SPHEREx: An All-Sky Spectral Survey

A NASA Small Explorer Satellite Selected for Phase A

Jamie Bock for the SPHEREx team

SPHEREx Addresses All 3 NASA Science Goals in Astrophysics

- Map the large scale structure of galaxies to study the process of Inflation in the early universe, addressing NASA’s objective to **Probe the origin and destiny of the Universe.**
- Determine how interstellar ices bring water and organics into proto-planetary systems, furthering NASA’s objective to **explore whether planets around other stars could harbor life.**
- Measure the total light production from stars and galaxies across cosmic history, addressing NASA’s objective to **explore the origin and evolution of galaxies.**

**High Throughput Spectroscopy**

- Wide-field telescope 20 cm off-aperture
- Passive cooling system
- Deployed photo-shields

SPHEREx has uniquely large spectral light-collimating power designed for mapping the full sky

**History of Galaxy Formation**

- SPHEREx explores the lifecycle of galaxies, determining their mass, star formation, and evolution through deep surveys across the full sky.
- We will measure at least 50,000 high-redshift quasars with well-determined redshifts, mapping large-scale structure and probing early galaxy evolution.

**Core Science Objectives**

- **Interstellar Ices:** Probing Inflation
- **History of Galaxy Formation:** Inflation in the early universe, addressing NASA’s objective to **explore the origin and evolution of galaxies.**

**All-Sky Spectral Legacy Catalog**

- SPHEREx provides a near-IR spectrum for every point on the sky, rich science
  - 10^6 detected galaxies
  - 10^5 galaxies with z > 7
  - 10^5 clusters, reionization, viral masses
  - 10^4 QSOs
  - All-sky line maps

**Probing Inflation**

- Cosmic variance: SPHEREx
  - Layout and Science
  - High-redshift QSOs
  - Reduced redshift

- SPHEREx measures the abundance and composition of interstellar ices, furthering NASA’s objective to **explore whether planets around other stars could harbor life.**

**More Information**

http://spherex.caltech.edu

**SPHEREx Mission Overview**

- **Mission Overview**
  - BCP 100 spacecraft
  - Deployed solar panels

- **Science Team**
  - Jamie Bock (PI)
  - Liz Kremer
  - Mark Arnold
  - Michael Werner
  - Elizabeth Weiner
  - Emily Gapinski
  - Daniel Masters
  - Kasi pool
  - Kasi pool

- **Fields of View**
  - 4 maps produced over 2 years

- **Orbit**
  - Low-earth sun-synchronous

- **Spacecraft**
  - 6.2" x 6.2"

- **Telescope Aperture**
  - 2 x Hawaii-2RG 5.3m; 2 x Hawaii-2RG 2.5m

- **Spectral Resolution**
  - λ / Δλ = 4.1 - 4.8

- **Field of View**
  - 2 x (3.5° x 7.0°); dichroic

- **Cooling**
  - LVF spectrometer has no moving parts

- **Detectors**
  - 72 spectral channels

- **Data Archive**
  - IRSA

- **Data Pipeline**
  - IPAC

- **Data Products**
  - Science Legacy Data Catalog

- **Filter, Detectors, Test Chamber**
  - Mechanisms, electronics, software, instrument I&T

- **Management, thermal system, optics, software, instrument I&T, data pipeline, science legacy, project scientist, science team**

- **Spacecraft**
  - BCP 100

- **Science Responsibilities**
  - High-redapt technologies
  - All-passive cooling with large margins

- **Deployment**
  - Deployed solar panels

- **Slew & Settle Agility**
  - ≤ 10 s for 70" telescope

- **Orbit**
  - Low-earth sun-synchronous

- **Launch**
  - Ball BCP 100

- **Mission Duration**
  - 2020-2023

- **Mission Status**
  - Phase A

- **Euclid**
  - To measure the total light production from stars and galaxies across cosmic history.

- **COSMOS**
  - To measure the total light production from stars and galaxies across cosmic history.

- **WFIRST**
  - To measure the total light production from stars and galaxies across cosmic history.

**Hardware Roles**

- **JPL**
  - Management, thermal system, mechanics, electronics, software, instrument I&T, data pipeline, science legacy, project scientist, science team

- **Caltech**
  - Instrument development, support

- **KASI**
  - Project scientist

- **IPAC**
  - Data archive at IRSA

**Core Science Objectives**

- **Interstellar Ices:** Probing Inflation
  - Cosmic variance: SPHEREx
  - High-redshift QSOs
  - Reduced redshift

- **History of Galaxy Formation:** Inflation in the early universe, addressing NASA’s objective to **explore the origin and evolution of galaxies.**

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