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Radiation Pressure on Dust Aggregates of Submicron Grains

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Radiation pressure force diminishes the gravitational force acting on dust grains in circumstellar disks. Dust particles exposed to high radiation pressure are ejected from the circumstellar disk while grains at low radiation pressure stay in bound orbits around the central star. Furthermore dust grains are decelerated due to radiation pressure, known as the Poynting-Robertson effect. Grains on bound orbits spiral toward the central star and evaporate at high temperatures while grains in unbound orbits may be captured in bound orbits due to Poynting-Robertson effect.

Numerical calculations of radiation pressure are based on light-scattering theories. The light-scattering properties depend on the size, material, and structure of the dust grains. Interplanetary dust particles (IDPs) collected in the stratosphere of the earth indicate that unmelted IDPs are aggregates consisting of submicon grains. Therefore we assume that dust grains in circumstellar dust disks around other stars are also not spheres but possibly aggregates of submicron monomers. With known light-scattering theories it is possible to determine the light-scattering properties and therefore the inuence of radiation pressure on aggregates consisting of submicron grains. Combining Mie theory and Maxwell-Garnett mixing rule the light-scattering properties of aggregates can be estimated while interactions between the monomers are not taken into account. The lattice dispersion relation (LDR) used in the discrete-dipole approximation (DDA), the T-Matrix method and the generalized multiparticle Mie theory give good results for the calculations of light-scattering properties of aggregates consisting of spherical monomers. These methods take the interactions between the monomers into account. But the computation is limited to small grain sizes due to computational requirements.

We present calculations of radiation pressure on aggregates consisting of spherical monomers of 100nm in size. We determine the light-scattering properties of Ballistic Cluster Cluster Aggregates (BCCA) and Ballistic Particles Cluster Aggregates (BPCA) for carbon and silicate and compare the results determined with the different theories.