The Impact of the Dynamic Ergodic Divertor on Limiter H-mode plasmas in TEXTOR

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The application of resonant magnetic perturbations to produce stochastic magnetic fields are regarded as one possible option to control excessive transient heat loads to plasma facing components in future fusion devices such as ITER which are associated to Edge Localised Modes in H-mode discharges. A proof of principle of such a concept has been provided at the tokamak DIII-D at ITER- like collisionalities [1]. However, the physical mechanisms behind the ELM suppression are not fully resolved so far. Therefore, for extrapolation of such a scenario to ITER, studies of transport in stochastic edge plasmas – in particular in presence of transport barriers – are required. In this context, the impact of the mode spectrum of the perturbations on transport and structure formation is of special importance.

We report on experimental results of limiter H-mode plasmas in the tokamak TEXTOR under the influence of the Dynamic Ergodic Divertor (DED). This scenario is characterized by enhanced pressure gradients mainly caused by the formation of a density pedestal, a substantial spin up of poloidal rotation into electron diamagnetic drift direction in the edge region and ELM-like particle and heat flux bursts to plasma facing components with frequencies in the range of 500 – 1500 Hz.

Both the edge pedestal and the associated barrier relaxations are strongly influenced by the formation of the stochastic edge layer induced by the resonant magnetic perturbations. In the low m/n = 3/1 base mode configuration of the DED the low threshold to excite 2/1 tearing modes strongly limits the operational domain to control edge transport with the DED in DC operation for typical values of the edge safety factor in our limiter H-mode plasmas (q_a = 3.2 – 4.5). In the 6/2 configuration the particle and heat bursts can be steadily reduced with increasing perturbation current on the expense of a correspondingly reduced edge pedestal. Finally, the ELM-like bursts are fully suppressed but also the pedestal is completely lost. We will compare the changes of transport characteristics induced by DED in detail with the topology of the perturbed magnetic field.

[1] T. Evans et al., Nature Physics Vol 2, (JUNE 2006) 419

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