

Filtering of grains in the protosolar disk as a prerequisite to planet formation

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Circumstellar disks are known to contain a significant mass in dust ranging from micron to centimeter size, and meteorites are evidence that individual grains of those sizes were collected and assembled into planetesimals in the young Solar System. We investigate the filtering efficiency of dust by a swarm of planetesimals and reach two important conclusions: (1) filtering is more efficient at short orbital distances (typically, inside about 1 AU) and later in the disk evolution when some of the gas has gone and the drift of dust becomes slower; (2) Even with a fully-formed planetesimal disk (with a mass equal to that of solids in the present solar system all in planetesimals), the accretion of micron to meter size dust is inefficient when the planetesimals are considered to be larger than about 1 km in size. This implies that either dust grew rapidly beyond 10-meter size through another mechanism or that it has been filtered by smaller planetesimals. We discuss the consequences for the composition of planets.