SOLPS modeling of ELM-free and inter-ELM H-mode edge plasmas

J. Canik[1], L. Owen[1], X. Bonnin[2], D. Coster[3],
R. Groebner[4]

[1]Oak Ridge National Laboratory
[2]CNRS-LIMHP Université Paris
[3]Max-Planck-Institut für Plasmaphysik - Garching
[4]General Atomics

The H-mode edge pedestal (HEP) benchmarking exercise seeks to identify, clarify, and quantify the key physical processes involved in the formation and evolution of DIII-D H-mode pedestals through benchmarking comparisons between various types of transport modeling codes. Modeling of the ELM-free phase of discharge 118897 at 2140 ms and an inter-ELM time slice of 98889 with the Scrape-Off Layer Plasma Simulation (SOLPS) code will be discussed. SOLPS is a suite of codes consisting of grid generators, the plasma fluid code B2.5, the Monte Carlo neutrals code Eirene, and a diagnostics package. With data-constrained, coupled B2.5-Eirene simulations of the pedestal, SOL, and divertor plasma regions, the relative roles of particle and energy transport and fueling in the pedestal are investigated.

Several forms of spatially dependent anomalous transport coefficients are used. These include particle and energy diffusivities that are determined directly from the balance equations using tanh fits to the measured upstream density and temperature profiles, and parameterized D, V_{conv} and χ profiles in which the parameters are adjusted to fit the data. Transport models in which V_{conv} is directed radially inward (pinch) or radially outward in the pedestal region are compared, as are models in which D and χ contain edge transport barriers. With the plasma transport, neutral transport, and wall/plate recycling determined self-consistently the simulations indicate that in these discharges fueling in the pedestal region is dominated by recycling of plasma from the divertor plates rather than the vessel walls.

For the anomalous transport coefficient models used, the peak plasma particle and heat fluxes into the pedestal region occur near the low field side midplane. The results show that pedestal fueling is dominated by ionization of neutrals in the X-point region where the flux expansion is large. The calculations show a lack of ion/neutral temperature equilibration in this region, suggesting a significant charge exchange energy sink.