3D numerical analysis of magnetic topology and edge transport for TEXTOR-DED and DIII-D limiter configurations with resonant magnetic perturbations

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Resonant magnetic perturbations (RMPs) are applied in the tokamaks TEXTOR-DED, DIII-D and JET in order to control particle and heat flux in the plasma edge layer. This allows to mitigate edge localized modes (ELMs), an instability intrinsic to H-mode plasmas. The application of RMPs induces an open chaotic system at the plasma edge, leading to a complex 3D magnetic field structure. In this contribution the relation between this perturbed magnetic topology and the edge transport characteristics is analyzed in limiter plasmas at TEXTOR and DIII-D.

At TEXTOR, three topological different domains can be identified in the perturbed edge layer: a region with resonant *magnetic island chains*, a region with island overlap - leading to an *ergodic* field line behavior - and a *laminar region* with helical flux tubes connected to targets. The flexible setup at TEXTOR allows to change the relative importance of each domain and examples of the magnetic topology for different scenarios will be presented in this contribution. The effect on particle and heat transport is investigated using the 3D plasma and neutral transport code EMC3-EIRENE. A significant 3D modulation of electron density n_e and temperature T_e is observed in the laminar region both experimentally and in simulations, showing that the radial and poloidal extend of laminar flux tubes as well as the field line connection length in this region is of crucial importance.

For future numerical analysis of ELM control experiments at DIII-D, comparisons of results for TEXTOR to first results for a limiter scenario at DIII-D will be shown. In the analyzed case the plasma edge layer is dominated by ergodic field lines and this magnetic topology is similar to TEXTOR scenarios associated with a density drop in the confined plasma - the so called particle pump out effect. Particle and heat deposition pattern on the limiting wall element are investigated numerically, indicating a strong diffusive transport characteristic in the perturbed edge layer.

In addition to the ergodic domain, the influence of large magnetic islands at the plasma edge in TEXTOR on transport properties is investigated. An analysis of the local and global impact on particle transport will be presented including comparisons to experimental observations.