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The physics of steady-state CHI in an ST A.J. REDD, T.R. JARBOE, W.T. HAMP, B.A. NELSON, R.G. O'NEILL, R. RAMAN, R.J. SMITH, University of Washington, Seattle, WA USA — The HIT-II spherical tokamak (major radius 0.30 m, minor radius 0.20 m) is capable of using Coaxial Helicity Injection (CHI) to form and sustain low-aspect-ratio axisymmetric discharges. The physics of CHI-driven HIT-II discharges is now fairly well understood, with intuitively derived models and scalings matching the entire HIT-II experimental database. These physics results include: (1) open-flux CHI discharges are current sheets attached to the electrodes, and the sheet thickness is proportional to the inter-electrode distance; (2) the injector current and open-flux toroidal current match the models, including the independence of open-flux current Ip from the TF coil current; (3) thin-sheet CHI discharges can exhibit poloidal flux amplification and buildup of toroidal current beyond the open-flux results; (4) the mechanism for poloidal flux amplification is injector-based reconnection activity (not a coherent mode in the confinement region) requiring a minimum rotation of the magnetic field in the injector region; and (5) flux-amplification discharges exhibit features of a confined plasma core. Flux-amplification discharges in HIT-II are strongly paramagnetic, have total Ip as high as 350 kA, and exhibit flux amplification in both low-TF and high-TF regimes. These physical results will be explained in detail, as well as the key parameters, scalings, and thresholds.

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