Robust schemes for Two-Fluid MHD

Harish Kumar

INRIA Bordeaux,
France

Abstract

Two-fluid plasma equations are derived by taking moments of Boltzmann equations. Ignoring collisions and viscous terms and assuming local thermodynamic equilibrium we get five moment equations for each species (electrons and ions), also known as two-fluid plasma equations. These equations allows different density, temperatures and velocities for electrons and ions, unlike ideal magnetohydrodynamics (MHD) equations.

In this work, we present second order MUSCL schemes for two-fluid plasma equations based on strang splitting of the flux and source terms. The source is treated both explicitly and implicitly. Both of these schemes are shown to preserve positivity of the pressure and density. In the case of explicit treatment of source term we drive condition on the time step for it to be positivity preserving. The implicit treatment of the source term is shown to preserve positivity unconditionally. Furthermore, the resulting algebraic system of equation from implicit scheme is treated carefully, and shown to be needed only solving a local (in each cell) linear system of equations. Benchmark numerical experiments are presented to illustrate the robustness and efficiency of the schemes.

This is a joint work with Prof. Remi Abgrall.