§3. Transport Analysis for ECH Plasma with Internal Transport Barrier

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It is important to investigate heat transport characteristic of ECH plasma with internal transport barrier (ITB) on CHS. We carry out transport analysis with PROCTR-MOD [7]. We assume that the electron power balance equation is as follows. The ECH plasma with ITB is of almost steady state, and the variation of the temperature is negligible in this case.

$$Q_{cond}=Q_{conv}+Q_{reth}-Q_{ion}+Q_{ech} \qquad (1)$$

Here, Q_{cond} and Q_{conv} indicate heat conduction and convection of the electron, respectively. Q_{reth}, Q_{ion} indicate electron-ion rethermalizations and ionization and radiation loss from neutrals. Q_{ech} indicates an elect electron cyclotron heating. The calculation is carried out about a typical ECH plasma with ITB which has ~2.2 keV central electron temperature and large E_r shear on the location of ITB. We did not measure an ion temperature profile of this shot. We used an typical ion temperature profile which has an almost same electron temperature and same ITB. The ion temperature profile is measured with a charge exchange spectroscopy with a diagnostic NBI. The central ion temperature of this profile is ~130 eV ,which is considerably lower than the electron temperature (~2.2keV) . When B_T is 0.8 T and gyrotron frequency is 53 GHz, the resonance zone of the ECH is at the location of the plasma center. In the case of the low density on CHS, all the injected ECH power is propagated to the plasma center and absorbed.

Though there is large difference between the ion and electron temperature, an amount of rethermalization energy from electron to ion is considerably smaller than that of the convection term and the conduction term.

Our calculation indicates that the electron conduction is steeply dropped in very narrow width at the r = 0.28 which is the location of ITB. The area of reduced conduction almost coincides with the large E_r shear region.

Fig. 1 shows electron thermal diffusivity, χ_e. The χ_e is calculated from the following equation.

$$\chi_e = Q_{cond}/(\text{grad } T_e\, n_e) \qquad (2)$$

The χ_e also steeply reduced at the location of ITB. Therefore, the improvement is localized at large E_r shear region. The minimum χ_e at ITB is ~3 m^2/s, which is comparable to the value of the neoclassical electron thermal diffusivity.

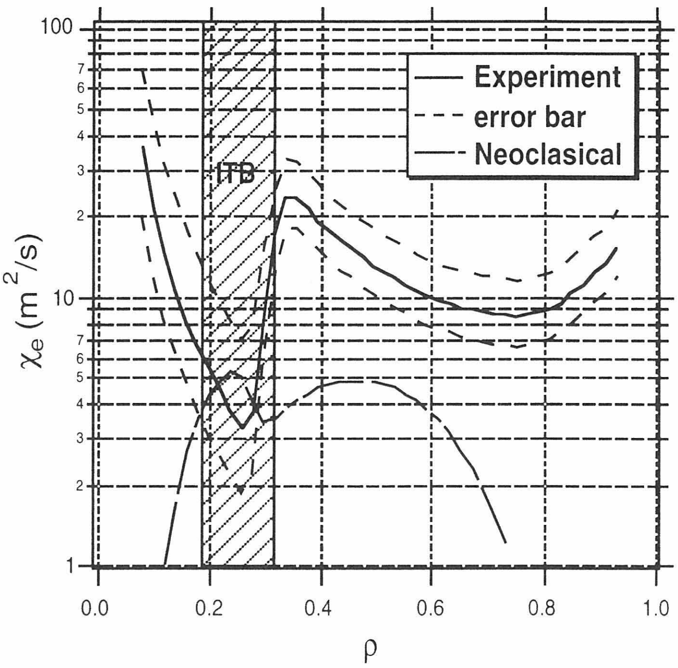

Fig.1. Radial profile of electron thermal diffusivity of ECH plasma with ITB.
The broken line indicated error bar.