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Synthetic edge and SOL diagnostics - a bridge between experiments and theory

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The Scrape off Layer (SOL) plasma and its coupling with the edge dictate the performance of a discharge to a high degree –especially as all plasma has to go through the SOL, which is the main exhaust channel for the hot plasma. The understanding of the SOL plasma is a key topic in contemporary fusion research.

This contribution provides an overview of the modelling efforts of the plasma dynamics in the Scrape-off-Layer (SOL) coupled with the edge. We employ fully dynamical fluid models, e.g. the HESEL code. HESEL simulates density, ion and electron pressure evolution together with the evolution of the generalized vorticity [1] and assumes that the SOL is mainly fuelled at the outboard midplane. Parallel losses, including sheath couplings at the material surfaces, have been parameterized in the SOL. HESEL includes a neutral gas module to model the influence of neutrals on the plasma performance in the SOL and outer edge in their interplay with the intermittent SOL turbulence [2].

For interaction with experiments, HESEL is equipped with synthetic diagnostic tools as probe arrays, Li-beam spectroscopy, and Gas Puff Imaging. Running HESEL in a Kepler workflow, developed within the EUROfusion Integrated Modelling framework[3], allows direct and automated access to experimental data and discharge parameters. A workflow for generating synthetic Lithium beam data, where fluctuation data from HESEL are passed to the RENATE code[4] will be discussed.

Using the synthetic probe arrays to measuring the electron and ion heat advection and conduction, we obtain the upstream power fall-off length for a broad range of plasma parameters and by applying non-linear fitting procedures we derive the scaling of the fall-off length with different key parameters. The obtained results are in agreement with recent experimental observations from L-mode AUG data [5].

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