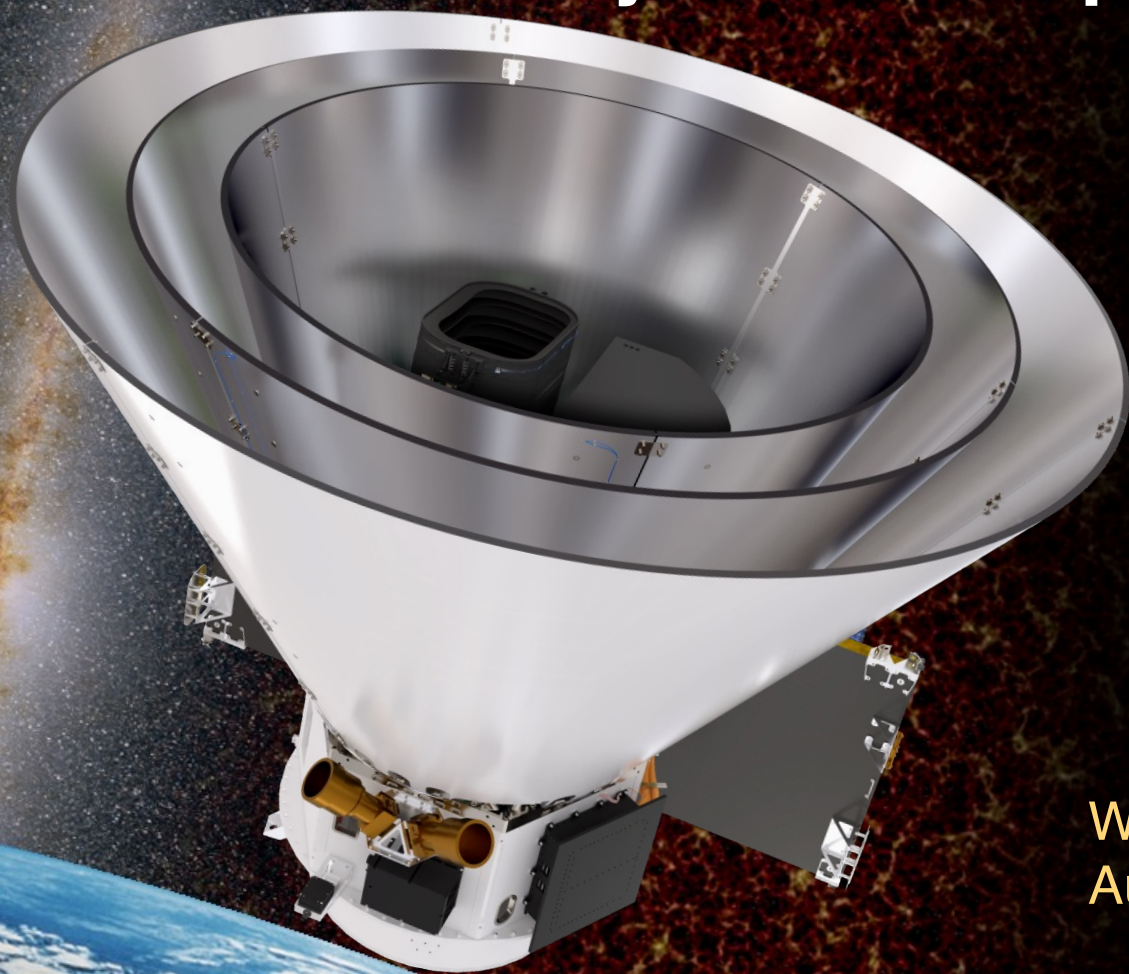


SPHERE^x: An All-Sky Infrared Spectral Survey Satellite



Designed to Explore

- Origin of the Universe
- Origin and History of Galaxies
- Origin of Water in Planetary Systems

First All-Sky Near-IR Spectral Survey

A Rich Legacy Archive for Astronomy
with 100s of Millions of Stars and Galaxies

Windows on the Universe
August 06, 2023

Howard Hui — Caltech
For the SPHEREx Collaboration



Howard Hui - Caltech

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				Michael Zemcov	RIT

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SPHERE^x ADDRESSES 3 FUNDAMENTAL QUESTIONS



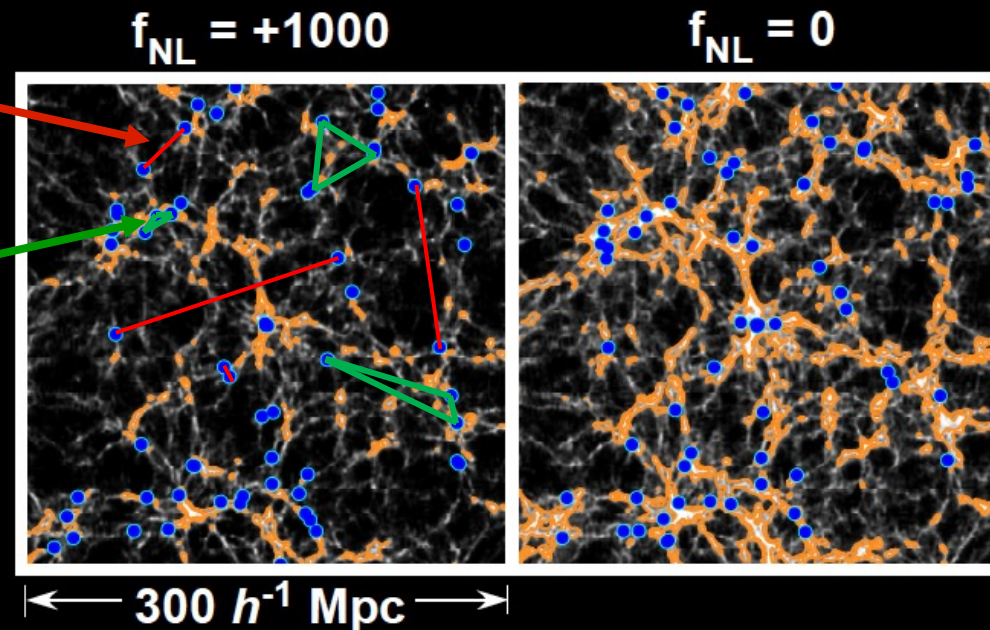
How Did the Universe Begin?

Probe the physics of the young inflationary Universe through the 3D spatial distribution of galaxies

Quantified through the Power Spectrum via 2 point correlation function

And the BiSpectrum via the 3 point correlation function

f_{NL} Affects the clumpiness of galaxies.
Probes the non-gaussianity at early times.



Non-Gaussianity appears on largest spatial scales – need a large volume survey

SPHERE^x ADDRESSES 3 FUNDAMENTAL QUESTIONS



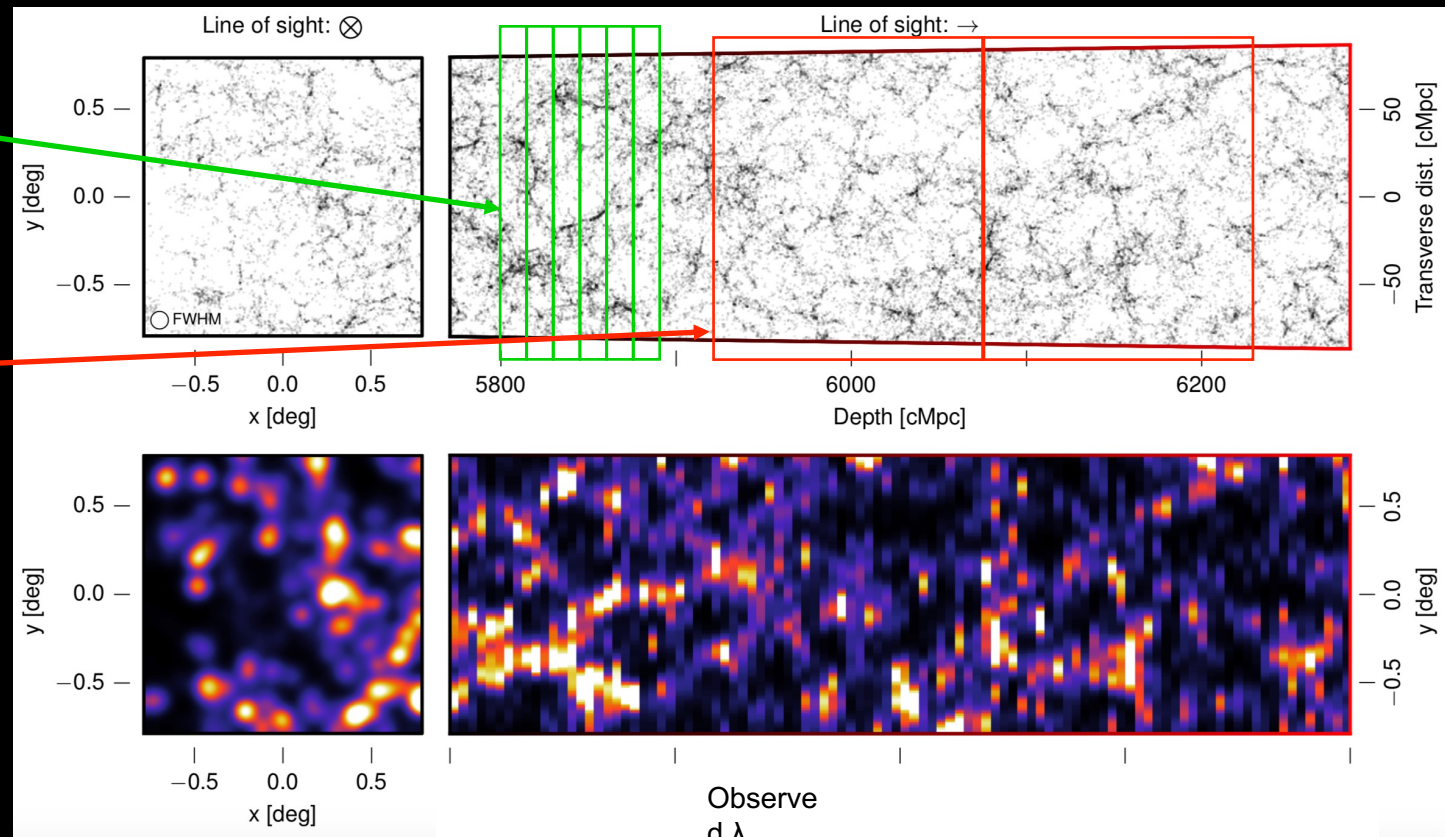
How Did Galaxies Begin?

Study the cosmic history of light production through near-infrared background fluctuations

Measurements in fine bins trace line emission

Measurements in coarse bins trace continuum emission

Power spectra allow us to quantify the measurements and compare to models

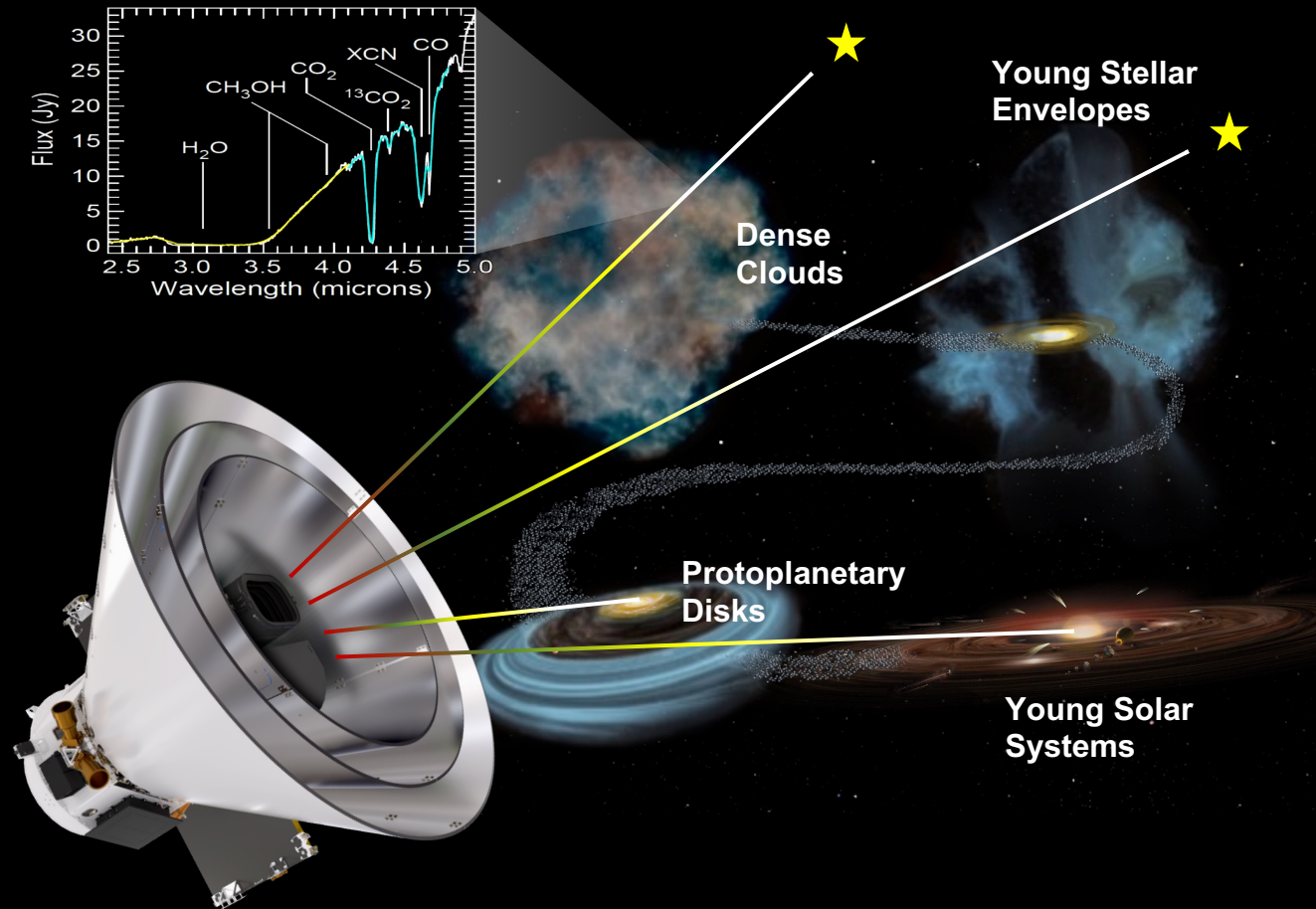


SPHERE^x ADDRESSES 3 FUNDAMENTAL QUESTIONS



What are the Conditions for Life Outside the Solar System?

Survey the Milky Way for water ices and other biogenic molecules



SPHERE^x ADDRESSES 3 FUNDAMENTAL QUESTIONS



How Did the Universe Begin?

Probe the physics of the young inflationary Universe through the 3D spatial distribution of galaxies



How Did Galaxies Begin?

Study the cosmic history of light through near-infrared background fluctuations



What are the Conditions for Life Outside the Solar System?

Survey the Milky Way for water ices and other biogenic molecules

By constructing the first all-sky near-infrared spectral survey

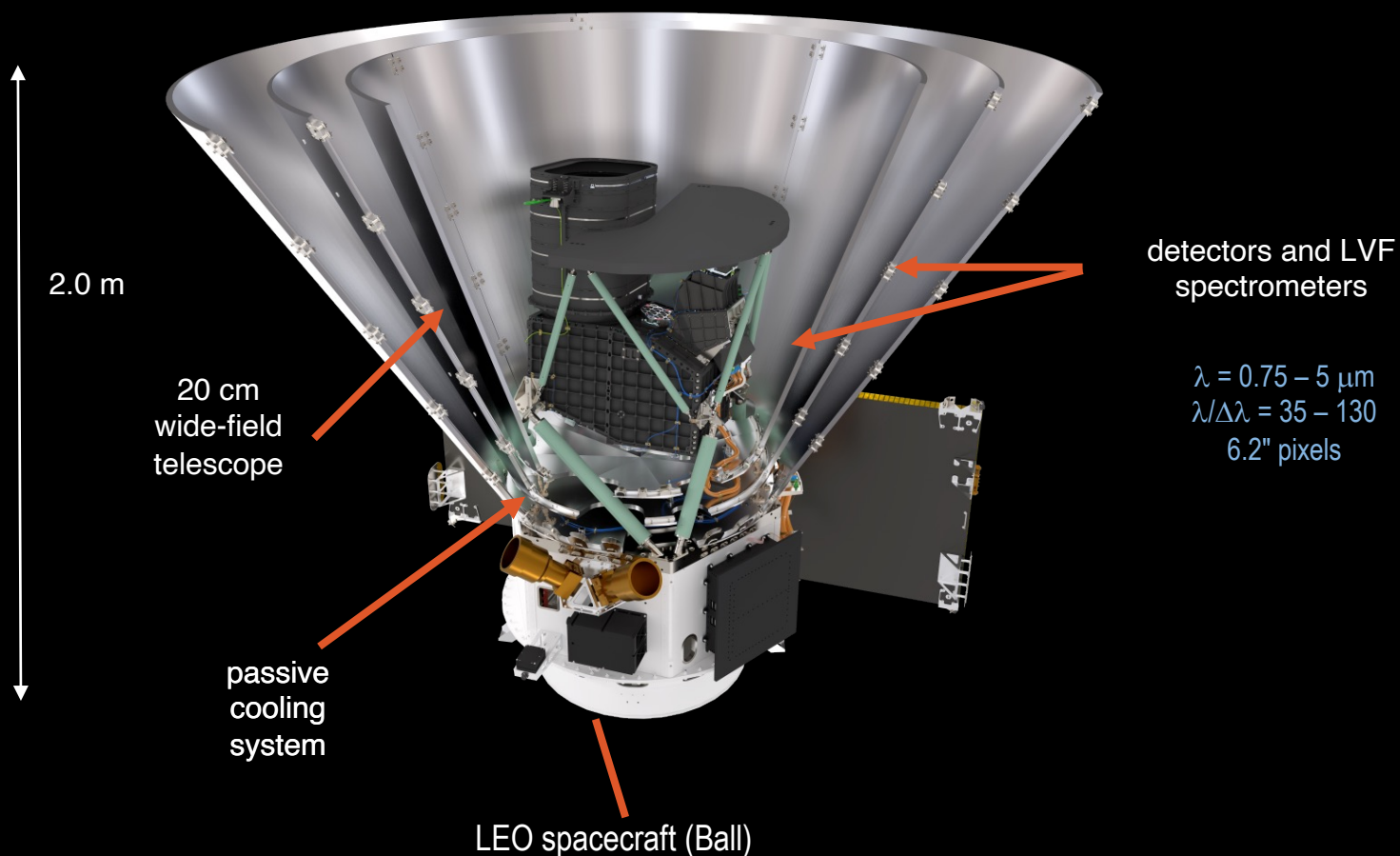
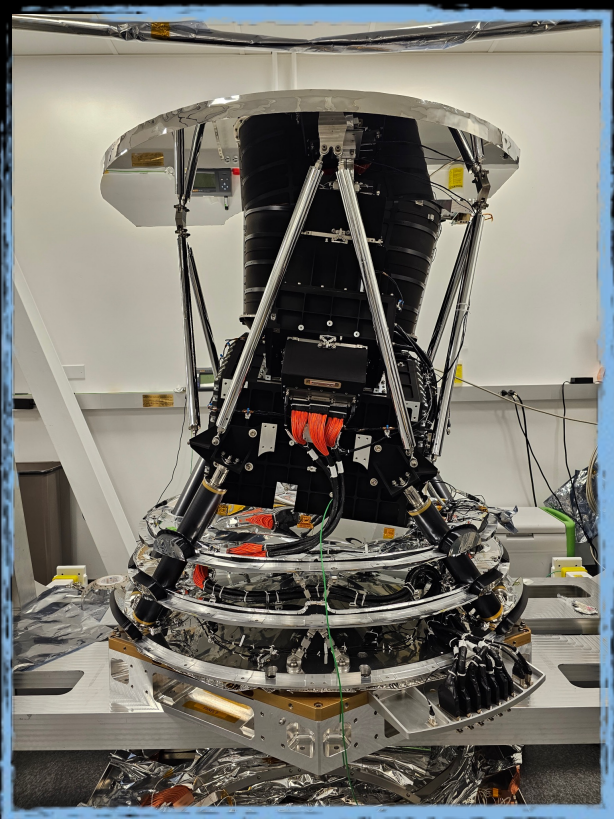
- *For every 6.2" pixel over the entire sky:*
 - *R = 35-41 spectra spanning 0.75 to 3.82 μm*
 - *R = 110-130 spectra spanning 3.82 to 5.0 μm*
- *All-sky survey with 102 fine photometric bands*

On target to launch in early 2025!

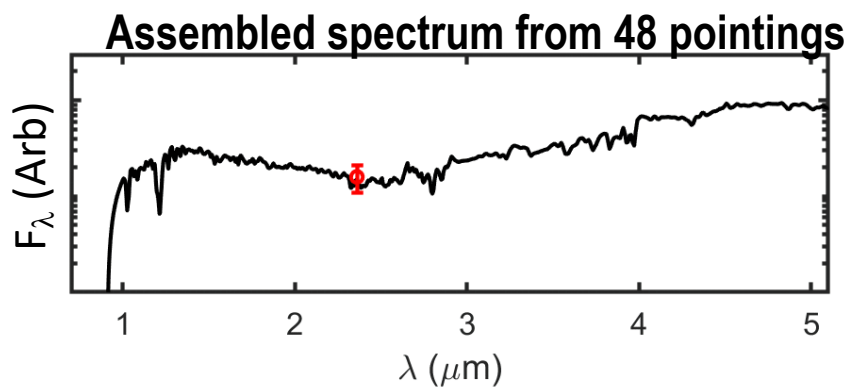
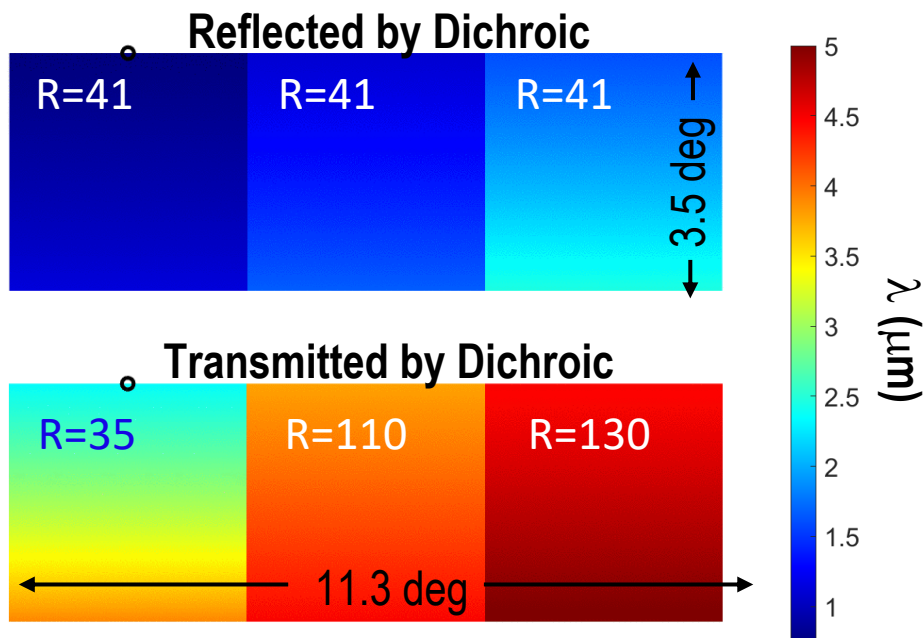
SPHEREx^x instrument



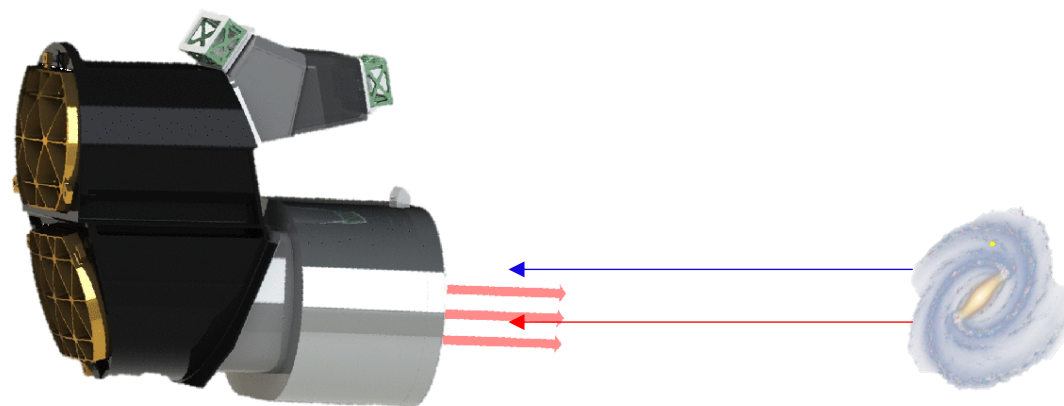
- 3-Mirror off-axis anastigmat
- 20 cm effective aperture
- 3.5° x 11.3° FOV
- 25 million 6.2" pixels



SPHEREx^x Focal Planes & LVFs



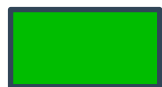
- 6 x 2048 x 2048 H2RG Arrays
- Linear-Variable Filters
 - $\lambda = 0.75 - 5 \mu\text{m}$
 - $\lambda/\Delta\lambda = 35 - 130$



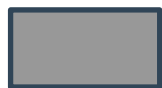




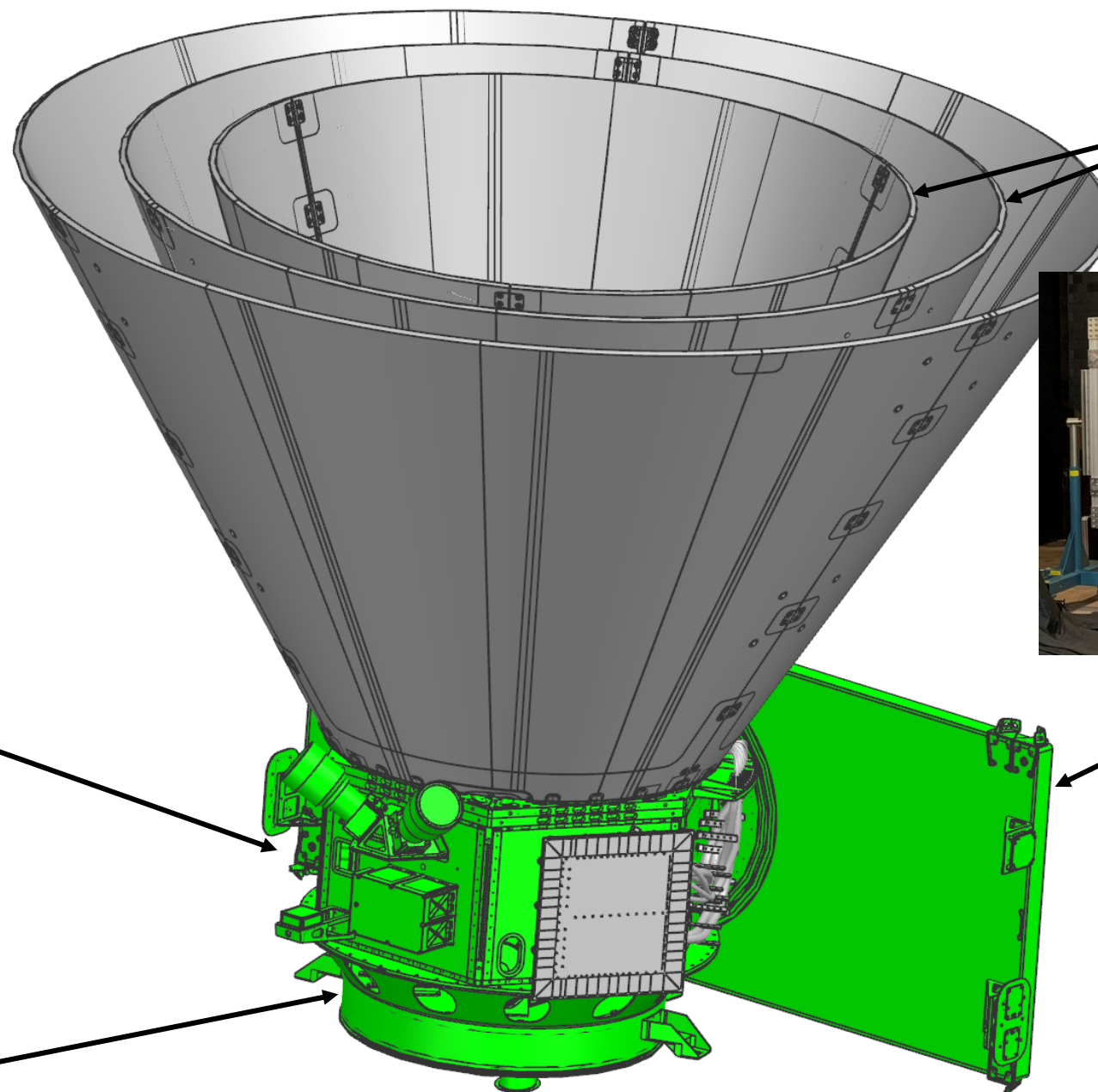
FLIGHT HARDWARE RECEIVED



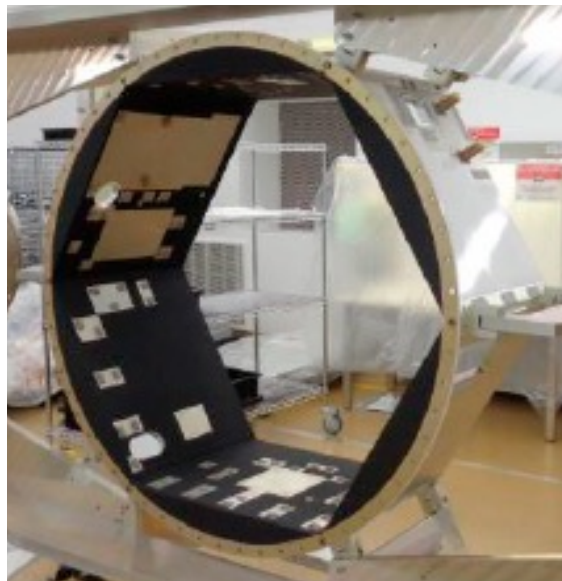
Delivered



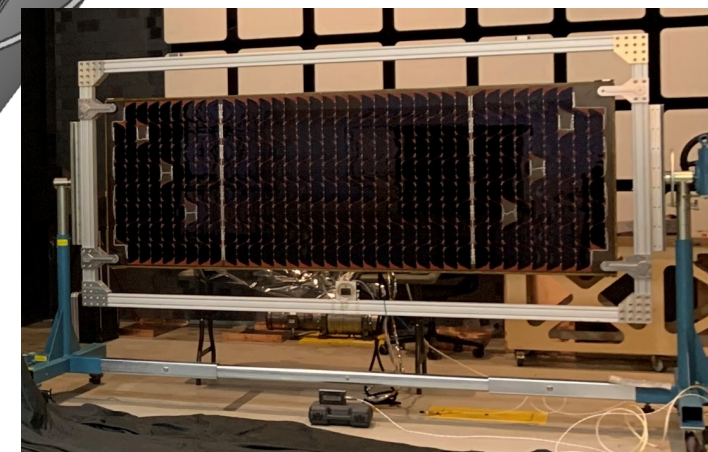
Delivery Pending



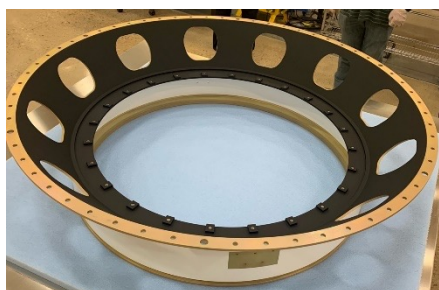
Photon Shields
Delivery 9/2023



Spacecraft Structure

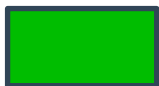


Solar Panel



LV Conic Adapter

FLIGHT HARDWARE RECEIVED



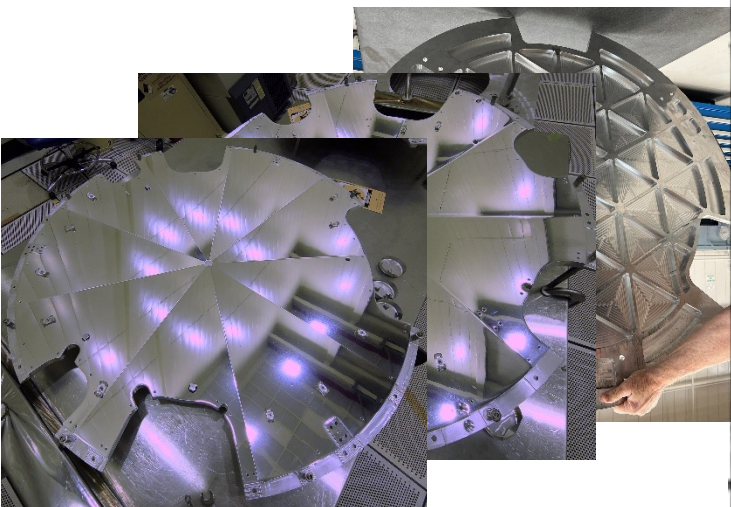
Delivered



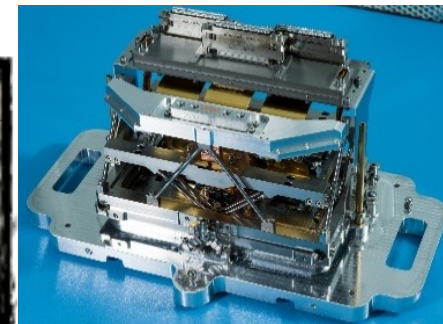
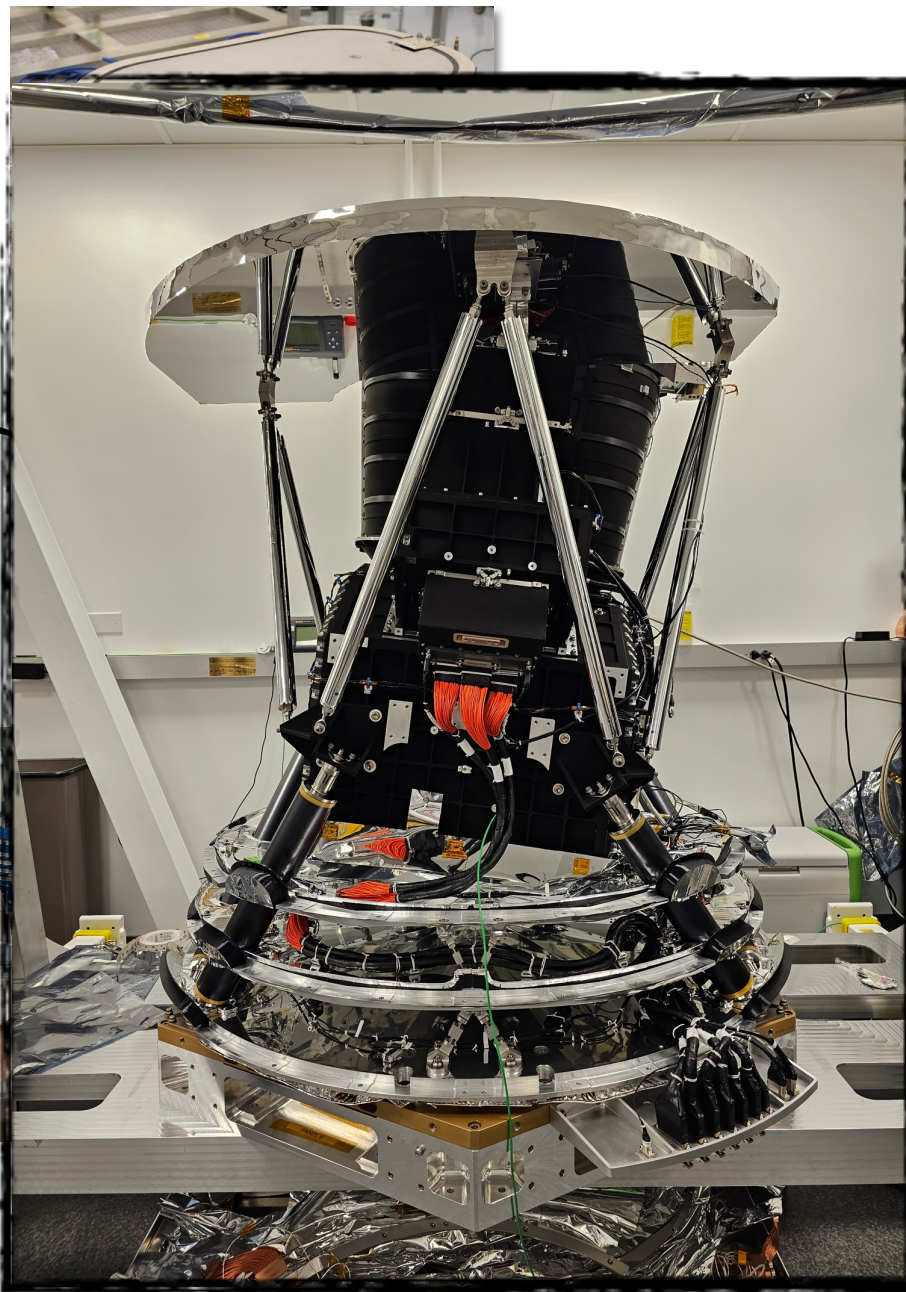
Delivery Pending



Telescope



V-Groove Coolers



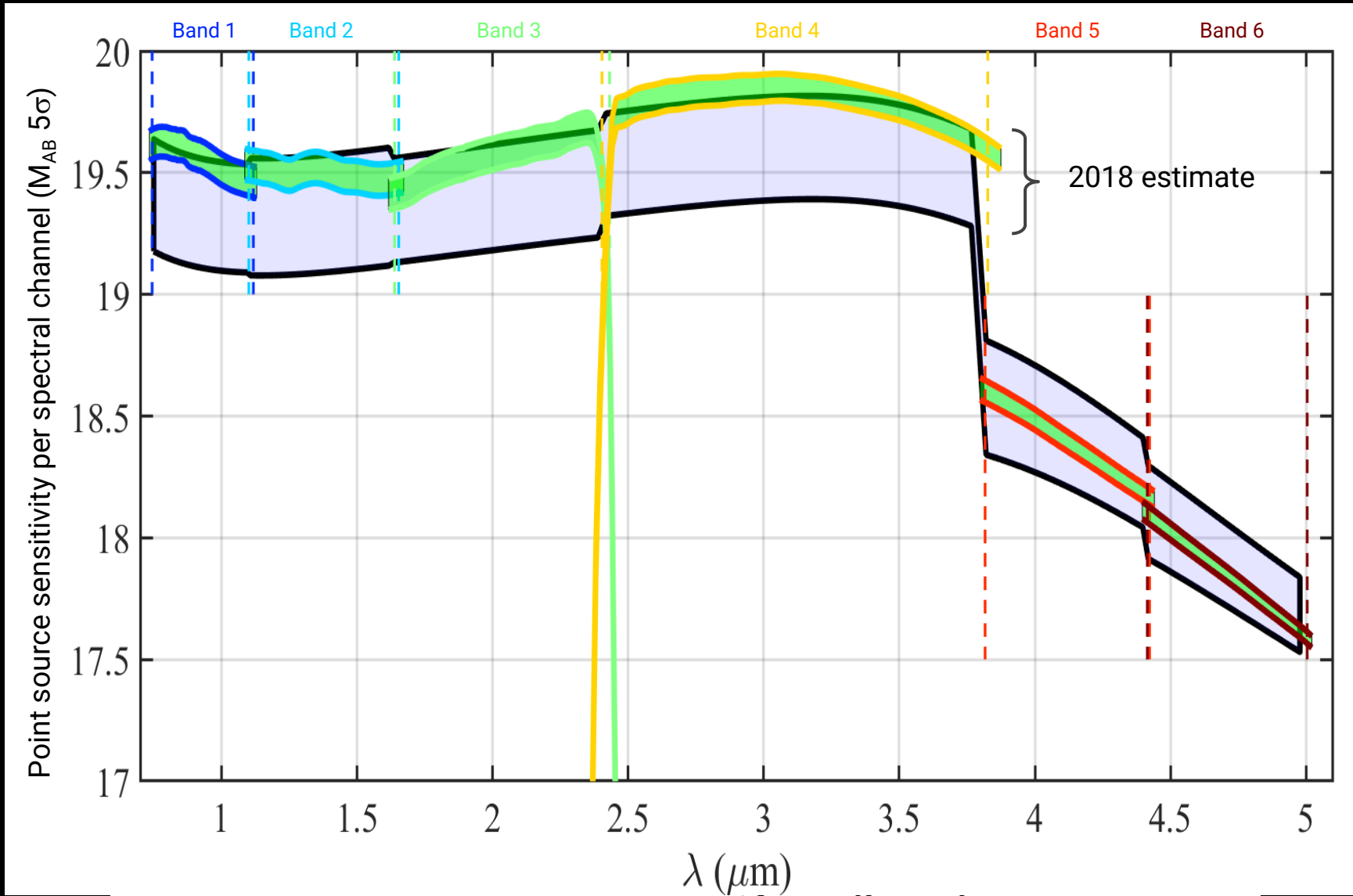
Focal Plane Assemblies



Instrument Electronics
EM unit assembled
FM boards mid-delivery



POINT SOURCE SENSITIVITY FORECAST



Summary


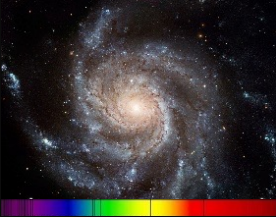





- SPHEREx will construct the first all-sky near-infrared spectral survey.
 - For every 6.2" pixel over the entire sky
 - $R = 35-41$ for 0.75 to $3.82\mu\text{m}$
 - $R = 110-130$ for 3.82 to $5.0\mu\text{m}$
- Received most of the flight hardware.
- Current at full payload testing, on target to launch in early 2025.
- For more information, see spherex.caltech.edu



SPHEREx will provide a rich all-sky spectral archive

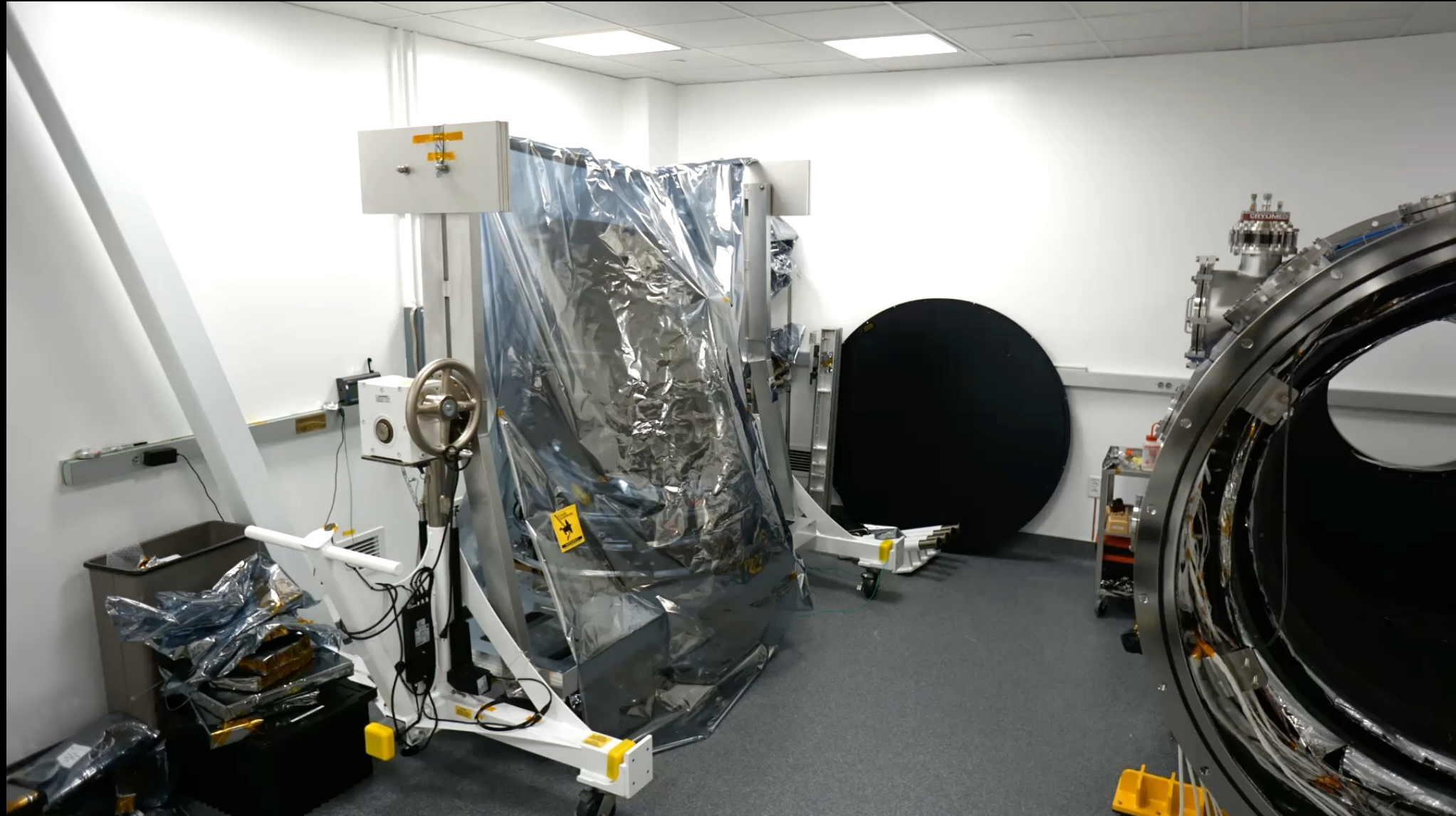


	Detected > 1 billion	Med. Accuracy z's > 100 million	High Accuracy z's 10 million	Clusters 25,000
Galaxies				
	Main Seq. Spectra > 100 million	Dust-forming 10,000	Brown Dwarfs > 400	Cataclysms > 1,000
Stars				
	Quasars > 1 million	Quasars $z > 7$ 3 – 300?	Asteroid Spectra 10,000	Galactic Line Maps PAH, HI, H ₂
Other				

All-Sky surveys demonstrated high scientific returns with lasting data legacy used across astronomy (COBE, IRAS, GALEX, WMAP, Planck, WISE)

Many exciting discoveries will come from the community

SPHEREx^x full system Integration and Testing



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