# Sensitivity of the pedestal characteristics to the SOL limiter model in gyrokinetic simulation

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Recent full particle distribution electrostatic gyrokinetic plasma simulations [1] have been accomplished for a combined pedestal-SOL regime including a possible magnetic separatrix regime.

The actual problem of describing the SOL turbulence and related transport together with neutral particles and pedestal formation is nevertheless still very challenging for electromagnetic particle gyrokinetic codes to resolve, mostly due to the avoidance of conventional flux coordinate systems, high resolution demands, and stability issues required to resolve the complex SOL physics with radiation, sheaths, particle recycling, etc.

In the present work, a less challenging target is set to study the effect of simplified SOL models on the pedestal characteristics in electrostatic gyrokinetic simulation of the combined pedestal-SOL plasma. Here, the SOL is created by a toroidal limiter, allowing therefore the conventional flux coordinate system. Recycling is modeled by a balance of lost electrons and ions onto walls and limiter with neutrals emanating from the material surfaces.

Radiation losses with impurities, ionization losses, and Ohmic heating in the core plasma as a heat source are included. The plasma evolution is followed in time using the Elmfire full particle distribution gyrokinetic code [2]. Starting from an initial state one may follow either the creation of an Ohmic equilibrium, or by adding an extra core heating to modify the state towards an enhanced pedestal at the edge.

The problem is considered by two different SOL descriptions, one with a poloidally homogenized model in which the limiter effect is simply accounted for by a special pick-up process of ions and electrons out of the SOL region according to their travelled distance within it, and another with a full 3D description of the SOL and its plasma evolution.

The former method is fast and efficient, and actually can provide many relevant physical constraints on the plasma inside the separatrix like the particle and energy losses across the separatrix, and thus some relevance to the pedestal formation is seen. However, it fails to provide the proper variation of the radial electric field through the separatrix and inside the SOL, and evidently does not describe the turbulence correctly in the SOL within this electrostatic limit. On the other hand, the second method avoids these caveats. With the latter method, the SOL flows and the variation of the radial electric field with the pedestal evolution are investigated as a function of boundary conditions set at the limiter surfaces for the particles and fields.

[1] C.S. Chang et al., Contrib. J. Phys: Conference Series **180** (2009) 012057
[2] J.A. Heikkinen et al., J. Comp. Phys. **227** (2008) 5582.