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Validity and Numerical Implementation of the 13 Moment Multi-Fluid Plasma Model SEAN MILLER, URI SHUMLAK, Aerospace & Energetics Research Program, University of Washington — Fluid-based plasma models have typically been applied to parameter regimes where a local thermal equilibrium is assumed. While this parameter regime is valid for most fusion and confinement applications, it begins to fail as plasmas near the collisionless regime and kinetic effects dominate the physics. To avoid costly kinetic calculations, the validity of the fluid regime is expanded using an anisotropic 13 moment fluid model derived from the Pearson type-IV probability distribution function. This model evolves the heat flux vector in addition to the density, momentum, and energy, and the plasma species are coupled through Lorentz forces, Maxwell's equations, and collision operators. For this study, Maxwell's equations utilize a parabolic cleaning method to locally remove divergence errors in the electric and magnetic fields arising from the numerical scheme. The full multi-fluid plasma model is tested against the generalized Brio-Wu electromagnetic shock problem for various scalings of the Debye length and Larmor radius. The physical model is implemented using a hybrid CENO finite volume method for unstructured meshes developed within the University of Washington's WARPM (Washington Approximate Riemann Plasma) framework for use on heterogeneous GPU clusters.

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