Turbulent Transport of Plasma Observed in Model-Independent Simulations of the Scrape-Off-Layer

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A novel approach to self-consistent simulations of plasma at the core edge and in the scrape-off-layer (SOL) yield model-independent solutions of non-linear effects.

Numerous computer experiments based on the approach lead to the discovery of basic conditions of edge-localized modes (ELM) for particular configurations and to detailed observations of the mechanism of turbulent plasma transport.

We observed periodic expansion of the plasma edge accompanied with bunches of plasma moving outwards alongside the connection length from the edge to the divertor target. They cause fast leakage of SOL plasma and the crush of ELM followed by the filling with plasma of the emptied SOL volume, slow but progressive detachment of plasma from the target (similar to the moving of void towards the core), the recovery of plasma density at the edge of the core, and edge plasma expansion in the SOL volume.

The simulation observations are similar to the picks moving outwards and voids moving towards the core seen in DIII experiments (Boedo et al this TTF Workshop).

The self-consistent simulations are based on numerical solution of exact equations of motion of charged particles in the magnetically confined plasma and precise procedures for Monte Carlo simulations of particle collisions and emitted radiation.