Operation status for the asteroid explorer, Hayabusa2

October 23, 2018

JAXA Hayabusa2 Project

Contents Today

Regarding Hayabusa2:

- Report on TD1-R1-A
- TD1-R3 operation plan

TD1-R1-A : Touchdown 1 rehearsal 1A (equivalent to the second rehearsal)
TD1-R3 : Touchdown 1 rehearsal 3 (equivalent to the third rehearsal)

Topics

0. Hayabusa2 overview & mission flow outline
1. Project status & overall schedule
2. TD1-R1-A operation report
3. TD1-R3 operation plan
4. Press conference at DPS
5. Future plans

TD1-R1-A : Touchdown 1 rehearsal 1A (equivalent to the second rehearsal)
TD1-R3 : Touchdown 1 rehearsal 3 (equivalent to the third rehearsal)
DPS : Division for Planetary Sciences of the American Astronomical Society
（one of the world's largest meetings for planetary science）

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

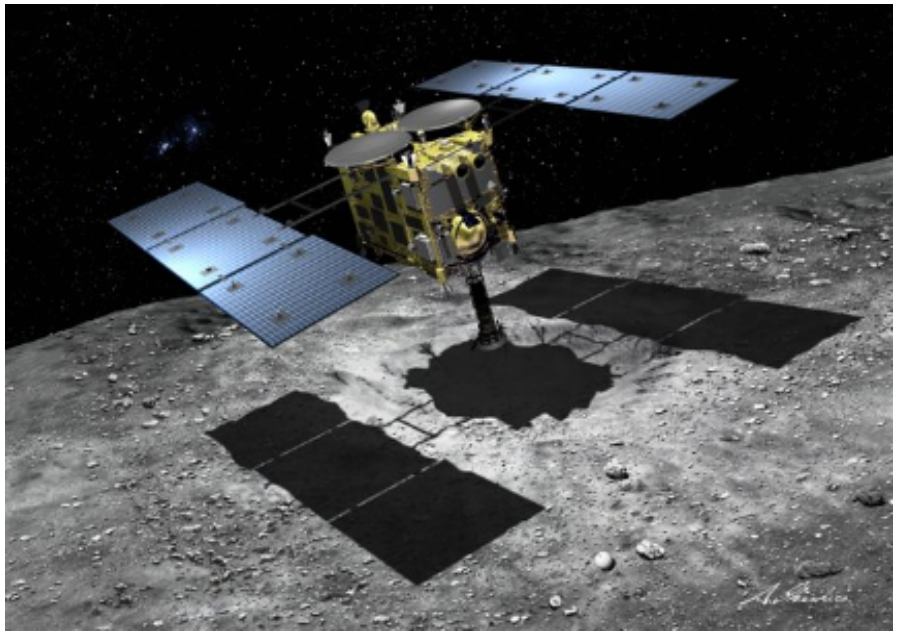
- By exploring a C-type asteroid, which is rich in water and organic materials, we will clarify interactions between the building blocks of Earth and the evolution of its oceans and life, thereby developing solar system science.
- Japan will further its worldwide lead in this field by taking on the new 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

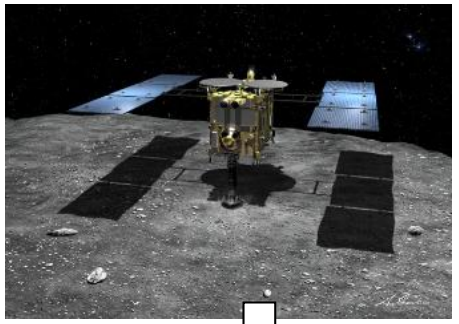
Sampling mechanism, re-entry capsule, optical cameras, laser range-finder, scientific observation equipment (near-infrared, thermal infrared), impactor, miniature rovers.

Mission Flow

Launch
3 Dec 2014

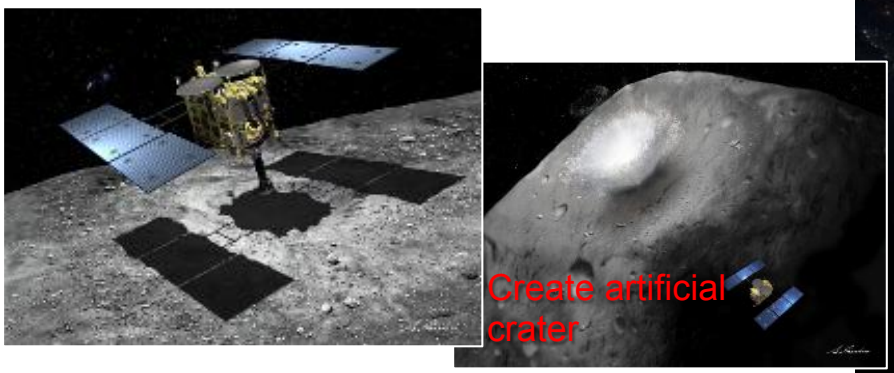
Earth swing-by
3 Dec 2015

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

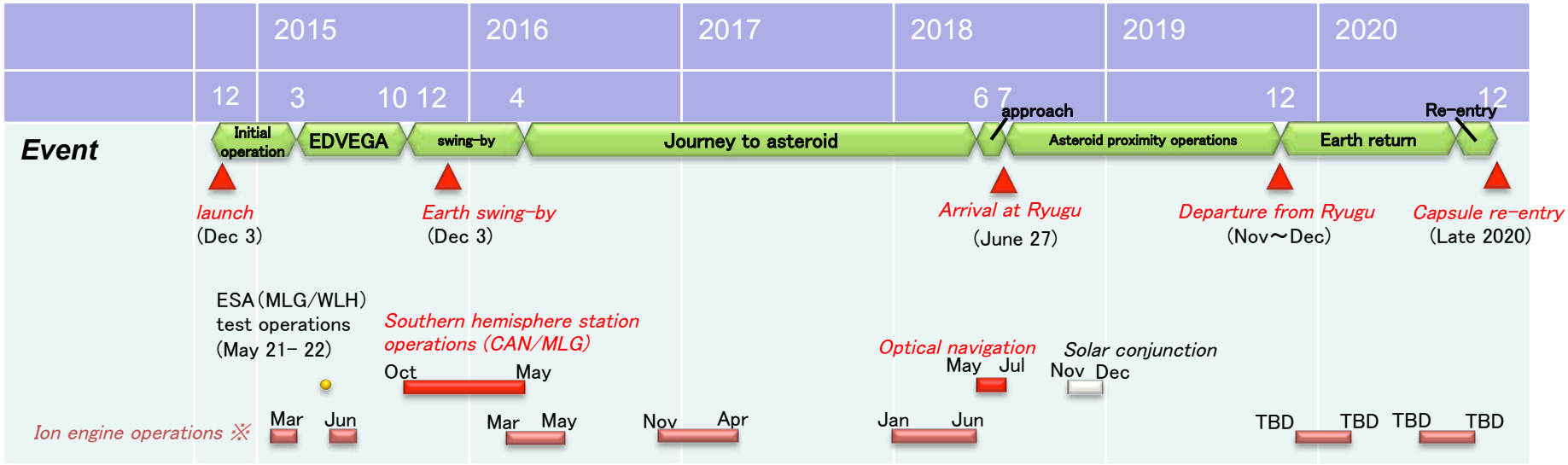
(Illustrations: Akihiro Ikeshita)

1. Current project status & schedule overview

Current status:

- Second rehearsal for touchdown, TD1-R1-A, was performed between October 14 – 16. The spacecraft descended to an altitude of 22.3m on October 15 and confirmed the functionality of the LRF.
- The third rehearsal for the first touchdown (TD1-R3) will be held from October 23 – 25 (already started).

Schedule overview:



2. TD1-R1-A operation report

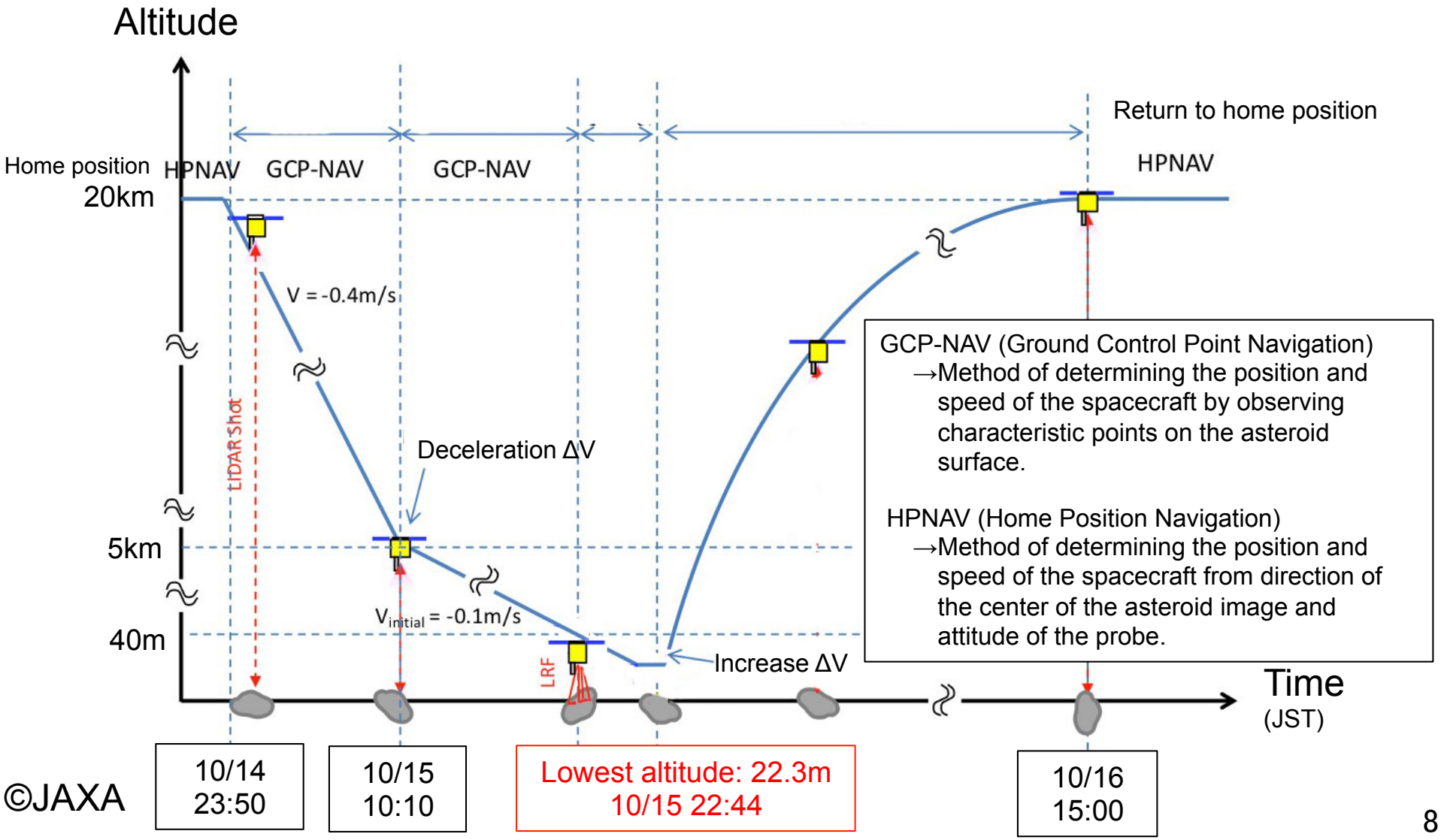
TD1-R1-A purpose

- Confirmation of navigation guidance accuracy at low altitude (altitude less than 40m).
- Confirmation of operation characteristics of LRF (Laser Range Finder) that measures altitude at short distances.

※This is the second rehearsal for the touchdown, but repeated operations that could not be competed during the first rehearsal (TD1-R1, September 10-12). We therefore refer to this as TD1-R1-A. (To avoid confusion, the name TD1-R2 will not be used as this is the name of a second rehearsal planned for the first time.)

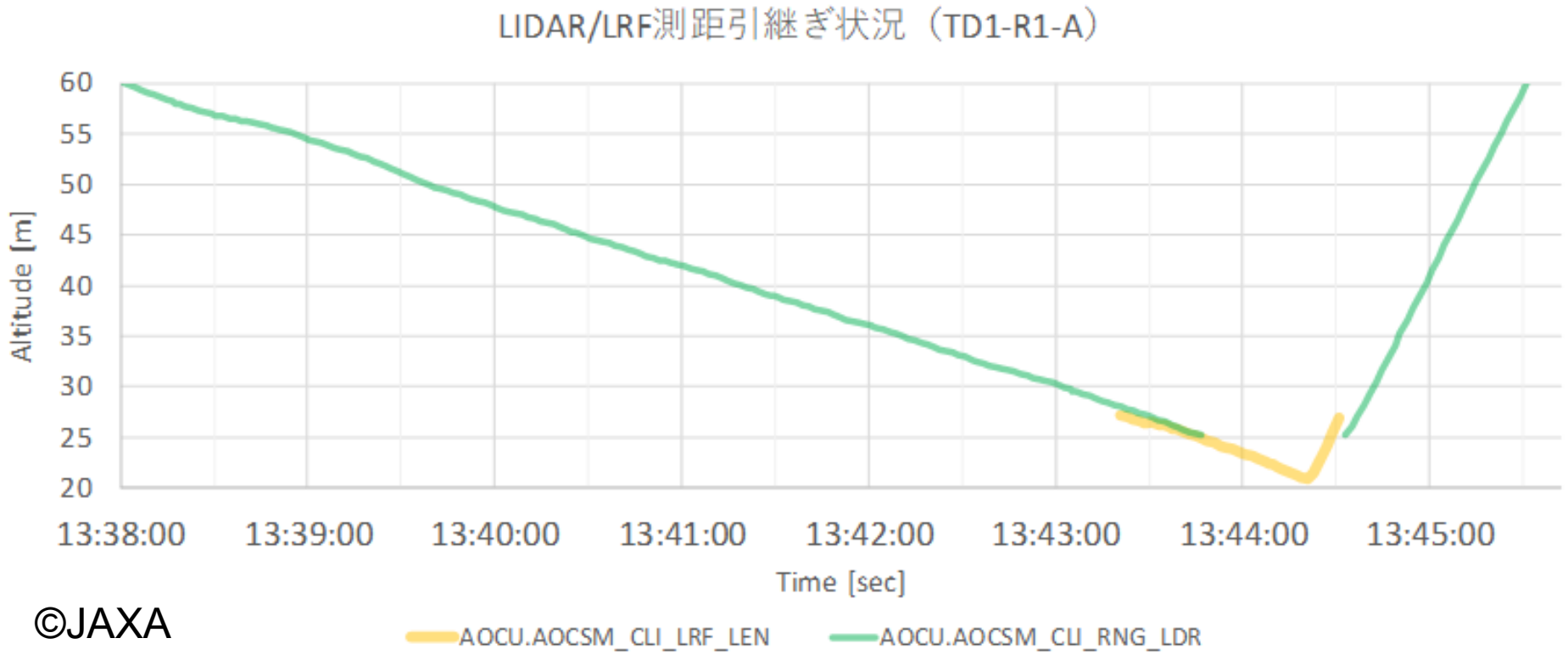
2. TD1-R1-A operation report

TD1-R1-A operation



2. TD1-R1-A operation report

Trajectory record from LIDAR to LRF



Altitude measurement value using LIDAR (green) and the LRF (yellow) almost coincide over the overlapping altitudes from 27m to 25m, indicating the altitude measurement was inherited correctly from LIDAR to LRF.

2. TD1-R1-A operation report

Level of accuracy in navigation guidance

In this operation in which the spacecraft descend to an altitude of 22.3m, the level of accuracy recorded was 10.8 on the asteroid surface.

2. TD1-R1-A operation report

New image

Image captured by the ONC-W1 near lowest point

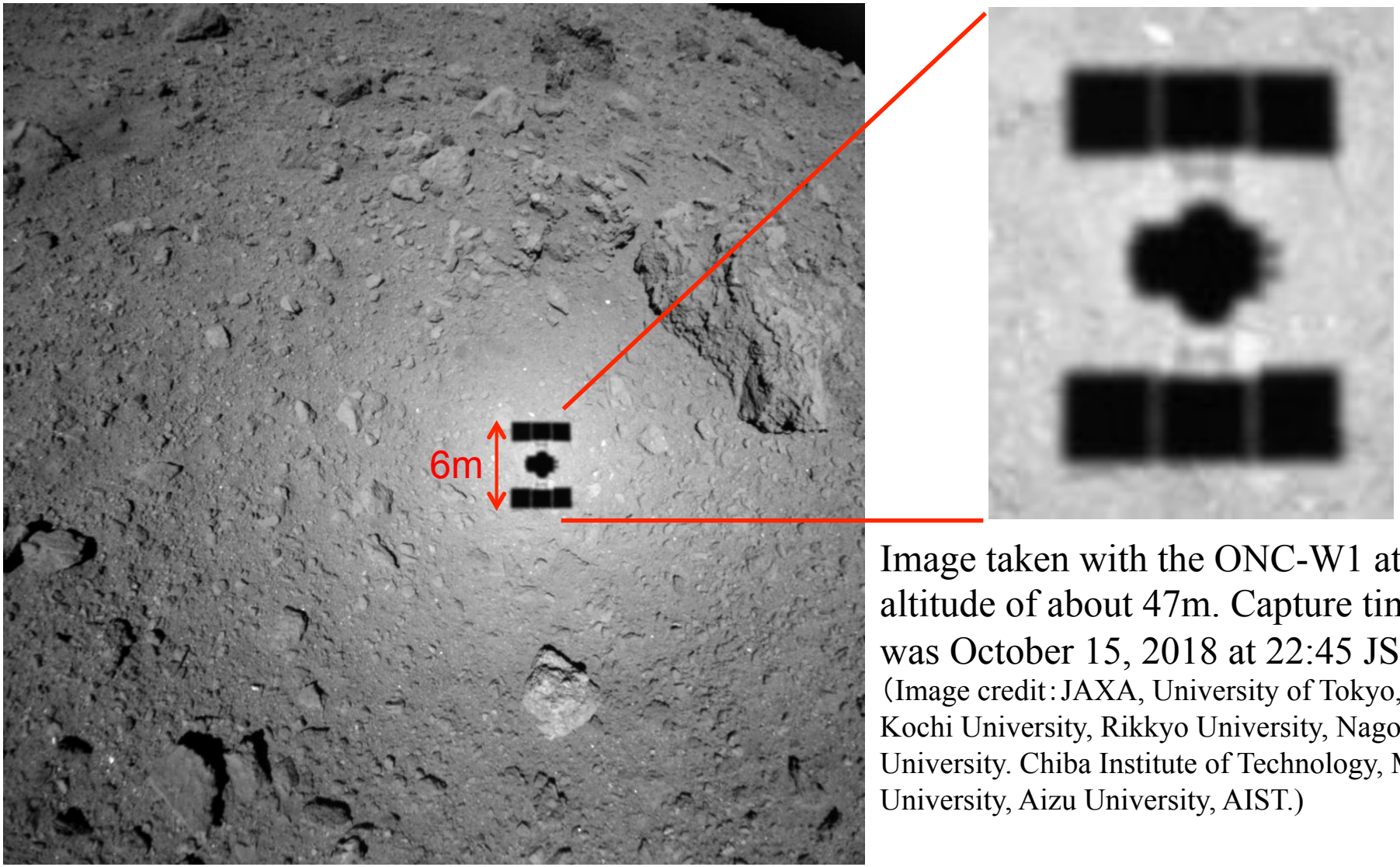


Image taken with the ONC-W1 at an altitude of about 47m. Capture time was October 15, 2018 at 22:45 JST.
(Image credit：JAXA, University of Tokyo, Kochi University, Rikkyo University, Nagoya University. Chiba Institute of Technology, Meiji University, Aizu University, AIST.)

2. TD1-R1-A operation report

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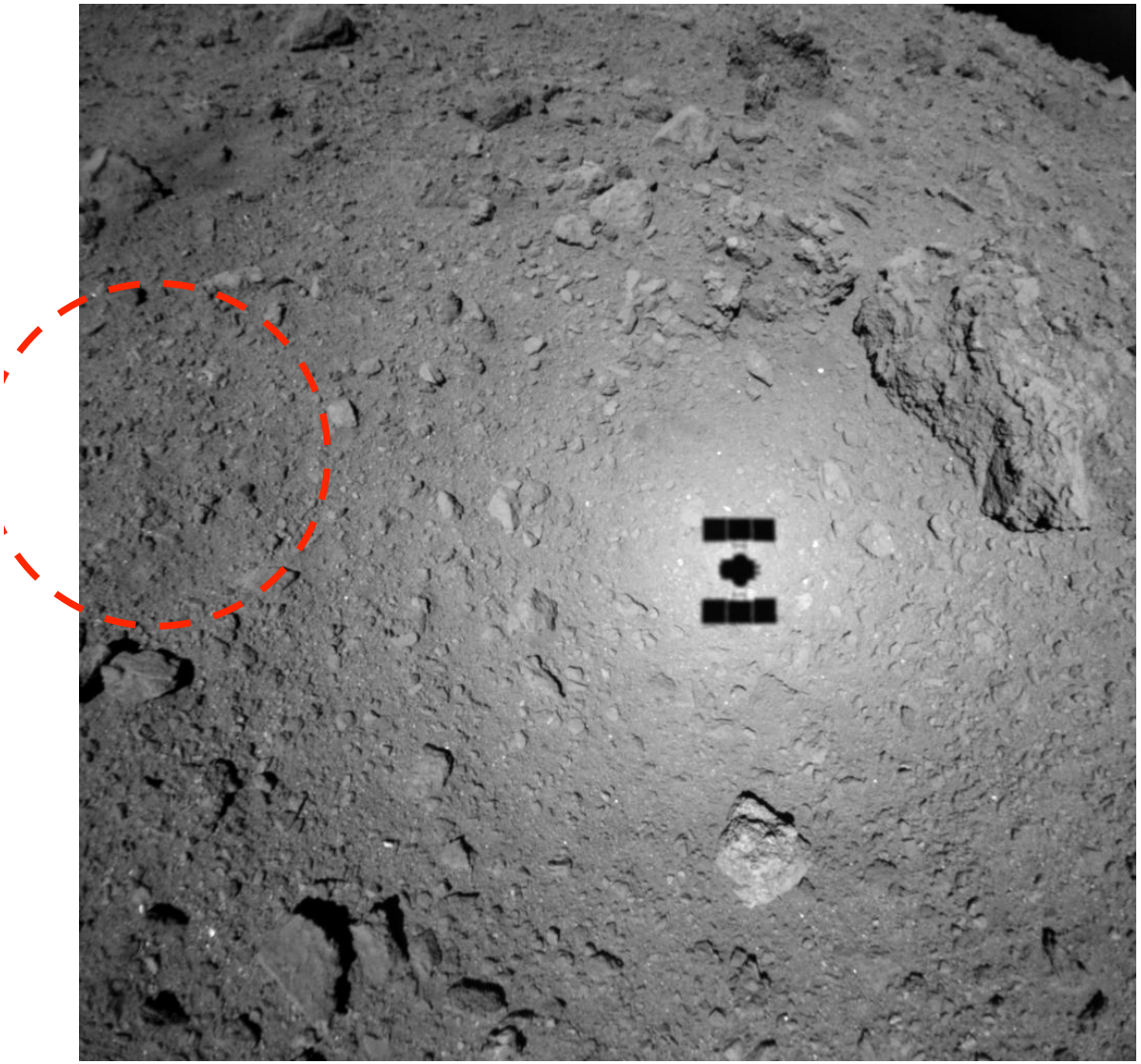


Red circle marks the candidate touchdown site, L08-B.

Image taken with the ONC-W1 at an altitude of about 47m. Capture time was October 15, 2018 at 22:45 JST.
(Image credit：JAXA, University of Tokyo, Kochi University, Rikkyo University, Nagoya University. Chiba Institute of Technology, Meiji University, Aizu University, AIST.)

3. TD1-R3 operation plan

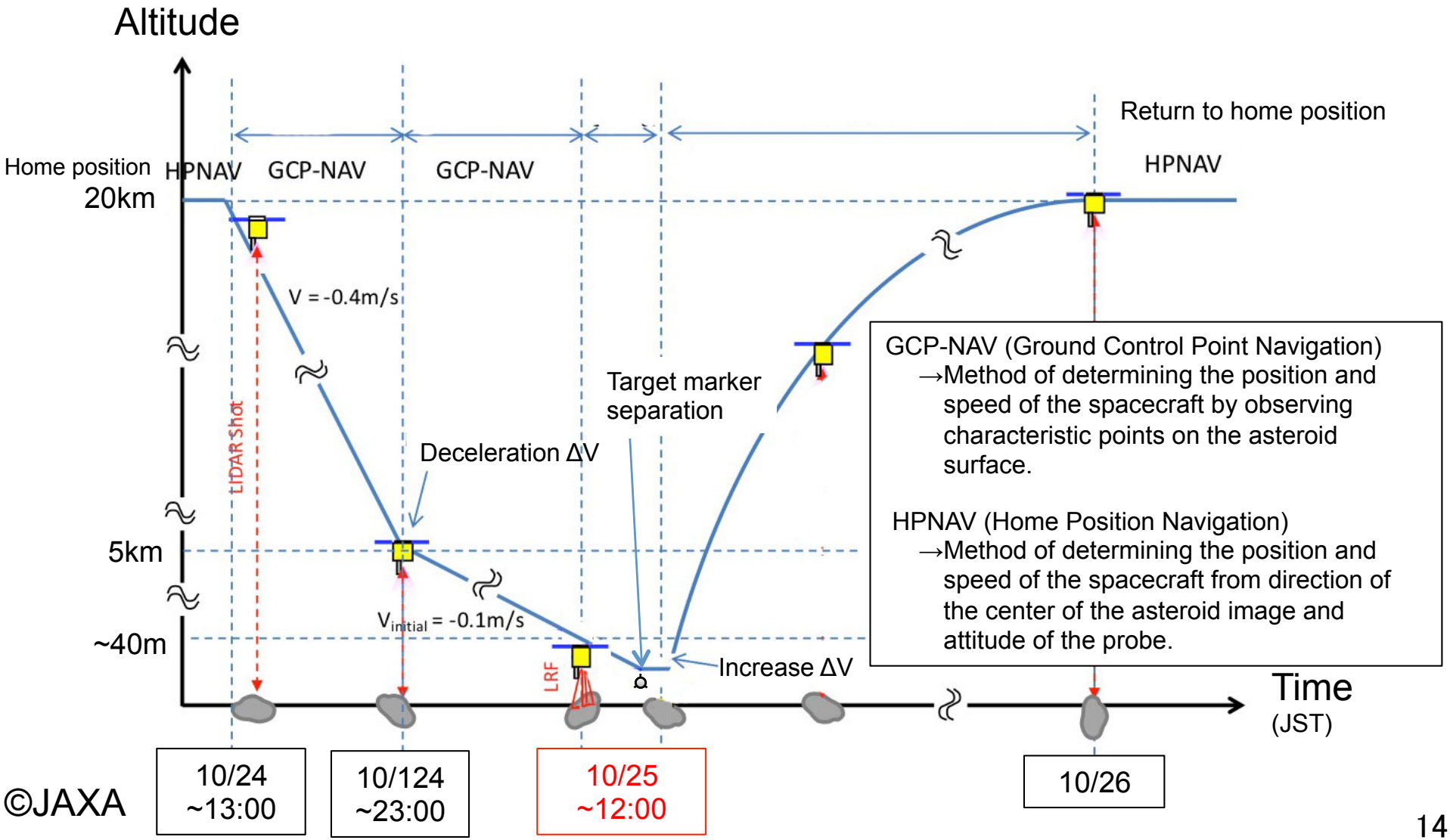
From October 23 - 25, the third rehearsal for touchdown will be performed.

■Aim

- Confirm the accuracy of the navigation guidance control at low altitude by the following steps.
- Use the measured LRF（Laser Range Finder） value to control the spacecraft.
- If conditions are satisfactory, release a target marker.
- Track released target marker.

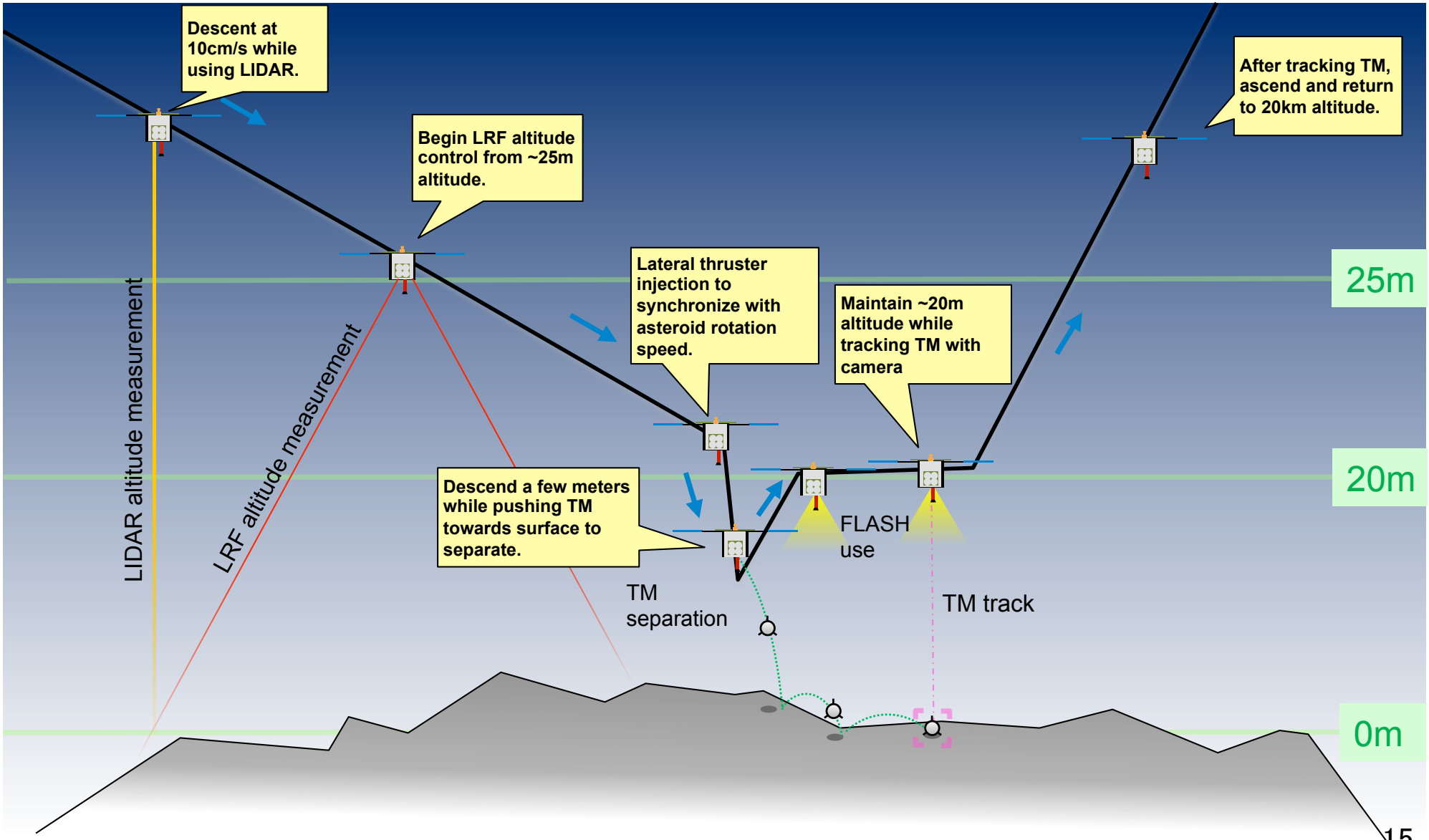
3. TD1-R3 operation plan

TD1-R3 schedule



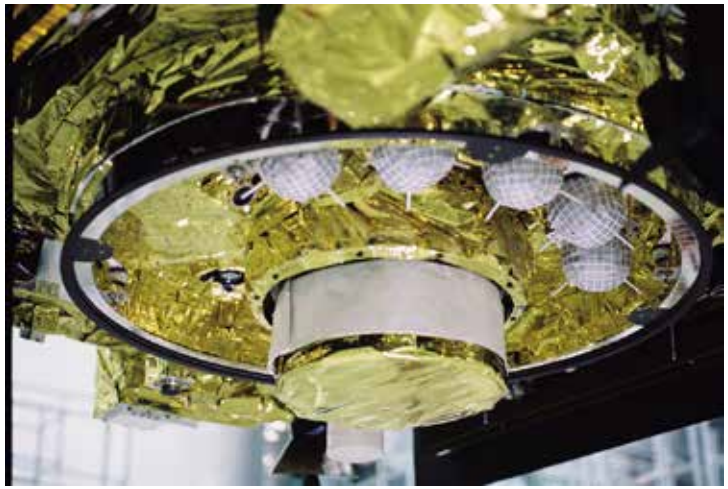
3. TD1-R3 operation plan

TD1-R3 low altitude sequence



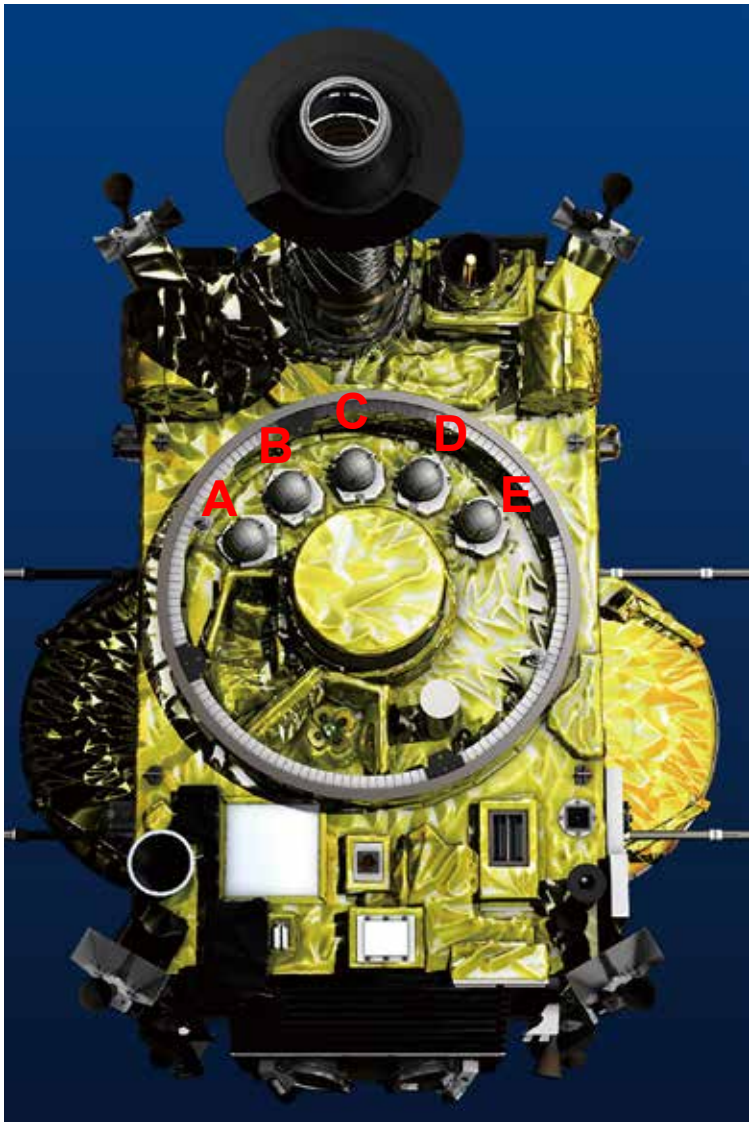
3. TD1-R3 operation plan

Target marker



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

- First to separate : B
- On the inside of the target marker is a sheet on which is written the names of members from the general public.



4. Press conference at DPS

DPS = Division for Planetary Sciences of the American Astronomical Society（one of the world's largest academic societies in planetary science, date/place: October 21 – 26, Knoxville, USA）

- Hayabusa2 press conference: October 25, 12:15～13:15（October 26, 01:15～02:15 JST）
- Information：https://aas.org/meetings/dps50/2nd-media-advisory
- Title：Hayabusa2 Explores Asteroid Ryugu
- Presenters（titles omitted）：Masaki Fujimoto（JAXA）、Hikaru Yabuta（Hiroshima U.）, Eri Tatsumi（U. Tokyo）、Deborah Domingue (Planetary Science Institute)、Lucille Le Corre (Planetary Science Institute)、Ralf Jaumann (German Aerospace Center)
- New information：also to be released in Japan

※Hayabusa2 special session in DPS
・Oct 25 (Poster presentation : 13), Oct 26 (Oral presentations : 9)

5. Future plans

■Scheduled operation

- October 23 – 25 : TD1-R3（3rd touchdown rehearsal）

■Press and media breifings

- November, 8 (Thurs)　11:00～　Press briefing @ Ochanomizu
- December 6 (Thurs)　Afternoon TBD～　Press conference @ Sagamihara