§2. Improvement of Ion Confinement by Neoclassical Internal Transport Barrier on CHS

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Recently the neoclassical internal transport barrier (N-ITB) has also been observed for EC heated NBI (ECNBI) plasma. 53.2GHz 2nd harmonic EC wave ($P_{inj} \sim 130kW$) is injected into the NBI plasma ($P_{inj} \sim 0.7MW$) with the central electron density ($n_e(0) = 3.5 \times 10^{12} cm^{-3}$). As observed in ECH plasma, the central electron temperature $T_e(0)$ increases up to $\sim 2keV$ that is about 2 times higher than the higher density plasma without N-ITB ($n_e(0) = 4.5 \times 10^{12} cm^{-3}, T_e(0) \sim 900eV$)

The N-ITB is formed at the outer location ($\rho = 0.4 - 0.6$) compared with the N-ITB in the ECH plasma. The electron temperature profile becomes "bell" shape rather than "dome" shape, so that the improved confinement region is expanded. It is also confirmed with HIBP measurement that this barrier results from the large positive radial electric field ($E_r \sim 15kV/m$) and electric field shear ($dE_r/dr \sim 300kV/m^2$), which are induced by the transition from the ion to the electron root. The ion temperature is increased ($T_i(0) \sim 400eV$) by about 100% compared to the plasma without N-ITB due to the existence of the ion heating source inside N-ITB as shown in Fig.1 .

There is a problem whether the increase in the ion temperature is due to the improvement of the ion transport or due to the increase in the deposition power of NBI. To make sure of this, the calculation of the power deposition is carried out with MC NBI Code. The deposition power to the ions in the plasma with N-ITB is almost same as that in the plasma without N-ITB, because the electron temperatures are almost same around $\rho = 0.6$, so that the deposition is mainly determined by the plasma density. The ion thermal diffusivities are clearly reduced on the barrier compared to the plasma without N-ITB as shown in Fig.2. The experimental χ_i ($2-6m^2/s$) is dropped around $\rho = 0.6$ which almost coincides with the region of the large radial electric field shear.

Thus two effects with N-ITB are confirmed, which are the improvement of the neoclassical transport due to the radial electric field and the reduction of anomalous transport due to the radial electric field shear.

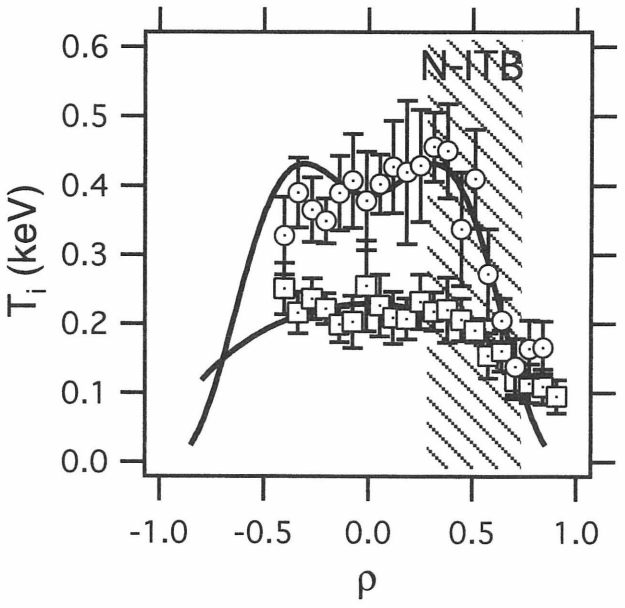

Fig.1: Ion temperature profiles in EC heated NBI plasma. Circles and Squares correspond to low density plasma with N-ITB and high density plasma without NITB, respectively

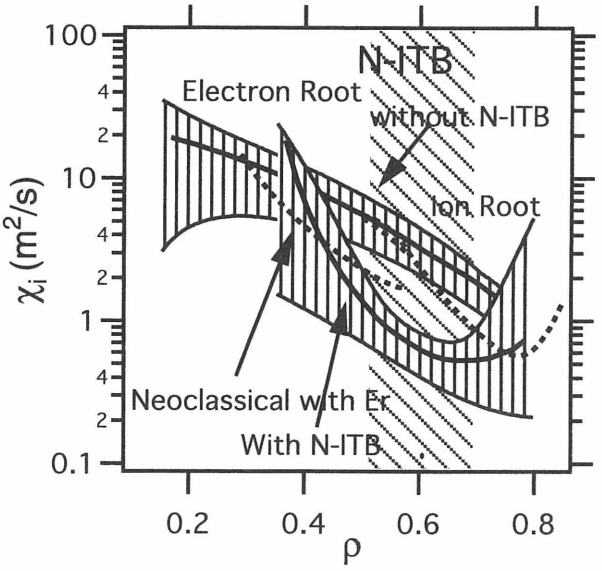

Fig.2: Thermal diffusivity for ions. Plasmas with N-ITB and without N-ITB are compared. Neoclassical calculations (effect of radial electric field is taken into account) are plotted by dotted lines.