

Numerical simulations and the formulation of dust compression process

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In protoplanetary disks, planetesimals are formed through the gravitational instability or simple coalescence. If the gravitational instability occurs, it needs that dust aggregates become large aggregates (a few m) that gas drag force is not efficient. Small dust aggregates have the fluffy structure. However, dust aggregates are compressed before it becomes large. Thus, large dust aggregates can not have such fluffy structure. Such compression changes the cross section and the strength of dust aggregates. The gas drag force which governs the dust motion is proportional to cross section. The strength determines the compression and fragmentation at collisions. Thus, when and how to occur compression is important on dust growth.

In this study, we perform the N-body simulation of aggregate collisions.

We repeat the following process (1-3): 1, Rotates two same dust aggregates randomly before the collision respectively. 2, Collision. 3, Copy the resultant aggregate onto new aggregate. We examined the compression process in the course of coagulation.

In our simulation, collisions between dust which have a variety of monomer number and the density occur. We examined the density change at such collisions. We introduce the pressure and construct the model which is consistent with our numerical simulations. In this model, the pressure of dust depends on the density only. This model describes the density change at any collisions. However, it is on the basis of head-on collisions. We will perform the off-set collisions and examine their effects.