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Experimental study on impact into sand under simulated reduced gravities

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The geographical feature of the surface of asteroids, which is largely covered by regolith, is mostly governed by the collision phenomenon. Because gravitational acceleration at the asteroid surface is very small, when considering the evolutional process of the asteroids surface, it is important to understand the impact crater formation under microgravity condition.

However, not many impact cratering experiments under microgravity condition have been conducted. As one of few examples, Gault and Wedekind (1977) conducted the experiment in which the target was hung by springs of constant force with different spring constants and was dropped to achieve smaller gravitational acceleration than the earth's gravitational acceleration. The acceleration of the target was varied over a range of 0.1-1 G. The impact velocity was between 0.4 and 8.0 km/s, and the target material was quartz sand. The crater diameter was proportional to -0.165 power of the acceleration. On the other hand, Takagi et al. (2007) conducted a series of microgravity experiments by using a drop tower. The gravitational acceleration for the target was less than 10ˆ-5 G, impact velocity was between 45 and 360 m/s and the target material was soda-lime glass beads with mean diameter of 0.08 to 0.9 mm. The crater diameter formed under microgravity was not different from the crater diameter formed under 1 G, which was contradictory to the result of Gault and Wedekind (1977). Because there is little experimental data, the reason of the difference between these results is not fully understood, and further experiment is required.

Therefore, we started to conduct a new impact experiments of low velocity under simulated smaller gravities by dropping the target with springs of constant force. As a preliminary experiment, sea sand (grain diameter is approximately 0.1 mm) in a container was used as a target, and we changed the acceleration by changing the weight attached to the container. The acceleration was measured by an accelerometer and was determined with a fluctuation of +/-6∗10ˆ-3 G.

We will present the result of impact experiments conducted at reduced gravity using this device.

Keywords: impact experiment, microgravity, crater