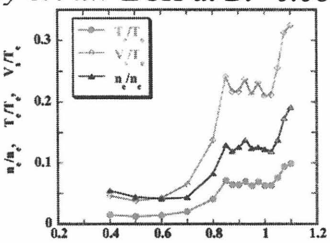

Fig.2 Radial profiles of relative levels of density, electron temperature and plasma potential fluctuations.

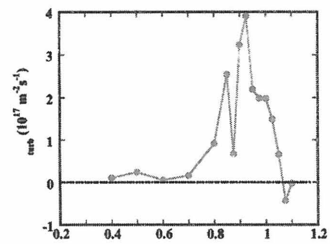

Fig.3 Radila profile of the turbulent particle flux.

References
[1] B.B. Kadomtsev, Sov. J. Plasma Phys.**1**, 295(1975).
[2] B.A. Carreras, IEEE Trans. Plasma Sci. **25**, 1281 (1997).