SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (4)

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SMALL CARRY-ON IMPACTOR OF HAYABUSA-2 MISSION

Abstract

The Japanese asteroid explorer HAYABUSA launched in 2003 arrived at its target asteroid ITOKAWA in September, 2005. HAYABUSA has made amount of scientific discoveries and technological achievements during its stay at ITOKAWA. It left ITOKAWA in December, 2005 and came back to the Earth on June 13 June 2010. Under this situation, the study of the next asteroid exploration mission has been performed supposing a launch in 2014. The spacecraft is called HAYABUSA-2 and its design basically follows HAYABUSA in order to shorten the development time. From the point of the scientific objective, 1999 JU3 which is the asteroid with the primitive composition (C-type) is chosen as the target. C-type asteroids are rocky like ITOKAWA(S-type), but it is thought that their rocks obtain much more organic matters.

Some new components are planned to be equipped in HAYABUSA-2 mission such as MINERVA-2 and NIRS-3(3um Near Infrared Spectrometer). A small carry-on impactor is one of the new challenges that were not seen with HAYABUSA. The observations by the HAYABUSA spacecraft discovered that ITOKAWA is rubble-pile body with the macro-porosity. However, we have no direct observational data as for their internal structures and sub-surface materials. One of the most important scientific objectives of HAYABUSA-2 is to investigate chemical and physical properties of the internal materials and the internal structures in order to understand the formation history of small bodies such as small, un-differentiated asteroids. In order to achieve this objective, the impactor is required to remove the surface regolith and create an artificial crater on the surface of the asteroid.

High kinetic energy (about 2km/s impact speed and 2kg impact mass) is required to make a meaningful crater. But the traditional acceleration devices such as rocket motors and thrusters are difficult to hit the asteroid because the acceleration distance becomes large. To overcome this difficulty, the powerful explosive is adopted to accelerate the metal impact head. By this means, the accelerate time become less than 1ms and it becomes possible to crash into the asteroid On the other hand, this method has one serious problem. The broken pieces of the impactor will be scattered when the explosive detonate and

the fragments could damage the spacecraft. Consequently, the spacecraft will move behind the asteroid to get out of the "line of fire".

This paper presents the overview of our small carry-on impactor system and impact operation of HAYABUSA-2 mission.