Simulating ITER Target Steady State and Hybrid Plasma Using Multi-Mode version 7.1 and GLF23 Transport Models

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The combination of the TSC and PTRANSP codes is used to simulate ITER discharges from ramp-up through flat-top. The TSC code computes free-boundary equilibrium, coil currents, temperature and magnetic *q*-profile from start-up through the flat-top stage. The PTRANSP code is used either in analysis mode or in predictive mode. In analysis mode, PTRANSP is used to compute toroidal angular rotation profiles and refine power deposition and current drive profiles for use in subsequent TSC simulations. In predictive mode PTRANSP is used to compute temperature, magnetic *q* and toroidal rotation profiles using either the new Multi-Mode version 7.1 model (MMM7.1) or the GLF23 anomalous transport model. The dependence of heat deposition is studied with varying ICRF frequency, number of beam particles, beam orientation and ECRH launch direction. The NCLASS module is used to compute neoclassical resistivity and bootstrap current. The Porcelli module is used to compute the effect of sawtooth crashes. The formation of an internal transport barrier in temperature and rotation frequency is predicted using MMM7.1 for both ITER target steady state and hybrid simulations. In hybrid discharges, the MMM7.1 model and the GLF23 model both predict that 500MW of fusion power (fusion Q=10) is achieved in 1000 second simulations. In target steady state discharges, it is found that there is a significant improvement in fusion production when lower hybrid heating and current drive is turned off after 500 seconds. The improvement occurs because the lower hybrid current, which is driven near the plasma edge, is replaced by core current when the total current is held constant. As a result there is a flattening of the *q* profile and a reduction in magnetic shear. The PTRANSP simulations also indicate that significant improvement in fusion power production occurs when the lower hybrid current drive is replaced with electron cyclotron current drive. This result also occurs because of the increase in core current. A study has been carried out to examine the sensitivity of fusion power production to the height of the H-mode pedestal and setting a different rotation frequency at the boundary. As the pedestal temperature increases, there is an associated increase in bootstrap current in the pedestal region. If the total current is maintained constant, the core current decreases. It is shown that this decrease in core current can negate the improvement in fusion power production associated with an increase in pedestal height that might be expected given the stiff nature of the MMM7.1 and GLF23 models.