# §11. Influence of the Resonant Magnetic Perturbations on Transport in Large Helical Device

Jakubowski, M. (Max-Planck Institut für Plasmaphysik, Greifswald), Masuzaki, S., Tanaka, K.

The purpose of these studies were investigations of the non-linear plasma response of transport due to stochastic effects. On LHD, perturbation coils create a Resonant Magnetic Perturbation (RMP) with the m/n = 1/1 and 2/1 Fourier components. Depending on the plasma conditions, the perturbation either enhances or heals the natural m/n = 1/1 magnetic island. For the case of an amplified island the enhanced heat and particle transport across the island causes a rather significant reduction of the confinement.

Figure 1 shows example of pressure profiles with and without RMP. Flattening is observed at R=4.2-4.4m with +1.9kA and -1.9kA. The difference of the flattening at different current polarity is likely to be naturally existing error field.. These changes coincide with an increasing width of the open stochastic volume at the plasma edge near the X-point.

In order to perform qualitative studies density modulation experiments were performed (see Fig. 2) Clear dependence on the island size is visible with minimum corresponding to LHD error field. In order to affect the electron temperature by RMPs, one needs to seed a rather large island, otherwise the stochastic transport does not yield transport changes strong enough to achieve that.

Additionally systematic experiments were performed, changing the amplitude of the perturbation linearly with $I_{RMP}$ in the range of 0 to 2.7 kA. Two scenarios were investigated: first, the discharge was ramped up with an external perturbation already superimposed on the main magnetic field. Second, the external perturbation was applied to the plasma already ignited (similar to experiments with RMPs in tokamaks). Figure 3 shows comparison of Te profile in the RMP current ramping up and down cases. As shown in Fig.3. the flattening width is almost identical (~125mm) but RMP current is clearly differe3nt. In ramping up case, it is 2.75kA, in ramping down case it is 0.75k. Such hysteresis is observed up to a certain amplitude of the external perturbation. Interstingly for the same island size there is clear difference in confined energy, when comparing scenarions with ramping up and ramping down RMP. For the same island size, steeper edge $n_e$ and $T_e$ gradients were obtained with pre-existing magnetic perturbation, and this resulted in better plasma performance.

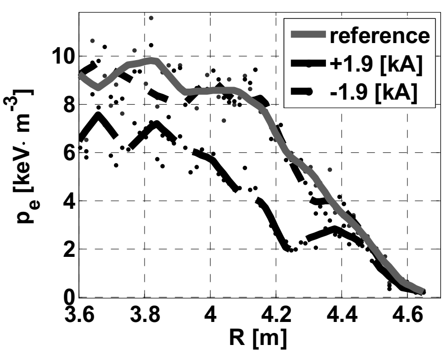


Fig.1 Changes in electron pressure profiles with and without external magnetic perturbation ($I_{RMP}$=1.9kA)

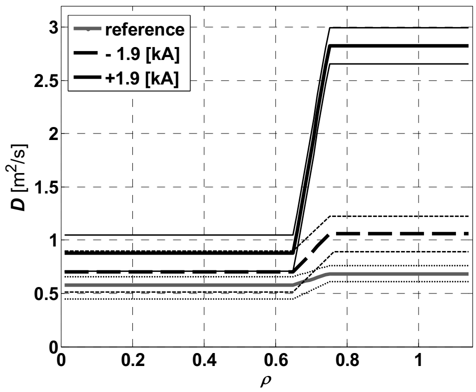


Fig.2 Diffusion coefficients measured from density modulation experiments

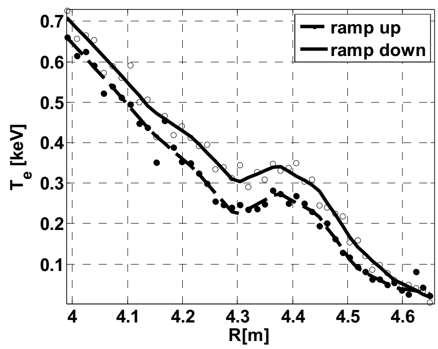


Fig.3 Electron temperature profiles for two discharges at same island width at ramp up and down cases.