FIRSST

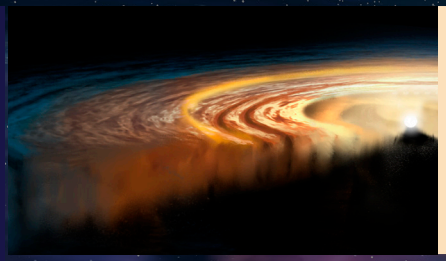
FAR-INFRARED SPECTROSCOPY SPACE TELESCOPE

Revealing the Pathways from Galaxies to Water Worlds

FIRSST is a flexible pointed observatory that will transform our understanding of the dynamic Universe from small rocky planets to galactic-scale cosmic ecosystems.

PI-led science program addresses Astro2020 Decadal questions and goals.

FIRSST Science Objectives



Fingerprinting Planetary Reservoirs: Determine how planets form in disks around young stars, and explain the observed diversity of planets.

Are we alone?

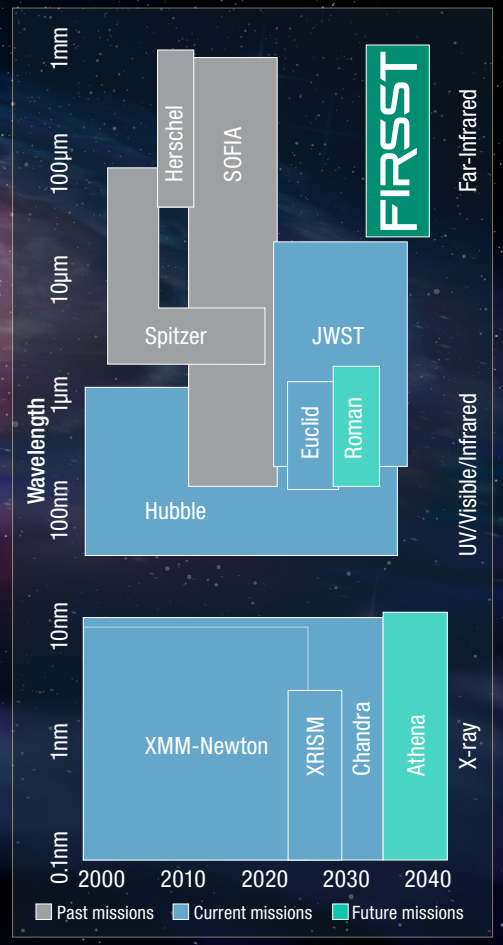
Tracing Water to Rocky Planets: Determine the source of water in planet-forming disks, and explain how water accumulates into oceans.

How did we get here?

Unveiling the Drivers of Galaxy Growth: Determine how the intergalactic medium influences star formation, and explain how galaxies grow.

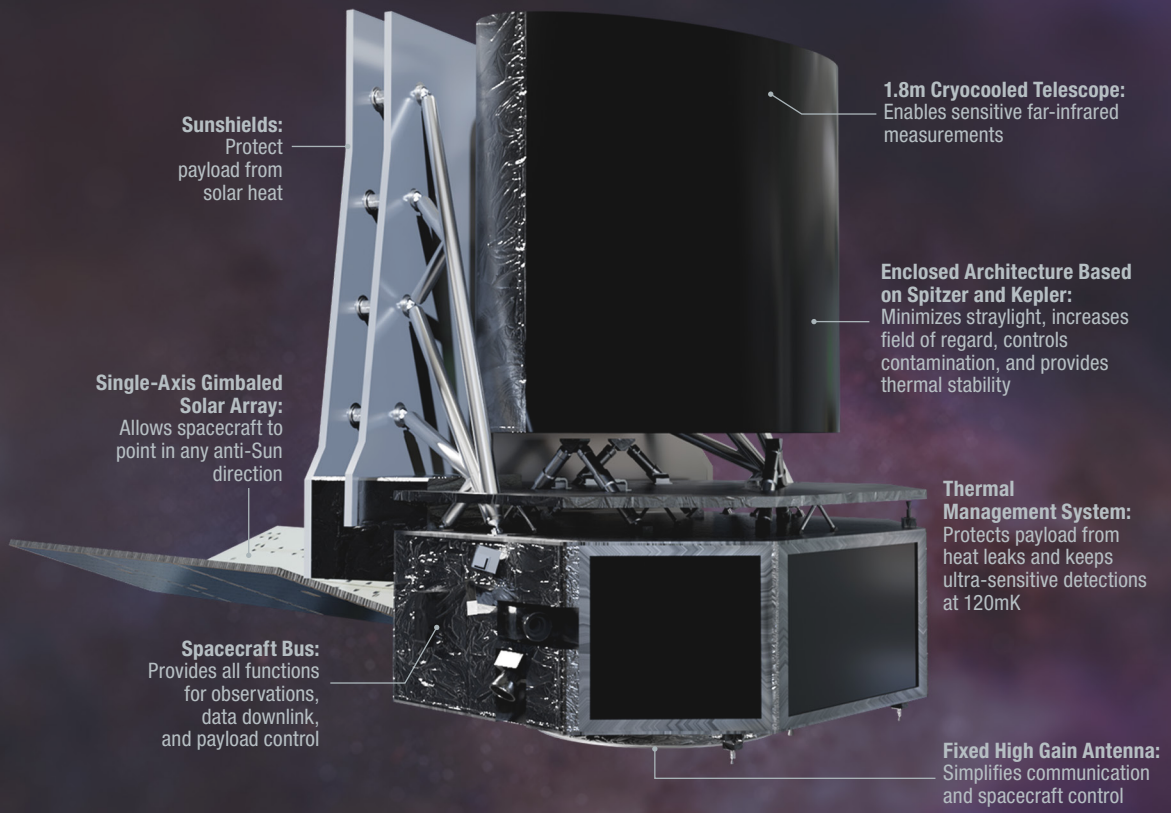
How does the universe work?

Guest Observer Program: FIRSST empowers discovery by filling the large information gap between mid-IR and sub-millimeter wavelengths. Using 75% of the 5-year mission for the astronomical community, FIRSST will invigorate astrophysics research and find new phenomena that transform our understanding of the Universe.



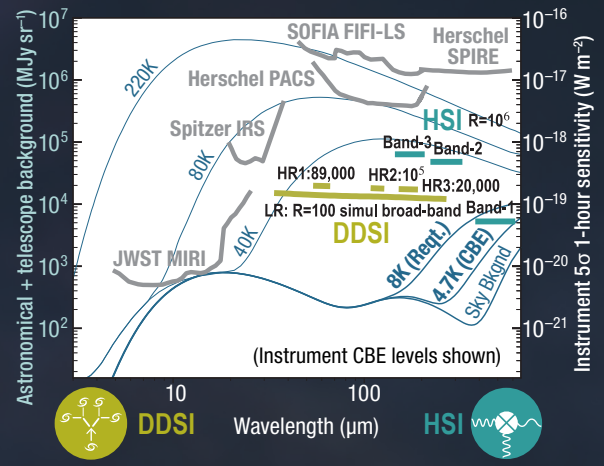
FIRSST fills the crucial gap at far-infrared wavelengths where there are no current or planned missions.

FIRSST is a pointed observatory with high-heritage APL spacecraft bus and Ball cryogenic far-infrared payload.



Direct Detection Spectrometer Instrument (DDSI) has sensitive superconducting detector arrays with both high and low spectral resolving power modules.

Heterodyne Spectrometer Instrument (HSI) provides sub-km/sec super-high-velocity resolution spectra of atomic and molecular lines from ground and sub-orbital platforms.



FIRSST improves FIR sensitivity with a 1.8m primary mirror cooled to <8K. Left axis: Blue curves show telescope and astronomical background emission at temperatures common to past and existing observatories. Right axis: Instrumental sensitivities show FIRSST performance.

Instrument Overview

- 35–600μm wavelength coverage opens large discovery space
- High spectral resolving power delivers kinematic information and tomography
- Coaligned slits in DDSI optical design maximize observing efficiency
- First heterodyne focal plane array in space increases spectral mapping speed
- JWST-heritage beam steering mechanism enables 3D spectral mapping
- Large instantaneous field of regard of more than 2π enhances time-domain astronomy

PROJECT MANAGEMENT TEAM	
UC Irvine	Dr. Asantha Cooray, PI
APL	Project management, project systems engineering, project scientist, flight systems, mission operations, launch vehicle interface
Ball	1.8m far-infrared telescope, 4K cryocooler, DDSI (with Cornell oversight and design), payload AI&T, thermal management
GSFC	Sub-Kelvin ADR
IPAC	Science Operations Center
Obs. Paris	HSI
SAO	