DISTRIBUTION OF IMPACT EJECTA AROUND A SMALL ASTEOIRD: IMPLICATION TO ARTIFICIAL IMPACT EXPERIMENT IN HAYABUSA-2 MISSION TO THE ASTEROID 1999JU3.

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Introduction: Trajectory of ejecta from an impact crater on an irregular-shaped small asteroid shows complex behavior due to its weak but asymmetric gravitational field. Fine member of the ejecta is also affected by solar radiation pressure. The study of asteroid ejecta is important to understand distribution of regolith and boulder on the asteroid's surface. For example, Shoemaker crater on the asteroid Eros is identified as a source of most boulders on Eros by tracing their trajectories [1].

Hayabusa-2 is a asteroid exploration mission succeeding the Hayabusa mission, which is planned to launch in 2014. Hayabusa-2 has a small carry-on impactor (SCI) to create a small crater on the target asteroid 1999JU3. The artificial impact experiment with SCI is aimed to excavate unaltered material beneath the surface, but it is also significant to examine cratering phenomena on a small body under a well controlled condition. The spacecraft will closely approach to the impact point to observe crater morphology and ejecta distribution. Thus it is important to expect a distribution of ejecta deposit emplaced on the surface of asteroid. Expectation of ejecta distribution in orbits around the asteroid after impact is also important for safe operation of SCI and the spacecraft.

We examine the trajectories and fate of impact ejecta around the asteroid 1999JU3 by numerical simulation. An asymmetric gravitational field of the asteroid, effect of solar radiation pressure, and size and velocity distribution of ejecta particles are considered in our simulation.

Method: Gravitational field of the asteroid is estimated by a polyhedron method [2]. Two independent shape models with different rotation parameters of 1999JU3 are available [3-4]. Both of them are used in our simulation. As the density of asteroid is currently unknown, it is controlled as a parameter varied within a reasonable range. We take account of effect of solar radiation pressure to small ejecta grains with a cannonball method [5]. Trajectories of ejecta are calculated by Runge-Kutta method. Ejecta trajectories are traced until they fly far away from the asteroid or emplaced on the surface. In the latter case, emplacement locations are recorded to evaluate distribution of the ejecta deposit. Experiment conditions including impact points, an impact angles and solar phase angles are defined according to the actual operation plan of the Hayabusa-2 mission.

Result: We present preliminary results of our numerical simulation in this abstract (Fig. 1). They covers a part of possible parameters of the actual SCI experiment. Validity of our calculation code is evaluated through these test runs. We attempt to compute more runs to estimate spatial densities of ejecta particle around the asteroid.

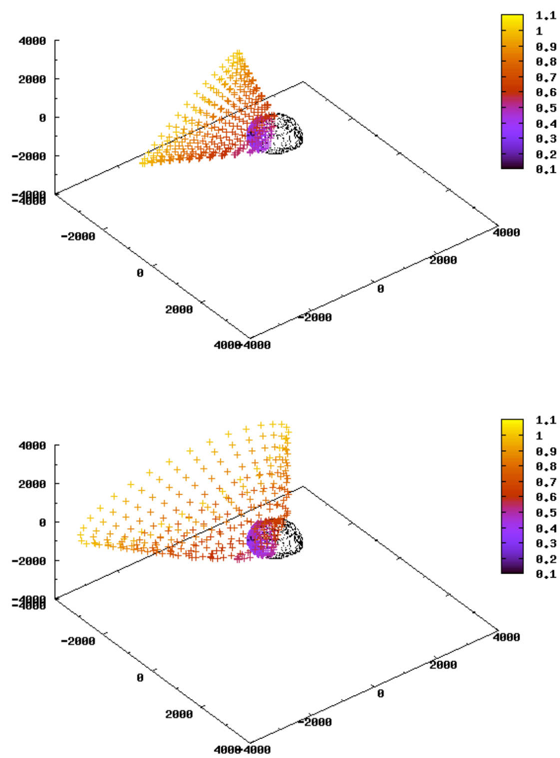

Figure 1. Snapshots of ejecta from a impact point of SCI on the asteroid 1999JU3. Upper panel: 60 min after impact. Lower panel: 90 min after impact. Grain size of ejecta is set to 1mm in this simulation. Both plots are drawn in the body-fixed coordinate of the asteroid. Color represents velocities of ejecta particles.

References: [1] Thomas P. C. et al. (2001) *Nature*, *413*, 394-96. [2] Werner R.A. and Scheeres D.J. (1997) *Celestial Mechanics and Dynamical Astronomy*, *65*, 313-344 (32). [3] Muller T. G. et al. (2011) *A&A*, 525. [4] Kawakami K. (2009) Master thesis, University of Tokyo. [5] Scheeres D.J. (2005) *LPS XXXVI*, Abstract #1919.