EXPERIMENTAL STUDY OF MOMENTUM TRANSFER EFFICIENCY FOR HIGH POROSITY TARGETS T. Aoki[1], A. M. Nakamura[1], T. Okamoto[1], and S. Hasegawa[2], [1]Graduate School of Science, Kobe University, 1-1 Rokkoudai, Nada-ku, Kobe, Japan, [2]Institute of Space and Astronautical Science, JAXA.

Introduction: Non-gravitational effects that can affect the orbital motion of small bodies include electromagnetic effects such as Yarkovsky effect as well as mutual collision [1][2]. It is therefore very important to determine 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. Several laboratory impact experiments on momentum transfer have previously been performed, showing that momentum-transfer efficiency exceeds unity due to ejecta [2][3][4][5]. The momentum-transfer efficiency increases with the impact velocity [2][3]. Most of the previous studies were performed for targets with less porosity and higher density, however, recent observational studies showed that there are asteroids with high porosity, such as 253 Mathilde and 283 Emma [6]. The porosity of these objects is more than 50%. Asteroid 25143 Itokawa explored by Hayabusa spacecraft has porosity of about 40% covered with boulders and considered to be a rubble pile object which was formed by reaccumulating fragments of a disrupted parent body.

Experiment: 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 with velocities of 2.0-7.5 km/s. We used two or three high-speed framing cameras in order to determine the motion of the post-impact targets.

Results and discussions: Fig.1 shows an example of data derived from the high speed camera images. It was found that the ejecta can carry tens of % of the projectile momentum similarly to those found for lower porosity targets in the previous studies, which is shown in Fig.2. The large error bars of sintered glass beads targets are due to the limited range of the time coverage of the high speed images.

References: [1] Dell'Oro A. and Cellino A. (2007) *Mon. Not. R. Astron. Soc., 380,* 399-416. [2] Housen K. and Holsapple K. (2012) *LPS XLIII,* 2539. [3] Shirono S. et al. (1993) *Planet. Space Sci.,* 682-692. [4] Yamashita M. Hasegawa S. and Shirogane N. (1996) *Icarus 123*, 192-206. [5] Yanagisawa M. and Hasegawa S. (2000) *Icarus 146*, 270-288. [6] Baer J. et al. (2011) *AJ 141*, 143.

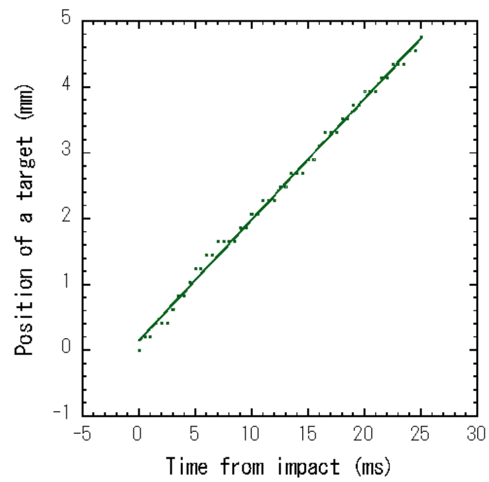

Fig.1. Position of a sintered glass beads target versus time from the impact (time=0). The line is a fit to the data.

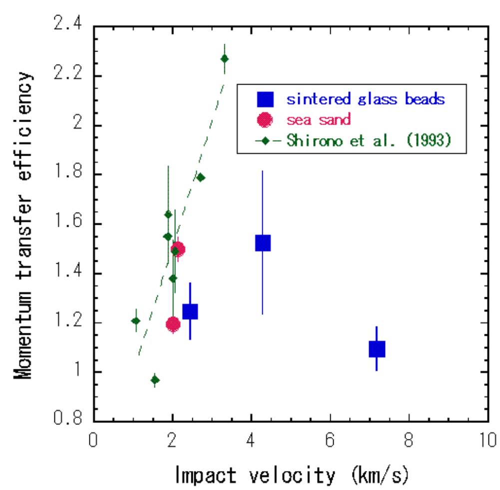

Fig.2. Momentum transfer efficiency of targets versus impact velocity. The dashed line is a fit to the previous experiment data of mortar [3].