Asteroid explorer, Hayabusa2, press conference

December 6, 2018

JAXA Hayabusa2 Project

Topics

- Report on the current status of Hayabusa2
- Q & A and discussion
- Tour of the control room
  （Please understand that only people who applied in advance can join the tour)

Contents

Overview of Hayabusa2

Objective

We will explore and sample the C-type asteroid Ryugu, which is a more primitive type than the S-type asteroid Itokawa that Hayabusa explored, and elucidate interactions between minerals, water, and organic matter in the primitive solar system. By doing so, we will learn about the origin and evolution of Earth, the oceans, and life, and maintain and develop the technologies for deep-space return exploration (as demonstrated with Hayabusa), a field in which Japan leads the world.

Expected results and effects

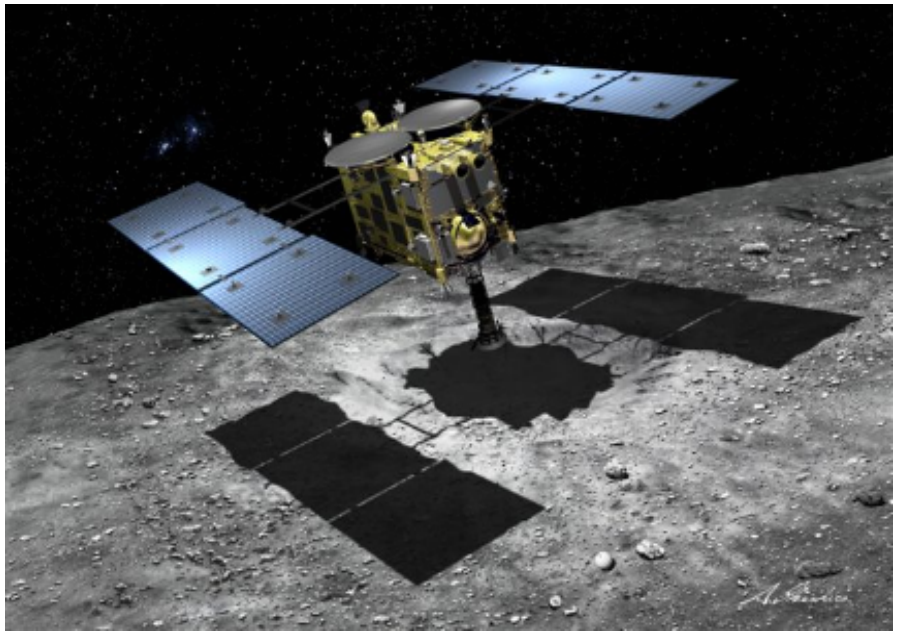
- By exploring a C-type asteroid, which is rich in water and organic materials, we will clarify interactions between the building blocks of Earth and the evolution of its oceans and life, thereby developing solar system science.
- Japan will further its worldwide lead in this field by taking on the new challenge of obtaining samples from a crater produced by an impacting device.
- We will establish stable technologies for return exploration of solar-system bodies.

Features:

- World's first sample return mission to a C-type asteroid.
- World's first attempt at a rendezvous with an asteroid and performance of observation before and after projectile impact from an impactor.
- Comparison with results from Hayabusa will allow deeper understanding of the distribution, origins, and evolution of materials in the solar system.

International positioning:

- Japan is a leader in the field of primitive body exploration, and visiting a type-C asteroid marks a new accomplishment.
- This mission builds on the originality and successes of the Hayabusa mission. In addition to developing planetary science and solar system exploration technologies in Japan, this mission develops new frontiers in exploration of primitive heavenly bodies.
- NASA too is conducting an asteroid sample return mission, OSIRIS-REx (launch: 2016; asteroid arrival: 2018; Earth return: 2023). We will exchange samples and otherwise promote scientific exchange, and expect further scientific findings through comparison and investigation of the results from both missions.



(Illustration: Akihiro Ikeshita)

Hayabusa 2 primary specifications

Mass	Approx. 609 kg
Launch	3 Dec 2014
Mission	Asteroid return
Arrival	27 June 2018
Earth return	2020
Stay at asteroid	Approx. 18 months
Target body	Near-Earth asteroid Ryugu

Primary instruments

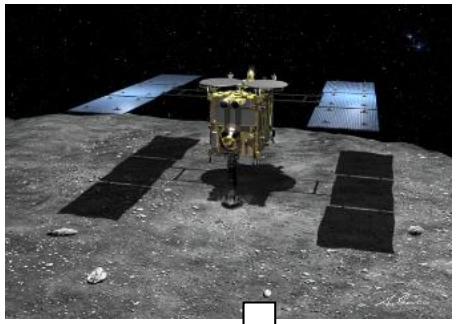
Sampling mechanism, re-entry capsule, optical cameras, laser range-finder, scientific observation equipment (near-infrared, thermal infrared), impactor, miniature rovers.

Mission Flow

Launch
3 Dec 2014

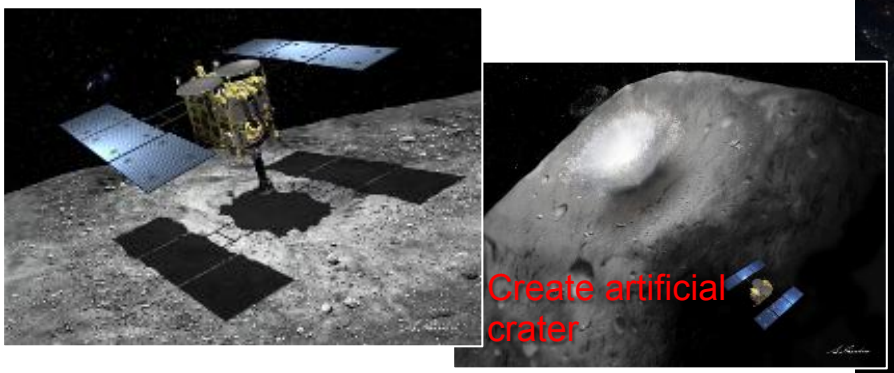
Earth swing-by
3 Dec 2015

Arrival at asteroid
June 27, 2018



Examine the asteroid by remote sensing observations. Next, release a small lander and rover and also obtain samples from the surface.

Use an impactor to create an artificial crater on the asteroid's surface



After confirming safety, touchdown within the crater and obtain subsurface samples

Depart asteroid
Nov–Dec 2019

Earth return
late 2020

Sample analysis

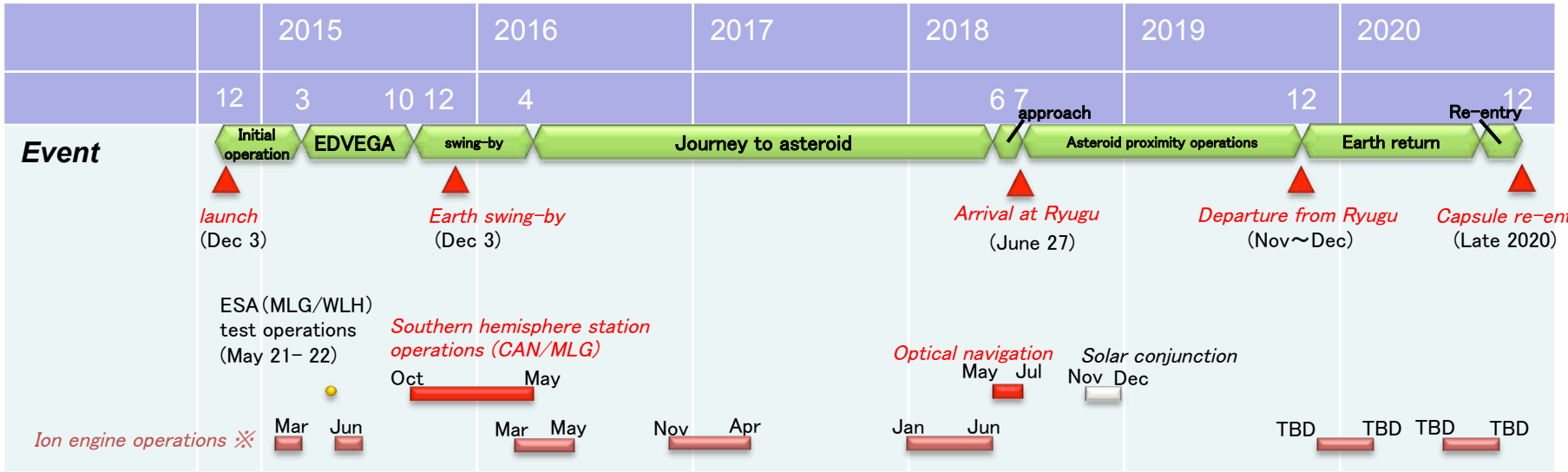
(Illustrations: Akihiro Ikeshita)

1. Current project status & schedule overview

Current status:

- On November 23, a ΔV operation was performed and the spacecraft started moving at a speed of about 12 cm/s in the direction away from Ryugu.
- From here, Hayabusa2 will reach a distance of 100km from Ryugu and return to the home position at the end of December.
- The HJST (Hayabusa2 Joint Science Team) international science conference was held on December 3 – 4.

Schedule overview:



2. Conjunction Operation Report

- On November 18, preparations for the solar conjunction began. A attitude rotation of 180 degrees was then performed in anticipation of the reversal of the relative positions between the Sun, Earth and asteroid, which will mirror the configuration before conjunction.
- On November 23, the spacecraft was placed into the conjunction transition orbit (COI: Conjunction Orbit Insertion), and started moving at about 12 cm/s in the direction away from Ryugu (towards the Sun).
- The trajectory of the spacecraft was accurately estimated and the first trajectory correction maneuver (TCM 1) was made on November 30.
- Currently, the angle between the Sun-Earth-spacecraft is less than 3 degrees, so communication with Hayabusa2 is difficult.
- A second trajectory correction maneuver is planned for December 25 and ΔV（HPR：Home Position Recovery）operation on December 29 to return the spacecraft to the home position.

2. Conjunction Operation Report

Orbit and trajectory control operation

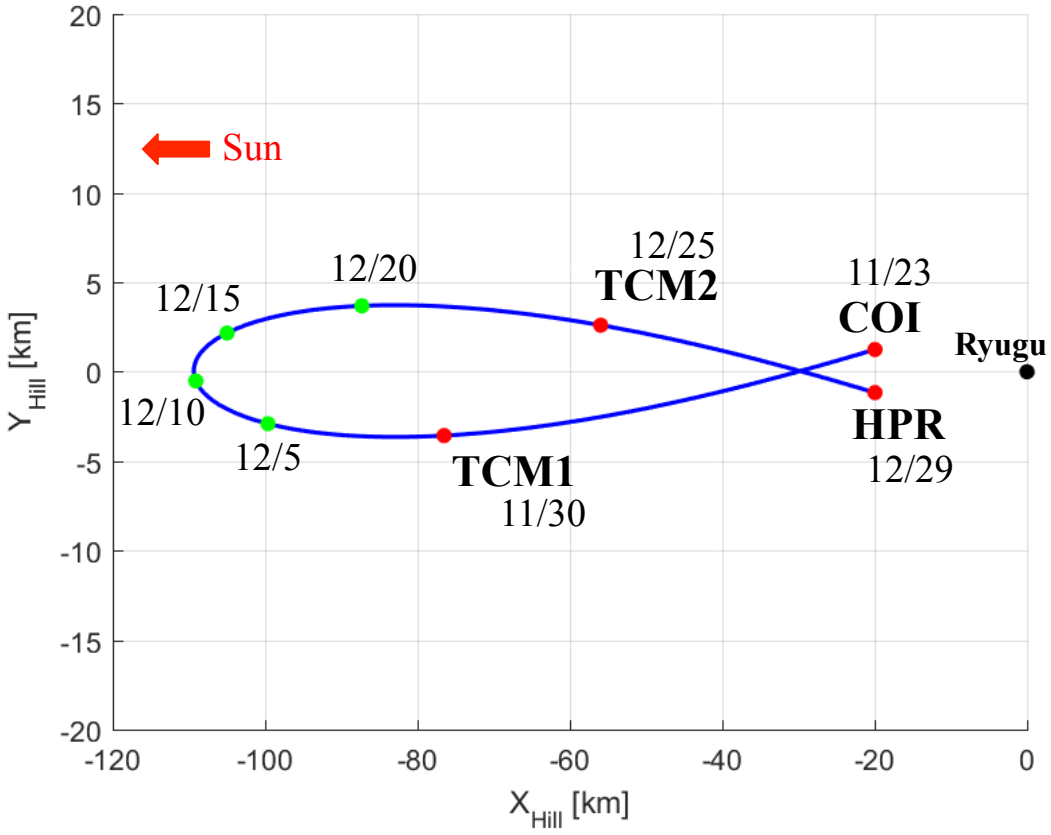
Orbit control

Name	Date
COI	2018/11/23
TCM1	2018/11/30
TCM2	2018/12/25
HPR	2018/12/29

COI : Conjunction Orbit Insertion

TCM : Trajectory Correction Maneuver

HPR : Home Position Recovery



Conjunction transition orbit in the Hill coordinate system

3. Image release

Summary of the following images:

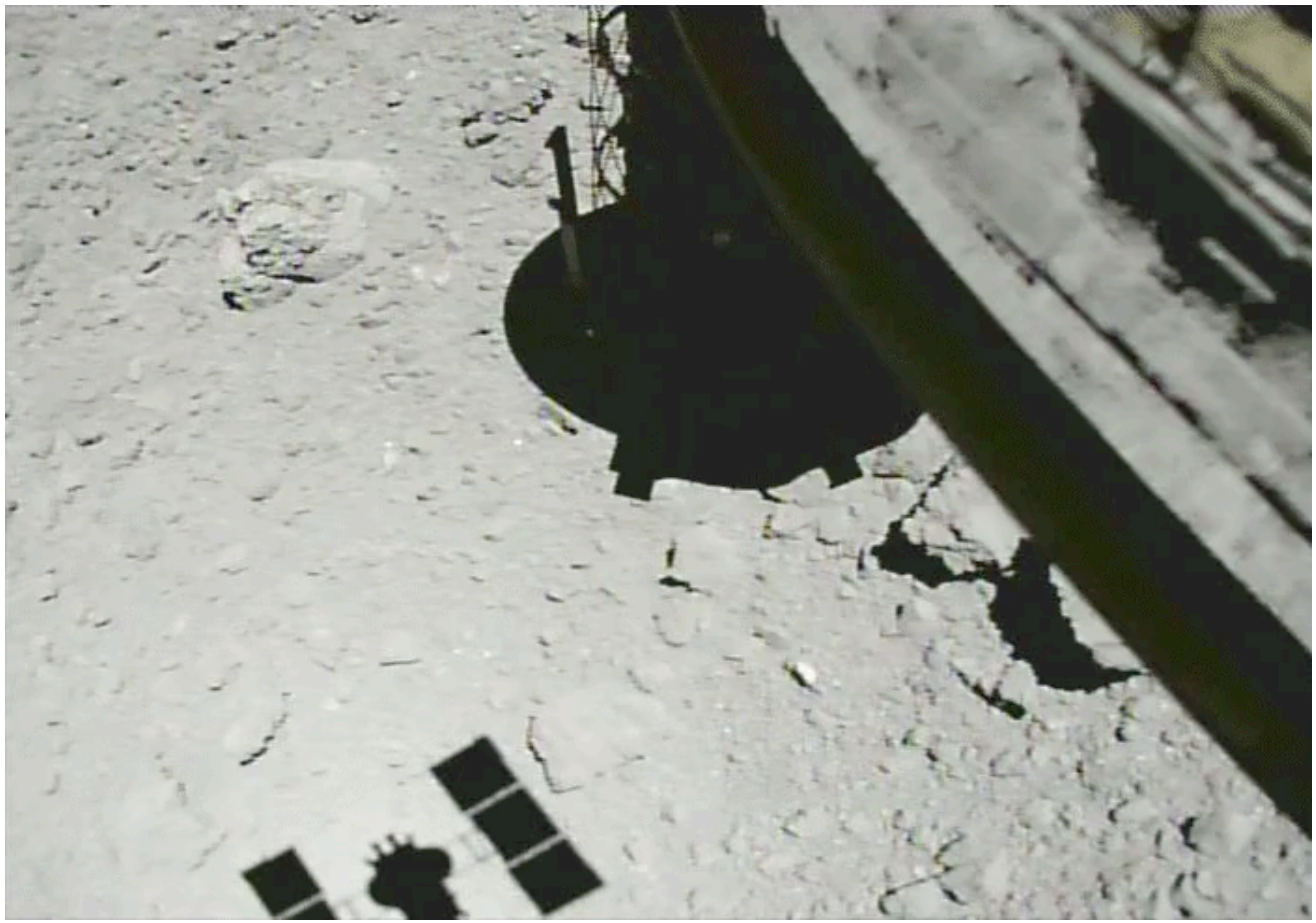
- Movie of the surface of Ryugu using the small monitor camera (CAM-H).

  ※Full version of previously published video.

- Separation of target markers and subsequent tracking movie.
- High resolution image captured close to the touchdown candidate site.

3. Image release

Movie of the surface of Ryugu by the small monitor camera (CAM-H)



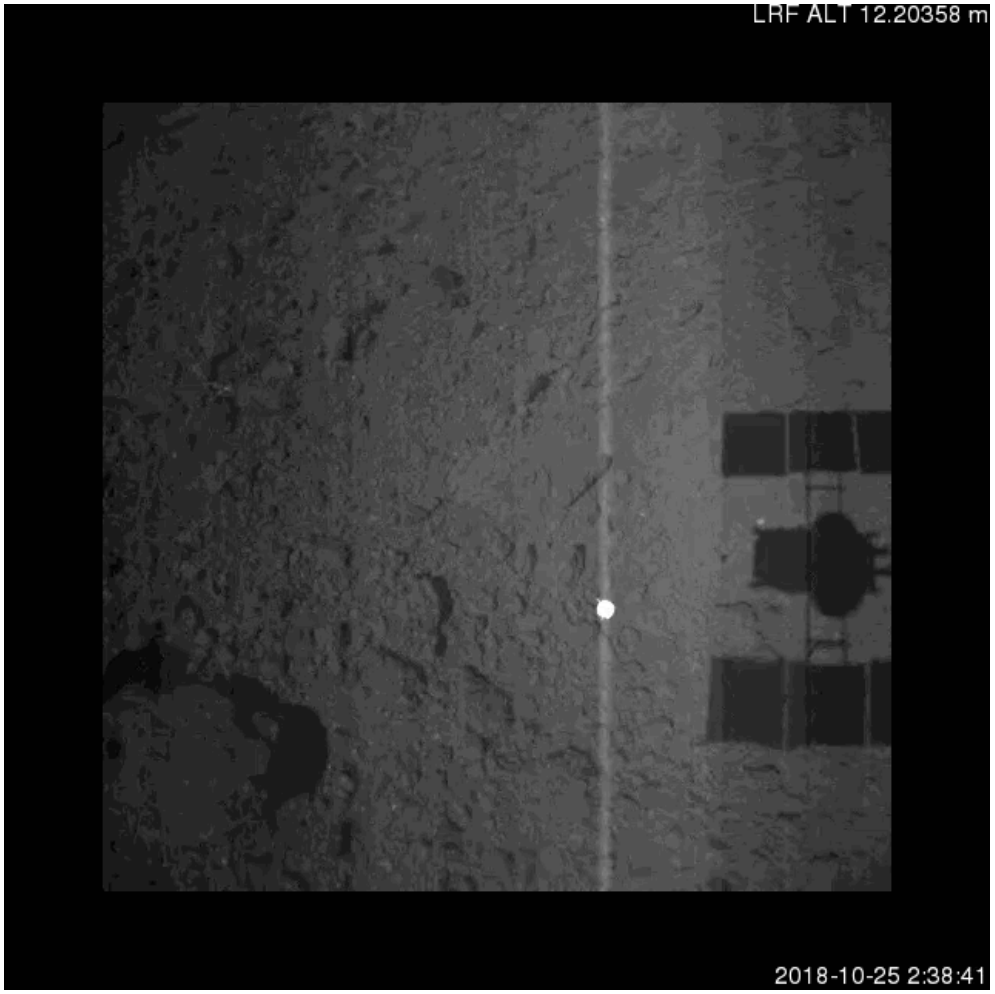
（movie
20 x speed）

Sequential images taken with the small monitor camera (CAM-H) during Touchdown 1 Rehearsal 3 (TD1-R3). The images were captured just after the spacecraft began to ascend at 11:47 JST on October 25, 2018 (altitude of about 21m). The rising speed is about 52 cm/s. The last image is at 11:53 JST at an altitude of about 200m. The images in the first and the last parts have a 5 second interval, while the others were captured ever second.（Image credit：JAXA）

3. Image release

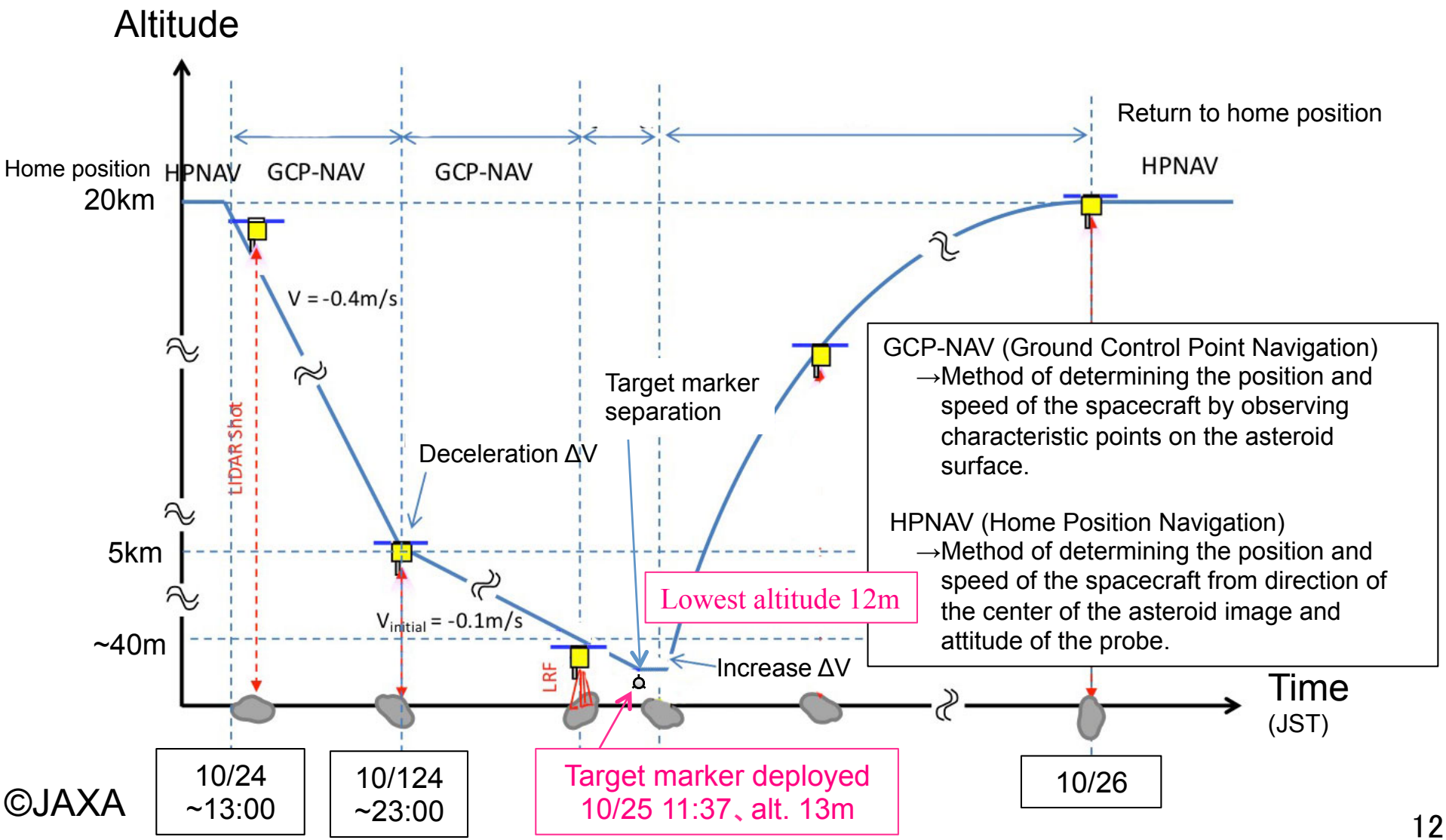
Separation of target markers and subsequent tracking video

（movie 40x speed）

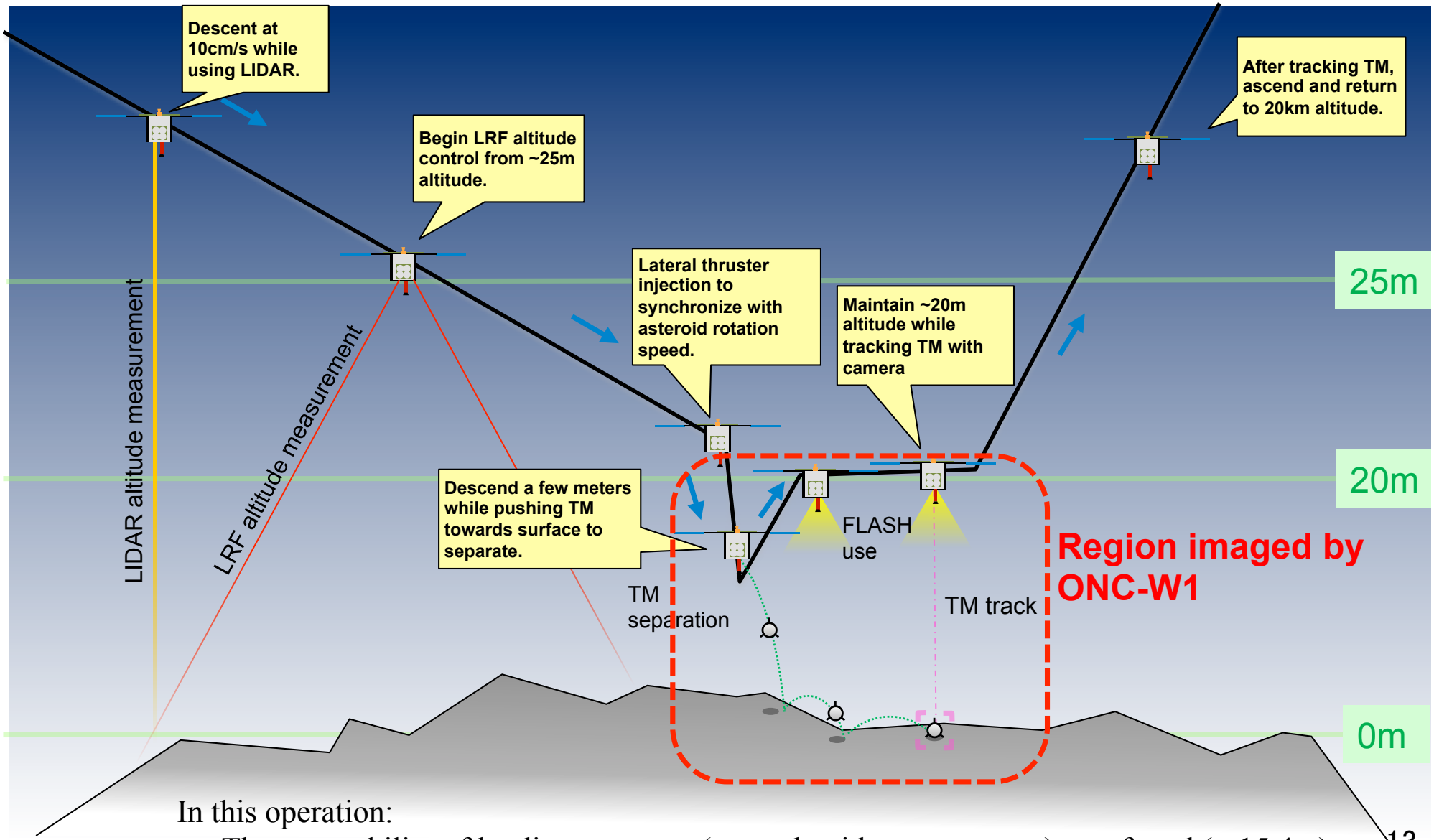


Tracking the target marker after release during Touchdown 1 Rehearsal 3 (TD 1-R3). The images were captured from October 25, 2018 at 11:38 to 11:48 JST. The altitude is about 12m at the beginning of the movie and 56m at the end. (Image credit: JAXA).

(REF) Actual progress of TD1-R3 operation



(REF) TD1-R3 low altitude sequence



In this operation:

- The exact ability of landing accuracy (ground guidance accuracy) was found (= 15.4m).
- Implemented the possibility of landing using a target marker as a reference point.

3. Image release

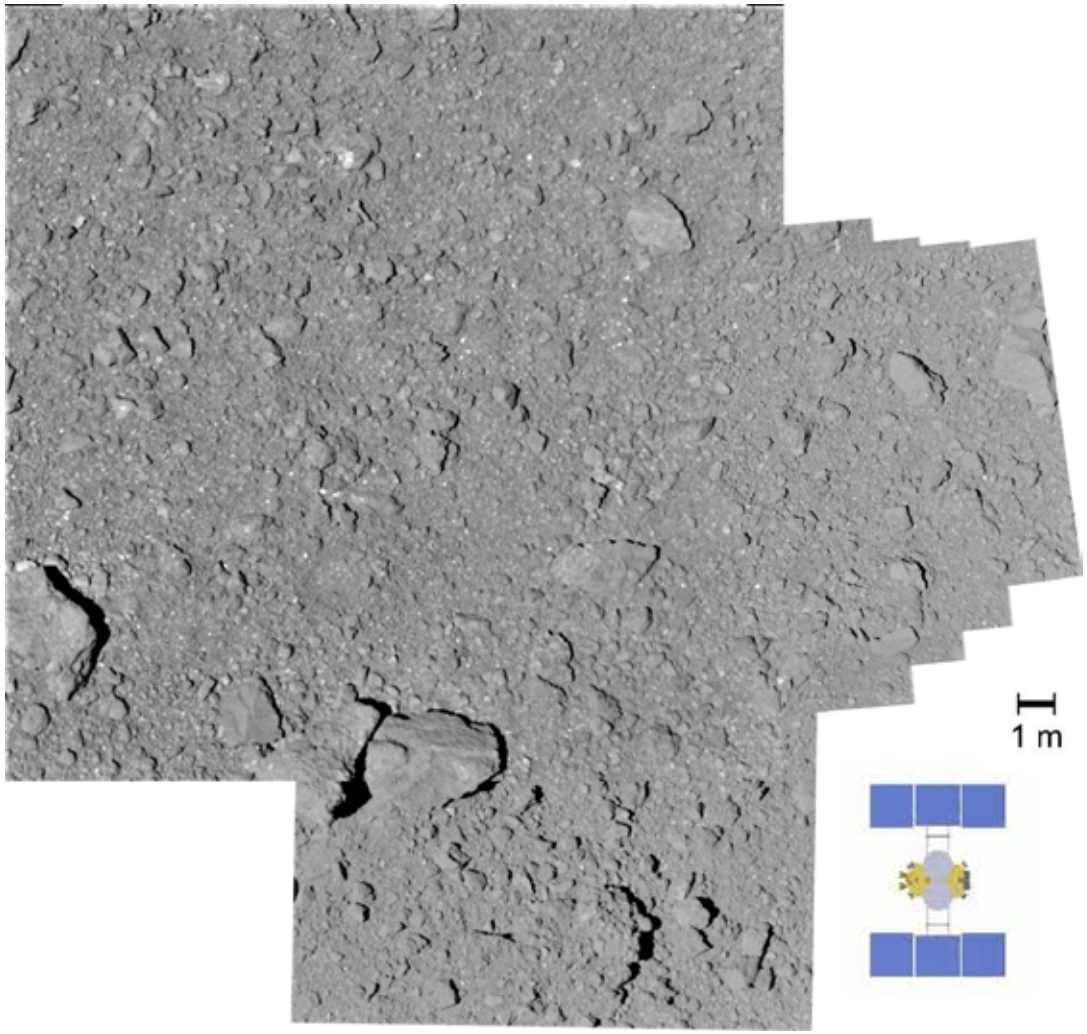
Separation of target markers and subsequent tracking video

（movie 10x speed）

Tracking the target marker after release during Touchdown 1 Rehearsal 3 (TD 1-R3). The images were captured from October 25, 2018 at 11:38 to 11:48 JST. The altitude is about 12m at the beginning of the movie and 56m at the end. (Image credit: JAXA).

3. Image release

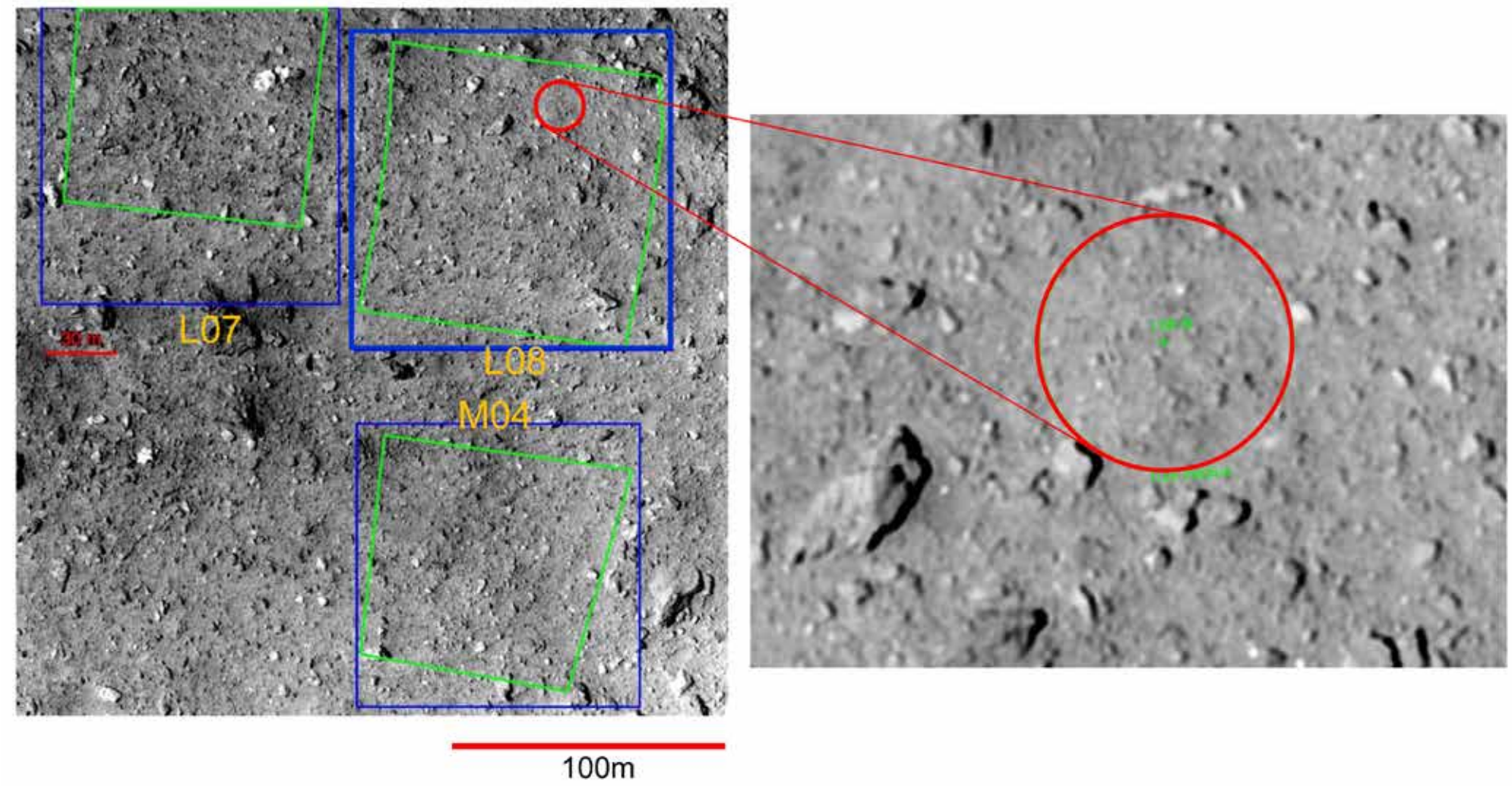
High resolution image near the touchdown candidate site



Composite of images taken near the touchdown candidate site
（Image credit：JAXA, University of Tokyo, Kochi University, Rikkyo University, Nagoya University, Chiba Institute of Technology, Meiji University, University of Aizu, AIST.）

（REF）Touchdown candidate site: L08-B

（Previously published images）



（ Image credit：JAXA, University of Tokyo, Kochi University, Rikkyo University, Nagoya University, Chiba Institute of Technology, Meiji University, University of Aizu, AIST ）

4. Other

■HJST（Hayabusa2 Joint Science Team）Meeting

- On December, 3 – 4, an international science meeting was held to discuss future operations and the scientific results so far.

（©JAXA）

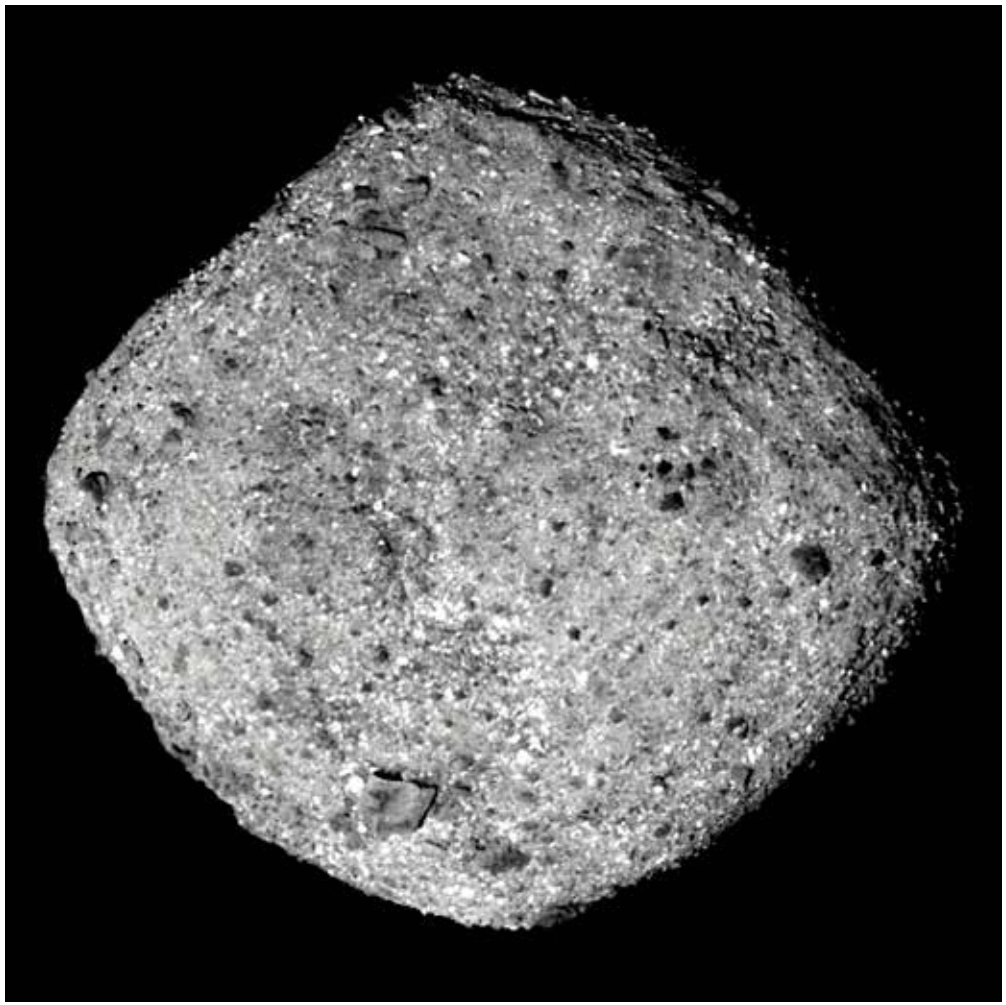
■Place names on Ryugu

- We are currently awaiting the results from the IAU (International Astronomical Union）Working Group for Planetary System Nomenclature.

4. Other

■OSIRIS-REx

- Arrived at Bennu on December 3 (US time)



（movie）

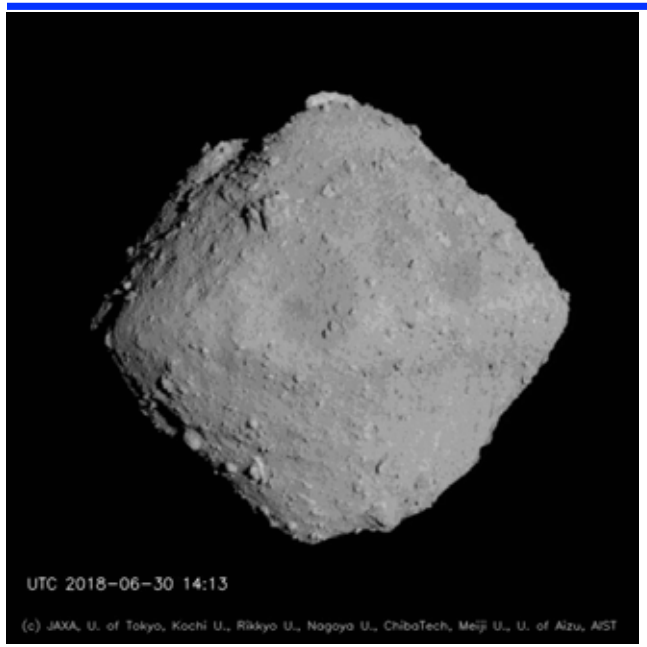
This series of images taken by the OSIRIS-REx spacecraft shows Bennu in one full rotation from a distance of around 50 miles (80 km). The spacecraft's PolyCam camera obtained the 36 2.2-millisecond frames over a period of four hours and 18 minutes. Credit: NASA/Goddard/University of Arizona

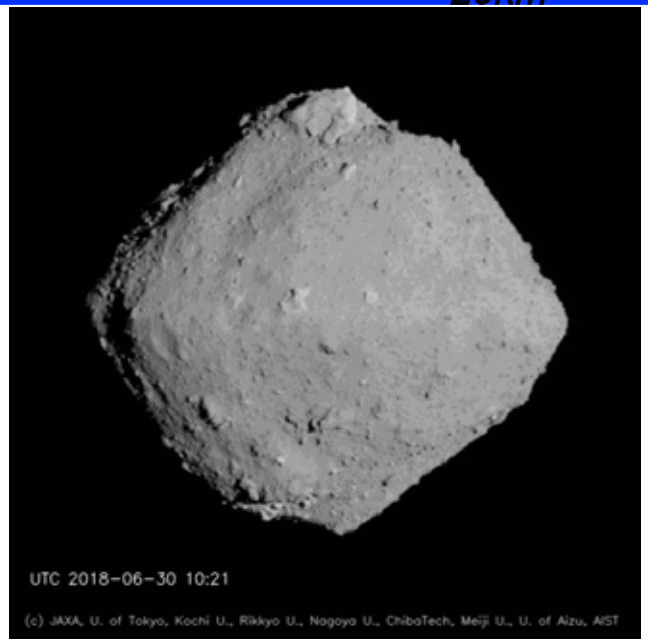
Ryugu

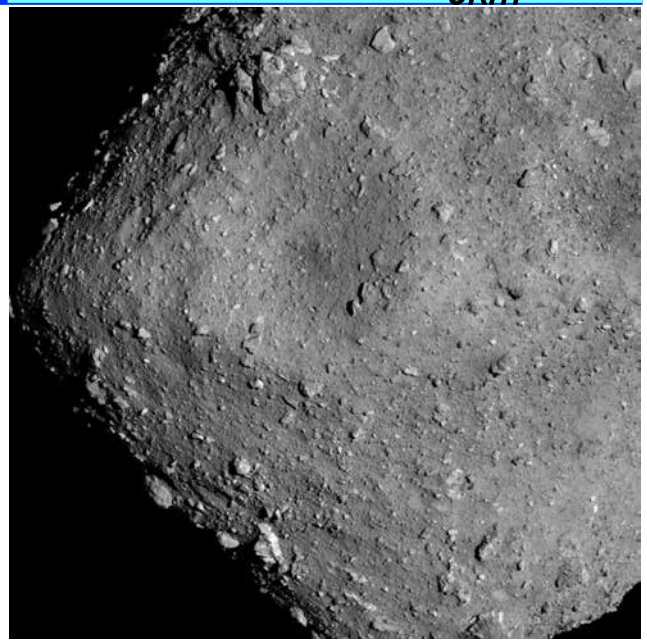
Image credit：JAXA, University of Tokyo, Kochi University, Rikkyo University, Nagoya University, Chiba Institute of Technology, Meiji University, University of Aizu, AIST.

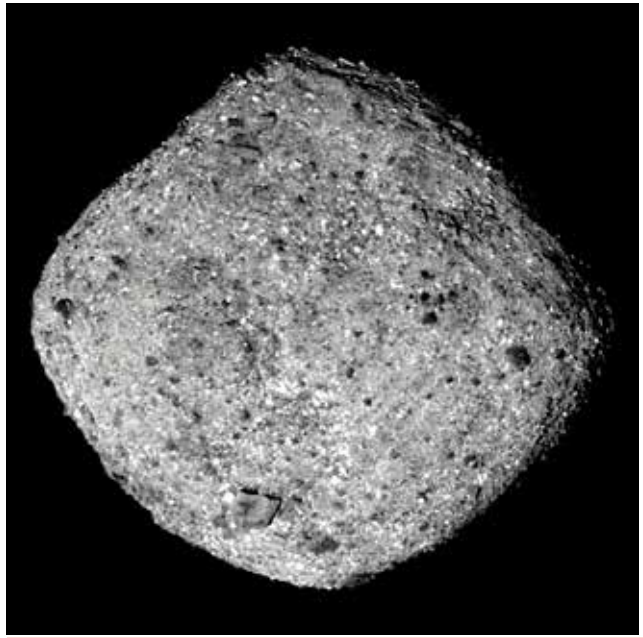
distance 20km

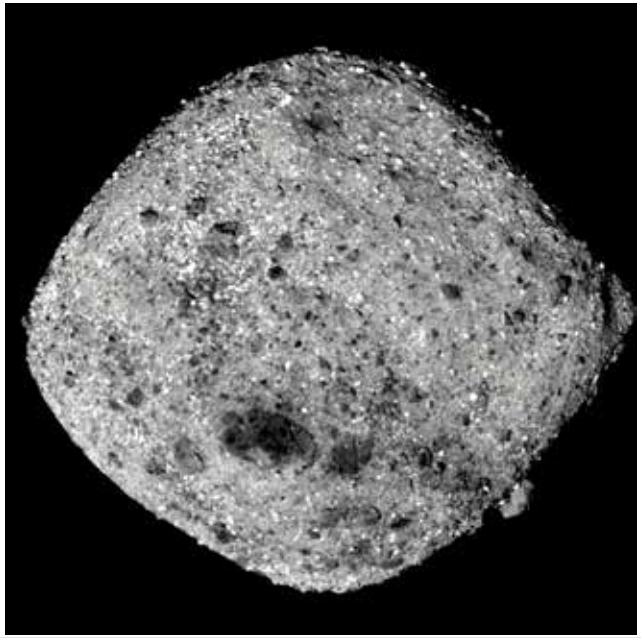
distance 6km

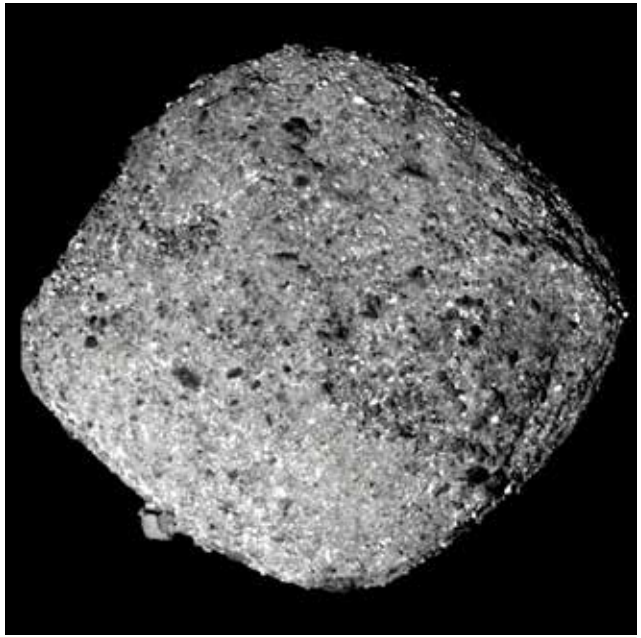










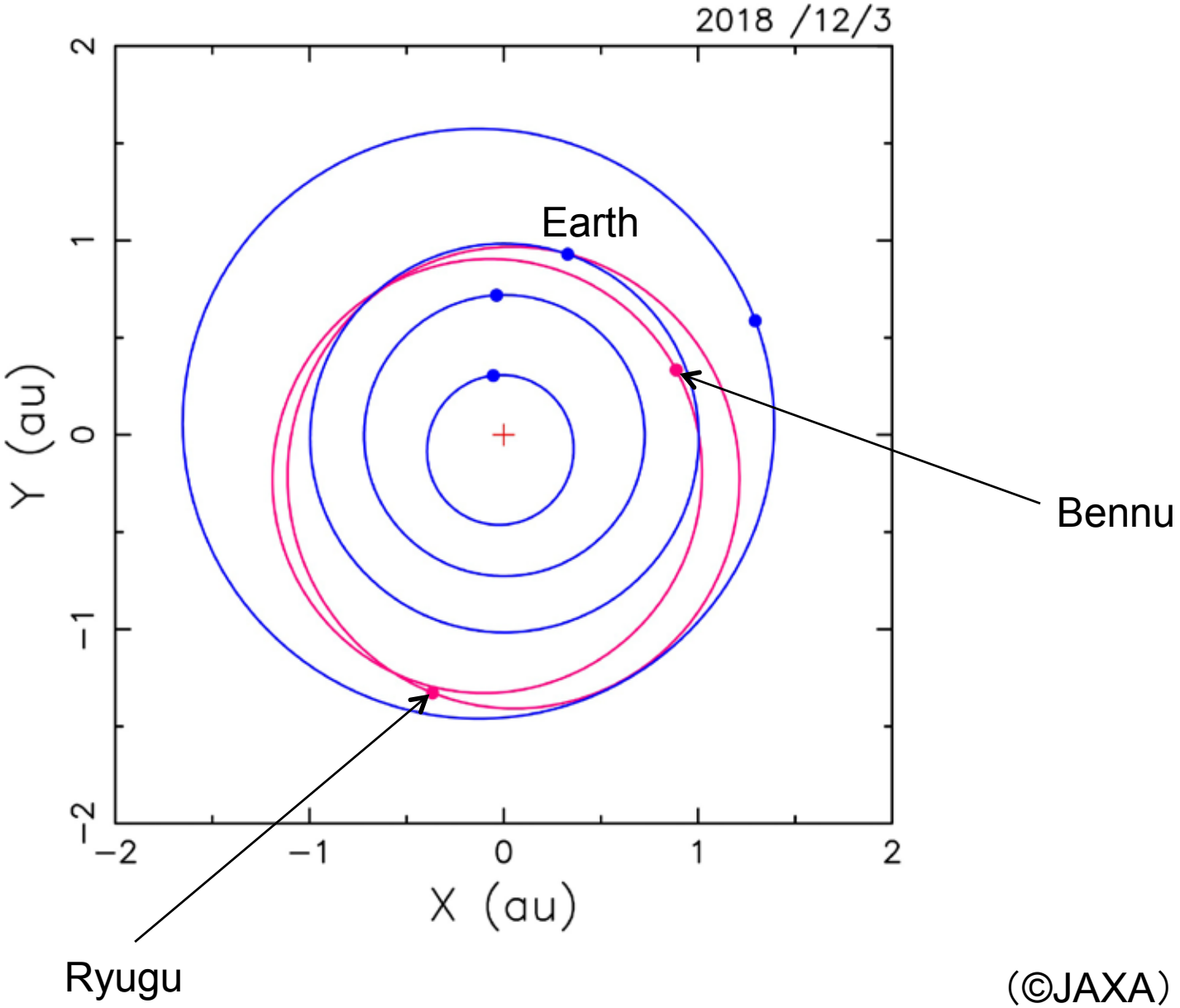


Bennu

Credit: NASA/Goddard/University of Arizona

distance 80km

(REF) Location of Ryugu & Bennu



(©JAXA)

4. Other

■Joint session with OSIRIS-Rex at the AGU Fall Meeting

- AGU = American Geophysical Union（large planetary science society in the USA)
- Fall Meeting : December 10 – 14, 2018, Washington DC
- Session name：A First Look at 162173 Ryugu and 101955 Bennu: Hayabusa 2 and OSIRIS-REx Arrive at Their Respective Target Asteroids
- Session date: December 11 (oral), December 12 (poster).

5. Future plans

■Scheduled operations

- Until the end of December　: Conjunction operations
- From January 2019 : Normal operations

■Announcement of winners for the Ryugu Imagination Contest

- Scheduled late December.

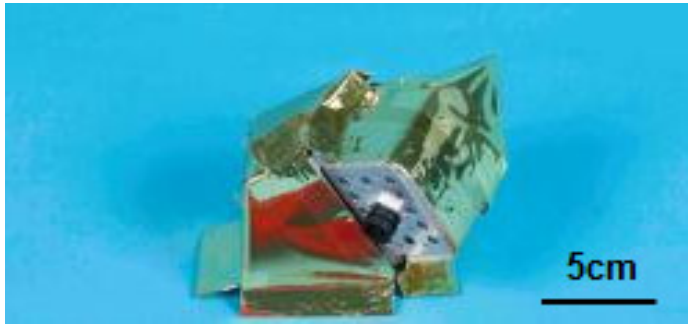
■Press briefing and media

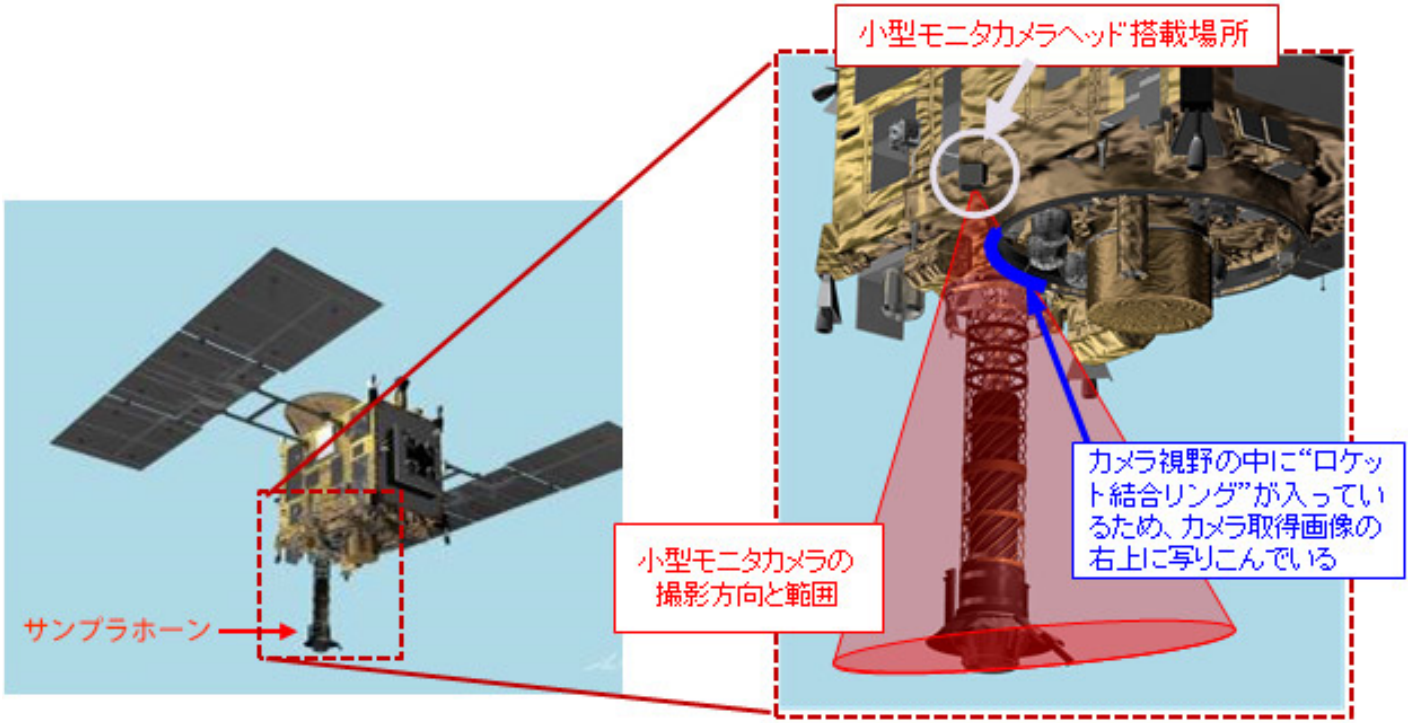
- December 13 (Thursday)　15:30～　reporter briefing @ Ochanomizu

Reference material

Small Monitor Camera（CAM−H）

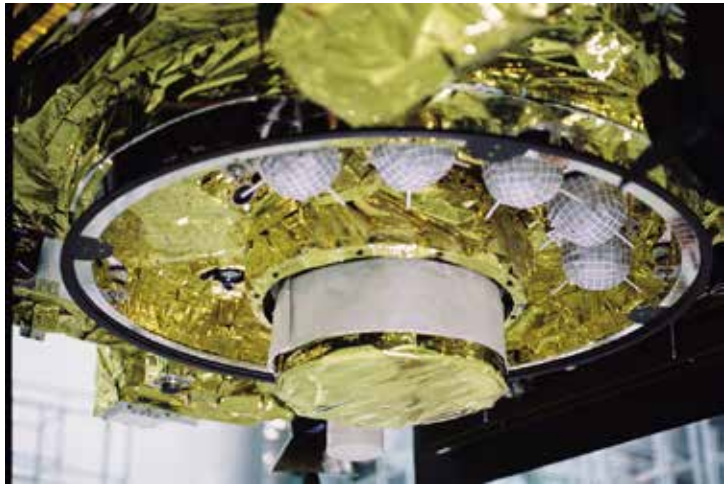
- Camera built & mounted from donation funds.
- View down sampler horn.





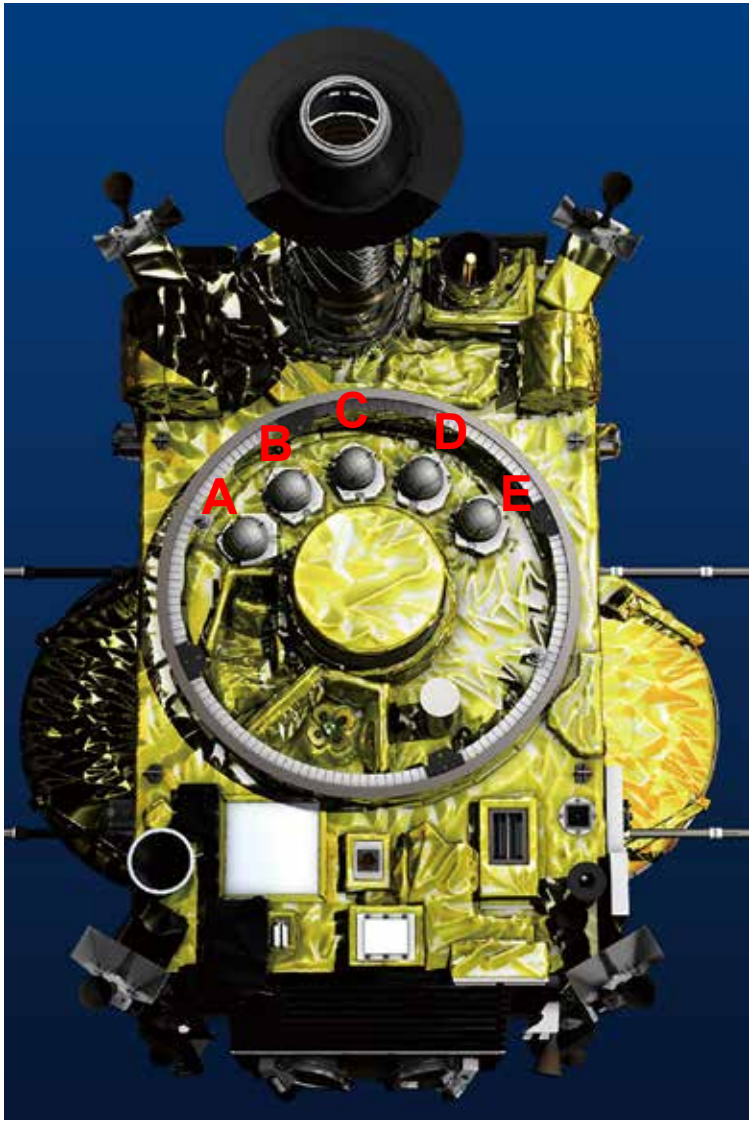
（©JAXA）

Target marker



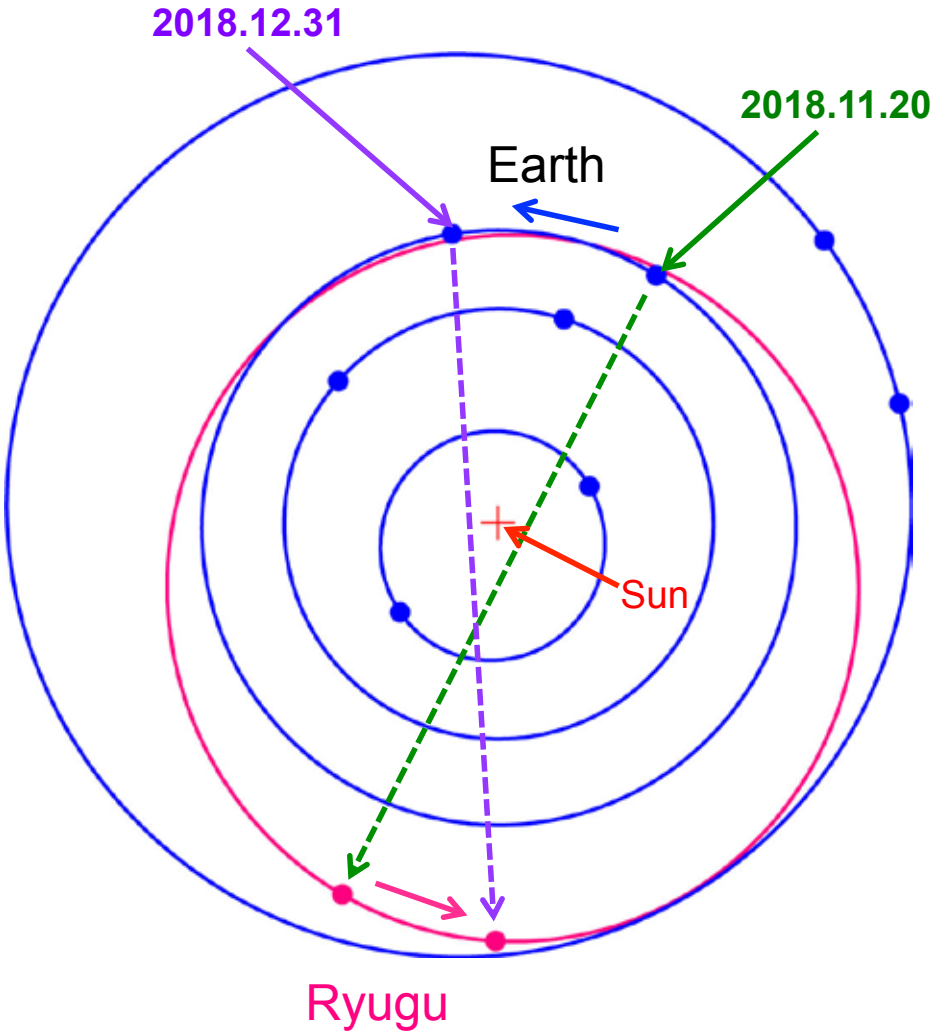
- Size of body (ball): about 10cm
- Retroreflective film
- 4 bars : rolling prevention
- Inside contains many polyimide globules

- First to separate : B
- Sequence of separation: B→A→E→C→D
- On the inside of the target marker is a sheet on which is written the names of members from the general public.



Conjunction operation

- "Conjunction" for spacecraft operation refers to the case where the spacecraft is in the direction that almost directly overlaps with the Sun when viewed from Earth.
- The alignment means that communication with the spacecraft is not secure due to radiowaves radiated by the Sun.
- In this period, critical operation is not carried out.
- For Hayabusa2, the duration of this period is from late November 2018 – end of December.



Positions of Ryugu and the Earth

Conjunction operation

Orbit and trajectory control during the operation

Orbit control

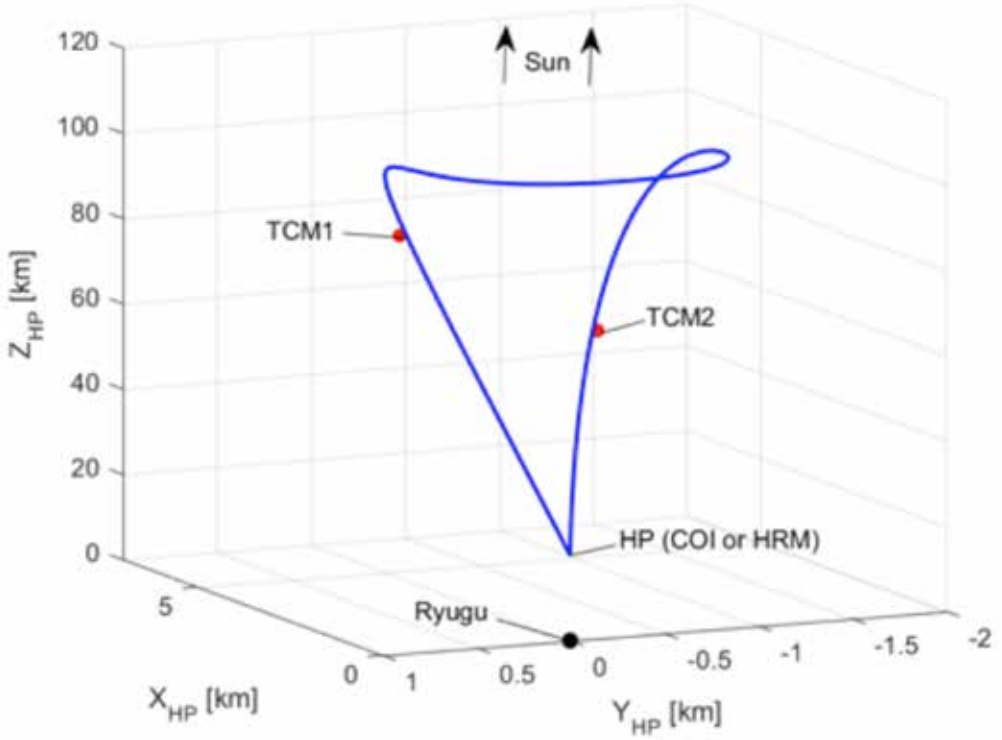
Name	Date
COI	2018/11/23
TCM1	2018/11/30
TCM2	2018/12/25
HPR	2018/12/29

COI : Conjunction Orbit Insertion

TCM : Trajectory Correction Maneuver

HPR : Home Position Recovery

Due to the influence from solar tidal forces, asteroid gravity and solar light pressure, the trajectory forms a complex shape.



Transition orbit during solar conjunction in the home position coordinate system