

Committee on Astronomy and Astrophysics

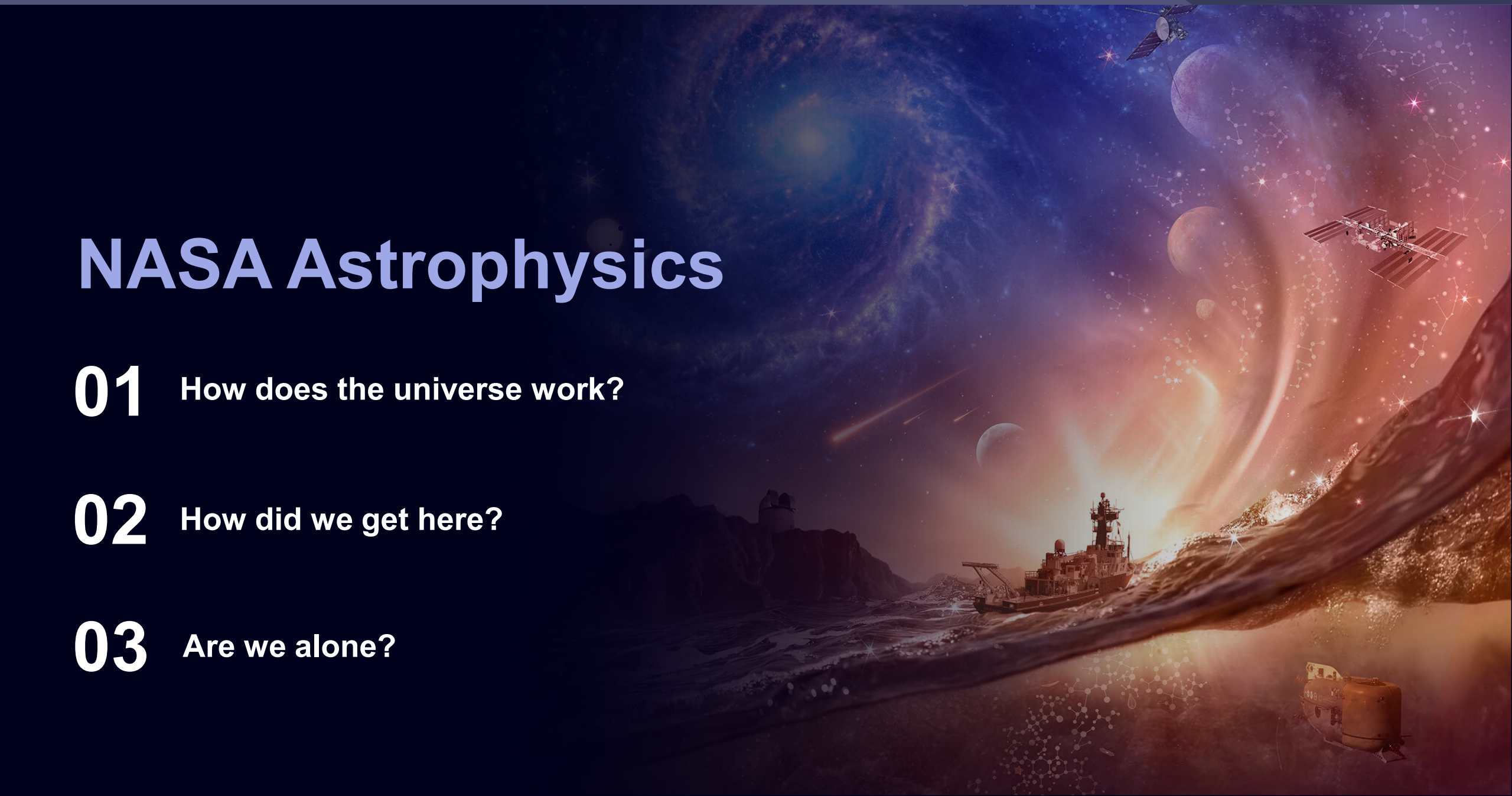
Dr. Shawn Domagal-Goldman
NASA's Acting Astrophysics Division Director

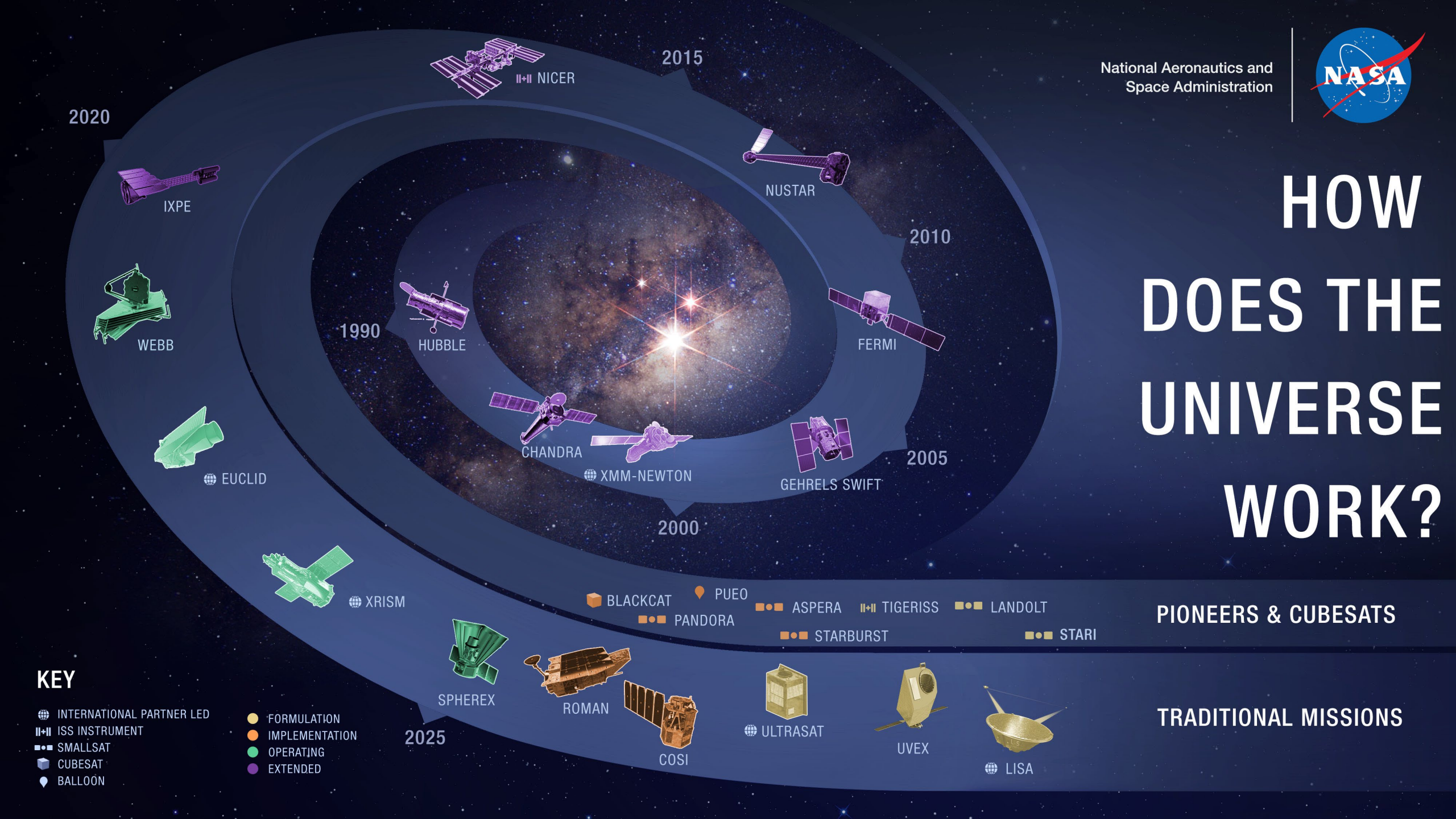
NASA Astrophysics

01 How does the universe work?

02 How did we get here?

03 Are we alone?




National Aeronautics and Space Administration
NASA
HOW DOES THE UNIVERSE WORK?
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UVEX
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ASPERA
TIGERISS
LANDOLT
STARBURST
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PIONEERS & CUBESATS
TRADITIONAL MISSIONS
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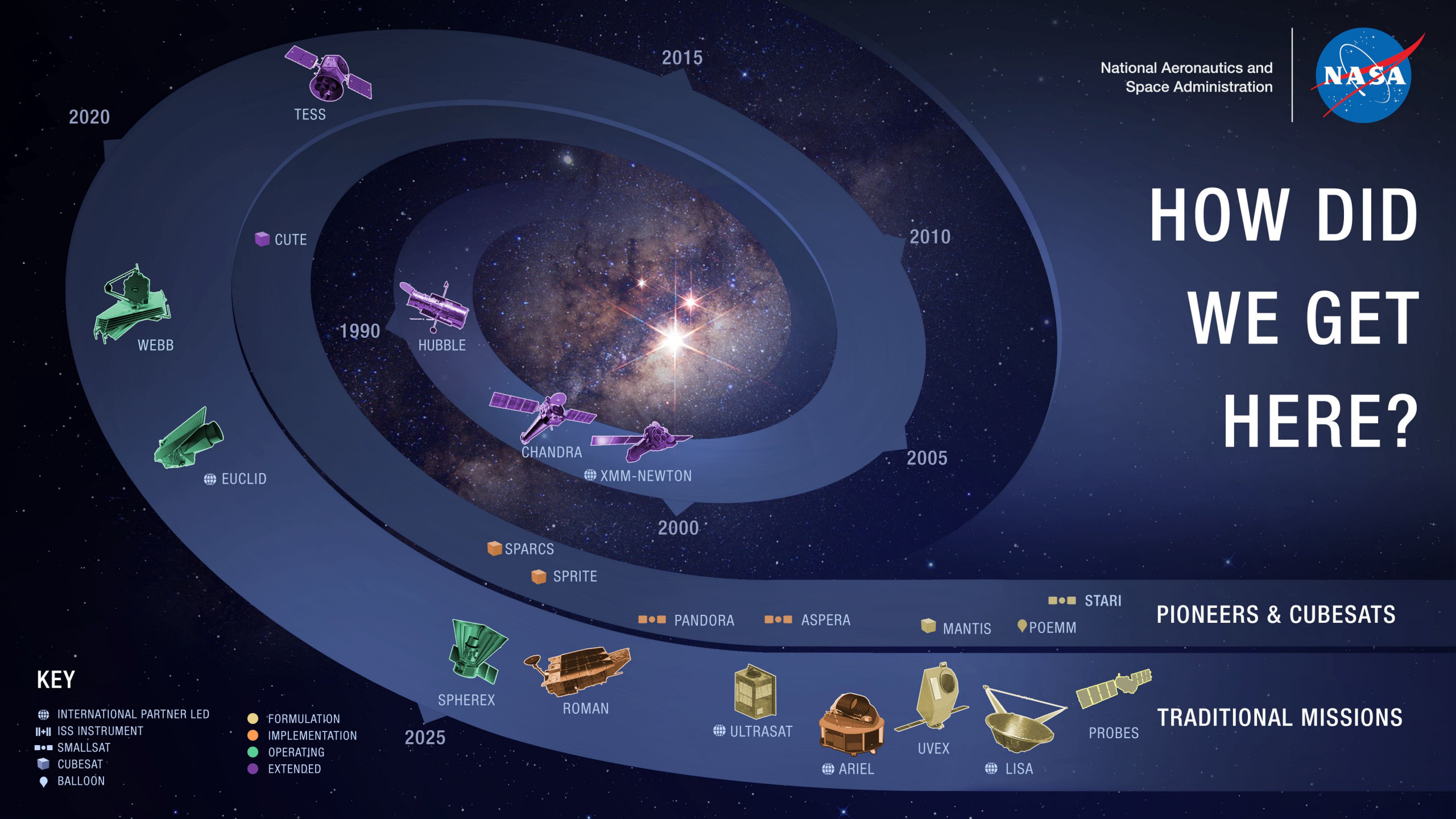
CUBESAT
BALLOON
FORMULATION
IMPLEMENTATION
OPERATING
EXTENDED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HOW DID WE GET HERE?
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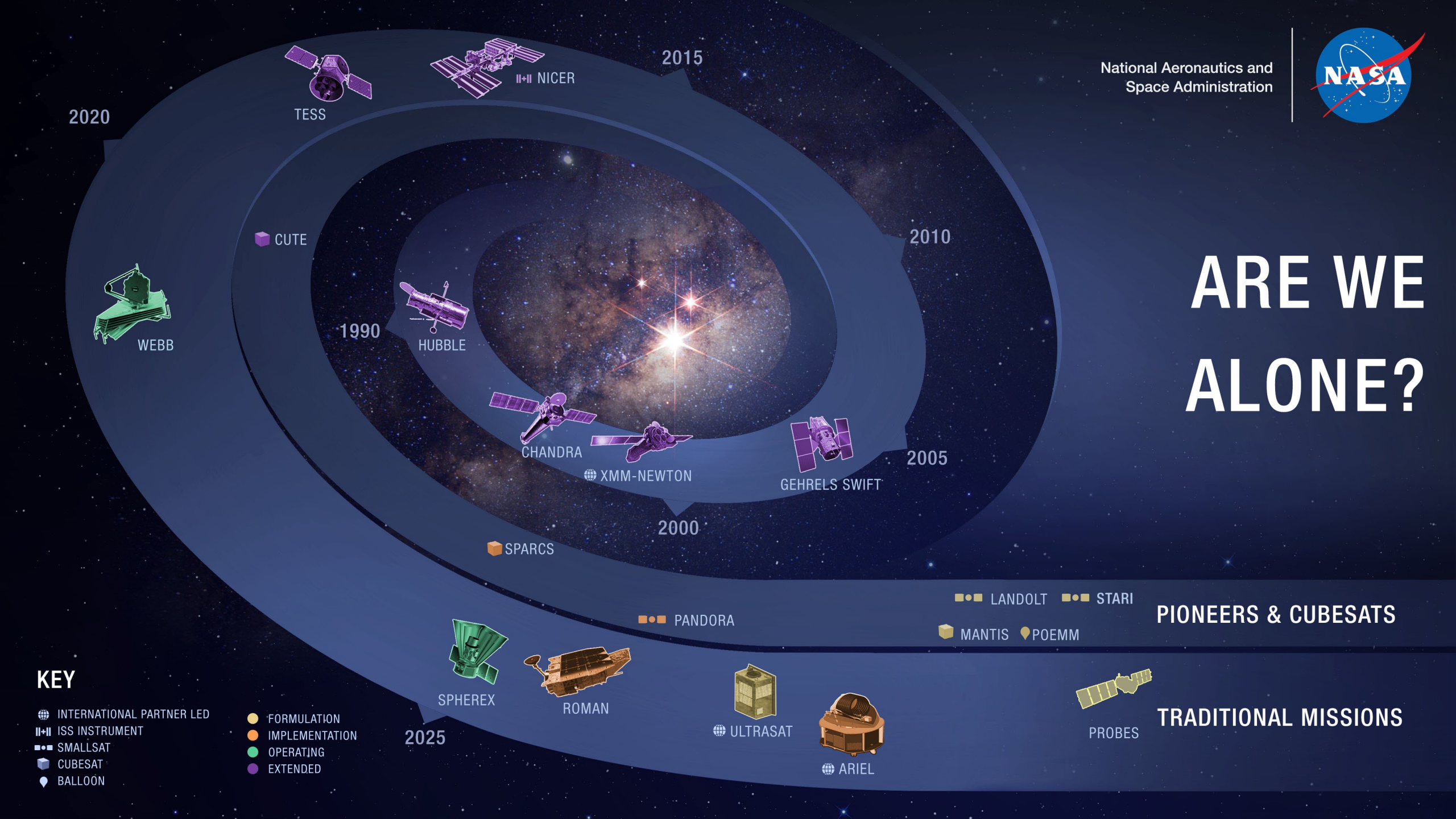
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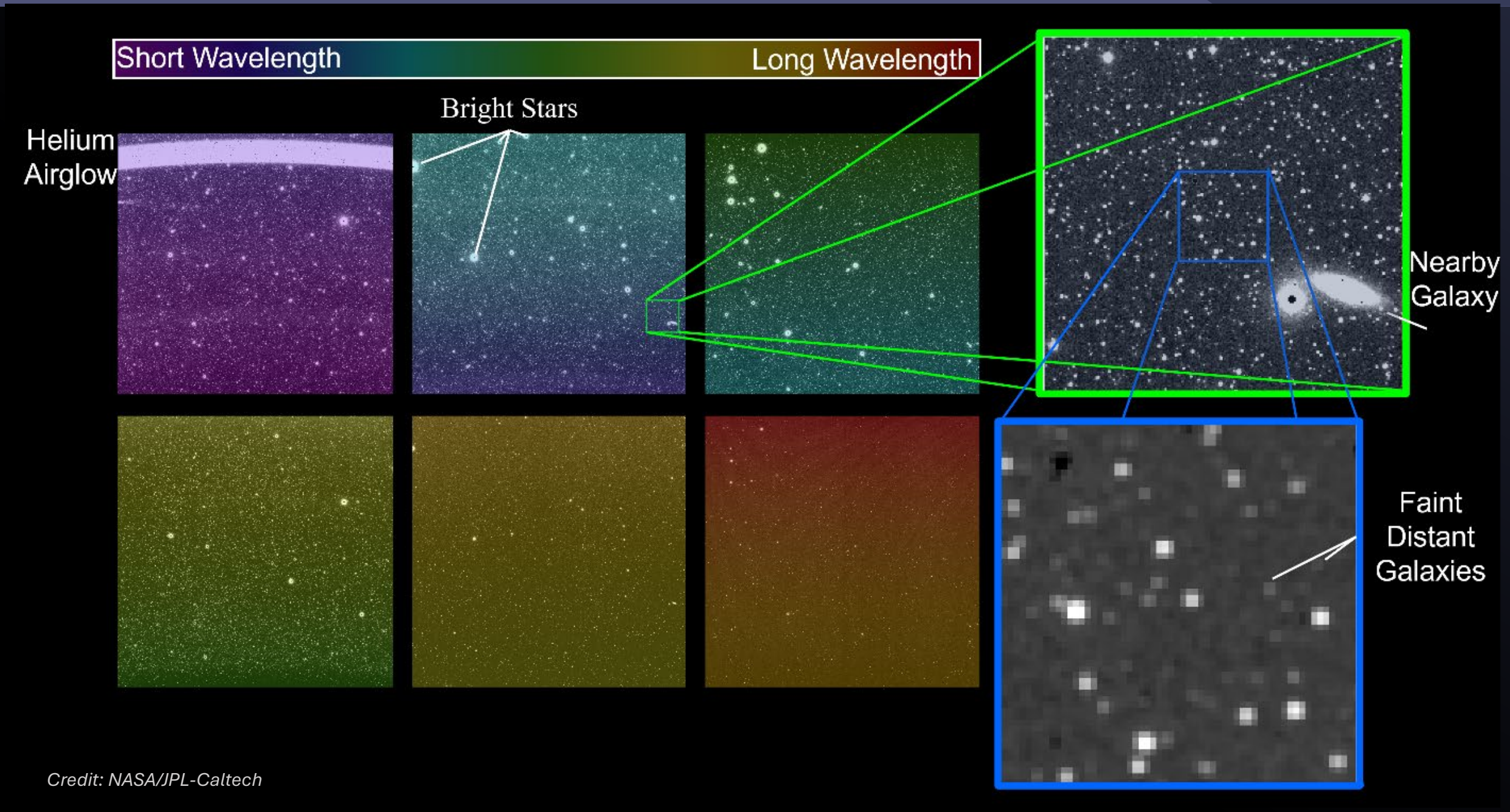
SPHEREx First Images



Credit: NASA/JPL-Caltech

ESA Previews Euclid Mission’s Deep View of ‘Dark Universe’



ESA/Euclid/Euclid Consortium/NASA; image processing by J.-C. Cuillandre, E. Bertin, G. An-selmi

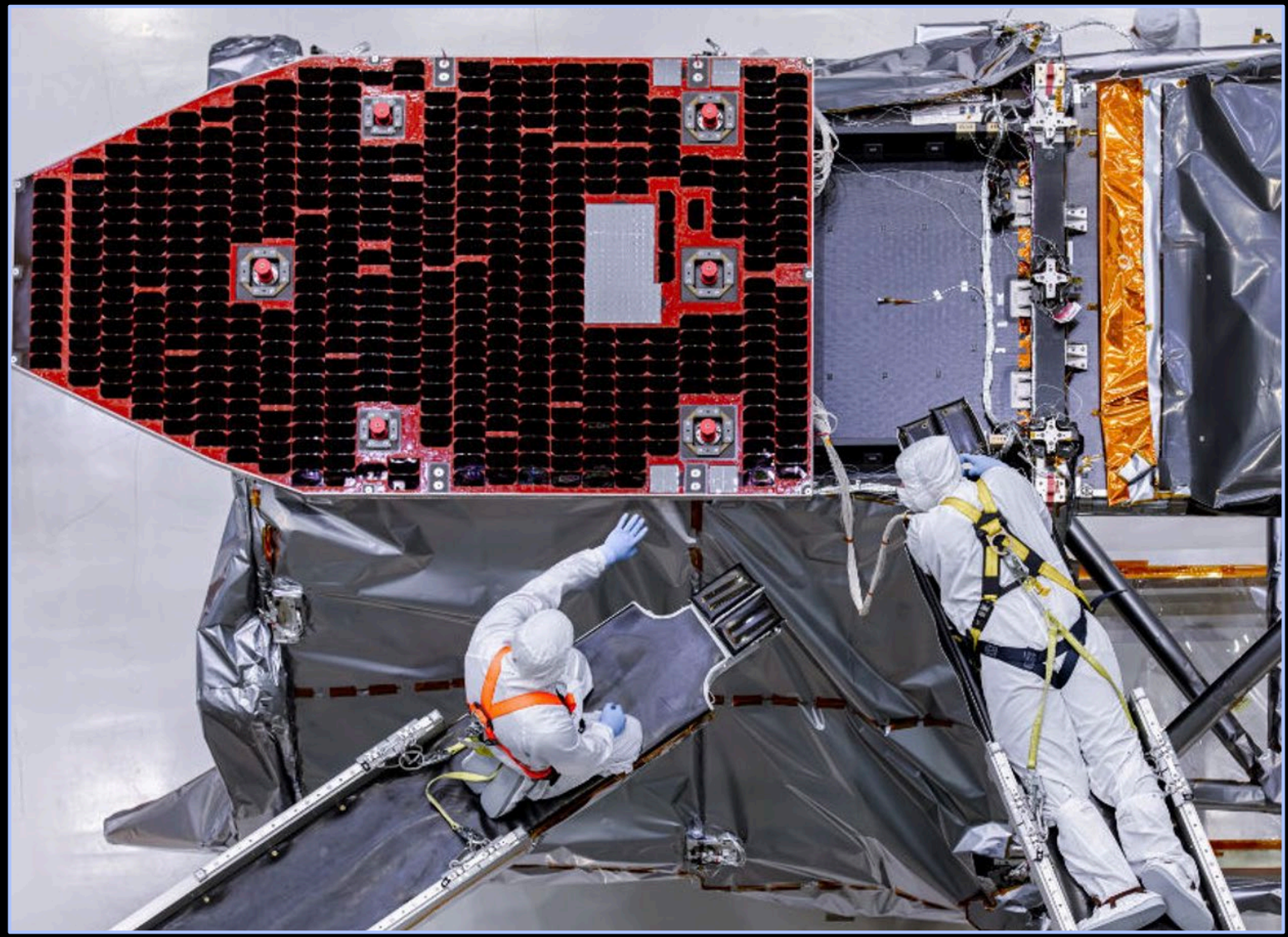
Webb Images Young, Giant Exoplanets, Detects Carbon Dioxide



Credits: NASA, ESA, CSA, STScI, W. Balmer (JHU), L. Pueyo (STScI), M. Perrin (STScI)



Roman team integrates sunshade to the outer barrel assembly.



SASS-A Panel Fit Check to OBA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10


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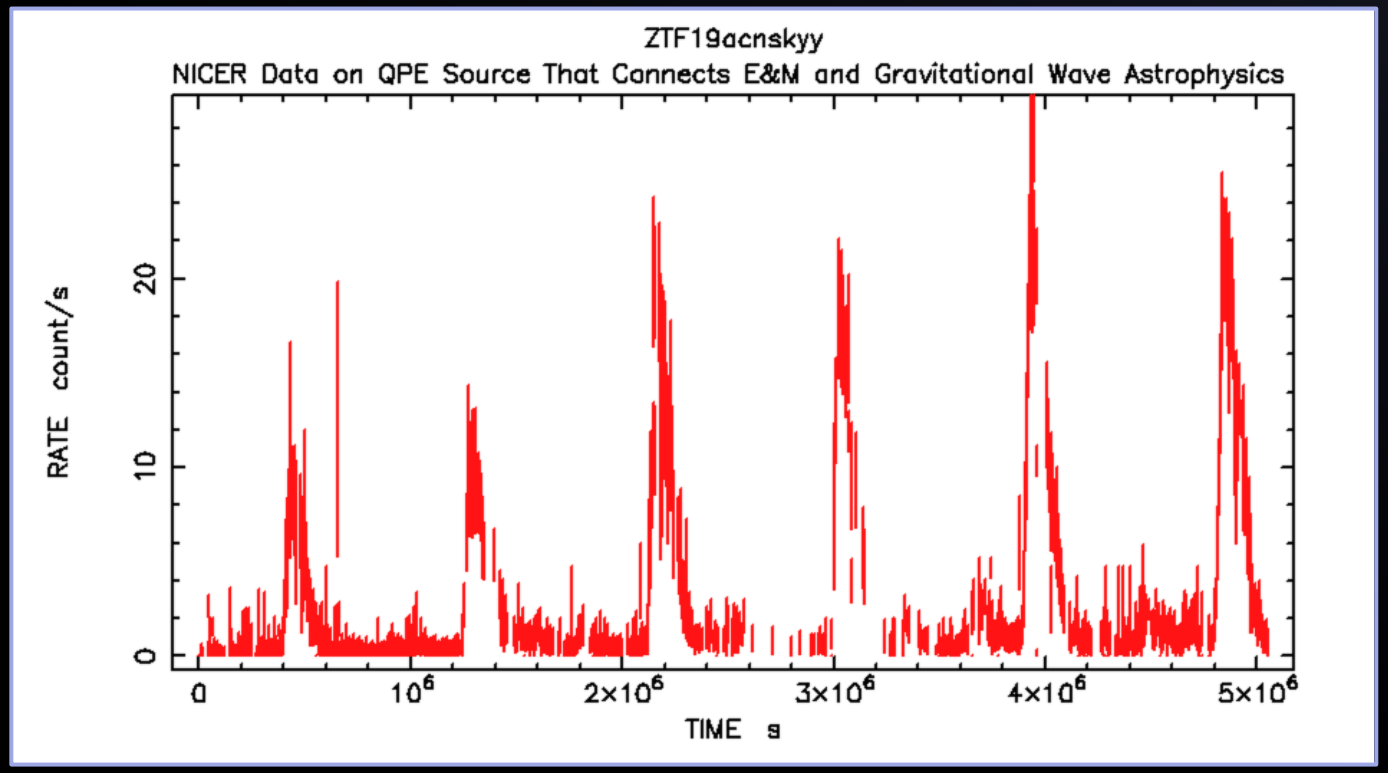
T+ 00:42:35
SPHEREX / PUNCH
DEPLOY
DEPLOY



NICER Repair Update





Example of Unique NICER capabilities even during orbit day:

- *Soft Response*
- *Flexible scheduling allowing for observations every 90 minutes for 2 months*

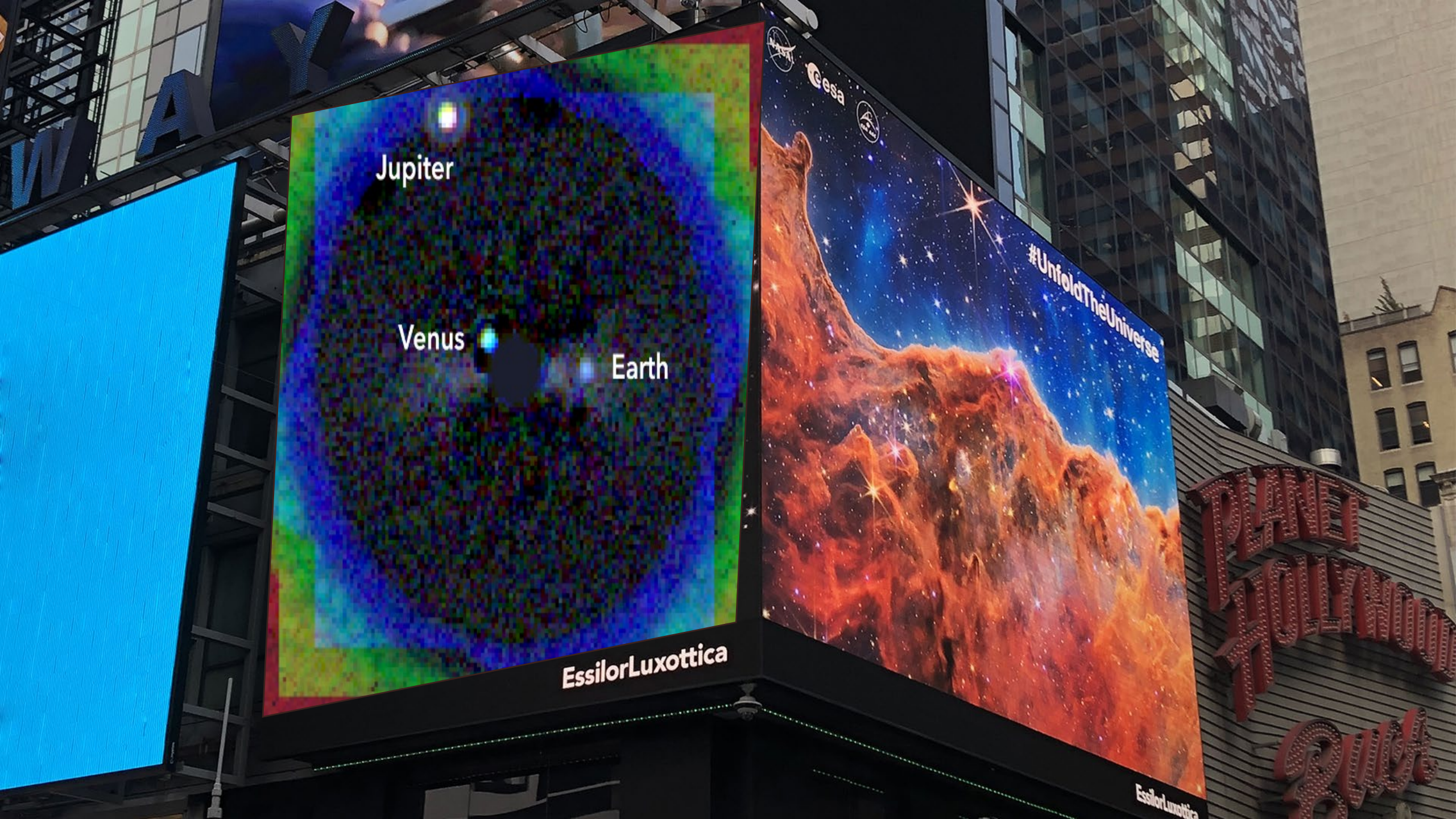
Astrophysics Explorers Program 2025 Small Explorer (SMEX)

- The NASA Science Mission Directorate (SMD) plans to release an Announcement of Opportunity (AO) in 2025 to solicit Small Explorer (SMEX) Principal Investigator (PI)-led space science investigations under the Astrophysics Explorers Program.
- The AO Cost Cap for a 2025 Astrophysics SMEX mission is $170M in NASA Fiscal Year (FY) 2025 dollars, not including the cost of standard launch vehicle and launch services, or any contributions.
- NASA may select two or three Step-1 proposals for the conduct of 9-month Phase A concept studies and submission of Concept Study Reports (CSRs).
- Astrophysics Explorers projects selected from this AO have been determined to be Category 3 projects with Class D payloads.
- An Astrophysics Explorers investigation will be launched as the primary payload on a single launch vehicle (LV) that NASA will provide as Government Furnished Equipment (GFE).
    - The standard launch performance capability will be consistent with available certified LVs on the NASA Launch Services II (NLS II) contract.
    - PI-provided access to space may not be proposed.

APD SMEX

The time frame for the solicitation is intended to be:	
Expected Release of final AO	April 2025
Pre-proposal conference	~3 weeks after final AO release
Notice of Intent	NET 45 days after AO release (May 2025)
Proposals due	NET 90 days after AO release (July 2025)
Step 1 Selection announced	March CY2026 (target)
Concept Studies due	January CY 2027 (target)
SMEX Down-selection	NLT 2nd Quarter CY2027 (target)
AO-Required Launch Readiness Date	NLT May 31 CY2031


esa
EssilorLuxottica
esa
#UnfoldTheUniverse
EssilorLuxottica


Jupiter
Venus
Earth
EssilorLuxottica
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#UnfoldTheUniverse
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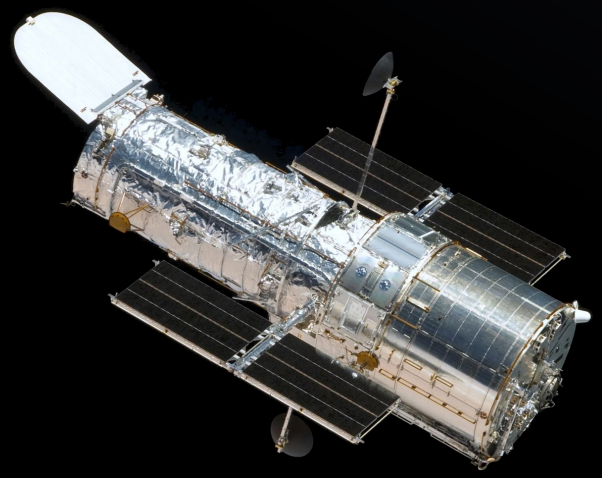
What is Habitable Worlds Observatory (HWO)?

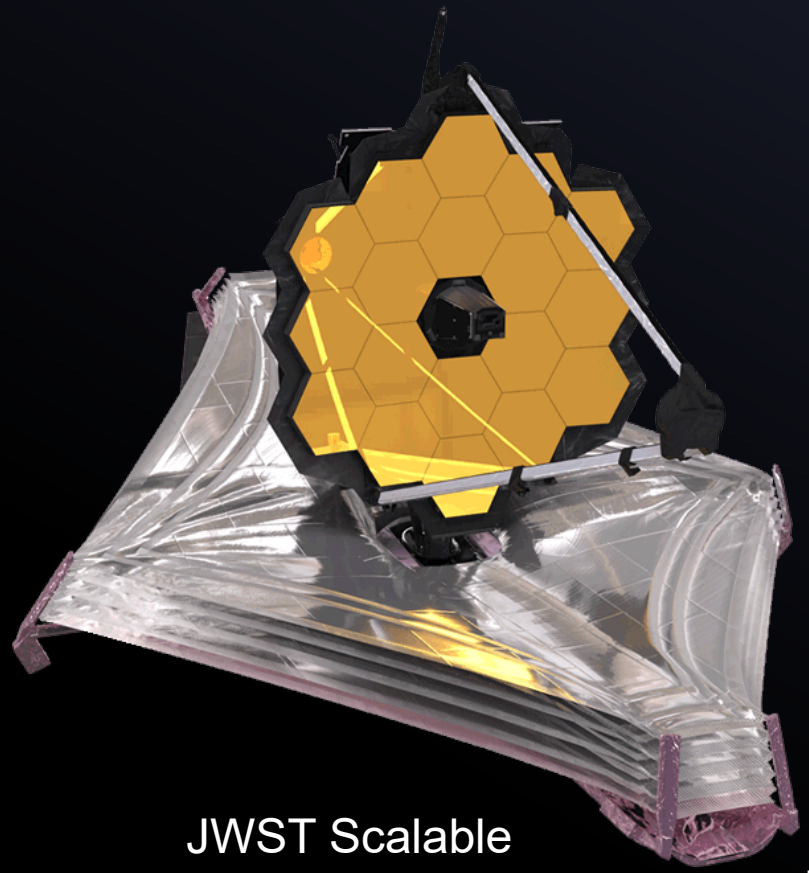
HABITABLE WORLDS OBSERVATORY

HWO evolves relevant technologies and architecture: Consider previous investments

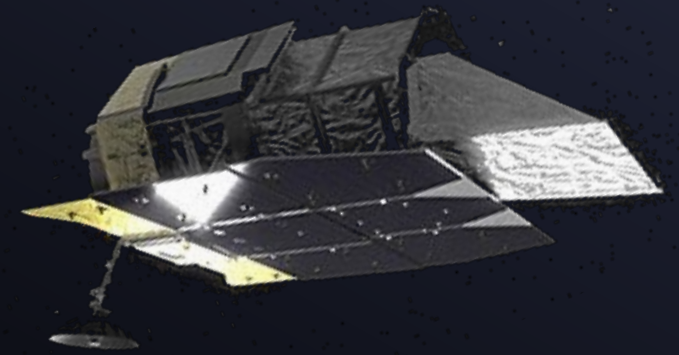
NASA's decades-long investments in developing large space telescopes pay off with awe-inspiring science results

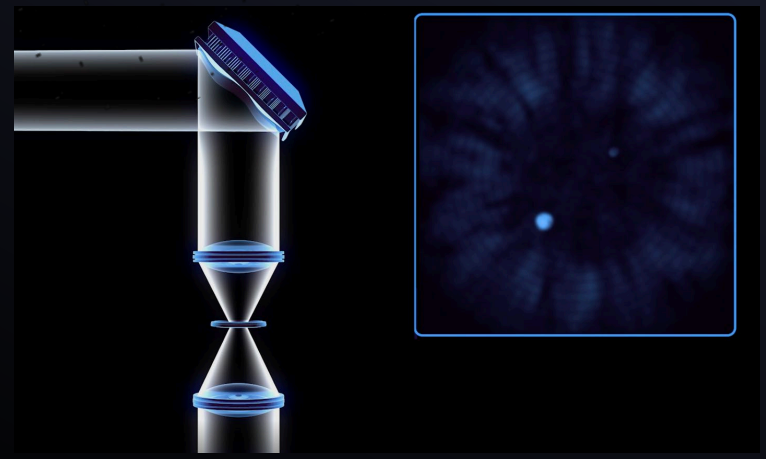


Hubble Space Telescope
UV-Vis-NIR Flagship
Serviceability



JWST Scalable Segmented Observatory
L2 Operations





Nancy Grace Roman Space Telescope
High-Contrast Imaging
Vis-NIR Detectors

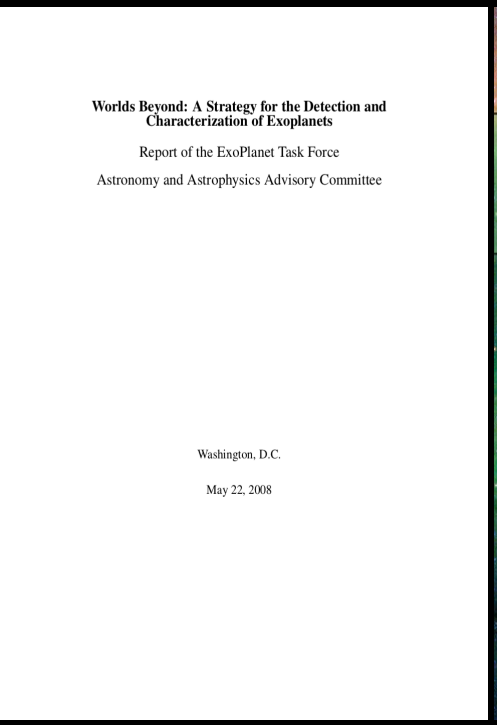
Focus on new challenges, not inventing new ways to do things we know how to do

Initial Exploratory Analytic Cases (EACs) vs. Final Architecture

Historic Public & NASA Committees Recommending an HWO Mission

Worlds Beyond: Exoplanet Task Force Report

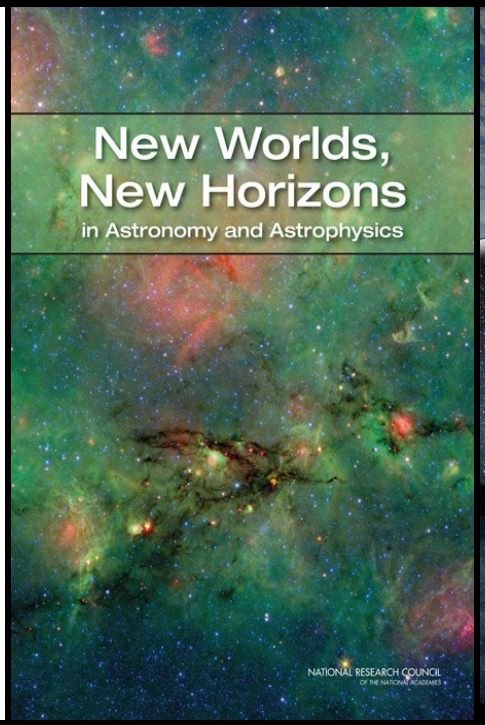
2008



Astrophysics Advisory Committee (APAC)

Astro2010 Decadal Survey

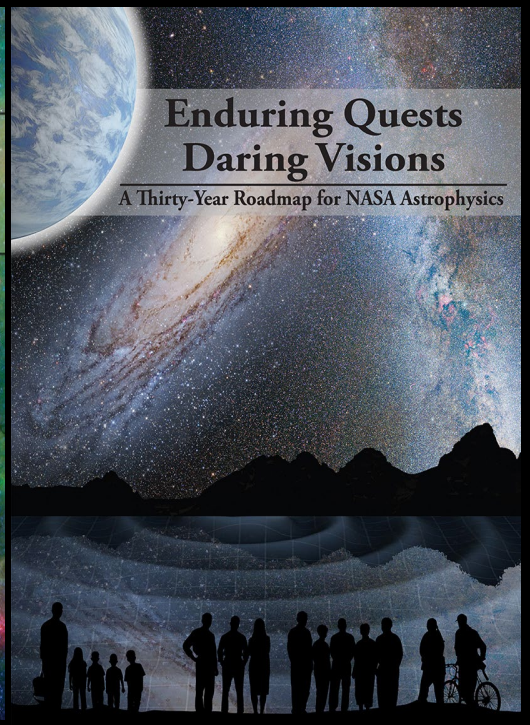
2010



National Academy of Sciences

Astrophysics Roadmap

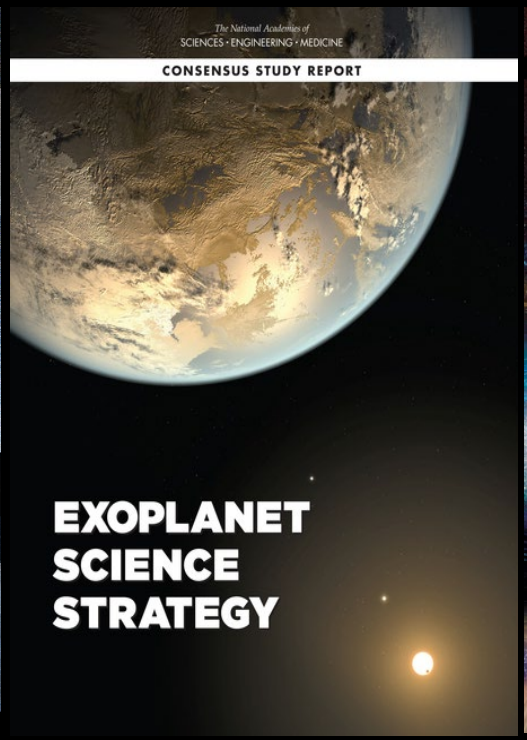
2013



NASA

Consensus Study Report

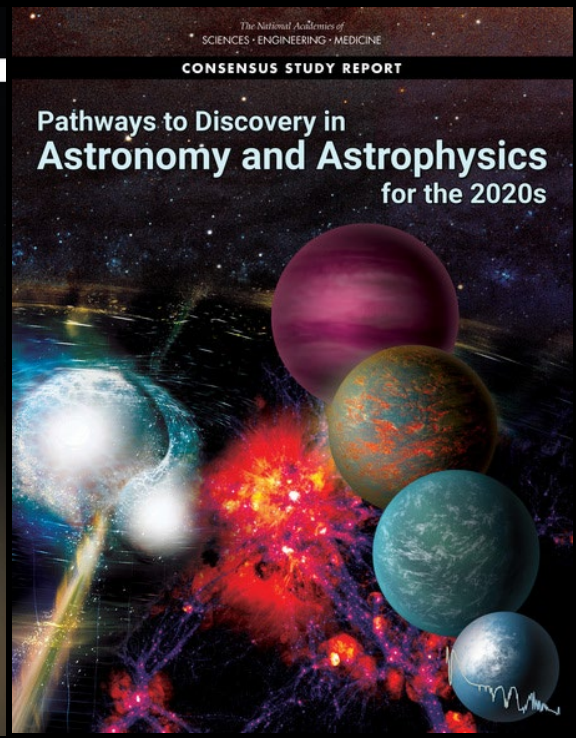
2018



National Academy of Sciences

Astro2020 Decadal Survey

2021



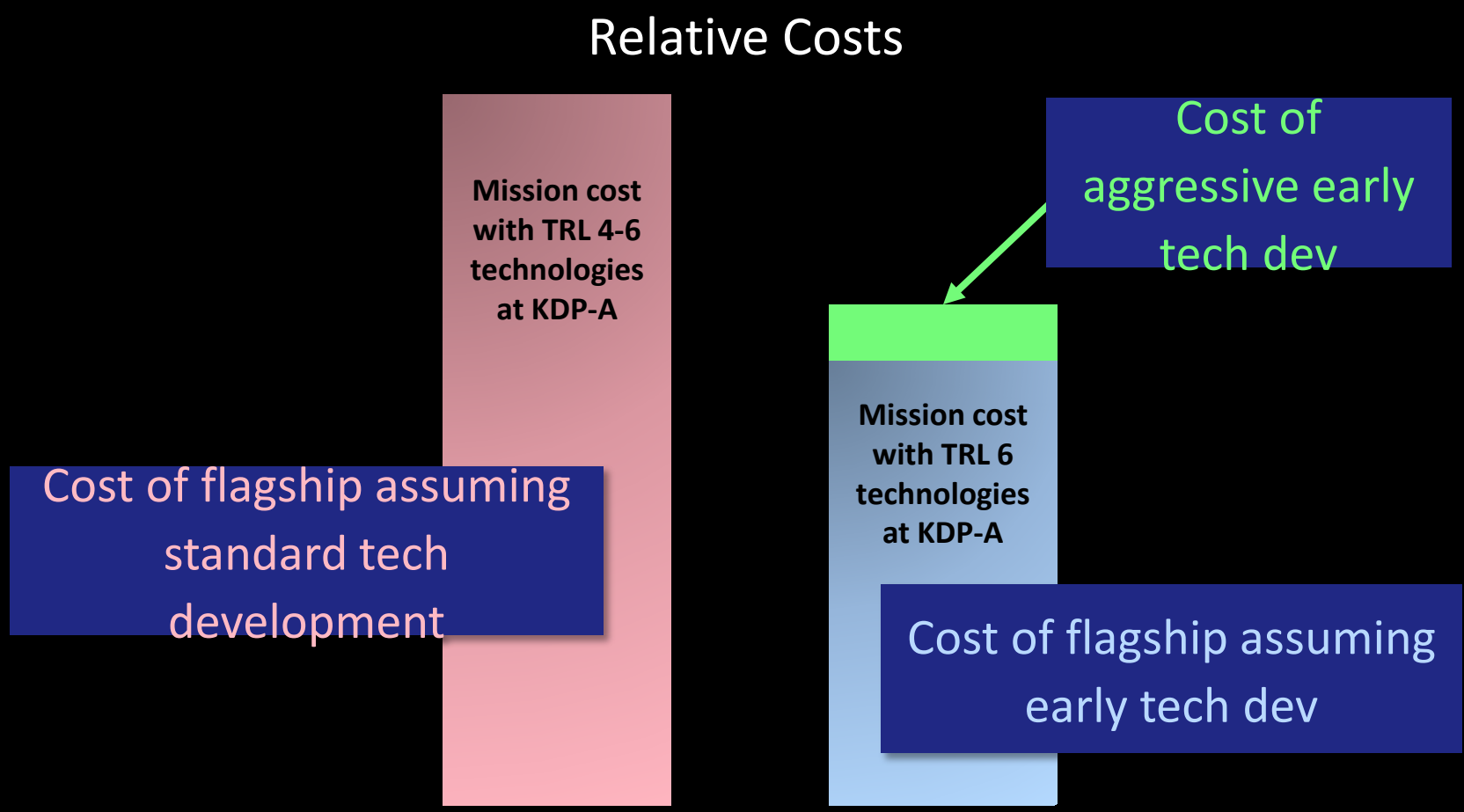
National Academy of Sciences

The Six Dimensions of Concept Maturity



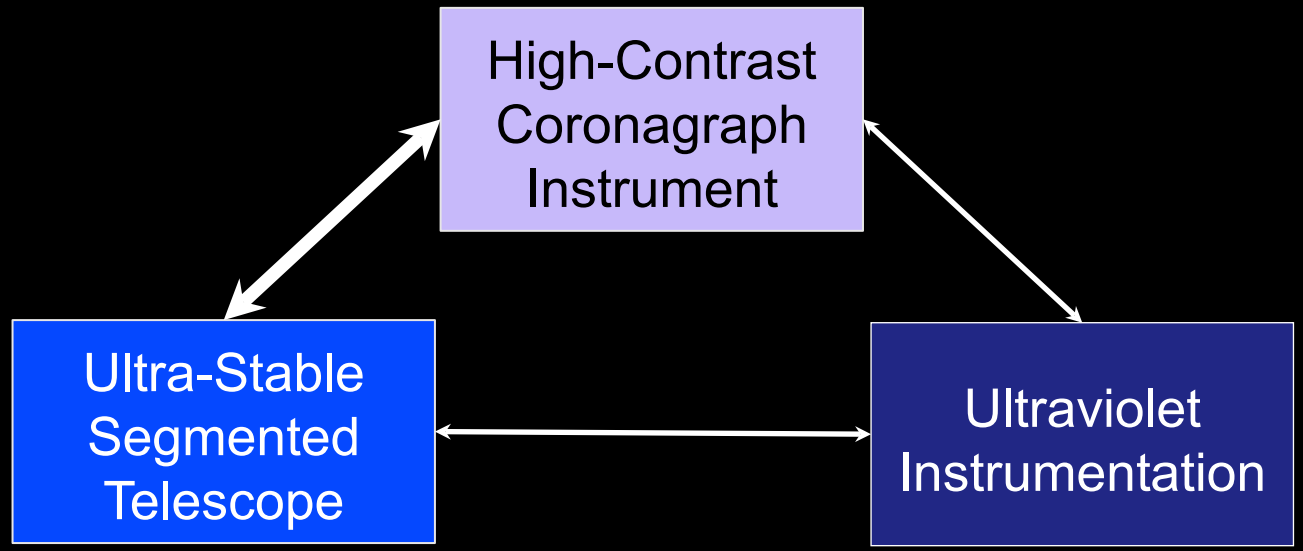
- Using CMLs helps concept teams understand the work that needs to be done in parallel during pre-Phase A
  - The Large Mission Study Report recommended using CMLs and SMD is studying how they can be incorporated into NASA's practices
- Each of the six dimensions of concept maturity has its own set of expected status and evidence at each CML
- If any one dimension gets ahead or is not connected to the others, ideas and requirements can become "locked in" too early, causing rework

Manage Complexity with Earlier Technology Development



Know what we build will work

Three Technology Development Systems



Three development paths mature each of the technologies at the system level

Technology systems are coupled, and must be developed in parallel with cross-validation

HABITABLE WORLDS OBSERVATORY

TECHNOLOGY ROADMAP



2025 — *Coronagraph Testbeds Available For Use* — *Keck Sensing & Control Demo* — *Ultra-stable & System Testbeds Available For Use* — **MCR** *Critical Technology Demonstration Milestone*

Ultra-stable Telescope System

- *System Architecture*
- *Meter-Class Mirror Cell*
- *Industry Initial Efforts*
- *Segment Sensing & Control*
- *Ultra-stable Structures*
- *Disturbance Isolation*
- *Deployable Baffle*

Coronagraph System

- *Coronagraph System*
- *Large Deformable Mirrors*
- *Coronagraph Wavefront Sensing*
- *Coronagraph Visible and Near IR Detectors*
- *Near-UV Coronagraph Science & Technology Investigation*

Currently Funded | *Development / Fabrication*
Design and Analysis | *Characterization / Demonstration*

High-Sensitivity UV & Instrument Technologies

- *Mirror Coating Uniformity Demo*
- *Far-UV Multi-object Selection Device*
- *Large-format Far-UV Detector*
- *Near-UV/Visible Detectors*

NASA ROSES 2017

System-Level Segmented Telescope Design (SLSTD)

NNH17ZDA001N-SLSTD

NASA ROSES 2019

SLSTD – Technology Maturation

NNH19ZDA001N-SLSTD

NASA ROSES 2023

Critical Technologies for Large Telescopes

NNH23ZDA001N-CT4LT

NASA ROSES 2024 (Offers Due: 3/4/2025)

HWO System Technology Demonstrations and Mission Architecture Studies

NNH24ZDA001N-HWOTAS

ROSES SAT AND APRA

Numerous funded efforts in coronagraphy, UV technology , detectors, etc

Current open APRA and SAT Calls are HWO focused

HWO25 | JULY 28 – 31, 2025

Towards the

HABITABLE WORLDS OBSERVATORY

VISIONARY SCIENCE AND TRANSFORMATIONAL TECHNOLOGY

JOHNS HOPKINS BLOOMBERG CENTER, WASHINGTON DC

PRELIMINARY PROGRAM
ANNOUNCED MARCH-APRIL

STScI | SPACE TELESCOPE SCIENCE INSTITUTE

JOHNS HOPKINS UNIVERSITY

NExScI

Advisory Committees

In response to Executive Order 14217, NASA acting Administrator Janet Petro has directed the agency to consolidate five science committees – one for reach division within NASA's Science Mission Directorate – into a single advisory committee with broad representation from across the NASA science community. This restructuring will provide the opportunity to retain one non-statutory science committee and ensure continued support of NASA science goals, improving efficiency, while ensuring NASA maintains the important process of engaging with the science community.

NASA's Science Mission Directorate is in the process of determining the best structure, scale, and scope for the merged committee. The directorate is committed to ensuring representation from all areas of expertise relevant to the Science Mission Directorate's objectives.

The Science Mission Directorate is committed to continuing to engage with the science community in a variety of ways – both formal and informal.

NASA Hubble Fellowship Program (NHFP)



- 2025 Class of Fellows has been selected (press release coming soon).
- The NHFP still remains the most prestigious and selective Postdoctoral Opportunity in Astrophysics.
  - We received 650+ proposals
  - Post triaged proposals were evaluated by 8 panels
  - Success rate 4%
  - Fellows cover a wide range of science and technology that are **key to NASA Astrophysics objectives**
- The NHFP Program Review taskforce continues its work implementing the review recommendations that are aligned with current Administration and Agency priorities.
- Resources have been augmented to provide professional development opportunities to the fellows.



Time Domain and Multi-Messenger Astrophysics (TDAMM)

- NASA is looking forward to the upcoming space missions which will strengthen NASA's TDAMM fleet and provide both workhorse and discovery potential: Roman, StarBurst, COSI, UVEX
- The Physics of the Cosmos ACROSS initiative is evolving the way NASA missions do TDAMM into a whole-of-fleet approach
- The community has responded enthusiastically to Astro2020's TDAMM emphasis, with workshops, White Papers, and Science Analysis Groups providing valuable input to NASA's TDAMM Initiative
- NASA's top concern regarding the TDAMM initiative is the provision of adequate Space Communications capabilities: addressing them is necessary to achieve our top scientific priorities and mission needs, and to strengthen US leadership in aerospace technology development.

Astrophysics R&A Highlights

The Astrophysics R&A Program remains responsive to NASA goals and community interests:

- The number of ROSES Astrophysics solicitations are at/near an all-time high.
- In FY 2024 we evaluated 1,252 proposals in R&A peer reviews (ROSES programs only), 5231 proposals, including JWST, HST, and Chandra – more than ever
- Despite high proposal pressure, selection rate was 21% R&A wide
- We notified 80% of all PIs within 133 days, exceeding internal 150d/180d goals
- We disbursed ~$140M in community funding – the largest amount in APD history
- Proposals were evaluated using dual-anonymous peer reviews for most ROSES elements
- We postponed proposal due dates to help those affected by wildfires in California
- We keep reevaluating all R&A programs for better efficiencies, communication, in alignment with Astrophysics Division’s strategic and programmatic goals.

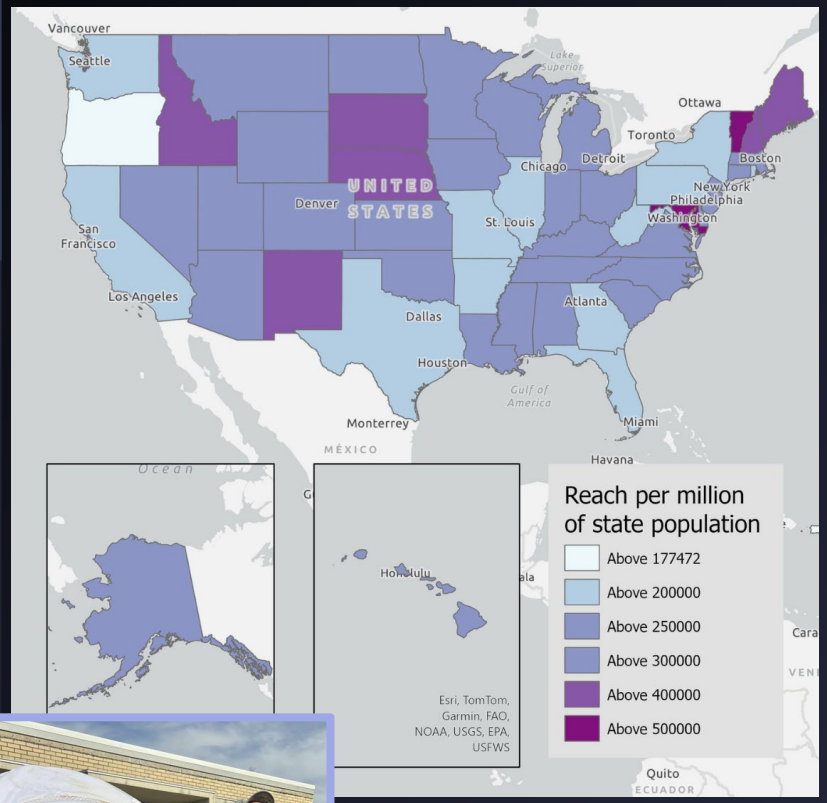


National Aeronautics and Space Administration

NASA Science Activation

Record Set with 119 million Public Interactions in 2024!

- **48 Science Activation teams** across the US worked together to engage more than 1.5 times as many Americans with NASA science in 2024 as in the previous year
- These engagements benefited the public with:
  - Livestreams and in-person events around the April eclipse
  - Science center exhibits and family-friendly activities
  - In-person and virtual high school internships
  - Self-directed and facilitated science experiences
  - Opportunities to participate in real NASA science
- 55% of interactions related to April 8, 2024 total solar eclipse
- In addition, top 3 digital resources had **42.7M active users:**
  - Astronomy Picture of the Day
  - NASA's Eyes
  - SpacePlace



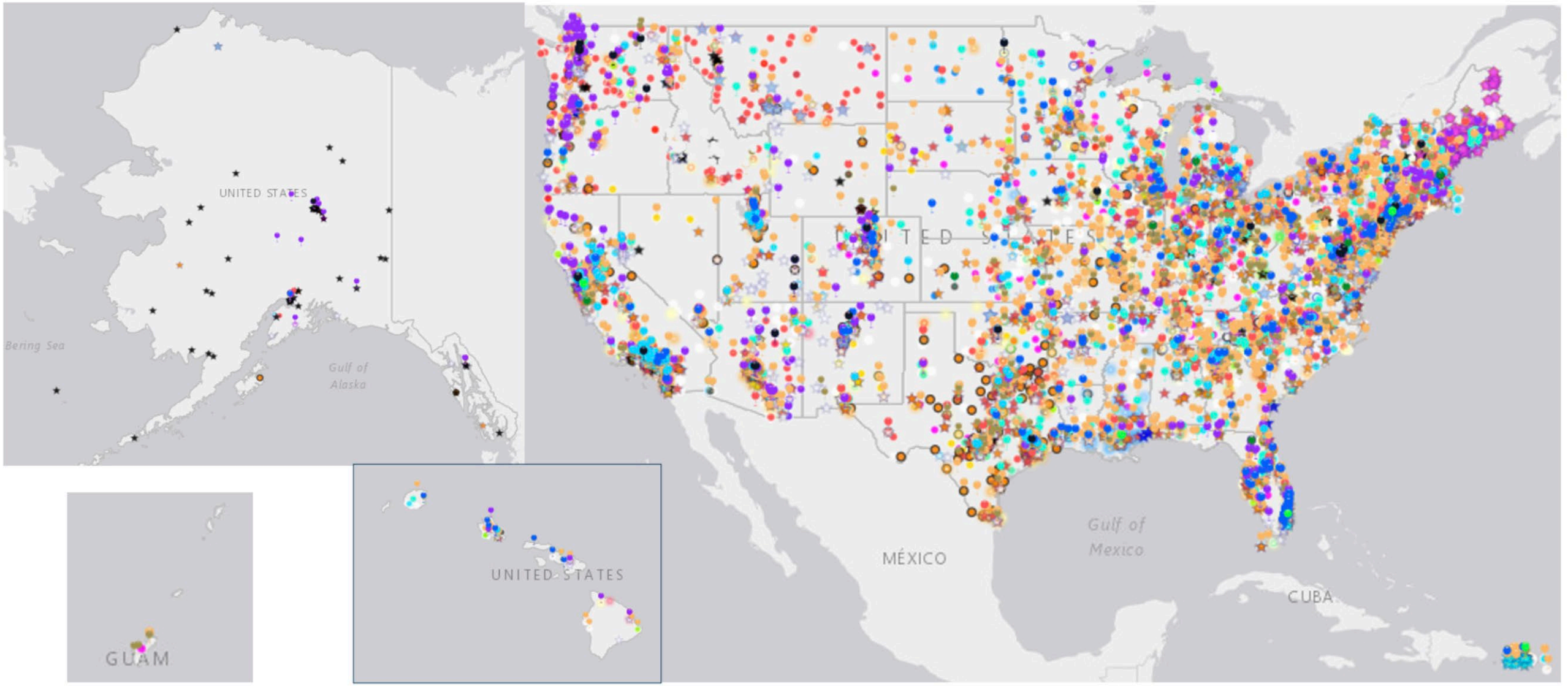


157% More Engagement!

All 50 states and 4 US territories

97% of reach in US

NASA SciAct Reach Map: > 19% of zip codes reached in 2023



"Emerging Technologies for Astrophysics Missions" Workshop

NASA Ames, Silicon Valley

March 25-27, 2025

Motivation: Emerging technologies are accelerating their impact in science and technology
Objective: Identify emerging technologies that could impact future astrophysics missions
Format: 3-day in person, with 60+ invited experts from academia, government, industry, and NASA centers

Astrophotonics
(as applied to spectroscopy and imaging)

Artificial Intelligence and Machine Learning Algorithms
(for technology development)

Advanced Materials
(meta-materials, nanofabrication, additive manufacturing, composites)

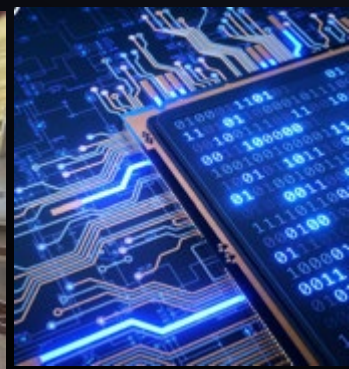
Quantum Technologies
(sensing, imaging, calibration)











Science Mission Directorate

ASTROPHYSICS

Organizational Chart

DIVISION MANAGEMENT



Shawn Domagal-Goldman
Acting Director



Sandra Cauffman
Deputy Director

ADMINISTRATIVE SUPPORT
Jennifer Baker, Balam "Orby" Yaxkin, James Jackson

DIVISION LIAISONS

Resource Management
Elijah Owuor (Lead)
Danielle Gervalis
Jennifer Holt

Communications
Alise Fisher

Policy
Shea Kearns

OIIR
Peyton Blackstock

Program Support Specialist
Lina Carrington

CROSS CUTTING

Technologist
Mario Perez (Chief)
Dominic Benford (Deputy)

Executive Officer
Rhiannon Roberts

Science Activation Lead
Hashima Hasan

APD Communications
Liz Landau (OCOMM)
Julie Stoltz (Strategic Communications)

FLIGHT PROGRAMS

Associate Director
Joe Smith

PROGRAM EXECUTIVES

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

RESEARCH & ANALYSIS

Associate Director
Stefan Immler

R&A Lead
Roopesh Ojha

PROGRAM SCIENTISTS

Alessandra Aloisi
Megan Ansdell
Dominic Benford
Mia Bovill
Valerie Connaughton
Antonino Cucchiara
Doris Daou
Michael Garcia
Thomas Hams
Hashima Hasan
Hannah Jang-Condell
Patricia Knezek
David Morris
Roopesh Ojha
Joshua Pepper
Mario Perez
Pablo Saz Parkinson
Linda Sparke
Sanaz Vahidinia
John Wisniewski

RESEARCH PROGRAM SPECIALIST
Ingrid Farrell

ASTROPHYSICS STRATEGIC MISSIONS

Program Director
Sandra Cauffman

Program Manager
Garth Henning

PROGRAM EXECUTIVES

Lucas Paganini
Miles Skow

PROGRAM SUPPORT
Tony Comberiate, Andre Davis



BACKUP

What is Habitable Worlds Observatory (HWO)?



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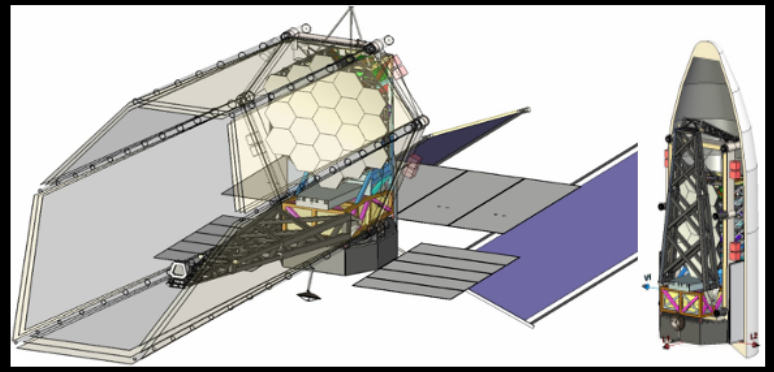
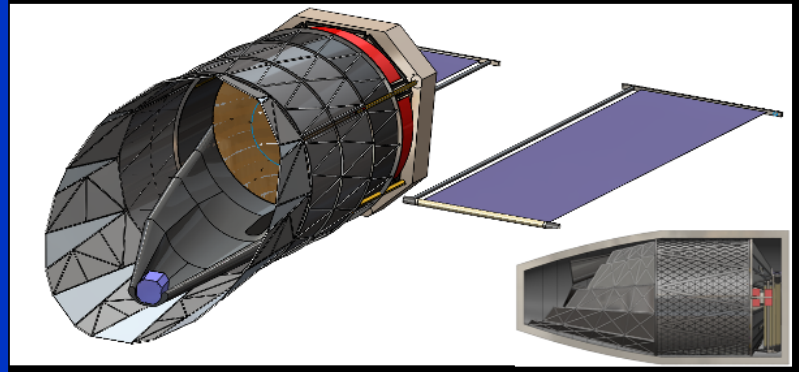
Credit: T. Robinson / G. Arney

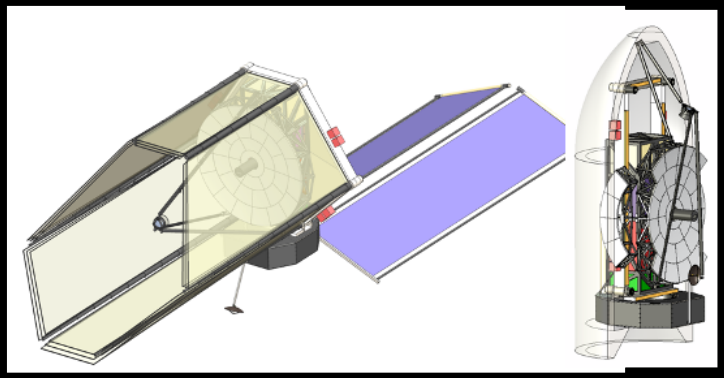
Initial HWO Exploratory Analytic Cases (EACs)



EAC1	Assumption	Comments
Launch Vehicle	New Glenn (or Starship)	7m diameter Fairing
Mass	Bottoms up estimate	
#of Mirrors	19 Hex Segments	1.65m point to point
Telescope Diam + Config	Off-Axis, 6M ID/7.2m OD	Starshade compatible
Deployment	JWST-like Wings,SM Hinged tower	



EAC2	Assumption	Comments
Launch Vehicle	Starship or Equivalent	9m diameter Fairing
Mass	Bottoms up estimate	
#of Mirrors	6+1	3m central mirror, 6 Keystone
Telescope Diam+Config	Off-Axis, 6m Circ.	Starshade compatible
Deployment	SM hinged, Barrel only	

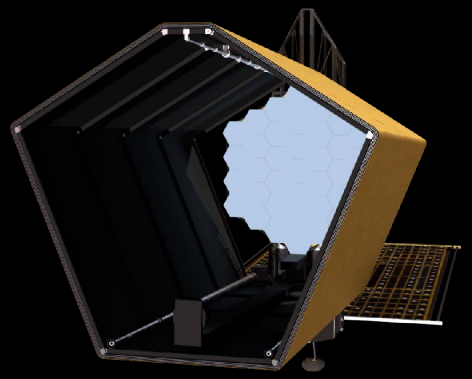


EAC3	Assumption	Comments
Launch Vehicle	Starship or Equivalent	9m diameter Fairing
Mass	Bottoms up estimate	
#of Mirrors	34 Keystone	
Telescope Diam+Config	On-Axis, 8m Circ.	Starshade compatible
Deployment	JWST-like Wing, SM	

HWO preliminary specs & candidate instruments

Telescope

Diameter	~6.0 m (inner)
Bandpass	~100–2500 nm



Fourth Instrument

To be defined

Coronagraph

High-contrast imaging and imaging spectroscopy	
Bandpass	~200–1800 nm
Contrast	~1e-10
	Vis: ~140 NIR: ~70, 200



High-Resolution Imager

UV/Vis and NIR imaging	
Bandpass	~200–2500 nm
Field-of-View	3x2 arcmin
~67 science filters + grism	
High-precision astrometry?	



Ceres

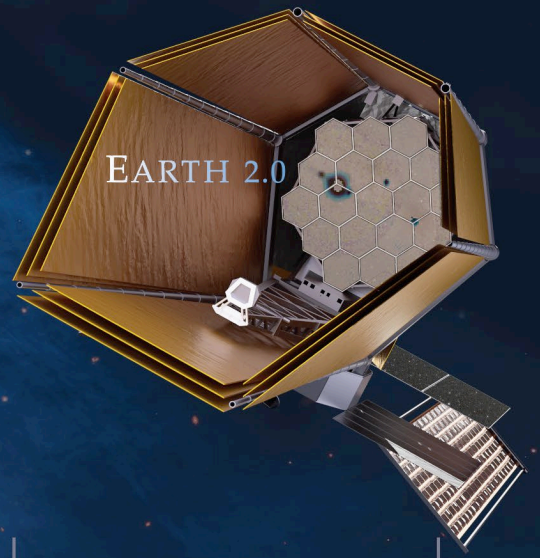
UV Multi-Object Spectrograph

UV/Vis multi-object spectroscopy and FUV imaging	
Bandpass	~100–1000 nm
Field-of-View	
Apertures	0.2 x 0.1 sec
Resolution	500–50,000



HABITABLE WORLDS OBSERVATORY

Habitable Worlds Observatory Plan to MCR



Community Science and Instrument Team and HWO Advisory Board

Concept Maturity Level-3 EAC 1-3 complete

Science + Technology Conference

HWO Journal Special Editions

Concept Maturity Level-*4* EAC *4,5* complete

Science Drivers Draft L1 Requirements

Concept Maturity Level-5 (EAC6/Baseline Concept)

Draft Science Cases

05/25 07/25 08/25

Define EAC 4,5

Instrument Studies Start

Define EAC 6/ Baseline Concept

03/29

06/29 Independent Technical Review

10/29 MCR

2025 *2026* *2027* *2028* *2029* *2030*

Contingent on Funding