IN-SITU FORMATION OF THE URANIAN SATELLITES FROM WIDE DEBRIS DISK FORMED BY GIANT IMPACT

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We adopted the so-called giant impact scenario to explain both the large axial tilt of Uranus and the formation of the Uranian regular satellites simultaneously. Hydrodynamic simulations for a giant impact onto proto-Uranus have been carried out, which showed that the giant impact can explain the large axial tilt of Uranus and also suggested that ejected materials produced by the giant impact could be distributed throughout the current orbits of the Uranian regular satellites.
In this study, we modeled wide debris disks of solids with several conditions, and performed N-body simulations to investigate the in-situ satellite formation from the wide debris disks to constrain the parameters of debris disks for the in-situ satellite formation. We found that the five major satellites formed around the current orbits from wide debris disks with several times the total satellite mass. Although one or two large satellites usually form inside the current orbits of the major satellites, such satellites would migrate inward due to the tidal torque from the planet and finally be disrupted by the planetary tides or fall onto the planet over several hundred million years. We also propose that the Uranian rings could form from the disrupted satellites and the inner regular satellites could form by use of the ring materials.

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