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Physics-model-based Actuator Trajectory Optimization and Feedback Control of the Plasma Safety Factor Profile and Internal Energy Dynamics in DIII-D[1] J.E. BARTON, E. SCHUSTER, Lehigh University, M.L. WALKER, D.A. HUMPHREYS, General Atomics — Simulation and experimental results in DIII-D are presented to demonstrate the potential of integrated physics-model-based q profile and internal energy control algorithms for systematic attainment and repeatability of discharges. Both simulations and experiments demonstrate improved profile control accuracy relative to open loop (feedforward) control alone, by using a combined feedforward + feedback scheme. The scheme is constructed by embedding a nonlinear, first-principles-driven, physics-based model of the plasma dynamics into the control design process. Firstly, a tool to numerically design actuator trajectories that steer the plasma to a desired operating state (feedforward) is developed with the objective of supporting the traditional trial-and-error experimental process of advanced scenario planning. Secondly, an algorithm to track a desired q profile and internal energy evolution (feedback) is developed with the goal of adding robustness to the control scheme.

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