# Speculation about mechanisms of penetration track formation in silica aerogel using high-speed camera images

# Kyoko Okudaira[1]; Hajime Yano[2]; Sunao Hasegawa[1]

[1] ISAS/JAXA; [2] Dept. of Planetary Sci., JAXA/ISAS

**Background and objectives of this study**: Micrometeoroid capture in space such as STARDUST mission and the related laboratory experiments have been well-practiced. Silica aerogel, a material with ultra-low density (0.03 g/cm$^3$) has been used as a suitable capture medium. The authors have been conducting experiments for evaluation of thermal alteration of particles captured by silica aerogel (1) and energy partition (2), using a two-stage light gas gun. On another front, mechanisms of track formation or particle capture by materials with ultra-low densities are not fully understood, although there are a few researches on track formation in aerogel (e.g. Dominguez et al. 2004). There is no established model or scaling law as to cratering in targets with ultra-low densities. This study thus aims at finding empirical facts constraining energy partition.

**Methods**: $Al_2O_3$ and some mineral particles were fired into silica aerogel (0.03 g/cm$^3$) with hypervelocity using a two-stage light gas gun at ISAS/JAXA. Formation of penetration tracks in aerogel was observed and recorded by a high-speed camera.

**Results and discussions**: Single track formation process was successfully recorded by a high-speed camera in one shot (a 500 micron- $Al_2O_3$ grain shot at 4.25 km/s). Concerning a so-called carrot track, a thin track grew in the direction of penetration at first and then it started to swell into a carrot. For silica aerogel with 0.03 g/cm$^3$ density, the aerogel surface was dragged inward as a particle penetrates into the gel. No spallation at the surface was observed differently from higher density aerogel. Obvious gas or material outward flow was not observed in this study so far (8 shots). Concerning energy partition, it can be said that that particles can be captured with less damage compared with higher density capture medium as the kinetic energy of the particle is consumed for compaction of the target. With an intensive image analysis, shock wave dissipation in aerogel can be recognized. Sufficient number of experiments and diversified, systematic approach are required as future work.

**References**:
(1) Okudaira K. et al. (2004) Advances in Space Research 34, 2299-2304.
(2) Okudaira K. et al. (2006) Proceedings of 2nd International Hayabusa Symposium, 90-91.