§21. Electrostatic Fluctuations in a Dimensionally Similar Low Temperature Plasma with Internal Transport Barrier

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Electrostatic fluctuations have been measured by Langmuir probe from edge to core in low temperature plasma which is produced by 2.45 GHz microwaves at very low field less than 0.1T. It has the almost same dimensionless parameters, such as a normalized collisional frequency $\nu_p^* \sim 0.05\text{-}1$, plasma beta $\beta \sim 0.001\text{-}0.02\%$ with those in high temperature one, except normalized ion gyro radius $\rho_s^* \sim 0.015\text{-}0.04$.

On the condition where the magnetic axis R_{ax}=97.4cm, toroidal magnetic field B_ϕ=0.0613T, input heating power P_{ecr}=17kW (oblique injection of O-mode) and hydrogen filling pressure $p_H = 7.0\times10^{-5}$ Torr, the transition in electron density n_e profile is often observed [1]. Time evolutions of n_e and line average density n_{e_2mm} measured by 2mm microwave interferometer are shown in Fig.1. During the decreasing phase of n_{e_2mm}, n_e in the core region (ρ=0.3) suddenly increases at t~112ms, but that in the edge (ρ=0.7) suddenly decreases. Radial profiles of n_e, electron temperature T_e, space potential V_s and the amplitude of normalized fluctuations before transition (t=95-105ms) and after transition (t=120-130ms) are compared in Fig.2. When the n_e profile is changed to a profile with a steep gradient inside ρ=0.7, the relative amplitude of density fluctuation $\tilde{n}_e/n_e$ is obviously reduced at ρ=0.5-0.6. However, $\tilde{T}_e/T_e$ and $\tilde{V}_s/T_e$ are increased.. Note that the profile of V_s changes from flat (radial electric field:Er~0) to peak (Er>0) in the core region. This clearly indicates the plasma goes into the electron root regime. Fluctuation driven particle flux Γ_{turb} and neoclassical particle flux Γ_e^{nc} before and after transition is shown in Fig.3. Γ_{turb} is much larger than Γ_e^{nc}. Γ_{turb} remains unchanged across the transition, but Γ_e^{nc} changes the sign across the transition. The flux change of Γ_e^{nc} is caused by the change to Er>0.

[1] K. Toi et al., 13th Int. Toki Conf., Toki, 2003.
[2] M. Yokoyama et al., J. Plasma Fusion Res. **79** (2003) 816

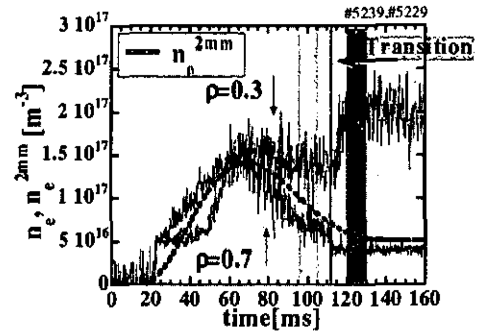

Fig.1 time evolution of electron density n_e and line average density n_{e_2mm}

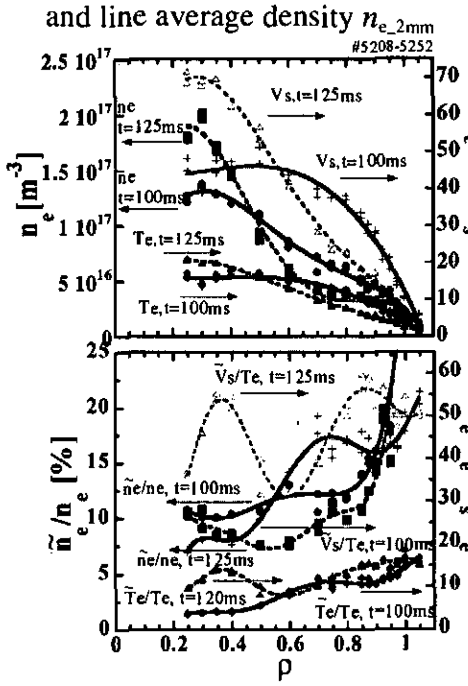

Fig.2 radial profiles of n_e, electron temperature T_e, space potential V_s and the amplitude of normalized fluctuation before transition (t=100ms) and after transition (t=125ms)

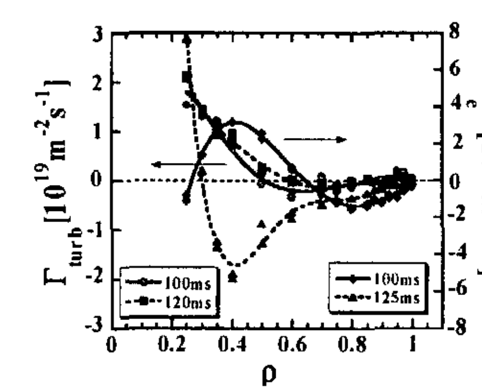

Fig.3 radial profiles of fluctuation driven electron flux Γ_{turb} and neoclassical electron flux Γ_e^{nc} before and after transition