CURRENT PROFILE MODELING TO EXTEND THE DURATION OF HIGH PERFORMANCE ADVANCED TOKAMAK MODES IN DIII–D*

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High performance has been obtained in a number of tokamaks with internal transport barriers. In the DIII–D tokamak, ion transport approaching neoclassical values across the entire plasma cross section has been obtained in discharges that combine an internal transport barrier with an H–mode edge barrier.[1] High performance modes with optimized magnetic shear profiles and H–mode edge plasma are typically limited by MHD instabilities driven by high pressure gradients at the edge. Negative Central Magnetic Shear (NCS) discharges without an edge transport barrier but with an L–mode-like edge do not encounter the edge instabilities. These NCS discharges are limited either by MHD instabilities resulting from the peaked pressure profiles associated with the internal transport barrier, or by q_{min} passing through a low order rational. The NCS profiles have been obtained transiently by auxiliary heating during the current ramp, so that both q_{min} and the radius at which it occurs, $\rho_{q_{min}}$, decrease in time as current diffuses inward. The measured current profile, as calculated with the equilibrium code EFIT using measurements with the 35 chord Motional Start Effect (MSE) diagnostic[2] including the radial electric field corrections, are compared to that predicted by the Corsica code (a time-dependent, 2D equilibrium and 1D transport code) which calculates the temporal evolution of the current density using the measured temperature, density, and Z_{eff} profiles. We further explore Corsica's predictive capabilities using various models for the thermal transport, including critical gradient models which have the feature of reduced ion transport in the negative shear region. With the availability of high power electron cyclotron and fast wave heating and current drive, we will be beginning experiments to actively control and sustain the hollow current profile. We expect that both the performance and the duration of the high performance NCS discharges can be increased if $\rho_{q_{min}}$ is increased. These experiments will be guided by a Corsica modeling effort focused on extending the duration of NCS scenarios by optimizing the timing and magnitude of NBI power, fast wave heating, off-axis ECH and ECCD, and inductive current ramps. The results of these calculations for the optimization of the formation of NCS discharges and of the best techniques to sustain them, consistent with DIII–D experimental conditions, will be presented.

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