§72. Analysis of Plasma Current Driven by Electron Cyclotron Waves

Idei, H. (Kyushu Univ.), Notake, T., Shimozuma, T., Kubo, S.

Electron Cyclotron Current Drive (ECCD) experiments have been conducted to investigate the effect of generated local current to MHD activities and plasma confinement in the LHD. For the ECCD experiments, the high electron temperature plasmas were produced by fundamental Electron Cyclotron Heating (ECH) injection using the 82.7GHz ECH/ECCD system at the power level of 0.3MW. The fundamental and second harmonic ECCDs were applied to the target high electron temperature plasmas using the 84GHz and 168GHz ECH/ECCD system. The additional ECCD power was totally 0.6MW. The 2-O port antenna system, which has high flexibility of the $N_{//}$ scanning, was used for the ECCD injections. Figure 1 shows the configuration of the ECCD injections in the co- and counter- directions at the 2-O port antenna system. The magnetic axis was 3.5m, and the magnetic field was 2.829T. Figure 2 shows observed time evolutions of the plasma current component driven by the ECCD injections. There were clear differences in the driven current directions between the co- and counter injections. The observed driven current was 2∼3 kA. In the ECH and ECCD injections, the higher electron temperature of 5.5 keV was attained at the electron density of $0.4 \times 10^{19} m^{-3}$. Figure 3 shows the electron temperature profiles in the co-, balanced and counter injections. The Internal Transport Barrier (ITB) were observed at these electron temperature profiles, but with same foot-point positions. The formation of the ITB and its foot-point position are discussed with the plasma current profile. The observed driven currents of 2∼3 kA did not affect the ITB features well. The high power experiments using the 1.5L-port antenna system, together with the 2-O port system, is planned to study the effect of the plasma current to MHD activities and plasma confinement.

The power deposition in the oblique injection (finite parallel refractive index $N_{//}$) for the ECCD experiment was evaluated using a ray tracing code developed and modified at NIFS. The TASK ray-tracing code [1] is rebuilt to apply to the power deposition analysis of the LHD experiment, taking the relativistic effect into consideration. The helical geometry of the LHD will be included into the code. The deposition analysis will be linked to the velocity distribution analysis using Monte Carlo and/or Fokker-Plank codes to evaluate the generated current by ECCD. The TASK code can treat arbitrary velocity distribution functions in general.

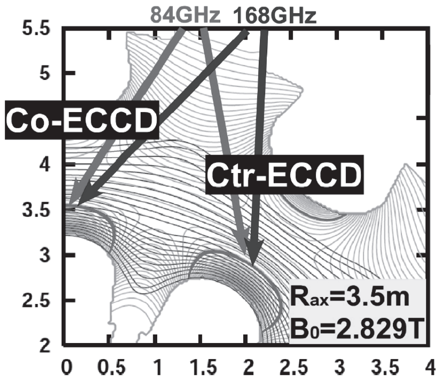

Fig. 1: Configuration of the ECCD injections in the co- and counter- directions at the 2-O port antenna system.

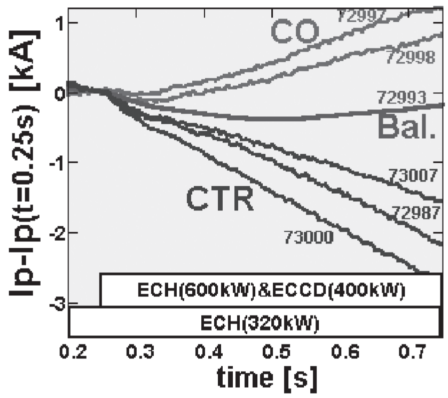

Fig. 2: Time evolutions of the plasma currrent component driven by the ECCD injections.

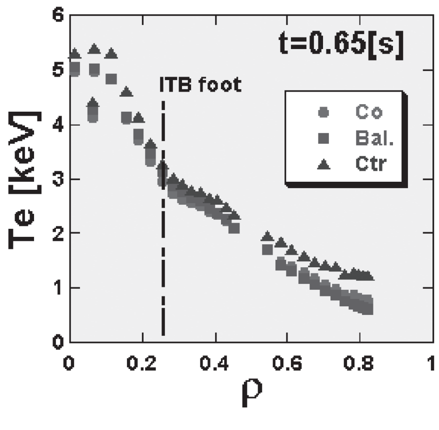

Fig. 3: Electron temperature profiles in the co-, balanced and counter injections.

This work was realized by the collaboration organized by NIFS (NIFS05KLRR005).

References

[1] Fukuyama A., *et al.*, Fusion Eng. and Design, **53**, 71 (2001).