Temperature Profiles and Turbulent States of Circumplanetary Disks

Yuri I. Fujii[1], Sanemichi Z. Takahashi[1], Satoshi Okuzumi[2], and Shu-ichiro Inutsuka[1]
[1]Nagoya University [2]Tokyo Institute of Technology

Circumplanetary disks, which form around gaseous planets, are thought to be the formation sites of satellites. In order to make realistic models of satellite formation, we need to know the temperature profiles and mass accretion rates of circumplanetary disks. These properties strongly depend on not only turbulence but also the disk opacities that are mainly due to dust grains.

In our previous work, we focused on magnetic turbulence driven by the magnetorotational instability (MRI). For a disk to sustain the MRI, gas must be sufficiently ionized. However, we found that non-thermal ionization –due to cosmic rays, X-rays from the host star, and the decay of radionuclides– is insufficient to drive MRI turbulence. If there is no effective gas accretion mechanism other than the MRI, a circumplanetary disk becomes very massive and gravitationally unstable due to gas infall from the surrounding protoplanetary disk. Once gravitational instability occurs, a disk becomes turbulent. If gravitational turbulence is dissipated as heat in situ, viscous heating may cause thermal ionization and thereby the MRI. The disk temperature profile strongly depends on opacity, and if there are sufficient dust grains the temperature will readily increase such that the disk can sustain the MRI. If MRI turbulence is too strong however, the disk becomes thin and opacity will decrease. In this presentation, we will discuss the conditions for a circumplanetary disk to sustain MRI turbulence.