ランダウ流体近似のMHDによる磁気回転不安定の局所シミュレーション

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Local MHD simulation study of magneto-rotational instability under Landau fluid closure

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The magnetorotational instability (MRI) is one of MHD instabilities occurring in a magnetized differentially rotating plasma, which is originally proposed by Velikhov in 1951 and Chandrasekhar in 1960. Since Balbus and Hawley pointed out its importance on astrophysics in 1991, the MRI has been studied in detail under MHD approximation and now is widely accepted as an origin of strong turbulence which transports angular momentum in accretion disks.

In radiatively inefficient accretion flow (RIAF) models for accretion onto compact objects, however, the plasma density is quite low and the proton temperature is larger than electron temperature. Therefore the plasma must be collisionless, and it is required to understand the angular momentum transport beyond the standard MHD model.It is also known that the MHD assumption is not a good approximation in the accretion disk with a high beta plasma.In our study, the pressure anisotropy and Landau damping are taken into account as a better description of the collisionless accretion disk, and we adopt kinetic MHD equations obtained by taking moments of the drift-kinetic equation together with the so called Landau fluid closure that can correctly reproduce the kinetic linear Landau damping rate.

In a collisionless accretion disk, it is expected that the presence of anisotropy can alter an accretion rate, because a stress tensor, which determines the level of angular momentum transport, has an additional contribution due to pressure anisotropy.In our presentation, we first perform the linear analysis to investigate how pressure anisotropy modulates the MRI growth rates, and then proceed to numerical simulations in the local shearing box. We would like to discuss the kinetic effects on the nonlinear MRI evolution.