

Current Drive Mixing Experiments on the Helicity Injected Torus (HIT-II)

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The Helicity Injected Torus (HIT) experiment studies the development of noninductive methods of current drive in ST plasmas and the coupling between helicity injection current drive and other current drive methods. The existing HIT-II device is a modestly sized Spherical Tokamak (major and minor radii of 0.3 m and 0.2 m, elongation of 1.75), capable of using both Ohmic (with up to 60 mWb Ohmic flux available) and Coaxial Helicity Injection (CHI) current drive. Current-drive studies using the HIT-II device have demonstrated toroidal plasma currents of up to 200 kA using only Ohmic drive, and up to 240 kA using only CHI. Recent experiments have focused on two current-drive mixing scenarios: CHI startup of an Ohmically-driven plasma (CHI+Ohmic), and CHI enhancement of an Ohmic discharge (Ohmic+CHI). The plasma diagnostics used in these experiments include a multi-chord FIR interferometer, multi-point Thomson scattering and a single-chord ion Doppler spectrometer (IDS). Also, recent improvements have enabled the reliable use of EFIT equilibrium reconstructions for these HIT-II discharges.

CHI startup, with subsequent handoff to Ohmic drive, has demonstrated substantial improvements over comparable Ohmic-only discharges. This synergistic improvement can be quantified in terms of either volt-second savings or more toroidal current: CHI+Ohmic plasmas have achieved plasma currents of 250 kA, far higher than any Ohmic-only discharge on HIT-II. CHI+Ohmic discharges also exhibit better shot-to-shot repeatability and are less dependent on aggressive wall conditioning for good plasma performance. FIR and IDS radial scans, along with EFIT equilibrium reconstructions, will be presented for representative sets of CHI+Ohmic discharges and comparable Ohmic-only plasmas.