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Scalable Parallel Computation for Extended MHD Modeling of Fusion Plasmas ALAN H. GLASSER, Los Alamos National Laboratory — Parallel solution of a linear system is scalable if simultaneously doubling the number of dependent variables and the number of processors results in little or no increase in the computation time to solution. Two approaches have this property for parabolic systems: multigrid and domain decomposition. Since extended MHD is primarily a hyperbolic rather than a parabolic system, additional steps must be taken to parabolize the linear system to be solved by such a method. Such physics-based preconditioning (PBP) methods have been pioneered by Chacón, using finite volumes for spatial discretization, multigrid for solution of the preconditioning equations, and matrix-free Newton-Krylov methods for the accurate solution of the full nonlinear preconditioned equations. The work described here is an extension of these methods using high-order spectral element methods and FETI-DP domain decomposition. Application of PBP to a flux-source representation of the physics equations is discussed. The resulting scalability will be demonstrated for simple wave and for ideal and Hall MHD waves.

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