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Development Status of Hayabusa-2 Deployable Camera (DCAM3)

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Collisions between primitive planetary bodies are one of the most important physical processes in the planetary accretion from planetesimals to planets. Asteroids are small primitive bodies on the way to the larger bodies or the fragment bodies such as rubble piles of the evolved bodies, so that the asteroids are possibly be recognized as fossil bodies showing the accretion process in the solar nebula. Impact studies on the asteroid, such as the impact scaling rules related to the cratering and the disruption, are important to reveal the actual manner of planetary accretions in early stage of the evolution.

Small Carry-on Impactor (SCI) on Hayabusa-2 is a small detachable instrument that launches an artificial projectile and simulates planetary impacts on the asteroid 1999JU3. A copper-disk projectile is deformed by explosive in the SCI and forms a semi-spherical shell, and is accelerated to approx. 2 km/s. The tiny asteroid 1999JU3 is a good analogue of planetesimals and suitable to study the effect of micro-gravity on the impact process and elucidate the mechanical properties of planetesimals. The Deployable Camera (DCAM3) is a miniaturized detachable camera inherited from DCAMs in the Japanese IKAROS mission. The DCAM3 is currently under development for observations of the SCI impact. For avoiding a risk that the mother ship encounters high-speed ejecta from the asteroid, a separable instrument is necessary to obtain close up views of the impact while the mother ship is hiding in a safe region far from the impact point.

The scientific observations are performed by DCAM3-D that is a high-resolution visible observation subsystem in the miniaturized DCAM3 body. Scientific objectives of this camera are summarized as (1) clarifying the sub-surface structure, and (2) constructing the impact scaling rule applicable to the surface of asteroid 1999JU3. Observation objects of the camera are ejecta and a subsequent crater of the SCI impact, and a relative position of the SCI to the asteroid when it is launched. DCAM3-D can determine the size and the angle of the ejecta curtain, and the speed of the ejecta spreading or fragment spattering, which are the key information for the above objectives. In addition, low-speed ejecta (dust) spreading will possibly be observed around the DCAM3 in a few hours after the impact.

So far, we conducted the conceptual examinations to specify the required specification of the camera and a communication device. Engineering models were prepared for all components of DCAM3, and verification tests were conducted with them. Currently flight models are in tests for the observation and communication performances. The DCAM3-D sensor consists of a 2000 x 2000 pixels and 8 bit CMOS imager with a wide-angle optics (74 x 74 deg), which takes sequential images of the ejecta spreading with 1 frame/sec at maximum. The digital communication device can send the image data to the mother ship with 4 Mbps. DCAM3-D instruments in the mother ship receive and store all data taken by the deployed camera which continues to produce data for a few hours until batteries runs out or the DCAM3 falls and crashes on the asteroid. Total size of image data is estimated to be approximately 5 Gbits with image compression.

In this presentation, we show the science and the development status of the DCAM3 scientific part.