

National Aeronautics and  
Space Administration



# NASA Astrophysics Update

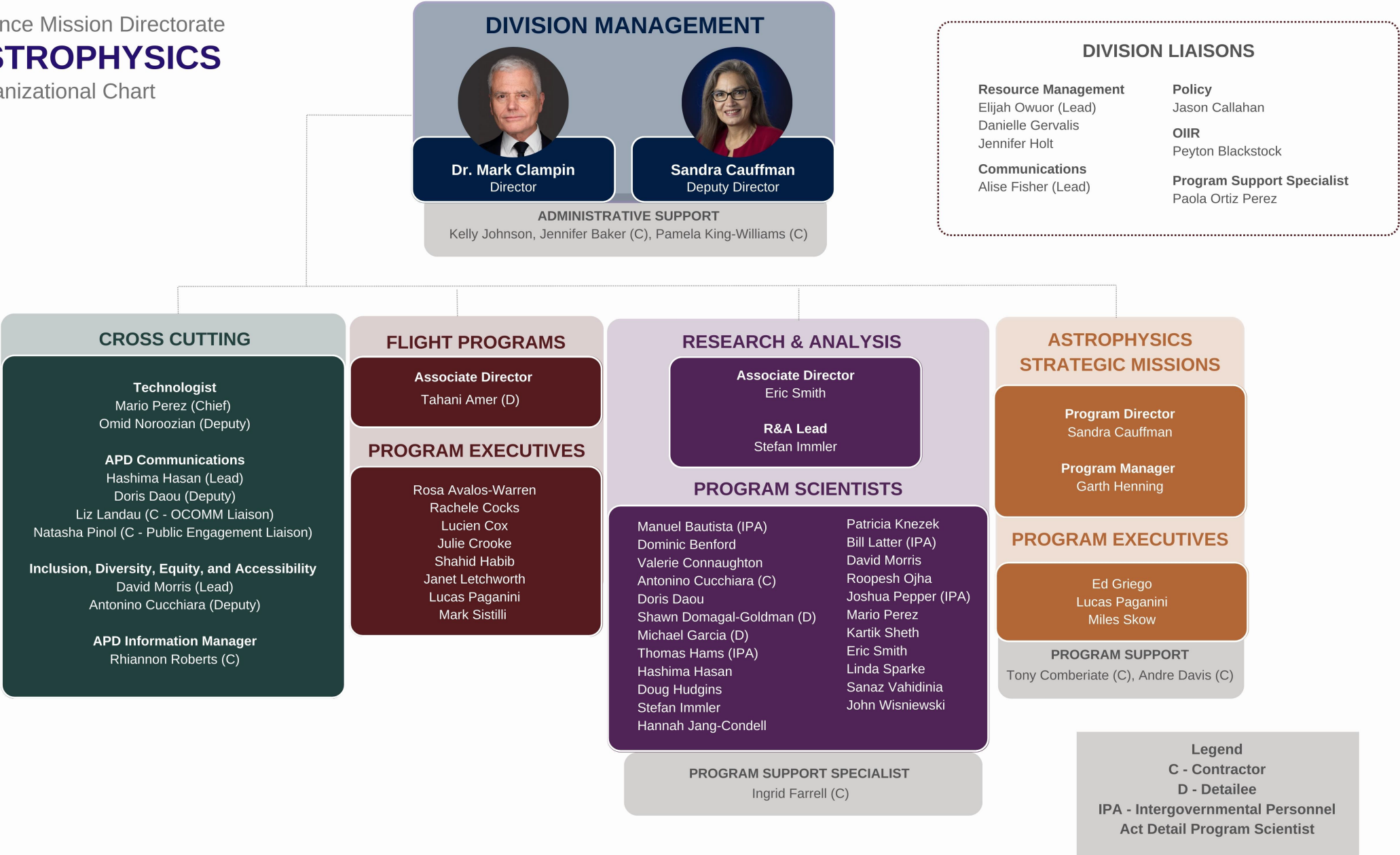
**Astrophysics Advisory Committee | October 19-20, 2023**

**Dr. Mark Clampin**

Director, NASA's Astrophysics Division

Science Mission Directorate

Science Mission Directorate  
**ASTROPHYSICS**  
Organizational Chart





**Sandra Cauffman**  
Program Director



**Garth Henning**  
Program Manager

The **ASTROPHYSICS STRATEGIC MISSIONS PROGRAM** develops, launches, and operates large strategic observatories in accordance with NASA's goals to understand the universe and our place in it.



**Ed Griego**  
Program Executive



**Lucas Paganini**  
Program Executive



**Miles Skow**  
Program Executive

## FLIGHT PROGRAMS



**Tahani Amer**  
Associate Director (Acting)

**PROGRAM EXECUTIVES** represent the mission for "up and out" HQ-level activities by tracking and reporting objectively on the status, risk, and issues; advocate for the mission within SMD; manage and coordinate communication among project, stakeholder, and community members.



**Rosa Avalos-Warren**  
SCAN



**Rachele Cocks**  
Pioneers, CubeSats,  
TDAMM



**Lucien Cox**  
GUSTO, XRISM, SOFIA



**Julie Crooke**  
GOMAP  
HWO



**Shahid Habib**  
LISA, Athena, Ariel/CASE,  
Euclid, Ultrasat,  
PhysCOS & COR



**Janet Letchworth**  
Operating missions



**Lucas Paganini**  
ExEP



**Mark Sistilli**  
COSI, SPHEREx,  
Balloons, Explorers

## RESEARCH & ANALYSIS



**Eric Smith**  
Associate Director



**Stefan Immler**  
R&A Lead

**PROGRAM SCIENTISTS** are the senior NASA Scientists responsible for the science content of an SMD Science investigation. They ensure that the science NASA selects is the science NASA gets and advocates at HQ for the science of the mission.



**Manuel Bautista**  
UltraSat, XMM, CubeSats and  
Pioneers Deputy, LabAstro,  
Probes Deputy, COR



**Dominic Benford**  
Roman, APRA



**Valerie Connaughton**  
HEA, PhysCOS, TDAMM



**Antonino Cucchiara**  
Fermi, FINESST, NHFP,  
Bridge Program, TDAMM  
Deputy



**Doris Daou**  
Euclid, NEO Surveyor,  
New Horizons, Precursor,  
ADAP Deputy



**Shawn Domagal-Goldman**  
GOMAP



**Michael Garcia**  
Hubble, Pioneers,  
CubeSats, UVO,  
Sounding Rockets Deputy



**Thomas Hams**  
GUSTO, LISA, Balloons,  
Sounding Rockets, PFP,  
IR Portfolio Deputy



**Hashima Hasan**  
IXPE, NuSTAR,  
Citizen Science, Keck,  
ADCAR Deputy



**Doug Hudgins**  
Ariel/CASE, EPRV, NexSCI,  
ADAP Deputy, EXEP,  
NNEExplore



**Stefan Immler**  
Chandra, COSI,  
Spektrum X Gamma



**Hannah Jang-Condell**  
Explorers, XRP, EXEP Deputy



**Patricia Knezek**  
SOFIA, Explorers, Probes,  
ADCAR Deputy, NHFP  
Deputy



**Bill Latter**  
GUSTO Deputy,  
LabAstro Deputy



**David Morris**  
Explorers Deputy,  
CubeSats Deputy,  
APRA Deputy



**Roopesh Ojha**  
NICER, High End  
Computing, ADCAR, Data,  
R&A Deputy



**Joshua Pepper**  
TESS, ADAP,  
EXEP Deputy



**Mario Perez**  
Swift, Keck, ISFM, RTF,  
SAT, UVO Deputy



**Kartik Sheth**  
On Detail



**Eric Smith**  
JWST



**Linda Sparke**  
ADCAR, Explorers  
Deputy, COSI Deputy



**Sanaz Vahidinia**  
XRISM, ATP, TCANN,  
IR Portfolio Deputy



**John Wisniewski**  
SPHEREx Deputy,  
XRP Deputy

**CROSS CUTTING staff are responsible for managing and developing the technology programs, coordinating IDEA activities and programs, as well as APD communications in support of the division.**



**Mario Perez**  
Chief Technologist



**Omid Noroozian**  
Deputy Technologist



**Hashima Hasan**  
Communications  
Lead



**Doris Daou**  
Communications  
Deputy



**Elizabeth Landau**  
OCOMM Liaison



**Natasha Pinol**  
Public Engagement  
Liaison



**David Morris**  
Inclusion, Diversity,  
Equity, and Accessibility  
(Lead)



**Antonino Cucchiara**  
Inclusion, Diversity,  
Equity, and Accessibility  
(Deputy)



**Rhiannon Roberts**  
APD Information  
Manager

National Aeronautics and  
Space Administration



# 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

2020

TESS

2015

NICER

NUSTAR

2010

FERMI

2005

GEHRELS SWIFT

2000

CHANDRA

XMM-NEWTON

1990

HUBBLE

GLOWBUG

XRISM



GUSTO

BURST-CUBE

SPARCS

BLACKCAT

SPRITE

PANDORA

ASPERA

STARBURST

PUEO

TIGERISS

MANTIS

## KEY

- INTERNATIONAL PARTNER LED
- ISS INSTRUMENT
- SMALLSAT
- CUBESAT
- BALLOON

- FORMULATION
- IMPLEMENTATION
- OPERATING
- EXTENDED



SPHEREX



ULTRASAT



ROMAN



COSI



ARIEL

2025

October 2023

## RESEARCH

~**350** U.S. Science PIs Funded  
~**120** Individual Institutions Selected  
~**\$130M** Awarded Annually

## SMALLSATS/ CUBESATS

**2** Science Missions Launched  
**9** Science Missions in Development  
**1** ISS-attached Science Mission  
**1** Balloon Mission

## SOUNDING ROCKETS

**15** Science Missions Launched  
(Suborbital)  
**6** In Development

## BALLOONS

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

## TECHNOLOGY DEVELOPMENT

~**\$220M** Invested Annually

## REFEREED PUBLICATIONS

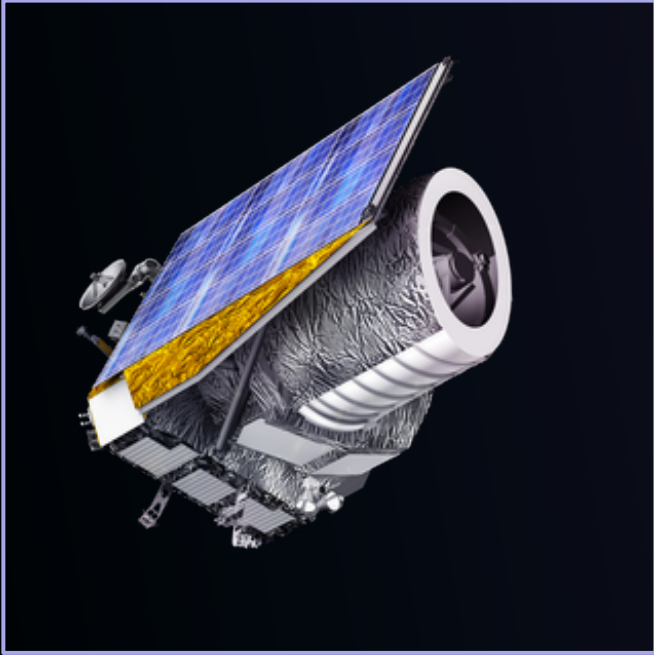
**>23,680** Total Publications  
(2018-Current)  
**>20,517** Hubble Publications  
(1991-Current)  
**>407** Webb Publications  
(July 2022-Current)

## MISSION SUMMARY

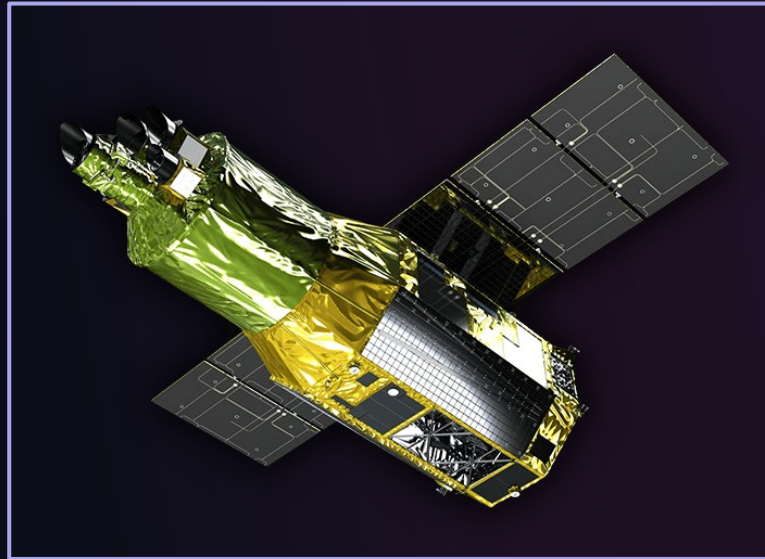
**14\*** Missions Operating  
**15\*** Missions in Development  
**2** Tech. Demos  
\*Including international

Astrophysics by the  
**NUMBERS**

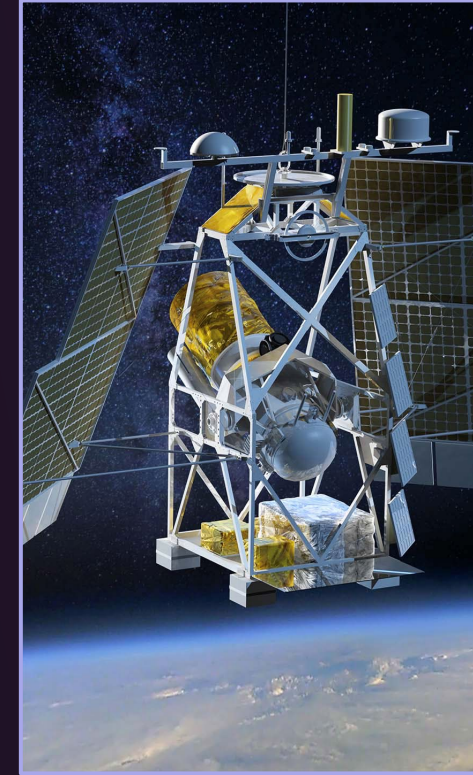
# Astrophysics Division Launches: 2023



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



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



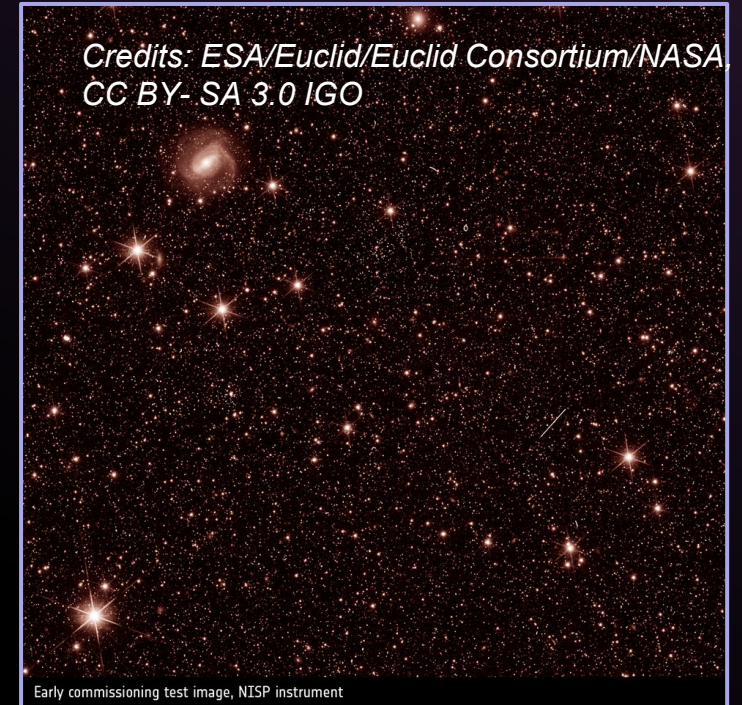
**GUSTO (SMEX Balloon)**  
Antarctica,  
December 2023

# Euclid Launch (July 1, 2023 from Cape Canaveral)

- The two instruments aboard Euclid have captured their first test images.
- NASA contributed a 16 detector, focal-plane camera for the Near Infrared Spectrometer and Photometer (NISP) instrument.
- Observatory is currently in performance verification phase.
  - Earlier issues pertaining to the fine guidance software failing to lock on guide stars, and the stray sunlight contamination detected in the VIS instrument have been solved.
  - Fine guidance software patch was uploaded and has solved its guiding issues. The next six years of observation schedules have been redesigned to mitigate stray sunlight.
- Euclid will now complete science commissioning
- Science operation is expected in early 2024.



Euclid GNC status



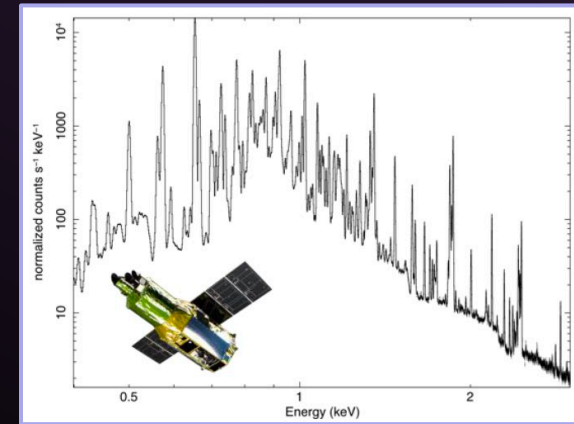
# XRISM Launch (Sept. 7, 2023 from the Tanegashima Space Center, Japan)

## The X-Ray Imaging and Spectroscopy Mission

- The commissioning is going well, and all aspects are nominal.
  - Sept.11- Oct. 6: Spacecraft commissioning
  - Oct. 7: Resolve check-out began
  - Oct.18: Resolve and Xtend check-out begins
  - Nov. 5: Resolve Gate Valve opens
  - Dec. 14 (TBC): End of commissioning
  - Mid-Dec. (TBC): First light/first observation
- The instruments onboard XRISM are
  - Resolve (a high-resolution X-ray spectrometer)
  - Xtend (a wide-field X-ray imager).
- The **combination** of Xtend's observations and Resolve's measurements provide a comprehensive view of extreme environments and energetic events.
- First/early release observations are planned for mid-December but since the instruments are not fully calibrated and pipeline tested yet, the early observations will be for press-release purposes and not of high scientific output at that time.

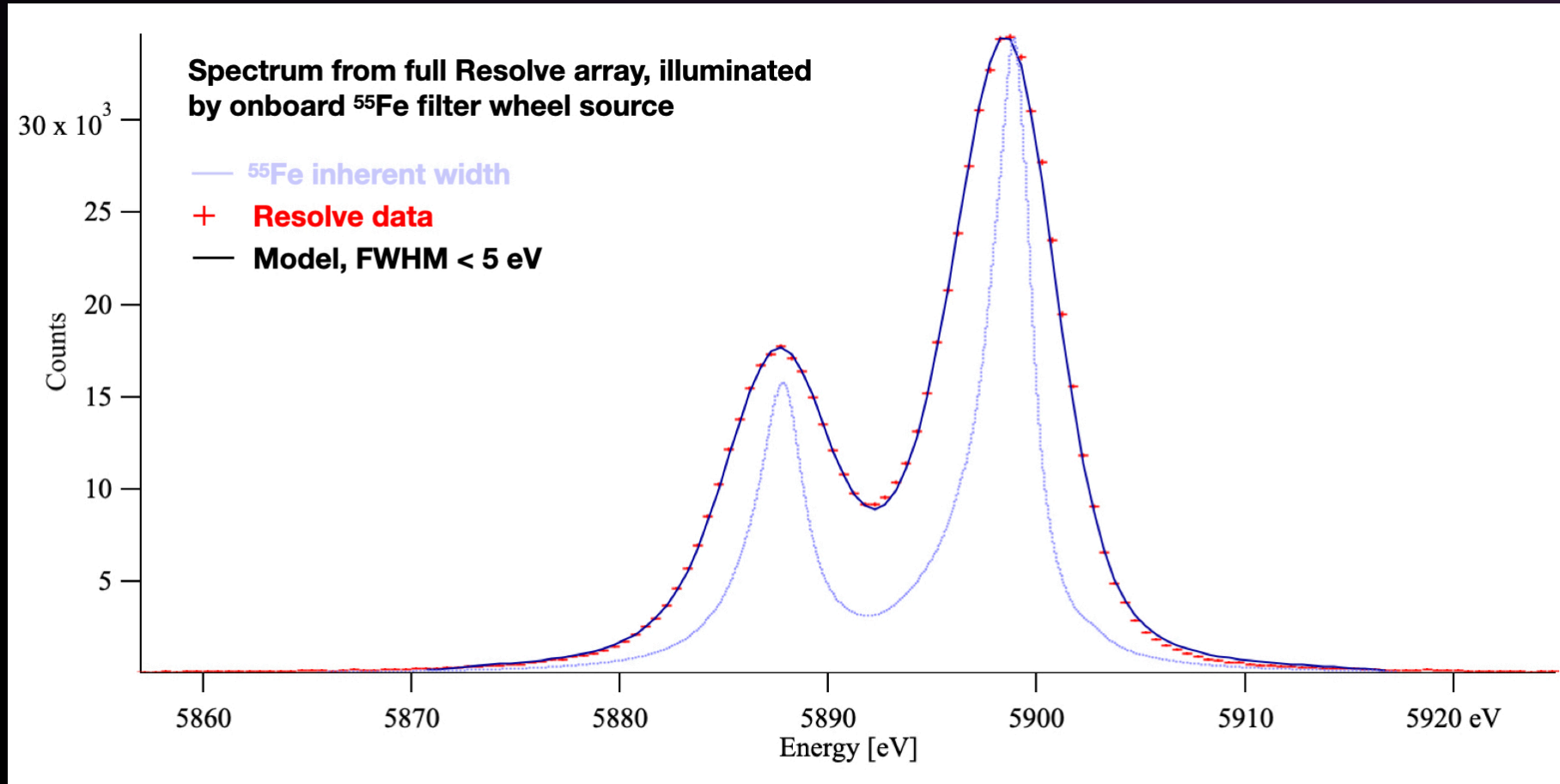


*Simulated XRISM spectrum*



*≤ 7 eV spectral resolution*

# XRISM Spectrum From Calibration Source



Full Resolve detector plane illumination of the Fe calibration source – about a million photons.  
Resolution 4.37 eV

# 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.

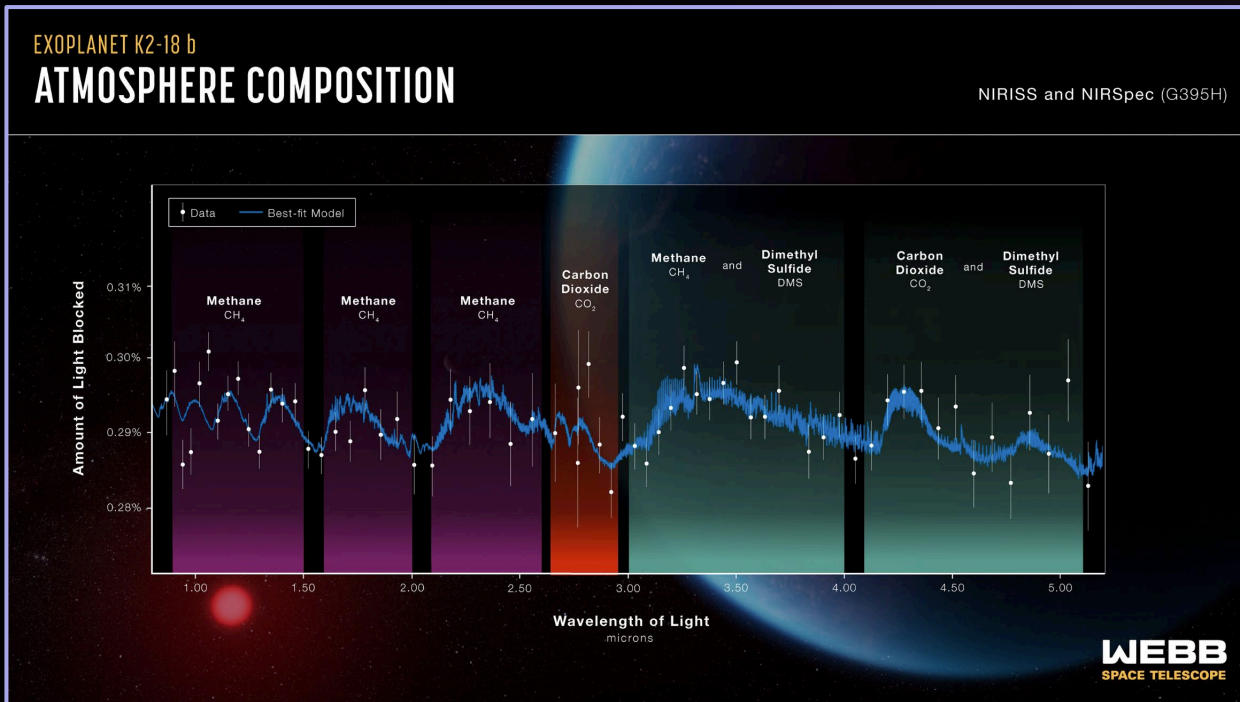
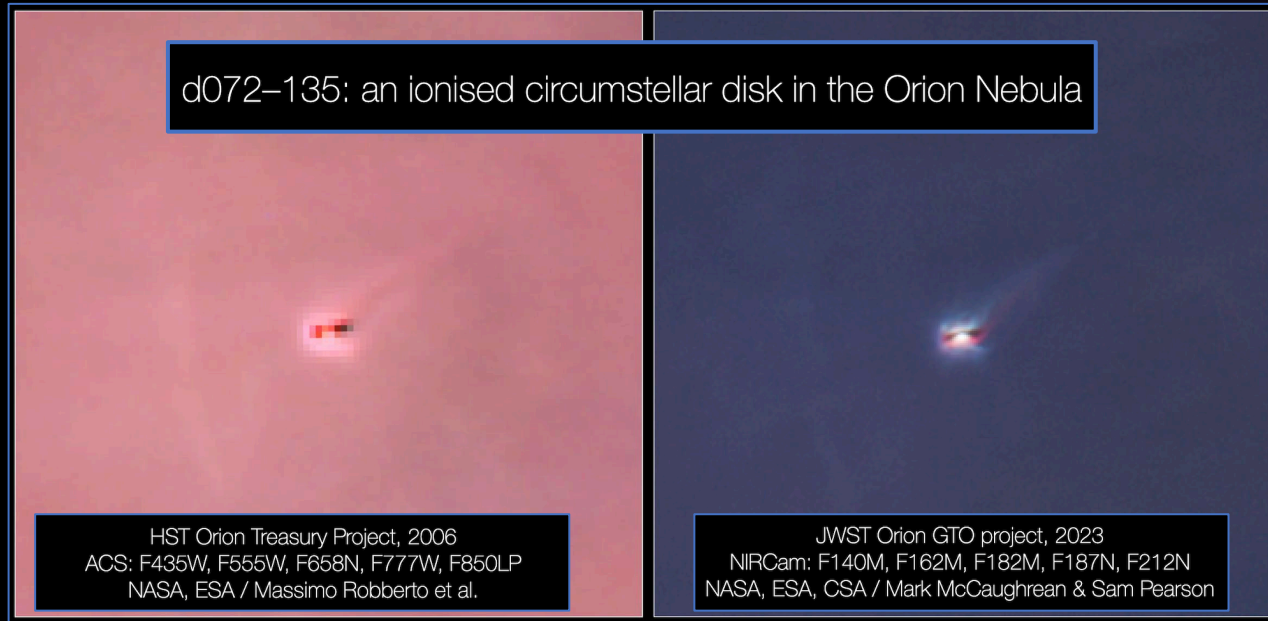


Illustration: NASA, ESA, CSA, Ralf Crawford (STScI), Joseph Olmsted (STScI).  
Science: Nikku Madhusudhan (IoA)

- 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.

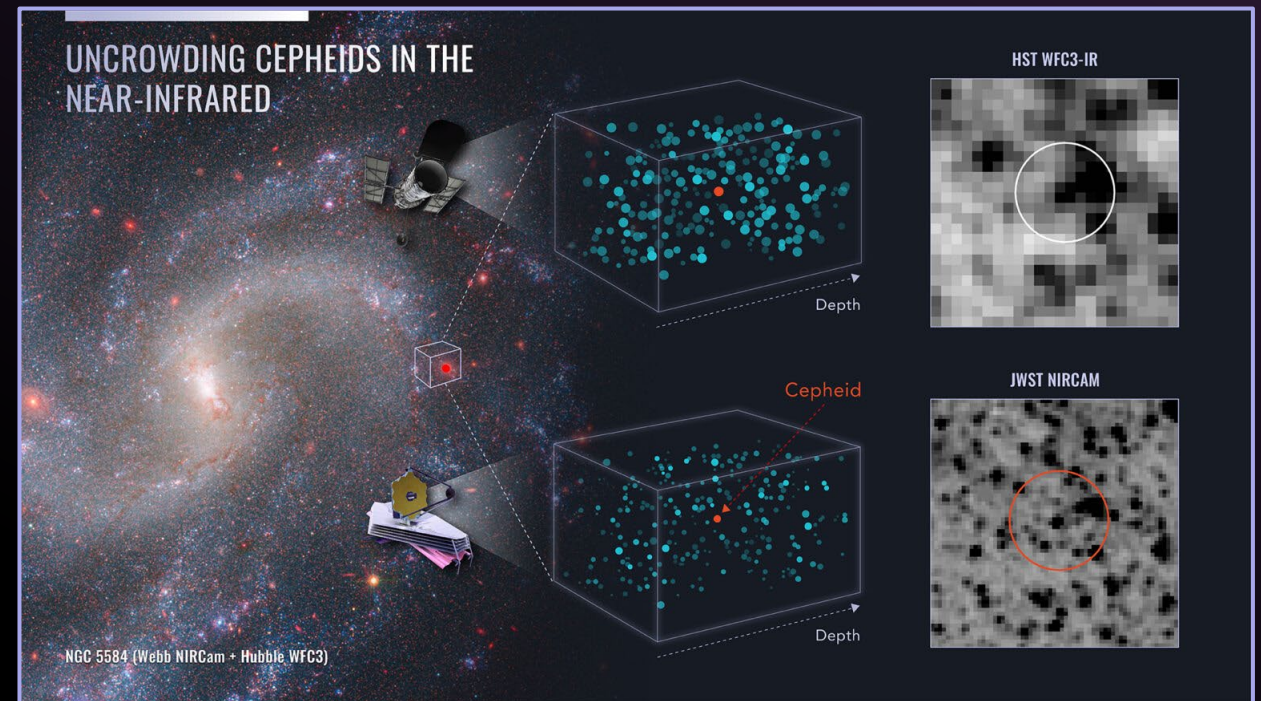
# Webb's Wide-angle View of the Orion Nebula in ESASky

- New images of the Orion Nebula from Webb have been added to ESA's [ESASky](#) application



# Webb Confirms Accuracy of Universe's Expansion Rate Measured by Hubble, Deepens Mystery of Hubble Constant Tension

- Recently, Nobel Laureate Adam Riess from the Johns Hopkins University and the Space Telescope Science Institute presented his and his colleagues' recent work using Webb observations to improve the precision of local measurements of the Hubble constant.
- Webb data confirmed the accuracy of 30 years of Hubble observations of Cepheids that were critical in establishing the bottom rung of the cosmic distance ladder for measuring the universe's expansion rate.
- With Webb confirming the measurements from Hubble, the Webb measurements provide the strongest evidence yet that systematic errors in Hubble's Cepheid photometry do not play a significant role in the present Hubble Tension.

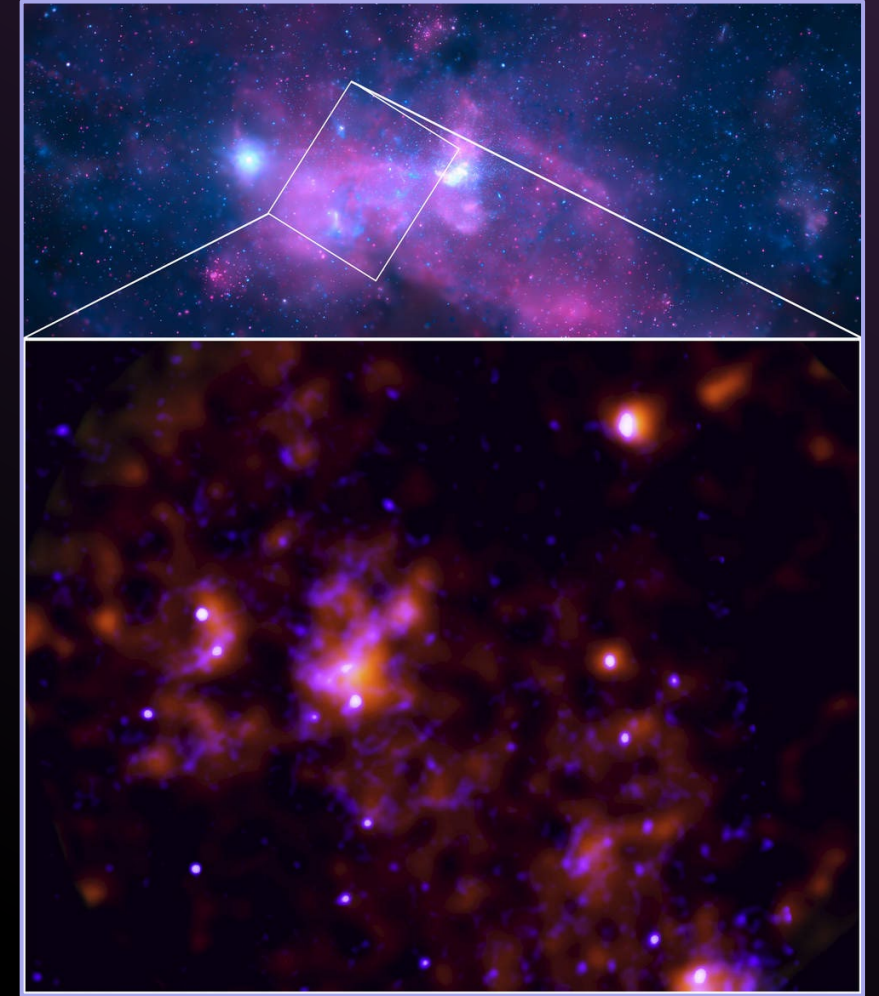


NGC 5584 is seen in a composite image from Webb's NIRCAM (Near-Infrared Camera) and Hubble's Wide Field Camera 3.

*Image Credit: NASA, ESA, A. Riess (STScI), W. Yuan (STScI).*

# 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*

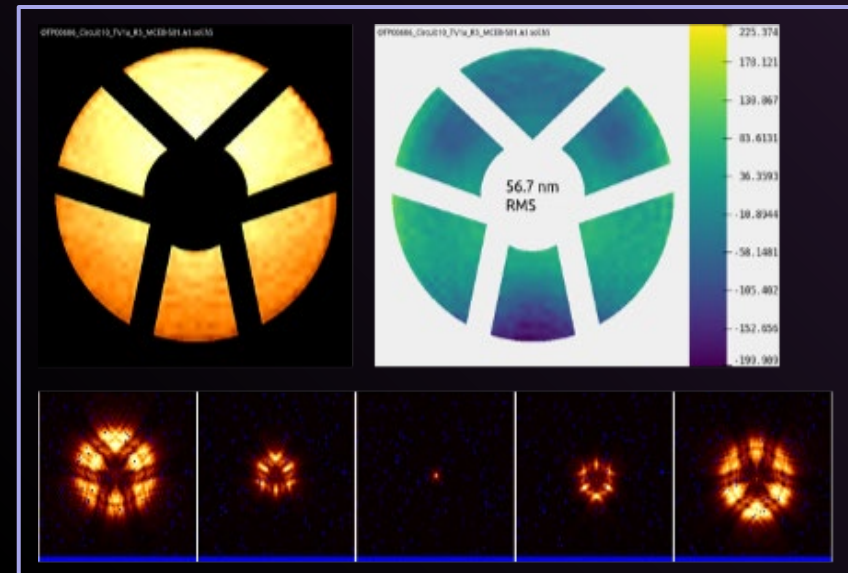
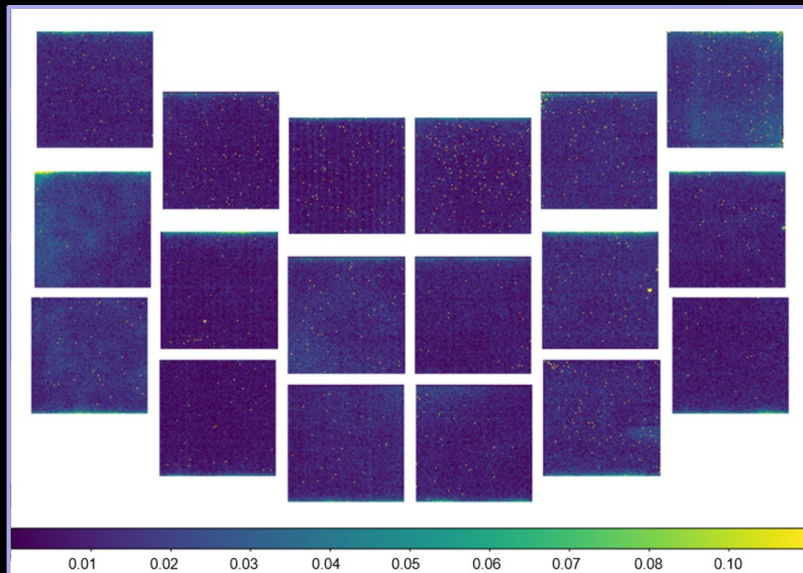
# Mission Status



# Nancy Grace Roman Telescope

## WFI Status and Accomplishments

- WFI TVAC-1 Preliminary (Quick Look) Assessments
  - Focal Plane System performance at WFI Level Is Consistent with Subsystem Level testing
  - Optical Wavefront Error and Focal Plane Placement are Excellent
  - Relative Calibration System is working as expected
  - The Complex Thermal Control System (85K to 263K gradient) is performing As Designed
  - Ground Support Equipment is performing As Needed to support verification



*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 in order to explore the origins of the universe.
- Both SPHEREx payload integration testing and spacecraft bus integration are ongoing.
- Systems Integration Review (SIR) planned for November 14-16, 2023 at JPL. SPHEREx schedule and budget to be reviewed.
- KDP-D: January 30, 2024
- SHPEREx launch planned for 2025



*JPL Director Laurie Leshin poses with SPHEREx at JPL.*

# 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)
- ORR: Held on September 27, 2023
- KDP-E: Held on October 17, 2023
- Observatory shipment via aircraft to McMurdo leaving US around October 16 followed by team deployment
- Launch is scheduled for early December 2023 from Antarctica



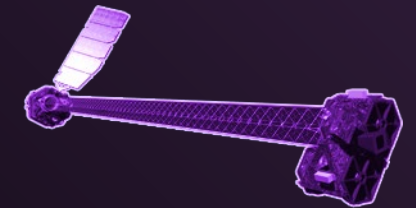
*The GUSTO Compatibility test was successfully conducted at CSBF on Aug 10*

## LDB Camp near William's Field (McMurdo Station, Antarctica)



# Operating Missions

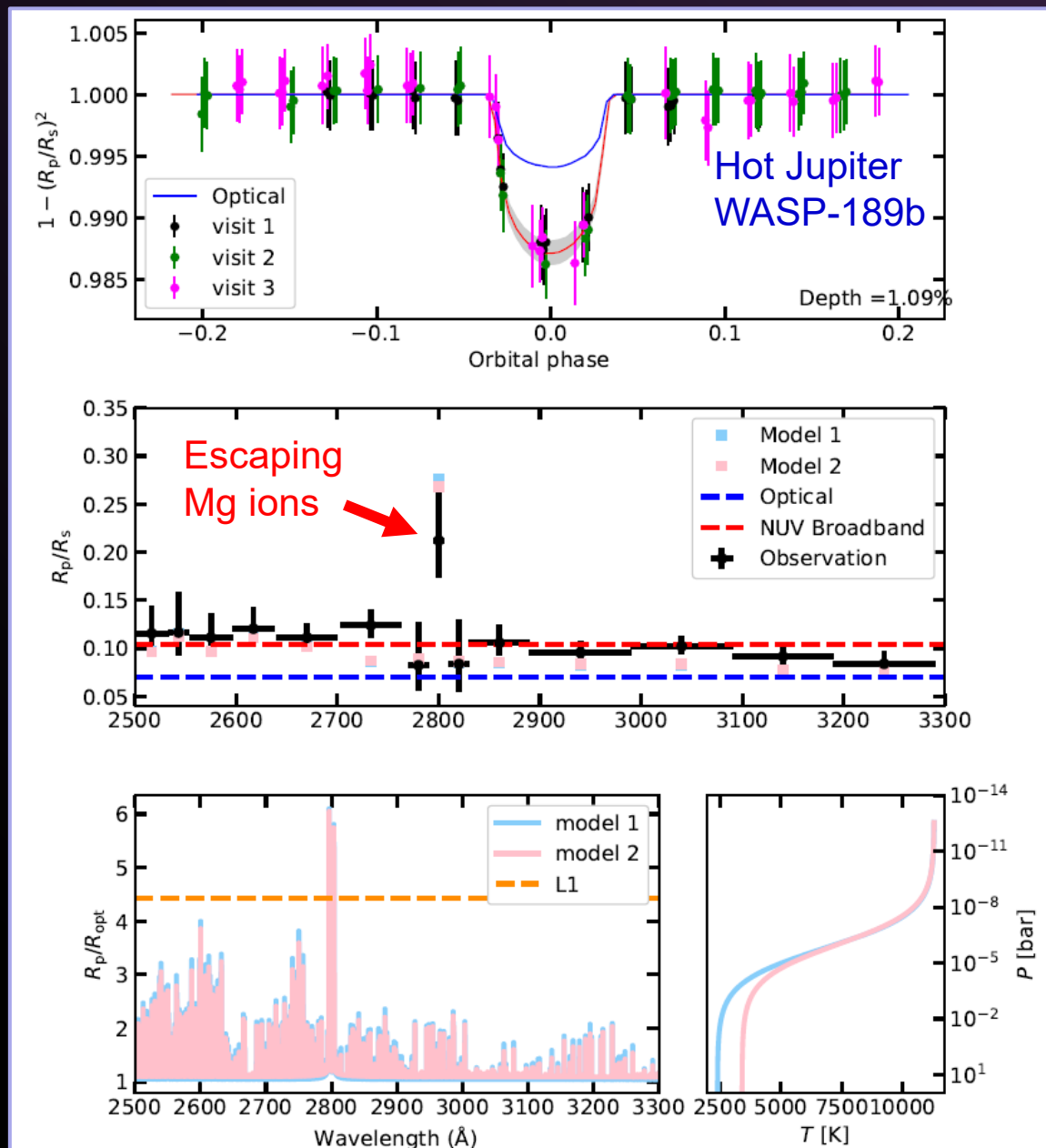
- Nuclear Spectroscopic Telescope Array (NuSTAR)
  - In its 11<sup>th</sup> year since launch, NuSTAR continues to study the universe in high energy X-rays to better understand the dynamics of black holes, exploding stars and the most extreme active galaxies.
  - NuSTAR coordinates observations with multiple observatories with the proportion of NuSTAR observations that are performed simultaneously with one or more observatories over 50 percent.
- Neil Gehrels Swift Observatory (Swift)
  - Community interest for Swift science remains strong as it was demonstrated by the number of proposals for cycle 20 (178, which is 20% increase compared to cycle 19 and 2022).
  - The Swift BAT XRT and UVOT instruments are nominal, and the spacecraft is operating with 5 reaction wheels. The battery is performing nominally and the rest of the S/C is operational.
- Fermi Gamma-ray Space Telescope (Fermi)
  - Fermi continues to deal with risk conjunction with constellation satellites
  - Fermi enabled accurate measurement of a Neutron star mass from "spider" millisecond binary using "gamma-ray eclipse" method.
  - Fermi 3rd LAT Pulsar catalog (more 150 objects) has been published providing key baseline for future Gravitational Wave detection using Pulsar Timing technique.



# CUTE

## The Colorado Ultraviolet Transit Experiment

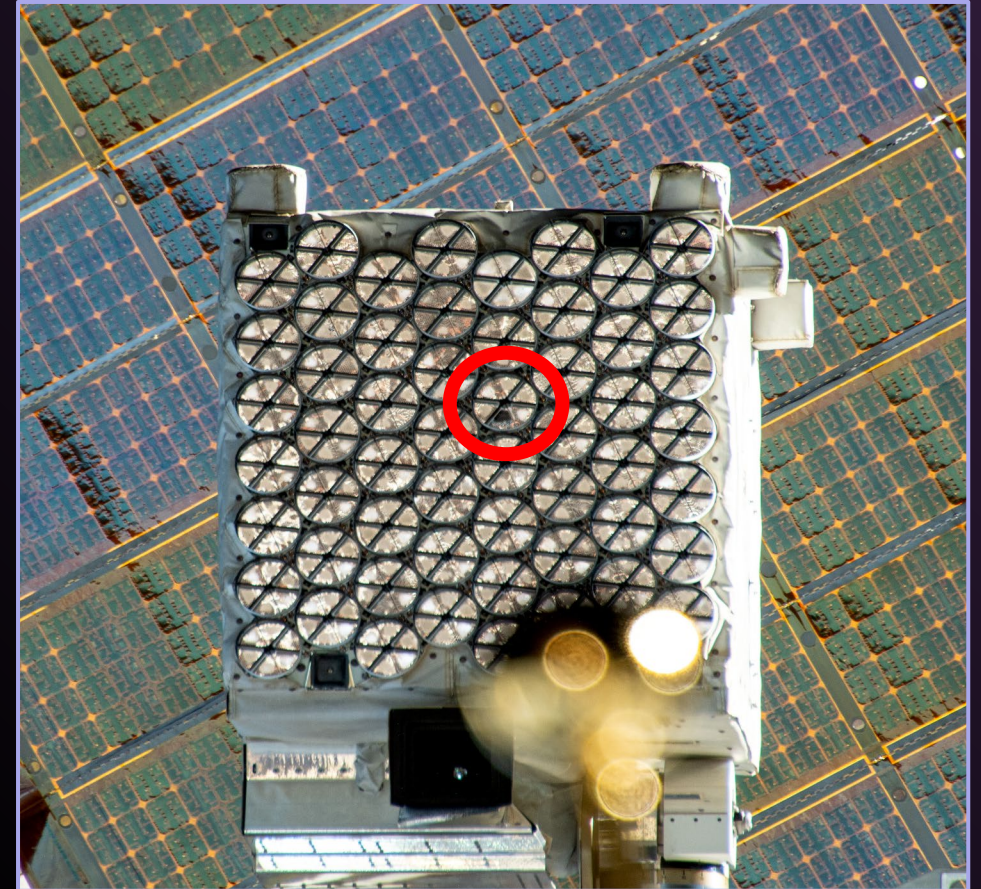
- NASA's first UV/optical astronomy and first exoplanet transit spectroscopy cubesat
  - PI – Kevin France, CU Boulder/LASP
- Launched September 2021, extended mission ongoing now
- Acquired 6 – 11 near-UV transit observations of six hot Jupiters
- Data delivered for archiving at NExSci
- Science and mission publications in the peer-reviewed literature



# NICER

## The Neutron Star Interior Composition ExploreR

- NICER is deployed on an external site of the ISS truss offering a uniquely favorable view for Astrophysics observations.
- NICER has experienced increased optical loading due to a puncture in the thermal shield of the Sun Shade that occurred on May 22, allowing stray light to enter the usually dark optical bench where its sensitive detectors are located.
  - Nighttime observations seem to be unaffected and daytime observations are notably impacted.
  - Operational work-arounds restored daytime observation capabilities to ~50% of the former level.
  - The NICER and ISS teams are collaborating on repair strategies to plug the areas and reduce the stray light.
  - EVA and EVR options are available and could be implemented around summer 2024.

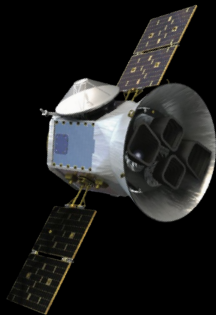


View of NICER from ISS Camera showing the array of Sun Shades with thermal shield damage

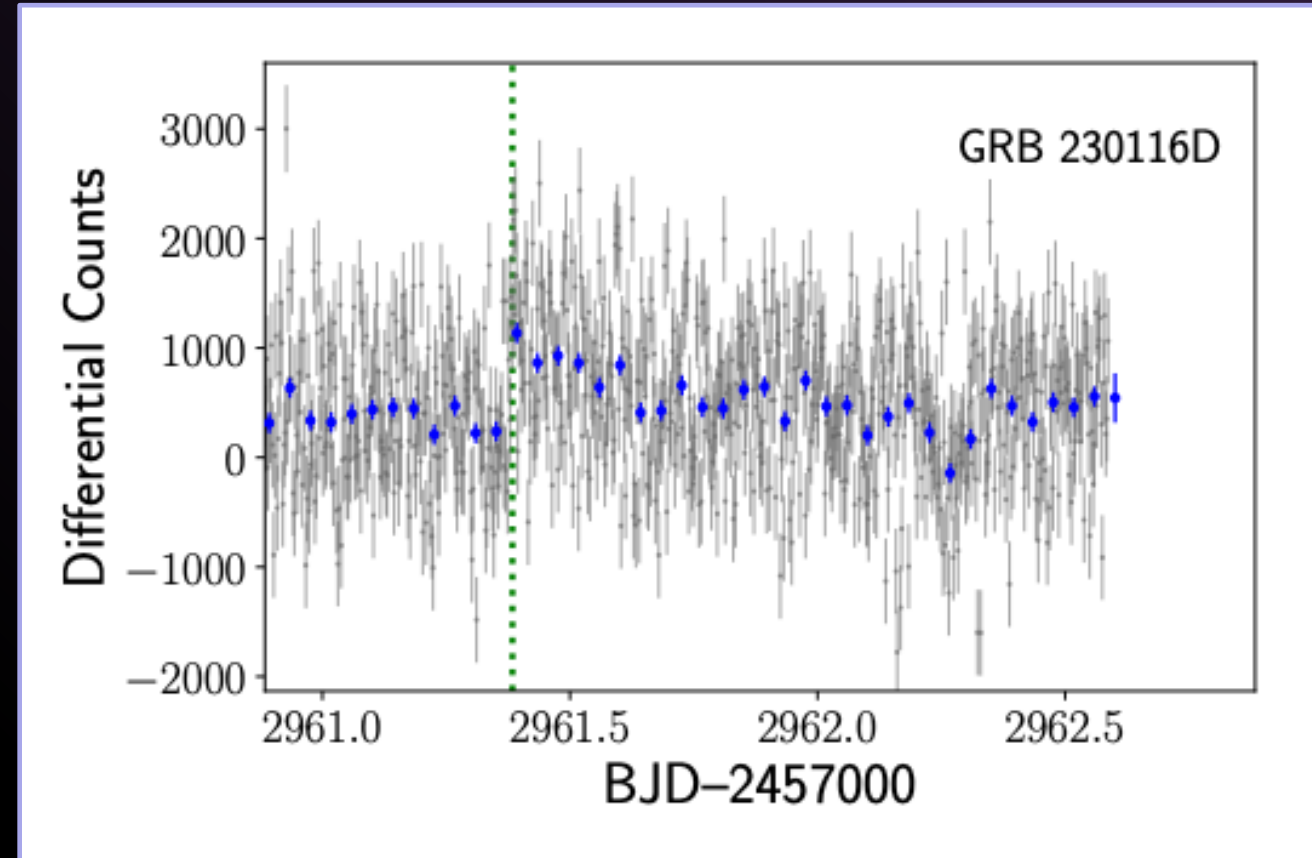
# TESS

## Transiting Exoplanet Survey Satellite

- Planet Count: 392 confirmed planets
  - 136 with radii  $< 2.5 R_{\text{Earth}}$
  - 252 with radii  $> 2.5 R_{\text{Earth}}$
  - 4 with unknown radii
  - 6,788 candidate planets
- Publication Count:
  - 1721 submitted, 1536 peer-reviewed
  - (41% exoplanets, 59% astrophysics)



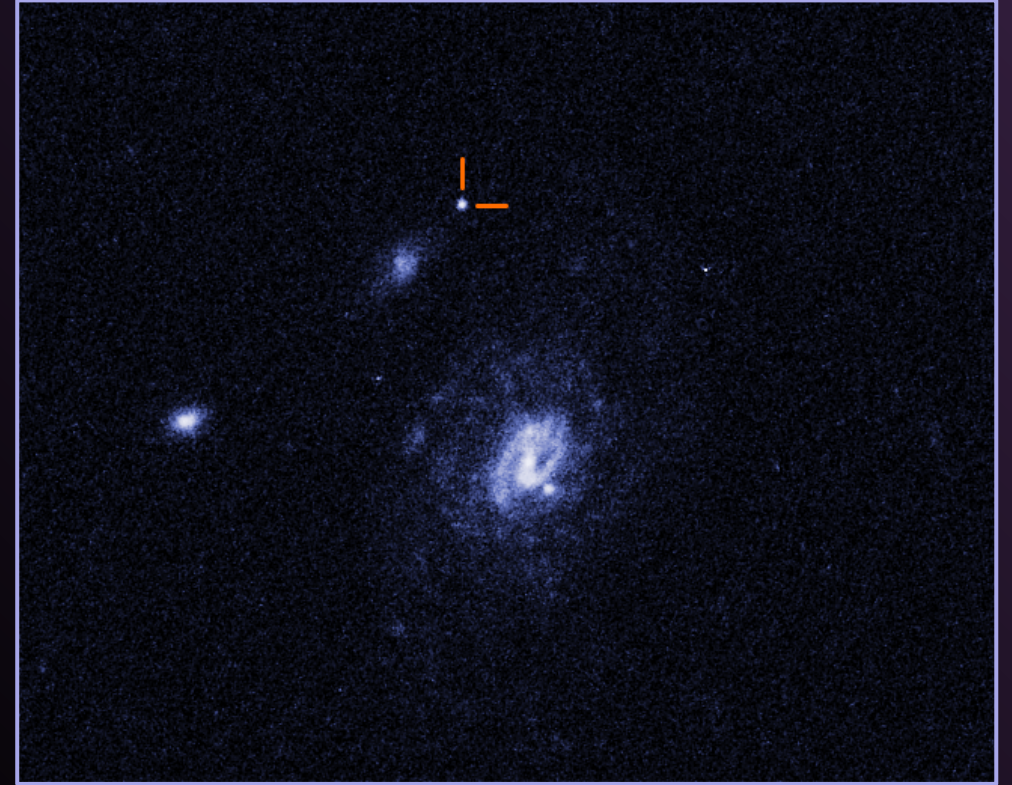
## TESS observed a gamma-ray burst!



“Gamma-Ray Bursts Observed by the Transiting Exoplanet Survey Satellite: Prompt Optical Counterparts and Afterglows of Swift-XRT Localized GRBs” (Jayaraman et al. 2023 arXiv:2308.05148.)

# Hubble

- Hubble oversubscription and publication rates continue at pre JWST rates.
- On Aug 12, gyro 3 (the noisy one) experienced a large bias shift that caused the observatory to go to safemode. As part of the recovery, the decision was made to transition the gyros to “high rate” mode, which, thanks to recent innovative control system updates is a fully functional science mode. As endorsed by the Anomaly Review Board, the gyros will be kept in high mode for the foreseeable future.
- Work is progressing on the B-side operations software, which will allow operational redundancy to be regained (with some missing housekeeping data) once complete.



*HST image of the Fast Blue Optical Transient (LFBOT) dAT 2023fhn. Only a handful of previous LFBOTs have been discovered since 2018. All previous LFBOTs have been found in star-forming regions in the spiral arms of galaxies, but 2023fhn lies at a large offset from both the barred spiral galaxy at right and the dwarf galaxy to the upper left.*

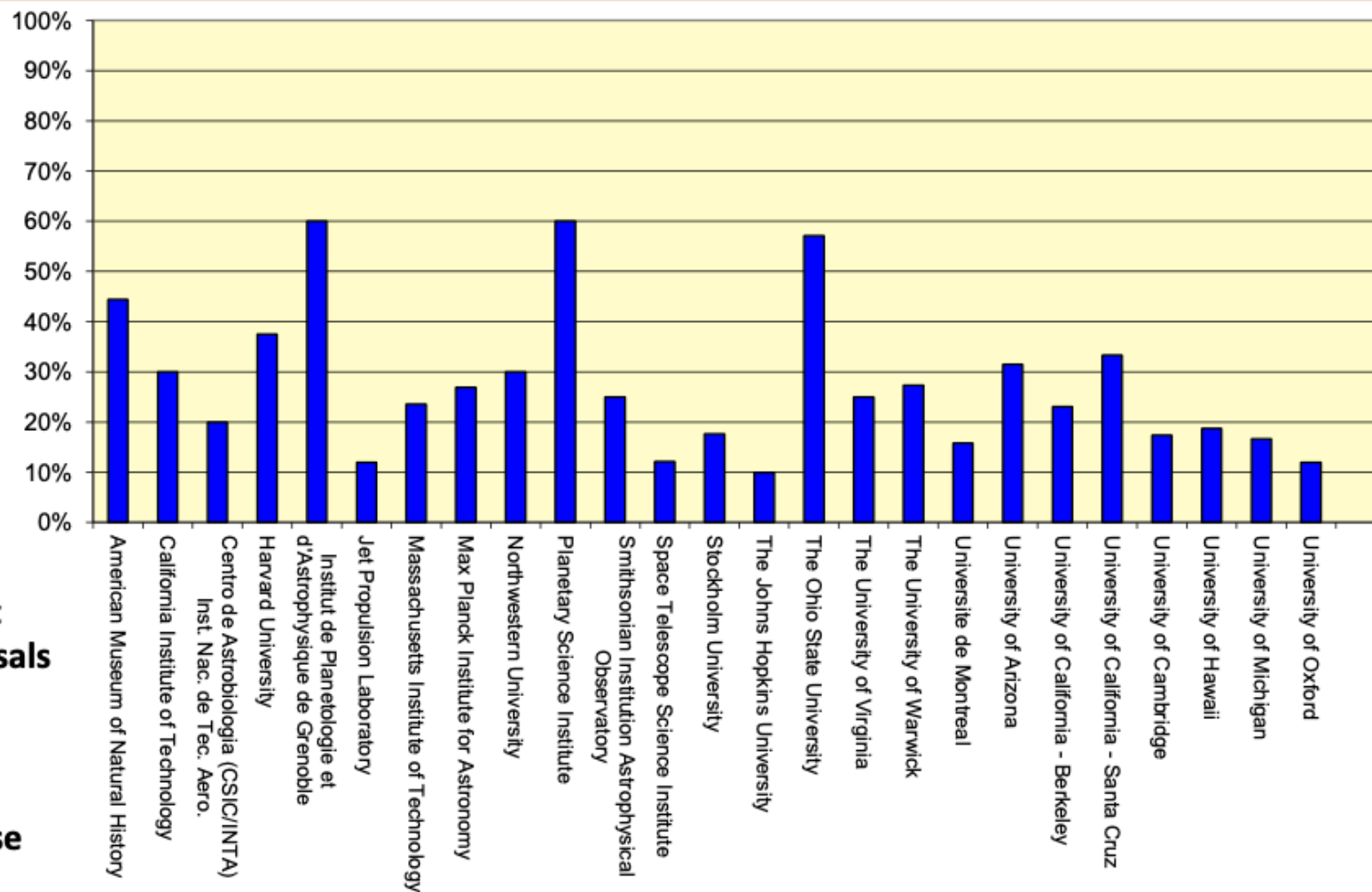
*Credits: NASA, ESA, STScI, Ashley Chrimes (ESA-ESTEC/Radboud University)*

# James Webb Space Telescope

- James Webb Space Telescope continues to operate at full science capability
  - 14 months into its 5-year prime mission.
- Cycle 1 and Cycle 2 observations are well underway
  - Cycle 3 Call for Proposals was released August 16, 2023 with proposals due October 25, 2023.
  - Cycle 3 observations will begin July 1, 2024.
- As of early October 2023, over 400 articles have been published in peer-reviewed journals with “JWST” in the title or abstract.
- The Operations team has implemented a Micrometeoroid Avoidance Zone (MAZ) constraint to help minimize impacts on the primary mirror. Observations can still be scheduled in the MAZ but efforts are taken to minimize the time the observatory is pointed into the RAM direction.



## Proposal Institutional Acceptance Fraction



Only shows  
Institutions that  
have  $\geq 3$  Proposals  
approved  
55% of the  
Recommended  
Hours from these  
26 Institutions

# James Webb Space Telescope

## MIRI Count Rate Loss

- In April 2023, the MIRI MRS team identified a drop in count rates at long wavelengths for flux standards, as well as in backgrounds counts.
  - Effect increases with wavelength; most severe in Channel 4C (~50% count rate loss)
  - Exponential decline, that appears to be stabilizing
- In July 2023, new imager data revealed that a similar issue is visible in our long wave imager filters
  - Effect is measurable in from F1280W onwards & increases with wavelength; F2550W shows a reduction of 18% in count rate
  - Temporal trend not very well constrained; additional observations are planned to address this.
- 3 public statements have been released via STScI (JWST Observer News) and NASA (Webb blog) with numbers, plots and advice for users.
- The root cause is under investigation, a time-dependent correction has been implemented in the calibration pipeline for MRS, additional standard star observations are being taken.

# Budget



# Federal Budget Process Overview

Date	Item
March CY	Program Planning & Budget Exercise instructions for FY+2 to projects (i.e., in CY XXXX, working FY XXXX+2)
May	Projects response to PPBE guidelines
July	SMD recommendations to NASA Office of the Chief Financial Officer (OCFO)
August	NASA budget decisions
September	NASA budget to Office of Management & Budget (OMB)
~November	OMB markup & passback
~February CY+1	President's FY +1 budget announced
March CY+1	Congressional authorization committees
August CY+1	Congressional appropriations committees
September CY+1	Congressional conference committee
October CY+1	President signs budget (begins FY+1)



FY+2  
Not Public  
FY+2: Information is Not Public

FY+1  
Public  
FY+1: Information is Public

# FY24 Presidents Budget

- Bipartisan Budget Agreement (Signed by the President June 3)
  - Expected to keep fiscal year 2024 non-defense non-VA spending government-wide flat at fiscal year 2023 levels and increase fiscal year 2025 non-defense non-VA spending government by 1%. Beyond fiscal year 2025, the agreement has no budget caps, only non-enforceable appropriations targets.
  - It is possible NASA's final fiscal year 2024 appropriation could be significantly below the \$27.2 billion President's request, which represented a \$1.8 billion increase, or 7%, above fiscal year 2023, to continue support for our priorities in Artemis, climate, science, and technology for future missions.
  - Both draft appropriations bills (House and Senate) are significantly below even the FY23 levels.
- NASA has deemed it prudent to plan for an FY24 budget lower than the FY24 Presidential Budget Request
- APD has taken steps consistent with the expectation that we'll have to stay roughly within our FY23 enacted budget levels during a CR.



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PROBE ~2033  
LISA ~2037  
ATHENA TBD

## COMPETED PHASE-A

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

## Missions in Prime Science Operations

## VERY SMALL MISSIONS

## TRADITIONAL MISSIONS

2020



WEBB



CUTE

1990



EUCLID

GLOWBUG



XRISM

2015

2010

2005

2000

2025

## KEY

- INTERNATIONAL PARTNER LED
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- SMALLSAT
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- FORMULATION
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- EXTENDED



# ASTROPHYSICS FLEET

PRE-FORMULATION

PROBE ~2033  
LISA ~2037  
ATHENA TBD

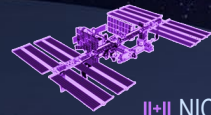
2020



IXPE

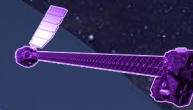


TESS



NICER

2015



NUSTAR

2010



FERMI

2005



GEHRELS SWIFT

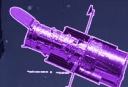
2000



XMM-NEWTON



CHANDRA



HUBBLE

1990

**Missions in Extended Science Operations**

VERY SMALL MISSIONS

TRADITIONAL MISSIONS

## KEY

- INTERNATIONAL PARTNER LED
- ISS INSTRUMENT
- SMALLSAT
- CUBESAT
- BALLOON

- FORMULATION
- IMPLEMENTATION
- OPERATING
- EXTENDED

2025



# ASTROPHYSICS FLEET

## PRE-FORMULATION

PROBE ~2033  
LISA ~2037  
ATHENA TBD

## COMPETED PHASE-A

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

## Missions in Formulation & Development

## VERY SMALL MISSIONS

## TRADITIONAL MISSIONS

### KEY

INTERNATIONAL PARTNER LED  
ISS INSTRUMENT  
SMALLSAT  
CUBESAT  
BALLOON

FORMULATION  
IMPLEMENTATION  
OPERATING  
EXTENDED

2025

2000

2005

2010

2015

2020

1990



GUSTO

BURST-  
CUBE

SPARCS

BLACKCAT

SPRITE

PANDORA

ASPERA

STARBURST

PUEO

TIGERISS

MANTIS



SPHEREX



ULTRASAT



ROMAN



COSI

# Astrophysics Division Director's Perspective

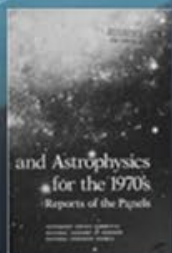
- Balance Portfolio of Missions and Science
  - Decisions made based on APD principles document for handling reduced budgets
  - Current considerations include:
    - 2010 Decadal Program of Record: Roman
    - 2021 Decadal Survey recommendations
      - e.g. Habitable Worlds Observatory, TDAMM, and Probe mission
    - Maintaining healthy R&A program
    - Cost of large missions in extended operations
- Protect Missions in Development, Future Missions & International Partnerships
  - Ensure that the Agency commitment to Roman continues to be met i.e. Cost and Schedule
  - Maintain international partnerships
  - Maintaining Explorer Program cadence

# Astrophysics Division FY24 Budget Decisions

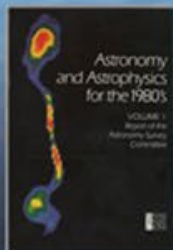
- Expectation that FY24 budget stays at enacted FY23 budget levels
- Adjustments to APD budget includes reductions in large, extended-operations missions
  - Chandra
  - Hubble
  - Mini Senior Review under consideration for ~mid 2024
- Protecting Missions in Development, Future Missions & International Partnerships
  - Ongoing commitment to delivery of Roman on cost and schedule
  - Ongoing Explorer missions in development
  - International partnerships:
    - LISA transitions to management by Explorers office following ESA adoption
    - ATHENA investments are reduced pending ESA reformulation and change in US contributions
  - Technology investments for Habitable Worlds Observatory

# Astrophysics

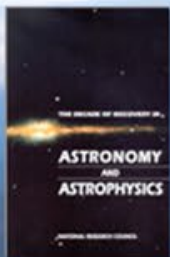
## Decadal Survey Missions



**1972**  
Decadal Survey  
*Hubble*



**1982**  
Decadal Survey  
*Chandra*



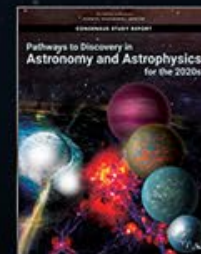
**1991**  
Decadal Survey  
*Spitzer*



**2001**  
Decadal Survey  
*Webb*



**2010**  
Decadal Survey  
*Roman*



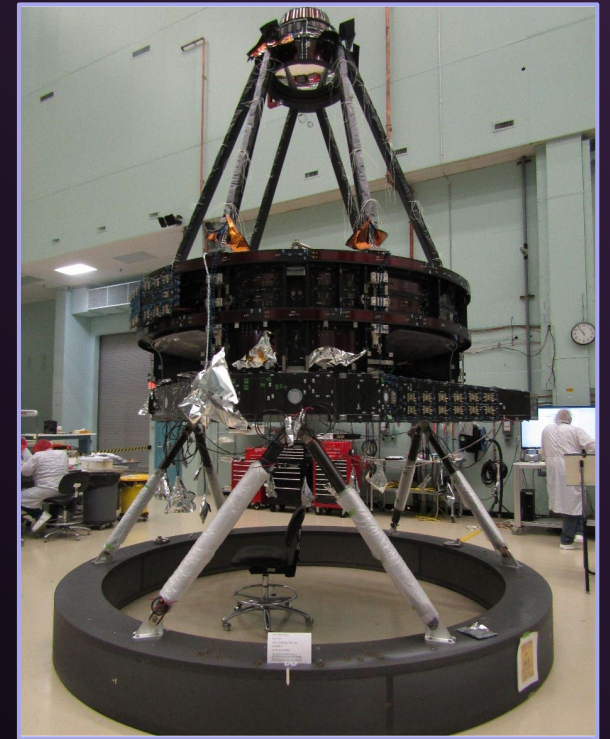
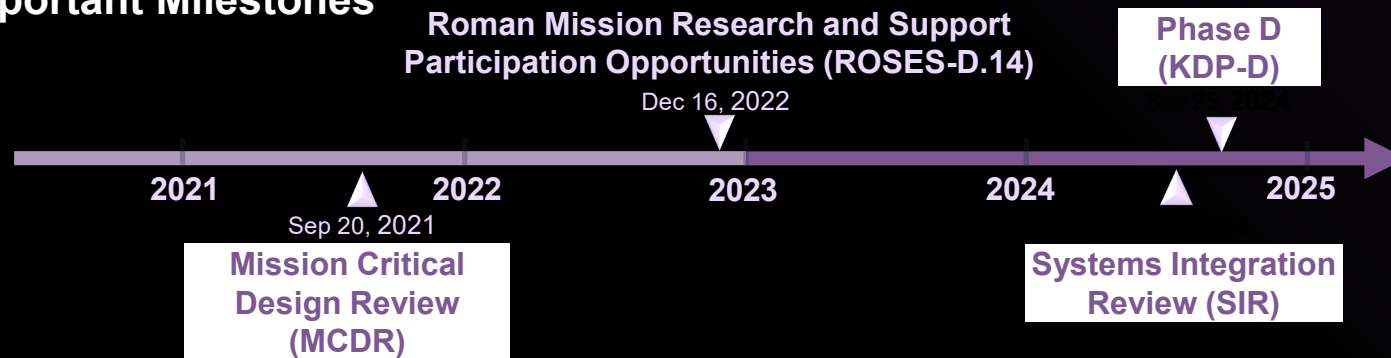
**2021**  
Decadal Survey

# Nancy Grace Roman Telescope

## Astrophysics' next flagship mission

- The Forward Optical Assembly (FOA) is complete, and the Integrated Optical Assembly (IOA) integration is underway at L3 Harris.
- Northrop Grumman completed the Instrument Carrier (IC) structure assembly and delivered to NASA's GSFC on Sep 19.
- The project team has completed assembly of the Wide Field Instrument and began environmental testing at Ball's largest thermal vacuum facility (aka. the Titan chamber).

### Important Milestones



Completed Forward Optical Assembly at L3H



Roman's Instrument Carrier delivered to GSFC

# Astrophysics Explorers Program

Selected before 2011



Gehrels  
Swift



NuSTAR

4 AOs per decade

ANNOUNCEMENT OF OPPORTUNITY  
EXPLORER 2011

Announcement of Opportunity  
Astrophysics Explorers Program  
2014 Small Explorer (SMEX)

Announcement of Opportunity  
Astrophysics Explorers Program  
2016 Medium Explorer (MIDEX)

Announcement of Opportunity  
Astrophysics Explorers Program  
2019 Small Explorer (SMEX)

Announcement of Opportunity  
Astrophysics Explorers Program  
2021 Medium Explorer (MIDEX)

DRAFT Announcement of Opportunity  
Astrophysics Explorers Program  
2023 Astrophysics Probe Explorer (APEX)

Announcement of Opportunity  
Astrophysics Explorers Program  
2025 Small Explorer (SMEX)

Downselect expected Jan-Mar 2024

PROBE 2023  
Proposals due 11/16/23

SMEX 2025

MIDEX 2011

SMEX 2014

MIDEX 2016


SMEX 2019

MIDEX 2021

Small and Mid-Size Missions



TESS



IXPE



SPHEREx



COSI

STAR-X  
UVEX

Missions of Opportunity



NICER



GUSTO



ARIEL

LEAP  
MoonBEAM

Directed 2013



Euclid

Directed 2017



XRISM

# Balloon Launches

- The balloon engineering test flight was successfully flown on Aug. 19 for ~5 hours.
  - Payload included a range of engineering, student and science areas.
- The GRAPE (Gamma-Ray Polarimetry Experiment) balloon payload was successfully flown on Aug. 27 for ~5 hours.
  - Additional payload included:
    - ComPair (Compton Pair Telescope) prototype astrophysics gamma-ray telescope
    - IRCSP (Infrared Channeled Spectro-Polarimeter) Earth observation payload
- The High-Altitude Student Platform (HASP) balloon mission was successfully flown on Sept. 7 for ~13 hours.
  - Payload included six student experiments.



The GRAPE (McConnell/Univ. New Hampshire) astrophysics balloon after launch in Albuquerque, NM

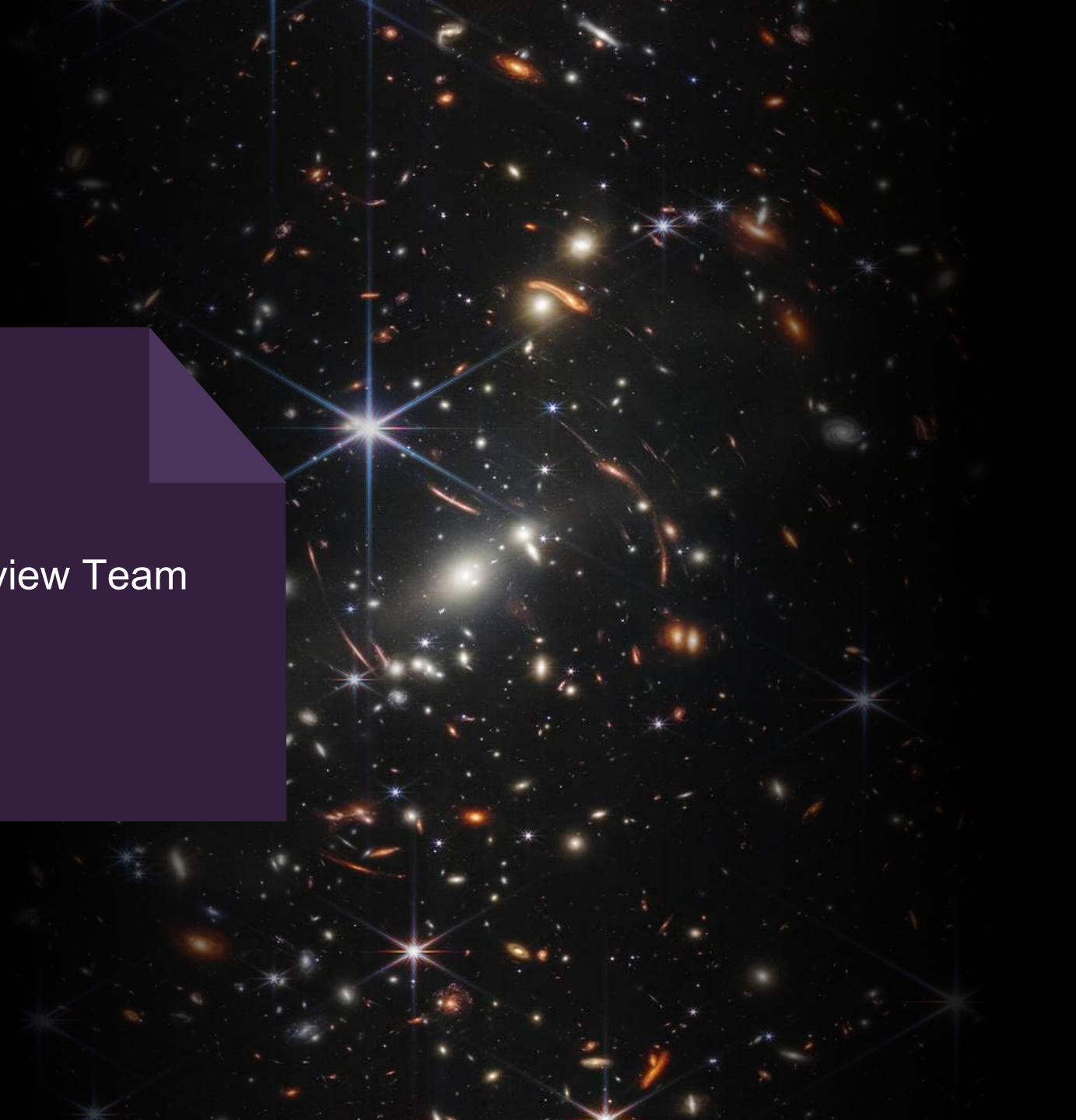
# Pioneers and CubeSats

- Five Pioneers projects are currently underway four selected from Pioneers-2020
  - **PUEO** – Long Duration Balloon to detect the highest energy neutrinos, PI Abigail Viergg, U. of Chicago
  - **Pandora** – Smallsat, Optical and IR characterization of exoplanet host stars, PI Elisa Quintana, GSFC
  - **Aspera** – Smallsat, UV mapping of IGM via OVI line imaging, PI Carlos Vargas, U. of Arizona
  - **StarBurst** – Smallsat GRB ASM, detecting NS/NS mergers along with LIGO, PI Daniel Kocevski, MSFCAdditional election from Pioneers-2021.
  - **TIGERISS** – ISS payload, measuring ultra-heavy (r-process) CR, PI Brian Rauch, Washington U.
- Although there are highly meritorious possible selections from Pioneers-2022, selections are being deferred pending clarification of the FY24 and FY25 budgets and after soliciting under ROSES-2020, ROSES-2021, and ROSES-2022. There will not be a solicitation under ROSES-2023, there is expected to be a solicitation under ROSES-2024.
- Four CubeSat projects are currently underway: BlackCat, BurstCube, SPARCS, Sprite and one Demonstration project: CANDLE (Demonstration)
- One CubeSat mission is in operation: CUTE

# GOMAP HWO Update

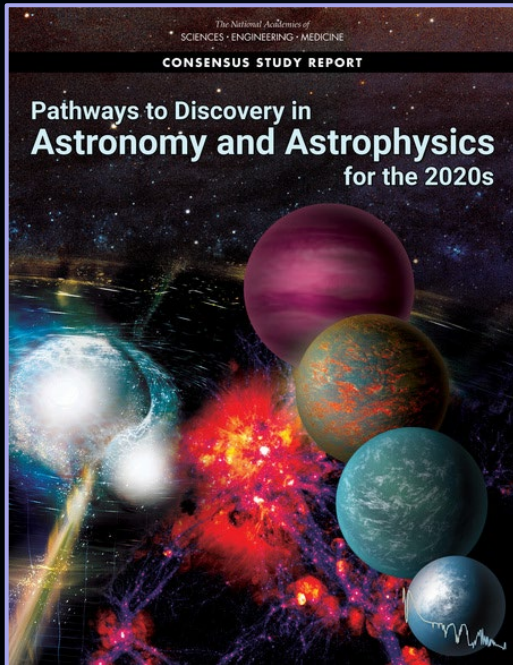
**START:** Science, Technology, Architecture Review Team

**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

Roadmap Science Traceability Matrix (STM)

## Additional Activities:

Mentoring

Super START: Science Analysis

Precursor Science

# The HWO START Selection Process

## START Co-chair required expertise:

- Leading diverse/inclusive teams
- Leading community-facing initiatives
- Demonstrated knowledge of mission studies
- Experience in HWO-related science/engineering
- Diversity of intellectual expertise and of demographic backgrounds.

## SELECTED CO-CHAIRS



**Courtney Dressing**

University of California, Berkeley



**John O'Meara**

W. M. Keck Observatory

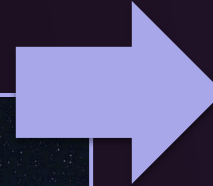
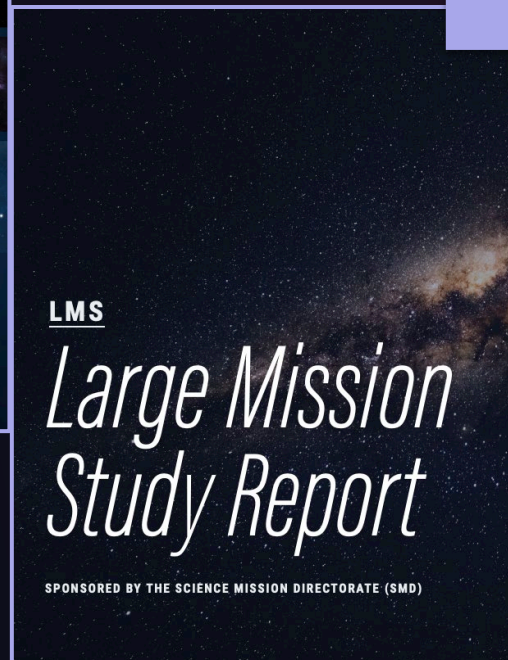
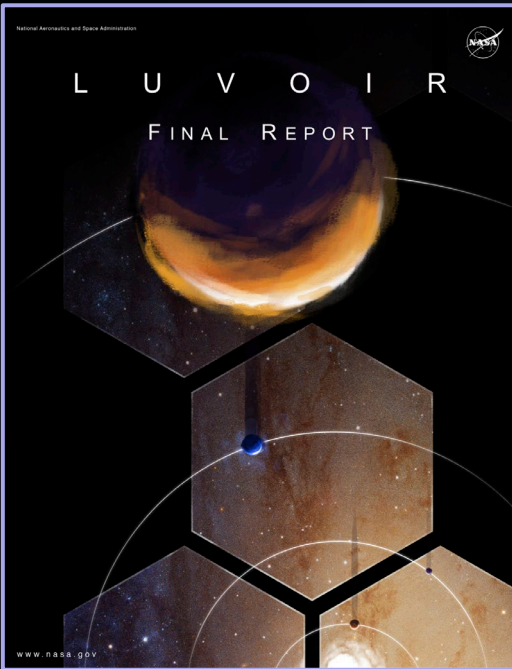
## START Member required expertise:

- Demonstrated commitment to fostering diverse and inclusive teams
- Commitment to community-facing activities
- Capability to conduct analyses outside team meetings
- Capable to serve as a mentor
- Expertise in HWO-related science/engineering/technology
- Achieve “team balance” with diverse institutions and knowledge base
- Self-identified diversity and input to diversify the START was considered



*Link to selection  
announcement*

# The Technical Assessment Group (TAG): Involve the Community



**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

# The HWO TAG

## 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 Mennesson**  
Co-Chair Scientist

## The TAG Selection Process:

TAG Co-chair required expertise:

- Leading diverse/inclusive teams
- Leading community-facing initiatives
- Demonstrated knowledge of mission studies
- Experience in HWO-related science/engineering
- Intellectual & demographic diversity

TAG Member expertise:

- Demonstrated commitment to fostering diverse and inclusive teams
- Commitment to community-facing activities
- Capability to conduct analyses outside team meetings
- Capable to serve as a mentor
- Expertise in HWO-related science/engineering/technology
- Intellectual & demographic diversity

# HWO Next Steps



- Oct. 31-Nov. 2, 2023: HWO START & TAG Kick-Off - first in-person meeting in Washington DC.
  - Public link to attend this meeting virtually via QR code
  - Meeting number: 2763 836 0009
  - Password: nressHD23!

## 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

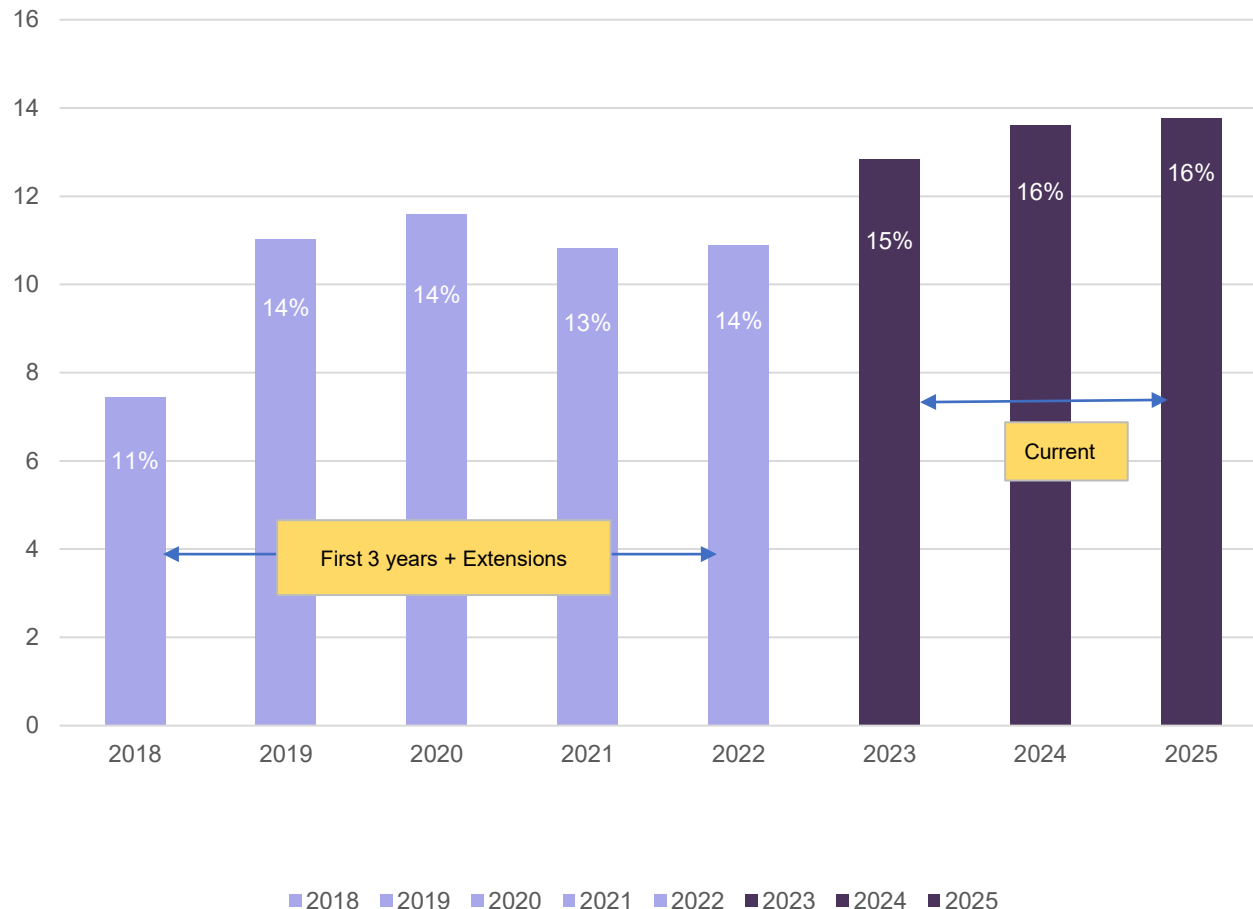
- Concept Maturity Level 8
- Technology Readiness Level > 6

# Technology Funding



# Technology Funding

**ISFM Work Packages Funding (\$M) Since Inception**  
(% of ISFM funding compared with competed technologies, goal is less than 25%)



## 10 Current ISFMs: 2023-2025

Center	Title	Astro2020
GSFC	Next Generation X-ray Optics: High Resolution, Light Weight, and Low Cost	PROBES, GO
GSFC	Advanced X-Ray Microcalorimeters	PROBES, GO
GSFC	Exoplanet Spectroscopy Technologies Work Package	HWO
GSFC	An Astrophysics Augmentation to the Sellers Exoplanets Environments Collaboration (SEEC)	HWO
GSFC	General Coordinates Network	TDAMM
MSFC	MSFC Relativistic Astrophysics - Multi-messenger Astrophysics Community Tools and Support	TDAMM
MSFC	MSFC Advanced X-Ray Optics: Formulation to Flight	PROBES, GO
MSFC	UV/Optical to Far-Infrared Mirror & Telescope Technology Development	HWO
ARC	NASA Ames Laboratory Astrophysics Directed Work Package (LADWP) Round 2 ISFM	HWO, WEBB
ARC	Multi-Star Wavefront Control: Continued development and maturation for Roman CGI and Astro2020 flagship	HWO



## 2022:

**Michael Bottom**, U. Hawaii (KID arrays for far-IR astronomy)  
**Briana Indahl**, U. Colorado (UV imaging and spectroscopy)  
**Jordan Wheeler**, NIST/Boulder (Large format sensors for IR astronomy)

## 2021:

**Brandon Chalifoux**, U. Arizona (X-ray telescope mirrors)  
**Jake Connors**, NIST (TES for far-IR astronomy)  
**Sona Hosseini**, JPL (Miniature UV spatial spectrometer)  
**Christopher Mendillo**, U. Mass Lowell (Exoplanet balloons)  
**Jonathan Pober**, Brown U. (Neutral hydrogen cosmology)  
**Paul Szypryt**, U. Colorado (TES for near-IR astronomy)

## 2020:

**Casey T. DeRoo**, U. of Iowa, (High energy spectroscopy)  
**Keri Hoadley**, U. of Iowa, (Ultraviolet grating spectroscopy)  
**Dmitry Vorobiev**, U. of Colorado (Multi-object spectrograph)

## 2019:

Not Solicited

## 2018:

**Regina Caputo**, NASA GSFC (cosmic rays/gamma-ray)  
**Sarah Heine**, MIT (optics and gratings for polarimeters)  
**Gregory Mace**, UT Austin (optics and spectroscopy)

## 2017:

**Manel Errando**, Washington University, St. Louis  
**Adam McCaughan**, NIST/Boulder  
**Varun Verma**, NIST/Boulder

## 2016:

**Abigail Vieregg**, University of Chicago  
**Omid Noroozian**, NRAO

## 2015:

**Erika Hamden**, California Institute of Technology  
**Daniel Cunnane**, NASA Jet Propulsion Lab  
**Rebecca Schindhelm**, Ball Aerospace

## 2014:

**John Conklin**, University of Florida  
**Brian Fleming**, University of Colorado  
**Tyler Groff**, Princeton University

## 2013:

Not solicited

## 2012:

**Cullen Blake**, University of Pennsylvania  
**Kevin France**, University of Colorado

## 2011:

**Judd Bowman**, Arizona State University  
**Michael McElwain**, NASA GSFC  
**Randall McEntaffer**, University of Iowa

# Astrophysics Division ISFM Programs

Name	Center	Item
W. Zhang	GSFC	Next Generation X-ray Optics: High Resolution, Light Weight, and Low Cost
J. Racusin	GSFC	General Coordinates Network
M. McElwain	GSFC	Exoplanet Spectroscopy Technologies
S. Smith	GSFC	Advanced X-Ray Microcalorimeters
E. Quintana	GSFC	An Astrophysics Augmentation to the Sellers Exoplanets Environments Collaboration
C. Wilson-Hodge	MSFC	Relativistic Astrophysics - Multi-messenger Astrophysics Community Tools and Support
J. Gaskin	MSFC	MSFC Advanced X-Ray Optics: Formulation to Flight
P. Stahl	MSFC	UV/Optical to Far-Infrared Mirror & Telescope Technology Development
R. Belikov	ARC	Multi-Star Wavefront Control: Continued development and maturation for Roman CGI and Astro2020 flagship
E. Sciamma-O'Brien	ARC	NASA Ames Laboratory Astrophysics

# LGBTQ+ Update



*From June APAC Recommendations: “The APAC requests an update from an LGBTQ Special Emphasis Project Manager at Headquarters, Goddard Space Flight Center, or Jet Propulsion Lab at the Fall 2023 meeting on APD IDEA efforts specifically for the LGBTQIA+ community.”*

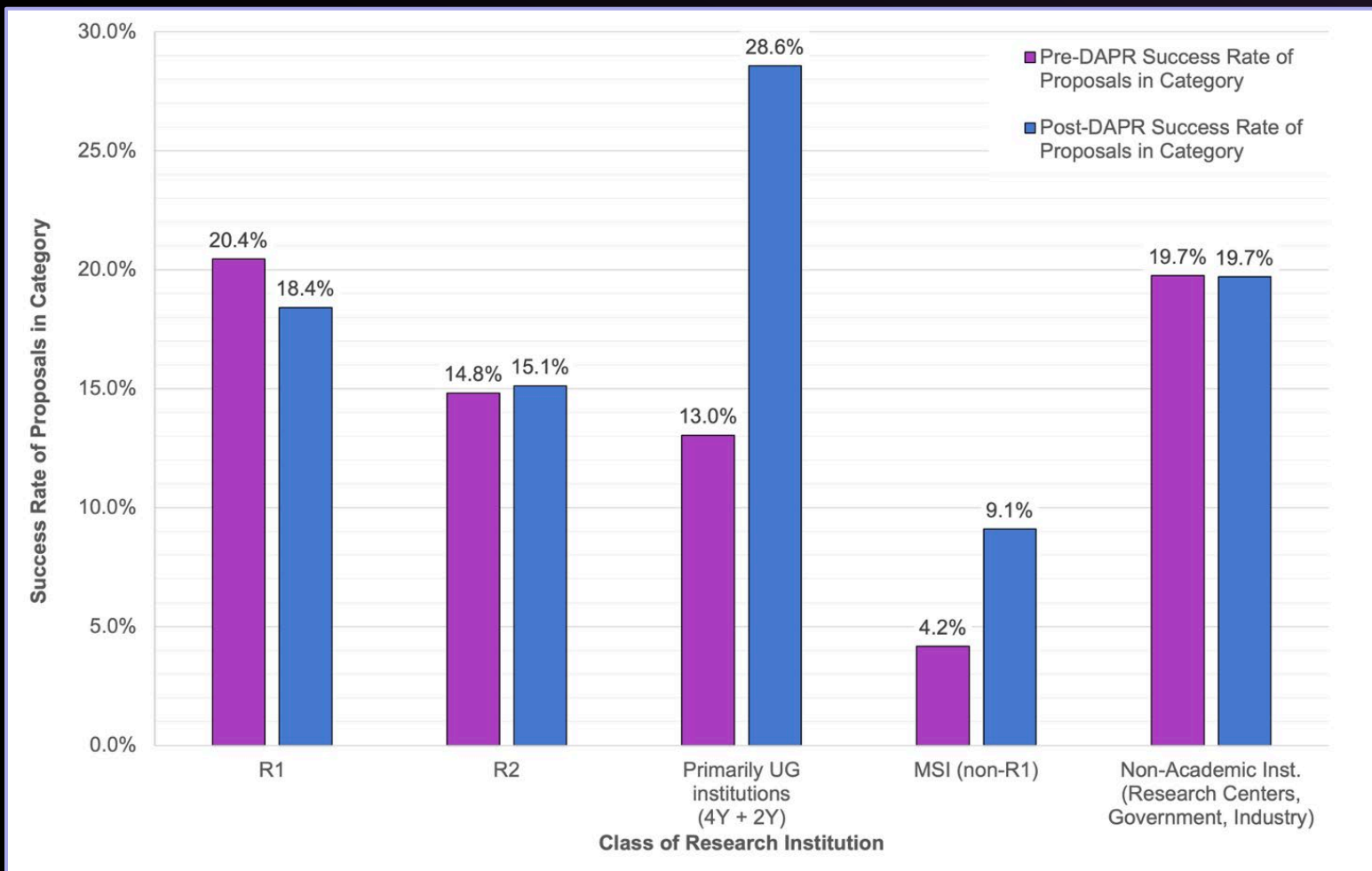
- At NASA Headquarters, LGBTIQ+ specific support initiatives have not yet been established, similarly for other historically excluded communities (e.g AANHPI or African American). However, there are several SMD-wide opportunities aimed at the creation of a safe, inclusive, and thriving working environment.
- Throughout the NASA Centers, there are several groups focused on career advancement as well as supporting different members of the NASA workforce community.
- We intend to serve all historically excluded groups with our initiatives, and when there are group specific challenges, we will address them.

**We welcome input and suggestions from APAC regarding the needs or the lack of support of specific groups at HQ or other NASA centers.**

# IDEA Update



# New Data on Impact of Dual-Anonymous Peer Review (DAPR)



- The data comes from the ADAP, ATP, and XRP.
- Overall, selection rates pre- and post-DAPR are basically the same.
- Most of the differences shown may not be significant but the factor of two changes in selection rates for Primarily UG and non-R1 MSIs look to be.
- These changes are precisely one of the expected benefits of DAPR.



# On-going & Planned IDEA Initiatives in APD

- Inclusion Plans in ROSES-22:
  - Piloting continues - APRA, LISA, SAT, TCAN, Roman, Precursor Science – lots of lessons being learned
  - IP assessment criteria are not part of evaluation criteria but if IP is inadequate, funding released only after IPs are judged to be adequate
- ROSES-23 has new standardized language and various programs across SMD will continue to pilot this effort (ATP, APRA, maybe SAT)
  - SMD plans another community workshop in late 2023 early 2024
  - Lessons learned and Inclusivity Best Practices Workshop being held with community members (UIUC and JPL-326 so far)
  - ROSES-23 APD panel mechanics/evaluations has changed to adequately respond to the community's feedback received after the six ROSES-22 solicitations.

# On-going & Planned IDEA Initiatives in APD

## Continued

- [Statement of Principles by APD](#) developed and shared across NASA Astrophysics ecosystem
- Regular attendance at National Society of Black Physicists (NSBP) and Society for Advancement of Chicanos and Native Americans in Science (SACNAS) meetings
- Attendance to the 2024 Emerging Research Network/AAAS meeting to engage with HBCUs administrators/faculty about current and new opportunities
- Special sessions will be held at next AGU and AAS meetings to discuss Inclusion best practices and lessons learned
- Other previous APD pioneering efforts:
  - [Code of Conduct for review panels](#) developed by APD, now adopted SMD-wide!
  - Changes in language to Senior Review (SR) aligned with NASA's core value of Inclusion – our changes to SR adopted SMD-wide!
  - Changes to AO language



Statement of Principles



Code of Conduct



SMD Inclusion Plan Resource Page

# Community Engagement

## Astrophysics Division Efforts Past and On-Going

- We must ensure that people from all over our nation are aware and engaged
- NASA Astrophysics (APD) launched a virtual and in person (when possible) “road tour” to visit with historically excluded communities.
  - The first of these events was with universities and other NASA stakeholders in Puerto Rico on March 7<sup>th</sup>
  - Follow-up visit by APD technical officers expected in fall 2023 to build community engagement
  - Continuing engagement by APD technical officers and leadership expected in spring 2024 to encourage more proposals to APD programs from Puerto Rico
- Multiple Astrophysics team members are actively engaged at the Science Mission Directorate level in IDEA working groups including sub-group focused on Community Engagement and Inclusion.

# APAC Recommendations



# APAC Recommendations from June 2023

Recommendation	Response
The APAC recommends that information on the length of (or lack of) proprietary time requested in JWST proposals (and other mission proposals as appropriate) be kept confidential from the TAC; this includes the default exclusive time. The STScl, HST, and JWST Users Committees should be made aware of this recommendation and if adopted, this change should be widely circulated.	The STScl has HST and JWST User Committees (STUC, JSTUC) as their advisory bodies for community input related to STScl practices and procedures. Scientists are free to contact STUC and JSTUC members with their concerns and suggestions. This APAC recommendation text was shared with the JSTUC at their last meeting (18-19 Sept).
The APAC approves the TDAMM Science Interest Group and the Starshade Science Analysis Group.	<p>We appreciate the consideration of the APAC in approving the TDAMM Science group, which <a href="#">has now been formed</a>. The SIG leadership is considering slinter sessions at upcoming national conferences, and are also considering the implications of the cross-PAG nature of this SIG.</p> <p>The <a href="#">Starshade SAG 24</a> has begun accepting applications for membership.</p>

# APAC Recommendations from June 2023

Recommendation	Response
The APAC recommends APD to develop a mitigation plan for the aging fleet on TDAMM capabilities and to prepare a long-term strategy to prioritize TDAMM within the budget profile, including cross-agency and international partnerships as well as prioritization within R+A.	For the past year, the Astrophysics Division through the Physics of the Cosmos Program has been studying the TDAMM activities of the NASA fleet. The report that will be produced from this study and the pilot program that has begun in parallel with LIGO's O4 science run will help NASA develop strategies to operate more efficiently and better support the community. This strategizing applies to both operating TDAMM missions and to those under development by NASA or by international partners, which both complement existing aging facilities and add new TDAMM capabilities to the fleet. TDAMM investigations are supported financially in both the R&A technology development programs (competed and directed) and through international partnerships. New TDAMM missions are under consideration in the current Phase A Explorer slate. We also note gratefully the activities of NASA-sponsored community groups analyzing science and infrastructure issues that are important to the future of TDAMM science and will be presented to this group to obtain advice on their findings.
The APAC recommends APD study the impact of increasing the FINNEST proposal selection rates to be more in line with other ROSES proposals.	The NASA Astrophysics Division funding allocation for the FINESST program has steadily increased from \$1.4M in FY20 to \$2.7M in FY23. As a result, the selection rates have steadily increased from 4% in FY19 to 12-15% over the last four years. Future changes to the FINESST program have been discussed at an R&A Offsite meeting on Oct 13 and the outcome of the discussions will be presented at the next APAC meeting

# APAC Recommendations from June 2023

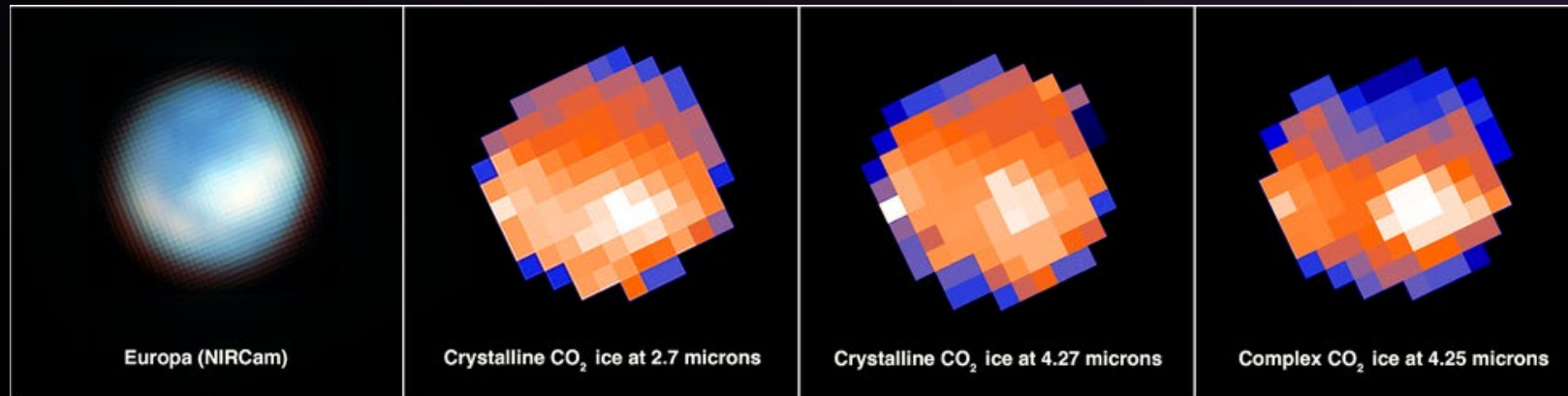
Recommendation	Response
The APAC recommends that APD undertake an investigation of the ethics, current and potential use cases, and best practices of artificial intelligence relevant to APD activities and opportunities.	The Astrophysics Division is not currently staffed to undertake the effort recommended. The ethical use of AI is a Science Mission Directorate concern, and the directorate is working the topic as part of its Open Science initiative including taking into account <a href="#">NASA's Scientific and Research Integrity Guidelines</a> .
The APAC agrees with the Swift Senior Review suggestion to employ an IDEA consultant to promote inclusivity, equity, and accessibility in Explorer missions, and recommends that APD accelerate the plan to provide professional IDEA support to the entire APD portfolio.	IDEA has been factored into HQ solicitations and proposal evaluations. There was no credible plan for how a single IDEA consultant would remedy the issues raised during the senior review.
The APAC applauds APD for emphasizing mentoring for early career researchers in the Habitable Worlds Observatory (HWO) Technology Assessment Group (TAG) solicitation. APD recommends that funding is allocated so that the mentees can fully participate in TAG activities.	We are currently planning to do this, though the amount will depend on the outcome of the budget process.
The APAC recommends a thorough presentation on the current status of key HWO technologies be given to the Science, Technology, Architecture Review Team (START) and TAG to prepare the teams, and that the APAC receives a similar review at a future meeting.	Recommend that the APAC requests this from the TAG at a future meeting. Now that the TAG has been formed, they can do this assessment.



THANK YOU



# Webb Finds Carbon Source on Surface of Europa



*Credits: Science Credit: Geronimo Villanueva (NASA/GSFC), Samantha Trumbo (Cornell Univ.), NASA, ESA, CSA.  
Image Processing Credit: Geronimo Villanueva (NASA/GSFC), Alyssa Pagan (STScI)*

- Astronomers using data from JWST have identified carbon dioxide in a specific region on the icy surface of Europa.
- Analysis indicates that this carbon likely originated in the subsurface ocean and was not delivered by meteorites or other external sources. Moreover, it was deposited on a geologically recent timescale.
- This discovery has important implications for the potential habitability of Europa's ocean.

# START MEMBERSHIP

Name	Institution
Charlie Atkinson (ex-officio)	Northrop Grumman
Giada Arney	GSFC
Natasha Batalha	Ames
Eric Burns	LSU
Jessie Christiansen	NExScI
Courtney Dressing ( <b>co-chair</b> )	UC Berkeley
Matthew East (ex-officio)	L3Harris
Kevin France	CU-Boulder
Scott Gaudi	Ohio State University
Renyu Hu	JPL
Alina Kiessling	JPL
Janice Lee	STScI
Bruce Macintosh	UCO
Eric Mamajek (ex-officio)	ExEP

Name	Institution
Alison Nordt (ex-officio)	Lockheed Martin
John O'Meara ( <b>co-chair</b> )	W. M. Keck Observatory
Jim Oschmann	retired
Rachel Osten	STScI
Chris Packham	UTSA
Lynnae Quick	GSFC
Swara Ravindranath (ex-officio)	COR
Jason Rhodes	JPL
Jane Rigby	GSFC
Ty Robinson	U of A
Dmitry Savransky	Cornell University
Evan Scannapieco	ASU
Evgenya Shkolnik	ASU
Erik Wilkinson (ex-officio)	Ball Aerospace

# TAG MEMBERSHIP

Name	Institution
Ruslan Belikov	ARC
Matthew Bolcar	GSFC
Jason Derleth (ex-officio)	COR
Lee Feinberg (Eng. Co-Chair)	GSFC
Kevin Fogarty	ARC
Jessica Gaskin	MSFC
Thomas Greene	ARC
Brian Kern	JPL
Marie Levine	JPL
Alice Liu	GSFC
Sangeeta Malhotra	GSFC
Dimitri Mawet	JPL
Michael McElwain	GSFC
Bertrand Mennesson (Sci. Co-Chair)	JPL

Name	Institution
Michael Menzel	GSFC
Patrick Morrissey	JPL
Niki Parenteau	ARC
David Redding	JPL
Aki Roberge (Sci. Co-Chair)	GSFC
Stuart Shaklan	JPL
Nick Siegler (ex-officio)	ExEP
Breann Sitarski	GSFC
Philip Stahl	MSFC
Christopher Stark	GSFC
Julie van Campen	GSFC
Feng Zhao	JPL
John Ziemer (Eng. Co-Chair)	JPL
TBA member - deferred start date	JPL