

Overview of transport studies with the Dynamic Ergodic Divertor in the tokamak TEXTOR

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The Dynamic Ergodic Divertor (DED) in the tokamak TEXTOR is a new versatile tool to study the impact of magnetic field perturbations on transport in magnetically confined plasmas and to investigate its potential for power and particle exhaust. The DED consists of 16 perturbation coils and 2 compensation coils wound helically around the torus on the inboard side which produce resonant magnetic perturbations centred at the $q=3$ surface. A novel and unique feature of the DED is its capability to rotate the perturbation field with frequencies up to 10 kHz. The installation allows for mode numbers $m/n=12/4$, $6/2$ or $3/1$. Most important to influence the plasma edge is the $12/4$ configuration with its considerably smaller penetration depth in comparison to the $3/1$ configuration which allows for an ergodization of the plasma up to $q=2$ surface. The perturbed volume consists of an ergodic region with overlapping magnetic islands, which is characterized by very long connection length to the divertor target tiles, and a so called laminar zone, where the connection length to the target is short. In the laminar zone a helical divertor structure is established.

In this contribution we give an overview of studies to investigate the impact of the DED on transport in both the plasma edge and the core in TEXTOR. The perturbation by the DED results in significant changes of the plasma edge structure, and the formation of the ergodic and the laminar zones has been observed based on divertor spectroscopy and measurements of density and temperature profiles of electrons and impurity ions at various poloidal and toroidal locations. All these observations correspond well to the topology of the perturbed magnetic field as calculated with field line tracing and mapping techniques. Along with the formation of the perturbed edge region with open field lines, measurements of the plasma rotation indicate a reversal of the electric field in this region and the possibility of an increased shear across its inner border. In this context we discuss experimental findings of a spin up of plasma rotation in the bulk. Furthermore, initial results on impurity transport (screening effects imposed by the DED) and radiation as well as on the impact of the DED on global energy confinement (including the performance in RI- mode discharges) are presented.