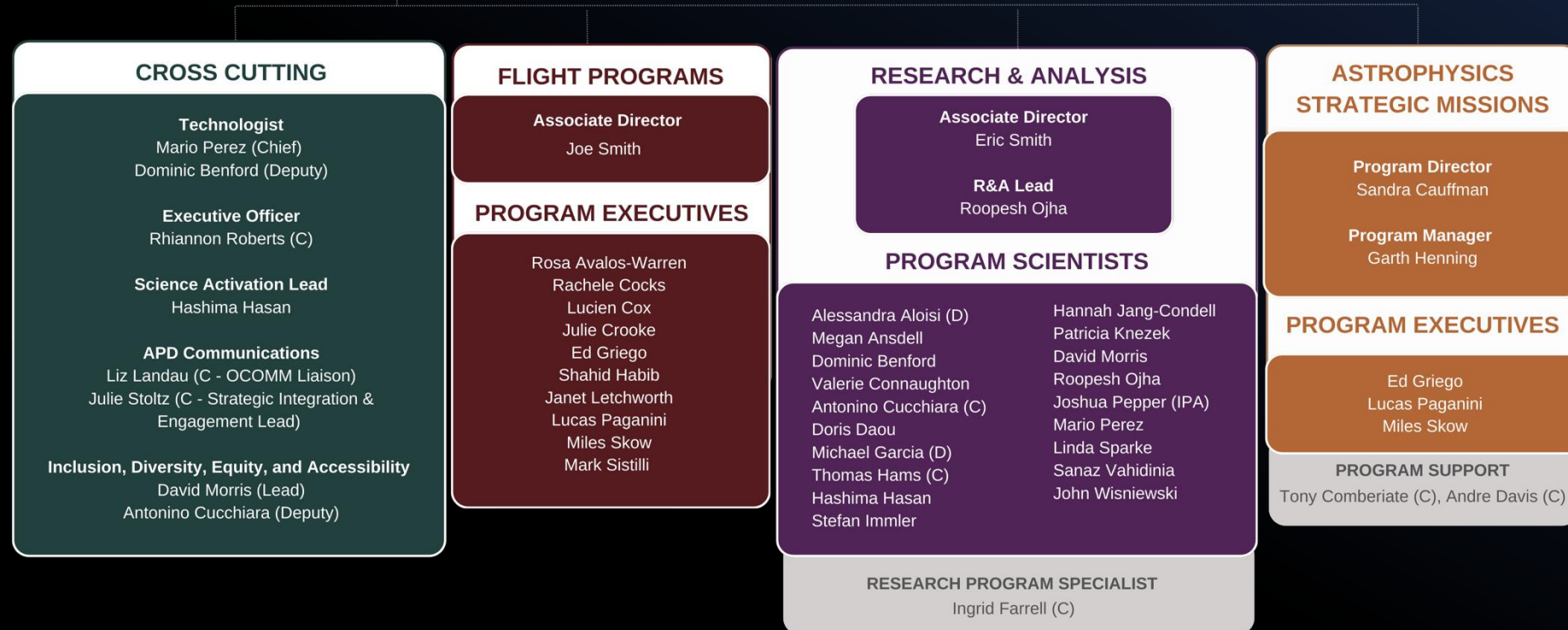
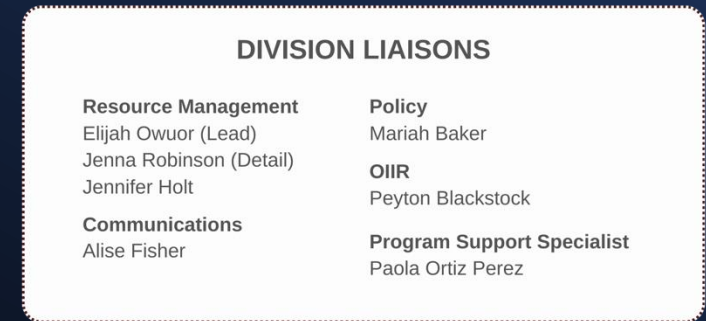




Science Mission Directorate
ASTROPHYSICS
Organizational Chart

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





ASTROPHYSICS FLEET

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

2020



IXPE



WEBB



EUCLID



XRISM

CUTE

1990



HUBBLE

GLOWBUG

BURSTCUBE
SPRITE

BLACKCAT
SPARCS

PANDORA
STARBURST

ASPERA

PUEO

TIGERISS

MANTIS

SPHEREX

ROMAN

COSI

UVEX

ULTRASAT

ARIEL

LISA

2015



TESS



NICER



NUSTAR

2010



FERMI

2005



GEHRELS SWIFT

2000



CHANDRA



XMM-NEWTON



2025

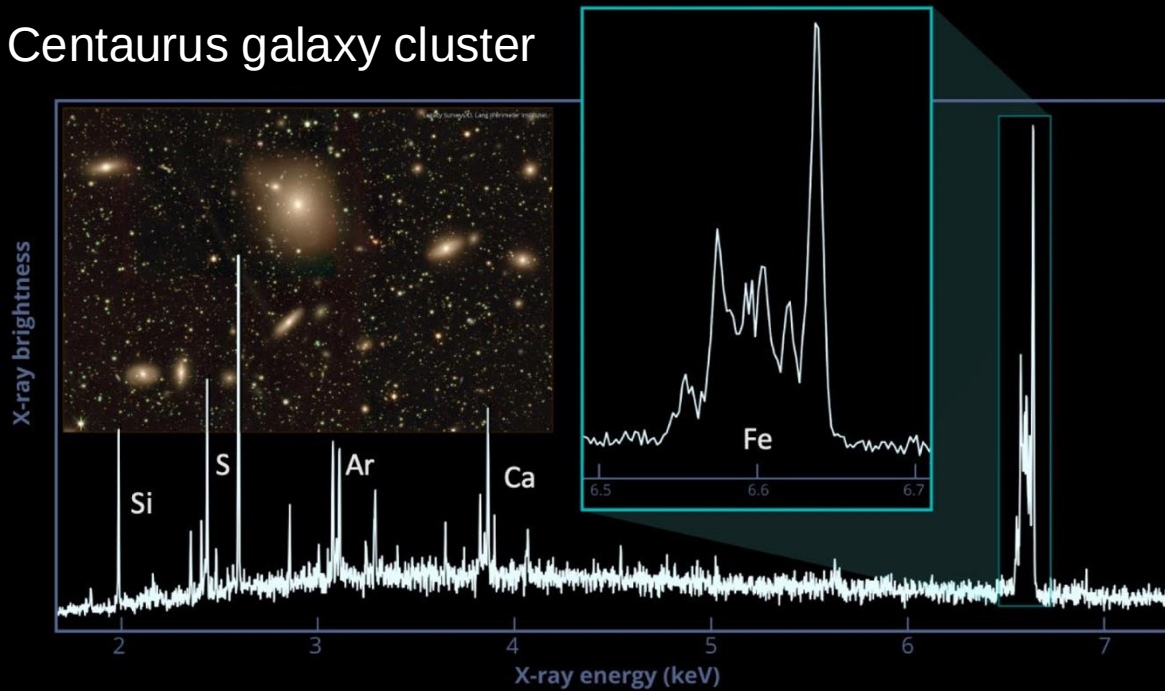
Recognition

- Dr. Jane Rigby, Senior Project Scientist for JWST, received Medal of Freedom for work on Webb
- Marcia Rieke, Professor at the University of Arizona and PI for the near-infrared camera (NIRCam), awarded Gruber Cosmology Prize for work on Hubble and Webb

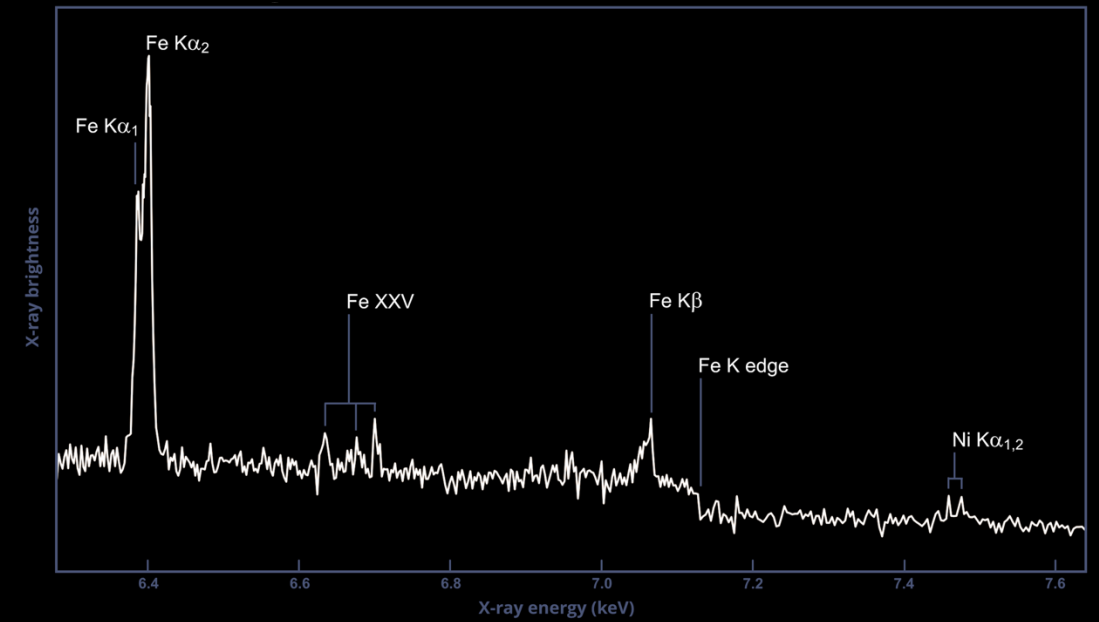


XRISM Resolve Data

Centaurus galaxy cluster



Vela X-1 high-mass X-ray binary



Courtesy: XRISM science Team

Super-Earth 55 Cancri e

NIRCam + MIRI Emission Spectrum

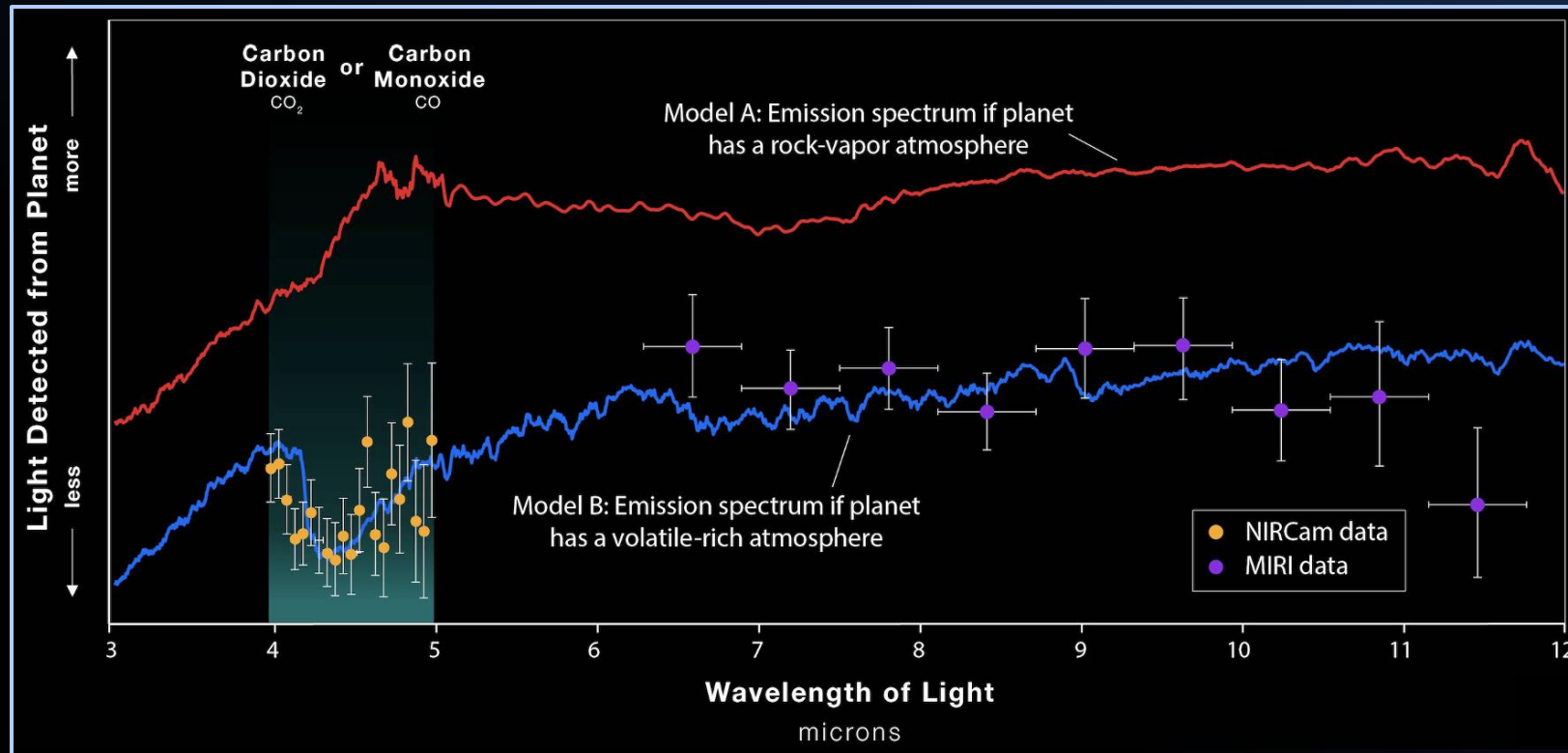
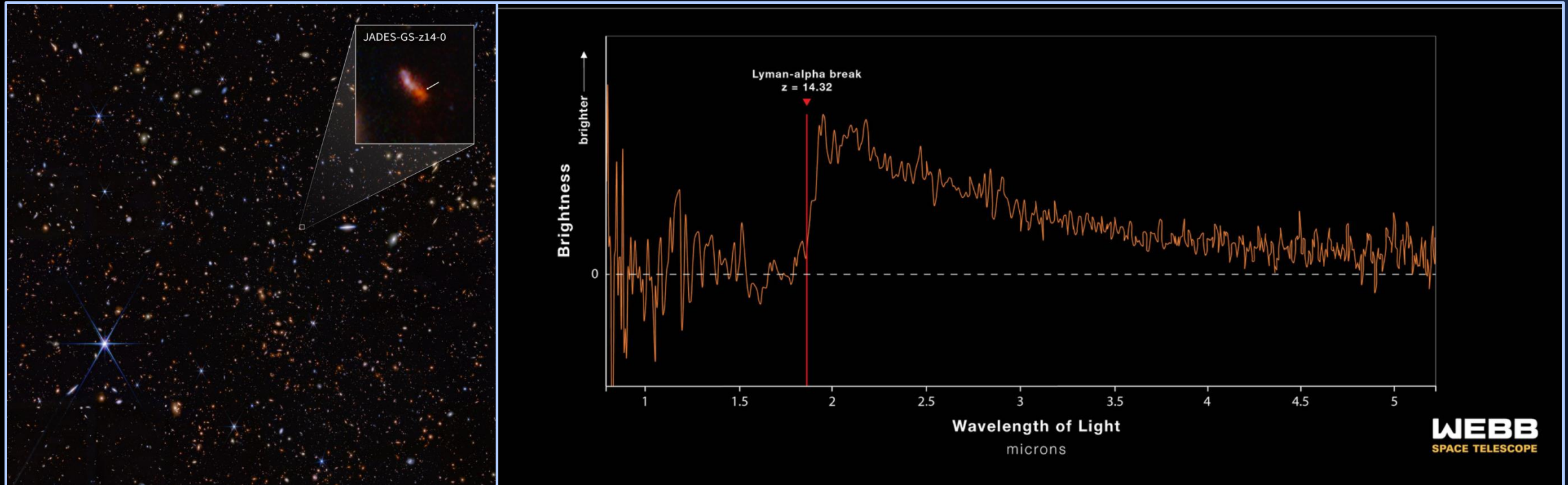


Illustration: NASA, ESA, CSA, Joseph Olmsted (STScI) Science: Renyu Hu (JPL), Aaron Bello-Arufe (JPL), Michael Zhang (University of Chicago), Mantas Zilinskas (SRON Netherlands Institute for Space Research)

A thermal emission spectrum of the super-Earth exoplanet 55 Cancri e, captured by Webb's NIRCam, GRISM Spectrometer and MIRI Low-Resolution Spectrometer, shows that the planet may be surrounded by an atmosphere rich in carbon dioxide or carbon monoxide and other volatiles, not just vaporized rock.

Webb Finds Most Distant Known Galaxy

NIRSpec Microshutter Array Spectroscopy



Credit: NASA, ESA, CSA, STScI, Brant Robertson (UC Santa Cruz), Ben Johnson (CfA), Sandro Tacchella (Cambridge), Phill Cargile (CfA)

Budget



Astrophysics Priorities

Explore/Innovate/Partner/Inspire

- Maintain a **balanced portfolio** during this decade and the next, by balancing investments in missions under development and future missions, against funding for large missions in extended science operations.
- Investment to advance the Astro2020 Decadal Priorities, including technology maturation for the **Habitable Worlds Observatory**, and the selection of an **Astrophysics Probe** mission.
- Ensure successful completion of the **Roman Space Telescope**, within the Agency commitment (cost/schedule)
- Protect international **partnerships** such as the Laser Interferometer Space Antenna (LISA), a gravitational wave mission.

Astrophysics FY24 Budget Decisions

- Maintain Agency commitment to delivery of Roman
- Maintain Explorer missions in development (SPHEREx and COSI)
- Proceed with newest MIDEX: UV explorer (UVEX)
- Review underway for Probe Mission (AO FY23)
- International partnerships:
 - LISA transitions to management by Explorers office following ESA adoption (January 2024)
 - ATHENA investments are being restructured in response to ESA program reformulation
- Technology investments for Habitable Worlds Observatory
- Reductions to operational cost of large, extended-operations missions
 - Chandra (25 years)
 - Hubble (34 years)

FY25 President's Budget

	Actual 2023	CR 2024	Request 2025	2026	Out-Years 2027	2028	2029
Astrophysics	\$1,510.0		\$1,578.1	\$1,587.0	\$1,613.6	\$1,647.1	\$1,673.4
Astrophysics Research	\$284.8		\$300.5	\$378.7	\$390.5	\$390.3	\$377.1
Cosmic Origins	\$314.8		\$319.0	\$312.8	\$307.7	\$300.4	\$282.1
Physics of the Cosmos	\$180.7		\$210.8	\$184.3	\$168.6	\$176.1	\$133.7
Exoplanet Exploration	\$502.9		\$478.5	\$459.0	\$366.1	\$323.8	\$339.9
Astrophysics Explorer	\$226.8		\$269.3	\$252.2	\$380.6	\$456.4	\$540.6

Hubble/Chandra

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.

Mission Updates



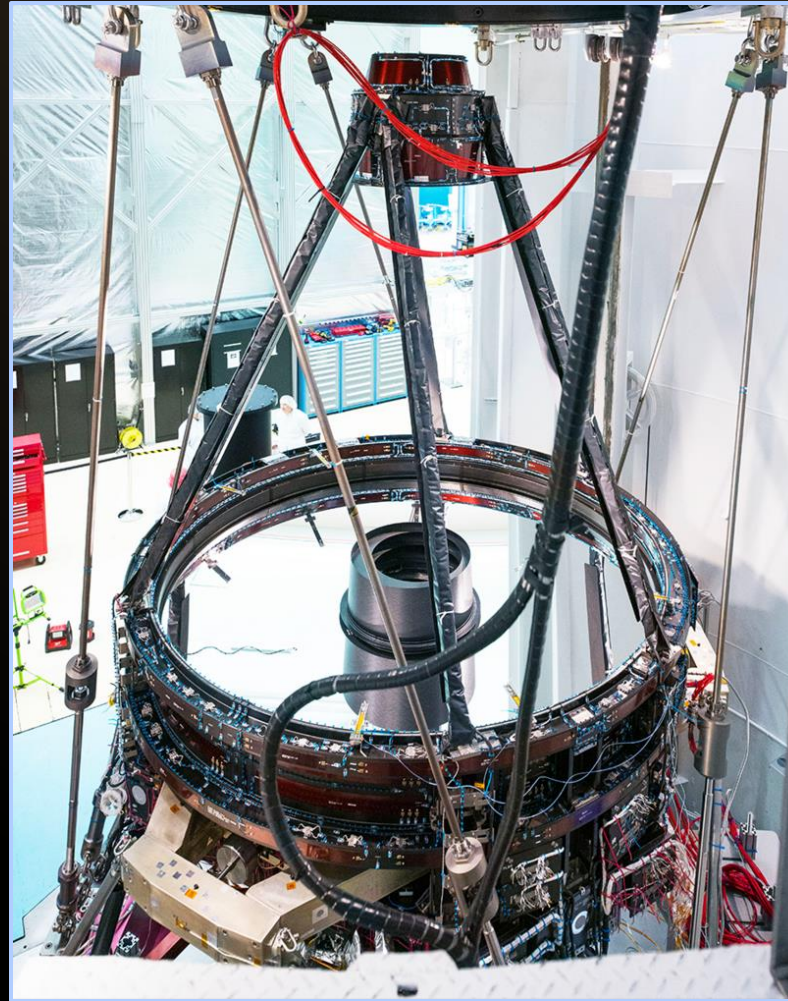
Nancy Grace Roman Space Telescope

Recent Accomplishments

- First light optical tests of the telescope achieved first light.
- Completed the OTA Pre-Environmental Review on Feb 7, 2024.
- Wide Field Instrument (WFI) completed its second and last thermal vacuum test and is proceeding to EMC testing.

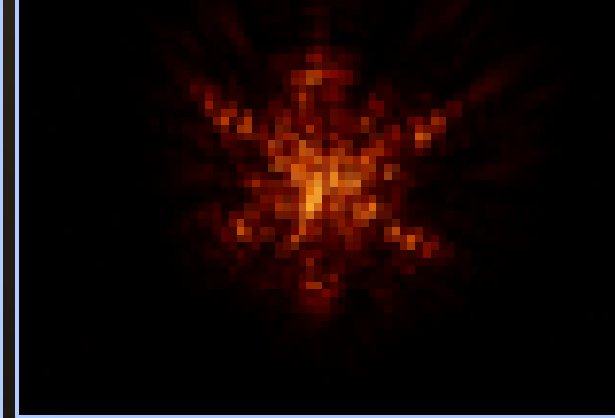
Upcoming 2024 Milestones

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



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)

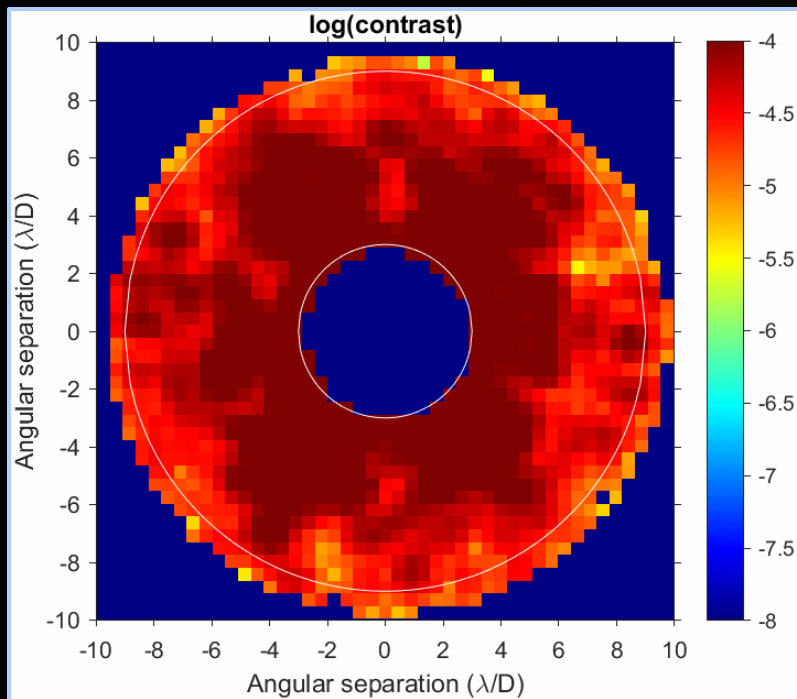


Roman WFI recently underwent vibration and acoustics testing and successfully completed its second and final thermal vacuum test in May.

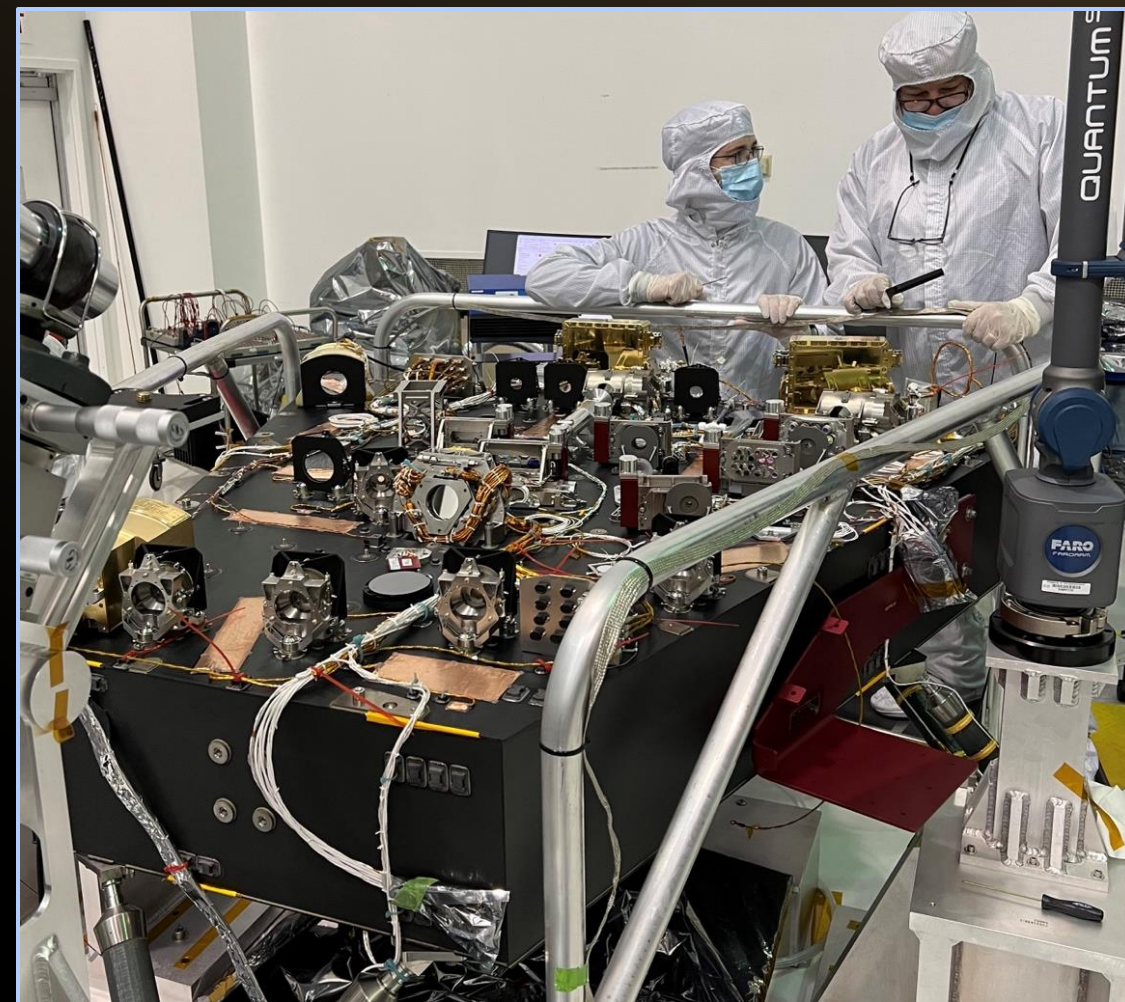
Roman Space Telescope

Coronagraph (CGI)

- CGI successfully delivered to GSFC on May 19 after completing ambient testing.
- Performance meets requirements in both modes, the Hybrid-Lyot and Shaped Pupil Coronagraph.



Sequence of high-order wavefront sensing and control iterations



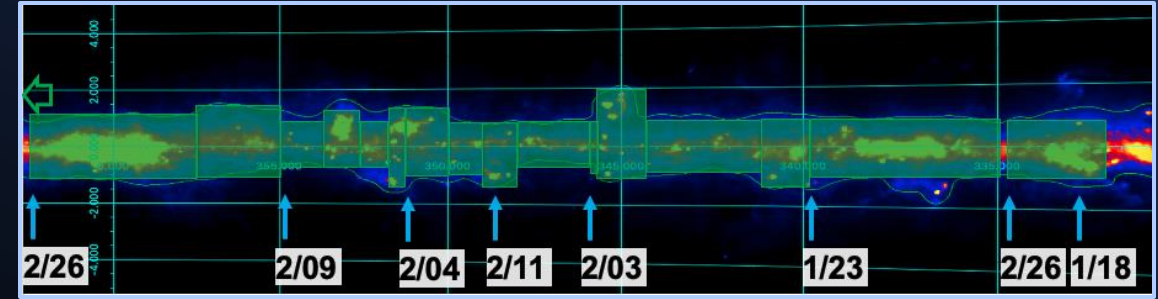
Coronagraph Instrument (CGI)

Astrophysics Probes

- Astrophysics Probe AO called for:
 - X-Ray or Far-IR imaging/spectroscopy mission concepts
 - Per Astro2020 recommendation
- Astrophysics Probe Announcement of Opportunity (AO) status:
 - 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

GUSTO Targeted Deep Sky Survey

- The GUSTO mission had a successful flight, launched on a balloon from McMurdo on Dec. 30, 2023.
- GUSTO** survey covered 62.5 deg² in the Galactic plane and 12,750 line of sights in the LMC.

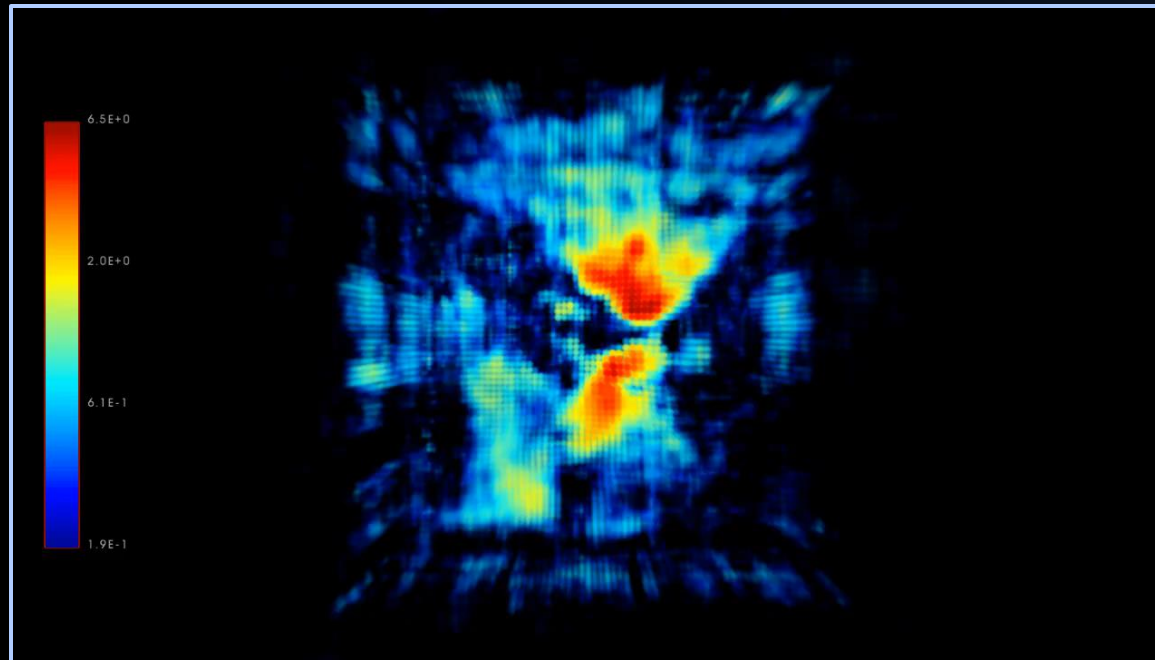


GUSTO Survey Coverage

NGC 3603

[CII] Line

Courtesy Dr. C. Walker
Univ Arizona



SPHEREx

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 $>3 \times 10^8$ galaxies along with $>10^8$ stars

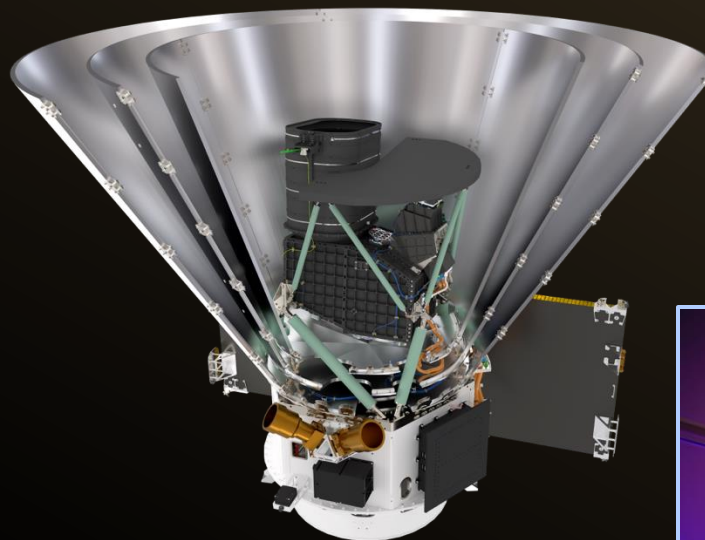
Recent accomplishments

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

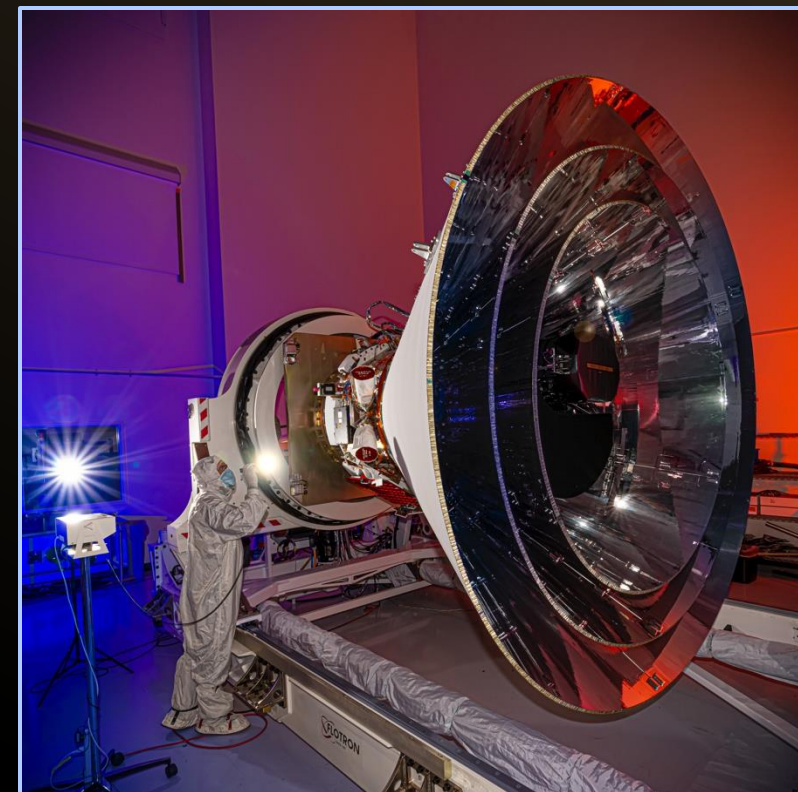
Upcoming Milestones

- Beginning thermal vacuum testing early June 2024.
- LRD remains February 2025.

Photon shields (shown cutaway)



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



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

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

Recent Achievements

- KDP-C successfully held on April 16

Upcoming Milestones

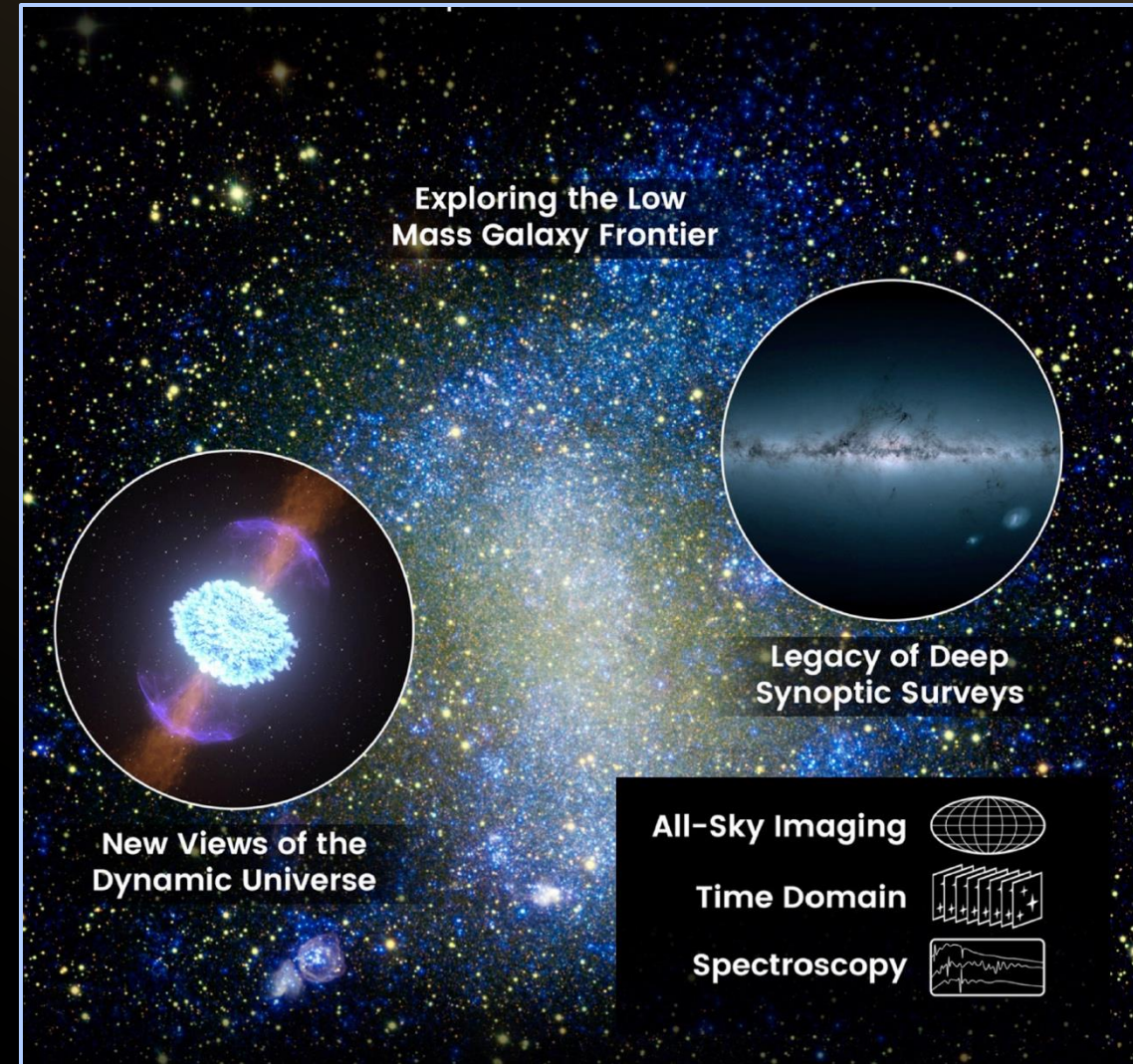
- December 2024: Critical Design Review (CDR)



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

MIDEX Selection: UVEX

- MIDEX mission the Ultraviolet Explorer (UVEX) has been selected to continue into Phase B.
 - PI: Dr. Fiona Harrison
- UVEX Science
 - Sensitive wide-field imaging in 2 UV bands
 - High angular resolution
 - Broadband UV spectroscopy
 - All-sky survey
 - Rapid pointing capability



LISA

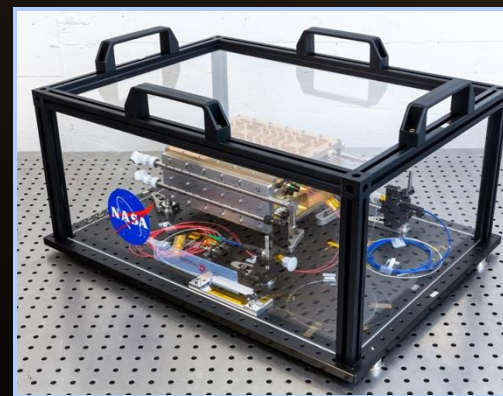
Laser Interferometer Space Antenna

Mission

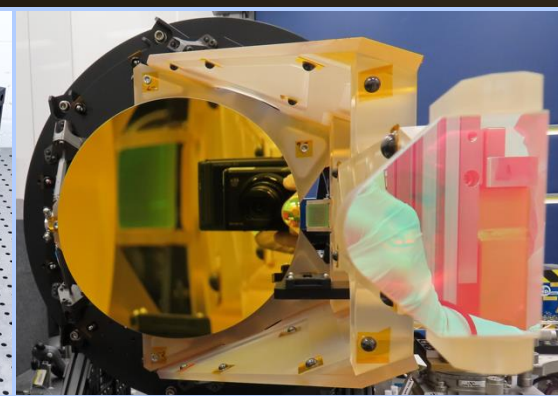
- ESA/NASA partnership to build & operate first space-based gravitational wave observatory

Status

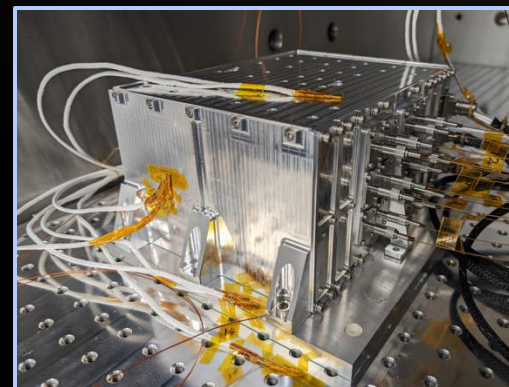
- LISA adopted by ESA on Jan 25, 2024
- NASA is now establishing a LISA project office at GSFC
 - NASA plans to transition to phase B in late CY24
- NASA contributions
 - Laser systems,
 - Telescopes,
 - Charge management devices
 - Science data center



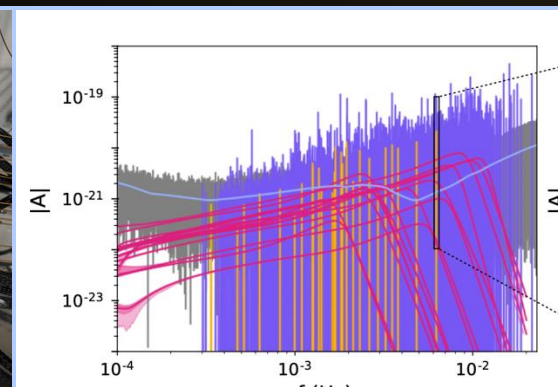
TRL5 laser head



EDU Telescope



Charge management device



Data processing

Pioneers

- **Aspera:** IGM Inflow/outflow from galaxies via OVI 10⁵K 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

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: BurstCube deployed
 - April 22: Commissioning is in progress.
 - May 31: Data collection is ongoing



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

← SNoPI
← BurstCube

Update on Hubble Gyro Resolution

- Gyro 3 grew increasingly problematic since late 2023 significantly increasing interruptions to science.
- Transition to one gyro science (OGS) operational mode was announced June 4.
 - Uses a larger solar exclusion angle and will take more time to acquire science targets
 - Expect to schedule ~500 fewer science orbits per year
 - Field of Regard at any one time will be reduced from ~82% to ~50% (comparable to Webb), the total sky will remain available over the course of the year
- The team is working to return Hubble to consistent science operations over the next several weeks



NASA Scientific Balloon Program

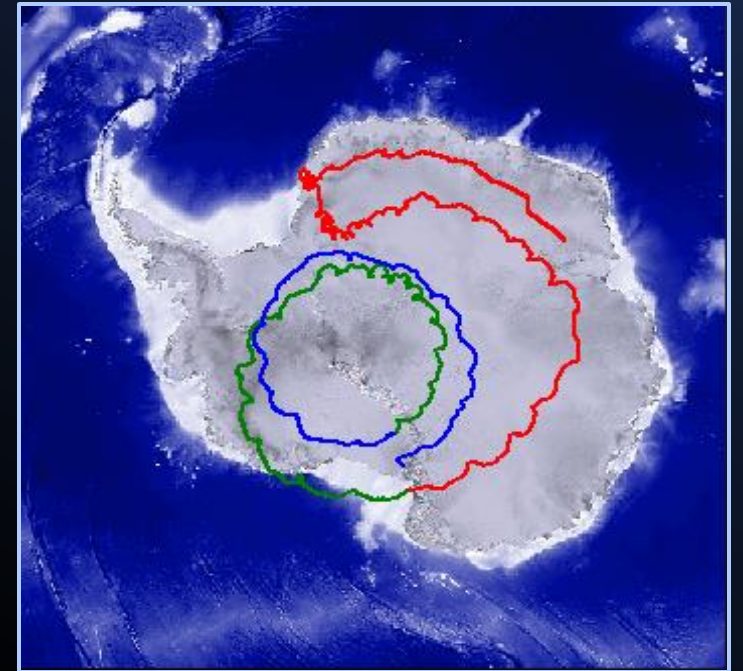
- The NASA Scientific Balloon provides rapid, low-cost access to near-space for all NASA science.
- In addition to the cutting-edge science yield, the program provides excellent technology maturation and training for NASA's future missions launch location and flight profile are driven by science needs.

Recent Achievements

- December 31, 2023: GUSTO Explorer mission launched
- January 1, 2024: 60 MCF Qualification Flight IV
- May 27, 2024: Launch of HELIX from Sweden first of 4 payloads

Upcoming Milestones

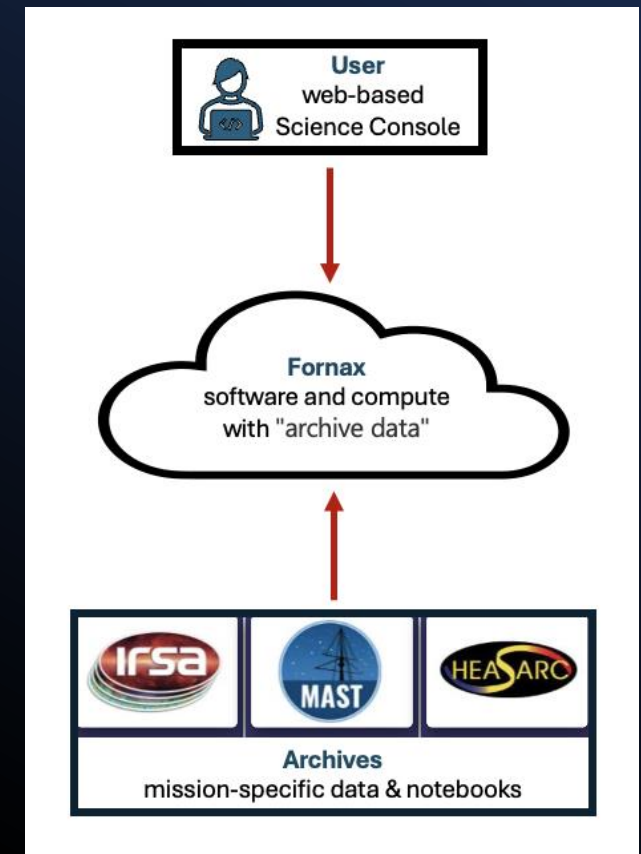
- Early May to mid-July 2024: Sweden and Ft. Sumner Campaigns
- ~August to October 2024: Ft. Sumner Campaign



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

Towards a Cloud-Based Solution for APD

- Major NASA archives already have downloadable data in AWS cloud
- NASA Astrophysics is developing the **Fornax** initiative, a cloud-based system that brings together data, open-source software, and computing so that researchers can focus on science:
<https://pcos.gsfc.nasa.gov/Fornax/>
 - Collaboration of the NASA astrophysics archives IRSA, MAST, and HEASARC with GSFC Astrophysics Project Division
 - Accessible by users with a wide range of expertise
 - Scalable and deployable to other cloud environments to meet the changing needs of the Astronomical community
- New solution enables multi-wavelength, time-domain, big-data and compute-intensive astronomy
- Aligned with NASA SMD consolidation of science core infrastructure



Astrophysics Postdoctoral Fellowships for 2024

- The NASA Hubble Fellowship Program fosters excellence and inclusive leadership in astrophysics by supporting a diverse group of exceptionally promising and innovative early-career astrophysicists.
- Out of 520 applicants, NASA Hubble Fellowship Program (NHFP) recently announced 24 new fellows to its 2024 roster.
- The NHFP remains one of the most prestigious post-doctoral opportunity available to recent graduates.

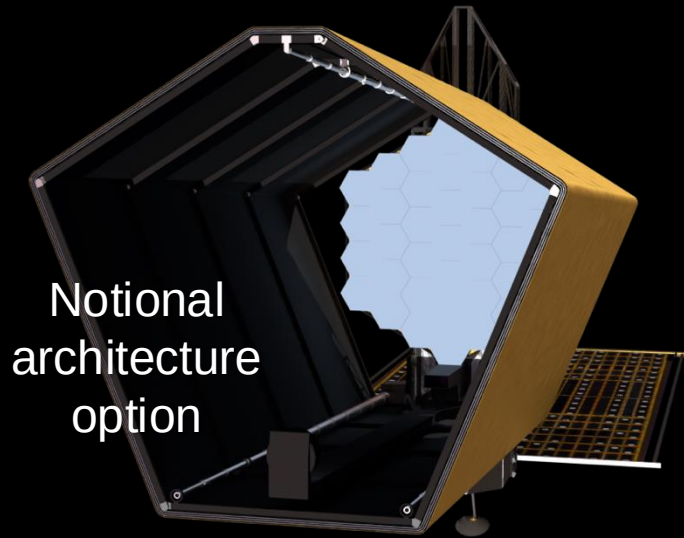


GOMAP/Habitable Worlds Observatory



What Is Habitable Worlds Observatory (HWO)?

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

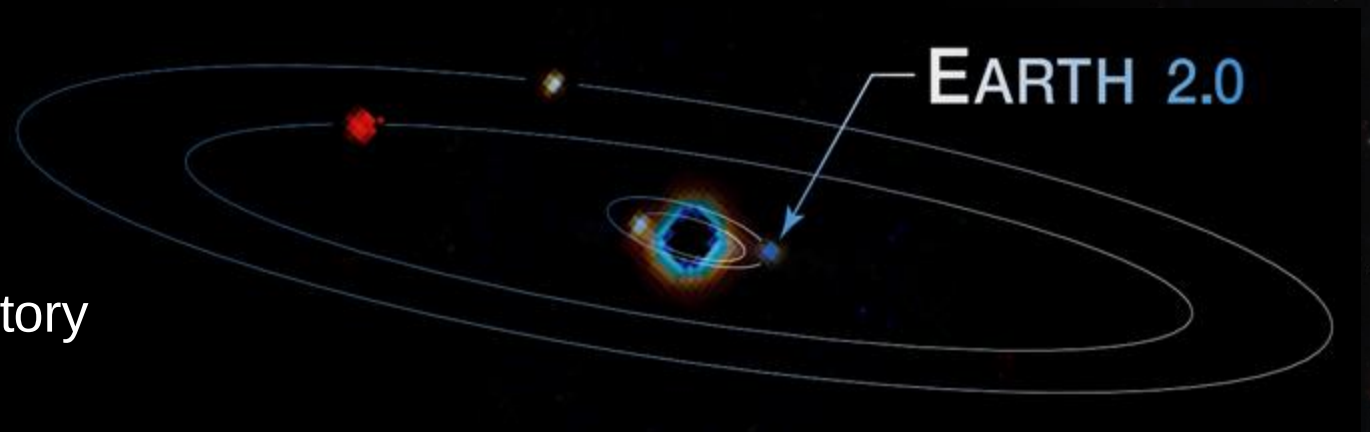


Notional
architecture
option

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



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



Habitable Worlds Observatory

Decadal Recommendations → Big Picture Strategy

- **Build to schedule:** Mission Level 1 Requirement e.g. Planetary mission strategy
- **Evolve technology:**
 - Build upon current NASA investments and TRL-9 technology
 - Segmented optical telescope system from JWST
 - Coronagraph from Roman's coronagraphic imager program
- **Next Generation Rockets:**
 - Larger telescope aperture sizes
 - Leverage opportunities offered by large fairings to facilitate mass & volume trades
- **Planned Servicing:** Robotic servicing at L2
- **Robust Margins:** Design with large scientific, technical, and programmatic margins
- **Mature technologies first:** Reduce risk by maturing the technologies prior to formulation

FY24 Appropriation : Next Steps

FY24 Conference Language Report

Habitable Worlds Observatory Appropriation

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.

Habitable Worlds Observatory Direction

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.

FY24 Appropriation: Resulting Changes

- **The START Terms of Reference (TOR) require the START disband once the Project Office is stood up, however the activities initiated by the START and the TAG will continue through CY24**
 - This provision in the TOR allows NASA to minimize conflicts as it formulates industry calls and science team solicitations
 - START chairs will transition to provide input to the PO directly during this transition period
 - START members will continue working as HWO Working Groups co-chairs and members

FY24 Appropriation: Resulting Changes

- **Working Groups**

- All Working Groups will continue as community efforts to complete the Science Case Development Documents (SCDD's)
- We will remunerate all Working Group co-chairs for their leadership efforts starting with the establishment of the Project Office through 2024
- During this phase, Working Group chairs will interface with the Project Office, which will lead regular meetings
- If you are a Working Group member (inc. international), you won't experience any changes with the exception of industry members

UV Science and Instrumentation Workshop

On the Way to the NASA Habitable Worlds Observatory and Beyond



Held on May 7-9 at JPL with 183 participants.

The image features a vibrant cosmic background with various celestial elements. In the center, a circular inset with a white border contains a detailed view of a nebula with a blue-green core and reddish-pink outer rings. Overlaid on this inset is the word "QUESTIONS?" in a bold, white, sans-serif font. The background outside the circle includes a blue and orange nebula on the left, a purple and blue galaxy on the bottom right, and a dark red region with bright pink stars on the top right. A large white diagonal line cuts across the entire image from the top-left to the bottom-right.

QUESTIONS?