Non-Solenoidal Startup Using High-Field-Side Local Helicity Injection on the Pegasus ST

G.M. Bodner, M.W. Bongard, R.J. Fonck, C. Pierren, J.A. Reusch, A.T. Rhodes, N.J. Richner, C. Rodriguez Sanchez, C.E. Schaefer, and J.D. Weberski

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

Local Helicity Injection (LHI) is a non-solenoidal startup technique that utilizes electron current injectors at the plasma edge to initiate a tokamak-like discharge. Injection on the high-field-side (HFS) provides significantly more helicity input than the low-field-side (LFS), but geometry constraints and increased PMI narrow the operating space as B_T increases. LFS-to-HFS handoff enables full-field operation up to $I_p \sim 0.2$ MA. Thomson measurements show a flat T_e profile ($T_{e,0} \sim 50$ eV) during initial LFS startup that transitions to peaked T_e and n_e profiles ($T_{e,0} \sim 125$ eV, $n_{e,0} \sim 1\times10^{19}$ m^{-3}) during the HFS drive. During HFS injection, high-amplitude $n = 1$ magnetic oscillations, attributed to large-scale instability of the injected current streams, can abruptly disappear while broadband magnetic fluctuations in the plasma edge region shift to higher frequency and presumably shorter wavelengths. This transition is coincident with a 10–20% increase in the net current drive efficiency. Initial visible bremsstrahlung measurements indicate average $Z_{eff} < 2.5$ at the end of the LHI injection phase. New experiments with the HFS injectors moved to smaller R_{inj} will test scalability to higher I_p via increased helicity injection rate.

Work supported by US DOE grant DE-FG02-96ER54375.