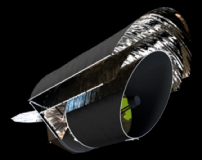
ORIGINS Space Telescope | From first stars to life



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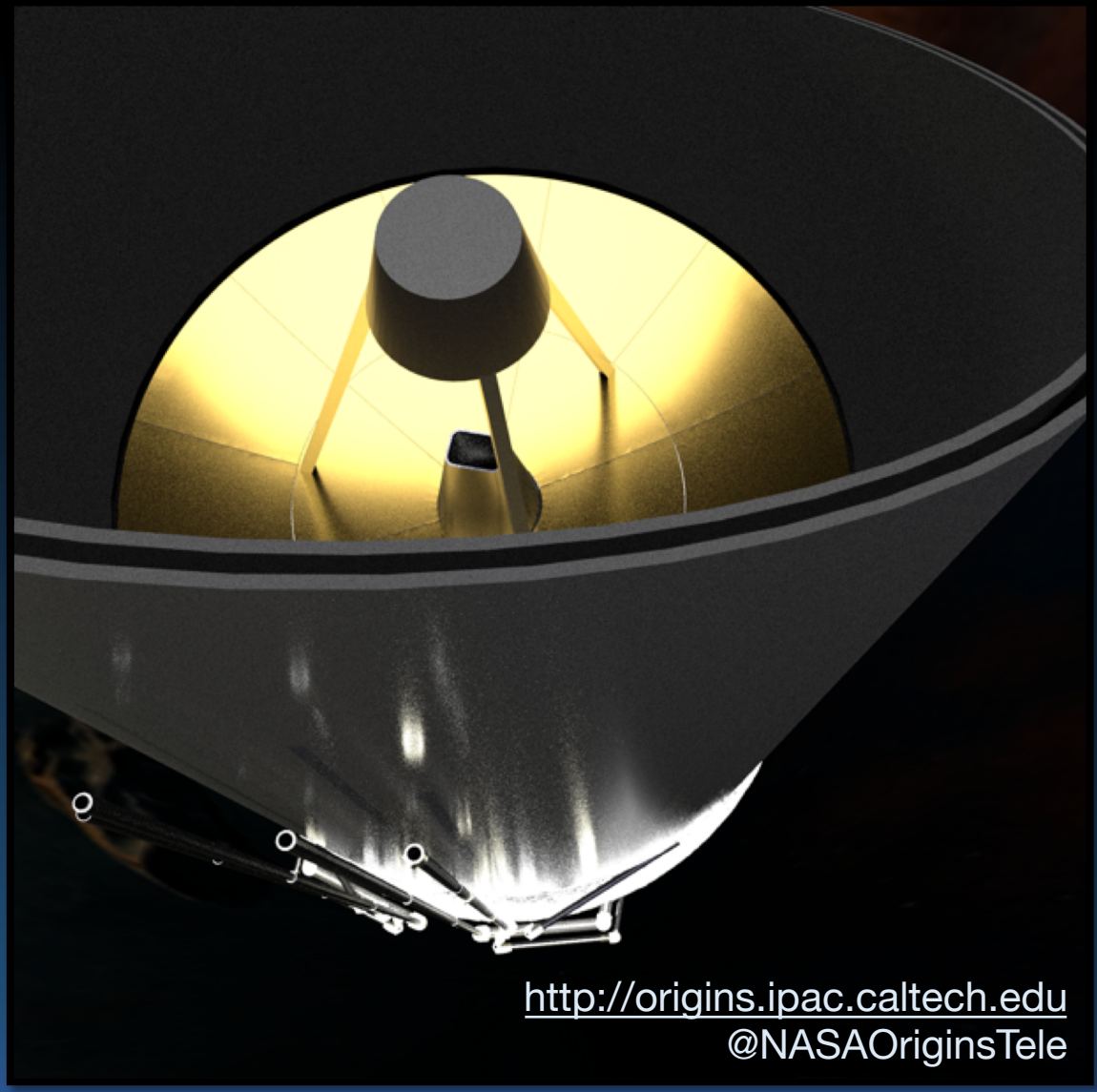
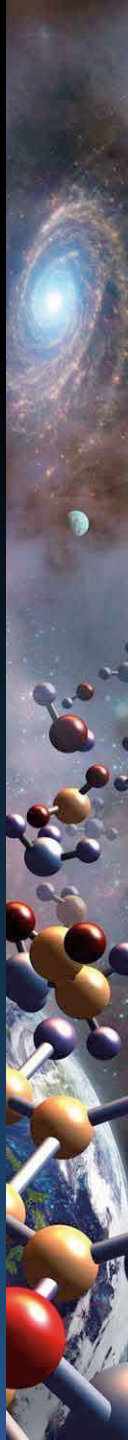
Origins

Klaus Pontoppidan
Space Telescope Science Institute

On behalf of the Origins Science and Technology Definition team



http://origins.ipac.caltech.edu
@NASAOriginsTele



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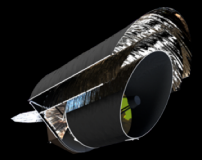

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By the community, for the community

- Through the Astrophysics Roadmap, the community expressed interest in a “Far-IR Surveyor” mission.
- Origins Space Telescope one of 4 NASA flagship concepts to be submitted to the 2020 decadal survey.

Origins Science and Technology Definition Team

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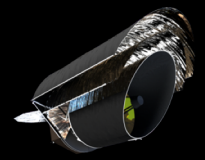

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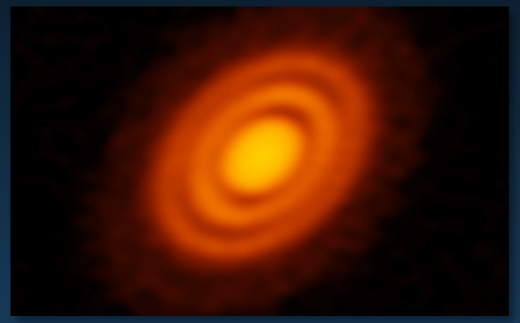
Three science themes



I. *How does the Universe work?*
How do galaxies form stars, build up metals, and grow their central black holes from reionization to today?

II. *How did we get here?*
How do the conditions for habitability develop during the process of planet formation?

III. *Are we alone?*
Do planets orbiting M dward stars support life?

IV. *Discovery space*
Dominated by general observer programs

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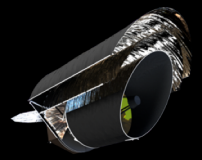

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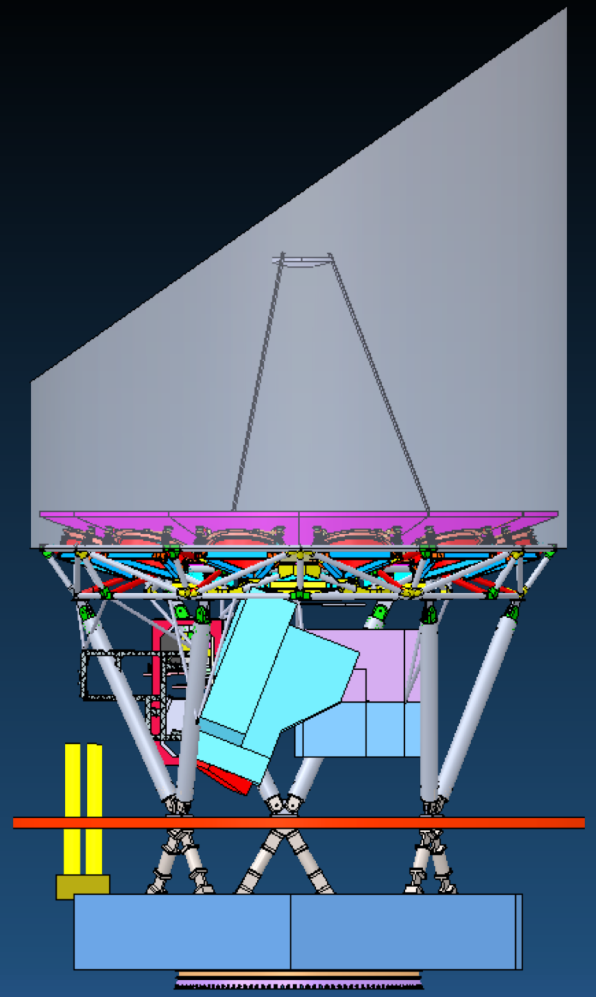
Baseline Mission Concept

- Only 1 new and simple Deployment: sunshield
- Launch on SLS or BF3, orbit at L2
- Wavelength Coverage 3-600 μm
- Telescope: JWST-size collecting area, ~25 m^2
- Cold telescope & instruments: ~4.5 K
- Three optimized instruments
- Fast motion of telescope: 60 arcseconds/second
- Affordable at current funding levels
- Detectors are the major technology development



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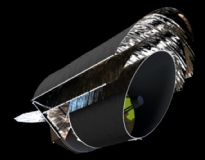

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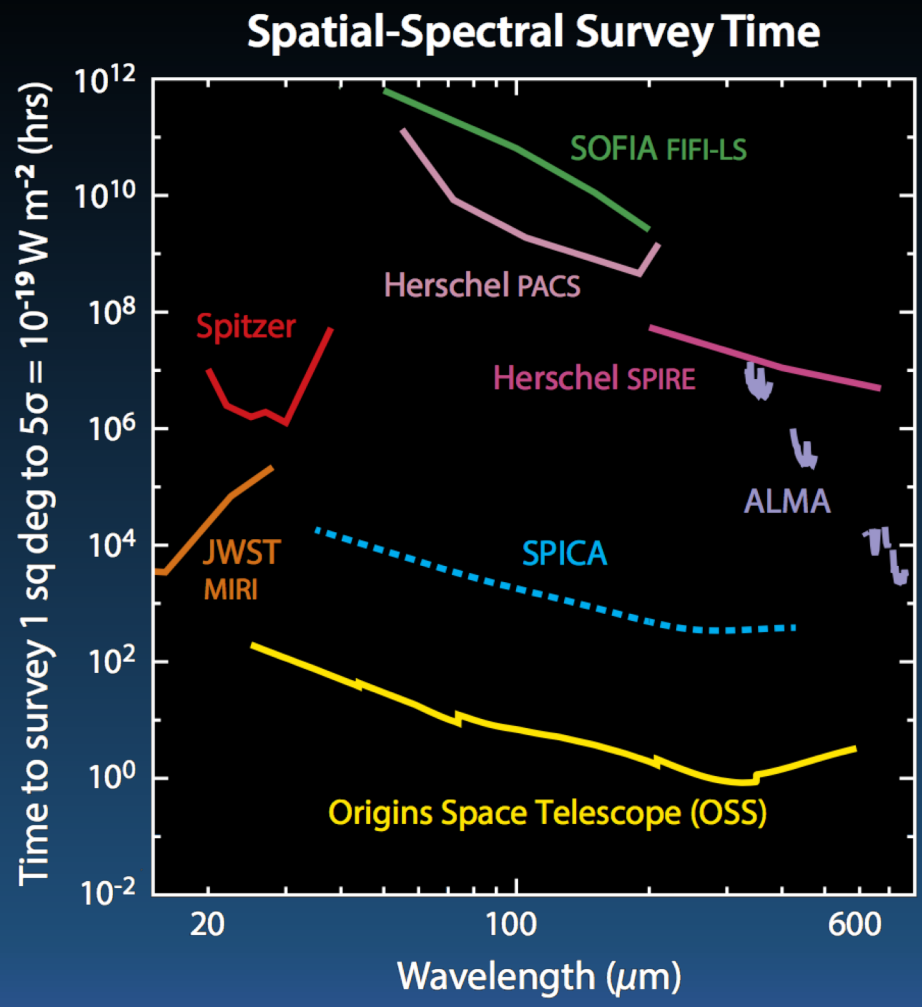
1000x better sensitivity -10^9x faster surveys

Equivalent difference for an optical telescope to achieve 1000 times higher sensitivity



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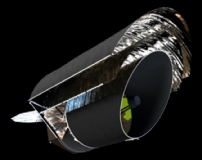

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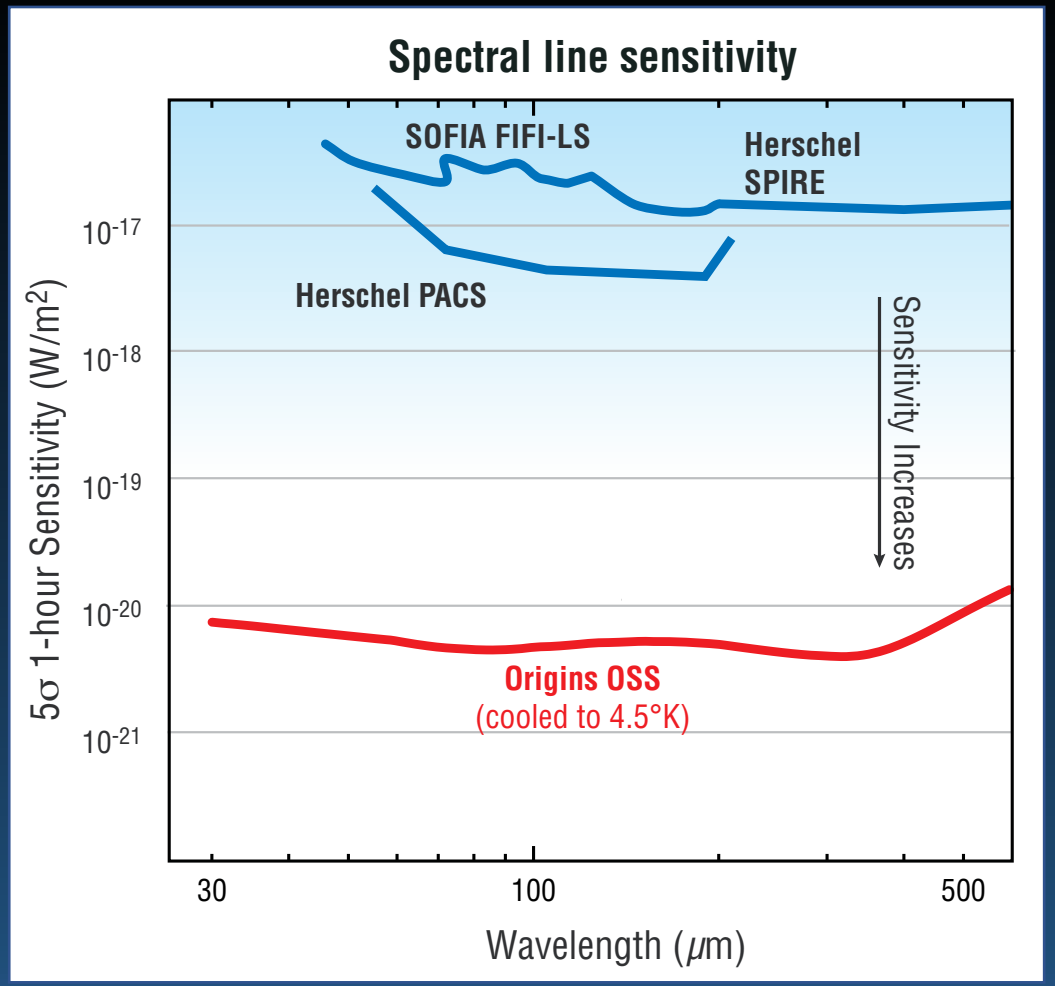

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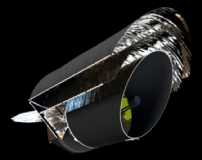

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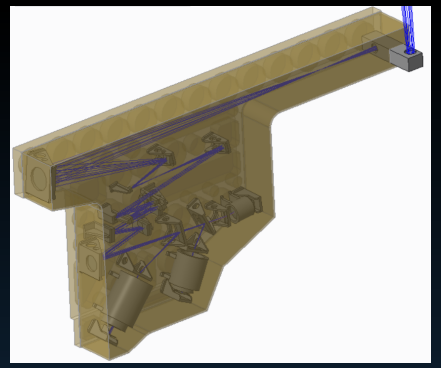
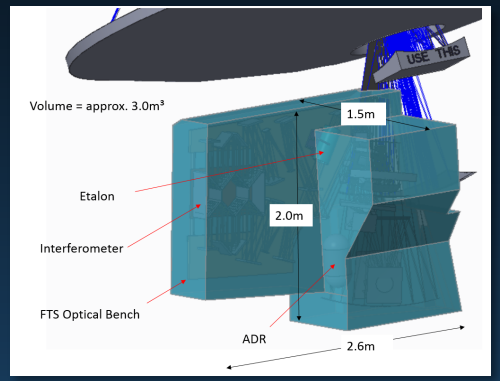
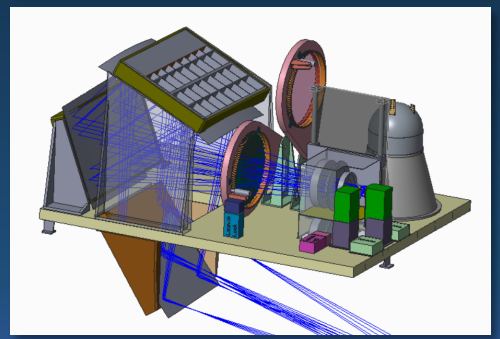
Instruments







Instrument	Wavelengths (μm)	Instantaneous Field of View	Observing Modes
MISC Mid-Infrared Spectrometer	2.8–20 (simultaneous)	5" (2.8 - 10.5 μm) 3."4 (10.5 - 20 μm) set by field stop	Transiting exoplanet spectrometer
OSS Origins Survey Spectrometer	25–590 (simultaneous) 100-200 (with Etalon)	14' slit (grating mode); single beam (high-resolution modes)	R = 300 grating spectroscopy with wide-field survey capability R = 43,000(112 μm/λ) FTS R = 325,000(112 μm/λ) Etalon
FIP Far-Infrared Imager and Polarimeter	50 and 250 (two bands)	3.'6 x 2.'5 (50 μm) 13.'5 x 9' (250 μm)	Broadband imaging, pointed observations or wide-field survey; polarimetry

The OSS FTS mode offers a 1000-fold improvement to previous line sensitivities at high spectral resolution.

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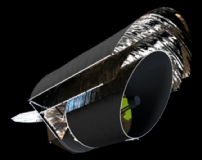

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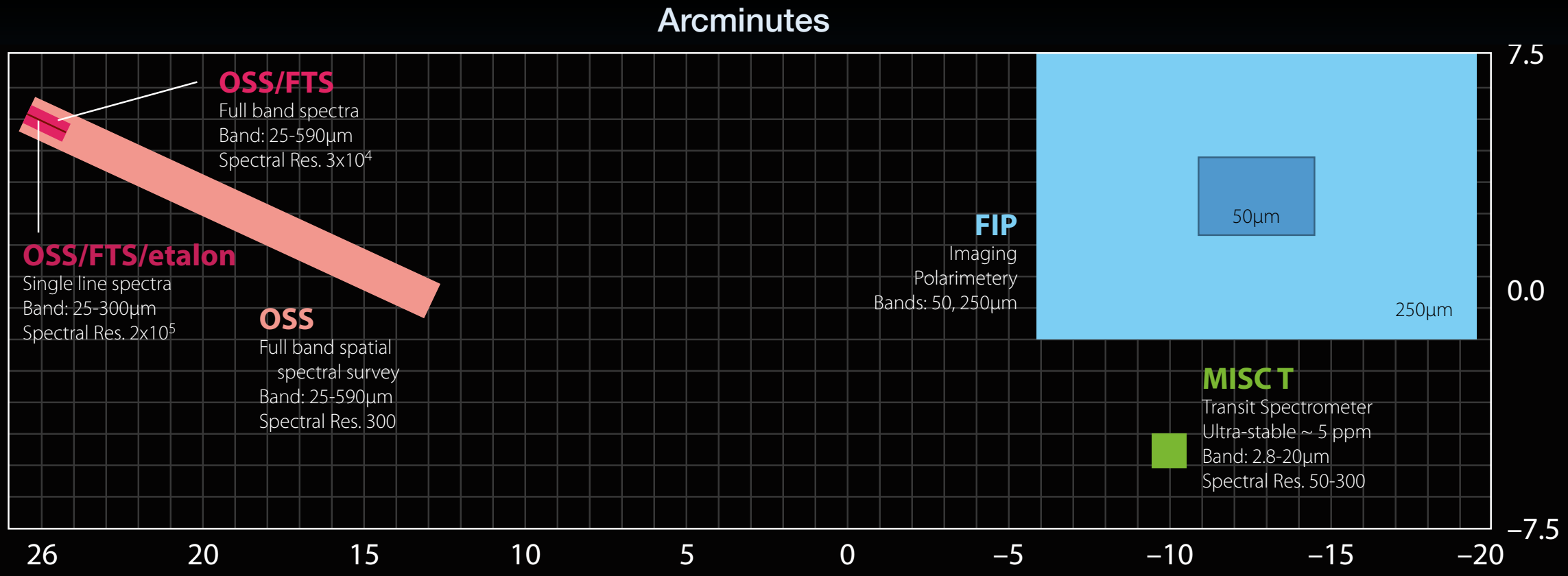
Instrument focal plane



OSS = Origins Survey Spectrometer
FIP = Far-infrared Imager and Polarimeter
MISC T = Mid-Infrared Transit Spectrometer
FTS = Fourier Transform Spectrometer for OSS

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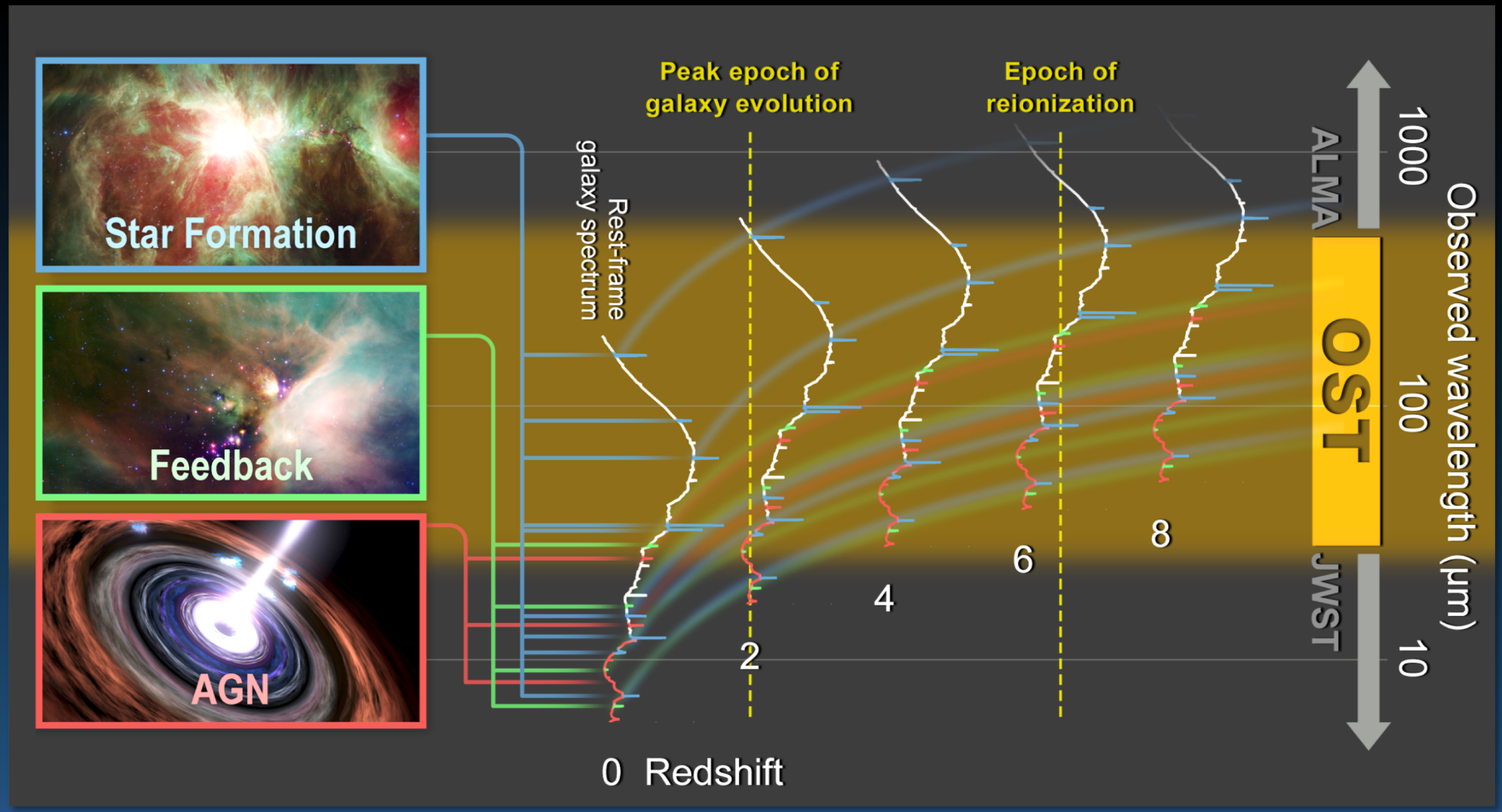
Tracing galaxy and black hole growth through cosmic time



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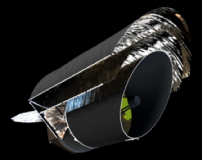

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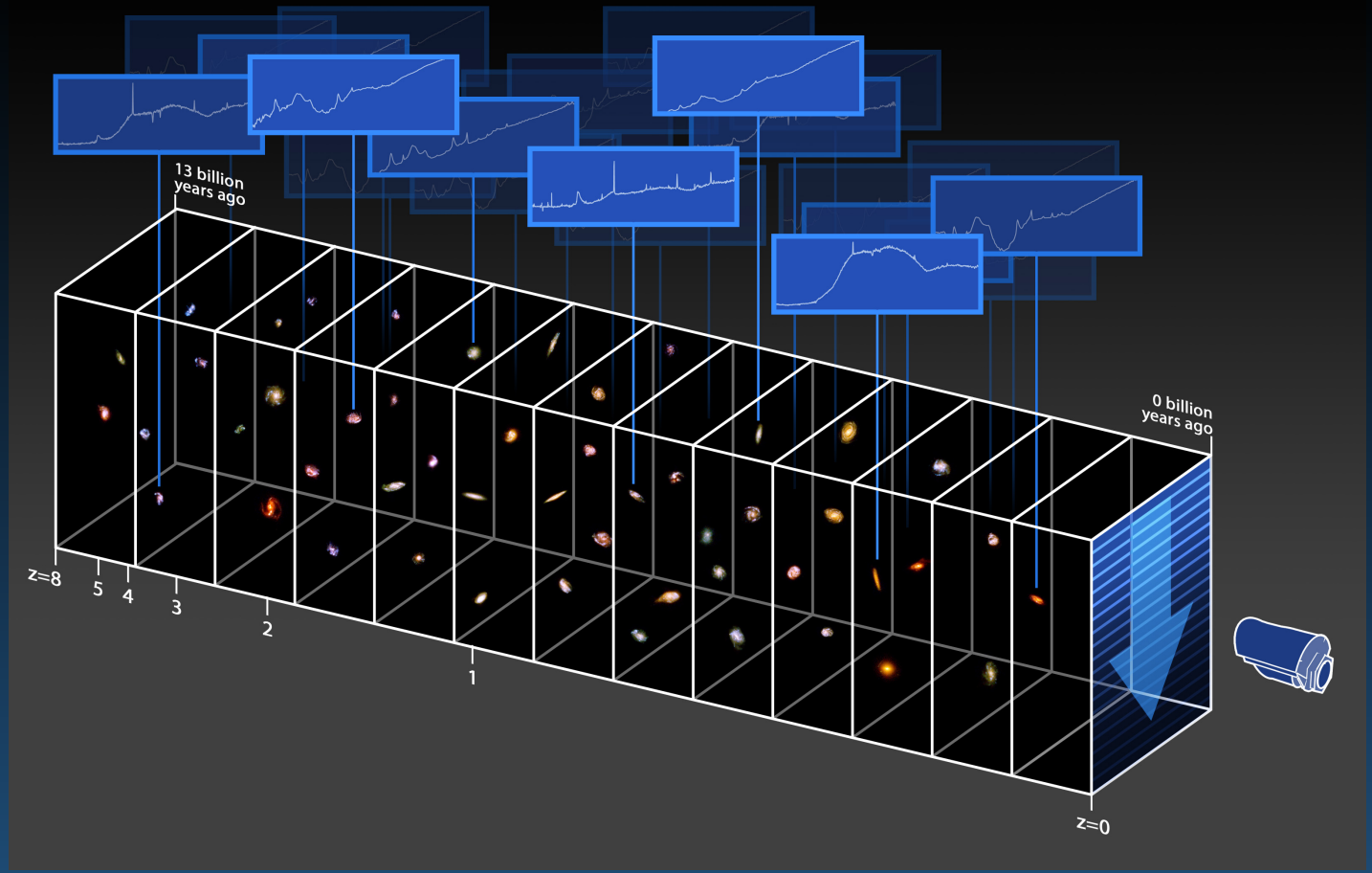
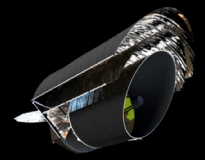
Origins mapping speeds enables vast unbiased galaxy surveys

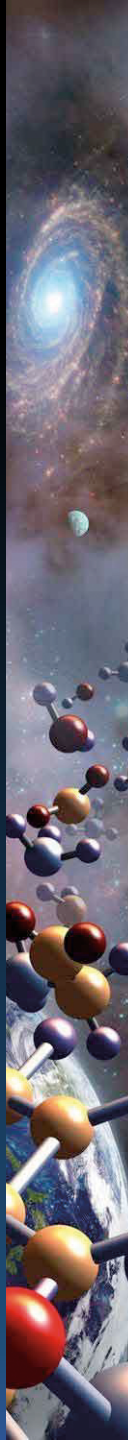
- Measure how galaxies form stars, build up metals, and grow their black holes from reionization (z=0-8) to today.
- Using massive, and deep, 3D surveys of millions of galaxies:
  - measure star-formation and black hole-accretion rates over 95% of cosmic time
  - trace the rise of metals, dust and organic molecules
  - measure galactic outflows and feedback over the past 10 Gyr





Following the trail of water

TRACING WATER EMISSION IN DISKS



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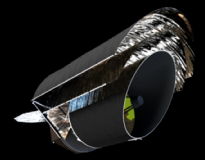

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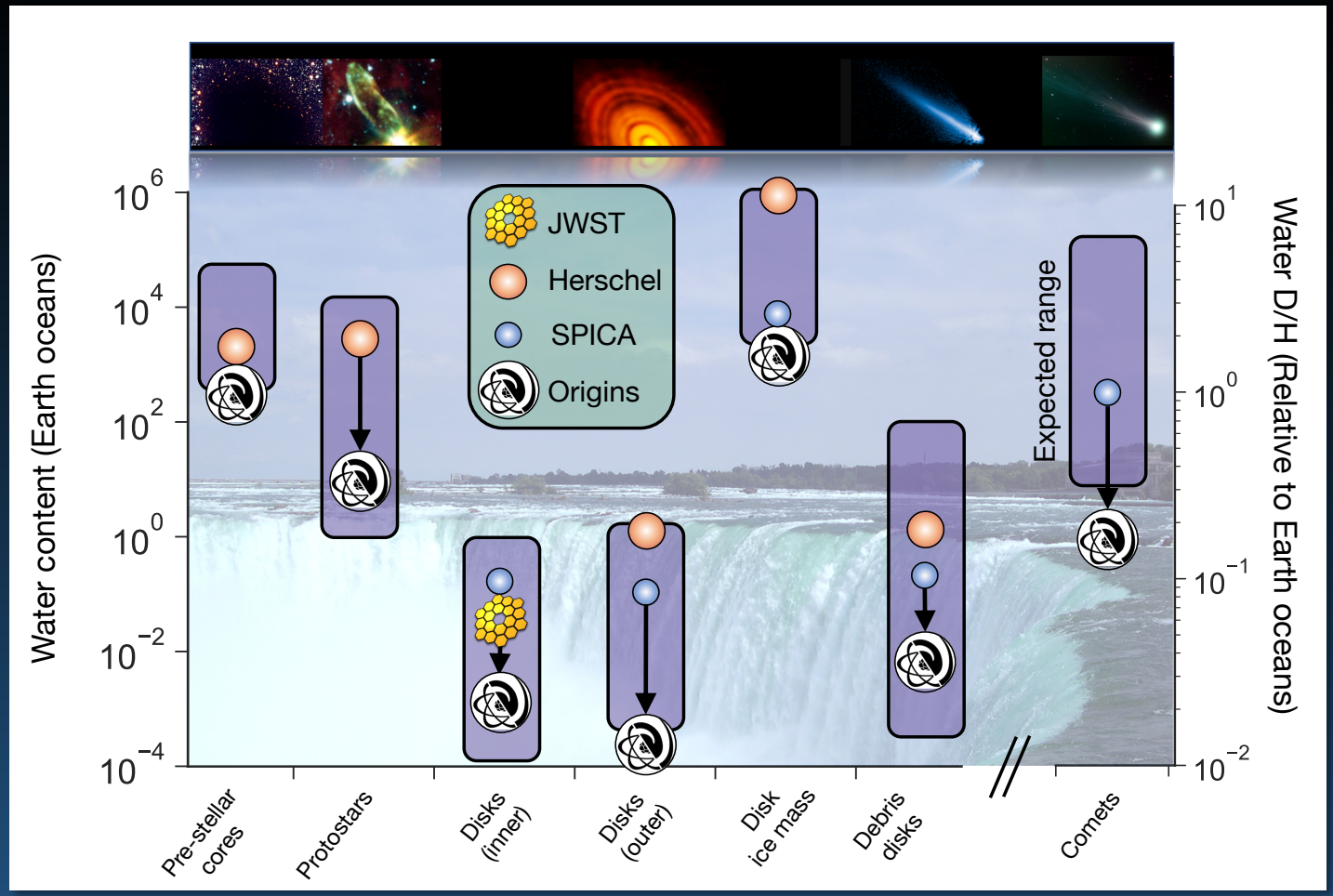
Water and disk masses across all evolutionary stages

- Detect nearly the entire rotational spectrum of water in 1000 planet-forming disks to reveal the trail of life's ingredients.
- Use the ground-state line of deuterated hydrogen (HD) to determine the planet-forming mass in disks.
- Measure the D/H ratio in over 100 comets to understand the delivery of water to our own inhabited planet.



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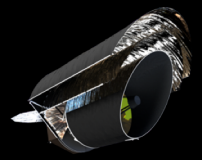

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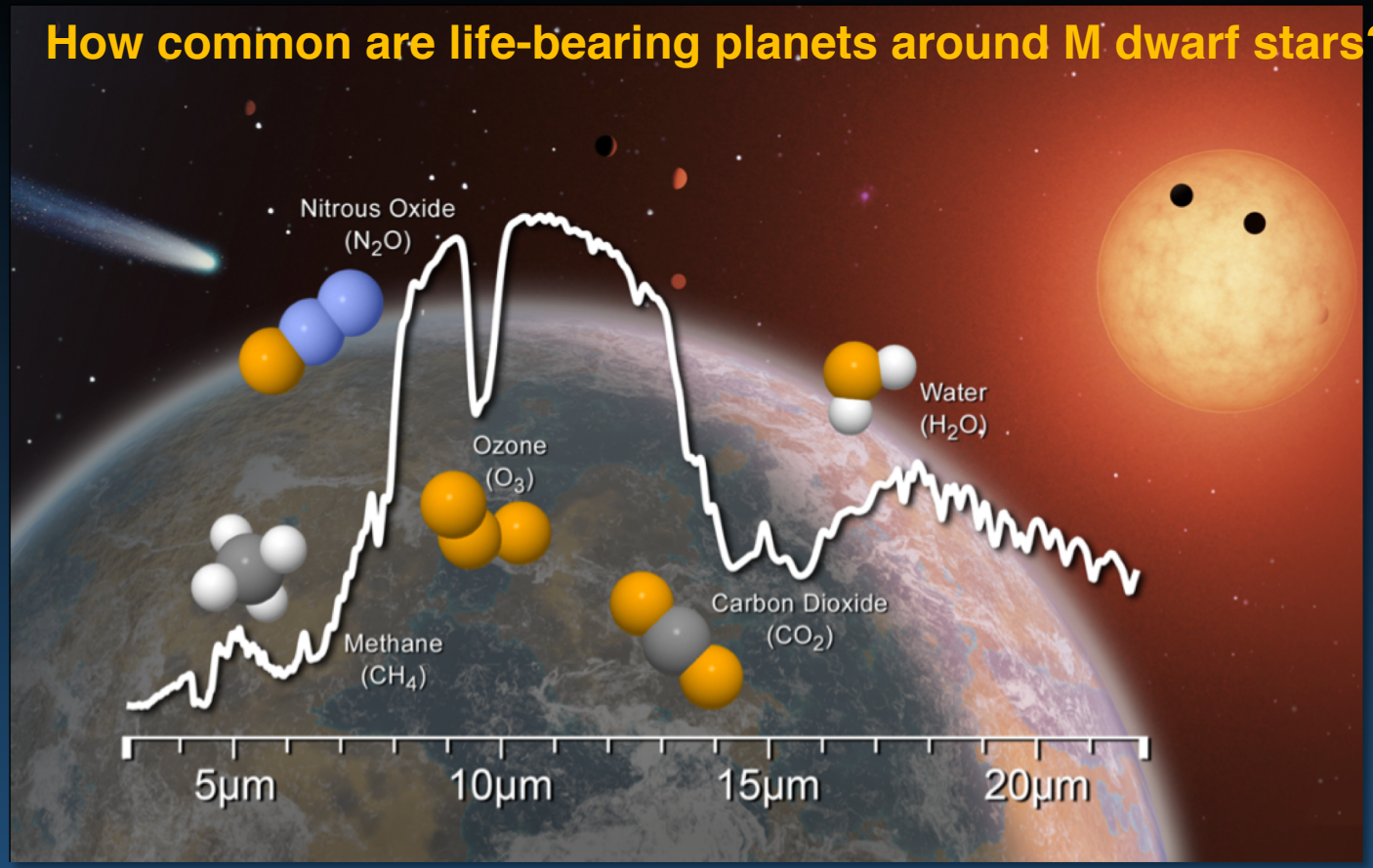
Searching for biosignatures in M-dwarf planets

- Assess the habitability of nearby exoplanets and search for signs of life.
- Constrain the presence of bio-indicators (H_2O and CO_2) and biosignatures (O_3, N_2O and CH_4) in rocky planets transiting M dwarfs.
- Be capable of answering the age-old question of "Are we alone?"



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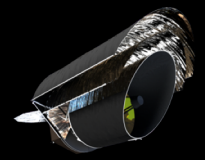

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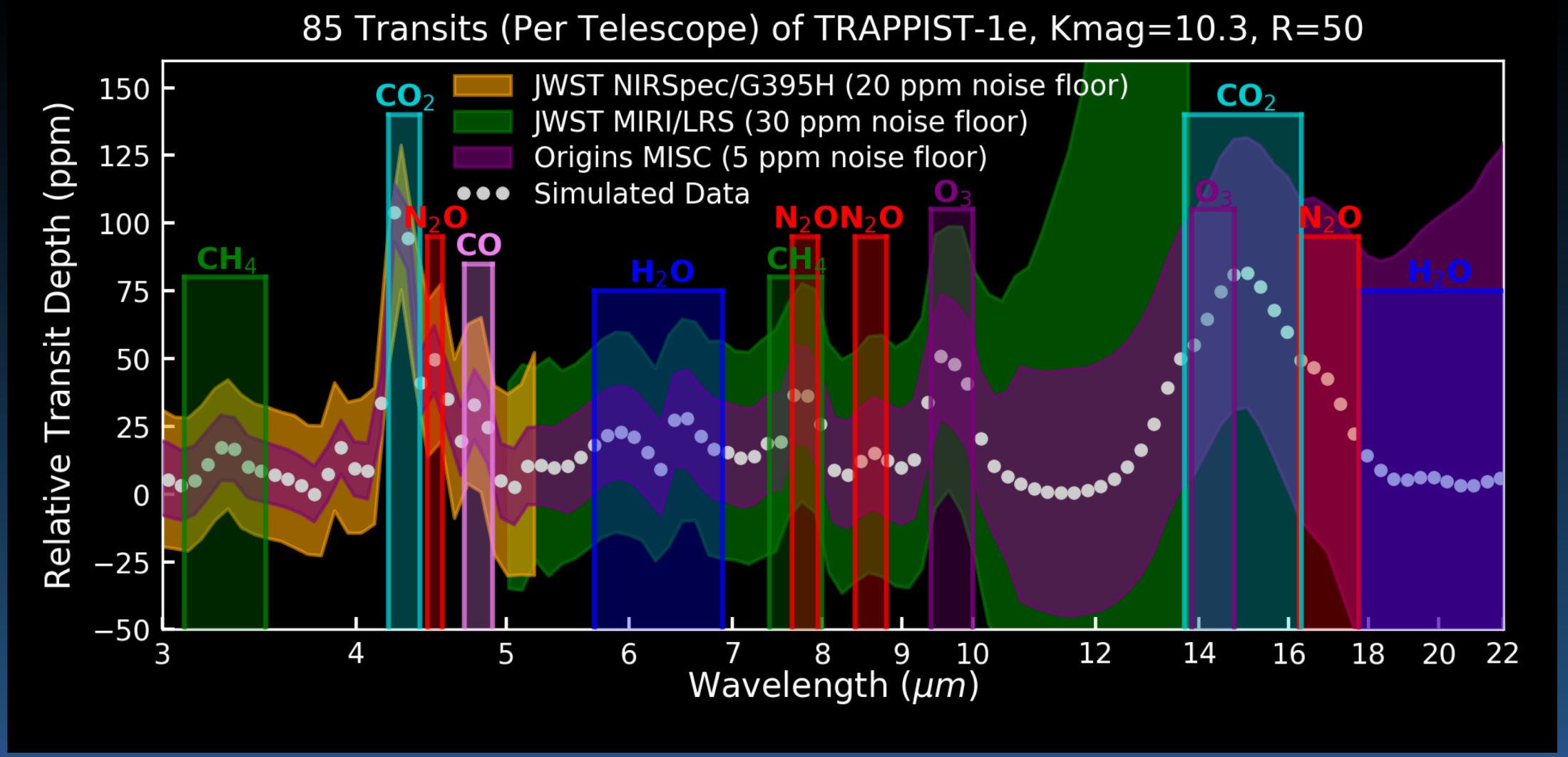
Detections of biosignatures require 5ppm precision



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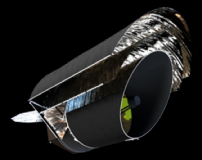

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Open vast, new discovery space

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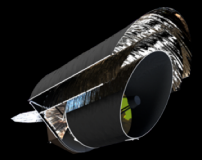

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Contact and next steps

- Meet the *Origins* team at the NASA booth
- Try the *Origins* Virtual Reality experience!
- Many *Origins* posters in multiple sessions
- Join the *Origins* Scavenger hunt!
- Follow us on @NASAOriginsTele
- More information on http://origins.ipac.caltech.edu

Consider *Origins* when preparing decadal white papers