National Aeronautics and Space Administration

NASA Astrophysics Update

Board on Physics and Astronomy | May 7, 2024

Dr. Mark Clampin
Director, NASA's Astrophysics Division
Science Mission Directorate

Science Mission Directorate

ASTROPHYSICS

Organizational Chart

Legend
C - Contractor
D - Detailee
IPA - Intergovernmental Personnel Act Detail Program Scientist

DIVISION MANAGEMENT

Dr. Mark Clampin
Director

Sandra Cauffman
Deputy Director

ADMINISTRATIVE SUPPORT
Jennifer Baker (C), Balam "Orby" Yaxkin (C), Joshua Diaz Calo (C)

DIVISION LIAISONS

Resource Management
Elijah Owuor (Lead)
Jenna Robinson (Detail)
Jennifer Holt

Communications
Alise Fisher

Policy
Mariah Baker

OIIR
Peyton Blackstock

Program Support Specialist
Paola Ortiz Perez

CROSS CUTTING

Technologist
Mario Perez (Chief)
Omid Noroozian (Deputy)

Executive Officer
Rhiannon Roberts (C)

APD Communications
Liz Landau (C - OCOMM Liaison)
Julie Stoltz (C - Strategic Integration & Engagement Lead)

Inclusion, Diversity, Equity, and Accessibility
David Morris (Lead)
Antonino Cucchiara (Deputy)

FLIGHT PROGRAMS

Associate Director
Joe Smith

PROGRAM EXECUTIVES

Rosa Avalos-Warren
Rachele Cocks
Lucien Cox
Julie Crooke
Ed Griego
Shahid Habib
Janet Letchworth
Lucas Paganini
Miles Skow
Mark Sistilli

RESEARCH & ANALYSIS

Associate Director
Eric Smith

R&A Lead
Roopesh Ojha

PROGRAM SCIENTISTS

Alessandra Aloisi (D)
Megan Ansdell
Dominic Benford
Valerie Connaughton
Antonino Cucchiara (C)
Doris Daou
Michael Garcia (D)
Thomas Hams (C)
Hashima Hasan
Stefan Immler
Hannah Jang-Condell
Patricia Knezek
David Morris
Roopesh Ojha
Joshua Pepper (IPA)
Mario Perez
Linda Sparke
Sanaz Vahidinia
John Wisniewski

RESEARCH PROGRAM SPECIALIST
Ingrid Farrell (C)

ASTROPHYSICS STRATEGIC MISSIONS

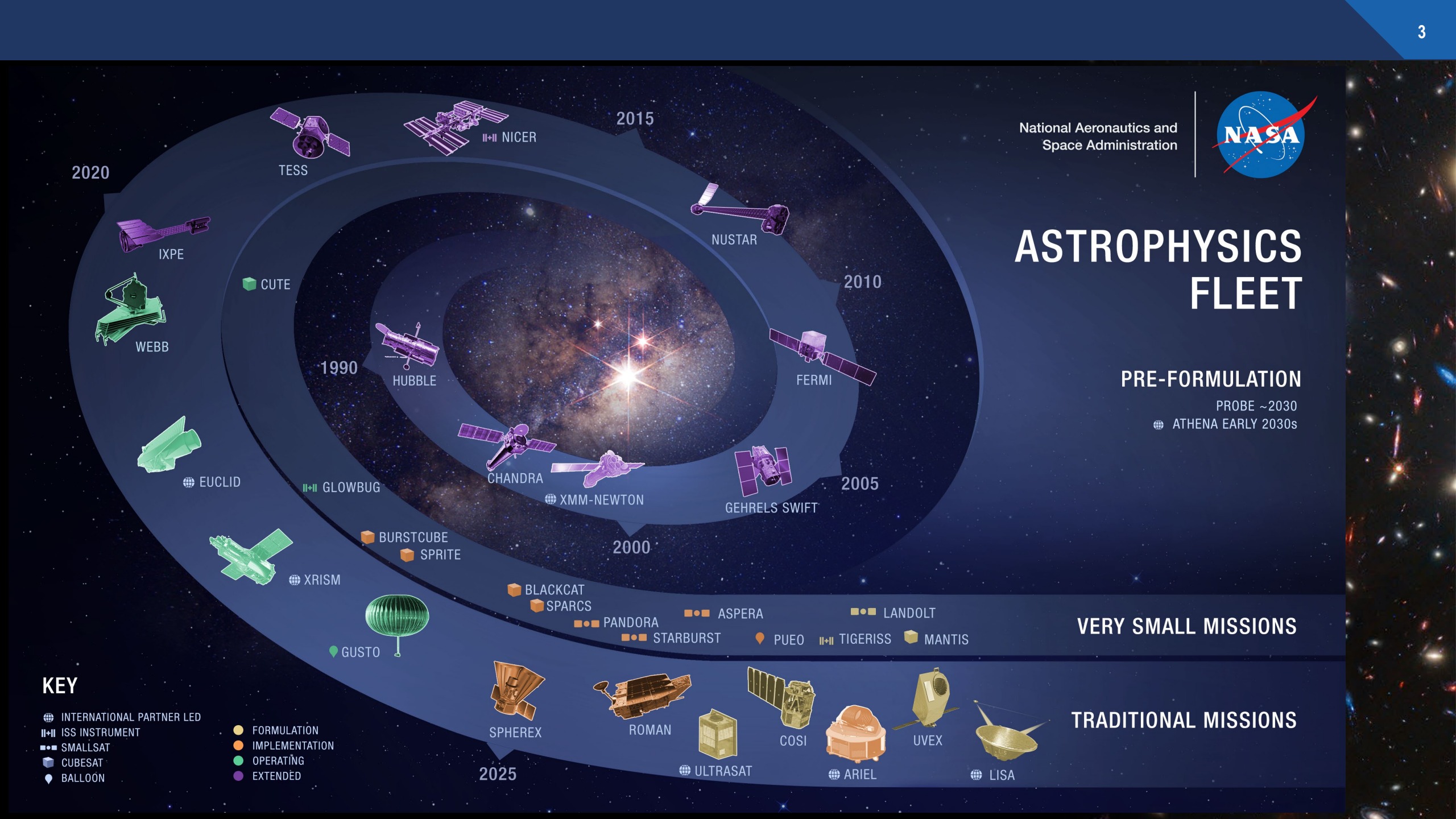
Program Director
Sandra Cauffman

Program Manager
Garth Henning

PROGRAM EXECUTIVES

Ed Griego
Lucas Paganini
Miles Skow

PROGRAM SUPPORT
Tony Comberiate (C), Andre Davis (C)


National Aeronautics and Space Administration
NASA
ASTROPHYSICS FLEET
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PANDORA
ASPERA
LANDOLT
STARBURST
PUEO
TIGERISS
MANTIS
GUSTO
SPHEREX
ROMAN
ULTRASAT
COSI
ARIEL
UVEX
LISA
PRE-FORMULATION
PROBE ~2030
ATHENA EARLY 2030s
VERY SMALL MISSIONS
TRADITIONAL MISSIONS
KEY
INTERNATIONAL PARTNER LED
ISS INSTRUMENT
SMALLSAT
CUBESAT
BALLOON
FORMULATION
IMPLEMENTATION
OPERATING
EXTENDED

NASA Awards Astrophysics Postdoctoral Fellowships for 2024

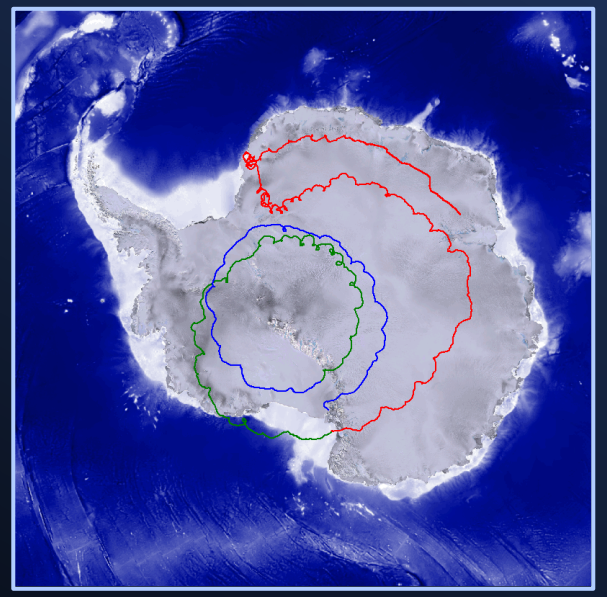
- Out of 520 applicants, NASA Hubble Fellowship Program (NHFP) recently announced 24 new fellows to its 2024 roster.

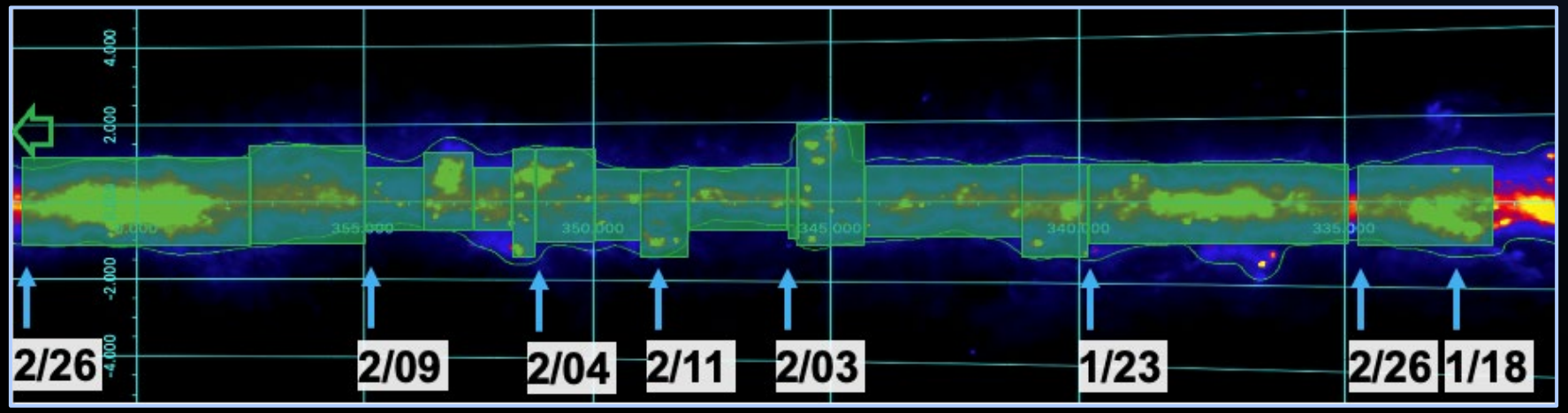
- The NHFP enables outstanding postdoctoral scientists to pursue independent research in any area of NASA Astrophysics, using theory, observations, simulations, experimentation, or instrument development.

GUSTO

- The GUSTO mission had a very successful flight, launched on zero pressure balloon from McMurdo late in the Antarctica season Dec. 30, 2023.
- The GUSTO balloon was terminated Feb. 26 at 6:24 p.m. EST, setting a new duration record for a NASA heavy-lift balloon flight with 57 days, 7 hours at float.
- The GUSTO Observatory consumables would have lasted until March 1, but repeated day-night cycles over the last 8 days forced an end to the balloon flight.
- GUSTO survey covered 62.5 deg^2 in the Galactic plane and 12,750 line of sights in the LMC.

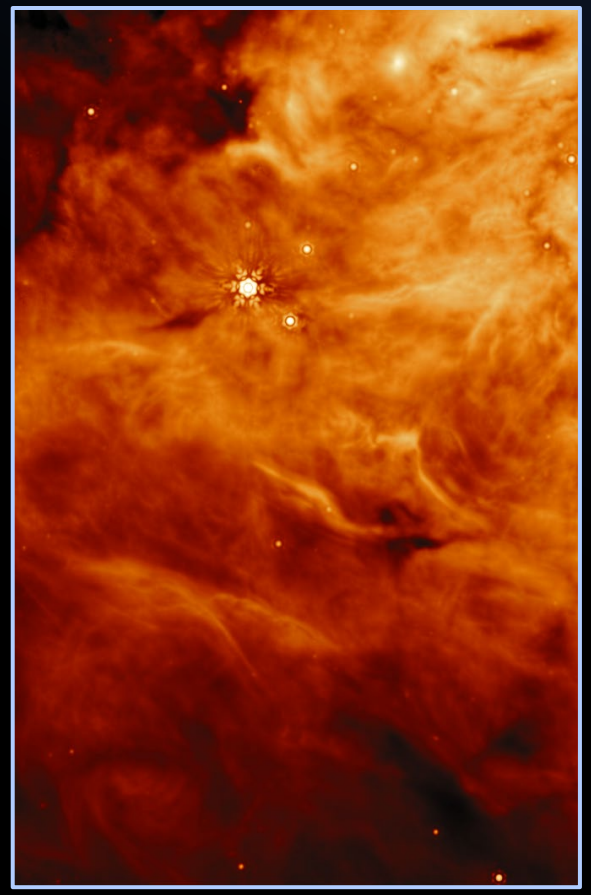
GUSTO has met and exceeded success criteria and will address all five science questions for which the mission was selected.





On The Fly (OTF) mapping proceeding on schedule

Webb Finds Ethanol, Other Icy Ingredients for Worlds



NASA, ESA, CSA, W. Rocha (Leiden University)

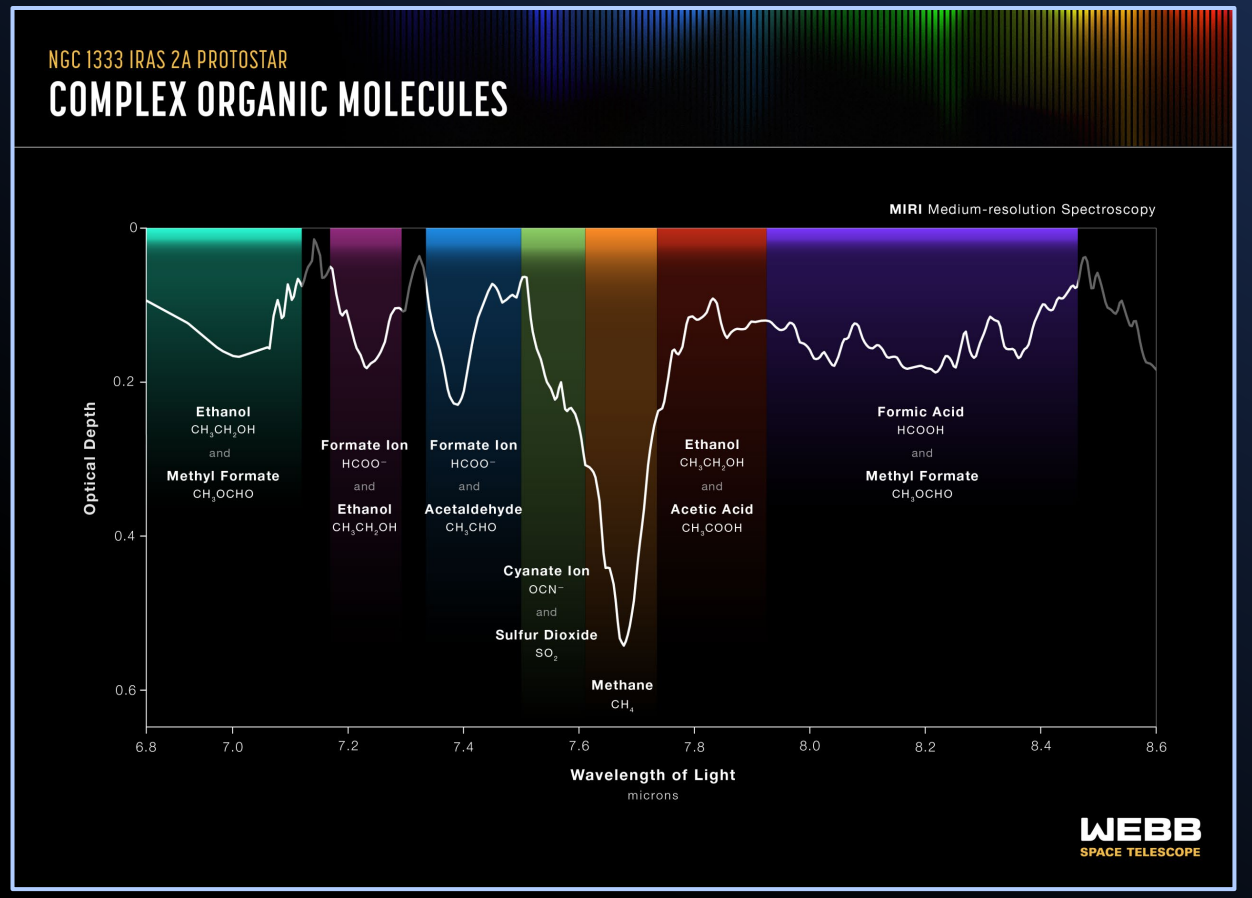


Illustration: NASA, ESA, CSA, L. Hustak (STScI). Science: W. Rocha (Leiden University).

- Webb's MIRI (Mid-Infrared Instrument) has identified a variety of complex organic molecules that are present in interstellar ices surrounding two protostars. These molecules, which are key ingredients for making potentially habitable worlds, include ethanol, formic acid, methane, and likely acetic acid, in the solid phase. The finding came from the study of two protostars, IRAS 2A and IRAS 23385, both of which are so young that they are not yet forming planets.

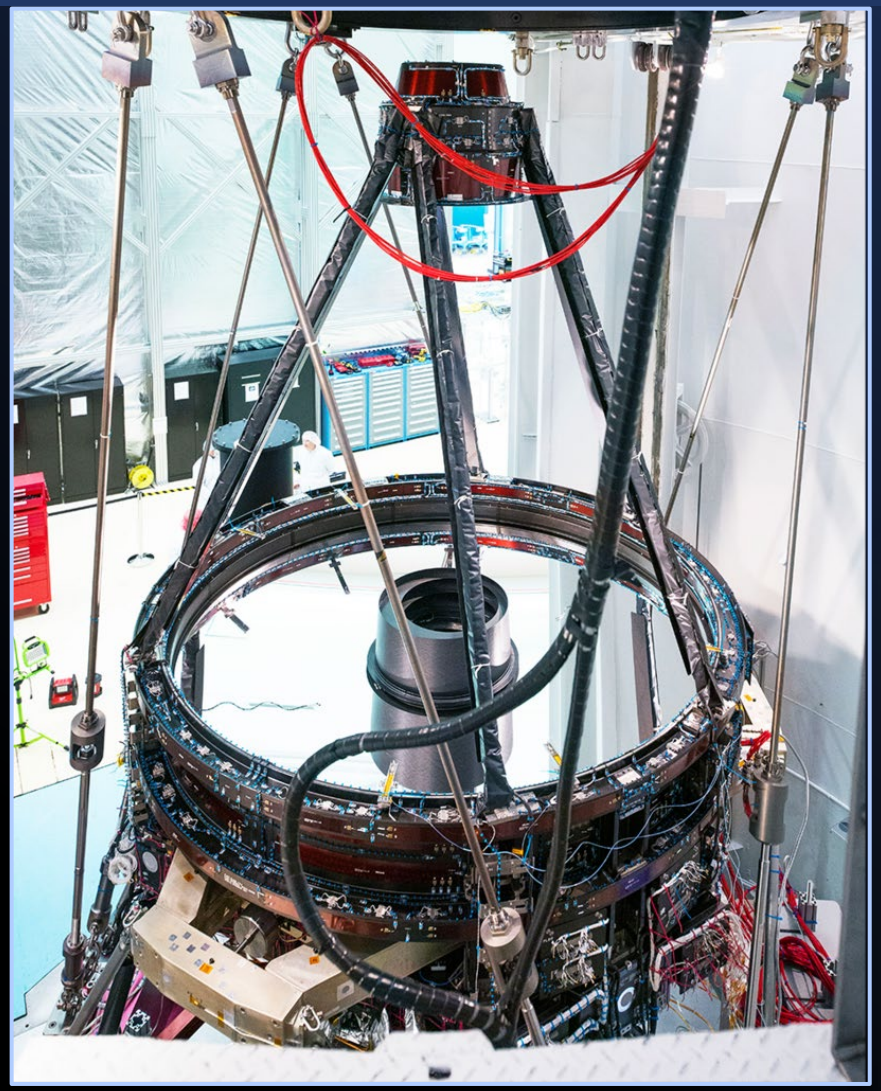
Nancy Grace Roman Space Telescope

Recent Accomplishments

- The first optical tests of the telescope were performed at ambient temperature and pressure, achieving first images.
- Completed the integration of the Imaging Optical Assembly (IOA).
- Completed the OTA Pre-Environmental Review on Feb. 7, 2024.
- Wide Field Instrument (WFI) in its second and last thermal vacuum test (TVAC2).

Upcoming 2024 Milestones

- August: WFI delivery
- October: Optical Telescope Assembly (OTA) delivery.



The entire optics system for Roman. Consists of 10 mirrors, including the 7.9-foot (2.4 meter) primary mirror seen at the base of this image called the Imaging Optical Assembly (IOA). Engineers recently integrated and tested the IOA at L3Harris Technologies in Rochester, NY. Credit: NASA/Chris Gunn

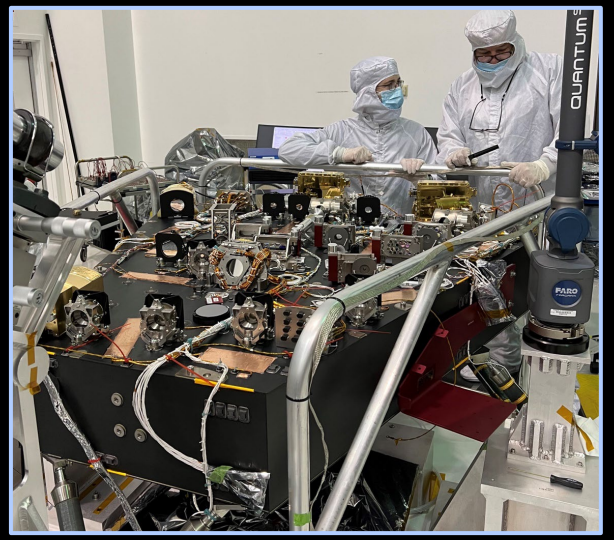
ROMAN- First image of a point source (pre-optical alignment, in-air)

WFI has been de-configured from vibration and acoustics testing and closed-out for thermal vacuum test

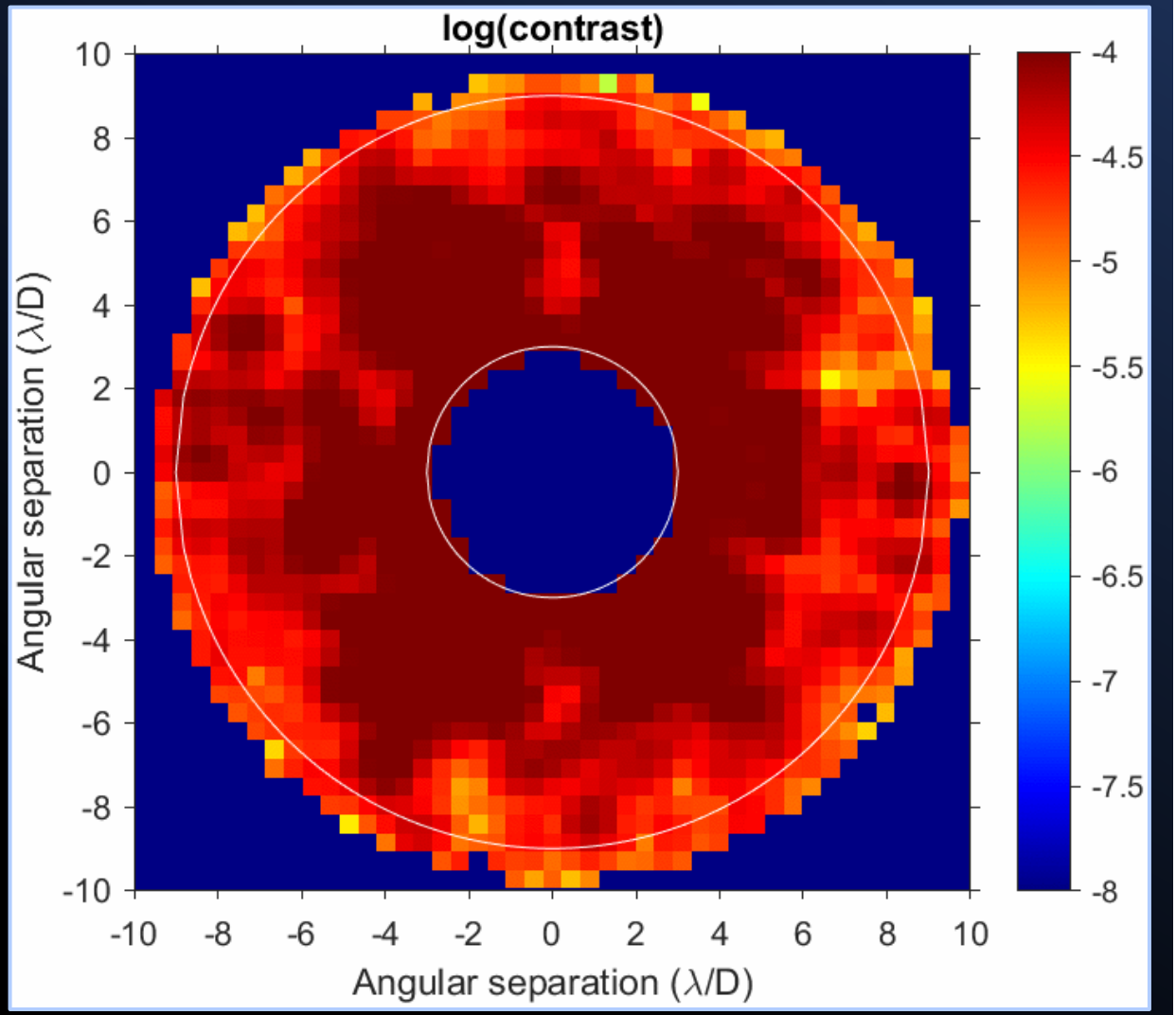
Roman Space Telescope
Coronagraph (CGI)

Recent Achievements

- CGI successfully completed TVAC testing.
- Performance meets requirements in both modes, the Hybrid-Lyot and Shape Pupil Coronagraph.
- Pre-ship review held on May 2.
- May 19: CGI delivers to GSFC



Coronagraphic Imager



Sequence of high-order wavefront sensing and control iterations

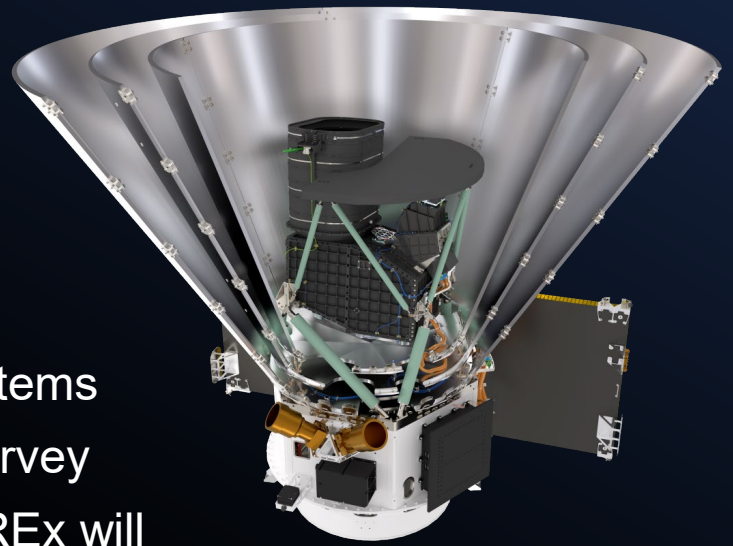
Probes

Astrophysics Probe Announcement of Opportunity (AO) proposal submission upcoming dates:

- Selection for competitive Phase A studies: Q4 CY 2024 (target)
- Concept study reports due: Q4 CY 2025 (target)
- Down-selection: Q2 CY 2026 (target)
- AO-Required Launch Readiness Date: NLT July 2032

SPHEREx

Photon shields (shown cutaway)



- Passive cooling
- LVF spectrometers
- 20 cm Wide-field telescope
- LEO spacecraft (BAeS)

Science

- 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 >300 million galaxies along with >100 million stars

Recent accomplishments

- SPHEREx observatory is fully assembled with the payload mated to spacecraft at BAE.

Upcoming Milestones

- LRD remains February 2025.

SPHEREx observatory in a horizontal position, showing all three layers of photon shields as well as the telescope. Credit: BAE Systems, Courtesy NASA/JPL-Caltech.

COSI
The Compton Spectrometer and Imager

Recent Achievements
- KDP-C successfully held on April 16.
- COSI Project planning proceeding into development

Science
- Source of 511 keV γ-ray lines, the signature of positron annihilation
- Evolution of massive stars and their SN explosions
- Polarization of GRBs and compact objects
- Multi-messenger astrophysics

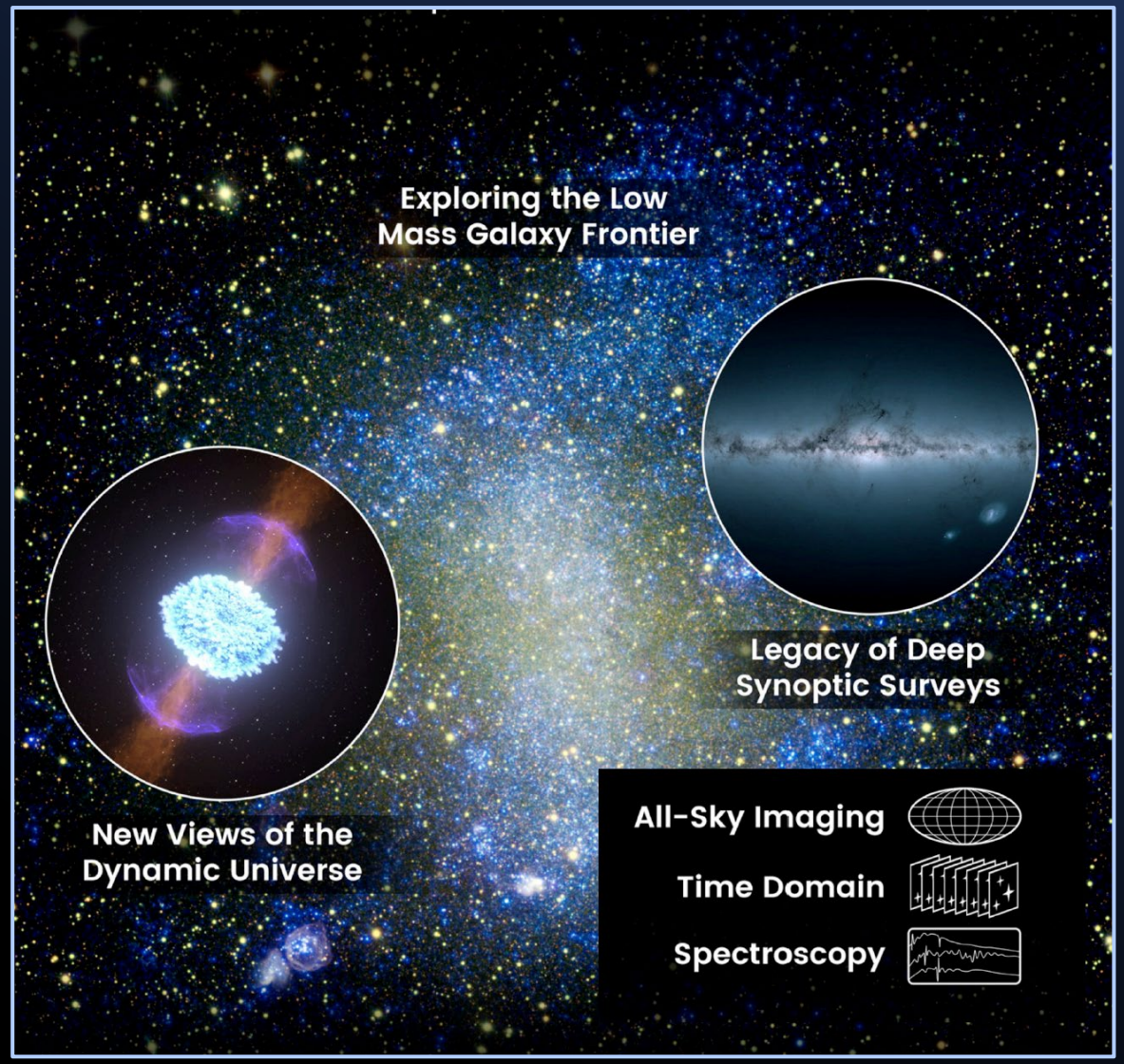
Upcoming Milestones
- December 2024: Critical Design Review (CDR)

Image by Jim Willis, courtesy of Northrop Grumman Corporation ½ Space Systems; background image courtesy of European Southern Observatory

MIDEX Selection: UVEX

- For the 2021 MIDEX/MO call, 2 MIDEX mission concepts and 2 Mission of Opportunity mission concepts were selected for a competitive Phase A study.

- On February 13, we announced that the MIDEX mission UVEX has been selected to continue into Phase B.
  - PI: Dr. Fiona Harrison
    - Sensitive wide-field imaging in 2 UV bands
    - High angular resolution
    - Broadband UV spectroscopy
    - All-sky survey
    - Rapid pointing capability

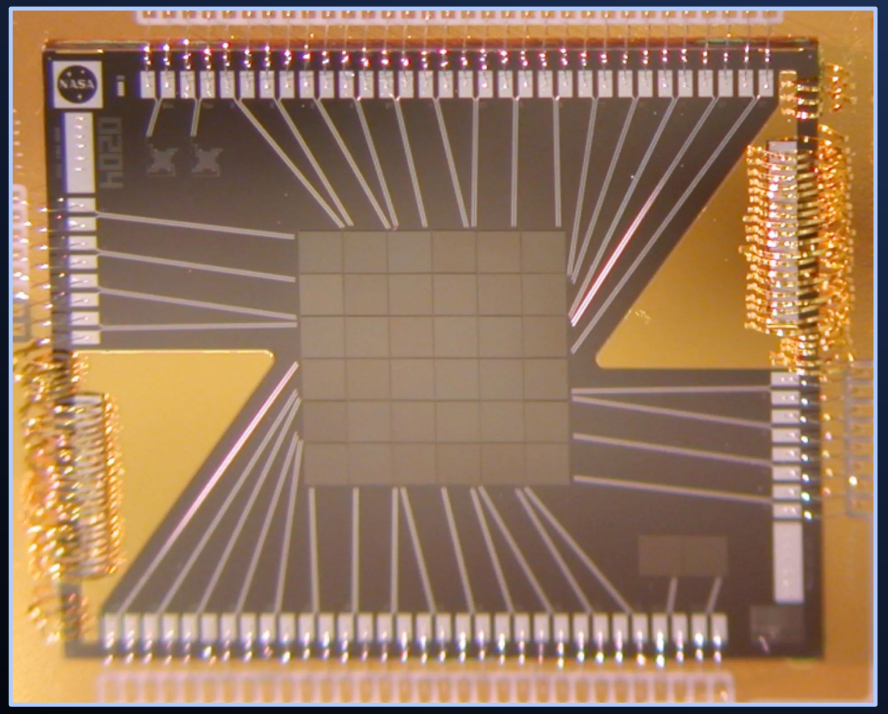


XRISM: Launched September 6, 2023

- The two instruments are performing exceptionally:
  - Resolve reaching a spectral resolution of 5 eV (exceeding the 7 eV requirement)
  - Xtend performing as expected.
- The Cycle 1 call for GO proposals has been announced

Mission

- XRISM detects “soft” X-rays. It will probe the universe’s hottest regions, largest structures, and objects with the strongest gravity, such as supermassive black holes in the cores of distant galaxies.
  - Resolve instrument has just 36 pixels operating in 3-D mode, where each image pixel accumulates a high resolution (~5 eV) spectrum.



The square structure at the center of this image shows the 6-by-6-pixel microcalorimeter array at the heart of Resolve. The device produces a spectrum of X-ray sources between 400 and 12,000 electron volts — up to 5,000 times the energy of visible light — with unprecedented detail.
NASA/XRISM/Caroline Kilbourne

LISA
Laser Interferometer Space Antenna

Mission

- Led by ESA, the LISA mission is a collaboration of ESA, NASA, and an international consortium of scientists
- A space-based gravitational wave observatory building on the success of LISA pathfinder.

Status

- ESA released an Invitation to Tender on March 28 for phase B2 inviting industry for the implementation of the LISA mission. NASA provided subsystem requirements which are part of the ITT package.
- NASA is responsible for three major subsystems: lasers, telescopes and charge management devices. These subsystems are progressing as planned:
- NASA HQ issued a Dear Colleague Letter inviting self-nominations for US representatives to the LISA Science Team. Applications were due on April 16. NASA will have six members on this international LISA science team. NASA along with ESA will also co-chair this team.
- NASA plans to transition LISA from a technology development/study phase to a full development project around November 2024.

NewATHENA

Advanced Telescope for High Energy Astrophysics

Mission

- ESA and NASA Partnership
- ATHENA will look deep into the X-ray Universe, studying the evolution of super-massive black holes and hot gas in and out of galaxies over the life of the Universe.

Status:

- ESA is in the process of selecting the NewAthena Science Study Team (NASST) with member appointment expected in April/May 2024. NASA is invited to nominate a member to NAAST, and NASA is in the process of selection.
- NASA is contributing detector system and a cryocooler for the X-ray Integral Field Unit Instrument (X-IFU).
  - X-IFU detector Demonstration Model unit is in fabrication at GSFC and is progressing
  - X-IFU Cryocooler Demonstration Model procurement request has been released in April.
- NASA will no longer be providing X-ray mirror calibration support to ESA.

Euclid: Launched July 1, 2023

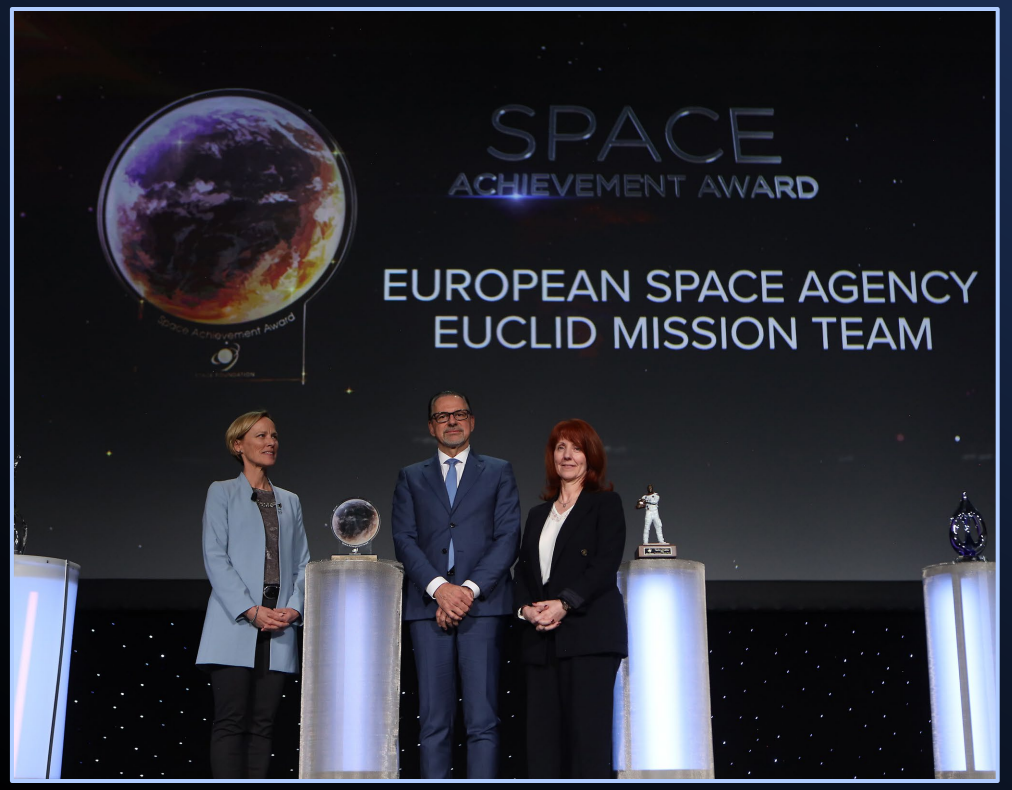
Recent Achievements

- The Euclid mission team was awarded this year's Space Achievement Award by the Space Foundation on April 8 in Colorado Springs.

- Euclid began survey mode on Feb 14.

Upcoming Milestones

- May 23 will be Euclid public data release of 7 deg^2 . This is from the ERO phase.



ESA Director General, Josef Aschbacher, and ESA Director of Science, Carole Mundell, collected the prize at the Space Symposium in Colorado Springs, USA, on April 8.

CASE: Contribution to ARIEL Spectroscopy of Exoplanets

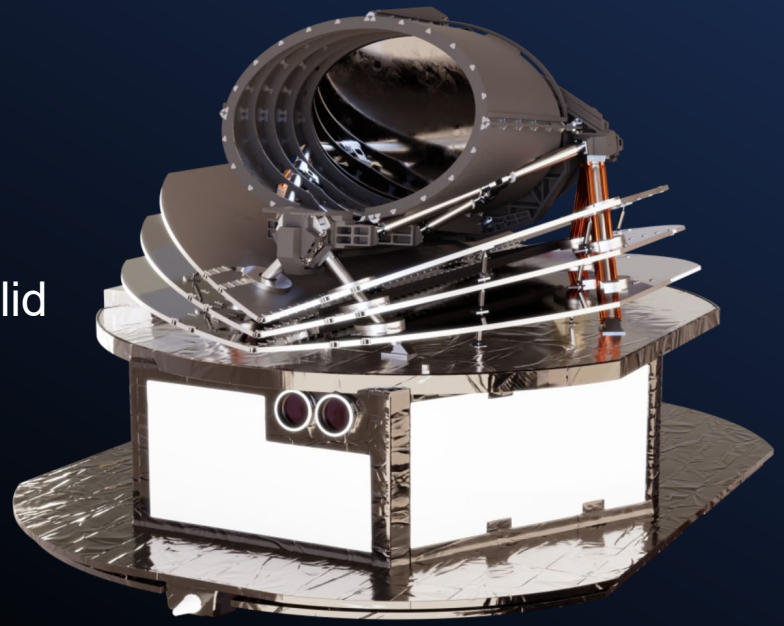
Mission

- CASE is a mission of opportunity to contribute to the European Space Agency's (ESA's) fourth medium-class mission, Atmospheric Remote-sensing Infrared Exoplanet Large-survey (Ariel), which will survey the atmospheres of ~1000 transiting exoplanets with continuous coverage spectroscopic observations, simultaneously in visible and infrared wavelengths.

NASA's Contribution

- Two Focal Plane Modules (FPM): Each comprised of a residual flight Euclid detector in an enclosure designed for the ARIEL FGS.
- Focal Plane Electronics (FPE): Comprised of two residual flight Euclid sidecar electronics in an enclosure designed for ARIEL.
- Cryo-Flex Cables (CFC)
- NASA hardware will be completed and shipped to ESA later this year

Participation in the science team and developing and maintaining NASA Ariel Science Center at NASA's Infrared Processing and Analysis Center (IPAC) for the US community



Pioneers

- Aspera: IGM Inflow/outflow from galaxies via OVI 10^5K emission line imaging. PI Carlos Vargas
  - Launch date: 10/2025
- Pandora: Multiwavelength Characterization of Exoplanets and their Host Stars
  - Launch date: 03/2025
- StarBurst: Gamma-ray ASM, Simultaneous detection of NS/NS mergers with LIGO
  - Launch date: 12/2025
  - CDR held on April 2-3, 2024
- PUEO: A Long-duration Balloon-borne Instrument for Particle Astrophysics at the Highest Energies
  - Launch date: 12/2025 in Antarctica
- TIGERISS: Measuring ultra-heavy (r-process) cosmic rays on ISS
  - Launch readiness date: 09/2026
  - Delta SRR/MDR completed on 2/15/2024. dPMP to be held in late May.
- Landolt: Absolute stellar photometry to <0.5%, PI Peter Plavchan, George Mason University
  - New Pioneers 2022 selection, started March 2024

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BurstCube: Launched March 21, 2024

- Primary goal is to detect, localize, and characterize short Gamma-ray Bursts (sGRBs)
  - March 21: NASA's BurstCube launched aboard SpaceX's 30th Commercial Resupply Services mission in Cape Canaveral.
  - April 18: The shoebox-sized satellite was deployed from the International Space Station, 'beacon' immediately seen – s/c is alive.
  - April 22: Accurate orbital parameters obtained, full communications established, the commissioning process is in progress.


BurstCube launched aboard SpaceX's 30th Commercial Resupply Services mission

NASA Scientific Balloon Program

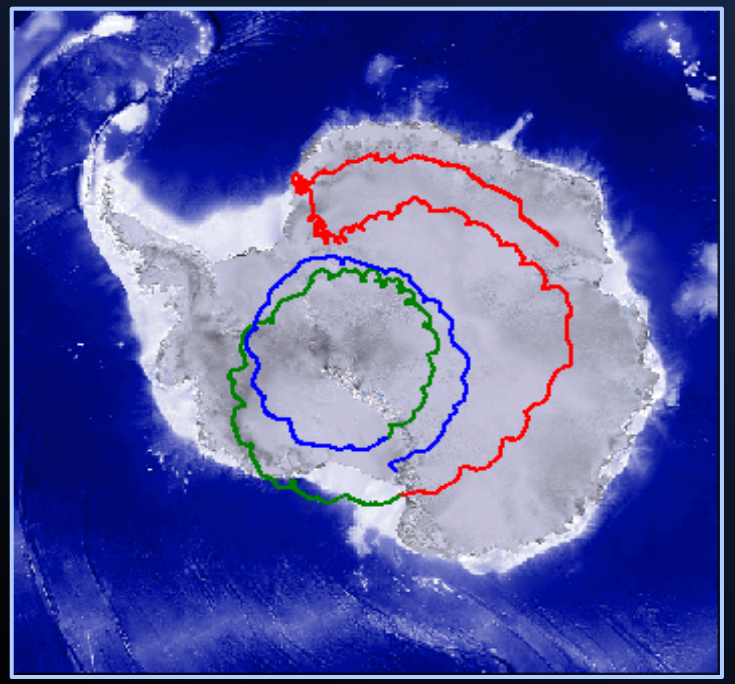
- The NASA Scientific Balloon provides rapid, low-cost access to near-space for all NASA science.
- In addition to the cutting-edge science yield, the program provides excellent technology maturation and training for NASA's future missions launch location and flight profile are driven by science needs.
- Launch Sides include Ft Sumner, NM; Alice Springs, Australia; Kiruna, Sweden; McMurdo, Antarctica, and Wanaka, New Zealand.
- Annually ~16 launches in 1 domestic (~10-24 h) and 2 foreign launch campaigns (3-5 days up to several weeks aloft).
- Super Pressure Balloon is currently under development with 60-100 days aloft, mid latitude in southern hemisphere (Wanaka).

Recent Achievements

- December 31, 2023: GUSTO Explorer mission launched
- January 1, 2024: 60 MCF Qualification Flight IV

Upcoming Milestones

- Early May to mid-July, 2024: Sweden and Ft. Sumner Campaigns
- ~August to October 2024: Ft. Sumner Campaign



New NASA Heavy Lift Balloon Record 57 Days from GUSTO earlier this year surpassing the prior 52-day Super-TIGER record in 2012.

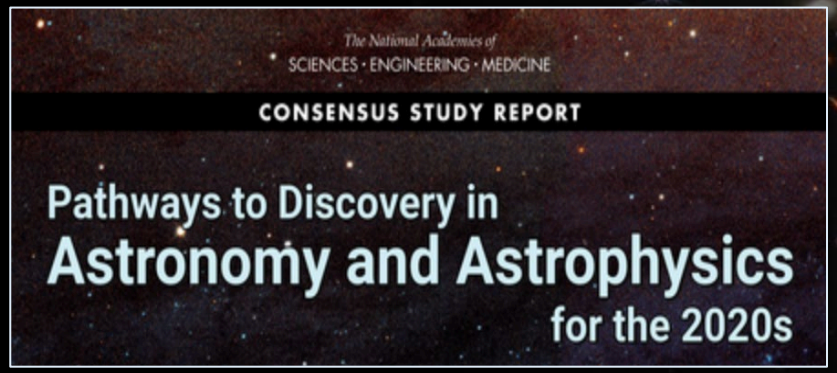
The APD will host an Operations Paradigm Change Review (OPCR) of the CXO and HST missions in 2024. The OPCR will assess proposed options for approaches to continue operations of missions in the extended operations phase, with reduced funding as proposed in the FY2025 President's Budget. The purpose of the review is to assist NASA in assessing the potential for limited scientific productivity and decreased operating efficiency of the HST and CXO missions under the current and future budget realities. NASA will use the findings from the OPCR to:

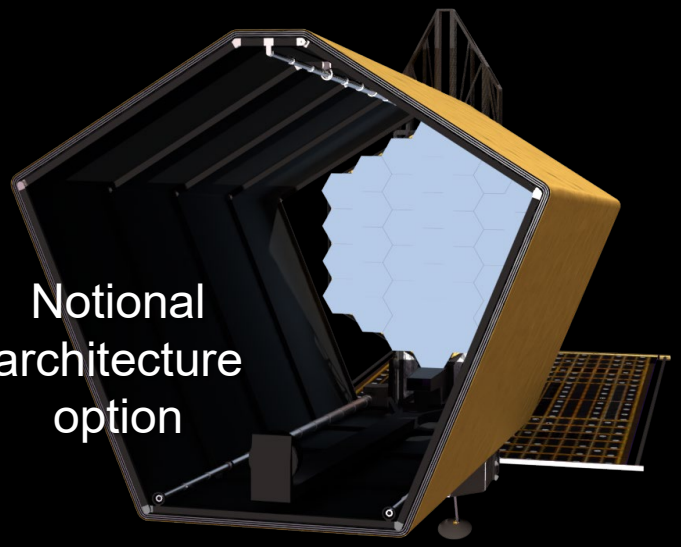
- Define an implementation approach consistent with astrophysics strategic objectives,
- Prioritize the operating mode(s),
- Provide programmatic direction to the missions and projects concerned for FY25, FY26 and FY27; and
- Issue initial funding guidelines for FY28 and FY29 (possibly to be revisited in the 2025 Senior Review).
-

NASA actions resulting from the OPCR could include authorizing a mission to; maintain the status quo; restructure the project; or terminate an ongoing science mission.

What Is Habitable Worlds Observatory (HWO)?

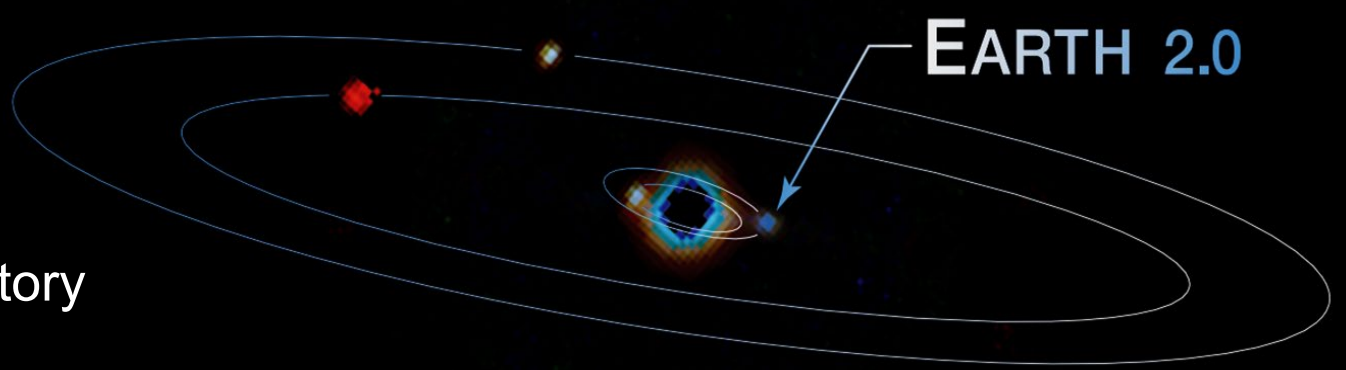
NASA's next flagship mission concept recommended by Astro2020 Decadal Survey





Notional architecture option

First telescope designed to search for signs of life on planets outside our solar system



Large-aperture UV / Optical / NIR observatory performing transformative astrophysics

Habitable Worlds Observatory Teams

APD - HQ

Megan Ansdell (PS)

Julie Crooke (PE)

Joshua Pepper (Dep. PS)

Science, Technology, Architecture Review Team (START)

Courtney Dressing
UC Berkeley
Co-Chair

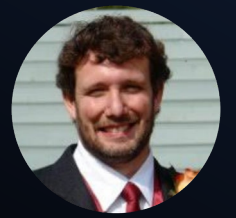
John O'Meara
W. M. Keck Observatory
Co-Chair

Technical Assessment Group (TAG)

Lee Feinberg
Engineer Co-Chair

Aki Roberge
Scientist Co-Chair

Bertrand Mennesson
Scientist Co-Chair



John Ziemer
Engineer Co-Chair

FY24 Conference Language Report

Habitable Worlds Observatory

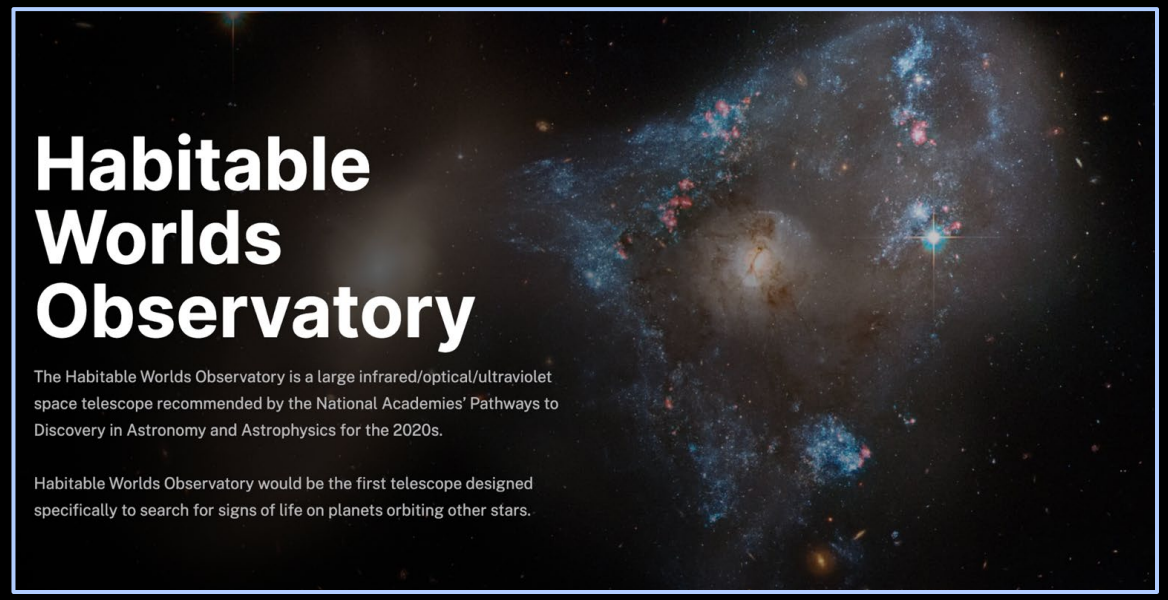
The Senate Report language regarding “Habitable Worlds Observatory” is adopted and the agreement provides no less than $10,000,000 for the mission. In addition, the agreement directs NASA to establish a Habitable Worlds Observatory project office at Goddard Space Space Flight Center to leverage expertise in astrophysics and segmented mirror technology.

Senate Report Language - Habitable Worlds Observatory

The Committee supports the Great Observatory Maturation Program (GOMAP) as recommended by the Decadal Survey on Astronomy and Astrophysics, “Pathways to Discovery in Astronomy and Astrophysics for the 2020s” [Astro2020]. GOMAP will mature science and technologies needed for future flagship missions starting with the Habitable Worlds Observatory to observe habitable exoplanets. In order to cement continued American leadership in astronomy, the Committee provides the requested level for GOMAP to implement the Astro2020 recommendations. NASA is encouraged to articulate funding for GOMAP separately in future budget requests.

Getting Involved

Visit NASA's HWO Website



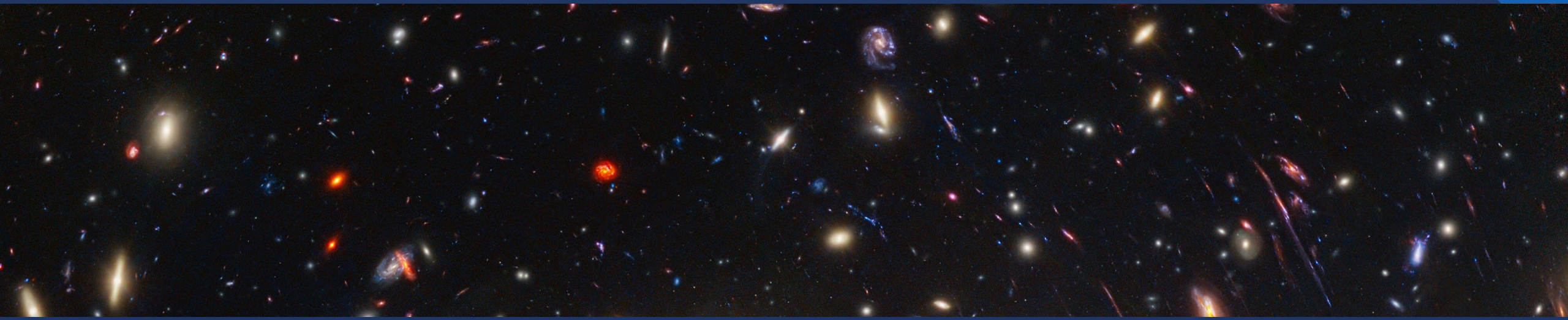
Over 1,000 scientists and engineers are involved with the planning and exploration for the mission including representatives from JAXA, ESA and CSA.

Join HWO Working Groups

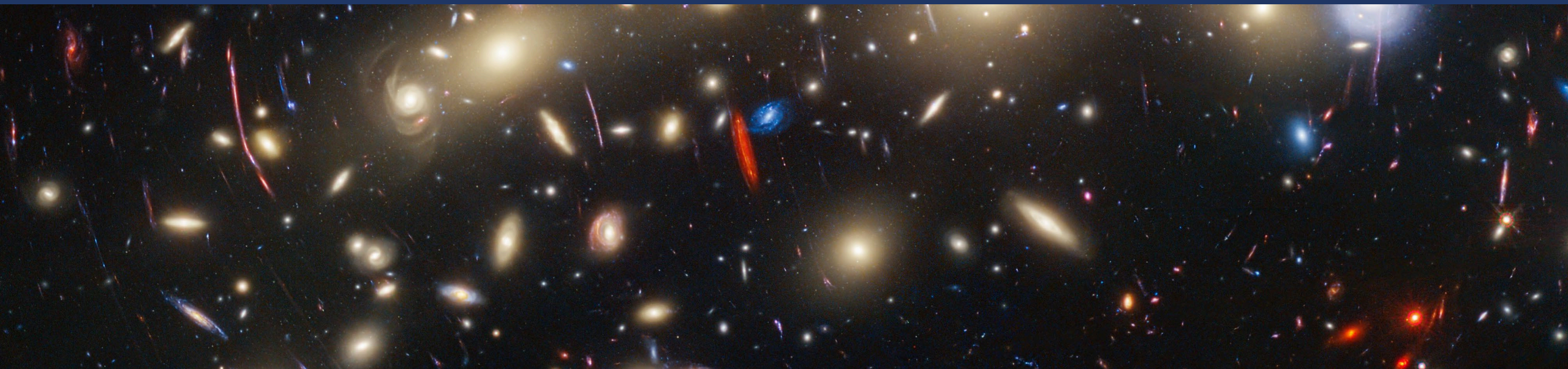
Anyone can join HWO Working Groups! Scan the QR code to view the complete list of Working Groups + Sub-Groups with links to sign-up forms.

Join HWO_Community Slack

Anyone can join the HWO_Community Slack and create new channels. Scan the QR code to sign up and join in discussions or start new ones!



Questions



Astrophysics by the NUMBERS

RESEARCH

~365 U.S. Science PIs Funded
~130 Individual Institutions Selected
~$136M Awarded Annually

TECHNOLOGY DEVELOPMENT

~$160M Invested Annually

REFEREED PUBLICATIONS

>23,432 Total Publications (2019-Current)
>21,249 Hubble Publications (1991-Current)
>542 Webb Publications (July 2022-Current)

MISSION SUMMARY

15* Missions Operating
18* Missions in Development
2 Tech. Demos
***Including international**

SMALLSATS/CUBESATS

4 Science Missions Launched
- **1** Mission complete
- **3** Operating/commissioning

11 Science Missions in Development
- **9** Free-flying CubeSats
- **1** ISS-attached Science Mission
- **1** Supporting Technology Development Project

SOUNDING ROCKETS

16 Science Missions Launched (Suborbital)
6 In Development

BALLOONS

23** Suborbital Balloons Launched
***Includes APD, HPD, PSD, ESD, educational, & engineering missions*
22 Missions in Development

Updated: March 2024