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Current drive experiments in the Helicity Injected Torus - II W.T. HAMP, A.J. REDD, T.R. JARBOE, B.A. NELSON, R.G. O'NEILL, R. RA-MAN, P.E. SIECK, R.J. SMITH, University of Washington, D. MUELLER, PPPL — The HIT-II spherical torus (ST) device has demonstrated four toroidal plasma current drive configurations to form and sustain a tokamak: 1) inductive (ohmic) current drive, 2) coaxial helicity injection (CHI) current drive, 3) CHI initiated plasmas with ohmic sustainment (CHI+OH), and 4) ohmically initiated plasmas with CHI edge current drive (OH+ECD). CHI discharges with a sufficiently high ratio of injector current to toroidal field current form a closed flux core, and amplify the injector poloidal flux through magnetic reconnection. CHI+OH plasmas are more robust than unassisted ohmic discharges, with a wider operating space and more efficient use of the transformer Volt-seconds. Finally, edge CHI can enhance the plasma current of an ohmic discharge without significantly degrading the quality of the discharge. Results will be presented for each HIT-II operating regime, including empirical performance scalings, applicable parametric operating spaces, and requirements to produce these discharges. Thomson scattering measurements and EFIT simulations are used to evaluate confinement in several representative plasmas. Finally, we outline extensions to the HIT-II CHI studies that could be performed with NSTX, SUNIST, or other ST devices.

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