# In situ observation of impact track formation in an ultra-low density material

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In NASA's Stardust mission, cometary dust of Wild2 has been captured using an ultra-low density material called silica aerogel (5-50 mg/cm$^3$). However, these dust particles were disaggregated into smaller grains and some of them were mixed with silica aerogel because of their hypervelocity impacts (6.1 km/s) into the capture media. Impact track morphology is a key to reconstruct the original dust, which has penetrated at the same velocity. Consequently, analog impact experiments [1] and theoretical approach [2] have been performed. However, we do not still well understand impact track formation process and no quantitative models have been established yet.

In the present study, we conducted hypervelocity impact experiments using a two-stage light gas gun at Nagoya University. Nylon, ball bearing and glass beads were fired into silica aerogel of 60 mg/cm$^3$ density at the speed of 3.2-4.5 km/s. In order to clarify impact track formation process, we imaged expansion of impact tracks using a high speed camera (ULTRANAC). By analyzing those movies, we confirmed experimentally for the first time that projectiles in silica aerogel are decelerated by inertia resistance as has been suggested by [3]. The drag coefficient of a ball bearing was determined to be 2. This value is the same as the value for a spherical object that is flying with a hyper-velocity in fluid or free molecule flow [4]. Hence, this result is applicable to extend previous models of penetration process (e.g., [2]). In addition, we also observed expansion of the tracks to the direction normal to the penetration.

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