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Relaxation of pressure anisotropy and the evolution of Magneto Rotational Instability in collisionless accretion disk

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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 was 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 effect of pressure anisotropy and results from the linear theory indicates that initial pressure anisotropy may severely affect the evolution of MRI. Since these studies were carried out with Landau fluid closure, relaxation process of ion pressure anisotropy was included by so-called ”Hard Wall approximation”.

In this study, we newly developed a hybrid code in a local differentially rotating system, including the process of ion’s pitch angle scattering in a self consistent manner. From the results, we find a relaxation of pressure anisotropy by effective pitch angle scattering during the evolution of MRI. In this presentation we would like to focus on the effect of initial pressure anisotropy on the evolution of MRI.

Keywords: Collisionless Plasma, Accretion disk, Magneto Rotational Instability