

# Resurrection of Subaru+COMICS for the study of solar system objects with ground-based mid-infrared observations II

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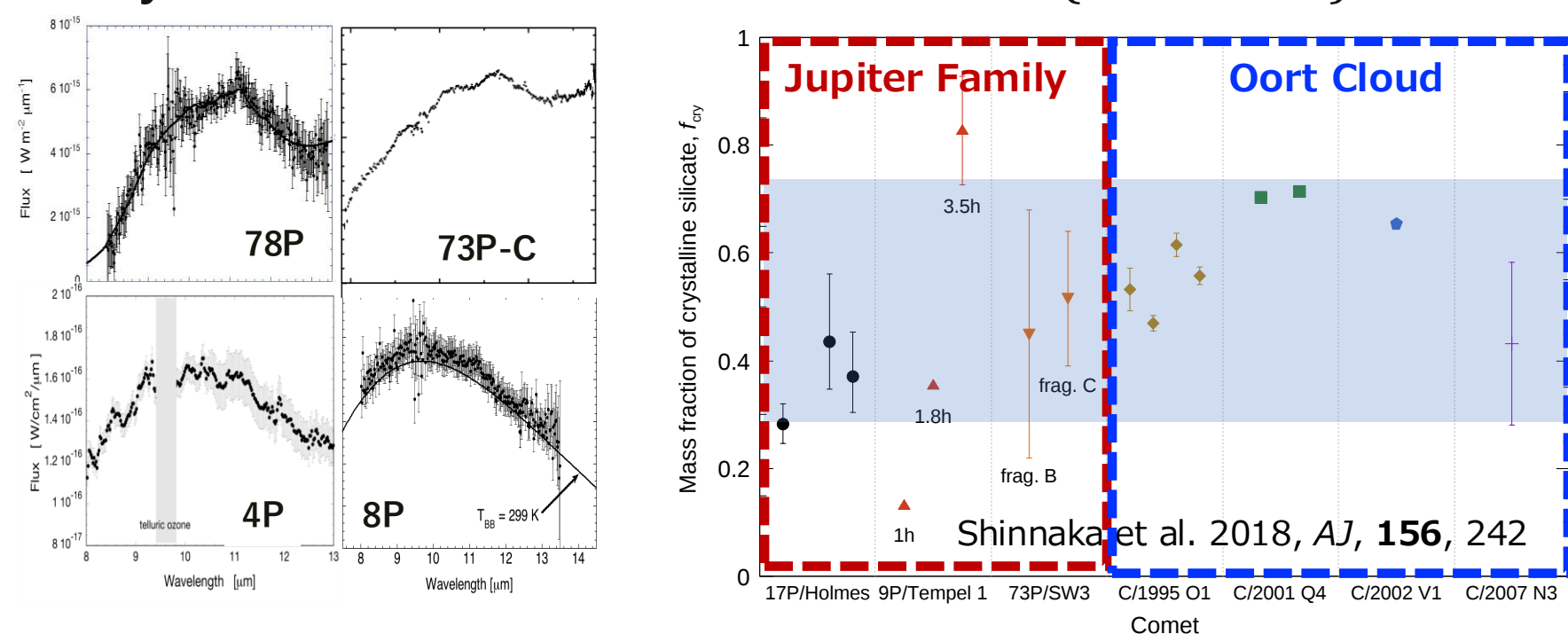
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Mid-infrared observations are essential for detecting thermal radiation from dust and the emission bands of organic molecules, making them critical for studying solar system objects with temperatures of ~50–500K. However, mid-infrared instruments on ground-based telescopes are extremely limited, hindering regular observations. The Cooled Mid-Infrared Camera and Spectrometer (COMICS), which operated on the Subaru Telescope for nearly 20 years, achieved significant scientific results but was decommissioned in 2020. While JWST provides mid-infrared capabilities with MIRI, access is highly competitive, and observations of solar system objects are constrained by solar elongation angles. Additionally, TAO/MIMIZUKU will require several more years to become fully operational. To bridge this gap, we initiated a project in 2023 to resurrect COMICS. This remains the most reliable and efficient approach for mid-infrared studies of asteroids and comets. COMICS offers imaging and spectroscopic capabilities in the 7.5–25  $\mu\text{m}$  range (N- and Q-bands). As a first step, we aim to restart imaging and low-resolution spectroscopy in the N-band. In this poster, we present the current status and progress of the project as of 2024.

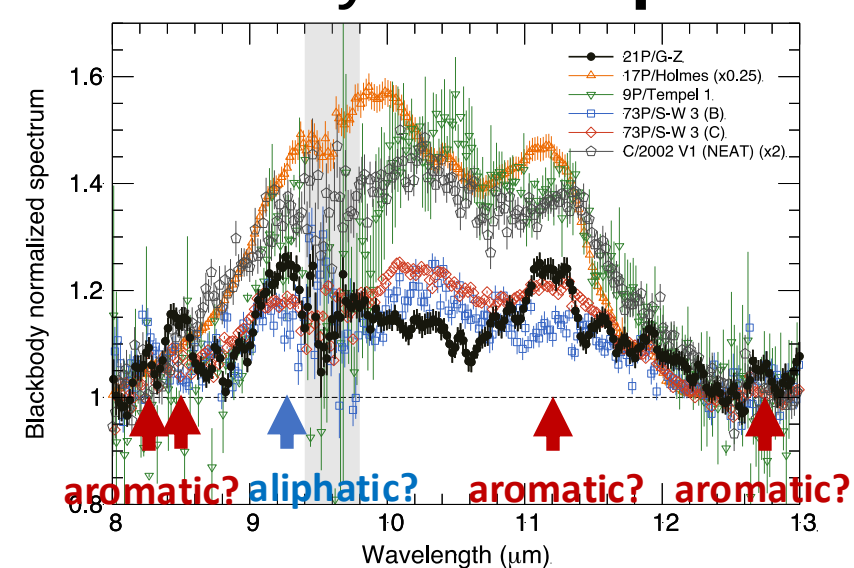
## Solar system sciences with COMICS

### ➤ 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. Crystalline fraction of silicate in comet (~30–70%) is estimated.

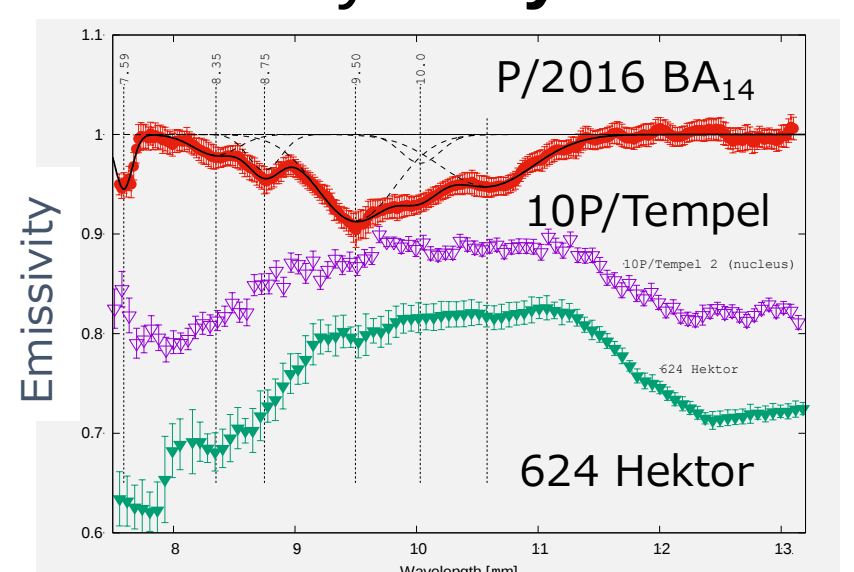


### ➤ Discovery of complex organics in comet



- COMICS detected the UIR features in the spectrum of comet 21P, which can be attributed to the 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 from the silicate that resemble large grains of phyllosilicates. (Ootsubo+ 2021)

### ● The reason why we want COMICS

- There are notable MIR spectral features for crystalline and hydrous silicate. COMICS is still a powerful tool for this study.
- JWST has started the observations in the mid-IR. However, JWST observation is highly competitive and strict for the moving objects with the limitation of the solar elongation angle.

To restart the COMICS is the most reliable and efficient for the asteroid/comet study in the mid-IR !!!

## Expected future results

COMICS is expected to unravel the thermal and dynamical evolution of comets/asteroids.

- Crystalline / amorphous silicate dust
- Hydration of dust in the comets/asteroids

Mid-IR observations are also essential to study and select the target objects for future asteroid/comet exploration.

### References:

- [1] Sugita et al., Science 310, 274 (2005); [2] Kadono et al., ApJ 661, L89 (2007); [3] Ootsubo et al., ESA Publ SP-643, 45 (2007); [4] Shinnaka et al., AJ 156, 242 (2018); [5] Ootsubo et al., Icarus 338, 113450 (2020); [6] Ootsubo et al., Icarus 363, 114425 (2021)

## Cooled Mid-Infrared Camera and Spectrometer (COMICS)



(NAOJ/Subaru Telescope)

- Subaru Telescope + COMICS
  - 7.5 – 25  $\mu\text{m}$  (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 had been in operation at Subaru Telescope for nearly 20 years until S20B, but it was decommissioned. We aim to restore COMICS to approximately 80% of its original performance in N-band spectroscopy, enabling successful scientific observations.

## The Road to the Resurrection of COMICS

### ● Progress so far

- We have secured a 3-year budget (until 2026/3).
- This year is the second year of the plan.
- Since COMICS has not been in operation for four years, we need to check the status of COMICS before the observations.
- We are preparing an environment for performance checks this fiscal year.

### ● Future plan

- We will submit the official proposal as soon as possible.
- We aim to conduct test observations during S25B, if possible, and scientific comet observations in early 2026.

We welcome new collaborative opportunities with and/or contributions from anyone in the wider astronomical community, not just those interested in the solar system science.