Local Helicity Injection Studies on the PEGASUS-III Experiment

M.W. Bongard, S.J. Diem, R.J. Fonck, J.A. Goetz, A.K. Keyhani, M.D. Nornberg,
J.K. Peery, C. Pierren, J.A. Reusch, A.T. Rhodes, N.J. Richner,
C. Rodriguez Sanchez, C.E. Schaefer, A.C. Sontag, J.D. Weberski

Department of Engineering Physics, University of Wisconsin-Madison, Madison, WI 53706 USA

Initiating high-I_p plasmas without a central solenoid benefits both the ST and AT concepts. The PEGASUS program improved the physics basis and predictive models for non-solenoidal startup using local helicity injection (LHI), demonstrating plasmas with $I_p > 0.2$ MA. Major upgrades have converted the PEGASUS facility into the solenoid-free PEGASUS-III ST. They include: increased $B_T = 0.6$ T; improved shape control; and retaining ultralow $A \sim 1.2$. This B_T supports a new mission to expand the breadth and range of solenoid-free startup research on the facility with multiple techniques. Initial LHI experiments will extend I_p and T_e scaling studies to $B_T > 0.15$ T and test projections of access to $I_p = 0.3$ MA using two pairs of compact injectors ($I_{inj} = 4$ kA, $V_{inj} \sim 1$ kV, $A_{inj} = 4$ cm^2 each) on the low-field-side of the tokamak and new voltage-controlled power supplies. A port-mounted, non-circular injector with equivalent helicity drive to the LFS arrays will test the feasibility of a compact, active current source geometry technically attractive to NSTX-U and beyond. Other planned studies include: beam-driven instabilities and dynamo current drive; impurity assessment; fueling; and scenario development for RF heating and CD.

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