Kinetic model of the COMPASS tokamak SOL

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In this work we report on results of kinetic modelling of the COMPASS tokamak SOL. COMPASS is a middle size ($R = 0.56$ m) machine equipped with different edge diagnostics [1]. Due to its size and availability of large set of edge diagnostic data, COMPASS represents a perfect candidate for full size kinetic modelling SOL with the ability of direct comparison of the simulation results with plasma edge diagnostic measurements [2].

For simulations we use a massively parallel electrostatic 1D3V PIC + MC code BIT1 [3], which includes set of elastic and inelastic processes covering plasma recycling and impurity sputtering in a self-consistent way. Simulation geometry corresponds to a single flux tube in the SOL adjacent to the separatrix. We consider inter-ELM and ELMy SOLs with different carbon sputtering yields and different divertor currents. The assumptions made during the simulations have been validated via comparison of results with the experimental observations.

Our simulations indicate, that i. kinetic effects are significant in the inner divertor (ID) plasma; ii. normalized power loads to the ID are above the classical values and are caused by non-Maxwellian super-thermal electrons [3]; iii. different divertor current regimes do not influence overall SOL parameters, except the ones for divertor sheath; iv. the divertor electron temperature during the ELMs increases significantly, but still it is well below 2/3 of the pedestal temperature predicted by the “free-streaming” ELM model [4]; v. we identify inelastic interaction of the ELM electrons with the thermal plasma as a source of ELM electron cooling.