LABORATORY PENETRATION EXPERIMENTS OF HIGH VELOCITY PROJECTILES INTO VERY POROUS TARGETS ON EXOTIC ORIGIN OF DUSTS IN PRIMITIVE BODIES. T. Okamoto[1], A. M. Nakamura[1], S. Hasegawa[2], K. Kurosawa[2], K. Ikezaki[3], and A. Tsuchiyama[3], [1]Department of Planetary Science, Kobe University,1-1 Rokkodai, Nada-ku, Kobe, Japan (tokamoto@stu.kobe-u.ac.jp), [2]Institute of Space and Astronautical Science, JAXA, [3]Department of Earth and Space Science, Osaka University.

Introduction: Through the evolution of the Solar System, dusts collided with each other to become primitive bodies. Such dusts are the original components, i.e. building blocks, of the bodies. Small porous bodies can also contain exotic components due to alternative process; they might have captured dusts which were once located in regions of different heliocentric distances and were eventually transported to the bodies. Stardust mission suggests that materials originated from different heliocentric distances co-exist in a single body [1][2].

The purpose of this study is to examine whether high velocity dusts can be captured by very porous small bodies and what physical processes occur when dusts penetrate and decelerate in the porous bodies.

Experiments : We prepared three different targets, fluffy 94, fluffy 87 and fluffy 80. Hollow glass microspheres of 55 µm in diameter were sintered in a cylindrical mold at different condition to have bulk porosities of 87 and 94 %. Glass particles of 5 µm in diameter were also sintered to have 80% bulk porosity.

Impact experiments were performed using a two-stage light-gas gun at ISAS, JAXA. The projectiles were Ti, Al and Stainless spheres of 1 and 3.2 mm in diameter, and basalt cylinder of 3.2 mm in diameter and 2.0 mm in height. The impact velocity was ranged from 1.7 to 7.2 km/s. We observed the deceleration process of the projectiles using a flash X-ray imaging system and a high-speed framing camera. The track morphology of the targets and the degree of the projectile fragmentation were observed on transmission images taken by an X-ray tomography system at Osaka University.

Results: The track was long and thin, called as carrot-shape, when the projectile was almost intact. While it was short and thick, called as bulb-shape, when the projectile was fragmented into small size. This is similar to those of aerogel [3].

Track volume. The volume of the track increases with the projectile kinetic energy. Such behavior was observed for dust penetration into foamed polymers [4]. The mass of the track is proportional to the projectile kinetic energy when the terminal projectile is still large.

Deceleration of the projectiles. Two images of flash X-ray taken at ~10 µs interval show the growth of the track and disruption of the projectile in the targets. The deceleration of the projectile was analyzed using the following drag equation:

$$m_p \frac{dv}{dt} = -\frac{1}{2} C_d \rho_t S v^2 \quad (1)$$

where m_p, v, C_d, ρ_t, S are projectile mass, projectile velocity, drag coefficient, target bulk density and the cross sectional area of the projectile, respectively. We determined drag coefficient by different shots and the value is 1.2 ± 0.4.

Using this drag coefficient, we discuss a model of penetration depth. Previous study presented a model for penetration depth of a carrot-shape aerogel track [5]. This model assumes that drag is proportional to the square of velocity when projectile has high velocity, while it is proportional to the strength of the target when it has low velocity. We modify this model. When the projectile collides with the target, the projectile is disrupted into fragments at impact point. Then they penetrate into the target following the drag equation [5]. Consequently, the track length is determined by the size of the largest fragment. The model roughly reproduced experimental data, shown in Fig.1.

References: [1] Brownlee, D. et al. (2006) *Science, 314*, 1711-1716. [2] Mikouchi, T. (2007) *The Japanese Society for Planet. Sci., vol.16, no.4,* 270-273 (in Japanese). [3] Hörz, F. et al. (2006) *Science, 314,* 1716-1719. [4] Kadono, T. (1999) *Planet. Space Sci. 47*, 305-318. [5] Niimi, R. et al. (2011) *Icarus, 211,* 986–992.

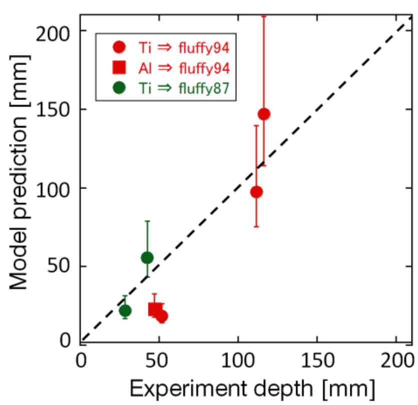

Fig.1. Comparison of experimental data and the model