Contribution to categories 2 + 3: transport of energy and particles in stochastic fields.

Identification and analysis of the transport domains in the stochastic boundary of TEXTOR-DED for different mode spectra

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The generic processes in stochastic magnetic boundaries are of growing relevance as a tool for edge transport control in both Tokamak and Stellarator plasmas. At TEXTOR the Dynamic Ergodic Divertor (DED) is available as a flexible facility to conduct manifold investigations in the field of stochastic boundary layers. It consists of $16+2$ coils wound helically on the inboard side of the torus. These coils can be connected such that different mode spectra with resonances on the $q = 3$ surface and poloidal/toroidal base mode numbers of $m/n = 3/1, 6/2, 12/4$ are created. This changes the penetration of the resonant error field and by this the magnetic topology induced. In this topology field lines with short and long connection lengths L_c to the DED target can be distinguished as one characteristic measure for the DED induced stochastic edge layer. Referring to the transport behavior it was expected that the field lines with short L_c, which are clustered into flux tubes with large radial and poloidal extend, act as a multipolar scrape off layer (SOL) structure, dominated by parallel transport along the field lines to the wall elements which they intersect. In contrast, the field lines with long L_c have the ability to diffuse and therefore to generate an ergodic domain with enhanced radial transport.

The demonstration of these generic properties by experimental investigations and comparative modelling with EMC3/EIRENE was reported in [1,2,3]. Based on these findings the properties of the different domains could be studied in detail and a thorough identification of both domains for all three base mode configurations is worked out in this contribution by analysis of experimental data and comparisons to the results from EMC3/EIRENE modeling.
The short L_c flux tubes show the predicted SOL-like sink activity as they lead to a strong, localized drop in the electron density n_e and the electron temperature T_e. This is caused by a particle and - mainly convective - heat flow to the target. The fluxes carried are topologically determined by the extension of the flux tubes which was varied by changing the base mode configuration. In the ergodic domains filled by field lines with long L_c, n_e and T_e are higher caused by an slightly enhanced radial transport of particles and energy.
However, these ergodic domains are always interleaved with the dominating short L_c flux tubes caused by the strong resonant near field of the DED coils. Therefore the effect of classical ergodicity is only weakly visible in plasmas which are positioned near the DED-target. The previous identification of the two transport domains allowed to control the character of the stochastic boundary layer: subsequently the impact of the short L_c field lines in the stochastic boundary was modified by changing the distance of the resonant flux surfaces to the DED coils. While for plasmas near the target a stepwise increase in the central electron density showed up, for plasmas shifted away from the DED coils, a pump out of particles was detected suggesting a dominating ergodic character for the field line behavior in this scenario.

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[2] M.W. Jakubowski, O.schmitz et al., Phys. Rev. Letters, **96** (2006)035004
[3] O.Schmitz et al., P3-30, PSI-17 (2006), accepted for publication in J. Nucl. Mater.

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