HAYABUSA ASTEROID SAMPLE RETURN MISSION

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Hayabusa asteroid explorer was launched by M-V rocket on May 9th 2003. It cruised in deep space using the novel ion engines and arrived at the asteroid Itokawa on September 12th 2005. Hayabusa executed the scientific observation staying around the asteroid in September and October 2005. And in November it succeeded twice touchdowns on it. Just after the lift-off so many troubles damaged the spacecraft. Innovative and dedicative engineering efforts solved these malfunctions and made Hayabusa on the return way to Earth. It dropped a reentry capsule to Earth and disappeared in the atmosphere above Woomera Australia on June 13th 2013. The reentry capsule was successfully retrieved and transported to the ISAS curation center. A lot of particles originated from Itokawa were found in the canister and devoted to precision scientific analysis to resolve the solar science.

Figure 1 shows the progress on resolution to observe asteroids. The telescopes indicate an asteroid as a luminous point. The ground radar may show dim image on an asteroid. Hayabusa brought us lot of complete images on Itokawa with meter-class resolution at the moment of rendezvous. At instant of landing it reveled the surface configuration as rubble pile structure with millimeter-class resolution. At the complete of Earth return the asteroid material showed itself in the microscope with micrometer-class resolution. And they are now devoted to the electron microscope, X-ray tomography isotope analysis and so on. The observation resolution has reached angstroms. This is the newest observation technique “Asteroid Sample Return” to elucidate the nature of the universe.

Hayabusa 2 space mission is under development using the design philosophy and heritage succeeded from Hayabusa mission for the purposes of investigating the C-type asteroid by in-situ observations and the sample return techniques and realizing the space system with robustness and reliability. The spacecraft of 600 kg aims to retrieve surface material of the asteroid 1999JU3 to Earth as a final goal. Its artist image under the powered flight by ion engines in deep space toward an asteroid is seen in Fig. 2. The near-infrared spectrometer, the thermal infrared camera, the wide/telescope cameras and the laser altitude meter will play important roles on remote sensing at the rendezvous phase. Especially the former two devices are turned to C-type asteroid in order to detect hydrate mineral. Four separation robots will challenge tangible observations. Material sampling in several opportunities will be performed using the sampling mechanism, the target makers, the flash the laser range finders and the navigation camera. A copper bullet of the impacting device accelerated by pyrotechnics will make a new crater, which moment will be observed by the deployment camera. Flesh material scattered from inside around the new crater will be collected. At the final moment the reentry capsule will dive from the heliocentric space into Earth atmosphere and bring us the asteroid samples. In the present plan it will be launched by H-2A rocket in 2014, arrive at 1999JU3 in 2018, and return to Earth in 2020.

Figure 3 shows the assembled spacecraft and the staff members of Hayabusa 2 project, who are very able, active and reliable. Hayabusa 2 space mission will open not only the era of space exploration but also the interdisciplinary science.

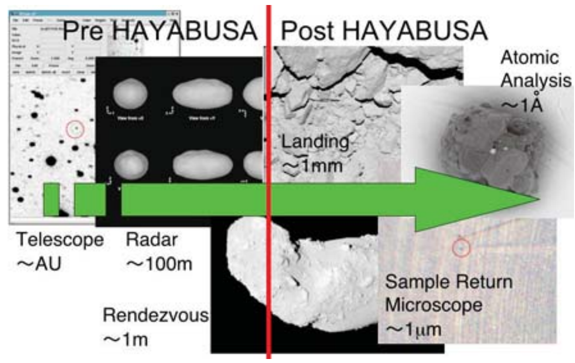

Fig.1 Progress on resolution for asteroid observation.

Fig.2 Artist image of Hayabusa 2 cruising.

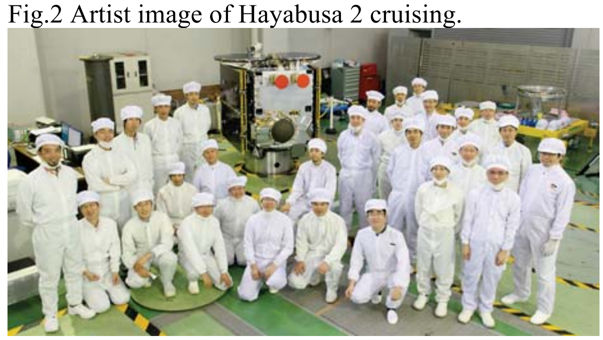

Fig. 3 Hayabusa 2 spacecraft and project members.