R008-P05 **会場: Poster** **時間: 11 月 21 日**

磁気回転不安定性の乱流駆動プロセスの高次精度 MHD シミュレーション

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MHD simulation of transition process from MRI to turbulence by using a high-order MHD simulation scheme

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In accretion disks, magneto-rotational instability (MRI; Balbus & Hawley, 1991) makes the disk gas in the magnetic turbulent state and drives efficient mass accretion into a central star. MRI drives turbulence through the evolution of the parasitic instability (PI; Goodman & Xu, 1994), which is related to both Kelvin-Helmholtz (K-H) instability and magnetic reconnection. The wave number vector of PI is strongly affected by both magnetic diffusivity and fluid viscosity (Pessah, 2010). This fact makes MHD simulation of MRI difficult, because we need to employ the numerical diffusivity for treating discontinuities in compressible MHD simulation schemes. Therefore, it is necessary to use an MHD scheme that has both high-order accuracy so as to resolve MRI driven turbulence and small numerical diffusivity enough to treat discontinuities.

We have originally developed an MHD code by employing the scheme proposed by Kawai (2013). This scheme focuses on resolving turbulence accurately by using a high-order compact difference scheme (Lele, 1992), and meanwhile, the scheme treats discontinuities by using the localized artificial diffusivity method (Kawai, 2013). Our code also employs the pipeline algorithm (Matsuura & Kato, 2007) for MPI parallelization without diminishing the accuracy of the compact difference scheme.

We carry out a 3-dimensional ideal MHD simulation with a net vertical magnetic field in the local shearing box disk model. We use 256x256x128 grids. Simulation results show that the spatially averaged turbulent stress induced by MRI linearly grows until around 2.8 orbital periods, and decreases after the saturation. We confirm the strong enhancement of the K-H mode PI at a timing just before the saturation, identified by the enhancement of its anisotropic wavenumber spectra in the 2-dimensional wavenumber space. The wave number of the maximum growth of PI reproduced in the simulation result is larger than the linear analysis. This discrepancy is explained by the simulation result that a shear flow created by MRI locally becomes thinner and faster due to interactions between antiparallel vortices induced by K-H mode PI, and this structure induces small scale waves which break the shear flow itself. We report the results of the simulation, and discuss how the saturation amplitude of MRI is determined.