[EE] Evening Poster | P (Space and Planetary Sciences) | P-PS Planetary Sciences

[P-PS02]Regolith Science

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Recent planetary explorations have revealed that almost all solid bodies in the solar system are covered with small particles, called regolith. The surface geology, especially regolith behavior on the surfaces of solid bodies, becomes increasingly more important as represented by Hayabusa mission and other on-going and planned sample-return missions such as Hayabusa2 going to an asteroid Ryugu, OSIRIS-REx going to an asteroid Bennu and MMX planning to go to the martian satellites.

For fully understanding the regolith science, it is required to know and compare the regolith conditions on various celestial bodies, from asteroids to planets, with various methods.

Therefore, this session welcomes broad topics related to regolith on various celestial bodies, such as asteroids, comets, the Moon, the martian moons, Mars, etc. Papers on the formation, evolution, and alteration processes of regolith particles and regolith systems on the surface of planetary bodies, remote and in-situ observational results and techniques, analyses and results of returned samples, and laboratory, numerical, and theoretical studies on the fundamental physical and chemical processes are all welcome.

[PPS02-P03]Conceptual Study of Deployable Camera 5 for Martian Moons Exploration mission

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We have conducted conceptual studies of DCAM5 (Deployable Camera 5) as a candidate scientific instrument for the Martian Moons Exploration (MMX) mission. Japan Aerospace Exploration Agency (JAXA) is currently examining the MMX mission as a next planetary exploration project. In this program, spacecraft voyages to and orbits around Phobos for over months with remote-sensing observations and several landing events. The spacecraft will sample a portion of regolith material during the landings and bring them back to the Earth. In this paper/poster, we present the status of the DCAM5 studies with scientific objectives and observation concept.

DCAM is a series of cylindrical-shaped small camera units of 10-cm-order length. The concept of the DCAM series is that a small unit separates from mother spacecraft and takes images with cameras at a distance away from the spacecraft for several hours. Data of the images are immediately sent to the spacecraft via one-way radio communications. DCAM1 and DCAM2 were initially developed by JAXA and mounted on Japanese solar-sail mission IKAROS, and they took images of the IKAROS spacecraft itself to demonstrate the sail deployment. DCAM3 is currently onboard the asteroid probe, Hayabusa2. It will capture the images of the Hayabusa2's impact experiment on the asteroid at a close distance,

while the mother spacecraft is at a safe distance to avoid contamination due to the impact fragments.

The new DCAM5 system is designed for MMX to deploy several small units from orbits down to the Phobos surface. Each unit has two visible-infrared multi-band cameras, close-up cameras, and a tri-axial accelerometer in a small cylindrical-shape chassis. The following scientific observations are conducted by DCAM5: (1) imaging the various scales of Phobos surface at visible-infrared at different altitudes on the descent trajectory, (2) measuring the acceleration response of a collision with the Phobos surface, which reflects the physical condition of the top surface layer, (3) taking close-up images of the regolith particles after the probe comes to rest on the surface, and (4, extra) imaging of flying dust from the impact point. Potential landing sites for DCAM5 will be selected in regions where the mother spacecraft cannot approach, due to, for example, high slope or complex topography.

While the most of the system and the electrical design of DCAM5 inherit from DCAM3 on Hayabusa2, main issues in the current conceptual studies are the radio communication antenna and transmitter on the separation unit, and the separation mechanism. Radio communications from the DCAM5 unit to the mother spacecraft must be omnidirectional since the attitude of the unit is not controllable after landing or bouncing on the Phobos surface. The antennas of the unit must be carefully designed to capture the mother spacecraft in the antenna pattern with a sufficient S/N, with considering radio reflection at the ground surface. The omnidirectional antenna on the unit was designed and selected via trade-off studies, and its performance was investigated by numerical simulations. Specifications of the separation mechanism affect a subsequent trajectory of the DCAM5 unit to Phobos. According to the results of the numerical studies for the descent trajectories of DCAM5, a relatively high separation velocity of 40-100 cm/s is desired for the separation mechanism. Therefore, a new separation mechanism was designed to satisfy this requirement.