SALTUS

Single Aperture Large Telescope for Universe Studies

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SALTUS: Single Aperture Large Telescope for Universe Studies
Far-Infrared Astrophysics Probe Explorer
SALTUS Goal: Understand our cosmic origins and the possibility of life elsewhere.

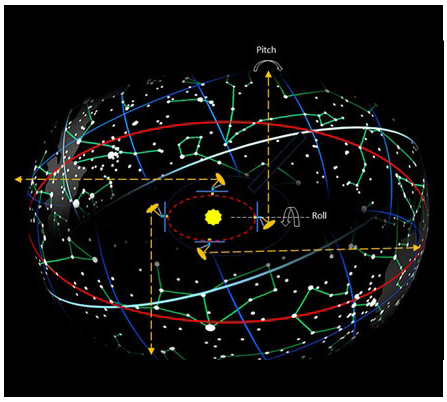
SO1: Trace galaxy and black hole co-evolution and heavy element production over cosmic time.

1.1 What is the role of star formation in feedback in the Local Universe?

1.2 When did metals and dusts form in galaxies, affecting the process of star formation?

1.3 What are the roles of feeding black holes in galaxies from the early universe to today?

1.4 Which feedback mechanism dominates as a function of time over cosmic history?



SO2: Probe the physical structure of protoplanetary disks and follow the trail of water and organics from protoplanetary disks to the solar system.

2.1 How does the mass distribution in protoplanetary disks affect planet formation?

2.2 What is the spatial distribution and evolution of water vapor and ice in protoplanetary disks?

2.3 How did Earth and Ocean Worlds get their water?

Importance of SALTUS to NASA Science Goals

The *SALTUS* Space Observatory, with its high spectral and spatial resolution, high sensitivity, and broad spectral coverage at critically needed wavelengths obscured from ground-based telescopes, addresses the APEX AO science goals.

1) How does the Universe work? Probe the origin and destiny of our universe, including the nature of black holes, dark energy, dark matter, and gravity;
2) How did we get here? Explore the origin and evolution of the galaxies, stars, and planets that make up our universe.

SALTUS' unique capabilities enable significant progress towards resolving high-priority Decadal Survey questions in the areas of i) tracing the astrochemical signatures of planet formation (within and outside the Solar System), ii) measuring the formation and buildup of galaxies, heavy elements, and interstellar dust from the first galaxies to today, and iii) probing the co-evolution of galaxies and their supermassive black holes across cosmic time.

Mission Design

- *SALTUS* provides a powerful far-infrared (far-IR) space observatory to explore our cosmic origins and the possibility of life elsewhere.
- *SALTUS* is a pointed observatory in an L2 halo orbit and allows correlation of data with the JWST.
- It performs groundbreaking studies towards 1000s of astrophysical targets, including the first galaxies, protoplanetary disks, and various solar system objects over its 5-year baseline mission.
- *SALTUS* employs a deployable 14-m aperture, with a sunshield that radiatively cools the large off-axis primary to <45 K, along with cryogenic coherent and incoherent detectors that span wavelengths from 34 to 660 μm at high and moderate spectral resolutions; this spectral range is unavailable to any existing ground or space observatory.
- *SALTUS* has 5x the collecting area of JWST and 16x that of Herschel, with a lifetime ≥5 years.
- >70% of *SALTUS* time is available for Guest Observers (GO).
- All *SALTUS* data will be made publicly available within 6 months of observation.
- With its large aperture and unique instrument suite, *SALTUS* bridges the knowledge gap between the local and distant universe, providing a quantum leap in the understanding of our cosmic origins.

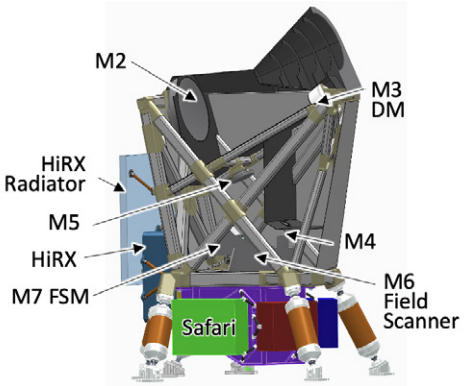
Mission Overview

- *SALTUS* operates in an L2 halo orbit and provides access to the entire sky over six month intervals, on any given day ~35% of the sky is available.
- Telescope can be on target for hours at a time, allowing deep integrations to be performed toward protoplanetary disks & galaxies.
- Similar orbit to JWST allows correlation of data at different wavelengths.
- An observing efficiency of >= 60% mission observation efficiency enables threshold target observations in the first year.
- 5-year mission life provides >3.5 years of GO.

Instruments

The SAFARI-Lite instrument is designed to provide R~300 resolution spectroscopy over 34-230 μm concurrently in for wavelength bands. By employing proven KIDs in combination with the uniquely large *SALTUS* aperture, a massive improvement in spectral line sensitivity is achieved over previous and foreseen missions.

The High-Resolution Receiver (HiRX) provides the ability to perform sensitive, high spectral resolving power (R~ 10^5 to 10^7) observations of the gaseous component of objects across the far-IR. It can detect water, HD, and other astrophysically important lines that are unobservable from the ground, and to velocity resolve and disentangle the underlying velocity fields. HiRX employs a cryogenic superheterodyne receiver system with four frequency bands ranging from 455 GHz (660 μm) to 4.7 THz (56 μm).



Instrument	Wavelength (μm)	Resolving Power	Sensitivity (5σ/1 hr)	Type	Format	Operating Temp (K)	Data Rate (Mb)	Downlink	Power* (W)	Mass (kg)
SAFARI-*Lite*	230 -34	300	$2x10^{-20}$ W/m^2	MKID Arrays Incoherent	180x6 4-Bands	0.12	0.5	Ka-Band	390	137
HiRX	660 -56	10^5 - 10^7	100 mK	SIS/HEB Mixers Coherent	1 Pixel per 4 Bands	5.3	0.1	Ka-Band	183	62