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EX/P4-13: Influence of the Resonant Magnetic Perturbations on Particle Transport in LHD

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Resonant Magnetic Perturbations (RMPs) recently became a very popular tool to control plasma exhaust in tokamaks following the results obtained on DIII-D. So called pump-out results from a pitch resonant coupling of the external field to the internal magnetic field. Large Helical Device (LHD) due to three-dimensional nature of the magnetic equilibrium a stochastic region is formed at the plasma edge. In spite of different origins stochastic boundary has similar features in tokamaks and helical devices, which results from heterogeneous open field lines region at the plasma boundary. Additionally at LHD, so called LID coils create perturbation with m/n = 1/1 and 2/1 components. Depending on plasma conditions either enhance or heal m/n = 1/1 magnetic island. In the first case there is rather significant reduction on the confinement, caused mostly by enhanced heat and particle transport across the island. In the latter one there is rather a small drop of beta increasing with increasing LID current. These changes coincide with increasing width of open stochastic volume at the plasma edge near the X-point. With increasing amplitude of magnetic perturbation field lines with very long connection length (L_c > 400 m) are replaced by laminar flux tubes with L_c ˜ 100 m. We also performed experiments where we changed the amplitude of the perturbation linearly with I_LID in the range of 0 –2.7 kA. We have realized two cases: first, where the discharge is ignited with external perturbation already superimposed to equilibrium magnetic fields (which cannot be realized in tokamaks) and second, where the external perturbation is applied to the plasma already ignited (typical case of tokamaks with RMPs). There is a clear difference in size of 1/1 island and dependence of n_e and T_e on LID current showing screening of external field in the latter case with a threshold in penetration of order of 600 A. Above 2 kA we observe global reduction of T_e and n_e profiles. In the case of pre-existing magnetic perturbation the threshold of 600 A is not present and for the same LID current island width is larger when compared to the case with magnetic perturbation applied after plasma ignition. As a result particle transport and confinement are affected much stronger in the discharges with pre-existing magnetic perturbation.

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