JAXA's Activities for Planetary Defense

Updates since the 25th SMPAG

Feb. 4, 2026@Vienna

JAXA Planetary Defense Team

JAXA's activities for planetary defense

※Planetary defense team has been established in April 2024.

Observations

- Bisei Spaceguard Center
- Stacking method
- Radar observation ★

Space Missions

- Hayabusa, Hayabusa2(#) ★
- DESTINY+, NGSR ★
- ESA's Hera, RAMSES

Orbit analysis

- Orbit propagation
- Orbit estimation
- Collision analysis

International activities

- SMPAG
- IAWN
- PDC
- IYAPD

Domestic activities

- Symposiums/meetings
- Sessions related PD

Outreach

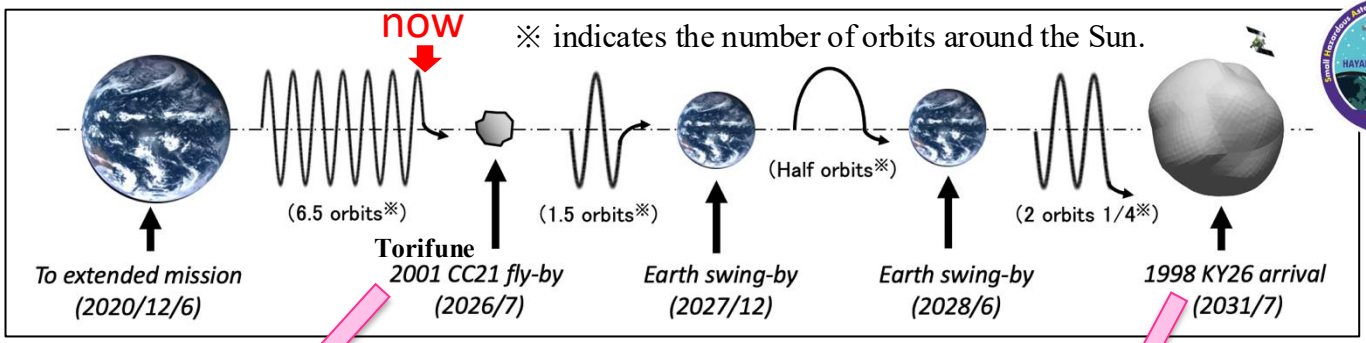
- Asteroid Day
- APAON
- Public events ★

★ Today's talk

Hayabusa2 Extended mission : Hayabusa2#

 # (SHARP) : Small Hazardous Asteroid Reconnaissance Probe

After Hayabusa2 returned the sample of Ryugu in Dec. 2020, we extended the mission for two more targets, (98943) Torifune (2001 CC21) and 1998 KY26.
The spacecraft is operated without major issues.



(©JAXA)

Relative velocity : 5km/s

Distance: < 10km, 1km?

High accuracy navigation is necessary.

Artist's illustration (by A. Ikeshita)

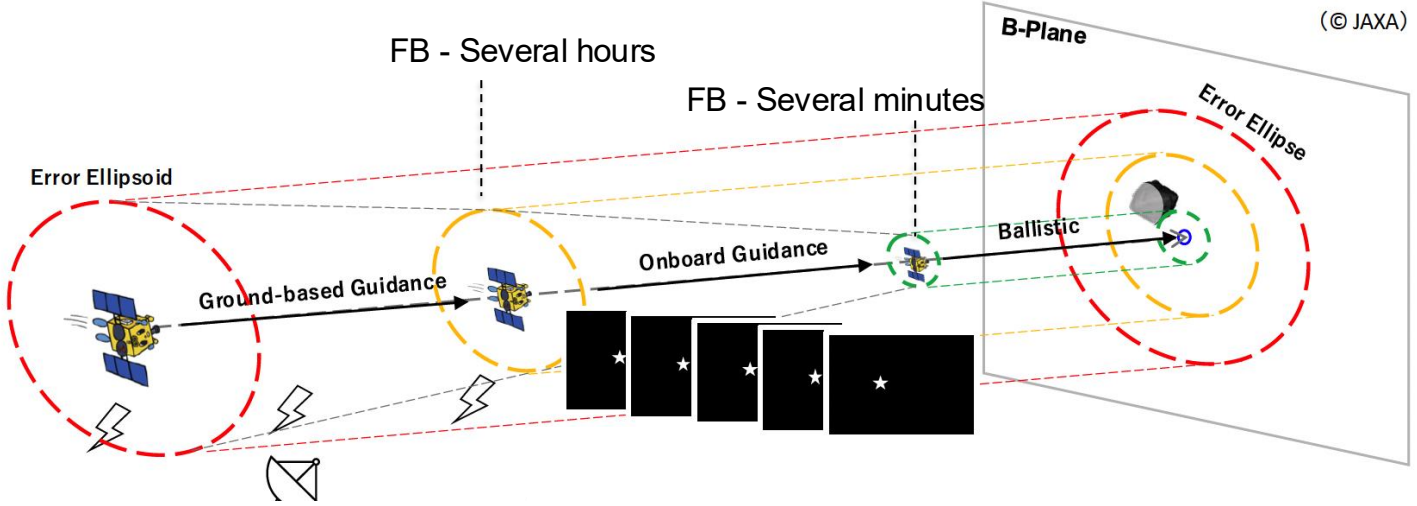
Asteroid size : ~30m or 11m? (spin period : ~11 or 5min?)

The collision probability of such asteroids with the Earth is once in 100~200 years.

Asteroid (98943)Torifune flyby

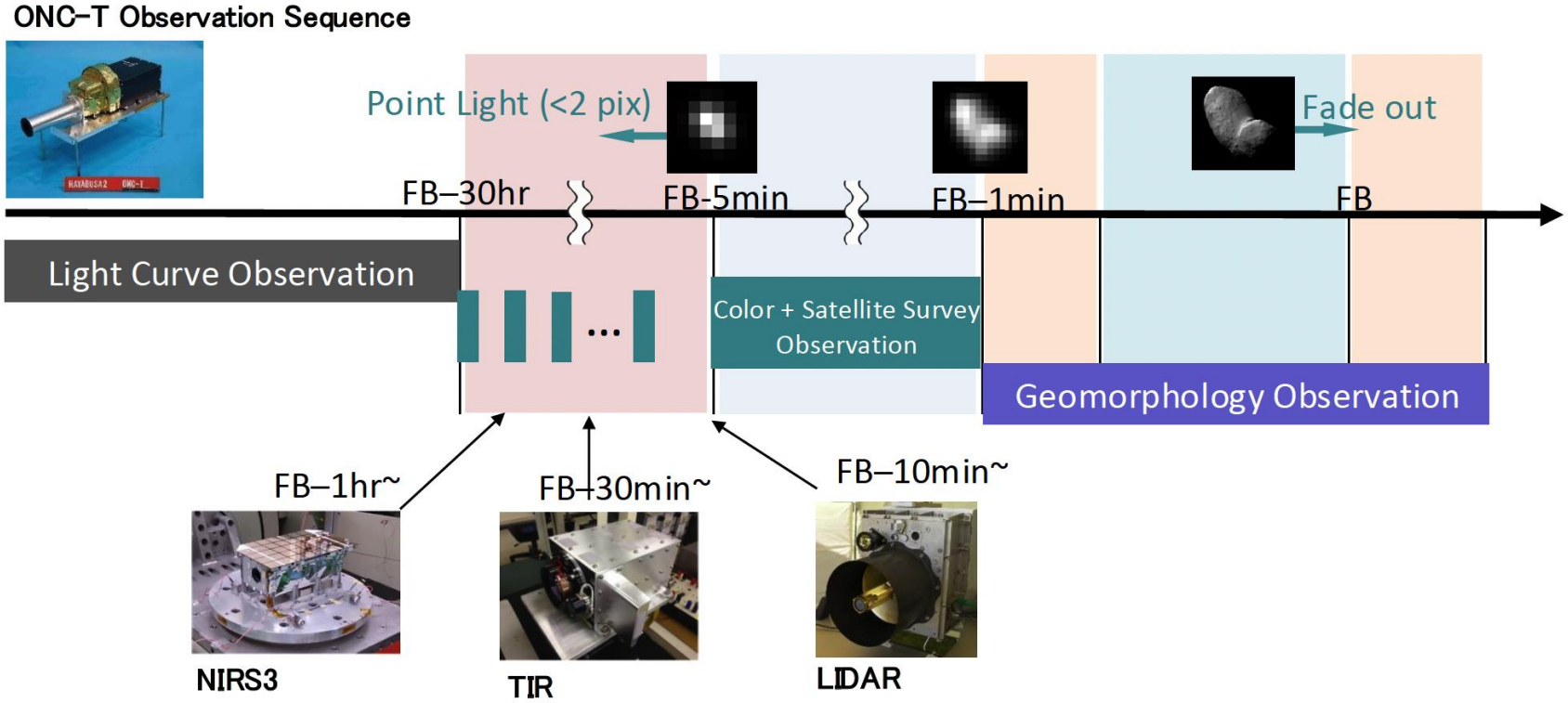
- **Flyby date : 5 July 2026**
- **Flyby distance : 1 – 10 km**
- **Relative velocity : 5 km/s**

Optical navigation on ground and on-orbit will be performed.



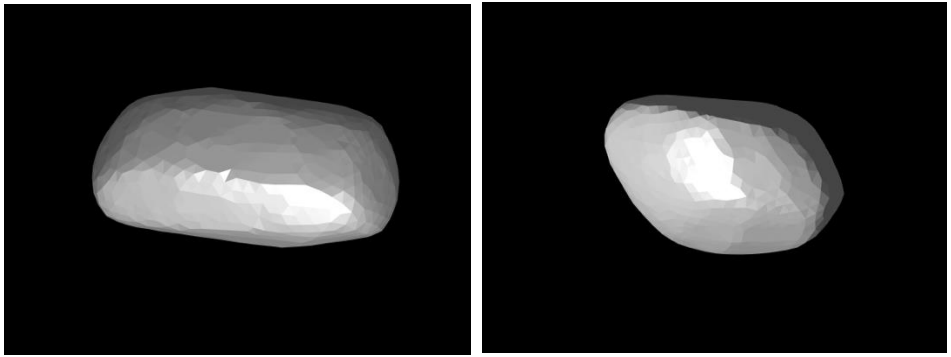
Science observations at the flyby

Four science instruments will perform the observation of Torifune.



Shape of Torifune

- Multiple groups performed Earth-based photometric observations to reconstruct Torifune's shape, suggesting its elongated shape.
- We need further observations.



Fatka et al. (2024) on the left, and Popescu et al. (2025) on the right

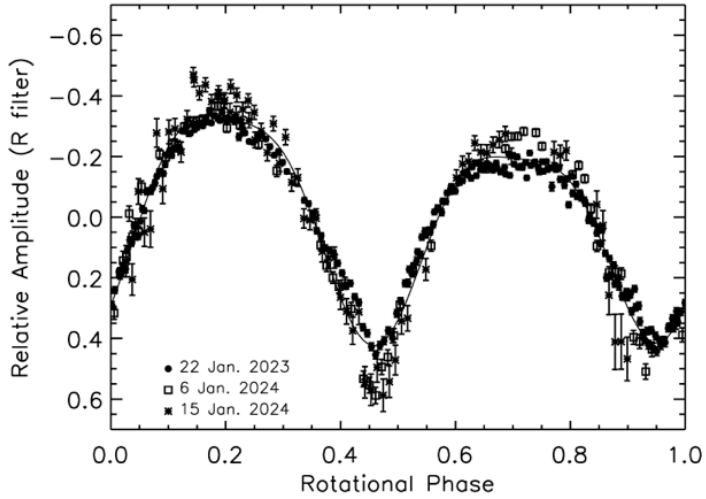
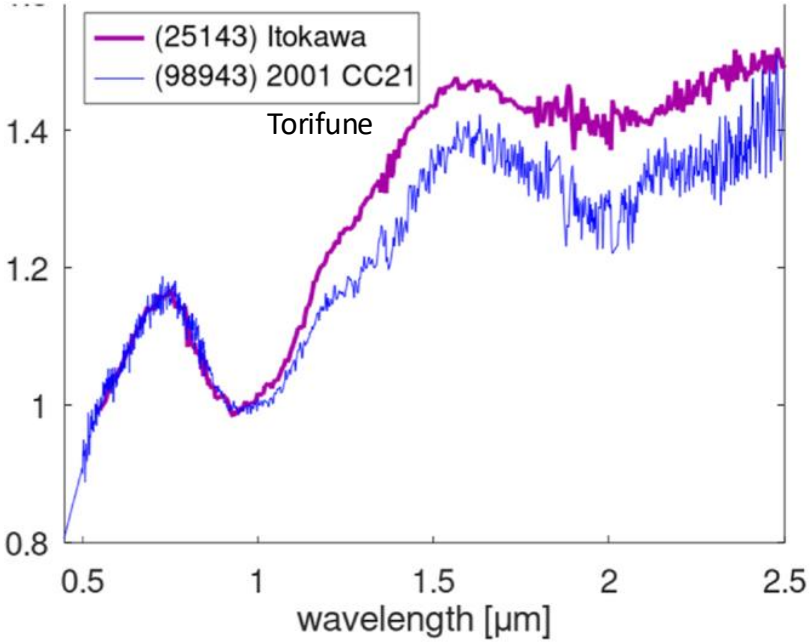


Fig. 2: Composite lightcurve of 2001 CC21. The zero phase time corresponds to JD 2460100.

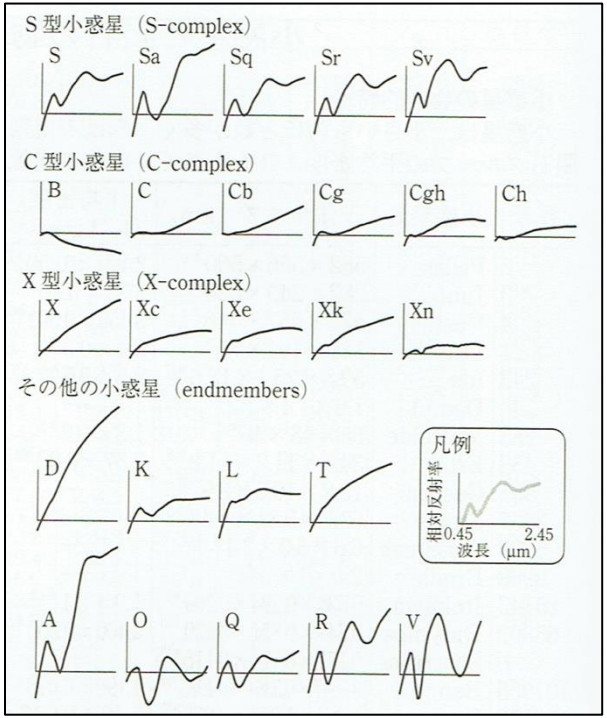
Lightcurve of Torifune (Fornasier *et al.*, 2024)

Spectrum of Torifune



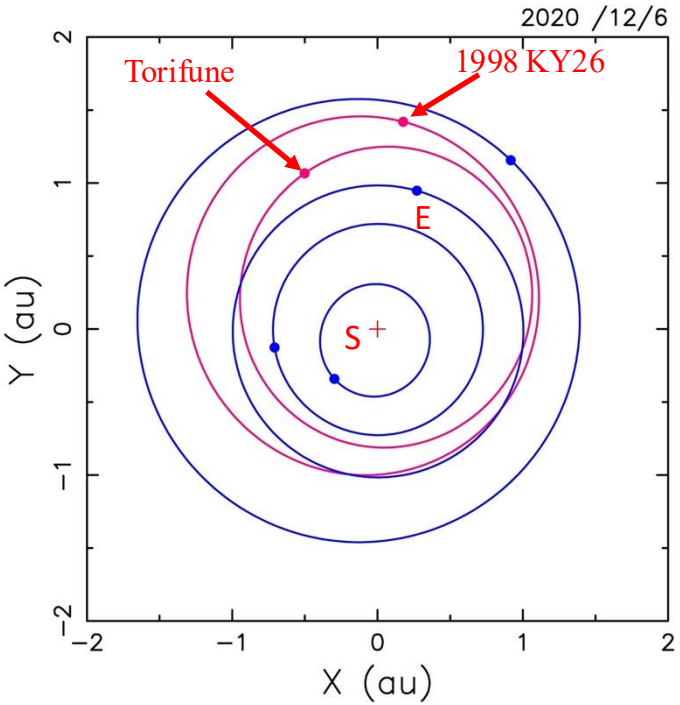
Spectrum

reference



Asteroid spectrum classification
(DeMeo et al. 2009, Icarus, 202, 160)

(98943) Torifune and 1998 KY26

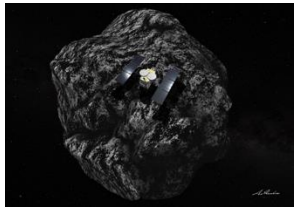


Object positions on 6 Dec. 2020

（Image credit：JAXA）

98943 Torifune (2001 CC21)

Shape	elongated : b/a <0.6, 0.37
H magnitude	18.70
diameter(mean)	450m
Spin period	5.0159 hours
Spectral type	L type → S - Sq type
Geometric albedo	0.2 – 0.23
Spin axis	λ=260-280, β=+84 deg
Semimajor axis	1.03 au
Eccentricity	0.22
Inclination	4.81 deg
Orbital period	1.05yr（383 day）



1998 KY26

Shape	Spherical (from radar observation)
H magnitude	25.91
Av. diameter	About 30 m → 11m
Spin period	10.7 min (0.178 hr) → 5.4min (0.089193hr)
Spectral type	Possible carbonaceous asteroid
Geometric albedo	0.52
Semimajor axis	1.23 au
Eccentricity	0.20
Inclination	1.49 deg
Orbital period	1.36yr（498 day）

NEO Missions related to JAXA

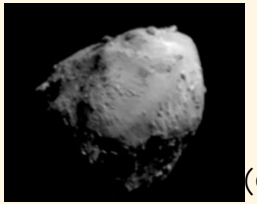
Hera (ESA)

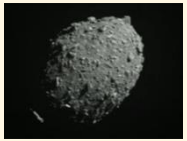
(2024 ~)

JAXA provided TIRI.

(TIRI : Thermal Infrared Imager)

Rendezvous in 2026





(©NASA)

Didymos S-type, 850m

Dimorphos S-type, 170m

RAMSES (ESA)

(2028 ~)

JAXA provides TIRI and solar array wings.

Rendezvous in 2029

Apophis

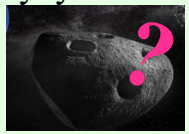
Sq-type, 340m

DESTINY+

(2028 ~)

Dual launch by H3 rocket

flyby in 2029



(©ESA)

Apophis

flyby in 2030

(©JAXA)

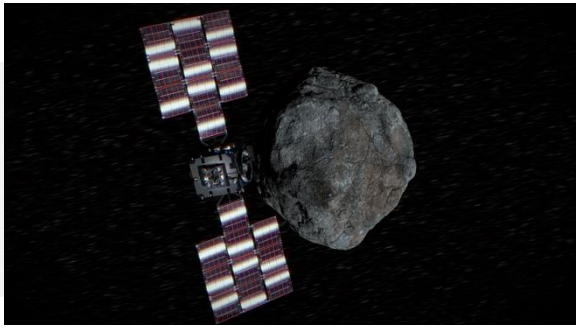
Phaethon

F-type, 6km

DESTINY+

Demonstration and **E**xperiment of **S**pace **T**echnology for **IN**terplanetary vo**Y**age with **P**haethon f**L**yby and d**U**st **S**cience

- Technology demonstration & science observation.
  - Engineering mission is led by ISAS/JAXA.
  - Science mission is led by Chiba Inst. of Technology.
- International collaboration with DLR for Dust Analyzer.



2028 : Launch with RAMSES
2029 : Apophis flyby
2030 : Phaethon flyby

Engineering Goals

- Expand the range of applications for electric propulsion
- Acquire advanced flyby exploration technologies

Science Goals

- Characterize cosmic dust en route to Earth (before atmospheric entry)
- Understand geology of Phaethon, Geminids parent and active asteroid

Science Instruments of DESTINY+

Phaethon imaging

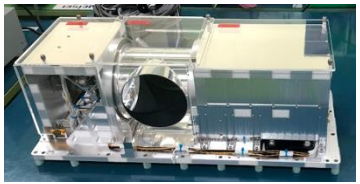
- 3D shape
- Surface geology <10 m/pix
- VIS-NIR spectral variation <100 m/pix

★Developed by PERC, ChibaTech

Telescopic CAmera for Phaethon (TCAP)

with a tracking mirror

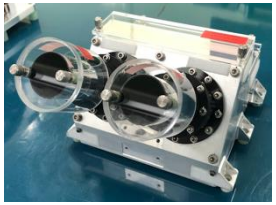
TCAP



Multiband CAmera for Phaethon (MCAP)

with compound eyes and four bands (425/550/700/850 nm)

MCAP



Dust analyses

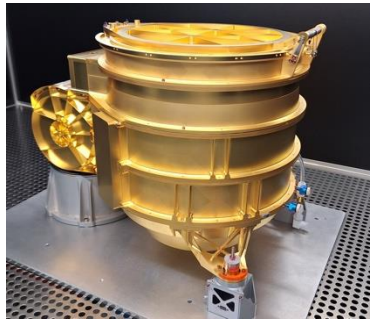
- Physical & Chemical properties of IDPs and interstellar dust
- Physical & chemical properties of nearby Phaethon & dust trails

★Developed by Univ. of Stuttgart

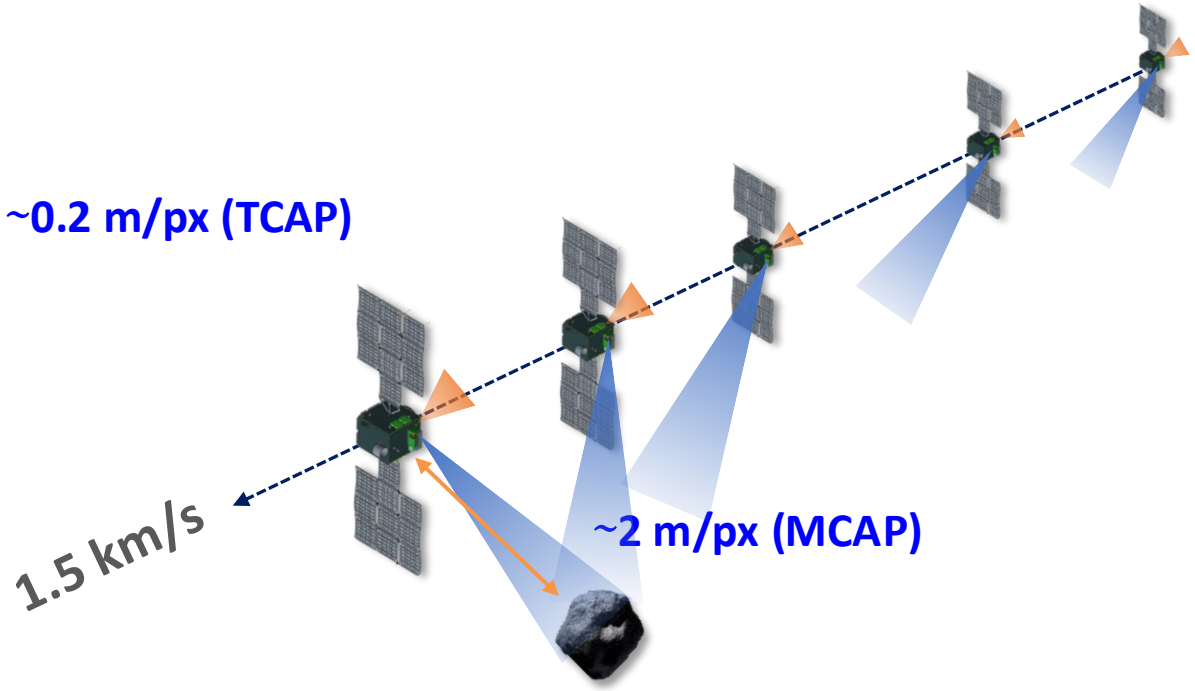
DESTINY+ Dust Analyzer (DDA)

Integrated impact-ionization trajectory sensor with TOF mass spectrometer

DDA



Apophis Flyby imaging sequence (TBD)



Closest distance (TBD) : 30 km
Flyby speed : 1.5 km/sec

Observation for 2025 FA22

2025 FA22

- March 29, 2025 : Discovered by Pan-STARRS 2
- Sept. 18, 2025 : Approached the Earth as close as 840,000 km
- Size : 130 ~ 290 m

JAXA's actions for this asteroid

➢ **Radar observation**

•JAXA participated in Australia's SHARP (Southern Hemisphere Asteroid Radar Program), and was able to receive radar signals transmitted from Canberra and reflected by the asteroid at Usuda Deep Space Center in Japan. (radar observation since 1996)

➢ **Light curve observation** *Asia-Pacific Asteroid Observation Network

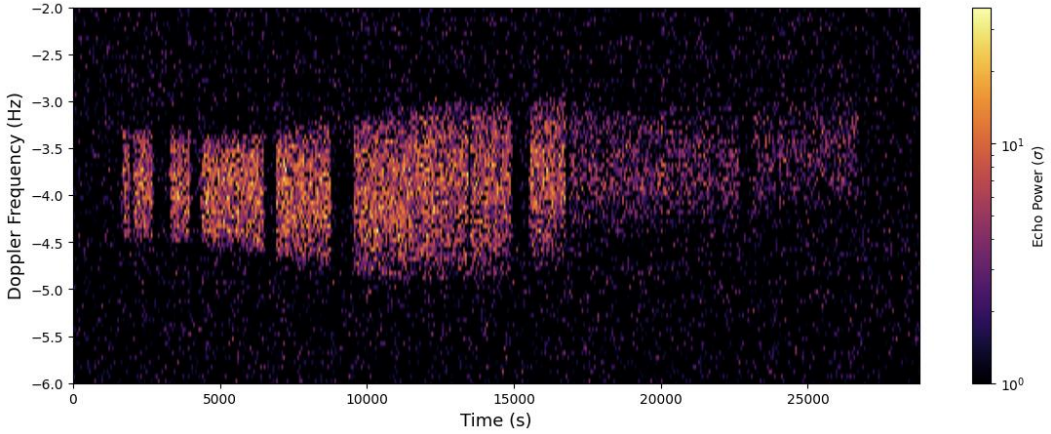
•JAXA asked APAON* members and Japanese amateurs who are members of Japan Spaceguard Association (JSGA) to get the light curve and seven observes got the light curve data: JSGA 3, APAON members (Thailand 2, Korea 1, Japan 1)

➢ **Outreach**

•JAXA worked with volunteers to organize an observation campaign for public people to try observing this asteroid. Shin-APAON（https://sites.google.com/view/shinapaon/）

Results of the radar observation of 2025 FA22

- 2025 FA22 has an elongated shape with major axis 340m (with some ambiguity).
- The data analysis is on going.
- The radar observation contributed the astrometry of 2025 FA22.



Sequence of radar echo power spectra (a waterfall plot) obtained between 14:30:00 and 22:15:45 UTC on September 18 at Usuda 64 m, receiving LCP. Time increases from left to right, frequency increases from bottom to top. The frequency resolution is 0.1 Hz and the time resolution is 1 min. DSS-35 transmitted RCP from 14:58:48 UTC (1728 s) until 19:09:00 UTC (16740 s), then transmitted LCP from 19:11:00 UTC (16860 s) until the end of the track at 21:55:00 UTC (26700 s). There are several gaps in echoes when the transmitter had to be stopped to avoid the illumination of live spacecraft. (from the report by Shinji Horiuchi (CSIRO))

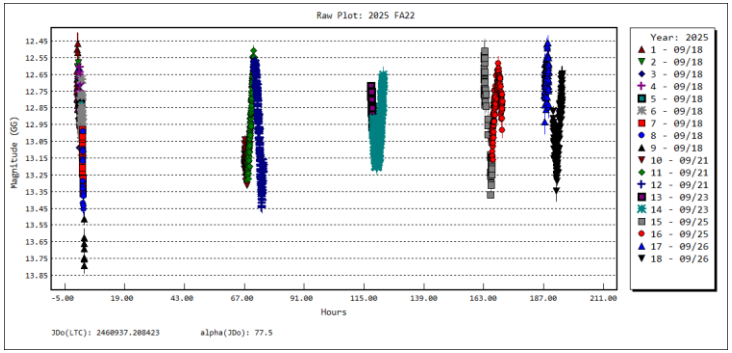
Results of the light curve observation of 2025 FA22

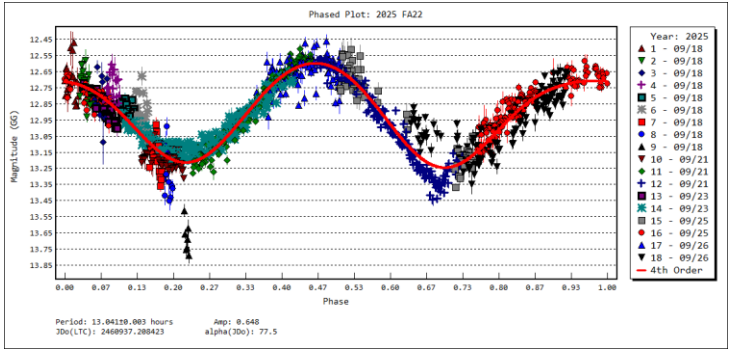
Observers

- APAON members
  - Thailand（Teerasak Thaluang, Matipon Tangmatitham)
  - Korea (Hong-Kyu Moon)
  - Japan (Sorato Wada, Haruka Nagasawa, Shigeyuki Sako)
- Japan Spaceguard Association (JSGA)
  - Hiroyuki Watanabe (渡辺 裕之)
  - Makoto Ishiguro (石黒 誠)
  - Yasukazu Ikari (井狩 康一)

- Seven teams attempted to observe the light curve.
- Observing in various locations is preferable because we can avoid the risk of weather.
- Some of them also participated in the IAWN campaign.

Example of the light curve observations

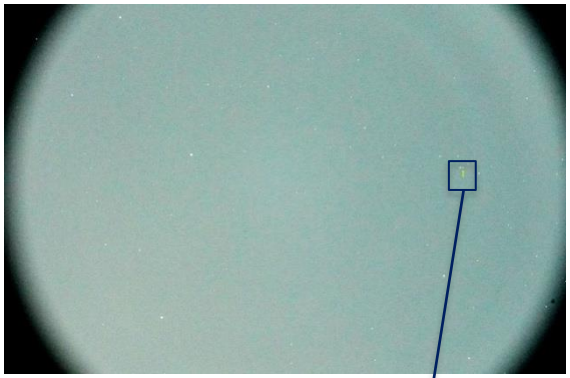




(by Hiroyuki Watanabe)

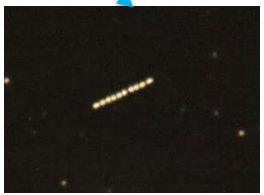
Results of the outreach observation campaign of 2025 FA22

2025 FA22 was photographed by amateur observers and local observatories in Japan.



Hoshinoko yakata
星の子館

19 Sept. 2025
15cm refractor
+SONY7sIII
Exposure 15s



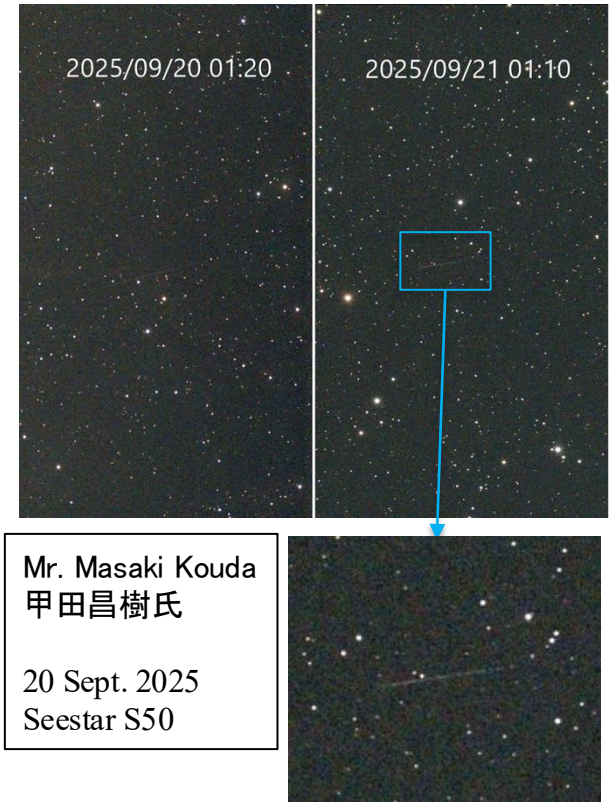
Rikubetsu Space and Earth Science Museum
銀河の森天文台

19 Sept. 2025
115cm reflector
Exposure 2s × 10

星と森のロマントピア そうま

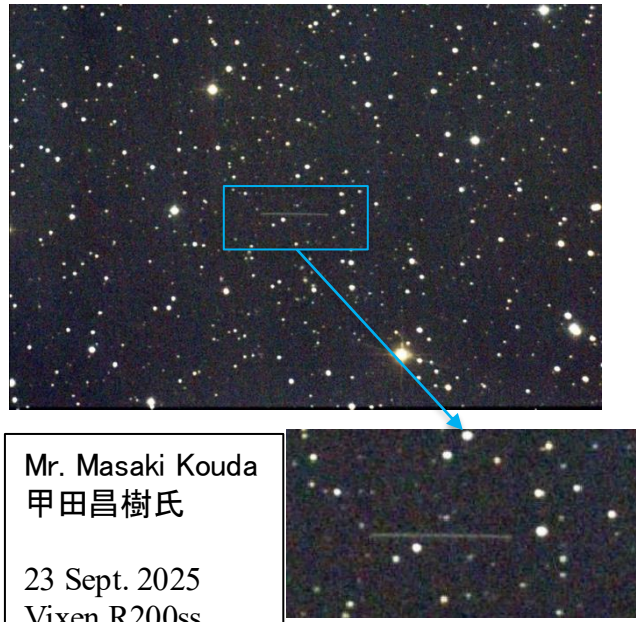
26 Sept. 2025
40cm reflector
+canon EOS Kiss X7
Exposure 30s

Observation campaign of 2025 FA22 for outreach



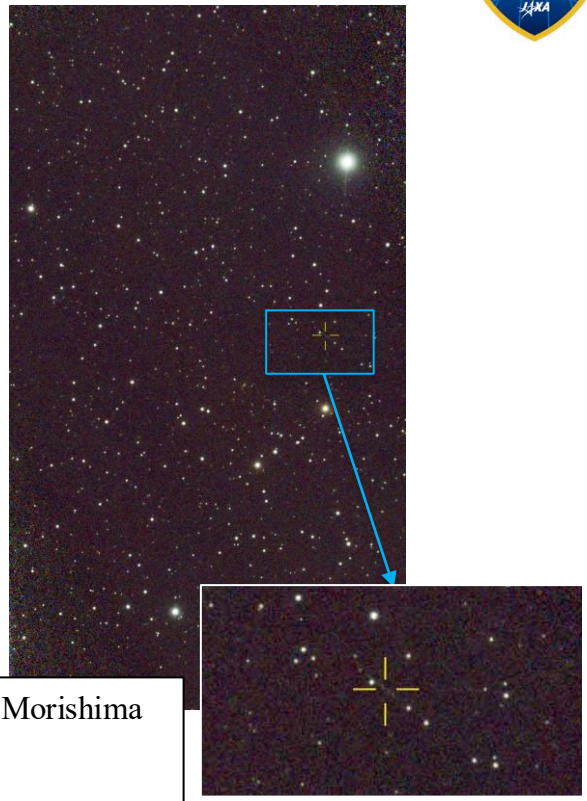
Mr. Masaki Kouda
甲田昌樹氏

20 Sept. 2025
Seestar S50



Mr. Masaki Kouda
甲田昌樹氏

23 Sept. 2025
Vixen R200ss
+ASI183MC



Mr. Kazuhiro Morishima
森島和博氏

22 Sept. 2025
Seestar

Next targets for radar and optical observation

Target	Year Mon Day Hour (UT)	Dec. (deg)	Size (km)	Distance (au/LD)	SNR/hr (sigma)	Comments	Visual magnitude
2013 GM3	2026 Apr 13 17:30 – 23:30 Apr 14 19:30 – 01:30	−21 +04	0.019	0.0033/1.3 0.0018/0.71	130 1700		17.4 16.1
1997 NC1 (152637)	2026 Jun 26 11:00 – 17:00 Jun 27 10:30 – 16:30	+10 −03	0.915	0.0177/6.9 0.0171/6.7	410 430	PHA	10.9 10.4
2025 AL2	2026 Aug 15 18:00 – 00:00 Aug 16 14:30 – 21:30	−33 −20	0.097	0.0094/3.7 0.0072/2.8	66 156		14.9 14.4