National Aeronautics and Space Administration

NASA Astrophysics Missions

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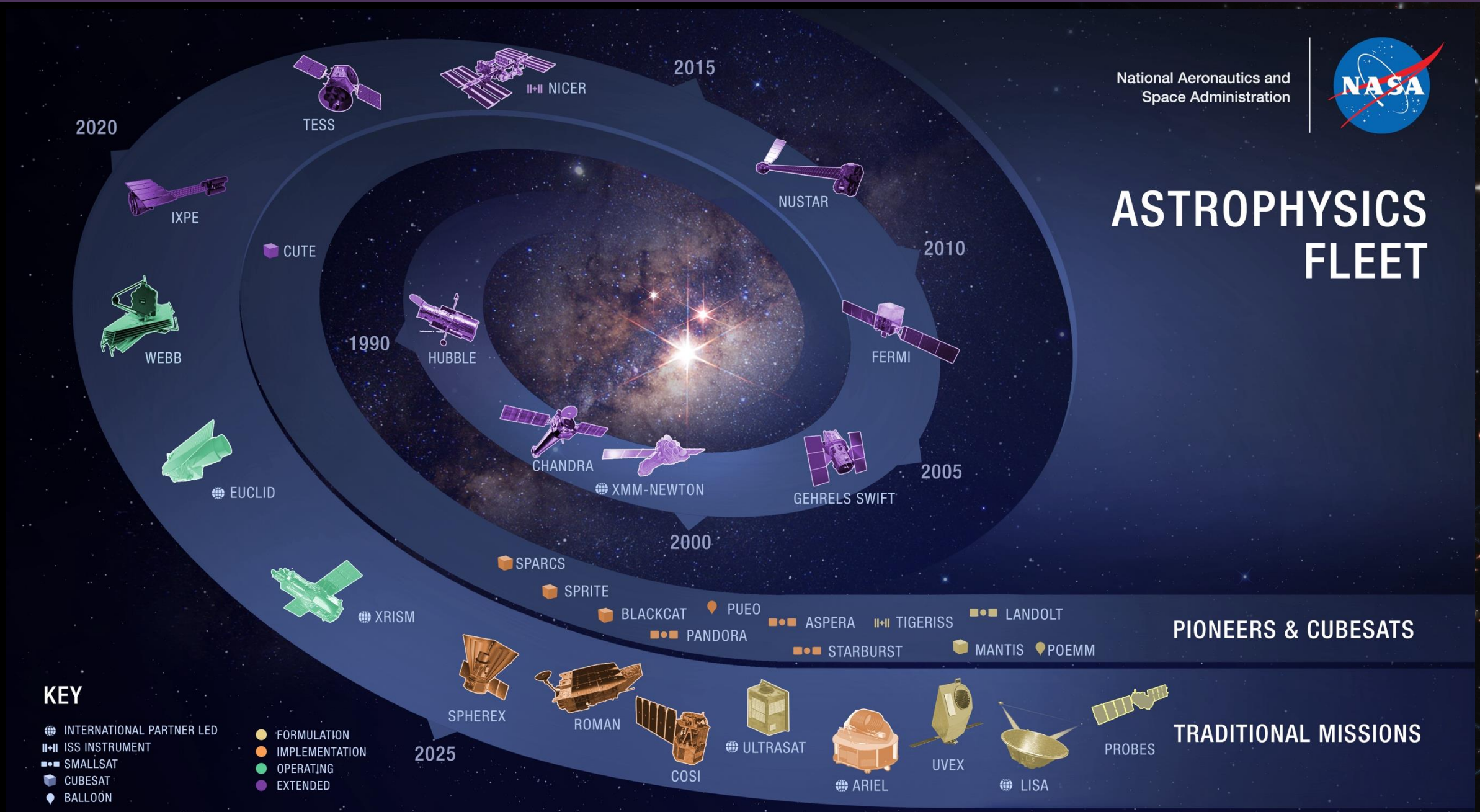
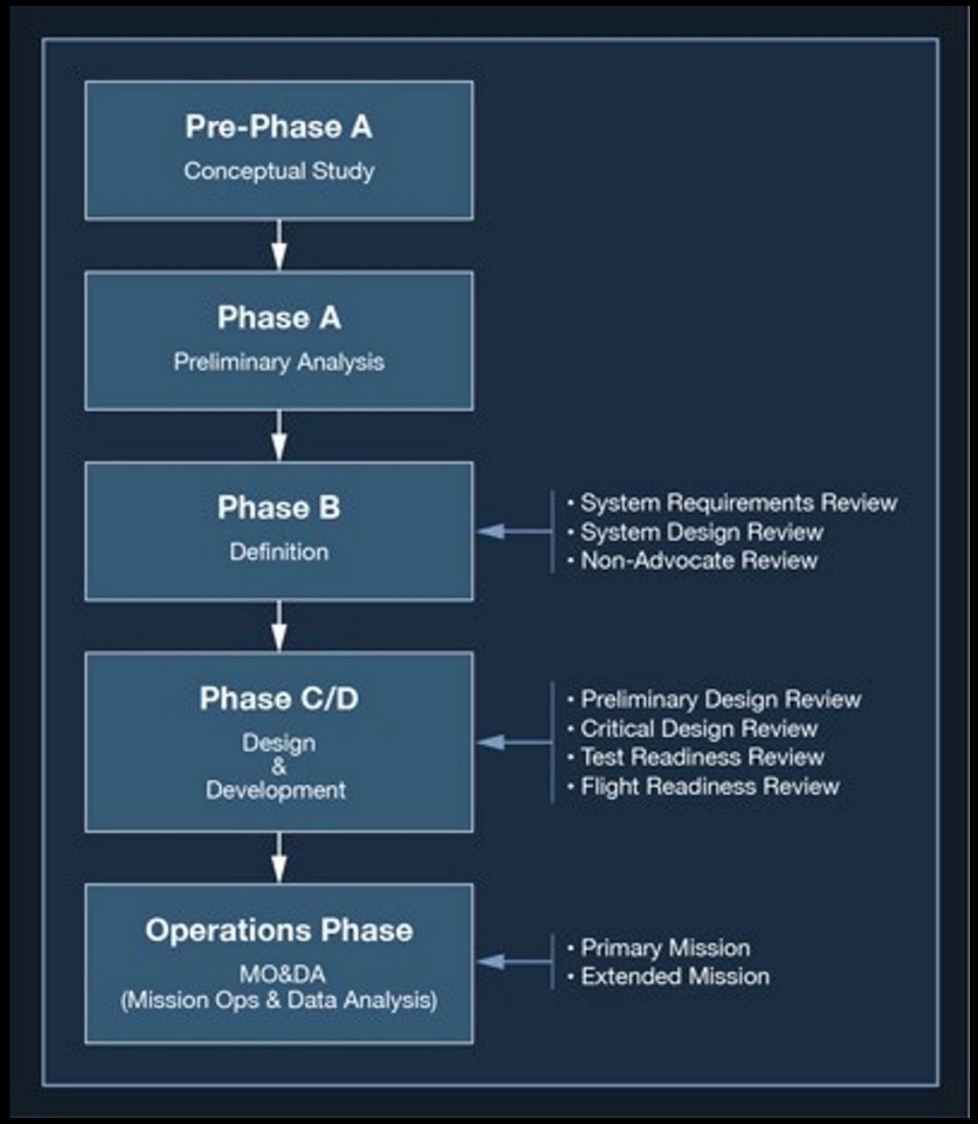
Astrophysics Division, Science Mission Directorate, NASA HQ


National Aeronautics and Space Administration
NASA
ASTROPHYSICS FLEET
2015
2020
2010
1990
2005
2000
2025
TESS
NICER
NUSTAR
IXPE
CUTE
WEBB
HUBBLE
FERMI
CHANDRA
XMM-NEWTON
GEHRELS SWIFT
EUCLID
SPARCS
SPRITE
XRISM
BLACKCAT
PUEO
ASPERA
TIGERISS
LANDOLT
PANDORA
STARBURST
MANTIS
POEMM
PIONEERS & CUBESATS
SPHEREX
ROMAN
COSI
ULTRASAT
ARIEL
UVEX
LISA
PROBES
TRADITIONAL MISSIONS
KEY
INTERNATIONAL PARTNER LED
ISS INSTRUMENT
SMALLSAT
CUBESAT
BALLOON
FORMULATION
IMPLEMENTATION
OPERATING
EXTENDED

Lifecycle of a NASA Mission

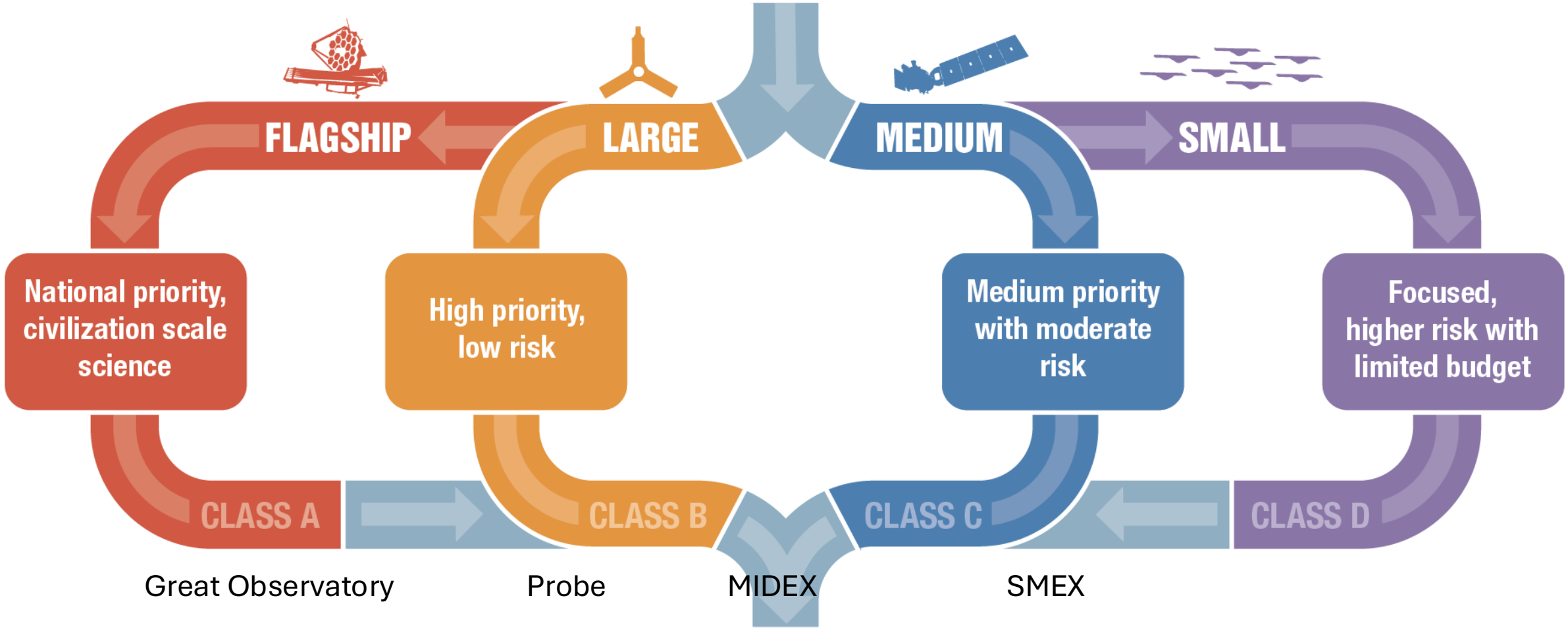


Formulation

Implementation

Operation

BALANCED MISSION PORTFOLIO



Great Observatory | Probe | MIDEX | SMEX

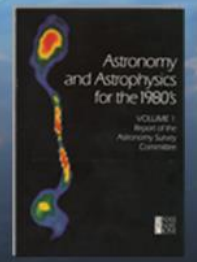
GREAT SCIENCE

+ SmallSats (Class D Tailored)
  Suborbital-class (Research Class)

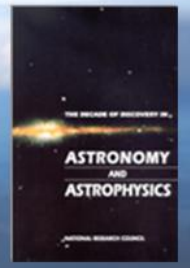
Astrophysics

Decadal Survey Missions

1972 Decadal Survey *Hubble*



1982 Decadal Survey *Chandra*



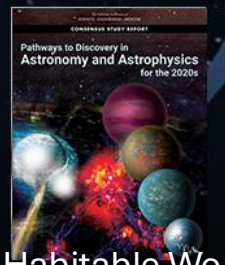
1991 Decadal Survey *Spitzer*

2001 Decadal Survey *Webb*

+ the Probe-class mission that became Fermi

2010 Decadal Survey *Roman*

+ 4 Explorers per decade



2021 Decadal Survey

Habitable Worlds Observatory

+ Probe mission competed beteen Far-IR and X-ray concepts

Astrophysics Mission Classes

DECADAL SURVEY

>$1B $1B

>$1B

LARGE CLASS

Great Observatory or Flagship

Hubble Roman
Chandra (HWO)
JWST

~$1B

MEDIUM CLASS

Probe

Fermi
AXIS
PRIMA

EXPLORER AO

$450M $250M

~450M

SMALL CLASS

Medium Explorer (MIDEX)

PICC $290M*

Swift
TESS
SphereX
UVEX

~250M***

SMALL CLASS

Small Explorer (SMEX)

PICC $170M*

NuSTAR
IXPE
COSI

SMEX Solicitation 2025

SALMON AO

$80M $40M

$80M

SMALL CLASS

Standard Mission of Opportunity

**

NICER ISS
Ariel CASE

$40M

SMALL CLASS

SmallSat Mission of Opportunity

**

Not solicited SMEX 2025

ROSES

$20M $5M

$20M

SMALL CLASS

Pioneers SmallSat

**

$10M

SMALL CLASS

APRA CubeSat

$20M

SUBORBITAL

Pioneers Balloon

$10M

SUBORBITAL

APRA Balloon

~$5M

SUBORBITAL

APRA Sounding Rocket

Updated for 2025 SMEX

Directed foreign partnerships

XMM (ESA) ULTRASAT (ISA)
Euclid (ESA) LISA (ESA)

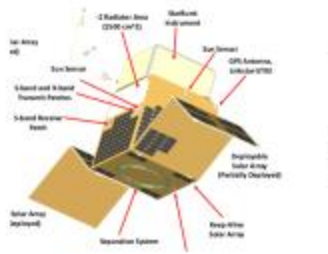
*PI Cost Cap **Includes ISS-attached Experiments

*** To be defined

- First solicited in ROSES 2020
  - Light-touch management by Wallops and NASA HQ (7120.8 vs 7120.5)
- Includes SmallSats, CubeSats >6U, major balloon payloads, modest ISS attached payloads (no longer), and lunar surface CLPS payloads. $20M maximum PI cost cap.
- Fills the gap between existing ROSES investigations (<$10M for APRA) and existing Explorers MO investigations (~$40M for SmallSats).

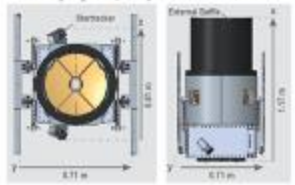
PUEO: A Long-duration Balloon-borne Instrument for Particle Astrophysics at the Highest Energies, PI Abigail Vieregg, U Ch

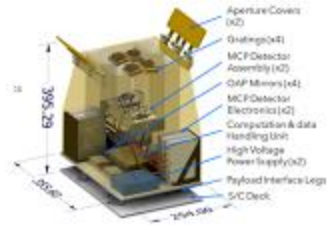
Figure 10: A rendering of the PUEO payload, including a design for the low-frequency drop-down instrument.



StarBurst: Gamma-ray ASM, Simultaneous detection of NS/NS mergers with LIGO, PI Daniel Kocevsk,i MSFC

Pandora: Multiwavelength Characterization of Exoplanets and their Host Stars, PI Elisa Quintana, GSFC





Aspera: IGM Inflow/outflow from galaxies via OVI 10^5K emission line imaging. PI Carlos Vargas, U of A

First 4 selections in 2021 (left) now joined by:

TIGERISS (ISS): Measuring ultra-heavy (r-process) cosmic rays on ISS
(PI Brian Rauch of Wash U)

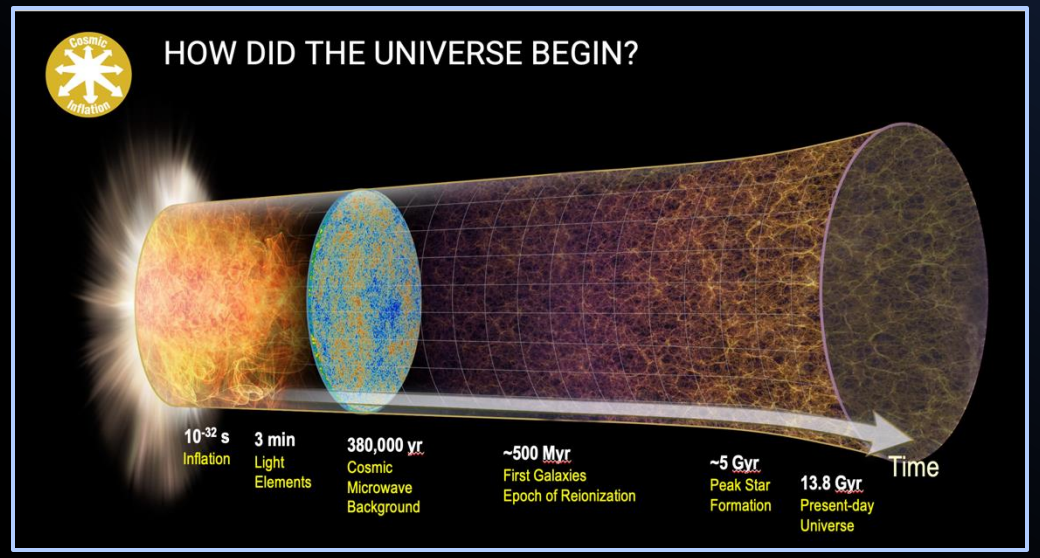
Landolt (SmallSat): Absolute stellar photometry to <0.5%
(PI Peter Plavchan of George Mason U)

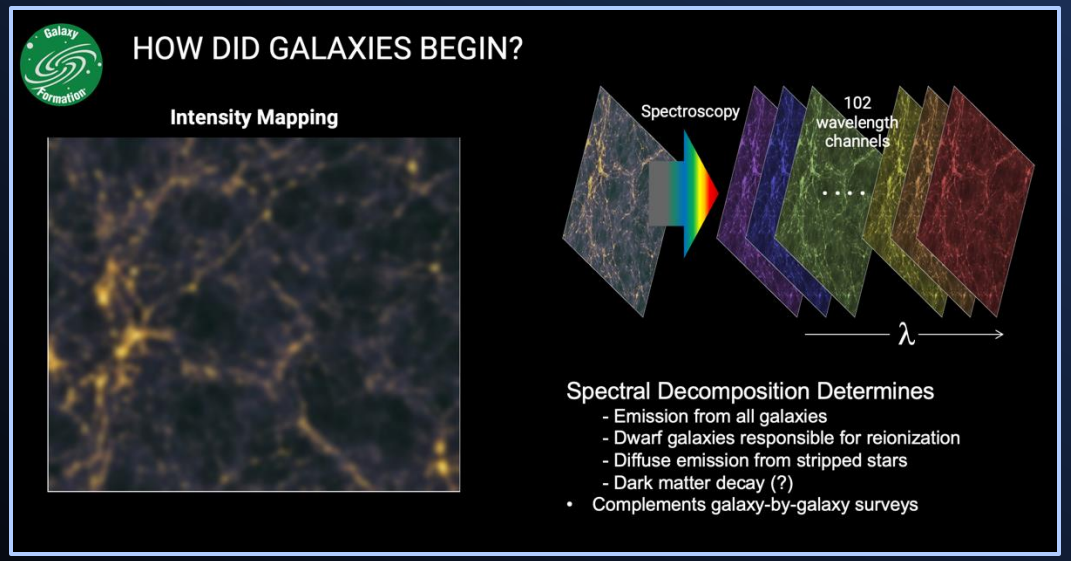
POEMM (Balloon): High resolution FIR tomography of protoplanetary disks
(PI Gordon Stacey of Cornell U)

- Astrophysics Missions and Programs
- NASA Mission Lifecycle
- Astrophysics SMEX 2025

Backup

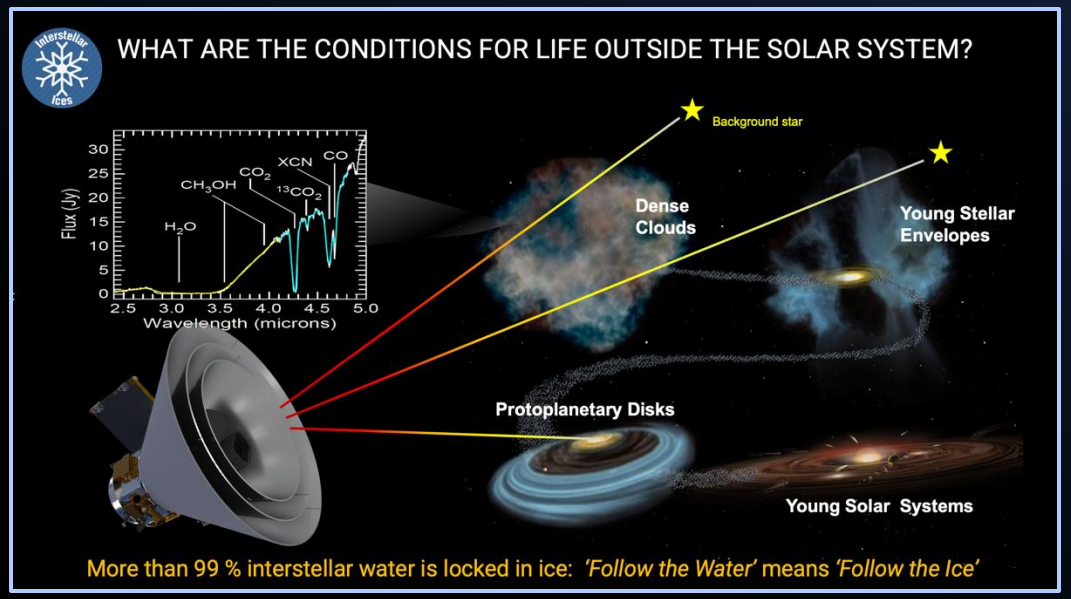
SPHEREx: Science Areas





SPHEREx will map entire sky in near-infrared light to study the origin of stars, galaxies, and the chemical composition of the universe.

- Origin of the Universe
- Origin and History of Galaxies
- Origin of Water in Planetary Systems
- First All-sky Infrared Spectral Survey
- Over a two-year mission SPHEREx will collect data on >3x10^8 galaxies along with >10^8 stars



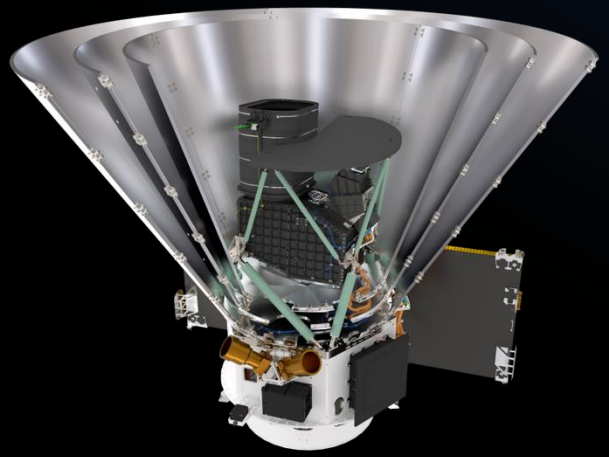
SPHEREx

Status:

- Reaction wheels have been reworked, re-integrated into the spacecraft and are currently undergoing regression testing.
- Maintaining schedule towards Feb 2025 LRD

Upcoming milestones

- December 10-12, 2024: ORR
- February 4, 2024: KDP-E
- LRD: April 2025



SPHEREx observatory being lifted and installed onto the vibration table, in the Z-axis configuration, at BAE Systems in Boulder CO in early August 2024.

COSI
The Compton Spectrometer and Imager

Science

- Source of 511 keV γ-ray lines, the signature of positron annihilation
- Reveal galactic element formation
- Insight into extreme environments with polarization
- Probe the physics of multi-messenger events

Status

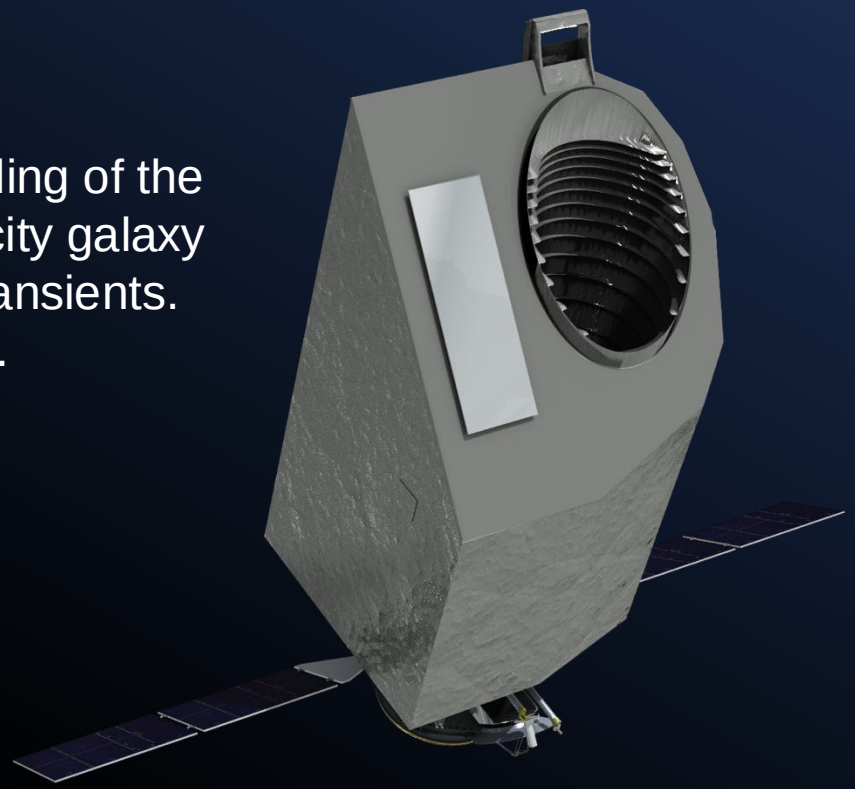
- The second of 16 flight germanium detectors successfully was completed (current schedule calls for all 16 flight detectors completion by mid-2025).
- SpaceX Falcon 9 selected as the COSI LV in July 2024.

Upcoming Milestones

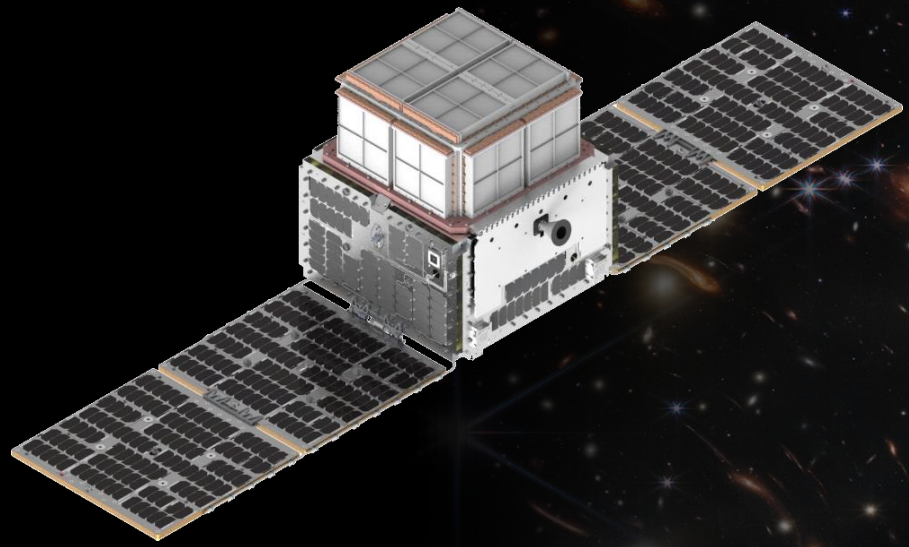
- December 4-6, 2024: COSI CDR at Northrup Grumman (Dulles, VA)
- August 2026: SIR
- September 2026: KDP-D
- August 27, 2027: LRD

UVEX (launch date ~2030)
UltraViolet Explorer

- UVEX selected as next astrophysics medium-class explorer.
  - Principal investigator: Fiona Harrison at Caltech.
  - UVEX will address outstanding questions in our understanding of the Universe, including the nature of the low-mass, low-metallicity galaxy population and the early ultraviolet emission of explosive transients. UVEX will also leave a rich legacy of all-sky ultraviolet data.
  - Team is making good forward progress in phase B



Upcoming Milestones
- February 2025: Systems Requirement Review



- StarBurst is part of NASA's Pioneer fleet
  - Part of first set of 4 selected in 2021 at $20M and under
  - Science goal is detection of short Gamma-Ray Bursts with LIGO
- LRD mid-2027 to align with next LIGO science run – need to procure launch
- Energy coverage: 30 keV – 1 MeV
- StarBurst sees the entire unocculted sky
  - Triggers onboard on transient events such as gamma-ray bursts and sends alerts to the ground.
  - Has a waiver to use TDRS system but concerns about cost
  - 5 x effective area of Fermi Gamma-ray Burst Monitor (GBM)
  - Nominal mission duration 1 year

PI Dan Kocevski at NASA MSFC