磁気回転不安定性のハイブリッドシミュレーション -不安定性の発展に伴う温度異方性の生成と緩和-

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Hybrid Simulation of Magneto Rotational Instability -Generation and Relaxation of pressure anisotropy-

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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. Therefore, relaxation process of ion pressure anisotropy was included by so-called 'Hard Wall approximation'.

In this study, we newly developed a hybrid code which can be applied to a local differentially rotating system. From the result of simulation, we have found a generation of ion pressure anisotropy during the nonlinear evolution of MRI. We have also evaluated the rate of ion pitch angle scattering and heat flux which can be important for the relaxation of pressure anisotropy. In this presentation, we would like to discuss details about a relaxation process of pressure anisotropy at the nonlinear stage of collisionless MRI.