Astrophysics > Galaxy Astrophysics

Evaluating the Magnetorotational Instability's Dependence on Numerical Algorithms and Resolution

Dinshaw S. Balsara, Chad Meyer

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We have studied saturated, MRI-driven turbulence using three-dimensional, isothermal simulations with resolutions that extend from 64 to 192 zones in each direction. The simulations were performed with several higher order Godunov algorithms. A variety of reconstruction strategies as well as a variety of Riemann solvers are tried. We show that the details of the isothermal MRI-driven turbulence depend principally on the Riemann solver and secondarily on the reconstruction strategy. Furthermore, we find that the effective viscosity parameter parameter tends to show progressively smaller decrements with increasing resolution when the best reconstruction strategy (WENO) and the best Riemann solver (linearized)are used. We attribute this result to the more sophisticated dissipation mechanisms that are used in higher-order Godunov schemes. Spectral analysis and transfer functions have been used to quantify the dissipative processes in these higher-order Godunov schemes.

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