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The simulation box size dependence of magneto-rotational instability in stratified disks

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Recent studies have revealed that magneto rotational instability (MRI), an MHD instability in a differentially rotating medium, is one of the important mechanisms to explain the angular momentum transport and generation of turbulence in accretion disks. MRI turbulence is thought to play a crucial role in planet formation (Johansen et al., 2007), mass loading from accretion disks (Suzuki and Inutsuka 2009), and so on. Understanding of the MRI turbulence is indispensable to understanding phenomena in accretion disks.
Since the characteristic scale of MRI turbulence is much smaller than the scale height of accretion disks, local shearing box simulation (Hawley et al., 1995), which treats a local area co-rotating with a disk medium in accretion disks, is useful to reconstruct MRI turbulence. Therefore, many numerical simulations using a local shearing box have been conducted. However, the physical factor determining the saturation level of the turbulent stress generated by MRI has not yet been clarified. This is because of the insufficient separation of physical and unphysical factors in numerical modeling. Especially, simulation box size dependence of the MRI turbulent stress, whose importance was pointed out in an unstratified disk model, is not clarified in a stratified disk model, which is closer to the real accretion disk situation than unstratified model. Since the most unstable wavelength in the linear stage of MRI depends on the magnitude of Alfven velocity, the linear stage of a stratified model, which has density gradient, would differ from that in an unstratified model. To clarify the physical factor determining the saturation level of the turbulent stress generated by MRI, it is needed to understand the simulation box size dependence of MRI turbulence in a stratified disk model.
We will show the results of MHD simulations about MRI, and discuss the box size dependence of the MRI turbulence in stratified disk models.