§2. Electron Temperature Profile of ECH Plasma with Internal Transport Barrier on CHS

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Recently, an electron temperature profile with internal transport barrier (ITB) [1] was observed in high temperature electron cyclotron heated (ECH) plasma with YAG Thomson scattering measurement on CHS Heliotron/Torsatron device (R=1.0m, a=0.2m).

Profiles of electron temperature and density were measured with a multipoint YAG Thomson scattering system [1] (24 spatial channels, 10 ms time resolution). Scattering light from low density ECH plasmas is too weak to calculate a value of the temperature and the density. Therefore, we superposed the scattering lights of 5-20 shots. Reproducibility of the shots was confirmed by line integral density with HCN interferometer and stored energy with diamagnetic measurement. For convenience, the plasma which has ITB and high electron temperature is termed high electron temperature mode (HET mode), while the plasma which has no ITB is termed L mode. We compare the electron temperature profile of the HET mode to that of the L mode. One condition of forming ITB is the injected ECH power. When the injected power is low (~150kW), the measured electron temperature profile has no ITB . The central electron temperature (1.3±0.1 keV) is almost half of the former case.

Fig. 1 (a) shows a typical electron temperature profile of ECH plasma with ITB. The plasma is produced by a gyrotron of which frequency is 53.2 GHz. A second harmonic resonance is exactly on axis (B_T = 0.88 T). The injected gyrotron power is ~200kW. The central electron temperature is 2.2±0.1 keV from 15 superposed shots. The electron density profile has a flat or slightly hollow shape and the central density is ~4×10^{12} cm^{-3}. Therefore, the steep pressure gradient exists at r/a~0.3. These profiles indicate that ITB is created. The gradient of the temperature atITB is 0.43 keV/cm.

The HIBP measurements of electric field and density fluctuation are available for B_T=0.88T [2]. The potential profile of the ECH plasma has a similar shape to the electron temperature profile,as shown in Fig.1 (b). A rather strong Er shear at the barrier location is deduced, whose value is approximately 40V/cm^2. It is also particularly notified that the reduction in the density fluctuation level by 40% is observed, compared to the level of the case without the transport barrier. The location of the steep electron temperature gradient coincides with the location of the maximum Er shear. The fluctuation suppression reduces the anomalous transport at the transport barrier.

There is no density gradient at the location of ITB, as shown in Fig.1 (c). This reason is that because of off-diagonal terms for neoclassical particle flux, a decrease in the fluctuation-driven particle flux compensates an increase in the neoclassical flux of the electron temperature gradient.

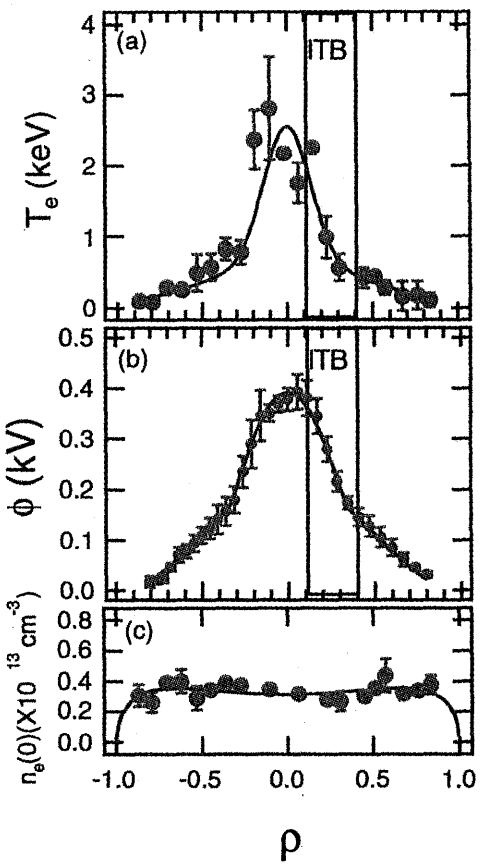

Fig. 1 (a), Electron temperature profile with YAG Thomson measurement. (b), Potential profile of ECH plasma with HIBP.(c), Electron density profile. Injected power is ~200kW. Profile has Internal Transport Barrier.

References

1) A.Fujisawa,et.al. Phys.Rev.Lett 82 (1999) 2669
2) K.Narihara, et.al. Rev.Sci.Instrum. 66 (9) (1995)