3D edge transport simulations for RMP experiments at DIII-D

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Resonant magnetic perturbations (RMPs) are a candidate for ELM control in ITER. Modeling of the perturbed magnetic field structure during RMP application in the vacuum approach suggests that an open chaotic system in the plasma edge layer is induced, leading to a complex 3D magnetic field structure.

To investigate the resulting impact on plasma and neutral gas transport, the 3D edge transport code EMC3-EIRENE has been extended to poloidal divertor geometry. For this a new grid topology, i.e. grid cells with non trivial neighbor relations, has been introduced to the code. This facilitates grids for simulation domains with profoundly poloidal asymmetric radial extension (as the edge layer in poloidal diverted tokamaks) with reasonable resolution.

This code extension allows for the first time numerical transport analysis of ELM control experiments at DIII-D. A significant 3D modulation of electron density ne and temperature Te is predicted, following the underlying perturbed magnetic topology. Comparison of these findings to experimental observations gives substantial evidence for open magnetic field lines in the plasma edge layer. A clear splitting of target particle and heat fluxes is predicted only for small anomalous perpendicular transport coefficients, in qualitative agreement with experimental observations.