Foreign Press Center Japan（FPCJ）Press Briefings

Asteroid Explorer Hayabusa2 Returns to Earth in World First Accomplishment

November 27, 2020 @ online

（Image credit：A. Ikeshita）

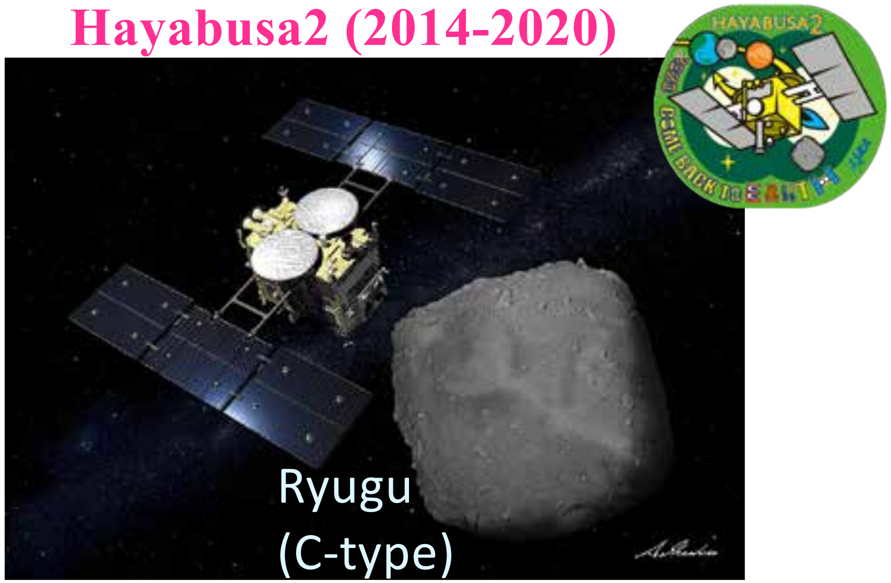
Makoto Yoshikawa (JAXA Hayabusa2 Project)

Hayabusa2 Mission

- The 2nd Asteroid sample return mission in the world (following Hayabusa)
- The target asteroid : Ryugu, C-type near earth asteroid
- Science objective : Origin and evolution of the solar system and the life, the organic matter at the beginning of the solar system
- Engineering objective : Technology to reliably perform round-trip mission

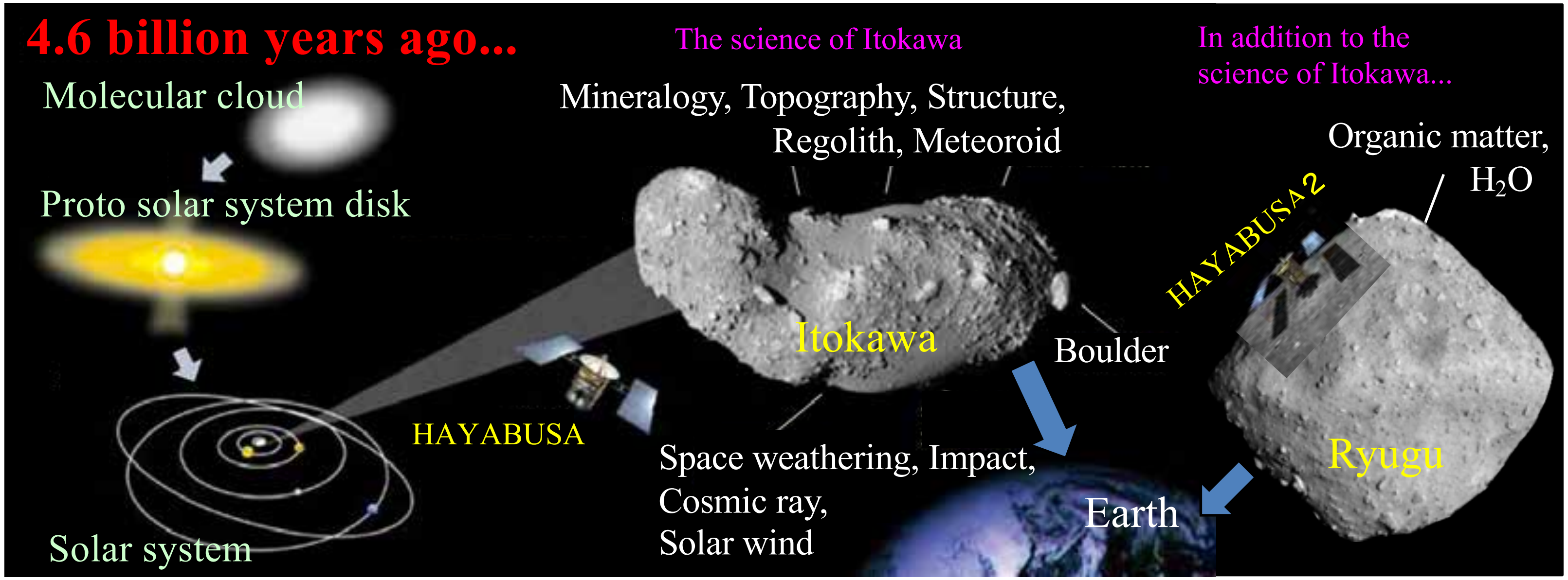
Hayabusa (2003-2010)

Hayabusa2 (2014-2020)



(Image credit: A. Ikeshita)

Science of asteroid sample return mission

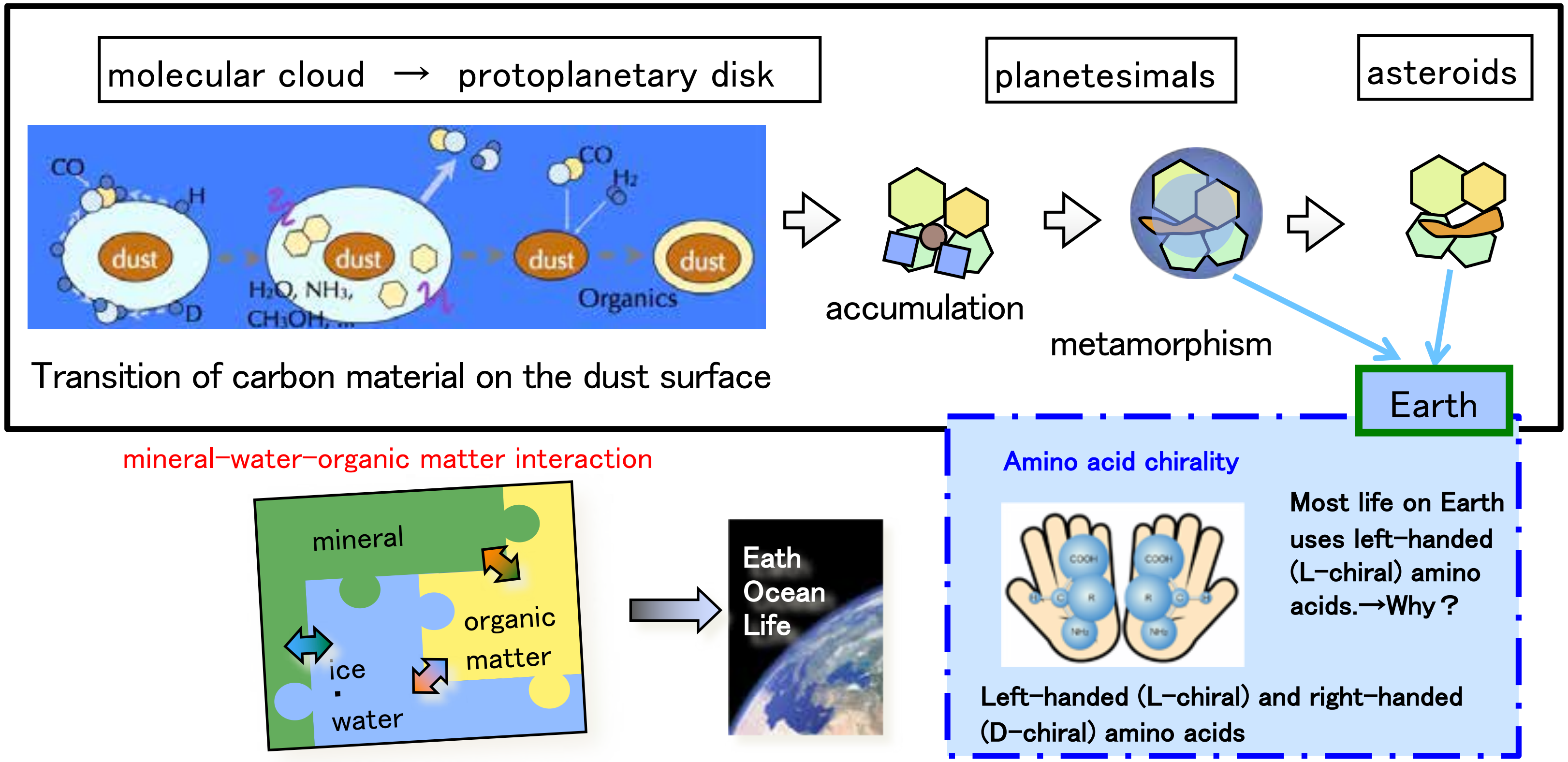


（Image credit：JAXA）

- The material that existed when the solar system celestial bodies were born 4.6 billion years ago remains on the asteroid.
- The material that made the planets and the original materials for life can be studied.
- The origin and evolution of the solar system and life can be studied.

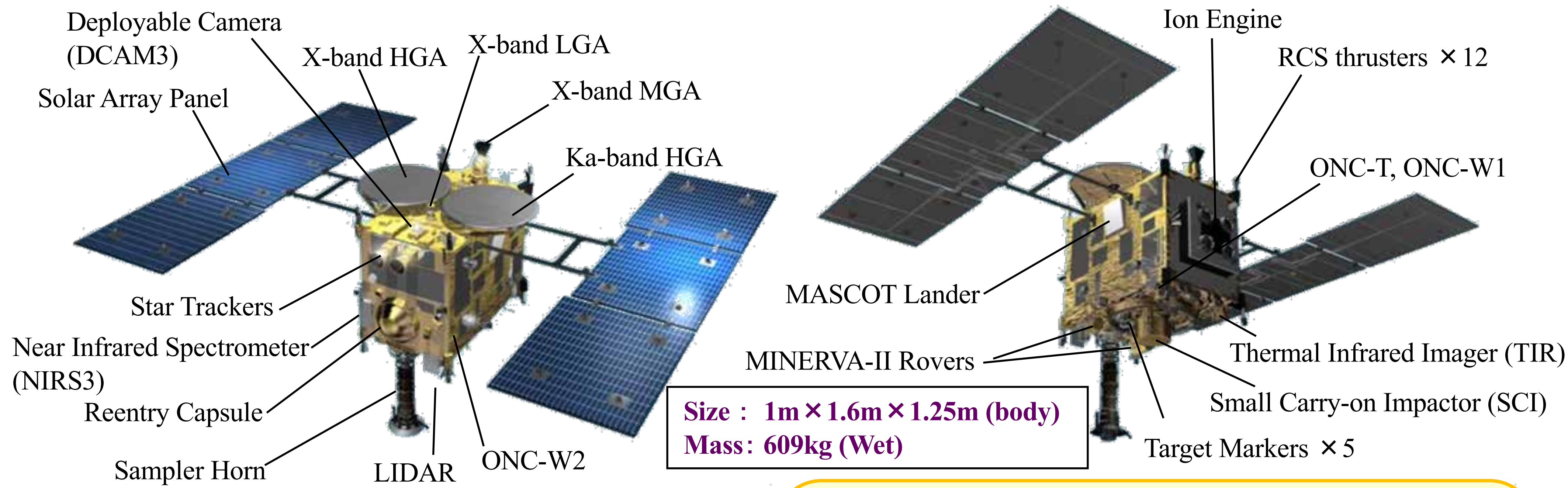
Research on organic matter by "Hayabusa2"

(1) Volatile substances such as water and organic matter were generated on the dust surface in the molecular cloud.
(2) They changed by water and heat in the protoplanetary disk or on the planetesimals.
(3) Finally, they accumulated on the earth and became a material for life on earth.



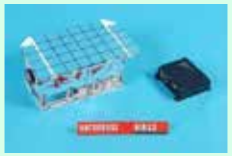
(Image credit：JAXA)

Hayabusa2 Spacecraft




ONC


LIDAR


NIRS3


TIR

Science Instruments

MASCOT


by DLR and CNES

MINERVA-II-1

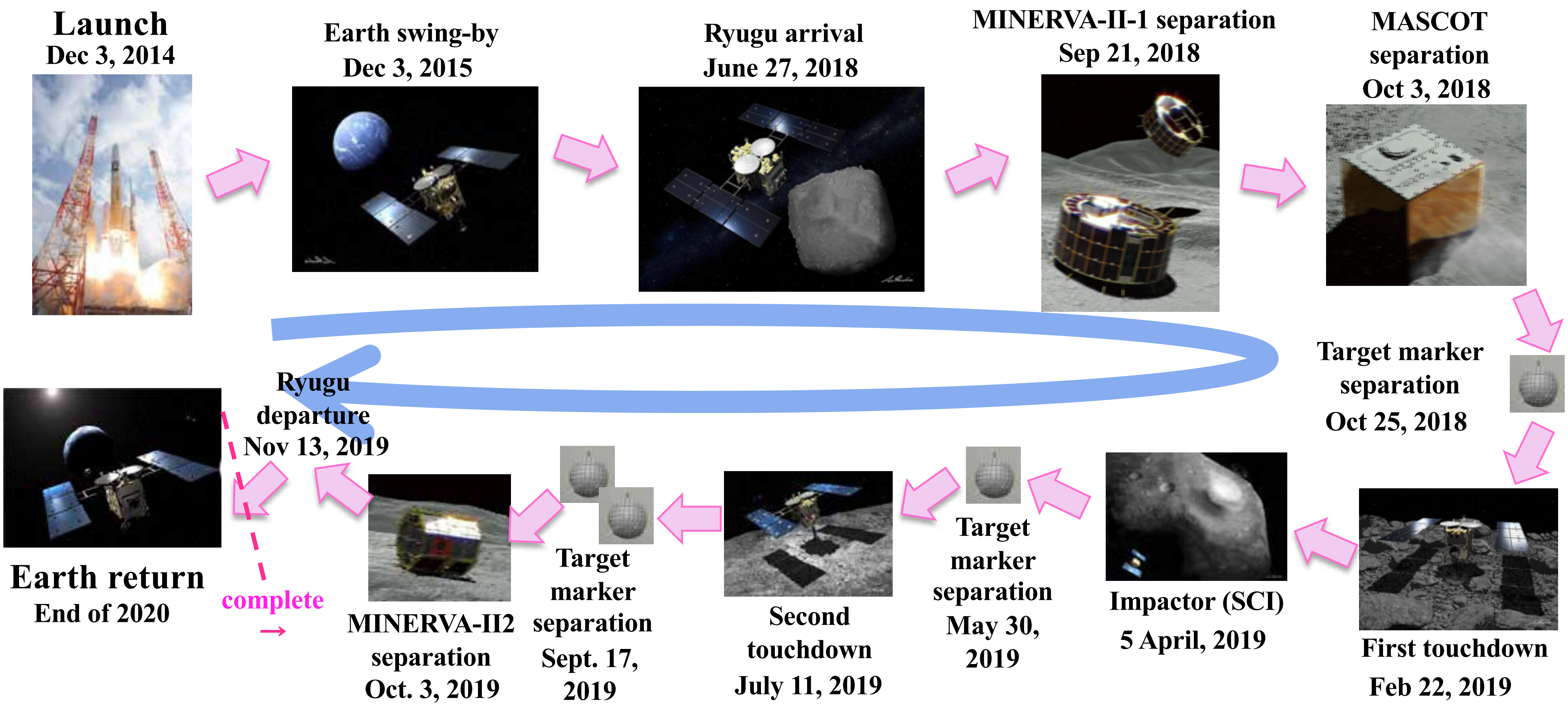
MINERVA-II-2

II-1 : by JAXA MINERVA-II Team
II-2 : by Tohoku Univ. & MINERVA-II consortium

Small Lander and Rovers

(Image credit : JAXA)

Hayabusa2 : Mission scenario

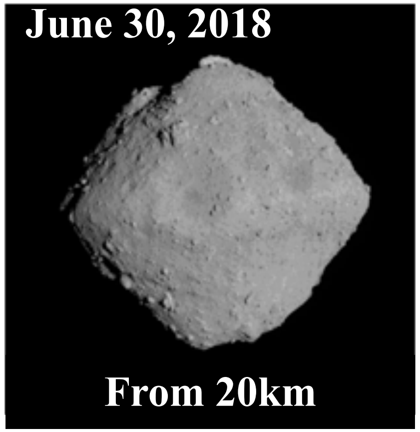


(Image credit: illustrations including spacecraft by Akihiro Ikeshita, others by JAXA)

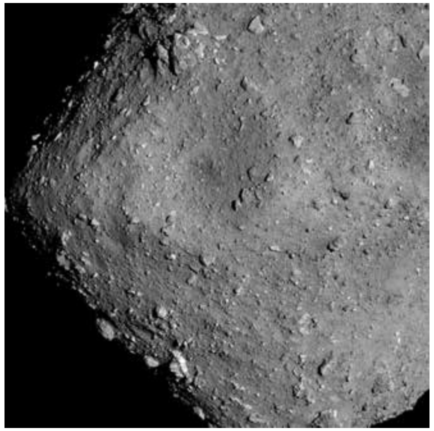
Seven world's first technologies achieved by "Hayabusa2"

1. Mobile activity of rovers on small body
2. Multiple rovers deployment on small body
3. 60cm-accuracy landing and sampling
4. Artificial crater forming and observation of impact process
5. Multiple landing on extraterrestrial planet
6. Subsurface material sampling
7. Smallest-object constellation around extraterrestrial planet

Asteroid Ryugu

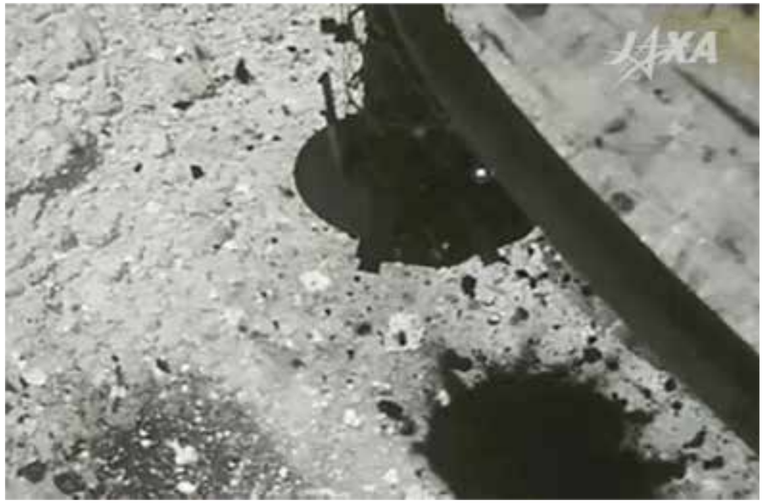

June 30, 2018
From 20km

October 15, 2018
From 42m

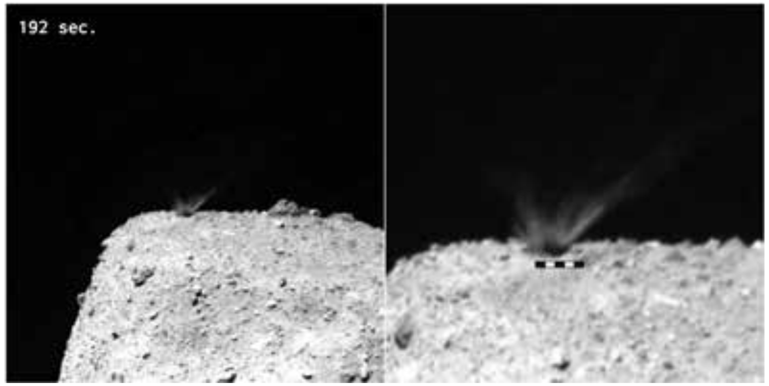

From 6km
July 20, 2018
(Image credit：JAXA and etc.)


surface view
September 23, 2018

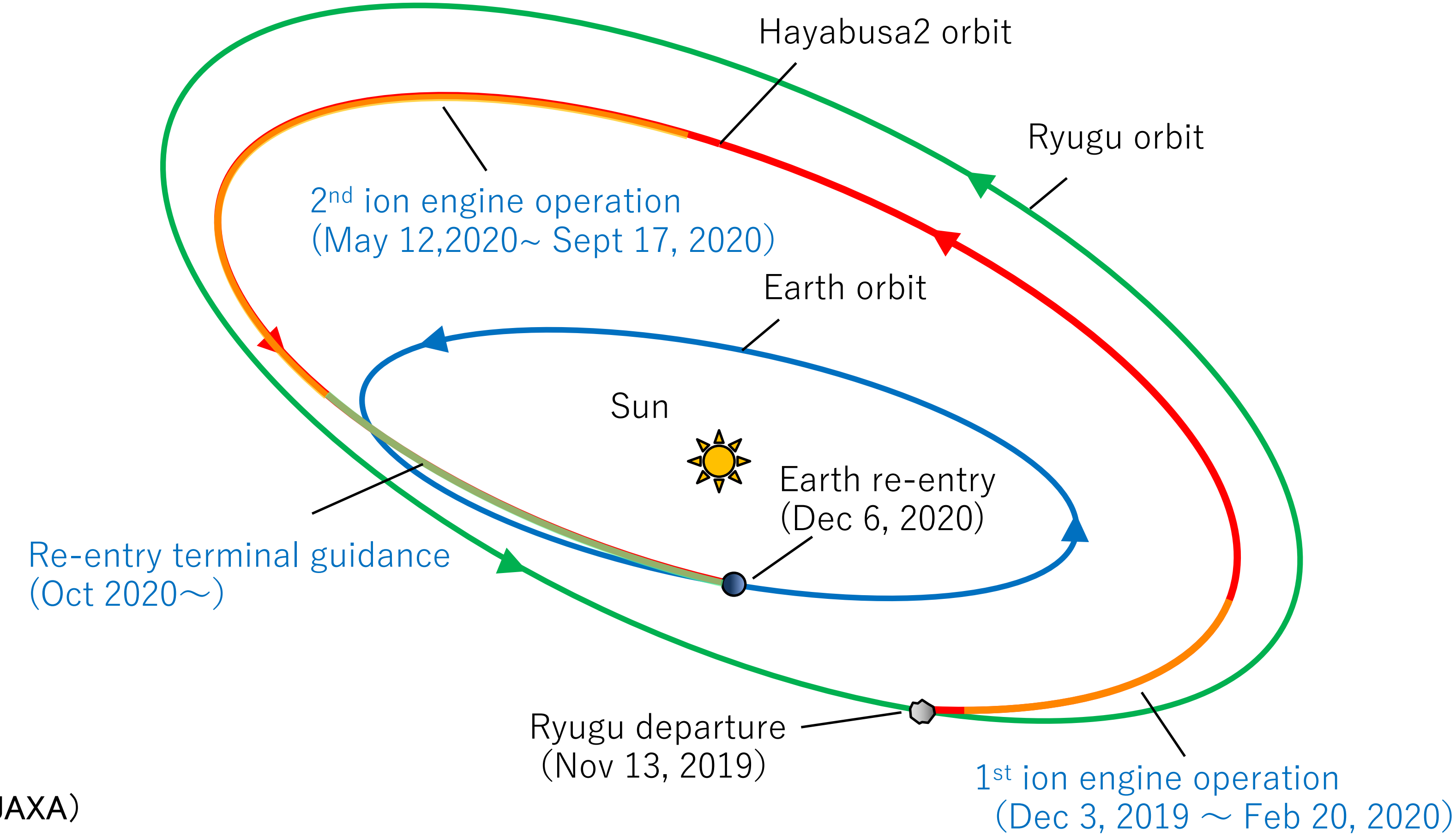
1st touchdown February 22, 2019



Impact experiment April 5, 2019



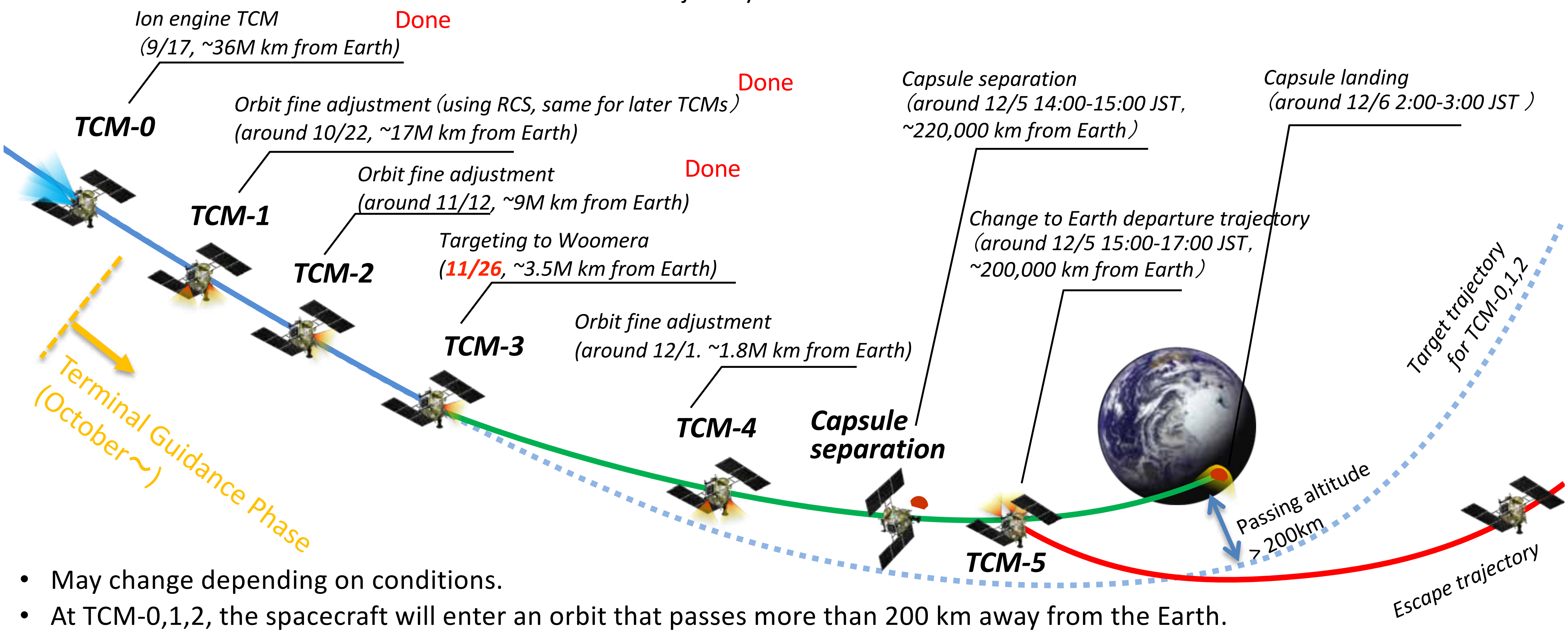
Hayabusa2 Return Phase Trajectory



(Image credit：JAXA)

Operation plan for re-entry terminal guidance

※TCM: Trajectory Correction Maneuver



- May change depending on conditions.
- At TCM-0,1,2, the spacecraft will enter an orbit that passes more than 200 km away from the Earth.
- After capsule separation, the spacecraft will divert from the reentry trajectory by TCM-5.

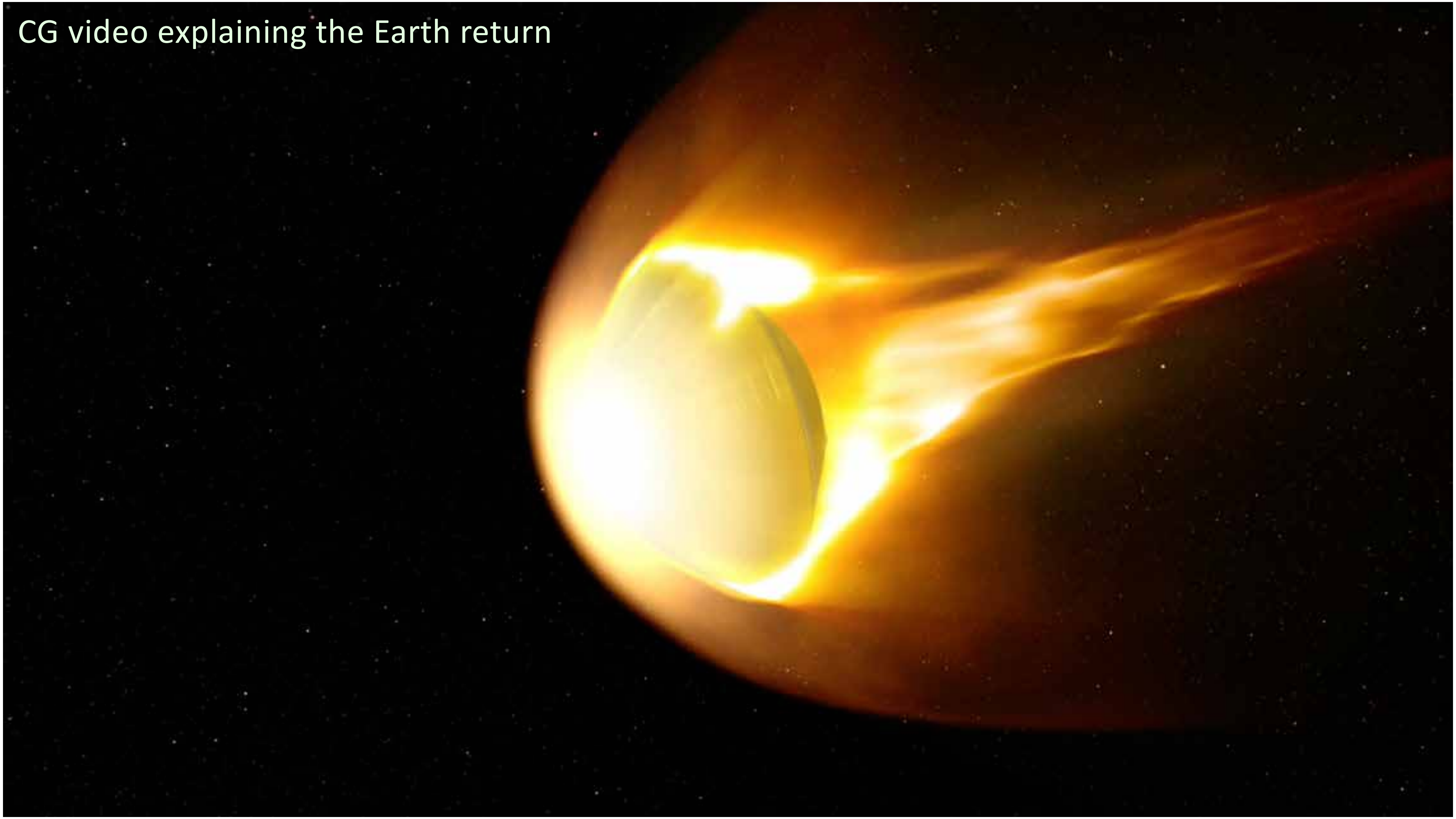
(Image credit：JAXA)

Hayabusa2 capsule return

- The capsule of Hayabusa2 will come back to the Earth on Dec. 6, 2020 (JST).
- The re-entry capsule of Hayabusa2 will land in the Woomera Prohibited Area (WPA) in the same way as the capsule of the first Hayabusa (in 2010).
- We are coordinating and preparing for the capsule collection work with the Australian space agency and related organizations.

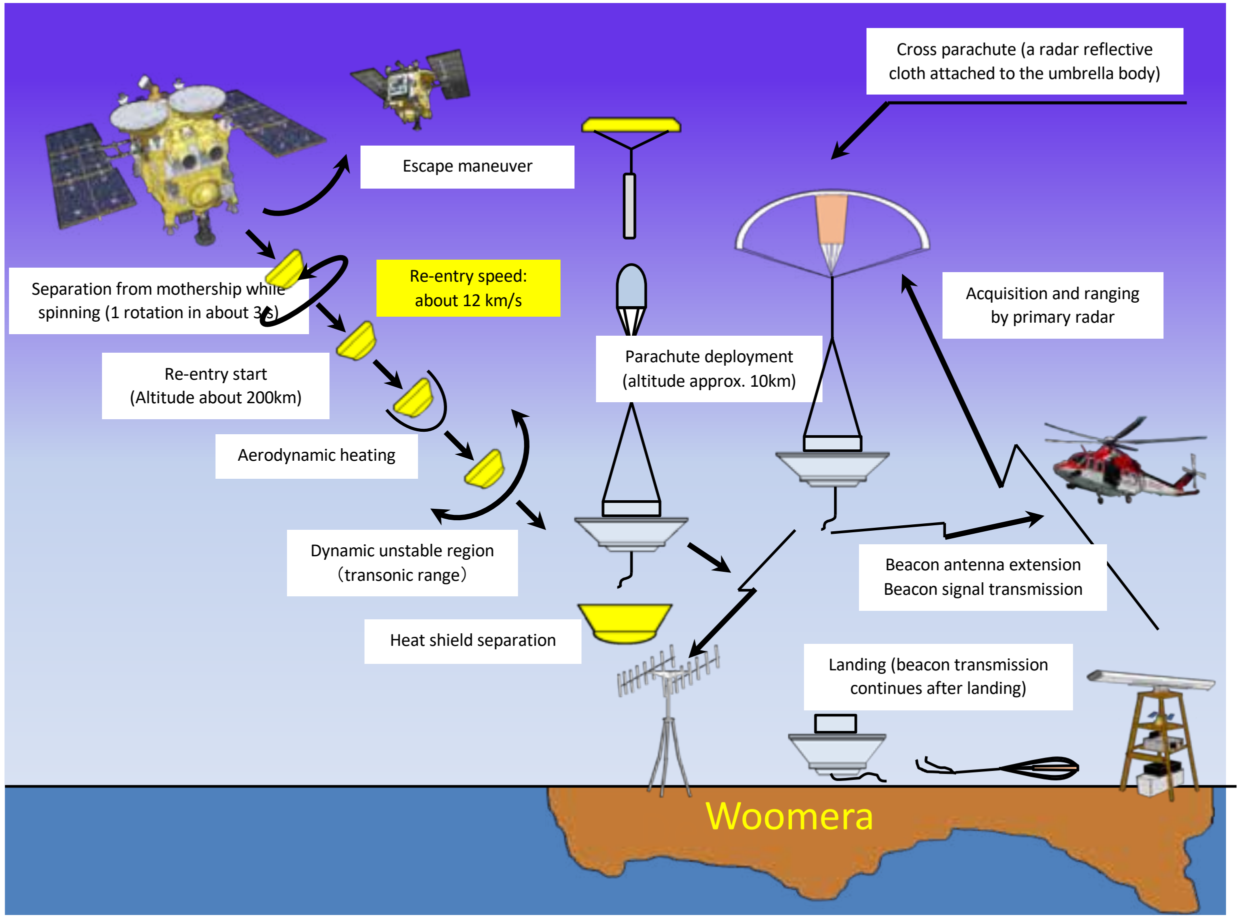
Image of the recovery candidate site (photographed in December 2018)

(Image credit: JAXA)


CG video explaining the Earth return

Re-entry capsule collection plan

Re-entry overview



- ■ Re-entry flight sequence
  - Atmosphere re-entry (capsule only for Hayabusa2 re-entry)

    ↓
  - Heat shied separation

    ↓
  - Parachute opening

    ↓
  - Beacon transmission

    ↓
  - Landing

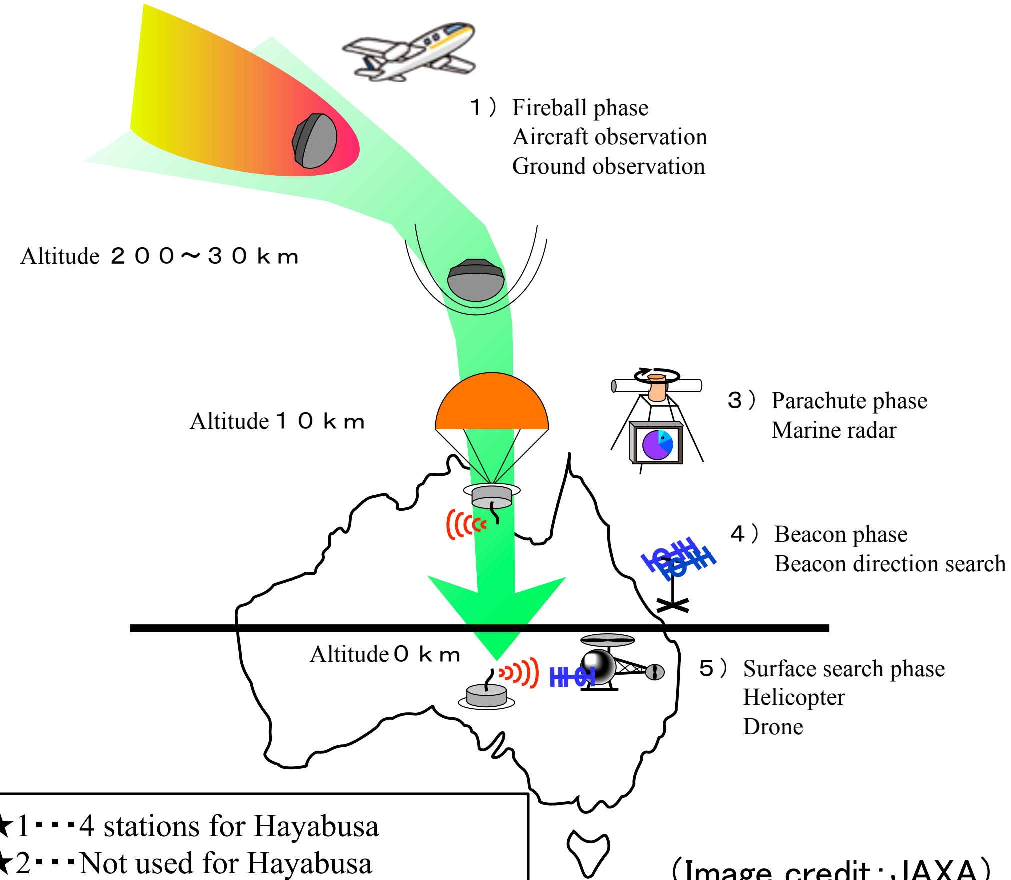
■ Landing location: Woomera, Australia

(Image credit: JAXA)

Re-entry capsule collection plan

- Search (fireball phase)
  - Optical observation (ground)
  Measuring light trails from several stations (principal of triangulation)
  - Optical observation (aircraft)
  Measuring light trails from above clouds (unaffected by weather)
- Search (parachute phase)
  - Direction search (beacon)
  Beacon received at a total of 5 stations★1 (Principal of triangulation)
  - Direction search (marine radar) ★2
  Direction and distance can be measured.
- Search (surface exploration phase)
  - Direction search (helicopter)
  Search for beacon after landing with a helicopter
  - Drone★2
  Aerial view from the sky. Identification via image analysis.
- Transport
  - Safety process、disassembly
  - Collection of gas in capsule★2 , transportation (to Japan)

Collection operation overview



★1･･･4 stations for Hayabusa
★2･･･Not used for Hayabusa

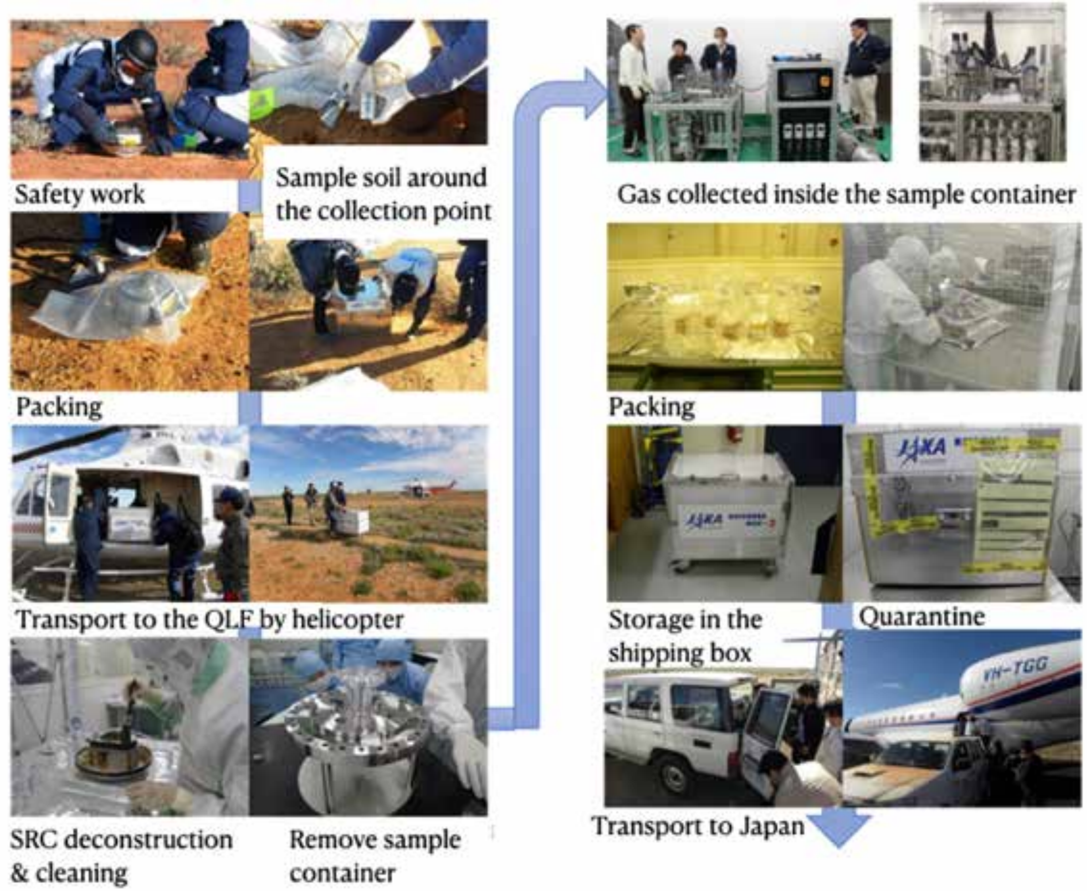
(Image credit: JAXA)

Work plan after capsule collection

～From capsule collection to airlifting to Japan～

Work flow after discovery (nominal case)

1. Of the capsule-related equipment found, the highest priority will be to collect the instrument module (I/M), which is the main body.
2. After the I/M safety processing at the collection site, transport will progress to the Quick Look Facility (QLF) by helicopter.
3. At the QLF, the I/M will be disassembled and the sealed sample container holding the Ryugu sample will be removed.
4. The gas sampling device will be connected to perform a simple analysis by extracting the gas that is thought to have been released from the Ryugu sample into the sample container. (This is newly developed for Hayabusa2)
5. Storage in a dedicated sealed transport box and airlifted to Japan.



Work flow after discovering the capsule (partly from the photos from Hayabusa)

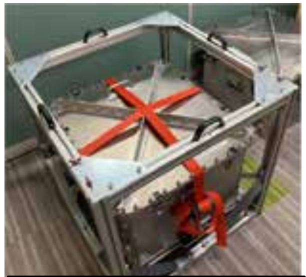
（Image credit：JAXA）

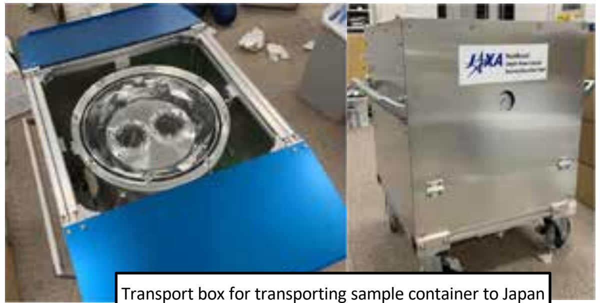
Work plan after capsule collection

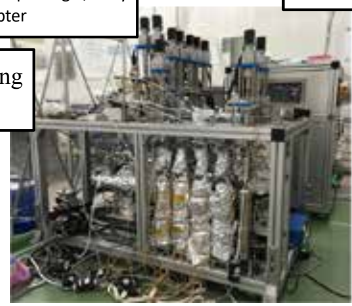
～Until sample reaches the curation chamber～

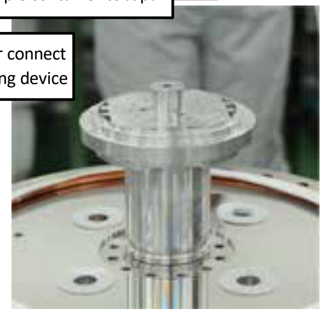
Work flow after discovery cont. (nominal case)

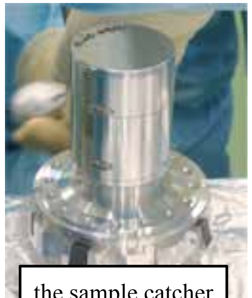
6. Operate from Haneda Airport to ISAS by land, bring into the clean room of the curation facility.
7. Perform some disassembly work, such as removal of the ablator.
8. Attach the “sample container opening mechanism”, perform disassembly work to connect to the clean chamber while maintaining the seal.
9. Connect to Room 3-1 (CC3-1) of the clean chamber and create a vacuum environment.
10. Take out the sample catcher from the sample container in a vacuum environment and remove the lid.
11. Pick up part of the Ryugu sample and store this in a vacuum environment. ※ Refer to curtain work for details after CC3-1.


Shipping box for transporting 1/M by helicopter


Transport box for transporting sample container to Japan


The gas sampling device

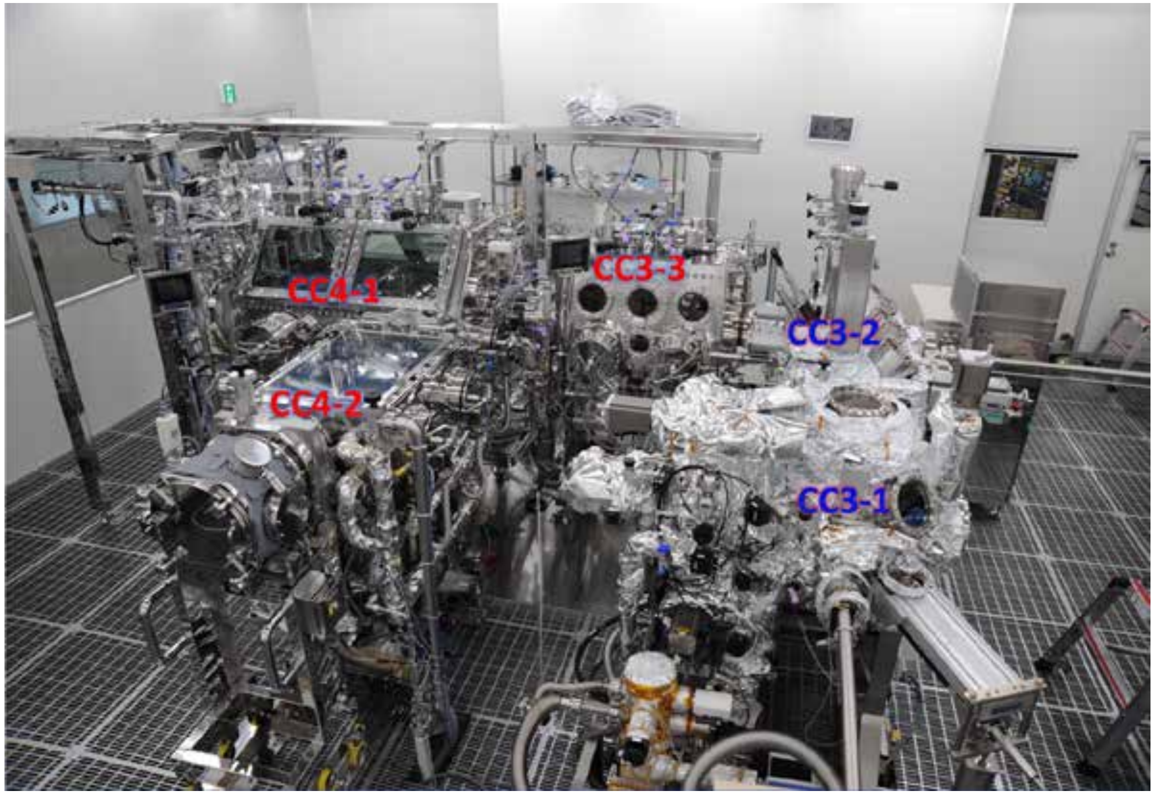

Sample container connect to the gas sampling device


the sample catcher


Connection to container opening mechanism and CC3-1 (rehearsal)

(Image credit：JAXA)

Clean chamber configuration



(Image credit：JAXA)

CC3-1 : Opening of the sample container (vacuum environment)

CC3-2 : Opening of the sample catcher and removal of part of the sample (vacuum environment)

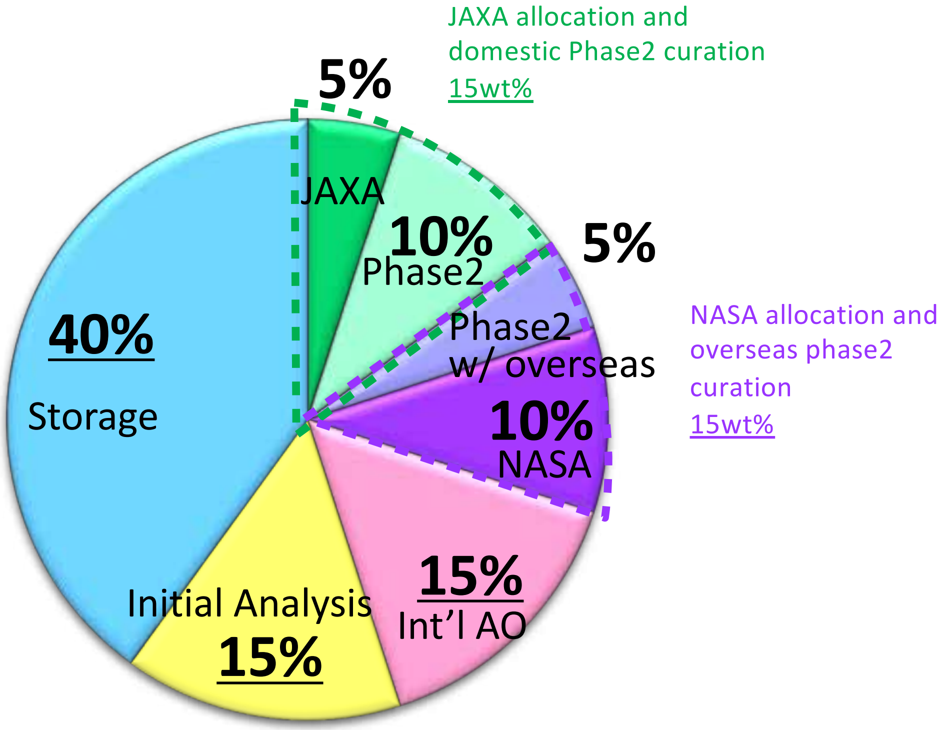
CC3-3 : Replacement of vacuum environment with nitrogen environment.

CC4-1 : Deconstruction of the sample catcher and bulk sample recovery (nitrogen environment)

CC4-2 : Individual sample collection and initial description (nitrogen environment)

(blue : vacuum environment Red : nitrogen environment)

Sample distribution policy

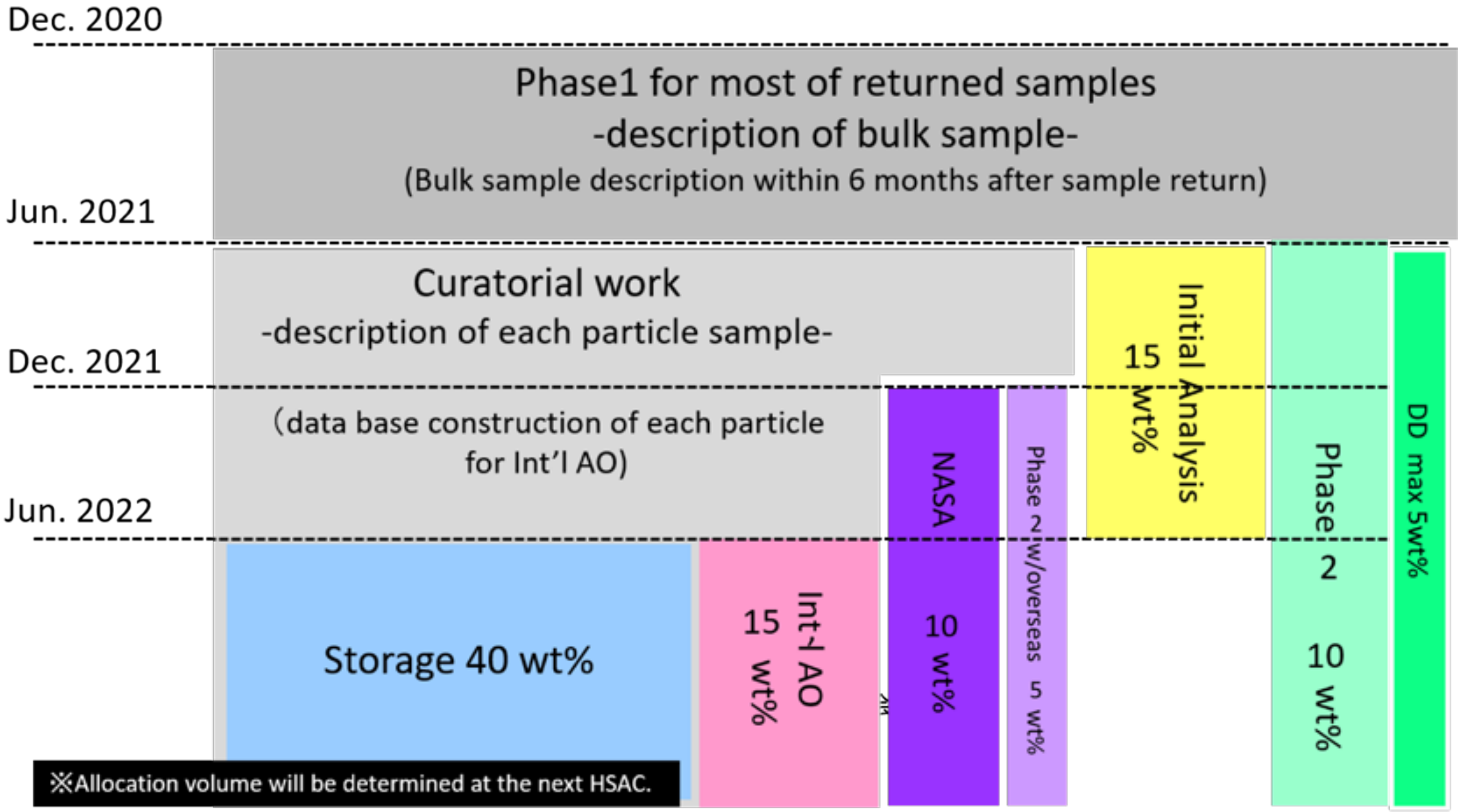


(Image credit：JAXA)

- Sample for detailed description by JAXA is 5wt%
- Allocation to domestic Phase2 curation is 10wt%
- Allocation to overseas Phase2 curation is 5wt%
- Allocation to NASA 10wt%
- Allocation for the 1st international analysis open call is 15wt%
- Allocation to the initial analysis team is15wt%
- The remaining 40wt% will be stored as a sample for future work and be used as a sample for the second and subsequent open call for participant analysis.

※ The sample distribution ratio will be finally decided by the Hayabusa2 Sample Allocation Committee (HSAC)

Sample distribution schedule (planned)



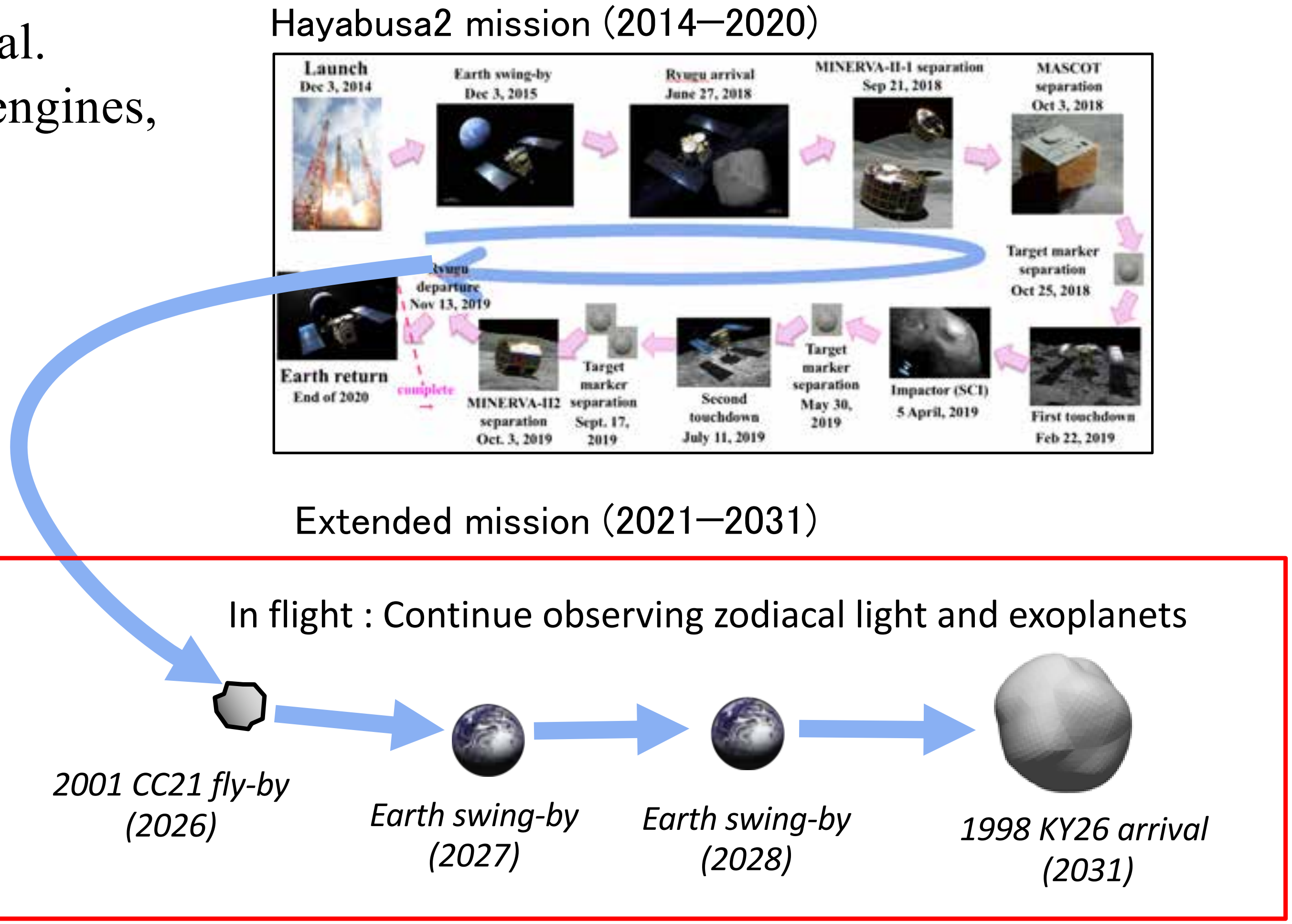
(Image credit : JAXA)

Extended mission

- The spacecraft is still operational.
- 50% of xenon, the fuel for ion engines, remains.

We want to do further exploration

- The technical challenge of long-term space navigation
- A type of celestial body that has never been explored (30 m in size, 10 minutes in rotation period)
- Science and technology related to planetary defense

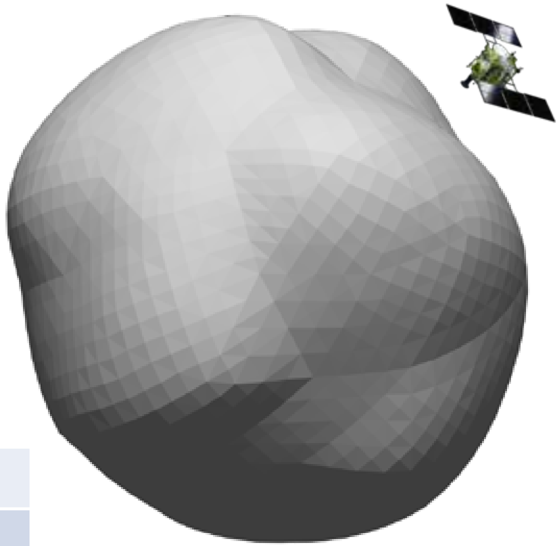


(Image credit：JAXA)

Extended mission destination：1998 KY26

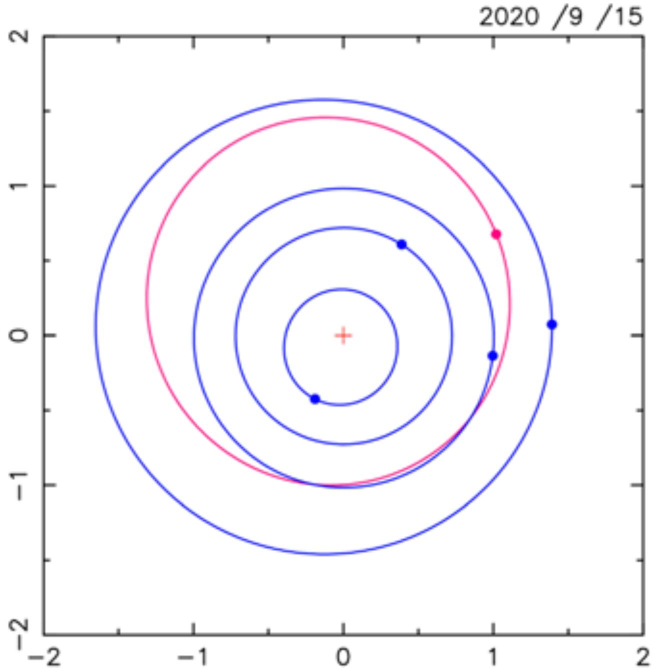
- Discovered by the US Spacewatch Project on May 28, 1999 (the closest distance to Earth at the time was about 800,000 km)
- Radar observations made in June, 1998（by S. Ostro）.

Shape	Spherical (from radar observation)
Av. diameter	About 30 m
Spin period	10.7 min (0.178 hr)
Tumbling motion	No short-term variability detected
Spectral type	Possible carbonaceous asteroid
Semimajor axis	1.23 au
Orbital period	1.37yr（500 day）



Shape model:

Image credit: Auburn University, JAXA
1998 KY26 original data for the shape model：
Ostro et al. (1999), Radar and optical observations of asteroid 1998 KY26, Science, 285, 5,427, 557–559.



Red is the orbit of 1998 KY26, blue is the orbit of planets (Mercury, Venus, Earth and Mars from inside to out). The position of the celestial bodies are of September 15, 2020. (Image credit: JAXA)