

Fragmentation and charge separation in pre-planetary dust collisions

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We experimentally investigate the early planetary growth from decimeter-sized, high-porosity dust aggregates to larger bodies. When decimeter-sized aggregates collide with smaller or fractal dust aggregates, the relative collision velocity may reach several m/s due to different friction in the nebular gas. In this velocity regime, sticking probabilities are very low and the collisions do not result in mass gain for the larger body, but can on the contrary even lead to fragmentation of the smaller and mass loss of the larger body. One currently discussed solution to explain the subsequent growth is that a systematic charge separation in collision may lead to a charging of the larger body which will finally reaccrete the surrounding, oppositely charged fragments. Strong collisional tribocharging was observed for impacts of single micrometer-sized grains on solid targets. However, the charging for macroscopic dust aggregates in fragmentation events is still unknown.

To simulate the conditions for fragmentation, collisions between millimeter-sized, highly porous dust projectiles and solid or porous targets of different materials are observed with a high-speed camera. The experiments are conducted at collision velocities between 1 and 10 m/s in high-vacuum conditions. To name only some observable values, the impact energy, the strength of fragmentation and the size-, angle- and velocity-distribution of the fragments are measured and mass gain or mass loss of the target can be determined. The first goal will be to find correlations between the measured values to get a better understanding for collisional fragmentation. In the next phase, the same setup will be used to measure charging of the target and the escaping fragments.