EXPERIMENTAL STUDY ON IMPACT DISRUPTION OF ROCKY RUBBLE-PILE BODIES. Y. Fujita[1], M. Aarakawa[2], S. Hasegawa[3] and Y. Shimaki[4], [1]Nagoya University (Furo-cho, Chikusa-ku, Nagoya, 464-8601, Japan: fujita@eps.nagoya-u.ac.jp), [2]Kobe University (1-1, Rokkodai-cho, Nada-ku, Kobe 657-8501, Japan: masahiko.arakawa@penguin.kobe-u.ac.jp), [3]Japan Aerospace Exploration Agency (3-1-1 Yoshinodai, Chuo-ku, Sagamihara 252-5210, Japan: hasehase@isas.jaxa.jp), [4]Nagoya University (Furo-cho, Chikusa-ku, Nagoya, 464-8601: shimaki@eps.nagoya-u.ac.jp)

Introduction: Rubble-pile bodies, which are constructed from rocky boulders accumulated gravitationally, are common in the history of the solar system [1]. It is important to evaluate the effect of the rubble-pile structure on the impact disruption in order to clarify the collision process of the solar system bodies. In particularly, the impact strength Q_D^* is the most important parameter for the collisional evolution of planetary bodies [2]. Then, we carried out high velocity impact experiments using several types of rubble-pile targets constructed from glass beads, and we examined the disruption condition of these rubble-pile targets.

Experimental method: Impact experiments were conducted by using a two-stage light gas gun set in Kobe Univ. and ISAS/JAXA. A nylon cylindrical projectile with the mass of 200 mg (m_p) was impacted at the velocity (v_i) from 2 to 6 km/s. A rubble-pile target was made of glass beads with the size of 7mm and the number of the beads was changed from 4 to 1000 corresponding to the mass from 1.8 to 550 g (M_t). The beads were assembled by a weak bond with the structure of a close-packed one. We are interested in the number of disrupted glass beads and the effect of the disruption on the ejection velocities of other intact glass beads. Thus, we used a high-speed video camera to observe the impact disruption and measured the fragment mass distribution.

Experimental results: We found that a lot of unbroken beads (intact beads) of rubble-pile targets were ejected very slowly compared to the fine fragments of disrupted beads around the impact point. When we compare these velocities with the antipodal velocity obtained for the single bead experiment, the intact beads velocities of the rubble-pile target were several times smaller than the antipodal velocity of the single bead at the same energy density (Q=1/2$m_p v_i^2/M_t$). This means that the projectile kinetic energy was effectively dissipated around the impact area and the rest of the area of the rubble-pile target did not receive the kinetic energy from the projectile enough. In order to discuss the degree of disruption, we defined the total mass of the small fragments M_{fsum} as a new parameter of impact disruption for rubble-pile targets, and calculated the crater volume for rubble-pile targets using this parameter, the crater volume is defined by the region where the beads are broken catastrophically. We compared them to that formed on a homogeneous basalt targets by using Pi-scaling [3] and found that the crater on rubble-pile targets was larger than that on basalt targets. We calculated the energy fraction f defined by the kinetic energy of the projectile transferred into the kinetic energy of the intact beads and found that the energy fraction f is from 0.001 to 0.01 for rubble-pile target (Fig.1). This extremely small value of f indicates that most of the projectile kinetic energy is transferred into the kinetic energy of the fine fragments generated by the disruption of the beads near the impact point.

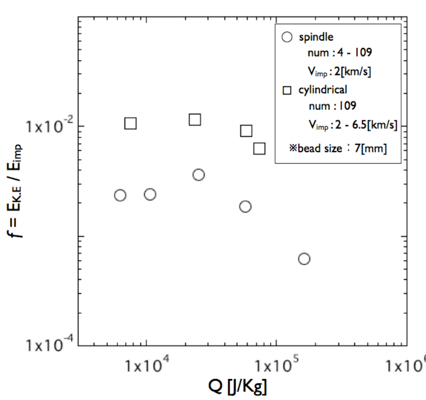

Fig.1. Relationship between f and Q for rubble-pile targets

Discussion: From these results, we estimated the Q_D^* of rubble-pile bodies from the re-accumulation condition of the dispersed intact constituents. As a result, it was found that Q_D^* for rubble-pile bodies becomes larger than that estimated only from the gravitational potential energy. Therefore, the re-accumulation of intact rubble-pile constituents is easy to occur. This indicates that rubble-pile body is a very strong body against the impact disruption by high velocity impacts.

References: [1] Davis D.R. et al. (1979) In *Asteroids* (T. Gehrels, ed.), Univ. of Arizona, Tucson, pp.528-537. [2] Ryan E.V. et al. (1991) *Icarus, 94,* 283-298. [3] Holsapple K.A. and Schmidt R.M. (1987) *JGR, 92*, 6350-6376.