Predictive Particle Transport Modeling Using the PTRANSP Code

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Particle transport is being implemented in the PTRANSP predictive integrated modeling code with transport coefficients computed using theory-based models such as MMM95, GLF23 and NCLASS. The equations for thermal, particle and momentum transport are coupled and solved implicitly using a Newton's iteration technique. The transport models are implemented using a transport common interface module. This common interface module addresses issues such as the different normalizations of plasma gradients used by the different models. In addition, the common interface module provides a common calling routine to the MMM95 and GLF23 modules and it standardizes the output. The algorithm that advances the plasma profiles in time treats the transport equations as though they were strongly coupled. The following are three examples of strong transport coupling: (1) The plasma toroidal velocity, which is advanced by the momentum transport equation, contributes to flow shear, which can strongly suppress different channels of turbulence-driven transport. (2) Density gradients influence drift wave thresholds and drive trapped electron mode turbulence, which drives all channels of transport. (3) The ITG and ETG mode transport is sensitively dependent on ion and electron temperature gradients. When the density profiles are advanced predictively in PTRANSP, an option is implemented to use a feedback loop on gas puffing in order to control the average plasma density. Previously existing routines are used in PTRANSP for ion sources due to neutral beam injection and edge recycling.