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The Magnetic Reconnection Code: Application to the Sawtooth Instability in Tokamaks K. GERMASCHEWSKI, A. BHATTACHARJEE, Center for Magnetic Self-Organization, University of New Hampshire — The Magnetic Reconnection Code (MRC), which integrates numerically the compressible Hall MHD or two-fluid equations in flexible geometry, is a massively parallel code in an Adaptive Mesh Refinement (AMR) framework. The code implements recent developments in advanced numerical methods. AMR is an effective tool to attain the resolution necessary at small scales of the reconnection layer(s), and also provides the basis for domain decomposition needed to run simulations on massively parallel machines. Incorporating two-fluid effects comes with two numerical challenges. First, the system loses its purely hyperbolic character and becomes partially elliptic. Second, dispersive waves are introduced into the system. We apply Newton-Krylov-Schwarz methods to implicitly advance the fields in time, avoiding a stringent CFL condition and gaining additional numerical stability. We have used the cylindrical MRC to study the effect of the Hall current and electron pressure gradient on the m=1 tearing mode. While we recover the near-explosive nonlinear growth observed in A. Aydemir's four-field studies under certain conditions, we also see effects associated with a poloidally asymmetric flow that can be stabilizing linearly as well as nonlinearly. The regimes of near-explosive nonlinear growth are delineated, and comparisons will be made with large tokamak experiments.

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