Studying the parallel dynamics of a train of blobs in a SOL of a medium-size tokamak using particle-in-cell simulations

J. Kovačič[1], S. Costea[2], D. Tskhakaya[3,4], I. Gomez[1], T. Gyergyek[1,5], Tsv. K. Popov[6], R. Schrittwieser[2]

[1] *Jožef Stefan Institute, Ljubljana, Slovenia*

[2] *Institute for Ion Physics and Applied Physics, University of Innsbruck, Austria*

[3] *Institute of Applied Physics, Vienna University of Technology, Austria*

[4] *Andronikashili Institute of Physics, Tbilisi, Georgia*

[5] *University of Ljubljana, Faculty of Electrical Engineering, Slovenia*

[6] *University of St. Kliment Ohridski, Faculty of Physics, Sofia, Bulgaria*

The filamentary transport in the SOL has since long been a hot topic in fusion research, because of its importance to the evaluation of the first wall heat loads [1]. The filaments cross the separatrix at outer midplane and intend to propagate in radial direction toward the wall. However, since the parallel conductivity is much higher then the perpendicular, they usually connect to divertor in parallel direction. The phenomena is intrinsically of kinetic nature, since the filaments (blobs) protruding into the SOL are significantly denser and several times hotter than the SOL plasma. The blobs arrive into SOL with irregularity in size and waiting times, however nowadays we have very good statistical description of such transport. What is missing is the understanding of the parallel and radial dynamics of blobs from kinetic perspective, taking into account the temporal development of local velocity distribution functions, which are influenced by many different particle-particle and particle-wall interactions.

In our work we have continued with the simulation of parallel blob dynamics inside a single flux tube of a medium-sized tokamak employing a 1d3v massively-parallel fully-kinetic code BIT1 [2], which includes a 2d3v module for neutral particle pusher. We have modified the code in a way, that it forms a repetitive source of blobs - a train of blobs - at the location of outer midplane. Furthermore, an additional constant source was added, mimicking cross-field diffusion. We also made cases with inclusion of recycling at the divertor plates, which extended our research into interaction of fast blob particles with the neutrals. In the simulations the domain is initially empty, and the SOL is built self-consistently from the sources and the sinks. As a result, we could extract not only profiles of fluid parameters, like density and temperature, but also detailed energy distribution functions in time, CX and ionization rate profiles.

References

[1] H.W. Müller et al., *Nucl. Fusion* **51** (2011) 073023

[2] D. Tskhakaya et al., *Journ. Nucl. Materials* **438** (2013) S522–S525