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NIMROD simulations of HIT-SI plasmas CIHAN AKCAY, THOMAS JARBOE, University of Washington, BRIAN NELSON, CHARLSON KIM, Psi Center, University of Washington — HIT-SI (Steady Inductive Helicity Injected Torus) is a current drive experiment that uses two semi-toroidal helicity injectors driven at 5-15 kHz to generate steady inductive helicity injection (SIHI). All the plasma-facing walls of the experiment are coated with an insulating material to guarantee an inductive discharge. NIMROD is a 3-D extended MHD code that can only model toroidally-uniform geometries. The helicity injectors of the experiment are simulated as flux and voltage boundary conditions with odd toroidal symmetry. A highly resistive, thin edge-layer approximates the insulating walls. The simulations are initial-value calculations that use a zero β resistive MHD (rMHD) model with uniform density. The Prandtl number ($Pr = 10$), and Lundquist number ($S = 5 - 50$) closely match the experimental values. rMHD calculations at $S \sim 10$ show no growth of an $n = 0$ mode and only a few kA of toroidal current whereas HIT-SI has demonstrated toroidal currents greater than 50 kA with a current amplification of 3. At higher $S(\geq 20)$ the simulations exhibit significant $n = 0$ magnetic energy growth and a current amplification exceeding unity: $\frac{I_{tor}}{I_{\rm inj}} \geq 1$. While HIT-SI has shown evidence for separatrix formation, rMHD calculations indicate an entirely stochastic magnetic structure during sustainment. Results will also presented for Hall MHD, anticipated to play a crucial role in the physics of SIHI.

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