

Abstract Submitted  
for the DPP14 Meeting of  
The American Physical Society

**Optimization of the Current Ramp-up Phase in DIII-D via  
Physics-model-based Control of Plasma Safety Factor Profile Dynamics<sup>1</sup>**

J.E. BARTON, W.P. WEHNER, E. SCHUSTER, Lehigh University, T.C. LUCE, G.L. JACKSON, J.R. FERRON, D.A. HUMPHREYS, A.W. HYATT, General Atomics — Simulations and experimental results in DIII-D are presented to demonstrate the potential of physics-model-based control of the  $q$  profile to improve the reproducibility of plasma startup conditions by achieving a specified target  $q$  profile at the end of the current ramp-up. Three different  $q$  profiles ( $q_{min}$  of 1.3, 1.65, 2.1 and  $q_{95}$  of 4.4, 5.0, 6.2, respectively) were specified as targets. A feedforward + feedback scheme is utilized to control the  $q$  profile and is constructed by embedding a nonlinear, physics-based model of the  $q$  profile dynamics into the control design process. A unique characteristic of the feedforward trajectories obtained by solving the optimization problem is the regulation of the plasma current ramp-up rate to achieve the target  $q$  profiles. The feedback controller is employed to add robustness to the control scheme and account for drifts due to external plasma disturbances.

<sup>1</sup>Supported by the US Department of Energy under DE-SC0001334, DE-SC0010661 and DE-FC02-04ER54698.

Justin Barton  
Lehigh University

Date submitted: 11 Jul 2014

Electronic form version 1.4