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PPS21-P24 Room:Convention Hall Time:May 22 17:15-18:30

Experimental Study on Momentum Change of Porous Small Bodies by Collisions

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Non-gravitational effects that can affect the orbital motion of small bodies include electromagnetic effects such as Yarkovsky effect as well as mutual collision. It is therefore very important to know the degree of momentum change of a small body when it is collided by smaller objects. The ratio of the momentum that a target has after a collision to before is called momentum transfer efficiency. Laboratory impact experiments on momentum transfer have previously been performed. One with nylon projectiles and mortar sphere targets showed the momentum-transfer efficiency exceeds unity and increases linearly with the impact velocity due to fragments ejected opposite to the projectile's trajectory (Sirono et al. 1993). The previous studies were performed for targets with less porosity, however, recent study showed that there are asteroids with high porosity, such as 253 Mathilde and 283 Emma (Baer et al. 2011). The porosity of these objects is more than 50%. Asteroid 25143 Itokawa explored by Hayabusa spacecraft has porosity of about 40% covered with boulders. Itokawa is a rubble pile object which was formed by reaccumulating fragments of disrupted parent body. After the reaccumulation event, the body may have experienced further impact events. How greatly Itokawa's orbit has changed after the reaccumulation will be better understood once the momentum transfer efficiency to porous bodies from small-mass impactor is clarified.

Therefore, we performed high velocity impact experiments using a two-stage light-gas gun at ISAS, JAXA. The projectiles are Aluminum and Titanium spheres of 1 and 3.2 mm in diameter. The targets are cylinders of sintered glass beads of different porosities and sea sand filled in a plastic container. The porosity of these targets are 40˜93 %. We suspended each target with two strings, and impacted a projectile at up to 7.5 km/s. We used three high-speed framing cameras. The preliminary results show that the ejecta can carry tens of % of the projectile momentum similarly to those found for lower porosity targets in previous studies.

Keywords: porosity, asteroid, impact, orbit