DESTINY+ and Ground-based Observation of its Target Asteroid (3200) Phaethon

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Mission overview

★ Joint mission of technology demonstration & science observation.
★ Selected in 2017 for a mission for JAXA/ISAS small-class program.
★ Planned launch in 2024 by Epsilon S rocket and flyby asteroid Phaethon in Jan. 2028.
★ Engineering mission led by ISAS_JAXA, and science mission led by PERC/ChiTech.

Motives of science mission

Cosmic dust is a key provider of organic matters to Earth, possibly served as prebiotic seeds of terrestrial life.

Science mission goals

1. Understand physical & chemical nature of cosmic dust en route to Earth before atmospheric entry.
2. Understand geology of asteroid (3200) Phaethon

Observation Targets

1. Interplanetary dust (mixed dust from comets/asteroids), interstellar dust
2. Meter shower dust trail (dust delivery route from known source).
3. Phaethon: Parent body of Geminid meteor shower (known dust sources), near-Sun asteroid (q=0.14 au), B-type, active asteroid.

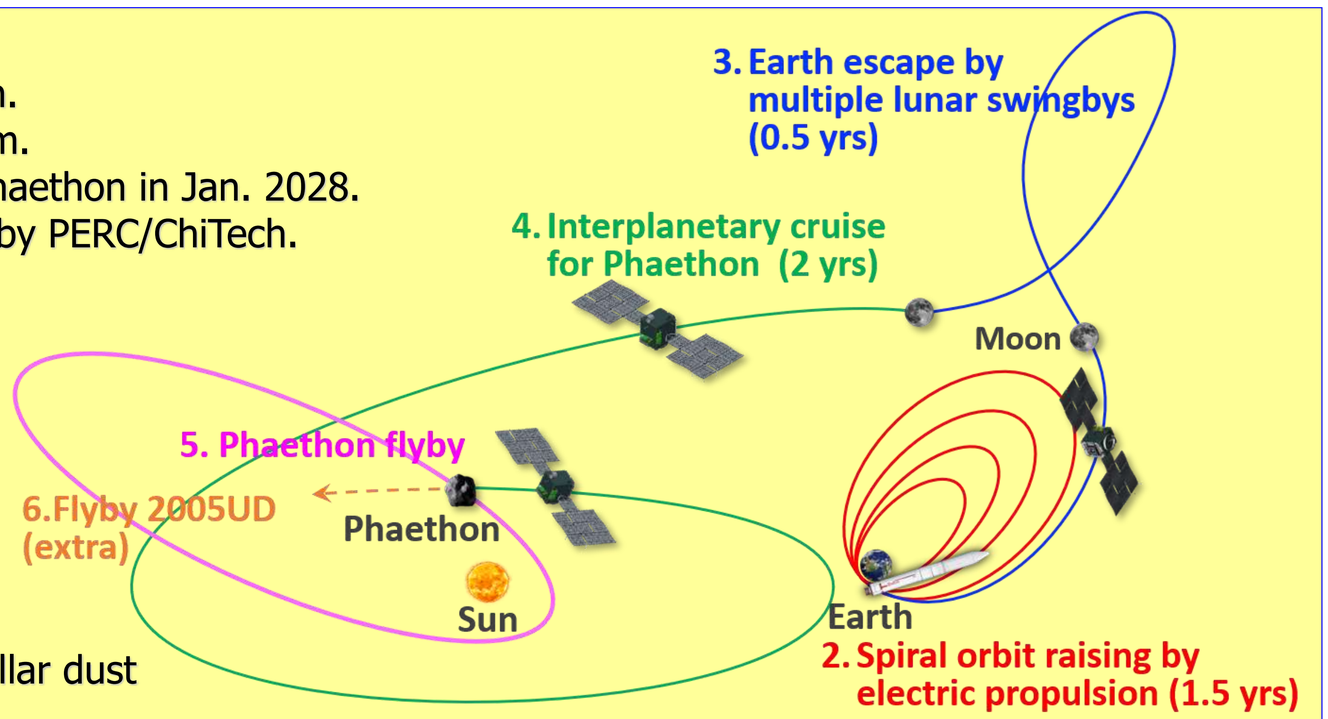


Fig. 1. DESTINY+ mission scenario

Outcomes of ground-based observation 2021 & 2022

Albedo
0.08 – 0.13 by Polarimetric observation (Geem et al., 2022)

Absolute magnitude
Hv = 14.25 ±0.06 mag. by Photometric observation (Beniyama et al., 2023)

Diameter
5.2 – 6.6 km by Polarimetric and Photometric observation (Beniyama et al., 2023, Geem et al., 2022)

Dimension
6.4 x 6.1 x 4.6 km, vol eq. 5.05 km by 3D shape model (Marshall et al., 2023)

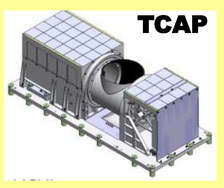
Science goals and related instruments

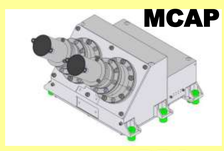
Phaethon imaging

- 3D shape
- Surface geology <10 m/pix
- VIS-NIR reflectance spectra <100 m/pix (425, 550, 700, 850 nm)

→ **Telescopic CAmera for Phaethon (TCAP)**
→ **Multiband CAmera for Phaethon (MCAP)**

Developed by PERC/Chitech (PI: K. Ishibashi)





Dust in-situ analyses

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

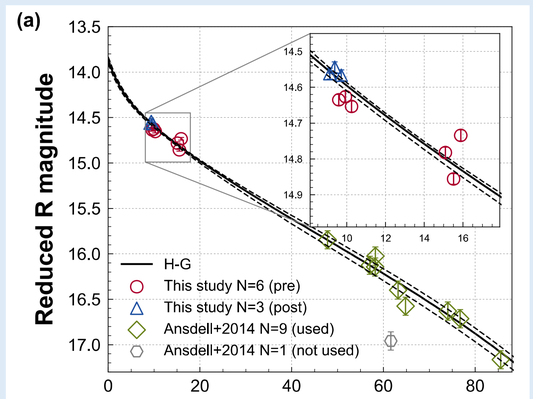
→ **DESTINY+ Dust Analyzer (DDA)**

Developed by Univ. of Stuttgart (PI: R. Srama, Co-PI: M. Kobayashi)

Photometric observation (Beniyama et al., 2023)

★ 9 nights in Oct.27 ～ Nov. 26, 2021.
★ Solar phase angle < 10 deg.

3.8m Seimei telescope of Kyoto Univsersity



Polarimetric observation (Geem et al., 2022)

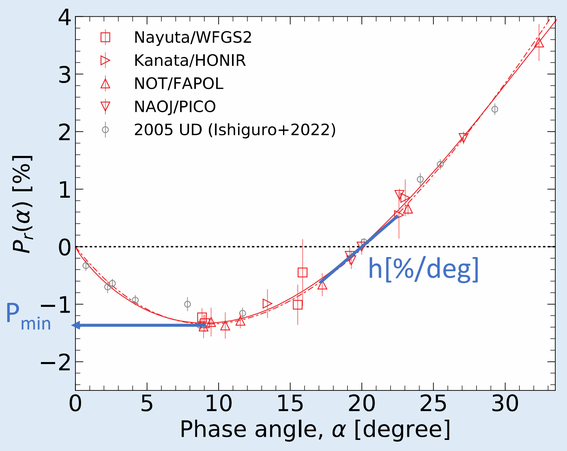
★ Oct.27, 2021 ～ Jan. 24, 2022.

1.5m Kanata telescope of Higashi-Hiroshima Observatory

2.0-m Nayuta telescope of Nishi-Harima Astronomical Observatory

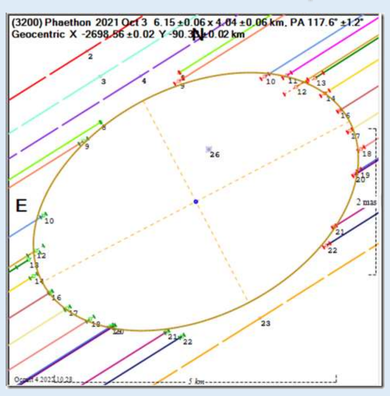
2.56-m Nordic Optical Telescope of Observatorio del Roque de los Muchachos, La Palma

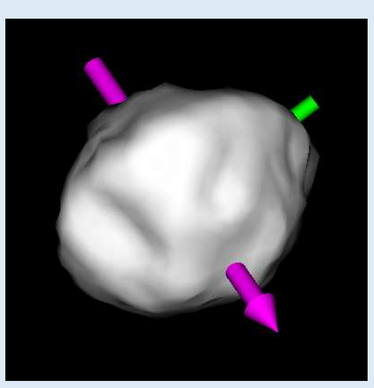
50-cm Telescope for Public Outreach at the Mitaka of NAOJ



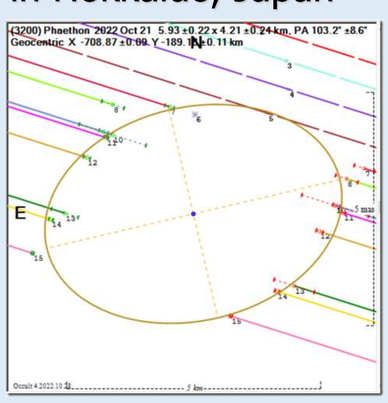
Stellar Occultation 2021 observation (Yoshida et al., 2022) + 2022 observation

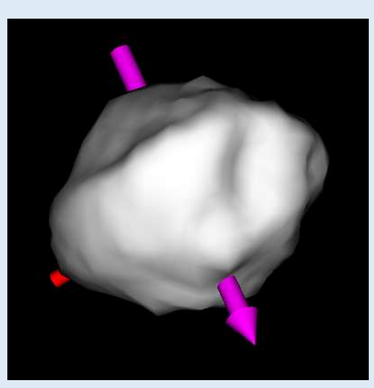
★ Oct. 3, 2021 (UT)
in southwestern Japan & south korea





★ Oct. 21, 2022 (UT)
in Hokkaido, Japan





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