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TH/P2-13: Physics Basis and Validation of MMM7.1 Anomalous Transport Module

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The MMM7.1 anomalous transport module, recently installed in the PTRANSP code, is used to compute thermal, particle and toroidal angular momentum transport. The new MMM7.1 is documented and organized as a standalone module, which fully complies with the NTCC standards. The new transport module can be used with a standalone driver as well as within the integrated PTRANSP code and in other whole device modeling codes such as ASTRA, TSC, ONE-TWO, SWIM and FACETS. The MMM7.1 module includes a model for ITG, TE modes and MHD modes as well as a model for ETG modes and a model for drift resistive inertial ballooning modes. The model for transport driven by ITG/TE modes now includes the diffusion and radial convective pinch of toroidal angular momentum. It is found that this ITG/TE model can predict the observed intrinsic plasma rotation given a relatively small toroidal rotation at the plasma edge. The theoretical foundation of MMM7.1 is significantly advanced compared to the earlier MMM95 model. The new ITG/TE model in MMM7.1 module more accurately computes the suppression of transport at low and reverse magnetic shear. The MMM7.1 module is further improved by making better approximations to the structure of the eigenfunctions along field lines in order to include the effects of non-circular flux surfaces, finite beta, and Shafranov shift. Simulations using the MMM7.1 module compute the internal transport barrier that is experimentally observed in reversed magnetic shear discharges with sufficiently large toroidal angular rotation. The fluid approach which underlies the derivation of MMM7.1, while not as complete as a kinetic approach, allows prediction of the evolution of plasma discharges on an energy transport time scale. In this study, the theory based MMM7.1 is derived and simulations of DIII-D and JET tokamak discharges are presented to illustrate how various elements of the transport model influence the evolution of the tokamak plasma discharges. The discharges simulated include Ohmic, L-mode, H-mode plasmas and plasmas with co- and counter-rotations and plasmas with internal transport barriers. Results will be presented to understand the interaction between physical processes that influence transport in magnetically confined plasmas.

Country or International Organization of Primary Author

USA

Collaboration (if applicable, e.g., International Tokamak Physics Activities)

See the Appendix of F. Romanelli et al., Proceedings of the 23rd IAEA Fusion Energy Conference 2010, Daejeon, Korea.

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