Abstract Submitted
for the DPP16 Meeting of
The American Physical Society

Advection-Dominant MHD Computation for External Kinks and Edge-Localized Modes[1] C. R. SOVINEC, University of Wisconsin-Madison — Separation of temporal and spatial scales is the primary consideration for computation of macroscopic dynamics in magnetically confined plasma. Dynamic shock capturing is not needed, but nonlinear external kinks and ELMs advect large gradients near the plasma surface. Using an implicit time-advance with Galerkin projection can be problematic in these applications when advection is stronger than dissipation on the spatial scale of the mesh. The applied math community has investigated many approaches to stabilizing numerical advection [Franca, Hauke, and Masud, CMAME 195, 1560]. One approach is the least-squares finite element method [Bochev and Gunzberger, SIAM Rev. 40, 789], which has previously been applied to MHD and plasma-fluid models [Adler, et al. SIAM J. Sci. Comput. 32, 229]. Here, we adapt this technique for MHD computation with the NIMROD code, starting with the scalar dependent fields that need to have definite sign: density and temperature. Time-splitting physical diffusion maintains the original size of the algebraic systems that are solved at each time-step. Upwinding explicit terms where derivatives are discontinuous avoids overshoot error while minimizing numerical dissipation.

[1]Work supported by U.S. DOE grant DE-FC02-08ER54975.

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Date submitted: 13 Jul 2016 Electronic form version 1.4