Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

Power Balance Modeling and Validation for ST Startup Using Local Helicity Injection[1] J.L. BARR, G.M. BODNER, M.W. BONGARD, M.G. BURKE, R.J. FONCK, E.T. HINSON, J.M. PERRY, J.A. REUSCH, D.J. SCHLOSSBERG, University of Wisconsin-Madison — Local Helicity Injection (LHI) uses localized current injectors for routine I_p<0.18 MA non-solenoidal startup on the Pegasus ST. A power-balance model is under development for predictive $I_p\,(t)$ using helicity-balance to quantify LHI's effective current drive, V_{eff}. Analytic formulas for low-A plasma inductance and vertical field are used to account for the inductive effects of dynamic shape evolution. These formulas are being validated against magnetic reconstructions of LHI discharges with varied shape evolutions. Initial results match experimental $I_p\,(t)$ within 20 kA with assumed shaping and average resistivity (Spitzer, T_e =60 eV). Geometric effects and inductive drive provide 2.0 V along with V_{eff} =0.3 V to balance 1.1 V of resistive losses and 1.2 V inductive reactance to ramping I_p. The model is especially sensitive to resistivity when T_e<150 eV. Initial Thomson Scattering results give core T_e =72±22 eV, and at times suggest higher central electron energies. Spatial and temporal scans are underway to quantify LHI plasma resistivity and transport. MA-class startup in NSTX-U will require increased area (A_{inj} ≥40 cm^2) LHI systems that play a larger role in current drive than geometric effects, with V_{eff} dropping from >10 V to on-par with inductive effects. This regime is accessed in Pegasus at I_p ≅300 kA.

[1]Work supported by US DOE grants DE-FG02-96ER54375 and DE-SC0006928.

J.L. Barr
University of Wisconsin-Madison

Date submitted: 23 Jul 2015 Electronic form version 1.4