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Comparing magnetic fluctuation dynamics in nonlinear MHD simulations of low-aspect-ratio RFPs to RELAX experiments K.J. MCCOLLAM, D.J. DEN HARTOG, C.M. JACOBSON, C.R. SOVINEC, University of Wisconsin–Madison, S. MASAMUNE, A. SANPEI, Kyoto Institute of Technology
— We present comparisons of magnetic tearing fluctuation activity between RFP experiments on the low-aspect-ratio RELAX device ($R/a \approx 2$) and nonlinear simulations of zero-beta, single-fluid MHD using the NIMROD code in both cylindrical and toroidal geometries at a Lundquist number of $S = 10^4$, nearly as high as experimental values. Time-average fluctuation amplitudes observed in the simulations are similar to those from the experiments, but more rigorous comparisons versus spectral mode numbers are in progress. We also focus on how the spatiotemporal dynamics of the fluctuations vary with RFP equilibrium parameters. Interestingly, at shallow reversal, cylindrical simulations show a relatively uncoupled spectrum of nearly quiescent modes periodically varying in time, whereas the corresponding toroidal cases show a fully chaotic spectrum of strongly nonlinearly interacting modes. We ascribe this to the geometric $m = 1$ coupling present in the toroidal but not the cylindrical case. We present initial results from convergence studies with increased spatial resolution for both geometries. Simulations at higher S are planned. This work is supported by the U.S. DOE and by the Japan Society for the Promotion of Science.

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