Clear Transition to High-T_e State with an Electron Internal Transport Barrier Creation in EC Heated LHD Plasmas

T. Shimozuma, S. Kubo, H. Igami, Y. Yoshimura, T. Notake[1], S. Inagaki[2], N. Tamura, K. Ida, M. Yokoyama, I. Yamada, K. Narihara, T. Mutoh, A. Komori and LHD experimental group

E-mail: shimozuma.takashi@LHD.nifs.ac.jp

National Institute for Fusion Science, Toki, Gifu, 509-5292, Japan
[1] Fukui University, Fukui 910-8507, Japan
[2] Kyushu University, Kasuga, Fukuoka, 816-8580, Japan

Transition to an internal transport barrier formation of electron heat transport (eITB) has been clearly observed in neutral beam (NB) sustained plasmas with strongly focused on-axis electron cyclotron heating (ECH) in Large Helical Device (LHD). During stepwise injection of ECH power, the core electron temperature started to build up spontaneously and became high temperature in the core (high-T_e state), on the other hand the temperature outside of ρ~0.3 drastically decreased. This phenomenon directly shows temporal and spatial behavior of formation process of eITB in the helical device. The transition phenomena to the high-T_e state with an ITB formation were mainly observed in plasmas sustained with counter-injected NBI [1]. It is speculated that this process includes the first expansion of a magnetic island (m/n=2/1) by low power ECH injection, subsequent disappearing or healing of the island by additional ECH power and final transition to high-T_e in the core and eITB formation by realization of so called "electron-root". Repetitive behavior between high and low temperature states in the core was also observed. We tried to contract and expand the island by the external coil field to investigate the effect of the seed island size on the transition. The results show that the island size possibly affect the threshold values of ECH power and collisionality on high-T_e transition. During ECH power injection, some crashes in the core temperature and flattening of temperature profile frequently occurred and they inhibit attainment of higher central electron temperature. Clarification of the eITB formation process contributes an achievement of higher electron temperature and high performance plasmas by ECH.

[1] T. Shimozuma et al., Nucl. Fusion 45 (2005) 1396.

This work is supported by a budgetary Grant-in-Aid No. NIFS06ULRR501, 502, 503 from NIFS.