Validation Study of MMM7.1 Anomalous Transport Module and Integrated Simulations of ITER Burning Plasma

T. Rafiq, A.H. Kritz, R.V. Budny, A.Y. Pankin

1Lehigh University, Bethlehem, PA, USA
2Princeton Plasma Physics Laboratory, Princeton, NJ, USA
3Tech-X Corporation, CO, US

The MMM7.1 anomalous transport module, recently installed in the PTRANSP code, is used to compute thermal, particle and toroidal angular momentum transport [1]. The new MMM7.1 is documented and organized as a standalone module, which fully complies with the NTCC (National Transport Code Collaboration) standards [2]. In this study, the theory based Multi-Mode module, MMM7.1, is derived and simulations of DIII-D tokamak and baseline ITER H-mode discharges are presented. The discharges simulated in the validation study of MMM7.1 include DIII-D Ohmic, L-mode, H-mode plasmas, plasmas with co- and counter-rotations and plasmas with internal transport barriers. The H-mode pedestal temperature is computed using the NTCC PEDESTAL module or the EPED1 module [2,3].

This research extends our previous integrated modeling studies of ITER steady state and hybrid scenarios [4] to ELMy H-mode baseline scenario with 15 MA current. The simulation results presented here are obtained using the PTRANSP predictive integrated modeling code with time evolved boundary conditions and the plasma shape provided by the free boundary Tokamak Simulation Code (TSC). The variation in density and in the level of Argon impurity provides insight to the sensitivity of fusion power production to the variation in the baseline ITER H-mode plasma parameters. Scans also include conditions that are under the control of experimentalists, such as the level of auxiliary heating power and the conditions that can be used to adjust current drive. The dependence of confinement and the associated fusion power production on the mixture of beam and RF heating as well as on the choice of RF heating mixes are examined.