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Session GP1 - Poster Session IV.
POSTER session, Tuesday afternoon, October 28
Fran Hill Southeast Exhibit Hall, ACC

[GP1.107] Solving Elliptic Problems Using the Magnetic Reconnection Code

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The Magnetic Reconnection Code (MRC), developed at the Center for Magnetic Reconnection Studies, solves Hall MHD equations using Adaptive Mesh Refinement (AMR) methods in collisional as well as collisionless regimes. The Navier-Stokes/Euler equations of hydrodynamics also fit into the MRC framework. Much of the previous work on AMR methods has concentrated on solving hyperbolic equations with explicit timestepping. However, for many problems, either due to their physical nature (e.g., collisionless reconnection dynamics in which electron inertia breaks field lines and incompressible Euler flows) or for performance reasons (semi-implicit and implicit numerical methods), it becomes necessary to solve global equations (Poisson and/or Helmholtz). This paper investigates the application and performance of well-established preconditioned Krylov-Schwarz solvers in an AMR context, using a combination of an outer multi-level method (fast adaptive composite) and iterative Krylov-Schwarz smoothers. We present an implementation within the MRC which allows us to leverage the powerful toolkit of preconditioners and linear solvers from the PETSc library. We show two applications of this new adaptive elliptic solver: the problem of finite-time singularities of 3D Euler flows using a highly symmetric initial condition due to Kida and the collisionless reconnection problem for the m=1 sawtooth instability using so-called two-field and four-field models which have been derived from the full two-fluid equations using asymptotic ordering. In the reconnnection problem, it is demonstrated that these reduced models produce parametric scalings in the nonlinear regime that are qualitatively different than those obtained from recent studies such as the GEM Reconnection Challenge.

- **Part G of program listing**