Numerical investigation of design and operational parameters on CHI spheromak performance

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Nonlinear, extended-MHD computation with the NIMROD code is used to explore magnetic self-organization and performance with respect to externally controllable parameters (e.g. bias flux and injector current trace) in spheromaks formed with coaxial helicity injection. The goal of this study is to inform the design and operational parameters of proposed proof-of-principle spheromak experiment. The calculations explore multiple distinct phases of evolution—initial formation, relaxation/sustainment, and adiabatic magnetic compression—which must be explored and optimized separately. Our results indicate that modest changes to the design and operation of past experiments, e.g. SSPX [E.B. Hooper et al. PPCF 2012], could have significantly improved the plasma-current injector coupling efficiency and performance, particularly with respect to peak temperature and lifetime. Though we frequently characterize performance relative to SSPX, we are also exploring fundamentally different designs and modes of operation, e.g. flux compression.

This work is supported by DAPRA under grant no. N66001-14-1-4044.