The Mid-Infrared Instrument (MIRI) for JWST

- **MIRI** is a NASA/JPL-led partnership with a European Consortium sponsored by ESA
  - NASA provides focal planes, signal chain
  - Consortium provides optical bench assembly

- **Functional capabilities include**
  - **Imaging**
    - $\lambda=5$-$27$ $\mu$m wavelength range
    - Diffraction limited imaging with 0.1” pixels
    - ~2 square arcmin field of view
    - Low resolution spectrograph ($R\sim100$; $\lambda=5$-$10$ $\mu$m) for single, compact sources
    - Coronagraph
  - **Spectroscopy**
    - $\lambda=5$-$27$ $\mu$m wavelength range, goal to reach $\lambda=28.3$ $\mu$m
    - Integral field spectroscopy with fields of view of 3” or more
    - $R\sim3000$ - 1000 from $\lambda=5$-$27$ $\mu$m

**Science team**

“Having NGST’s sensitivity extend to 27µm would add significantly to its scientific return.” .. “NGST would gain its greatest advantage over any ground-based telescope at the longer infrared wavelengths.” – Astronomy and Astrophysics in the New Millenium (McKee-Taylor decadal survey)
“NGST will cover the spectrum out to wavelengths of at least 5\(\mu\)m …extending the sensitivity of NGST farther into the thermal infrared would greatly increase its ability to study galaxies at high redshifts.” – Astronomy and Astrophysics in the New Millenium

All three objects at \(z = 15\).
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MIRI observations become essential if there is a small amount of reddening due to foreground damped Lyα systems.

NIRCam B4-B6 within 0.2 magnitudes for all three objects.

Flux (Jy), arbitrary norm.

100

10

wavelength (microns)

1.00E+05

1.00E+06

1

1.6

2.5

4

4.2

4.4

4.6

4.8

5

+ AV ~ 0.4 @ z = 3

first light: stars

older galaxy

quasar

NIRCam

MIRI
“[to trace quasar evolution] to earlier epochs we will require high-sensitivity detections in the near-to-mid-IR. The next generation of surveys will begin with the Space Infrared Telescope Facility (SIRTF) and be carried to unprecedented depths by JWST.” – Origins Roadmap

What were the properties of the first quasars, at $z = 10 - 20$?

NIRCam and MIRI will be needed together to compare their properties with those at lower redshift.
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mm-wave & far infrared probe the accretion disks and extended envelopes

actual protostars are accessible through their mid-infrared emission
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"The initial steps toward planet formation occur in the surrounding disk of material that avoids either falling into a forming star or being ejected in outflows…. JWST will penetrate the obscuration to image these disks.

“.. continuum and spectral line observations must be conducted at angular resolutions of 0.1 – 1.0 arcsec (10 – 100 astronomical units in the nearest star-forming regions).” --Origins Roadmap
“SIRTF will give us our first hints concerning gas and dust dispersal,

Debris Disks

(model of Vega system by Wilner et al. for submm)
“SIRTF will give us our first hints concerning gas and dust dispersal, but follow-on large space-based telescopes such as JWST and SAFIR are ideally suited to track the evolution and map the structure of vestigial debris disks around nearby main-sequence stars.” – Origins Roadmap

(model of Vega system by Wilner et al. for submm)
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