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Local Hybrid Simulation of Magneto Rotational Instability in dilute differentially rotating disks

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Magneto-Rotational Instability (MRI) is a plasma instability which is considered to take place in a magnetized differentially rotating astrophysical disks. It is first proposed by Velikhov in 1959 and later by Chandrasekhar in 1960. Its importance in astrophysical rotating disk was pointed out by Balbus and Hawley in 1991.

This instability can generate MHD turbulence within a few periods of orbit and can generate a strong turbulent viscosity. Thus this instability is considered to play a major role in the context of accretion which requires a strong viscous effect to transport angular momentum in the disk. These nonlinear behaviors of MRI, such as generation of turbulence or accretion due to the strong turbulent viscosity, are mainly studied by numerical simulations under MHD approximation which assumes the plasma as a single component fluid.

However, recent analytical and numerical studies have shown that kinetic effects can be important on the evolution of MRI in dilute accretion disks which are often found around black holes. These studies have mainly focused on the generation of pressure anisotropy during the evolution of MRI, and the plasma which constitutes the accretion disk is treated as a Landau fluid.

In this study, we developed 2-dimensional hybrid code to study local differentially rotating collisionless plasma. We treated ion as a particle and electron as a massless fluid, and included the effect of gravity and tidal force. In this presentation, we would like to discuss the generation and relaxation process of pressure anisotropy during the evolution of MRI.

Keywords: Plasma instabilities, Accretion disks, Magneto Rotational Instability, Kinetic plasma effects