

Oblique Impacts on Granular Surfaces in Low Gravity: Development of an Experimental System

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For asteroids and Martian satellites whose surfaces are covered with regolith, the impact process is considered to be gravity-dominated (or gravity-dependent). On the other hand, five small bodies (asteroid Eros, Itokawa, Ryugu, and Bennu, and comet Churyumov-Gerasimenko) for which detailed data have been obtained from recent orbital, landing, and sample return missions, as well as the objects targeted by very recent and forthcoming small body exploration programs (Martian Moons eXploration: MMX, DART and Hera) (Mars satellite Phobos, binary asteroid system Didymos-Dimorphos) have microgravity accelerations of less than one-thousandth of terrestrial gravity acceleration. Under microgravity, the cohesion between particles may not be negligible compared to the gravity acting on the particles.

How the knowledge on the impact processes of small bodies obtained under terrestrial gravity can be applied to microgravity small bodies? What effect the impact angle has on the gravity dependence? What mechanisms are specific to the impact processes of small bodies and what is their gravity dependence? In order to conduct a series of experiments under simulated low gravity to answer these questions, we are developing a laboratory experimental set-up specifically for the oblique impact process of granular materials under simulated low gravity. As a projectile acceleration mechanism, we use a powder gun to achieve an impact velocity greater than the speed of sound of granular materials. A container filled with granular material is held by a magnet, which is dropped with an appropriate delay from the timing of the projectile launch. The vertical distance from the projectile's impact to the target container's fall is set to approximately 1.5 m to ensure a low-gravity duration of 0.5 s. The experiments are performed under evacuated conditions. We will present the current development status.

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