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A High Resolution Wave Propagation Scheme for Two-Fluid Plasma Equations with applications to Field Reversed Configurations

AMMAR HAKIM, URI SHUMLAK, University of Washington — Algorithms for the solution of the five-moment ideal Two-Fluid equations are presented. The ideal Two-Fluid model is more general than the often used magnetohydrodynamic (MHD) model. The model takes into account electron inertia, charge separation and the full electromagnetic field equations and allows for separate electron and ion motion. The algorithm presented is the high resolution wave propagation scheme. The wave propagation scheme is a finite volume method of the Godunov type based on solutions to the Riemann problem at cell interfaces. The scheme presented here does not use dimensional splitting and is hence able to capture accurately flow not aligned along grid lines. The scheme is stable to Courant number of unity. Operator splitting is used to incorporate the Lorentz and electromagnetic source terms. To preserve the divergence constraints on the electric and magnetic fields two different approaches are used. In the first approach Maxwell equations are rewritten in their mixed-potential form. In the second approach the so called perfectly-hyperbolic form of Maxwell equations are used which explicitly incorporate the divergence equations into the time stepping scheme. Collisionless magnetic reconnection and Field Reversed Configurations are studied. Two-Fluid physics described by the ideal Two-Fluid model is highlighted.

Ammar Hakim
University of Washington

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