Ring Formation of 10199 Chariklo through the Accretion of a Debris Disk

Kim, Matthew

10199 Chariklo, a centaur and minor planet, is the smallest identified ringed object within the Solar System following the identification of a ring system in 2013. The relatively low mass of the asteroid conflicted with the prevailing theory which necessitated the existence of a massive central body for the formation of a ring system. Consequently, the development of hypotheses and theories incorporating the origin of rings around bodies of low mass was fundamental. One subsequent theory conjectured the origin of the ring system of 10199 Chariklo through the accretion of a particulate debris disk. The subsequent report details the substantiation of such a theory through the development and creation of computational simulations. The generated simulations were produced within the research-based programming language Wolfram Mathematica through the utilization of the 4th-Order Runge-Kutta Method to calculate particulate motion. The dynamic representation of 10199 Chariklo also incorporated collision detection amongst interacting bodies. The original simulations modeled a debris disk of 50 particulates achieving circular motion. However, a lack of accretion within the simulations resulted in the modification of the system to utilize randomly generated elliptical orbits. The subsequent simulations predictively accreted into relatively concise rings due to increased particulate interaction and collision. The consequent ring systems consisted of stable, coplanar rings of varying size and orientations. The simulated ring systems consisting of double rings and of dimensions similar to that of 10199 Chariklo provided a substantial validation for the hypothesis concerning the accretion of a debris disk.

Awards Won: