

National Aeronautics and
Space Administration



NASA Astrophysics Update

Astronomy and Astrophysics Advisory Committee | December 15, 2023

Dr. Mark Clampin

Director, NASA's Astrophysics Division

Science Mission Directorate



ASTROPHYSICS FLEET

PRE-FORMULATION

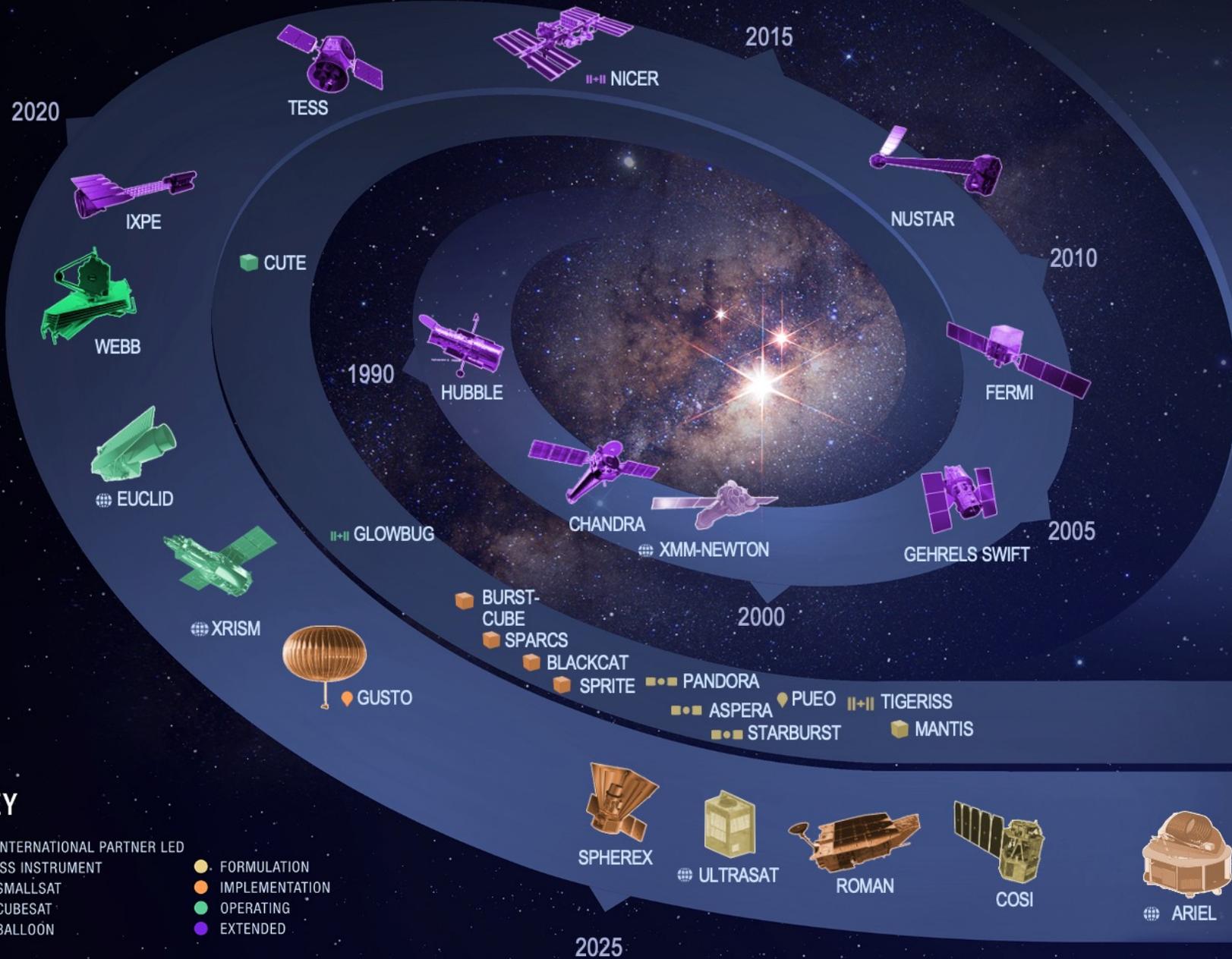
- PROBE ~2033
- LISA ~2037
- ATHENA TBD

COMPETED PHASE-A

- MO (LEAP/ MOONBEAM)
- MIDEX (UVEX /STAR-X)

VERY SMALL MISSIONS

TRADITIONAL MISSIONS



KEY

- INTERNATIONAL PARTNER LED
- ISS INSTRUMENT
- SMALLSAT
- CUBESAT
- BALLOON
- FORMULATION
- IMPLEMENTATION
- OPERATING
- EXTENDED

Webb Discovers Methane, Carbon Dioxide in Atmosphere of K2-18 b

- A new investigation with James Webb Space Telescope into K2-18 b, an exoplanet 8.6 times as massive as Earth, has revealed the presence of carbon-bearing molecules including methane and carbon dioxide.

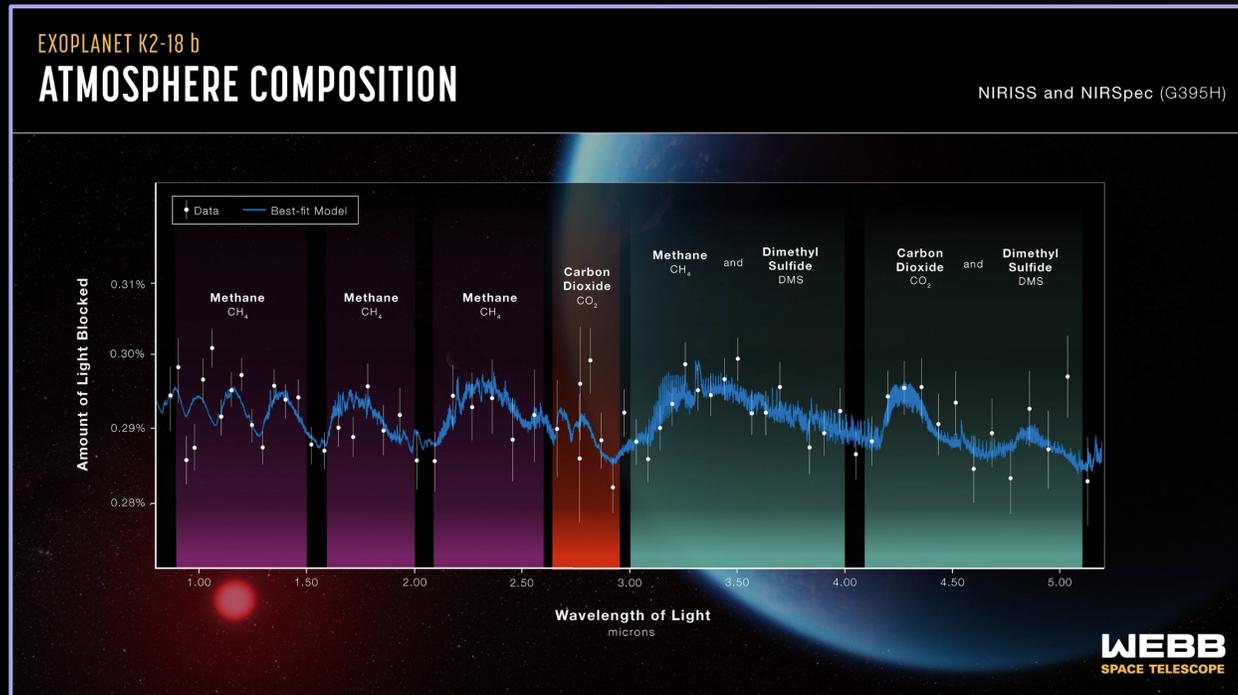


Illustration: NASA, ESA, CSA, Ralf Crawford (STScI), Joseph Olmsted (STScI).
Science: Nikku Madhusudhan (IoA)

- Webb's discovery adds to recent studies suggesting that K2-18 b could be a Hycean exoplanet, one which has the potential to possess a hydrogen-rich atmosphere and a water ocean-covered surface.
- These initial observations also provided a possible detection of a molecule called dimethyl sulfide (DMS). On Earth, this is only produced by life. The bulk of the DMS in Earth's atmosphere is emitted from phytoplankton in marine environments.
- MIRI observations later this Cycle will help determine if the DMS is actually present.

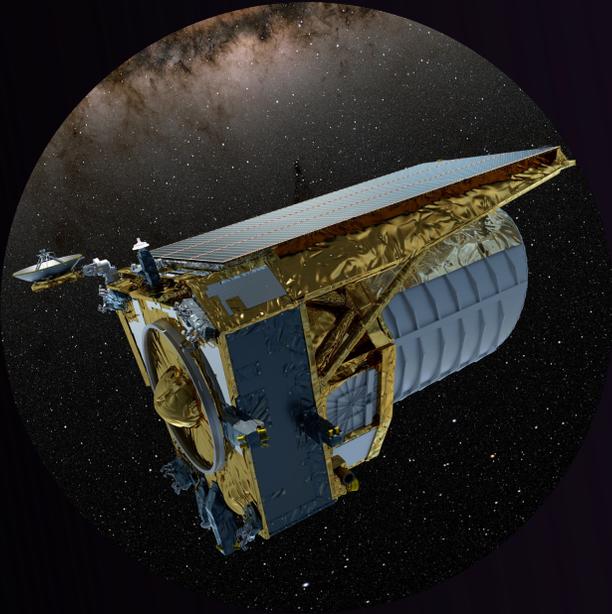
IXPE Finds that Milky Way's Central Black Hole Woke Up 200 Years Ago

- Imagery from the Imaging X-ray Polarimetry Explorer (IXPE) and Chandra X-ray Observatory have been combined to show X-ray data of the area around Sagittarius A*, the supermassive black hole at the core of the Milky Way galaxy.
- The combination of IXPE and Chandra data show that the X-ray light is bouncing off the molecular clouds
 - IXPE shows the X-rays are polarized.
- Those X-rays likely originated from Sagittarius A* during an outburst, but their path to us delays them by about 200 light-years.
- The IXPE mission will be extended by 20 months with a General Observer (GO) program from February 2024-September 2025.
 - NASA has released a ROSES22 program element



Credits: IXPE: NASA/MSFC/F. Marin et al; Chandra: NASA/CXC/SAO; Image Processing: L.Frattare, J.Major & K.Arcand

Astrophysics Division Launches: 2023



Euclid (launched)
Kennedy Space Center,
July 1, 2023



XRISM (launched)
Tanegashima, Japan
September 7, 2023 (Japan time)



GUSTO (SMEX Balloon)
Antarctica,
December/January 2023

Nancy Grace Roman Telescope



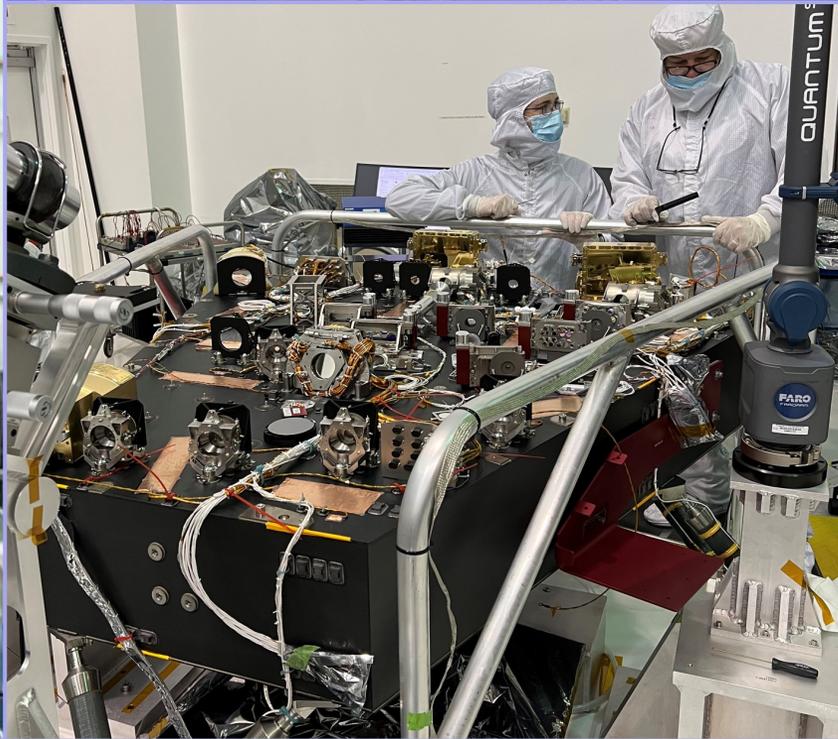
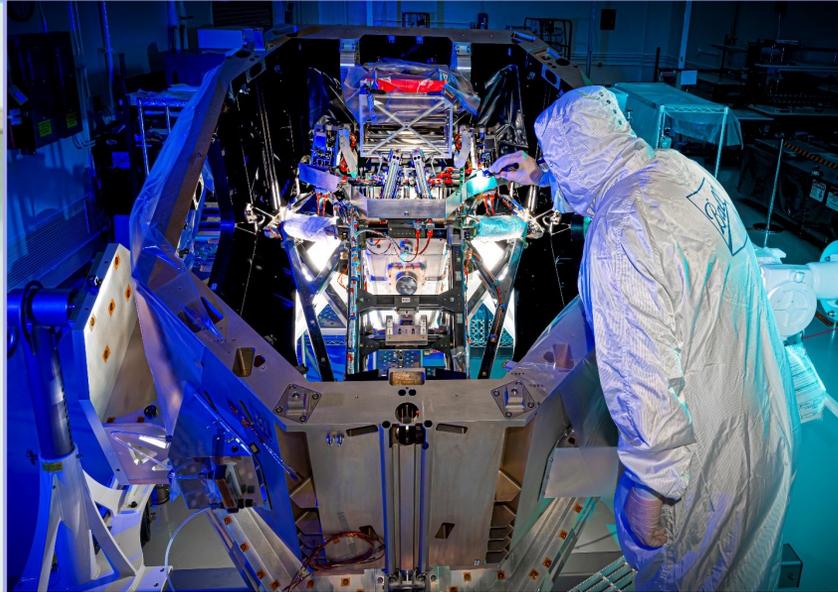
NASA observatory designed to unravel the secrets of dark energy and dark matter, search for and image exoplanets, and explore many topics in infrared astrophysics.

The Roman mission remains on plan for launch by May 2027, with telescope-level integration activities beginning in Aug. 2024 as its hardware components arrive from partner institutions to NASA GSFC.

- The Optical Telescope Assembly (aka. the telescope) integration continues at L3 Harris in preparation for environmental tests. The expected delivery to GSFC is in Aug. 2024.
- The Instrument Carrier completed fabrication at Northrop Grumman and was delivered to GSFC in Sep. 2023.
- The Wide Field Instrument (WFI) and Coronagraph Instrument (CGI) completed instrument integration, and continue environmental tests at Ball Aerospace and JPL, respectively, with estimated deliveries to GSFC in May-July 2024.

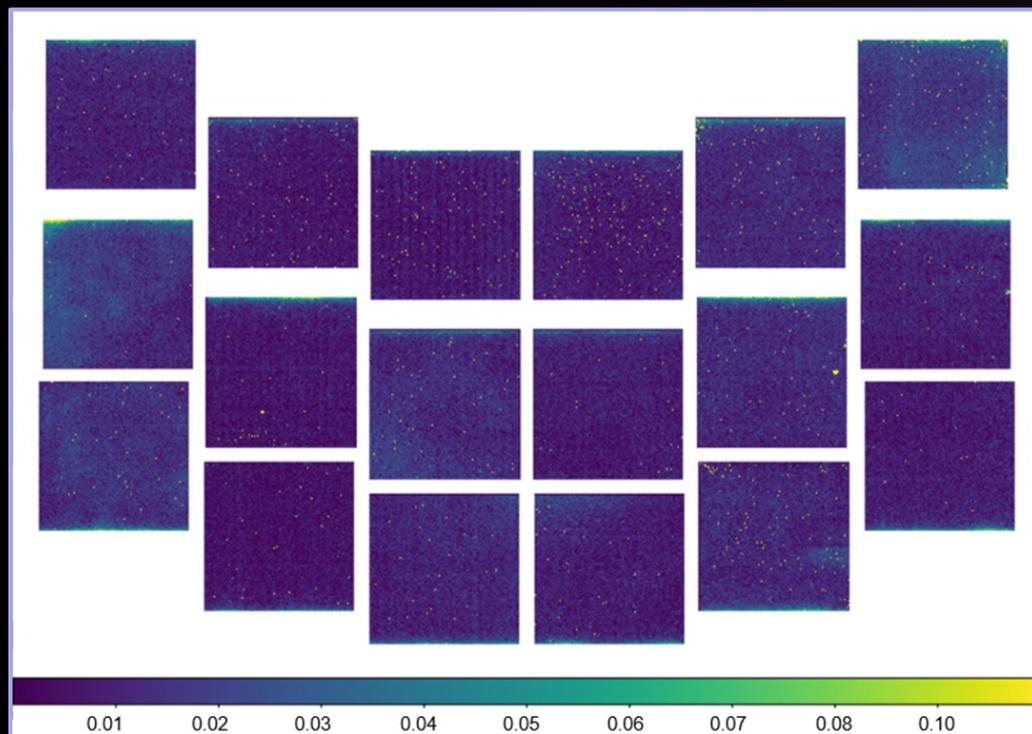
Important Milestones





Nancy Grace Roman Telescope

WFI Status and Accomplishments



WFI mean dark current at 88.5K several times better than requirement; high operability



Phase retrieval shows wavefront error at cold temperature significantly better than required

Preliminary Cold Qualification Test Results Indicate Excellent Instrument Performance

SPHEREx

Spectro-Photometer for the History of the Universe, Epoch of Reionization and Ices Explorer

- The SPHEREx mission will provide the first all-sky spectral survey (for every 6" on the sky).
- Over a two-year planned mission beginning in 2025, the SPHEREx team will analyze data on more than 490 million galaxies along with more than 9 million stars in the Milky Way to explore the origins of the universe.
- **Recent achievements**
 - SPHEREx Photon Shields completed vibration testing
 - Fourth and last payload thermal vacuum test is ongoing
 - SIR was successfully completed on November 16, 2023
- **Upcoming**
 - **Jan. 30:** KDP-D
 - SHPEREx launch planned for 2025



SPHEREx Photon Shield Fabrication at Aerospace Structures Corp. in Stockton, CA.

GUSTO

Galactic/Extragalactic ULDB Spectroscopic Terahertz Observatory

- GUSTO aims to provide a comprehensive understanding of the inner workings of the Milky Way and the Large Magellanic Cloud (LMC) by surveying them in 3 important far-infrared (THz) interstellar lines.
 - Provides a cost-effective approach to probe the full life-cycle of star formation and stellar evolution.
 - NASA's First Balloon Class D Explorer Mission
 - Pathfinder for future bold balloon programs
- PI is Dr. Christopher Walker (University of Arizona)
- GUSTO flight readiness scheduled for next week
- The stratospheric winds this year have set up later than in past years and are well aligned with GUSTO's launch.



GUSTO observatory performing pointing tests in the Payload Building 2 at LDB Camp near McMurdo Station, Antarctica..

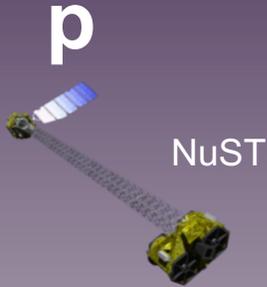
James Webb Space Telescope

- James Webb Space Telescope continues to operate at full science capability
 - 18 months into its 5-year prime mission.
- Cycle 1 and Cycle 2 observations are well underway
 - 1,931 Cycle 3 proposal total with final selection being notified on February 28 – More than any other observatory has ever received!
 - Cycle 3 observations will begin July 1, 2024.
- As of December 2023, over 450 articles have been published in peer-reviewed journals with “JWST” in the title or abstract.
- Congratulations to Webb Project Manager, Alan Johns, and the Deputy Project Manager, Bonnie Seaton, on their retirement.
 - Cathy Barclay is now Acting Project Manager while a permanent replacement for both positions are being filled.





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MIDEX
2011

Small and
Mid-Size
Missions

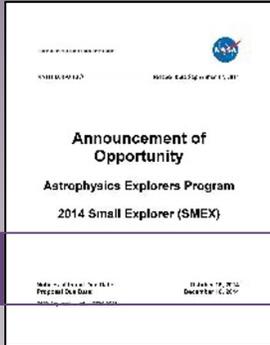


TESS

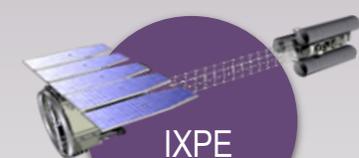
Missions of
Opportunity



NICER



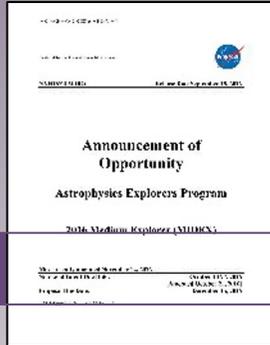
SMEX
2014



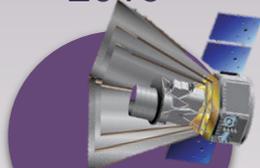
IXPE



GUSTO



MIDEX
2016



SPHEREx



ARIEL



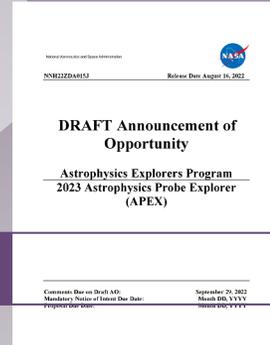
SMEX
2019



COSI



MIDEX
2021



Directed
2013



Euclid

Directed
2017



XRISM

The background of the slide is a deep space image showing a vast field of galaxies and stars. The galaxies are mostly orange and red, with some blue and white stars scattered throughout. A faint grid of blue lines is overlaid on the image. On the left side, there is a dark purple rectangular overlay with a folded corner effect.

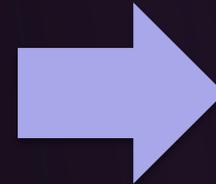
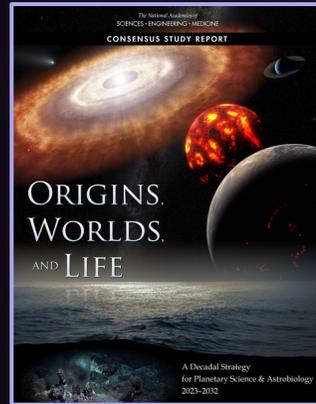
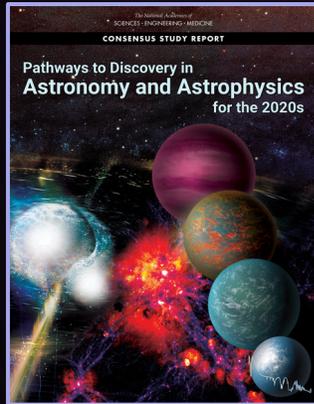
GOMAP HWO Update

START: Science, Technology, Architecture Review Team

TAG: Technical Assessment Group

The Science, Technology, Architecture Review Team (START) : Involve the Community

Responsibility: HWO Scope



Objectives:

HWO Goals, objectives, & observations

Quantify all science objectives

Identify performance breakpoints

Build in robust margins

SELECTED CO-CHAIRS



Courtney Dressing

University of California, Berkeley



John O'Meara

W. M. Keck Observatory



Link to selection announcement

Roadmap Science Traceability Matrix (STM)

Additional Activities:

Mentoring

Super START: Science Analysis

Precursor Science

The Technical Assessment Group (TAG):

Involve the Community

SELECTED NASA CO-CHAIRS

Goddard Space Flight Center

Jet Propulsion Laboratory



Lee Feinberg
Co-Chair Engineer



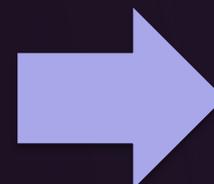
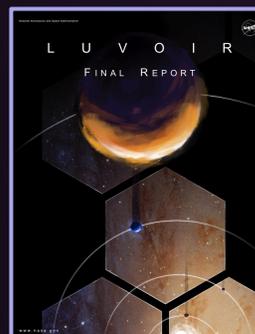
John Ziemer
Engineer Co-Chair



Aki Roberge
Co-Chair Scientist



Bertrand Menesson
Co-Chair Scientist



Responsibility:

HWO Responsiveness

Objectives:

Evolved Architecture Analyses
Aerospace Landscape Survey
Architecture Trade Deep Dives
Build in Robust Margins

Acting groups:

The TAG + Mentoring
Super TAG: Engineering Analysis
Aerospace Landscape Teams
Architecture Trades Teams

HWO Next Steps

- The kick-off START/TAG meeting was held F2F Oct. 31 – Nov. 2, 2023 in Washington, DC. The agenda, slides, and recordings are available on the [GOMAP website](#).
- Next HWO START + TAG in-person (F2F) meeting is planned for March 11-13, 2024 in Pasadena, CA.



GOMAP website

Near Term HWO

Goal

- Efficient project ready for funding

Objectives

- Ready for formal Pre-Phase A
- Concept Maturity Level 3
- Technologies at TLR 4
- Science goals & objectives explored

Roadmaps for

- Concept Maturity Level 5
- Technology Readiness Level > 6
- Science Traceability Matrix Definition

HWO By Astro2030

Goal

- Successful independent assessment

Objectives

- Ready for minimum formulation
- Concept Maturity Level 5
- Technologies > TRL 5
- Science Traceability Matrix finalized

Roadmaps for

- Concept Maturity Level 8
- Technology Readiness Level > 6



THANK YOU

