§44. The Local Island Divertor Experiment

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The local island divertor (LID) is an advanced closed divertor, utilizing an m/n = 1/1 island generated externally by 20 small perturbation coils. In the last two experimental campaigns, fundamental LID functions have been demonstrated experimentally.1)

In the recent LID experiment, relatively good energy confinement was achieved in the high density regime at the outward shifted magnetic axis position, R_{ax}, of 3.75 m.2) Experiments were performed with various $\bar{n}_e$'s in the LID and helical divertor (HD) configurations. In order to compare with the standard configuration at R_{ax}= 3.60 m, the improvement factor of the global energy confinement time, τ_E, over the ISS95 scaling as a function of $\bar{n}_e$ is presented in Fig. 1 (a). It can be seen that the improvement factor in the LID configuration is less than unity in the high density region above ~5 × 10^{19} m^{-3} and always inferior to that in the HD. On the other hand, in the outward shifted configuration at R_{ax} = 3.75m, the improvement factor in the LID keeps almost unity in the density range up to ~1.3 × 10^{20} m^{-3}. This is a remarkable feature of the R_{ax} = 3.75m configuration, which can never be seen at R_{ax} = 3.60m. It can be said that the energy confinement of the LID is better than that of HD in the R_{ax} = 3.75m configuration.

The reason for the different confinement characteristics between R_{ax} = 3.60 and 3.75 m configurations is not clear. One candidate of the explanation is the different recycling state between two configurations. In the R_{ax} = 3.6 m configuration, the island separatrix is completely isolated from the HD separatrix. Almost all particles diffusing out from the core region are ideally guided to the LID head, and then recycled there. On the other hand, in the R_{ax} = 3.75 m configuration, some amount of diffused particles is escaping to the HD target plates without being trapped by the island separatrix because of the edge ergodization. Then, some amount of particle recycling consequently occurs there. In fact, a longer density decay time, τ_p^*, suggesting higher particle recycling, was observed at R_{ax} = 3.75 m. Furthermore, the particle recycling at the LID head is also high at R_{ax} = 3.75 m, since the outer island separatrix may hit the leading edge of the LID head a little. This problem comes from the design concept of the LID head which was originally designed to fit the magnetic configuration at R_{ax} = 3.60 m.

During the high performance discharges, highly peaked ITB-like density profiles, n_e, were obtained in the reheat phase after pellet injections, together with the peaked electron temperature profiles, T_e, as shown in Fig. 2. It seems that those "barriers" exist near the rational surface of q=2. The large Shafranov shift of the magnetic axis suggests the high pressure at the plasma center. Although this phenomenon is very transient at present, such a favorable state may be kept or developed by optimizing the fueling and the magnetic configuration.

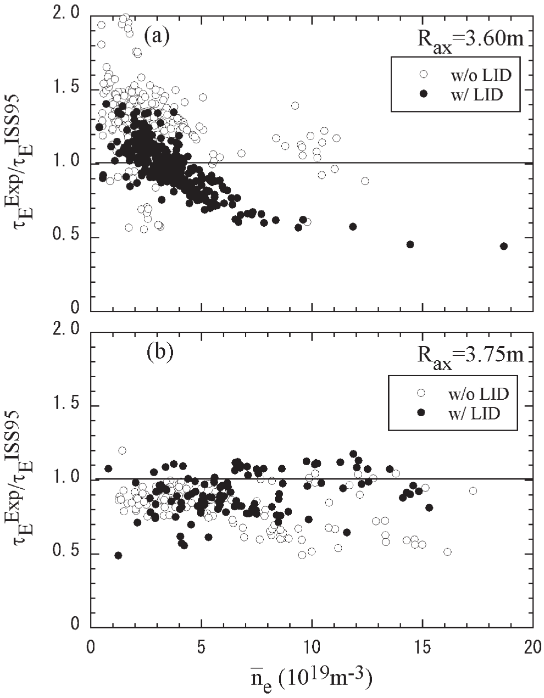

Fig. 1. Improvement factor of the energy confinement time τ_E from the ISS95 scaling law at (a) R_{ax}= 3.60 m and (b) R_{ax}= 3.75 m as a function of the line averaged density.

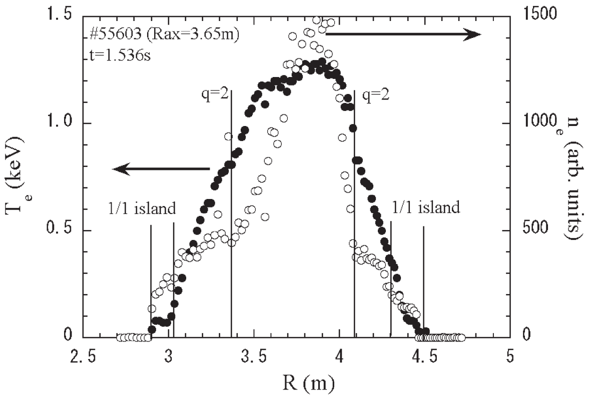

Fig. 2. Highly peaked n_e and T_e profiles in the reheat phase after pellet injections.

References
1) Morisaki, T. et al.: J. Nucl. Mater. **337-339**, (2005) 154.
2) Komori, A. et al.: Nucl. Fusion (to be published).