Abstract Submitted
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**Non-solenoidal Startup via Local Helicity Injection on Pegasus: Progress and Plans**[1] J.A. REUSCH, J.L. BARR, G.M. BODNER, M.W. BONGARD, M.G. BURKE, R.J. FONCK, E.T. HINSON, B.T. LEWICKI, J.M. PERRY, D.J. SCHLOSSBERG, University of Wisconsin-Madison — Non-solenoidal plasma startup via local helicity injection (LHI) at the Pegasus toroidal experiment now provides routine operation at $I_p \approx 0.17$MA with $I_{inj} \approx 5$kA and $V_{inj} \approx 1$kV from four active arc injectors. Experiments in the past year have advanced the understanding of the governing physics of LHI and its supporting technology. Injector impedance scales as $V_{inj}^{3/2}$ and is governed by two effects: a quasineutrality constraint on electron beam propagation, related to the tokamak edge density, and double-layer sheath expansion, related to $n_{arc}$. Injector design improvements permit operation at $V_{inj} \geq 1$ kV without deleterious PMI or impurity generation. Discharges with varied shape, $I_p(t)$, and helicity input test a predictive 0D power-balance model for LHI startup. Anomalous, reconnection-driven $T_i$ >800 eV and strong MHD activity localized near the injectors are observed during LHI. Preliminary core Thomson scattering measurements indicate surprisingly high $T_e$ >300 eV, which if verified may indicate the dominance of high-energy electron fueling from the injector current streams. A new divertor injector system has been designed to substantially increase the available helicity input rate and support critical studies of confinement during LHI and reconnection activity at high $I_p$. A proposed upgrade to the Pegasus experiment will extend these studies to NSTX-U relevant parameters.

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Joshua Reusch
University of Wisconsin-Madison

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