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Point-source helicity injection for ST plasma startup in PEGASUS[1]
A.J. REDD, D.J. BATTAGLIA, M.W. BONGARD, R.J. FONCK, D.J. SCHLOSSBERG, University of Wisconsin, Madison — Plasma current guns are used as point-source DC helicity injectors for forming non-solenoidal tokamak plasmas in the PEGASUS Toroidal Experiment. Discharges driven by this injection scheme have achieved $I_p \geq 100$ kA using $I_{\rm inj} \leq 4$ kA. They form at the outboard midplane, transition to a tokamak-like equilibrium, and continue to grow inward as I_p increases due to helicity injection and outer- PF induction. The maximum I_p is determined by helicity balance (injection rate *vs* resistive dissipation) and a Taylor relaxation limit, in which $I_p \propto \sqrt{I_{\rm TF} I_{\rm inj}/w}$, where w is the radial thickness of the gun-driven edge. Preliminary experiments tentatively confirm these scalings with $I_{\rm TF}$, $I_{\rm inj}$, and w, increasing confidence in this simple relaxation model. Adding solenoidal inductive drive during helicity injection can push I_p up to, but not beyond, the predicted relaxation limit, demonstrating that this is a hard performance limit. Present experiments are focused on increasing the injection voltage (*i.e.*, helicity injection rate) and reducing w. Near-term goals are to further test scalings predicted by the simple relaxation model and to study in detail the observed bursty n=1 activity correlated with rapid increases in I_p.

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