Numerical simulations of dust aggregate collisions: compression and disruption of three-dimensional aggregates

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Coagulation and fragmentation processes of dust aggregates by their mutual collisions in a protoplanetary disk are important to understand planetesimal formation. Recently, to compare with the pioneering study of Dominik and Tielens (1997), we carried out numerical simulations of two-dimensional dust aggregate collisions and obtained results on the processes of aggregate compression and disruption almost consistent with those by Dominik and Tielens (1997).

In this study, we carry out three-dimensional simulation of dust aggregate collisions. We examine the dependence of the collisional outcomes on the impact velocity as well as the aggregate size and the parameters relevant to the particle interaction in detail by treating aggregates composed of large number of particles and having various BCC structures.

Through the results on the gyration radius of the collisional aggregate and the number of contacts per particle in the aggregate, we discuss the compression and disruption processes of impacted aggregates in three-dimension. In addition, we will discuss the difference in such processes between two- and three-dimensions and the “equation of state” of collisional aggregates.