Connecting SOL transport with divertor exhaust physics

SOLPS modelling for ASDEX Upgrade

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Power and particle exhaust in an ITER-like, metallic divertor is sensitively connected to the transport processes in the main scrape-off layer, SOL. Radial transport in the SOL, including anomalous processes like filamentary transport [1,2], can widen the heat flux profile prior to the divertor entrance, alleviating the requirement of peak power flux mitigation and increasing the volume in which particle and heat losses can be achieved in the divertor. The radial transport competes with the parallel transport, which connects the particle fluxes crossing the separatrix with the divertor targets. Cross-field drifts can modify both the radial and parallel transport levels, playing a potential role in the in/out asymmetries of the divertor heat flux distribution [3]. All these processes can vary in strength in the poloidal direction, and they are coupled with the power dissipation processes in the divertor.

For analysing the connections between SOL transport and divertor exhaust physics, 2D edge fluid codes like SOLPS5.0 [4] have been developed. The codes calculate Braginskii-like fluid equations in the edge of the closed field-line region, in the SOL and in the private flux region. A Monte Carlo calculation of neutral trajectories is typically included, and some of the codes have models for drifts and currents. For the radial transport, arbitrary levels of diffusion and/or convection can be specified by the user, with variations in both radial and poloidal directions.

In the present contribution, we discuss the role of SOL transport in power and particle exhaust processes, focusing on comparisons between SOLPS5.0 simulations and ASDEX Upgrade experiments. The effects of cross-field drifts as well as the typical assumptions of radial transport made in the simulations to match experimental measurements are described. Various experimental conditions are addressed, ranging from attached divertor regimes with minimal power dissipation [5,6] to regimes in which the heat and particle exhaust is significantly modified by neutrals or seeded impurities [7,8,9]. Experimental conditions for which credible models cannot be achieved or for which untypical, high levels of radial transport are suggested [10,11] are discussed.

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