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Plasma Startup via Local Helicity Injection in Pegasus[1] R.J. FONCK, J.L. BARR, M.W. BONGARD, M.G. BURKE, E.T. HINSON, A.J. REDD, N.L. SCHOENBECK, D.J. SCHLOSSBERG, K.E. THOME, Univ. Wisconsin-Madison — Magnetic helicity injection from localized current sources at the outboard plasma edge and poloidal field induction produced plasma currents $I_p \leq 0.17$ MA using ~ 4 kA injected current I_{inj}, consistent with a model invoking helicity balance and Taylor relaxation. Varying the edge current density via source realignment raised the attainable I_p, as expected. A double-layer sheath describes the impedance of the current injectors, setting the helicity injection rate for a given I_{inj}. This suggests the helicity input and discharge evolution can be manipulated by the edge density. MHD activity during plasma growth correlates with rapid equilibrium shifts and current redistribution into the plasma interior. Impurity ion spectroscopy indicates strong heating during helicity drive. Plasmas can also be smoothly driven through the growth stage using passive, gas-fueled electrodes as the helicity sources, after initial tokamak formation with the active current sources. Such electrodes hold promise for optimization of both the Taylor limit that sets the maximum I_p and the achievable helicity input rates needed to attain it. Developing a fully predictive model of this startup technique will allow application to next-step fusion experiments.

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