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Modelling of Dynamic Ergodic Divertor effect on the density limit in TEXTOR

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Dynamic Ergodic Divertor (DED), recently installed on TEXTOR, has revealed a significant influence on the density limit, essentially depending on the DED operation mode and plasma heating scenario. In Ohmic discharges, where without DED detachment normally arises at the density limit, multifaceted asymmetric radiation from the edge (MARFE) develops when the DED is operated in dc mode and the maximal achieved density decreases with increasing DED current. With ac DED the density limit is due to detachment and its value, being lower than under normal conditions, exceeds the level achieved with dc DED at the same current. By additional heating with neutral beam injection, the density limit is always due to MARFE development. It is reduced by dc DED, but is increased above the standard value when DED is operated in ac regime.

In order to interpret the experimental results the model developed recently for the plasma edge in tokamaks [1], which combines self-consistently the effects from impurity radiation, particle recycling and edge turbulence in order to investigate the synergy of these phenomena in the density limit, has been improved in order to take into account the modifications due to DED. Thus, the computation take into account the presence of X-points provided by the DED coils near the inner wall, the motion of X-points when DED operates in ac mode and possible poloidal plasma flow induced by the rotating magnetic field perturbations. The corresponding development in the numerical approach includes, e.g., an adaptation of the model for periodic boundary conditions.

The results of calculations will be presented and compared with experimental observations. They reproduce well the most characteristic features of the DED effect on the density limit scenario and its level.

[1] M.Z.Tokar, F.A.Kelly and X. Loozen, submitted to Phys. Plasmas.