Coupled whole device simulations of plasma transport in tokamaks with the FACETS code

A. Hakim[1], J.R. Cary[1], T.D. Rognlien[2], R.J. Groebner[3], J. Candy[3], J. Carlsson[1], R.H. Cohen[2], K. Indireshkumar[4], S.E. Kruger[1], D. McCune[4] , A.Y. Pankin[5], A. Pletzer[1], S. Vadlamani[1], A.Y. Pigarov[5], T. Epperly[2], L. McInnes[7] , M. Miah[1], S. Shasharina[1], H. Zhang[5]

1) Tech-X Corporation, Boulder, CO 80026; 2) Lawrence Livermore National Laboratory, Lawrence, CA; 3) General Atomics, San Diego, CA;
4) Princeton Plasma Physics Laboratory, Princeton NJ; 5) Lehigh U., Bethlehem, PA; 6) UCSD, San Diego, CA; 7) Argonne National Laboratory

The FACETS project aims to provide computational tools for whole device simulation of tokamak transport for use in fusion applications.

The framework provides flexibility by allowing users to choose the best model for a given physics target. Our goals are to develop accurate transport solvers using neoclassical and turbulent fluxes with varying degree of fidelity and computational complexity, including embedded gyrokinetic simulations. Accurate sources using both ICRH wave absorption and neutral beam injection, using parallel source components, are included. Detailed modeling of the plasma edge using a fluid-based physics component, UEDGE, is performed and coupled to the core solver. The core region is simulated using a newly developed parallel, nested-iteration based non-linear solver while the UEDGE uses nonlinear solves from the PETSc/SNES solver package. As a first application we present coupled core-edge simulations of pedestal buildup in the DIII-D tokamak. The sensitivity of pedestal buildup to chosen transport models it studied. Fluxes computed from reduced models are compared to embedded gyrokinetic calculations at selected flux surfaces.