

Satellite Formation: Supply of Solid Material to Circum-Planetary Disk

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Most of major natural satellites around the giant planets in our solar system are classified into “regular satellites”, whose orbits are nearly in circular orbits and in the equatorial plane of the parent bodies. The satellites are thus thought to form in circum-planetary disks. However, the origin and the properties of circum-planetary disks are not well understood. Recently, some hydrodynamic simulations showed that, gas flow accreting toward the planet forms disk-like structure in the course of gas capturing process to be gas giant planets, thus circum-planetary disks are inevitably formed as by-products of the formation of gas-giant planets. In order to form satellites, however, solid material needs to be supplied to the circum-planetary disks. In this period, most of solid material are in the form of planetesimals or the fragments of them, not micron-size dusts, so the motion of these large objects are basically independent of gas flow and the objects need to be captured by the gas drag with the circum-planetary disks. In order to examine the supply rate of solid material to circum-planetary disks, we calculate the rate of delivered mass of solid materials by using an analytic calculation with some assumptions. We find that the supply of solid materials tend to be concentrated at inner region of circum-planetary disks, which implies that dust-to-gas ratio can change with distance from the planet and larger at inner region. We discuss this effect on the process of satellite formation.