NIMROD Simulations of HIT-SI Plasmas  C. AKCAY, C.C. KIM, T.R. JARBOE, B.A. NELSON, University of Washington, V.A. IZZO, UCSD — We present NIMROD simulation studies of current-drive, magnetic reconnection and relaxation behavior of the HIT-SI experiment. HIT-SI (Steady Inductive Helicity Injected Torus) is a spheromak that uses two semi-toroidal injectors to provide steady inductive helicity injection (SIHI). SIHI produces and sustains a spheromak by generating poloidal flux using relaxation current drive. The helicity injectors of the experiment are modeled as flux ($\psi_{\text{inj}}$) and current ($I_{\text{inj}}$) boundary conditions.

Our study uses a zero $\beta$ resistive MHD model with uniform density. Lundquist number $S$ and injector lambda, $\lambda_{\text{inj}}$ ($= \mu_0 I_{\text{inj}} / \psi_{\text{inj}}$) characterize the parameter space. $S \left( = \sqrt{\frac{\mu_0}{\rho} \frac{B}{2 \pi R_0 \eta \lambda_{\text{sp}}^2}} \right)$ is the ratio of resistive diffusion to Alfvén transit time, $\rho$ and $\eta$ are the plasma density and resistivity, $R_0$ is the magnetic axis and $\lambda_{\text{sp}}$ ($= \mu_0 j_\| / B$) is the spheromak lambda, $10.3$ m$^{-1}$ for HIT-SI. For our current simulations we set $\lambda_{\text{inj}}=30$, and perform a scan in $S$ for low values ($\sim 10 - 100$). Our results to date at $S=22$ and 35 show little relaxation during sustainment but growth of the $n=0$ magnetic energy and an increase in plasma current during the decay phase. Upon completion of this study at $\lambda_{\text{inj}}=30$ we will repeat the resistive MHD simulations at a lower $\lambda_{\text{inj}}$ ($\sim 20$) in order to chart the relaxation behavior as a function of $\lambda_{\text{inj}}$.

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