Comparison of Data-Driven and First-Principles Model-Based Control Approaches for Regulation of the Poloidal Flux Profile and $\beta_N$ in DIII-D Advanced Tokamak Scenarios

W. WEHNER, W. SHI, E. SCHUSTER, Lehigh U., M.L. WALKER, D.A. HUMPHREYS, GA — Modeling of the coupled evolution of the poloidal flux profile and $\beta_N$ in response to the heating and non-inductive current drive systems (neutral beam and electron cyclotron powers) as well as to the total inductive plasma current is carried out in this work with the ultimate goal of employing the developed models for control design. The modeling process follows two distinct approaches: data-driven modeling and first principles modeling. Using each model separately to design and test a controller for the regulation of the poloidal flux profile and $\beta_N$ around desired operating points, the advantages and limitations of the two approaches are compared. This study represents one of the first steps towards defining the modeling needs for successful model-based current-profile control in present and future devices. Results from numerical and experimental testing in the DIII-D tokamak are presented.

1Supported by the US Department of Energy under DE-FG02-09ER55064, DE-FG02-92ER54141 and DE-FC02-04ER54698

W. Wehner
Lehigh University

Date submitted: 12 Jul 2013

Electronic form version 1.4