SOLPS-ITER modelling of the COMPASS tokamak SOL and comparison with kinetic simulations

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The choice of boundary conditions is an important question in edge plasma transport modelling. The physical laws which govern the plasma parameters and processes inside the computational domain can fail at its boundary or require additional input. The case of the target sheath falls under the former; under most conditions the sheath is collisionless and, therefore, cannot be described using a transport code built upon the assumption of frequent collisions. Its effects on the plasma are instead captured with analytical formulas based on sheath theory, such as the target heat flux prescription, the sheath potential drop or the Bohm criterion. These formulas often contain parameters whose precise value is not immediately evident, such as the sheath heat transmission coefficient or the target Mach number. Also important are parameters of the parallel transport which can be influenced by the sheath, the heat flux and viscosity limiters. In transport modelling, their value can be adjusted to yield experiment-modelling fit, but it should also be based on a first-principle justification. The tool of choice for sheath investigation are kinetic codes, and thus transport modelling can be supplemented and validated by kinetic simulations.
In this contribution, the SOL of the COMPASS tokamak [1] discharge #16908 is modelled using SOLPS-ITER [2] and compared to the BIT1 results published in [3] as well as the 1D transport code SOLF1D [4]. The SOLPS-ITER simulations contain kinetic neutrals and intrinsic carbon impurities while leaving out drifts, which may be an important omission in closely matching the target conditions of COMPASS. The choice of suitable SOLPS-ITER boundary conditions and input parameters is discussed and conclusions are drawn for transport modelling of the COMPASS tokamak in general, including the recommended values for selected parameters.

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[2] S. Wiesen et al, Journal of Nuclear Materials **463** (2015) 480-484
[3] D. Tskhakaya et al, Nuclear Materials and Energy **26** (2021) 100893
[4] E. Havlíčková et al, Plasma Physics and Controlled Fusion **55** (2013) 065004