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Advancing High Current Startup via Localized Helicity Injection in the Pegasus Toroidal Experiment[1] E.T. HINSON, J.L. BARR, M.W. BONGARD, M.G. BURKE, R.J. FONCK, J.M. PERRY, A.J. REDD, D.J. SCHLOSSBERG, University of Wisconsin-Madison — Non-solenoidal startup via local helicity injection (LHI) and poloidal field induction is used to produce $I_p = 0.17$ MA tokamak discharges. Impurity contamination has been reduced to negligible levels by use of conical frustum cathode geometry and local scraper limiters. Attainable currents are governed by global limits of helicity and energy balance, and Taylor relaxation. A simple lumped parameter model based on these limits is used to project discharge evolution, and indicates that attaining 1 MA in NSTX-U will require LHI-driven effective loop voltages to dominate contributions from dL_p/dt. This regime contrasts with results to date and will be tested at 0.3 MA in PEGASUS with a new integrated multi-injector array. Injector impedance characteristics are consistent with magnetically-limited regimes observed in higher-power foilless diodes. Bursts of MHD are measured on time scales of order $\sim 100\mu$s, and correlate with rapid equilibrium changes, discrete rises in I_p, redistribution of the toroidal current, ion heating ($T_i \sim 1$ keV), transient drops in injector voltage, and apparent $n = 1$ line-tied kink activity at the injector. NIMROD simulations[2] of high-field-side HI discharges in PEGASUS are in qualitative agreement, suggesting I_p buildup results from inward propagating toroidal current loops created by intermittent reconnection of injected current streams.

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[2]J.B. O'Bryan *et al.*, Phys. Plasmas **19**, 080701 (2012)

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