§2. Density Dependence of Forming Internal Transport Barrier on CHS

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An electron temperature profile with internal transport barrier (ITB) has been observed in high temperature electron cyclotron heated (ECH) plasma with YAG Thomson scattering measurement on CHS Heliotron/Torsatron device [1].

The operation regime of forming ITB depends on the plasma density. Fig.1 shows electron temperature as a function of central electron density. There is a threshold density forming ITB, which is <5.5x10^{12}cm^{-3}. In this case, the injected power is ~120 kW, B_T is 0.88 T. Since gyrotron frequency is 53.2GHz, a resonance zone of the ECH is located at the plasma center. As the density decreases, the central electron temperature is steeply increased from the threshold density, while the temperature in outside of ITB (ρ=0.5) is almost same value and gradually increased. The ECH plasma with ITB is only obtained in low density regime. In the density regime from 3.5x10^{12}cm^{-3} to 5.5x10^{12}cm^{-3}, there are both plasmas with ITB and without ITB, moreover whose temperatures are clearly separated into two groups. This means both types of the ECH plasmas exist at the same density. These characteristics indicate that the phenomena have bifurcation nature.

The threshold density depends on the injected ECH power and also depends on the magnetic field strength. It is possible to create a higher density plasma with ITB at high field strength B_T =1.76T. There are two methods for ECH heating for high density plasma. One is the second harmonic heating; the plasma is heated by 106G gyrotron. Second is the fundamental heating; the plasma is heated by the same gyrotron as is mentioned above. The ITB is successfully formed by both methods. In the former method, the injected power is 250 kW. The central temperatures reached 1.9 keV. The gradient of the temperature at ITB is 0.15 keV/cm, and an achieved central density is ~9x10^{12}cm^{-3}. In the latter method, injected power is 180 kW, the central temperature is 1.8 keV, the gradient of the temperature at ITB is 0.25 keV/cm,and an achieved central density is ~8x10^{12}cm^{-3}. These results show that the threshold density is increased by the magnetic field strength and does not depend on heating method of ECH.

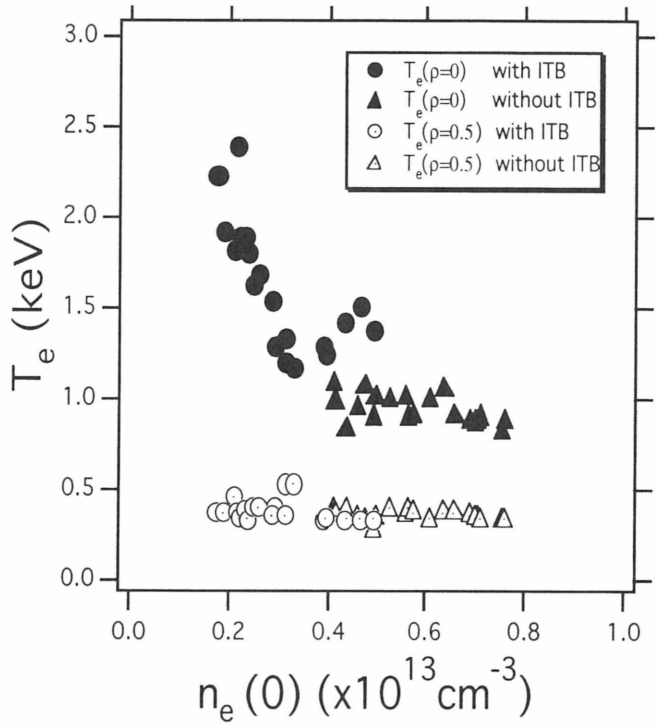

Fig.1 The electron temperature of ECH plasma as a function of central electron density. P_{inj}= ~120 kW, B_T= 0.88T, and the frequency is 53.2GHz.

References

1) A.Fujisawa,et.al. Phys.Rev.Lett 82 (1999) 2669