Ejecta Mass at Collisions of Dust Aggregates

Koji Wada[1], Hidekazu Tanaka[2], Hiroshi Kobayashi[3], and Satoshi Okuzumi[4]

[1]PERC, Chiba Institute of Technology, Japan, [2]ILTS, Hokkaido Univ., Japan, [3]Nagoya Univ., Japan, [4]Tokyo Institute of Technology, Japan

Collisional growth of dust aggregates is one of the essential processes to form planetesimals. High-velocity collisions produce a large number of small aggregates as ejecta fragments. Since ejecta would play an important role in dust growth and the total ejecta mass is a key to determine the mass loss rate through collisional cascades, we need a model of ejecta mass at high-velocity collisions of dust aggregates [1]. The amount of ejecta mass is also important for understanding the evolution of debris disks but still remains unclear because we do not know the ejection process in high velocity collisions of such small dust aggregates. In this study we carried out numerical simulations of dust aggregate collisions, focusing on the ejecta mass. In particular, we investigate the effect of the mass ratio between colliding two aggregates and of the monomer size distribution of aggregates on the ejecta mass. These two factors should be taken into account in considering actual collisions in the disks and the former cases are already done in the previous study [2]. In this paper we introduce the results in the previous study and report new results on the effect of monomer size distribution. As a result, we obtain a scaling relation such that ejecta mass averaged over the impact parameter is proportional to the projectile's momentum. Combining this scaling relation with the fragmentation model of Kobayashi & Tanaka (2010) [1], we also obtain a formula of the specific energy for ejecting the half mass of colliding bodies. These relations are useful for understanding planetesimal formation and fragment production rate in protoplanetary disks and debris disks.

[1] Kobayashi, H., & Tanaka, H. 2010, Icarus, 206, 735.

[2] Wada, K., Tanaka, H., Okuzumi, S., Kobayashi, H., Suyama, T., Kimura, H., & Yamamoto, T., 2013, A&A, 559, A62.