Core-Edge Integrated Modeling for Neutral and Fast Ion Transport

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The dynamic interplay between the core and the edge plasma has important consequences in the confinement and heating of fusion plasma. Recycled neutrals are produced at the plasma-material interface, which then travel through the Scrape-Off-Layer (SOL) into the core and serve as a major source of plasma fueling. Similarly, fast ions produced by either neutral beam injections (NBI) or fusion reactions typically have drift orbits that extend into the SOL and Larmor orbits comparable to the SOL width. The confinement of these particles will be influenced by both the core and the SOL, and has important consequences on the core plasma heating and confinement. In order to self-consistently study these coupled effects, a workflow has been developed to couple a reduced SOL model into the core transport solver TRANSP [1, 2]. A semi-structured SOL grid is generated at each time step, upon which a 2-D profile of the SOL plasma is solved with a combination of the heuristic drift and the modified 2-point model [3, 4]. The SOL model is then coupled to the neutral transport solver DEGAS2 [5] to calculate the neutral transport. A new particle tracing algorithm has also been developed to extend the NBI module NUBEAM into the SOL [6, 7, 8]. These new capabilities will be demonstrated with simulations performed using NSTX/NSTX-U plasma profiles, where the calculated SOL plasma and neutral profiles as well as fast ion distributions will be compared with experimental measurements.

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