02Ca02

JT-60Uにおける内部輸送障壁を有するプラズマの過渡的イオン熱輸送解析
Transient ion heat transport analysis in internal transport barriers on JT-60U

金史良、吉田麻衣子、竹永秀信、本多充、田村直樹、成田絵美、
神谷健作、坂東隆宏、若月琢磨、諫山明彦
F. Kin, M. Yoshida, H. Takenaga, M. Honda, N. Tamura, E. Narita,
K. Kamiya, T. Bando, T. Wakatsuki, A. Isayama
量研機構
QST

One of the purposes of JT-60SA is to establish schemes of steady-state operation for a fusion reactor. In such scenarios, the controlling of an internal transport barrier (ITB) is essential, because it can enhance a bootstrap current by its large pressure gradient. Therefore, a lot of works have been devoted to understand the physical mechanisms of the ITB. The ITB is known as the reduced transport states, i.e., the transport coefficients are decreased and their levels are closed to the neoclassical predictions. The transient transport experiments, however, show the contradictory results that the amplitude of cold pulse is enhanced inside the ITBs [1]. This indicates that the ITB is not simply sustained by the diffusive transport process, which was considered from a steady-state power balance analysis. One of the possible explanations of the increase of the cold pulse amplitude in the ITB region is provided by the critical gradient model; the ITB transiently returns to the turbulent transport state due to the changes of the local temperature gradient [1].

In this presentation, we show the results of transient transport experiments of ITBs performed in JT-60U by using a supersonic molecular beam injection (SMBI). The cold pulse of an ion heat channel is induced by the SMBI [2], and the dynamics of ion heat transport is analyzed for the weak magnetic shear ITBs [3]. As shown in Fig. 1(a), we observed that the flux-gradient relation contains a hysteresis, and the heat flux is independently changed with the local temperature gradient. We also observed that the changes of ion heat flux are independent to the other local parameter changes (T_i, T_e, T_e-gradient, n_e and n_e-gradient). These results indicate that the local model cannot fully explain the experimental results, and thus, non-local features should be also taken into account on the transport process of the ITB region. We also observe the relation between the hysteresis in flux-gradient relation and structure of ITBs. As shown in Fig. 1(b), the profile of the width of hysteresis ($\Delta q_i^{jump}/n_i$) is different according to the strength of ITBs. The appearance of the hysteresis seems to correlate with the width of ITBs. We will discuss the difference of cold pulse propagations with respect to the different cases of ITBs.

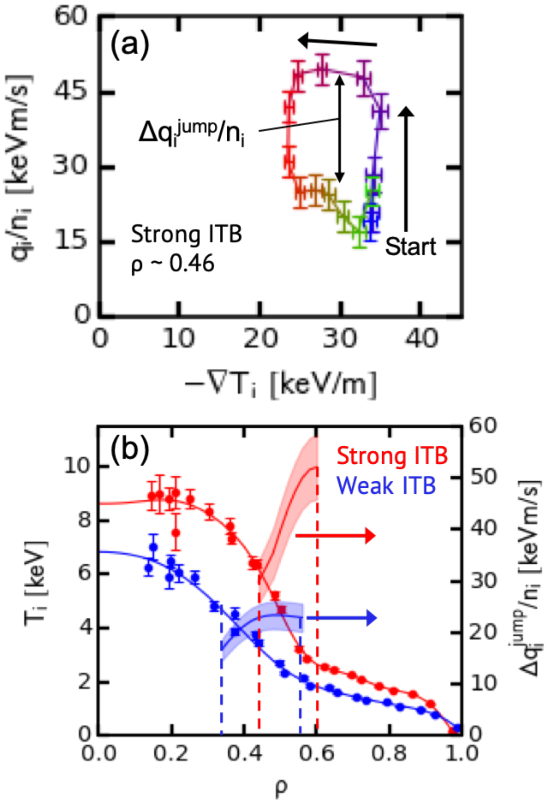

Fig 1. (a) Flux-gradient relation of ion heat channel. (b) Profiles of ion temperature and hysteresis width ($\Delta q_i^{jump}/n_i$).

Reference

[1] P. Mantica et. al., PPCF 44, 2185 (2002)
[2] H. Takenaga et. al., NF 49, 075012 (2009)
[3] F. Kin et. al., submitted to NF