Magneto-Rotational Instability in accretion disks under various situations; MHD simulations with CIP-MOCCT method

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As the gas rotates around the massive objects like the black holes, neutron stars and protostars and accretes to the central star, the accretion disks are formed around the central star. When the accretion disks have a weak magnetic field, it is well known that the magneto rotational instability (MRI) is excited in the disks. In this study, we have investigated the nature of the MRI by the two-dimensional numerical simulations using CIP-MOCCT method. First, we have confirmed the results by Balbus & Hawley (1991) in linear stage and Hawley and Balbus (1991) in non-linear stage. Then, we have performed simulation runs in various situations. One of the most notable results are from modeling of the interaction between the magnetosphere of a central star and an accretion disk. The results show that smoothing out of the Keplerian velocity shear in the disk make a large velocity shear to develop between the magnetosphere and the accretion disk. This implies possible subsequent excitation of the Kelvin-Helmholtz instability on the central plane of the disk. We have conducted several more simulations and confirmed the usefulness of the CIP-MOCCT method. In this presentation we will mention the interesting physical processes in the disk found in the new simulation results.