Ejecta size distribution from hyper-velocity impact disruption of planetary materials by a laser accelerated projectile

Susumu Takasawa[1]; Akiko Nakamura[2]; Toshihiko Kadono[3]; Taku Takeuchi[4]; Nagisa Machii[5]; Masato Setoh[6]; Masahiko Arakawa[7]; Koji Dohi[8]; Sohsuke Ohno[9]; Yoichiro Hironaka[10]; Tatsuhiro Sakaiya[11]; Shinsuke Fujioka[12]; Takayoshi Sano[13]; Keisuke Shigemori[14]

[1] Earth&Planet., Kobe Univ.; [2] Grad. Sch. of Sci., Kobe Univ.; [3] ILE; [4] Kobe Univ.; [5] Graduate school of Sci., Kobe Univ.; [6] Science, Kobe Univ.; [7] Grad. School Env. Studies, Nagoya Univ.; [8] Environmental Studies, Nagoya Univ.; [9] PERC/Chitech; [10] ILE, Osaka Univ.; [11] Osaka Univ.; [12] Inst. Laser. Eng., Osaka Univ.; [13] ILE, Osaka Univ; [14] Inst. Laser Eng., Osaka Univ.

Impact processes significantly influenced formation and evolution of the main asteroid belt. In order to understand the collisional evolution of asteroids and interplanetary dusts, it is of importance to conduct impact experiments over a wide range of collision velocity. However, acceleration of macroscopic projectiles to velocities higher than 10km/s has been a major technological challenge. Consequently, the details of impact fragmentation process at such impact velocity (higher than 10km/s) have remained highly unknown so far.

In the present study, glass and aluminum spheres of about 100-300 micrometer in diameter were accelerated to or higher than 10 km/s by laser ablation and were shot into basalt and anhydrite blocks. When the laser beam irradiation starts, a part of the projectile sphere vaporizes. The vapor pressure accelerates the projectile to above 10 km/s. Aerogel blocks and aluminum foils were deployed in front of the target in order to capture ejecta from the disruption.

We counted the number of ejecta and measured the size of each particle captured or detected by aerogels and aluminum foils on microscopic images. The size distributions we measured for the hyper velocity impacts showed an overproduction of particles in the smaller range compared to those ejected from the impact disruption at lower impact velocity.