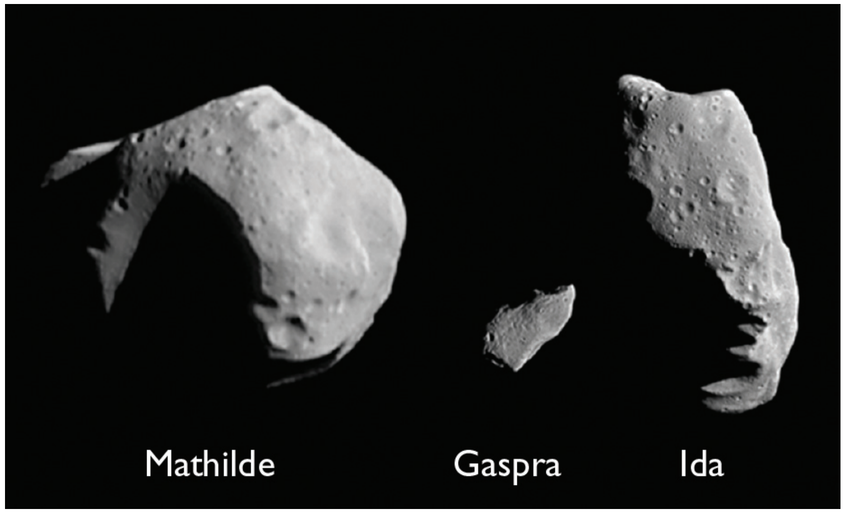
NASA's James Webb Space Telescope:
NIRSpec & MIRI Observations of Asteroids

Spectra obtained with the MIRI Low Resolution Spectrograph (LRS) of main belt asteroids will provide sensitive determination of the temperature distribution on their surfaces, as well as compositional information through the silicate emission features broadly clustered around 10 microns. The objects are mainly in two groups: A) high-albedo objects near 2.5 AU (S-type), and B) low-albedo objects near 3.5 AU (C-type). Each target could be observed twice in order to better constrain the thermal inertia of surface materials. For objects with large (>0.25 mag) rotational lightcurves the two observations would be timed to coincide with lightcurve minimum and maximum. For objects with smaller lightcurve amplitudes (0.1 – 0.2 mag), one observation will be timed to view dawn-side emission, with a second dusk-side observation roughly 6 months later.



JPL/NASA

JWST offers a wide range of imaging, spectroscopy and coronagraphic capabilities (see Tables). NIRSpec medium-resolution spectra in the 0.9 – 5 micron region will be used to search for organics, hydrated minerals and water ice for a sample of ~100 small (D < 20 km) asteroids in the outer main-belt (3.5 – 4 AU). Features from these materials will occur in the 1.5 – 5 micron region; spectra in the 0.9 – 1.5 micron region will constrain the silicate composition of each body so that a more accurate and complete picture can be drawn of the composition of each body, and of compositional diversity amongst objects in that region. Current dynamical models for the evolution of the solar system indicate that a fraction of the objects in this region may have originated much further from the Sun, so those objects may be revealed as a distinct compositional class by these data.

Near-Infrared Spectrograph (NIRSpec)

Micro-Shutter Assembly (MSA)
- 4 separate quadrants
- 365 (dispersion) x 171 (spatial) shutters per quadrant
- Observer specifies which shutters to open and close

Fixed slits (FS)
- Always open, no overlap with MSA on detectors
- One 0.4'' x 3.8'' slit
- Three 0.2'' x 3.3'' slits (offset along dispersion axis)
- One 1.6'' x 1.6'' large aperture

Integral Field Unit (IFU)
- 3'' x 3'' field of view (covered when not in use)
- 30 image slices, each 0.1'' (dispersion) x 3'' (spatial)

Mid-Infrared Instrument (MIRI)

Direct Imaging
- Nine (9) photometric bands from 5 to 28 μm

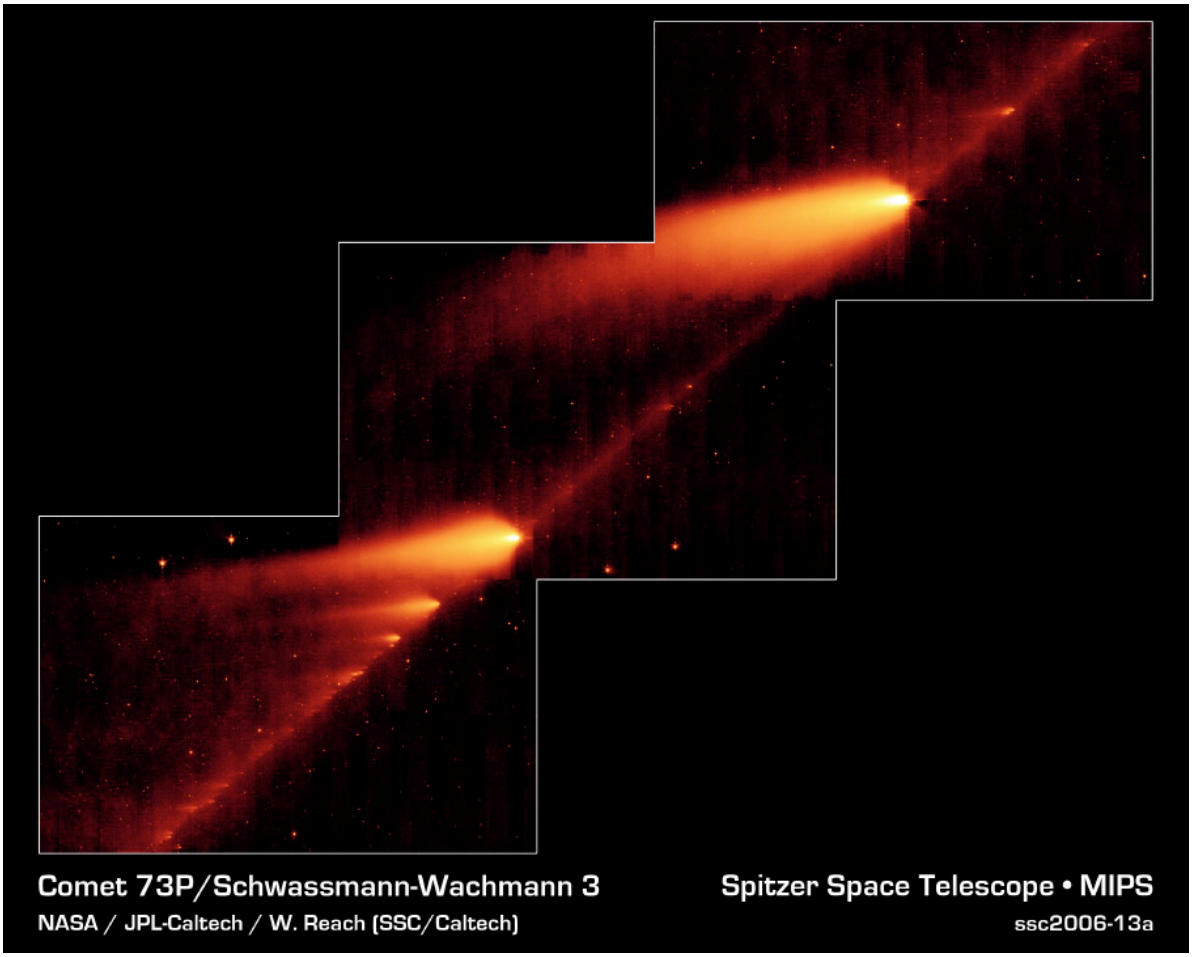
Coronagraphic Imaging
- Three (3) four-quadrant phase masks (4QPMs) at 10.65, 11.4, and 15.5 μm
- Lyot coronagraph at 23 μm

Low-Resolution Spectroscopy (LRS)
- 5 to ~ 14 μm
- $\lambda/\Delta\lambda$ ~ 100 at 7.5 μm
- 0.6'' x 5.5'' slit

LRS Slitless Spectroscopy
- Exoplanet studies

Medium Resolution Spectrometer (MRS)
- $\lambda/\Delta\lambda$ ~ 2200 – 3500
- 4.9 to 28.8 μm, enabled by four Integral Field Units (IFUs)
- 3.7'' to 7.7'' field-of-views (wavelength-dependent)

Composition and Activity of Periodic Comets



The composition and dynamics of dust and gas in the comae can be studied using MIRI and NIRSpec. MIRI LRS data from 5–14 microns can be used to characterize the composition of the dusty component of the comae, and will be sensitive to the emission features of silicates, PAHs and other large organic molecules. The LRS data also provide sensitive constraints on the temperature of the dust and its grain-size distribution. MIRI 10 – microns images of the comae and near-nucleus dust trails can also be obtained. The images will reveal jet structures in the coma, providing constraints on the rotation state of the nucleus, as well as the dust production rate and velocity of ejection. Each comet would be observed twice to sample activity at different phases in its orbit.

Comet Halley's Nucleus: An Orbiting Iceberg
Halley Multicolor Camera Team, Giotto Project, ESA

NIRSpec medium resolution spectra will enable characterization of broad emission lines from H_2O, CO_2 and organic molecules in the gas phase. These spectra will also be highly sensitive to the presence of water ice and silicates in the dust grains of the coma. Spectra will be taken of the region surrounding the comet nucleus to characterize the gas and dust composition before interactions with UV and chemical evolution have taken place, and also at a position offset from the nucleus to characterize the photochemical processes in the coma.

NIRSpec high resolution spectra will be used to measure abundances of higher-order organic molecules, and to measure the D-H ratio of the water in the coma. As with the medium resolution data, spectra will be acquired both on the nucleus and at an offset position.

See more at www.stsci.edu/jwst and jwst.nasa.gov
and do your own ETC calculations at jwstetc.stsci.edu/etc