Three-dimensionl Simulations of Head-on/Oblique Collisions of Sintered Dust Aggregates

*Hidekazu Tanaka[1], Satoshi Okuzumi[2], Koji Wada[3]

1. Tohoku University, 2. Tokyo Institute of Technology, 3. Chiba Institute of Technology

The ring structures in protoplanetary disks observed by ALMA can be explained by the effect of sintering on dust aggregates, which causes rebounds of dust aggregates rather than sticking growth. Polarization of protoplanetary disks recently observed by ALMA also indicates that dust aggregates have a rather compact structure. Since such compact structures can be formed through rebounds at their collisions, collisional properties of the sintered dust aggregates are important to examine the origin of compact dust aggregates in planetary disks.
In this study, we investigate the collisional properties of sintered dust aggregates, through 3D numerical simulations. Sirono and Ueno (2017) performed similar simulations for sintered dust aggregates and found that their collisional outcomes depend mainly on the the number of contacts in colliding aggregates (or the coordination number). However, their simulations are limited to head-on collisions of two-dimensional dust aggregates. In this study, on the other hand, we perform 3D simulations, including oblique collisions.
As initial colliding aggregates in our simulations, we use BPCA with the coordination number of 2 and BAM1 with the coordination number of 4. As initial aggregates with intermediate coordination numbers, we also use compressed aggregates obtained from collisions of BPCAs. Our simulations show that sintered dust aggregates with larger coordination numbers are apt to rebound rather than sticking with a higher rate. This result is consistent with Sirono and Ueno (2017). We also find that the rebound is frequent when the coordination number is equal to or larger than 3. Thus we have to clarify the evolution of the coordination number during dust collisional growth. We also discuss such evolution, using our simulation results on the increases in the coordination number.

Keywords: planet formation, protoplanetary disk, sintered dust

©2020. Japan Geoscience Union. All Right Reserved.