

P16 Resurrection of Subaru+COMICS for the Study of Solar System Objects with Ground-Based Mid-infrared Observations IV: Status as of June 2026

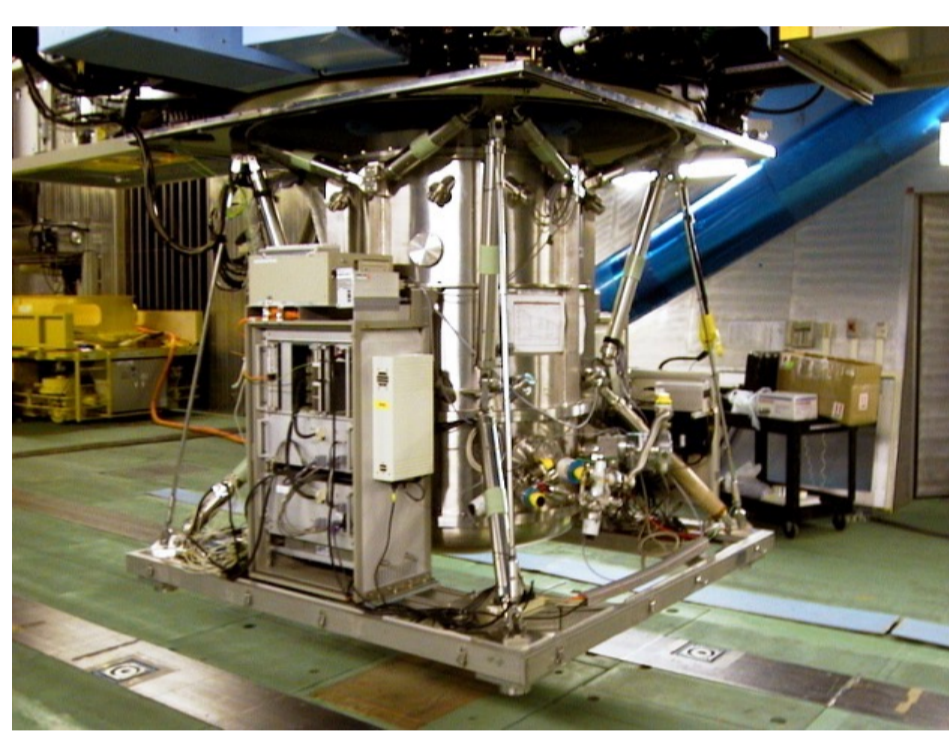
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Mid-infrared observations are essential for studying thermal radiation from dust and molecular emission bands in solar system objects. However, since the decommissioning of the Cooled Mid-Infrared Camera and Spectrometer (COMICS) on the Subaru Telescope in 2020, ground-based mid-infrared capabilities have been severely limited. To address this gap, we initiated a project in 2023 to resurrect COMICS. In FY2025, the PI team conducted a series of functional tests confirming the basic operability of the instrument. The following tests were all carried out successfully: the vacuum level inside the cryostat reached and has been maintained at levels consistent with past operations; all internal components cooled to their expected temperatures; all six detector chips were successfully read out; all motors for internal moving mechanisms operated correctly; and the COMICS observation control computer was confirmed to be functional and accessible via network login. This project was originally planned as a three-year effort and has since been extended through FY2026. On-telescope integration tests were subsequently performed, confirming that the instrument balance and mechanical operation on the telescope present no major issues. Based on these successes, a first on-sky test observation is scheduled for July 29, 2026. In this poster, we report the progress achieved through FY2025 and outline the plans for the upcoming test observation and the path toward resuming regular scientific operations.

Cooled Mid-Infrared Camera and Spectrometer (COMICS)



(NAOJ/Subaru Telescope)

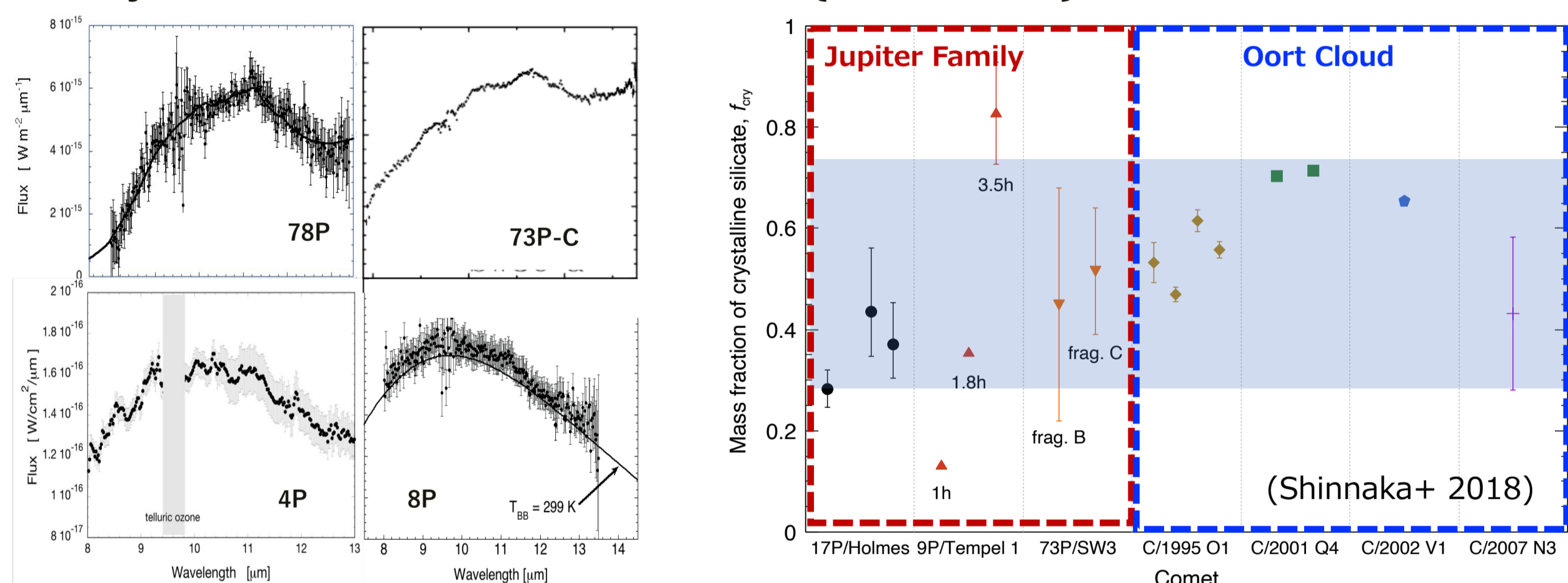
- **Subaru Telescope + COMICS**
 - 7.5 – 25 μm (N and Q-bands)
 - 320x240 pix Si:As detectors x 6
- **Imaging (42" x 32")**
 - N-band: 6 continuum + 5 narrow filters
 - Q-band: 4 filters
- **Spectroscopy (40"-length slit)**
 - N-band low resolution (R~250)
 - N- & Q-band mid resolution
 - N-band high resolution

COMICS was in operation on Subaru Telescope for nearly **20 years until S20B**, but it was decommissioned. We aim to restore COMICS to approximately 80% of its original N-band spectroscopic performance, sufficient for scientific observations.

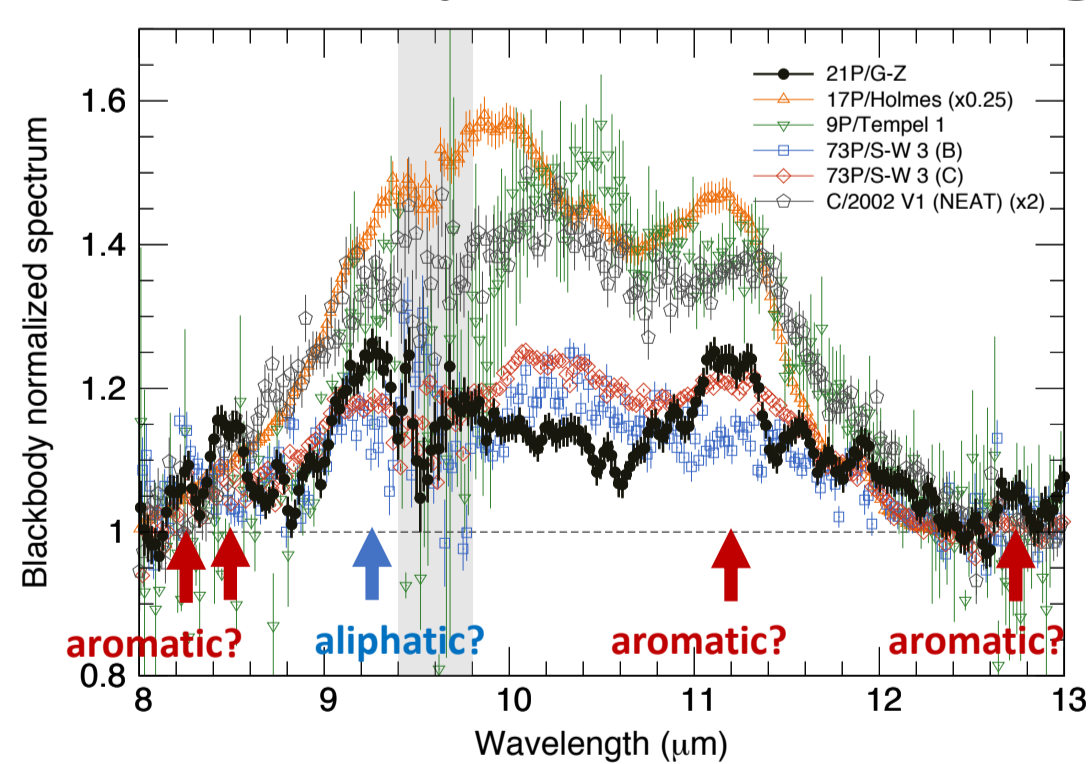
Solar System sciences with COMICS

➤ Crystalline Silicate grains in Comets

We observed **~10 short period** and **~15 long period** comets in 2003-2020 and detected crystalline silicate in various comets. The **crystalline fraction** of silicates (**~ 30-70%**) has been estimated.

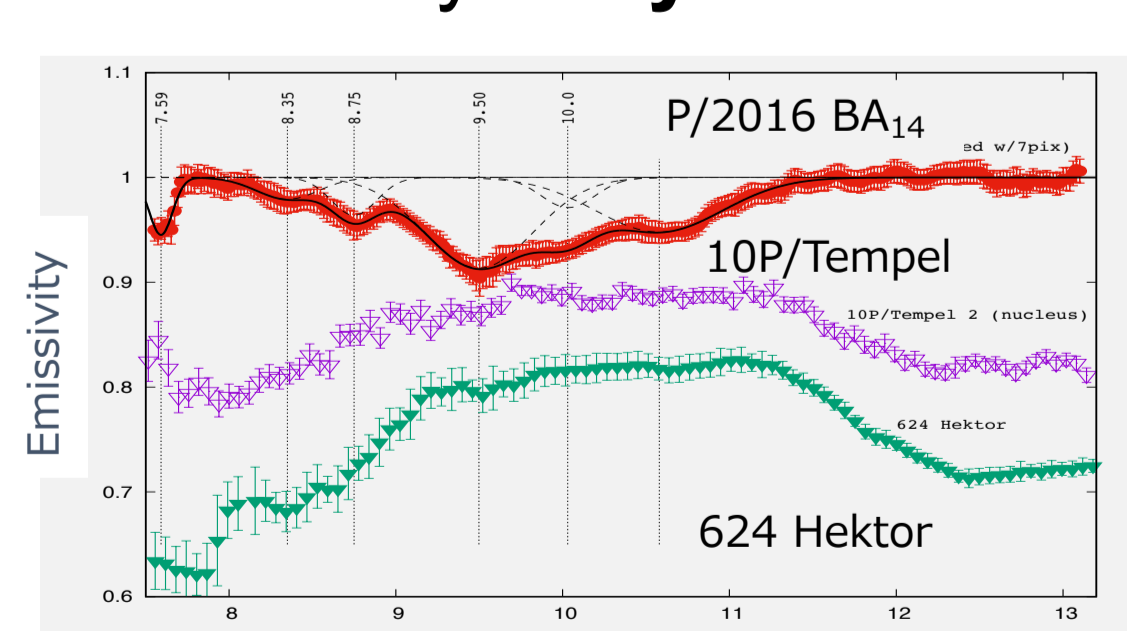


➤ Discovery of complex organics in comet



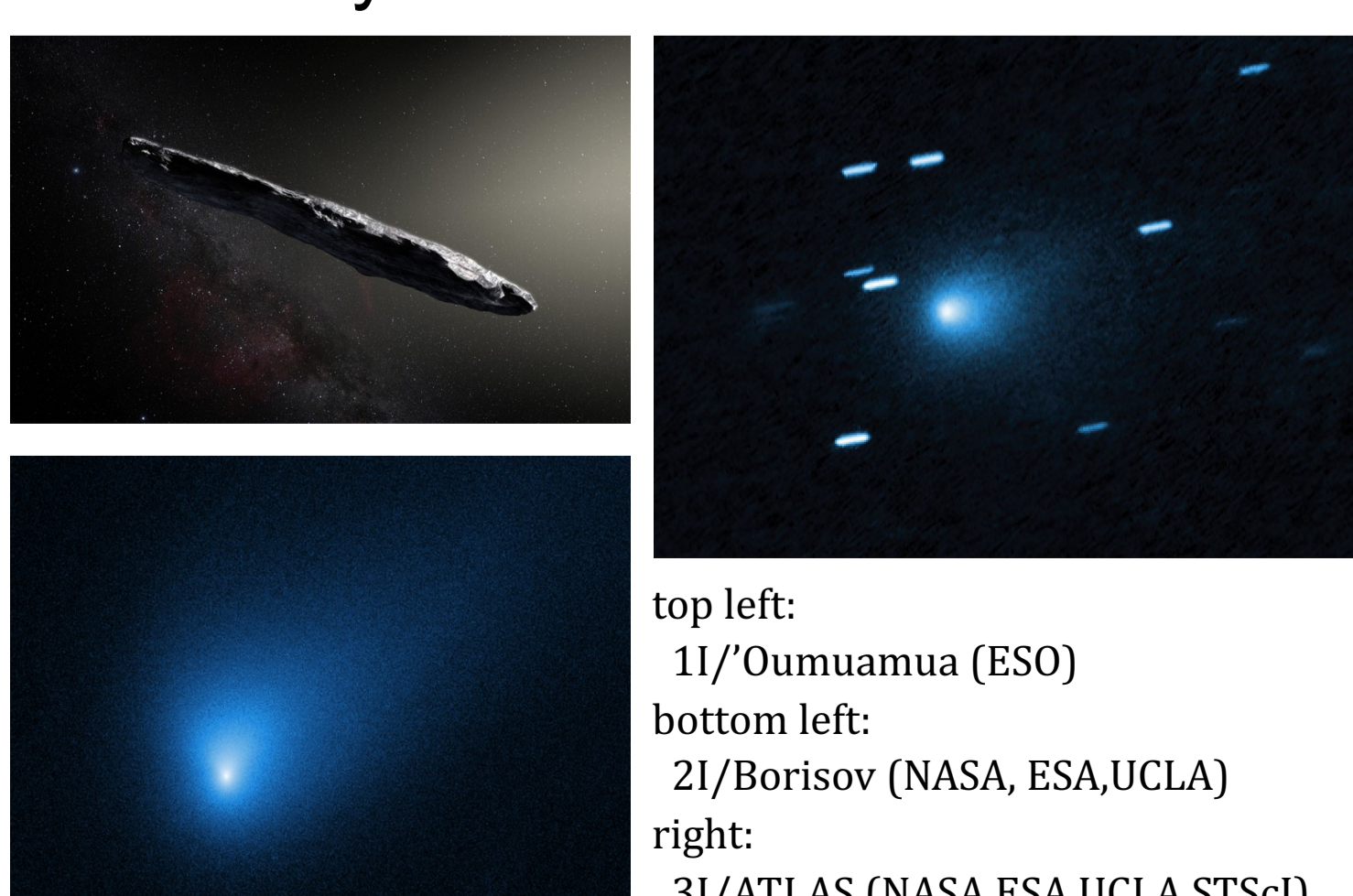
COMICS detected UIR features in the spectrum of comet 21P, which can be attributed to complex organics like aromatic hydrocarbons. (Ootsubo+ 2020)

➤ Discovery of hydrous silicates on the comet nucleus



COMICS observed the thermal emission from the comet nucleus of C/2014 BA₁₄. There are features resembling large grains of phyllosilicates. (Ootsubo+ 2021)

➤ Solar System comets vs Interstellar objects (ISOs)



top left: 1I/Oumuamua (ESO)
bottom left: 2I/Borisov (NASA, ESA, UCLA)
right: 3I/ATLAS (NASA, ESA, UCLA, STScI)

Are they different from solar system objects? The compositional nature of their dust is unknown. No mid- or far-IR data for ISOs have been obtained yet!

Why we need COMICS

- There are notable MIR spectral features of crystalline/hydrous silicate.
- **No other ground-based mid-IR instruments** currently provide high-quality data consistently.
- JWST has started observations in the mid-IR. However, JWST observation is highly competitive and highly restricted for moving objects due to the limitations of the solar elongation angle.
- Restarting COMICS is the most reliable and efficient approach for asteroid/comet study in the mid-IR !!!

Expected future results

COMICS is expected to elucidate **the thermal and dynamical evolution of comets and asteroids**, in particular through studies of:

- Crystalline and amorphous silicate dust
- Hydration of dust in comets and asteroids

Mid-IR observations are also essential for identifying **target objects for future asteroid/comet exploration.**

The Road to the Resurrection of COMICS

● Requested specifications of COMICS

Imaging			Spectroscopy			
Filter	Wavelength Center (μm)	Sensitivity (mJy)	Grating	Resolution (0.33" slit)	Coverage (μm)	Sensitivity (mJy)
N7.8	7.8	88	NL	250	7.8-13.3	340
N8.8	8.8	67	NM	2500	7.8-13.3	2500
N9.7	9.7	41	NH	11000	8.93-9.06	5500
N10.5	10.5	58		9300	10.38-10.54	6600
N11.7	11.7	25		8500	12.7-12.9	7200
N12.4	12.4	55	QM	-	16.5-25.5	3000
UIR8.6	8.59	29				
ArIII	8.98	35				
SIV	10.46	40				
UIR11.2	11.24	32				
NeII	12.81	75				
Q17.7	17.7	320				
Q18.8	18.8	360				
Q20.5	20.5	730				
Q24.5	24.6	1300				

- mandatory (N8.8, N12.4, NLspc)
- mandatory (either N18.8 or N17.7)
- optional (N7.8, Q20.5)

We need NL spectroscopy with a sensitivity of ~ 500 mJy. We can obtain the mid-IR spectra with S/N ~ 30 for comets of 150 mJy.

● Progress so far

- This year is **the final year** of the project, which was originally planned as a 3-year effort but has been extended by one year.
 - Since COMICS has been out of operation for five years, we are currently checking COMICS at the summit (**vacuum evacuation, cooling, electrical integrity, mounting at the Cassegrain focus, ...**).
- No HW issues with COMICS have been encountered so far!**

● Future plans

- **An engineering observation** will be conducted in **late July!**
- We aim to conduct engineering tests during S27A again and scientific observations starting in S27B, if possible.
- If we can secure funding, we would like to continue operations for three more years starting in FY2027.

Collaborators (and funding!) are most welcome!

No hardware issues with COMICS have been encountered so far! After a successful engineering observation, we look forward to expanding collaborations across a broad range of astronomical fields.

References: [1] Shinnaka et al., AJ 156, 242 (2018); [2] Ootsubo et al., Icarus 338, 113450 (2020); [3] Ootsubo et al., Icarus 363, 114425 (2021)