

R008-18
C 会場 : 11/27 AM2 (11:05-12:35)
11:20~11:35:00

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Secondary conservative finite difference scheme for compressible magnetohydrodynamics in orthogonal curvilinear coordinates

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The compressible magnetohydrodynamic (MHD) equations describe macroscopic plasma dynamics and are widely used in space plasma simulations. A key feature of this system is that the total energy, i.e., the sum of internal, kinetic, and magnetic energies, is conserved in a closed system. To quantitatively understand plasma heating in low-beta environments such as the solar corona, it is essential to accurately capture the transport and conversion of magnetic energy.

We previously proposed, in Cartesian coordinates, a new finite-difference scheme that exploits the discrete product rule to achieve secondary conservation (Iijima, J. Comput. Phys. 435, 110232, 2021). Without explicitly solving the internal-, kinetic-, and magnetic-energy equations separately, the scheme preserves interconversion among these energies exactly at the level of spatial discretization, enabling robust simulations in extremely low plasma-beta environments while maintaining strict total-energy conservation.

In this work, we report an extension to orthogonal curvilinear coordinates. We derive a discrete formulation that retains key properties (such as angular-momentum conservation in spherical coordinates) while achieving the same discrete energy consistency as in the Cartesian case.