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Linear analysis of Magneto-Rotational-Instability in accretion disks under the effect of dusty plasma

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Our space is considered to be filled up with plasma which is constituted by about 99% of electrons and ions, and about 1% of micron-sized dusts. These dusts often carry negative charge through several atomic processes such as collisions with electrons or photoelectric effects. Since the charge-to-mass ratio of a dust extremely differs from that of electrons and ions, the charged dusts can be treated as the third component of plasma in the MHD apporximation. Plasma phenomena like wave propagation or plasma instabilities are often modified by existence of dust component. In this presentation we argue that Magneto-Rotational-Instabilities (MRI) can be modified by including dusty plasma in accretion disks.

MRI was first proposed by Chandrasekhar & Velikov in the 1960's and rediscovered by Balbus & Hawley in 1991. This instability is believed to genarate plasma turbulence in accretion disks which can contribute to turbulent viscosity. Thus this instability is considered to play a major role in the context of planet formation which requires angular momentum transportation when considering radial displacement of particles. This instability is driven by a slow-mode-type wave which is split from Alfven mode by Colliori's force effect. So, since Alfven waves can be modified by exictence of dust particles in plasma, so as behaviour in MRI itself.

In this study we first solved a set of linearlized MHD equations with the so-called local approximation by neglecting the radial gradient scale, and found a singularity in the dispersion relation when the cyclotron frequency of dusts is as -2 times as large as that of Kepler rotation frequency. Next we extended it to the so-called non-local approximation by taking into account the radial structure of MRI, and studied numerically the behaviour around the singlarity as the linerlized eigenvalue problem. In this presentation we discuss linear analysis of MRI and its modification by the existence of dust particles.