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Category Number and Subject: 6.20 DIII-D Tokamak

[ ] Theory [X] Experiment

**Current Profile Control in DIII-D,\*** E. Schuster, J.E. Barton, M.D. Boyer, W.P. Wehner, *Lehigh University*; J.R. Ferron, D.A. Humphreys, A.W. Hyatt, G.L. Jackson, T.C. Luce, M.L. Walker, *General Atomics* – Experimental results successfully demonstrate the potential of physics-model-based control for systematic attainment of desired q profiles, with the subsequent benefit of enabling exploration and reproducibility. The control scheme is constructed by embedding a nonlinear, control-oriented, physics-based model of the plasma dynamics into the control design process. This modeling approach combines first-principles laws with empirical correlations obtained from physical observations, which leads to PDE models capturing the high-dimensionality and nonlinearity of the plasma response. Model-based control design includes not only the synthesis of feedback controllers for robust regulation or tracking, but also the determination of optimal feedforward actuator trajectories for a systematic approach to scenario planning. Feedforward+feedback (closed loop) control experiments in DIII-D consistently demonstrate improved current-profile control performance relative to feedforward (open loop) control alone.

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