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Non-solenoidal Startup through Local Helicity Injection in the Pegasus Toroidal Experiment[1] M.W. BONGARD, J.L. BARR, M.G. BURKE, R.J. FONCK, E.T. HINSON, J.M. PERRY, A.J. REDD, D.J. SCHLOSSBERG, N.L. SCHOENBECK, P.C. SHRIWISE, K.E. THOME, University of Wisconsin-Madison — Non-solenoidal plasma startup via local helicity injection is governed by helicity balance and Taylor relaxation constraints. Local helicity injection capabilities at Pegasus have been increased, supporting an expansion of the existing operational space towards $I_p \sim 0.3$ MA and characterization of helicity dissipation mechanisms during plasma startup, growth, and sustainment. After discharge initiation with an active current source, helicity injection may be provided by passive electrodes to continue its evolution and extend pulse length. Local magnetic measurements confirm that a local field null is transiently created by injected current streams prior to relaxation into a tokamak-like state and sustained helicity injection. Bursts of MHD activity during the growth phase are correlated with rapid equilibrium changes, redistribution of the toroidal current density, and observations of strong ion heating ($T_i \sim 1$ keV). The impedance of active injectors and thereby their helicity input rate appears constrained by a double-layer space charge limit at low currents and the Alfvén-Lawson limit for intense electron beams at high currents. Facility and diagnostic upgrades include an expanded poloidal field coil system for improved plasma control, new divertor coils, new plasma gun-electrode injector assemblies, a Thomson scattering system, expanded gas fueling techniques, and support for doubling the toroidal field.

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