Small Carry-on Impactor Elucidates the Nature of Craters and the Evolution of Solar System

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In this presentation, scientific challenges using Small Carry-on Impactor (SCI) in Hayabusa2 mission are introduced and discussed.

Hayabusa2 is now going to a C-type, Near-Earth Asteroid (NEA) 162173 Ryugu (Ryugu), bringing Small Carry-on Impactor (SCI). SCI will be exploded several tens of minutes after separated from Hayabusa2 at an altitude of ~ 500 m above the surface of Ryugu and will shoot 2 kg copper projectile at an impact speed of 2 km/s toward the surface of Ryugu. As a consequence of this impact, an artificial impact crater will be formed on the surface of Ryugu and a large number of fragments and grains from the excavated crater will be ejected, forming an ejecta curtain.

The scientific objectives of SCI mission are mainly classified into two themes: one is to open a window accessing the interior of the asteroid for understanding the present physical/chemical condition of Ryugu, while the other is to conduct an impact experiment on a real asteroid surface in space. In terms of the former objective, excavating the asteroid surface will hopefully enable us to observe fresh materials affected by no or weak space weathering and thermal alteration. Observing the ejecta curtain in-situ and the finally formed crater also allow us to estimate physical property of Ryugu’ s surface, contributing to the regolith science on small bodies. Furthermore, we hope to collect the asteroid sample excavated from depth of several 10 cm at around the crater. From a point of view of impact experiment in space, SCI impact is a precious opportunity to examine the effects of the projectile scale and the gravity on the scaling laws relevant to the crater cavity and the ejecta. Since this experiment is conducted on the real asteroid, the data will be anchor points for the science of impact cratering.

It should be noted that the moment of SCI impact and the growing ejecta curtain cannot be observed in-situ from the Hayabusa2 spacecraft itself because the spacecraft needs to escape far away, behind Ryugu, to avoid collisions of debris from SCI explosion. For in-situ observation, we have prepared a small, handy-sized camera that will be separated from the spacecraft in the middle way of escape, observing the SCI impact about 1 km away from the impact site. That camera is called Deployable Camera 3 (DCAM3). Images taken by DCAM3 will play a key role for understanding the cratering mechanism and the surface condition of Ryugu.

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