

A one-dimensional scrape-off layer model in the reactor systems code 'PROCESS'

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We have implemented a one-dimensional scrape-off layer (SOL) model in the PROCESS fusion reactor systems code. It allows reactor scenarios to be obtained while limiting both the plasma temperature of the SOL at the entrance to the sheath at the divertor target, and the power density on the target. The following physical processes are included: convected heat flux; thermal conduction; momentum conservation; radiation by deuterium, tritium and impurities; charge exchange; electron impact ionisation; and surface recombination. The isotropic emission of fast neutrals due to charge exchange from the part of the SOL adjacent to the target dominates the total power density on the target when the plasma temperature is reduced below 5 eV.

As the seeded impurity concentration is increased a discontinuous transition is observed between an attached state where the plasma temperature at the target is high, and an approximately detached state in which the temperature at the target hits the lower bound of the simulation.

The inclusion of a simple divertor model restricts the PROCESS optimisation to a more realistic subset of parameter space.

