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On the use of compatible discretizations with the multi-fluid plasma model SEAN MILLER, ERIC CYR, JOHN SHADID, EDWARD PHILLIPS, Sandia National Lab — In this presentation, we discuss the advantages and disadvantages of using compatible discretizations in continuous and discontinuous finite element methods for solving the multi-fluid plasma model. Maxwells equations, core components to the multi-fluid plasma model, are difficult to accurately represent due to the divergence involutions governed by Gauss laws. Many methods have been developed to deal with these divergence errors, notably the generalized Lagrange multiplier methods discussed in Munz et al 2000 and the vector basis discretization approach in Nedelec 1980. While the Lagrange multiplier cleaning schemes are effective and simple to implement, over long time scales the residual errors can have a large influence on the plasma. Compatible discretizations, such as those that represent the electric and magnetic fields on mixed HCurl edge elements and HDiv face elements, have been shown to be especially useful in the PIC community, however, their implementation can be complex. The goal of this research is to understand the benefits of using some of these divergence handling schemes and compare them in application to finite element methods with both implicit and explicit time integration.

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