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Towards a Predictive Capability for Local Helicity Injection Startup[1] J.L. BARR, M.W. BONGARD, M.G. BURKE, R.J. FONCK, E.T. HINSON, B.T. LEWICKI, J.M. PERRY, A.J. REDD, D.J. SCHLOSSBERG, University of Wisconsin-Madison — Local helicity injection (LHI) is a non-solenoidal tokamak startup technique under development on the Pegasus ST. New designs of the injector cathode geometry and plasma-facing shield rings support high-voltage operation up to 1.5 kV. This leads to reduced requirements in injector area for a given helicity input rate. Near-term experiments in Pegasus are testing the gain in I_p obtained with a 1.5× increase in the helicity input rate and the efficacy of helicity injection in the lower divertor region. A predictive model for LHI is needed to project scalable scenarios for larger devices. A lumped-parameter circuit model using power and helicity balance is being developed for LHI on Pegasus-U and NSTX-U. The model indicates that MA-class startup on NSTX-U will require operating in a regime where the drive from LHI dominates the inductive effects arising from dynamically evolving plasma geometry. The physics of this new regime can be tested in Pegasus-U at $I_p \approx 0.3$ MA. The LHI systems on the proposed Pegasus-U will be expanded to provide $3-4\times$ helicity injection rate and the toroidal field doubled to reach this regime. Predictive models to be validated on Pegasus-U include the 0-D power balance model, NIMROD, and TSC.

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