A Possible Formation Scenario of Saturn-Titan System

*Yuri Fujii[1], Masahiro Ogihara[2]

1. Institute for Advanced Research, Nagoya University, 2. Division of Science, National Astronomical Observatory of Japan

Satellite systems around gas giants that have only one large moon, such as Titan around Saturn, are known to be difficult to explain their formation processes. Relatively large moons are thought to form in gaseous circumplanetary disks. The orbits of moons are affected by the interaction between the disk gas, and thus, the final configuration of the system is determined when the disk has dissipated. According to previous N-body simulations, a system tend to have multiple moons or loses all the moons if a simple power-low disk is assumed.

We examine the orbital evolution of satellites in order to find a way to form a single-large-moon system. Because the direction and speed of the orbital migration depend on the properties of circumplanetary disks, we model dissipating circumplanetary disks with considering the effect of temperature structures. We calculate the orbital evolution of Titan-mass moons in the final evolution stage of various circumplanetary disks. We also perform *N*-body simulations of systems with initially multiple satellites to see whether single-moon systems form at the end.

We find that the radial slope of the temperature structure characterized by the dust opacity produces a patch of orbits where the Titan-mass satellites stop inward migration and even migrate outwards in a certain range of the viscosity. The patch assists satellites initially located in the outer orbits to remain in the disk, while others in the inner orbits are lost into the planet. We demonstrated for the first time that systems with only one large moon around giant planet can form. Our results suggest satellite formation was not very efficient in the outer radii of circumplanetary disks.

Keywords: satellite formation, single-moon system, Titan, gas giant, circumplanetary disk, orbital evolution

