Progress in Experiment and Modeling of ITER Demonstration Discharges in the DIII-D Tokamak*

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In previous work [1], four leading ITER operating scenarios (baseline, steady-state, hybrid, advanced inductive) were demonstrated on DIII-D, with plasmas matching the design values for the ITER plasma cross-section, R/a, I/aB, β_N H_{98} and f_{NI}. In more recent work [2], we have improved the match to anticipated ITER conditions for several key plasma parameters, and performed significant new theory-based modeling of the ITER demonstration discharges. Specifically, the match to ITER baseline scenario plasmas has been improved in the following ways: (1) Operating with reduced plasma density, so as to match the ITER edge target collisionality; (2) A limited data set was obtained with reduced plasma rotation, so as to study affects on confinement and stability; (3) Improved stationarity and density control was obtained, and; (4) Improved ELM conditions were obtained (smaller, faster). (5) In addition, initial data were obtained on the performance of baseline scenario plasmas with H-beam injection into He plasmas, as may be used during ITER's initial non-activated operating phase. The confinement and fusion performance of the He plasmas is substantially lower than that of comparable D plasmas. With regard to modeling, using an experimental edge pedestal boundary condition the theory-based TGLF transport model [3], reproduces experimental T_e and T_i profiles with similar or slightly better accuracy as obtained for conventional H-mode discharges [4]. Significantly, the modeling indicates that confinement, transport mechanisms, and ELM characteristics change as the ITER regimes of low collisionality and low rotation are approached from standard operating conditions in present day experiments.

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