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Development of a Spectral Element Multigrid Solver for Extended MHD A.H. GLASSER, University of Washington, V.S. LUKIN, Naval Research Laboratory — We report on the development of a Spectral Element Multigrid (SEMG) method as a scalable parallel solver for the 2D HiFi extended MHD code, using high-order modal basis functions on a logically rectangular grid. Coarsening and refining operations transfer the solution between higher and lower polynomial degrees within each grid cell, which is particularly simple for the nested subspaces of modal basis functions. The coarsest-level solver is SuperLU_dist, which is very efficient because of the reduced problem size. This is accessed through the PETSc library, which could be used in the future to easily explore other options. The key to successful operation is the smoother. It is well-known that the Jacobi smoother is very efficient for the Laplacian discretized with nodal spectral elements because the matrix is diagonally dominant. We have developed a method to exploit this by efficiently transforming between modal and nodal representations. Physics-based preconditioning is used to transform the extended MHD equations to diagonally-dominant form. Scaling tests will be presented for an extended MHD problems.

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