Abstract Submitted
for the DPP13 Meeting of
The American Physical Society

**Physics-based Control-oriented Modeling of the Current Profile Evolution in NSTX-Upgrade**[1] ZEKI ILHAN, JUSTIN BARTON, WENYU SHI, EUGENIO SCHUSTER, Lehigh University, DAVID GATES, STEFAN GERHARDT, EGEMEN KOLEMEN, JONATHAN MENARD, PPPL — The operational goals for the NSTX-Upgrade device include non-inductive sustainment of high-$\beta$ plasmas, realization of the high performance equilibrium scenarios with neutral beam heating, and achievement of longer pulse durations. Active feedback control of the current profile is proposed to enable these goals. Motivated by the coupled, nonlinear, multivariable, distributed-parameter plasma dynamics, the first step towards feedback control design is the development of a physics-based, control-oriented model for the current profile evolution in response to non-inductive current drives and heating systems. For this purpose, the nonlinear magnetic-diffusion equation is coupled with empirical models for the electron density, electron temperature, and non-inductive current drives (neutral beams). The resulting first-principles-driven, control-oriented model is tailored for NSTX-U based on the PTRANSP predictions. Main objectives and possible challenges associated with the use of the developed model for control design are discussed.

[1]This work was supported by PPPL.

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Date submitted: 10 Jul 2013 Electronic form version 1.4