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The optimization of the ergodic structure of dynamic ergodic divertor in the TEXTOR tokamak

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The Dynamic Ergodic Divertor (DED) [1] in TEXTOR is designed to provide an ergodized volume in the plasma edge in order to control heat and particle exhaust. Sixteen perturbation coils (plus two compensation coils) have been mounted on the high field side of the TEXTOR. The power to each coil is separately supplied through individual outlets, what gives large flexibility in choosing operational modes. It can be operated with different structure of the perturbation field, i.e. with the different base modes (e.g. $m/n = 12/4$, where m refers to the poloidal mode number and n to the toroidal mode number).

The currents flowing in the DED coils create magnetic islands; if these islands overlap, the magnetic field lines become ergodic. The near field of the DED deflects the magnetic field lines such that they intersect the walls. The topology of the magnetic field is substantial for the transport properties and plasma parameters. It is expected that the formation of the proper laminar zone – the region with short wall-to-wall connection lengths of the field lines allows decoupling the plasma edge from the core. Due to enhancement of the radial electron heat transport in the ergodic region the electron temperature in the plasma boundary is reduced. Therefore one needs to find the proper ratio of the ergodic and laminar zone, which gives optimal performance of the divertor.

The structure of the perturbed volume strongly depends on the safety factor profile and the plasma pressure. At the higher level of ergodization (i.e. at higher plasma current and lower beta poloidal) the laminar zone is dominant, while at the lower level of ergodization the ergodic region dominates. The complex structure of the ergodic region and the laminar zone with the helical divertor at the high field side of TEXTOR can be well correlated with the magnetic field topology as calculated by mapping techniques. In this work the studies on the role of the magnetic structures for the properties of the plasma boundary are carried out. The topology of the perturbed volume is modeled with the ATLAS [2] and basing on the results of modeling the experiments are performed and compared to the calculated structures. It was found that positive influence of the DED onto the plasma boundary is achieved by shifting the plasma towards the perturbation coils by few centimeters and adjusting the safety factor at the plasma edge to $10/4 \le q_a \le 12/4$.

[1] Fus. Eng. Des. , **37** (1997), No. 3 (special edition devoted to the DED, editor: K.H. Finken)
[2] M.W. Jakubowski *et al.*, Nucl. Fus., **44** (2004) S1