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Development of a Fast Scalable Parallel Solver for the HiFi 3D Extended MHD Code A.H. GLASSER, University of Washington, V.S. LUKIN, Naval Research Laboratory — We report on the development of a fast parallel solver for the HiFi 3D extended MHD code, porting and testing methods previously developed for the 2D version of this code. Physics-based preconditioning is used to reduce the order and condition number and increase the diagonal dominance of matrices. Static condensation is used to eliminate higher-order spectral element amplitudes by local application of SuperLU, automatically exploiting substantial sparsity among the physical dependent variables. A flexible interface to the PETSc library runtime options and profiling capabilities has been developed to test a variety of solvers and preconditioners on the resulting reduced linear systems, and identify bottlenecks amenable to optimization. Matrix assembly has been accelerated by collapsing 3D indices to one in much of the coding. Weak scaling tests up to 4096 cores of the NERSC Hopper Cray XE6 will be presented for a range of 3D test problems, including sound waves, ideal MHD waves, and merging spheromaks.

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