

National Aeronautics and
Space Administration



EXPLORE SOLAR SYSTEM & BEYOND

NASA Astrophysics Update

Astrophysics Advisory Committee | September 26, 2022

Mark Clampin

Director, Astrophysics Division

Science Mission Directorate

 [@NASAUniverse](https://twitter.com/NASAUniverse) [@NASAEoplanets](https://twitter.com/NASAEoplanets) [@NASAWebb](https://twitter.com/NASAWebb)

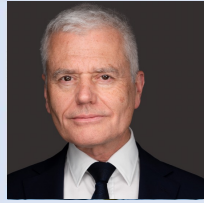


The NASA Team



NASA Astrophysics Division

Division Director

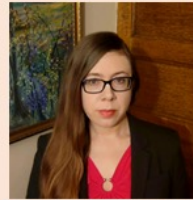


Mark Clampin
Astrophysics Division
Director



Sandra Cauffman
Astrophysics Division
Deputy Director

Program Executives



Rachele Cocks
Dep COSI, Dep
Ariel/CASE CubeSats



E. Lucien Cox
SOFIA, GUSTO,
XRISM, ExEP



Julie Crooke
GOMAP



Ed Griego
Roman, CGI



Shahid Habib
PCOS/COR, ARIEL,
Athena, Euclid, LISA,
UltraSat



Janet Letchworth
Operating Missions,
Decadal



Mark Sistilli
Explorers Program
SPHEREx, COSI
Balloons

Cross Cutting



Eric Smith
Chief Scientist
Webb
Precursor Sci



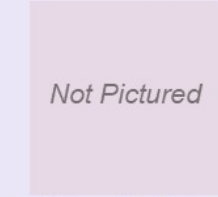
Joe Smith
Assoc Dir for Flight
ASM Program Manager



Mario Perez
Chief Technologist
SAT, RTF, ISFM, Swift

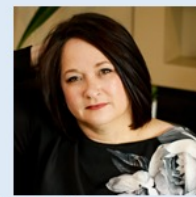


Omid Noroozian
Deputy Chief
Technologist



Not Pictured
Lisa Wainio
Information Manager,
Public Affairs Liaison

Administrative Support



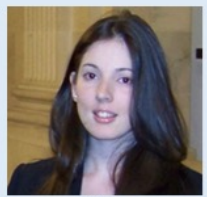
Jennifer Baker
Administrative
Assistant



Ingrid Farrell
Program Support
Specialist



Kelly Johnson
Administrative
Assistant



Sara Schwartzman
Program Support
Specialist

Program Scientists



Manuel Bautista



Dominic Benford
Roman, CGI, APRA
Lead



Terri Brandt
COSI Dep
APRA Dep
Pioneers Dep
Precursor Sci



Valerie Connaughton
APRA (High Energy)
XRISM, UltraSat, XMM,
TDAMM, PCOS
Program



Antonino Cucchiara



Michael Garcia
APRA (UV/Visible),
SmallSats/Pioneers
Hubble



Thomas Hams
APRA (CR, Fund.
Phys.)
Rockets/Balloons
GUSTO, LISA



Hashima Hasan
Education/Comms,
Citizen Science, Archives,
Advisory Committees,
NuSTAR, Keck



Douglas Hudgins
ExEP Program
ADAP Lead
TESS Dep, ARIEL



Stefan Immler
Astrophysics
Research Program
Mgr, Chandra, ART-
XC



Hannah Jang-Condell
XRP, TESS
ExEP, Explorers



Patricia Knezek
Explorers Program
Astrophysics Probe
SOFIA, Hubble Fellows



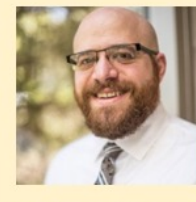
William Latter
APRA (Lab Astro)
SPHEREx, Fermi



Sangeeta Malhotra
Roman/CGI Dep
ATP/TCAN Dep



Roopesh Ojha
Data Lead, NICER,
HEC, AI/ML



Joshua Pepper
Deputy TESS, Deputy
ADAP, Deputy ExEP



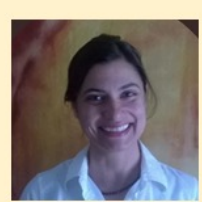
Kartik Sheth
Inclusion Plans
Technical assessments



Linda Sparke
2021 MIDEX/MO,
Archives, COSI



Eric Tollestrup
APRA (IR/Submm)
Euclid, IXPE, COR
Program



Sanaz Vahidinia
ATP/TCAN Lead

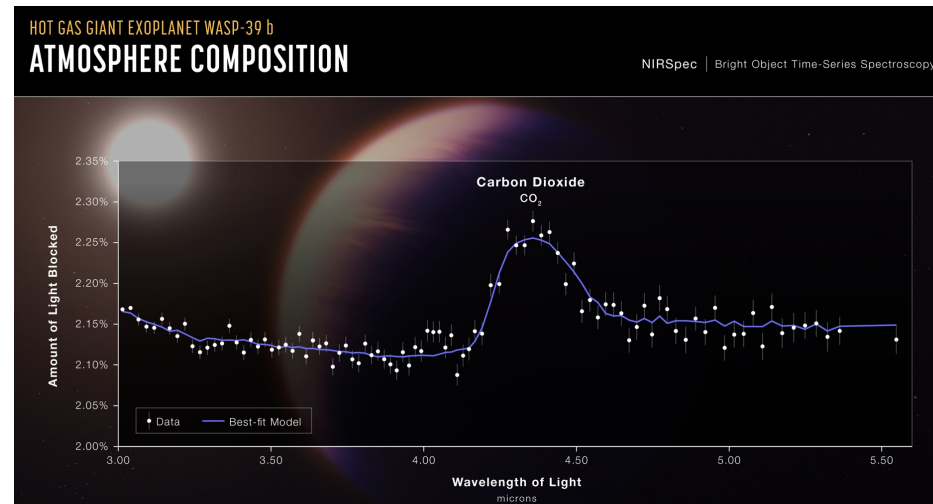
Launch of Webb Telescope



- Webb telescope commences Cycle 1 science programs
 - On-orbit performance exceeds mission requirements
 - Conducting Lesson-Learned exercise



**Webb Deep Field
SMACS 0723**

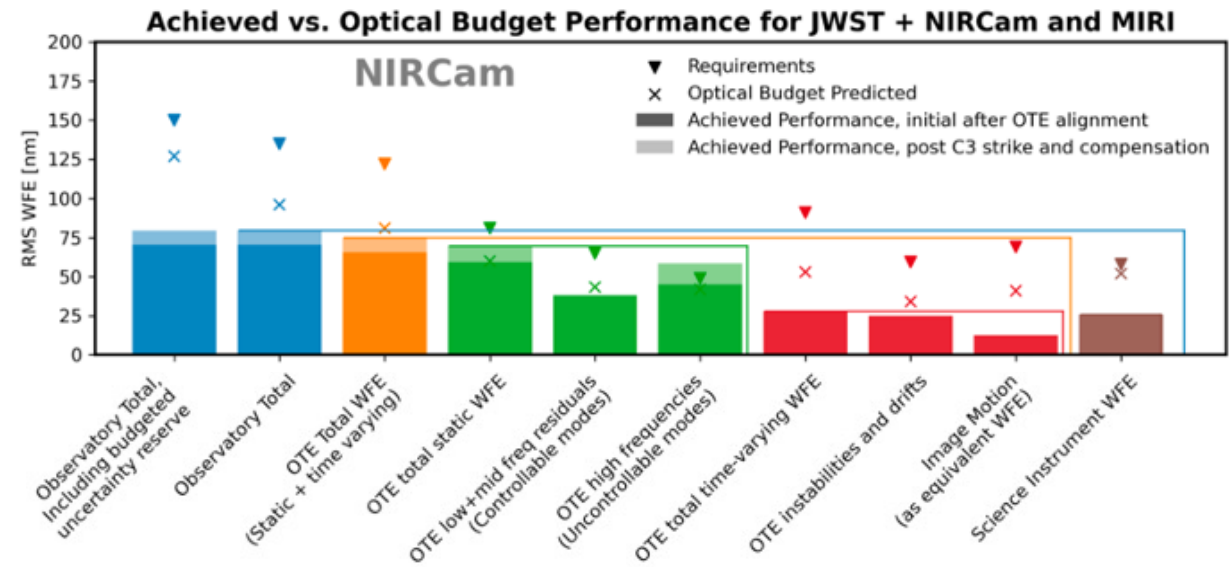


Early release science:

- ~100 papers submitted for publication within first 10 weeks of Cycle 1.
- Open Science success story

Webb Telescope: On-Orbit Performance

- Webb telescope exceeds on-orbit performance requirements
 - Optical performance



- Sensitivity

Wavelength (μm)	2	3.5
Requirement (nJy)	11.4	13.8
ETC prediction (nJy)	10	14.1
Actual (nJy)	7.3	8.8

Table 3: NIRCams limiting point source sensitivity. What is quoted is the faintest flux density that can be detected at SNR=10 in 10,000s. Values are for wide-band filters. Smaller numbers are better.

... and the world knows it

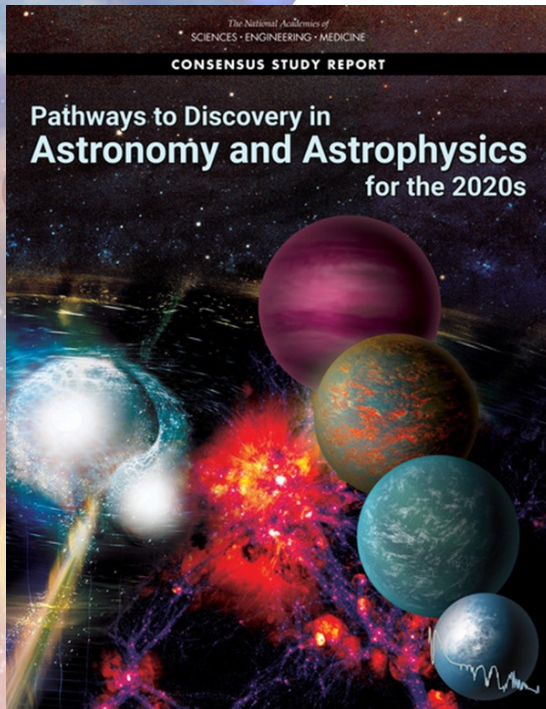
See presentation by Eric Smith on Day 2 of this meeting



Decadal Survey Recommendations

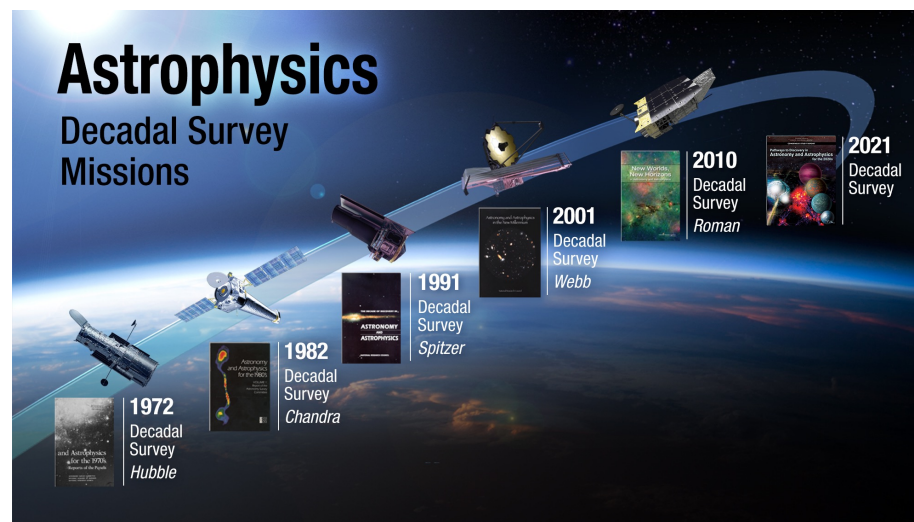


Astro2020 Decadal Survey



Key Mission Recommendations

- Great Observatories Mission and Technology Maturation Program (GOMAP)
 - IR/O/UV (first half of decade), far-IR and X- ray (second half of decade) missions
- Near- Infrared/Optical/Ultraviolet 6-m telescope with high-contrast imaging capability
 - Image and characterize earth-like exoplanets w/compelling astrophysics program
 - Formulate in second half of decade
- Space-based time-domain and multi-messenger counterparts program (*TDAMM*)
- Astrophysics Probe Mission
- End SOFIA operations by 2023



Astro2020 Acronyms

- GOMAP* – Great Observatory technology Maturation Program
- TDAMM* – Time Domain Astronomy and Multi Messenger counterparts
- IR/O/UV – Infrared/Optical/Ultraviolet

Importance of Inclusion, Diversity, Equity, Accessibility (IDEA)

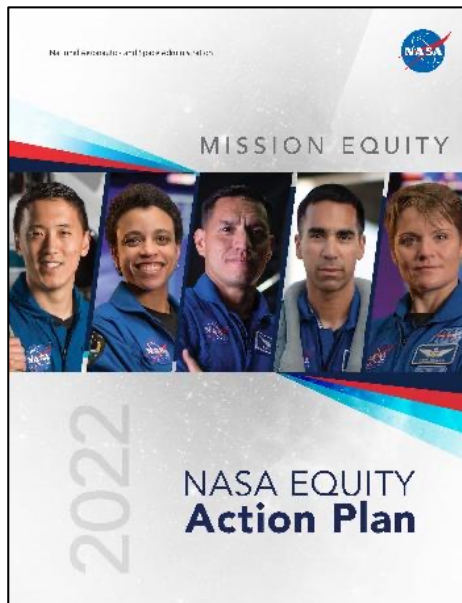


“The panel [on the State of the Profession and Societal Impacts] asserts that fundamentally, the pursuit of science, and scientific excellence, is inseparable from the humans who animate it.”

- *Pathways to Discovery in Astronomy and Astrophysics for the 2020s*

NASA is committed to integrating inclusion, diversity, equity, and accessibility (IDEA) into all activities (missions, programs, reviews, internal matters, etc.)

Inclusion & Diversity of Thought



Strategic Objective 4.1: Attract and develop a talented and diverse workforce. Cultivate a diverse, motivated, and highly qualified workforce through modernizing our Human Capital processes and systems, increasing our workforce agility and flexibilities, and implementing a robust Inclusion, Diversity, Equity, and Accessibility (IDEA) approach to ensure systematic and sustainable fairness, impartiality, and equity in our business practices.

NASA is continuing its journey towards equity. To this end, NASA has established four foundational focus areas:

- Increase Integration and Utilization of Contractors and Businesses from Underserved Communities to Expand Equity in NASA's Procurement Process
- Enhance Grants and Cooperative Agreements to Advance Opportunities, Access, and Representation for Underserved Communities
- Leverage Earth Science and Socioeconomic Data to Help Mitigate Environmental Challenges in Underserved Communities
- Advance External Civil Rights Compliance and Expand Access to Limited English Proficient (LEP) Populations within Underserved Communities

Building Excellent NASA Teams Requires Inclusion & Diversity



* Responsive to an Astro2020 Decadal Survey recommendation

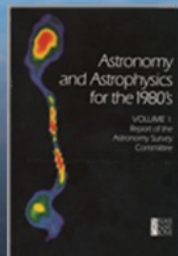
- IDEA is infused throughout everything we do. It is not a standalone or separate activity.
- Astrophysics has pioneered and piloted IDEA activities that are now adopted across SMD:
 1. Inclusion Plans adopted in ROSES elements across all SMD divisions *
 2. Code of Conduct now adopted for panel reviews across all SMD divisions
 3. [Dual Anonymous Peer Reviews](#) adopted across all SMD divisions
 4. Inclusion Criteria in Senior Reviews of Missions adopted across all SMD divisions *
 5. Increasing diversity of reviewers for all panels expected across all SMD divisions
- Other SMD level initiatives:
 7. Collection, evaluation, and publication of demographics of ROSES proposers and awardees *
 8. Regularly report data on proposal submissions and success rates *
 9. SMD Bridge Program funded for better engagement with MSIs *
 10. [National Academies study](#) of barriers to inclusion in mission leadership
 11. [National Academies study](#) of demographic data required to assess the health of the community *
 12. Regular participation at meetings such as SACNAS and NSBP
 13. PI Launchpad to incubate next generation of diverse leaders for missions *
 14. IDEA criteria being added to Announcements of Opportunity *

Astrophysics

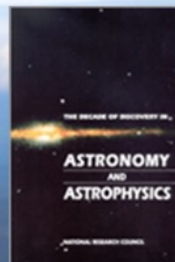
Decadal Survey Missions



1972
Decadal
Survey
Hubble



1982
Decadal
Survey
Chandra



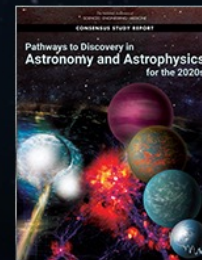
1991
Decadal
Survey
Spitzer



2001
Decadal
Survey
Webb



2010
Decadal
Survey
Roman



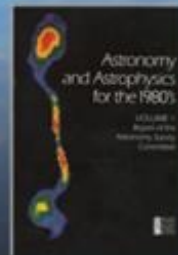
2021
Decadal
Survey

Astrophysics

Decadal Survey Missions



1972
Decadal
Survey
Hubble



1982
Decadal
Survey
Chandra



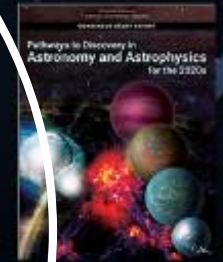
1991
Decadal
Survey
Spitzer



2001
Decadal
Survey
Webb



2010
Decadal
Survey
Roman



2021
Decadal
Survey

Waves of Great Observatories

- Wave 1: Hubble, Compton, Chandra, Spitzer
- Wave 2: Webb, Roman
- Wave 3: Astro2020 Future Great Observatories

Preliminary Response to Astro2020

Recommendation	Preliminary response
Great Observatories Maturation pg. 7-11	<ul style="list-style-type: none"> NASA conducted a Large Mission Study of lessons learned from the development of large space missions in the past NASA is initiating a Great Observatories Mission and Technology Maturation Program (GOMAP) to implement lessons learned, best practices, and Astro2020 recommendations leading to the development of Future Great Observatories
IROUV Great Observatory pg. 7-17	<ul style="list-style-type: none"> NASA will undertake a three-stage GOMAP leading to a future decision to begin formulation of NASA's next great observatory; the first stage has already been initiated
Time Domain Program pg. 7-19	<ul style="list-style-type: none"> NASA is committed to realizing the science of the recommended Time Domain Astronomy and Multi Messenger Astrophysics (TDAMM) program A TDAMM workshop is planned for August 2022
Astrophysics Probes pg. 7-20	<ul style="list-style-type: none"> NASA issued a second community announcement on May 19, 2022, with details regarding a planned AO for an Astrophysics Probe mission An Astrophysics Probe AO is planned for July 2023
Roman Sci Prog Review pg. 7-35	<ul style="list-style-type: none"> NASA asked the CAA to conduct a non-advocate review of the Roman Space Telescope's science program; the CAA working group held its first meeting in February 2022
LISA Success pg. 7-37 (not in Table S.1)	<ul style="list-style-type: none"> NASA is a strong partner to ESA in the development and operation of LISA



Time Domain & Multi-Messenger Initiative

Actions are being developed to address Time Domain Astrophysics and Multi Messenger (TDAMM) recommendations of the 2020 Decadal Survey

- Operating NASA missions continue to make significant contributions to TDAMM and NASA expects future missions to pursue this science:
 - NASA is making investments in infrastructure – transient alerts, data archives, communications, software – which are essential to maximize scientific return; funding for these investments is included in the FY23 budget request.
 - Responding to transient astrophysical phenomena involves multiple ground- and space-based assets and NASA is studying efficiencies in how to deploy its fleet
 - Astro 2020 urges TDAMM be addressed across agencies and NASA is standing up interagency and international working groups to address this coordination
- TDAMM will be an initiative with extensive interagency and international cooperation, shaped using broad community input
 - Prioritizing the science NASA should address. Community workshop this 22-24 August 2022: <https://pcos.gsfc.nasa.gov/TDAMM/>
 - Partner-led TDAMM missions with NASA contributions
 - NASA missions with international partner contributions



Astrophysics Probe

NASA is drafting an AO for a PI-led Astrophysics Probe

A Community Announcement laying out the primary parameters of the upcoming Astrophysics Probe AO was released on Jan 11, 2022

A second Community Announcement with two updates was released on May 19, 2022

- The target date for the final Probe AO was revised to July 2023
- Due to European Space Agency (ESA) consideration of whether the Athena mission will be substantially replanned, it was no longer practical to require proposed X-ray probes to “complement ESA’s Athena Observatory.” This requirement was therefore removed. Astrophysics will now accept proposals for:
 - A far-infrared imaging and/or spectroscopy mission
 - An X-ray probe

Community announcements and FAQ at <https://explorers.larc.nasa.gov/2023APPROBE/>

Release of draft AO:	August 2022 (target)
Release of final AO:	July 2023 (target)
Proposals due:	NET 90 days after AO release



Future Great Observatories

- Large observatories are a critical component of NASA's astrophysics portfolio
 - The Decadal Survey recommends a compelling, feasible, timely portfolio of future great observatories that is part of a balanced Astrophysics program
- Today NASA's priority is ensuring mission success for Webb and Roman
 - Webb passed its Post Launch Assessment review (PLAR) on July 15 and is now in its 5-year prime mission conducting normal science operations
 - Roman is progressing well in Mission Phase C "Final Design and Fabrication" and is on track for a mid-2027 launch
- Now is not the time to start a Future Great Observatory; now is the time to prepare
 - The report from the House CJS Appropriation Subcommittee markup of the NASA FY23 budget request states, "The Committee supports NASA's emphasis on developing the Roman Space Telescope before investing heavily in the recommendations of the next Decadal."
- NASA will take a deliberate, multi-stage planning and strategy approach to the next large observatory mission
 - NASA is formulating a Great Observatories Mission and Technology Maturation Program (GOMAP)



Flowchart – GOMAP Stages

Stage 1

Preparation: Assemble initial IROUV team, and focus on enabling science and technology

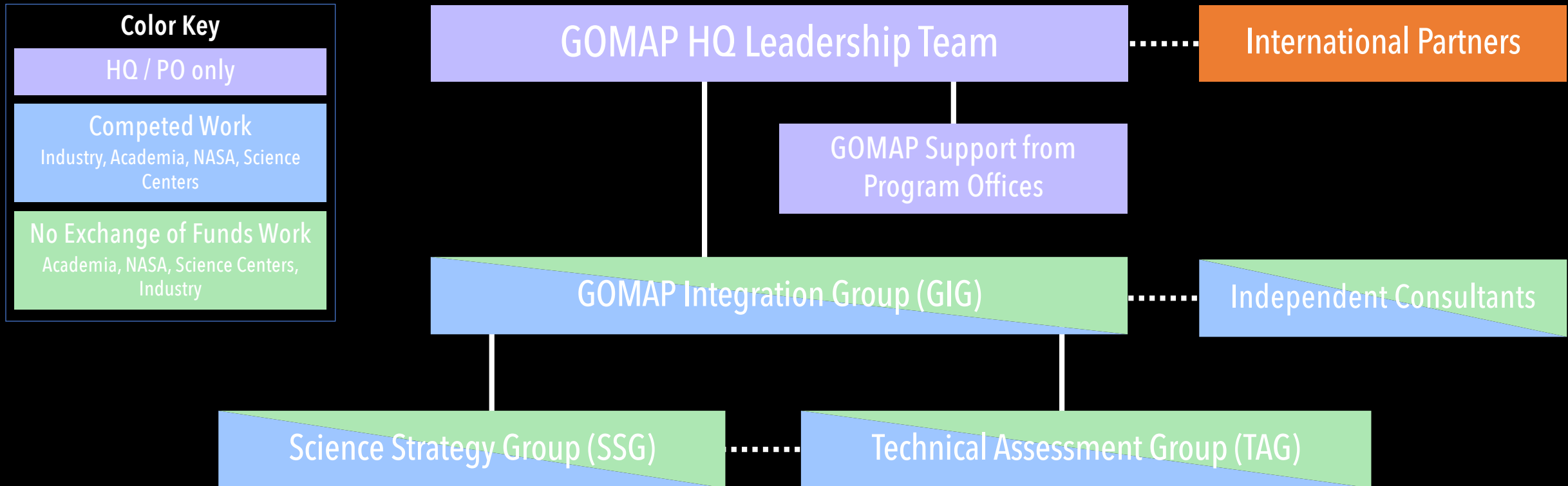
Stage 2

Prepare for IROUV Pre-Phase A: Begin the Decadal Survey recommended “Great Observatories Maturation Program”; conduct Analysis of Alternatives and science / technology / architecture trades

Stage 3

Evolved Pre-Phase A for IROUV: Execute & assess all trades relative to science; Mature technologies & mission design; Pre-formulation and decision to start the next Great Observatory

Team Structure for Stages 1 & 2





GOMAP Next Steps

Organize and populate GOMAP Teams

- Develop and approve GOMAP Code of Conduct
- Approve Terms of Reference for all teams
- Send out open calls for self-nominations

Reach out to academia and industry for ideas

- Issue an RFI for mission, architecture, technology, process, ideas to inform strategy teams

Leverage PAGs

- Establish appropriate SAGs for informing GOMAP strategy teams

Focus solicitations

- Ensure that future SAT and ISFM calls reflect technology strategies developed by GOMAP strategy teams



Astrophysics Probe

NASA is releasing an AO for a competed, PI-led Astrophysics Probe mission, per the recommendation of the 2020 Decadal Survey

A Community Announcement laying out the primary parameters of the upcoming Astrophysics Probe AO was released on Jan 11, 2022

A second Community Announcement with two updates was released on May 19, 2022

Draft AO was released August 16, 2022

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NASA will now accept proposals for:

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Release of final AO:	July 2023 (target)
Proposals due:	NET 90 days after AO release

Preliminary Response to Astro2020

Recommendation	Preliminary response
<p>SOFIA pg. 5-12</p>	<ul style="list-style-type: none"> On April 28, NASA and DLR (the German Space Agency) jointly announced that they will conclude the SOFIA mission, after a successful eight years of science SOFIA will finish out its scheduled operations for the 2022 fiscal year, followed by an orderly shutdown
<p>APRA Technology Funding pg. 6-4</p>	<ul style="list-style-type: none"> NASA will consider increases as part of its FY24 budget formulation process
<p>SAT Criteria pg. 6-5</p>	<ul style="list-style-type: none"> NASA amended ROSES 2021 on July 8, 2021, to expand the scope of the Strategic Astrophysics Technology (SAT) program element to include technology maturation targeted in strategic areas identified for the competed Probe class missions
<p>Balloon Review pg. 6-8</p>	<ul style="list-style-type: none"> Following a recommendation of the APAC at its Spring 2022 meeting, a Subcommittee has been established
<p>Explorer Cadence pg. 6-9 (not in Table S.1)</p>	<ul style="list-style-type: none"> NASA has maintained a cadence of Astrophysics Explorer AOs every 30 months (4 per decade) since 2011

Preliminary Response to Astro2020

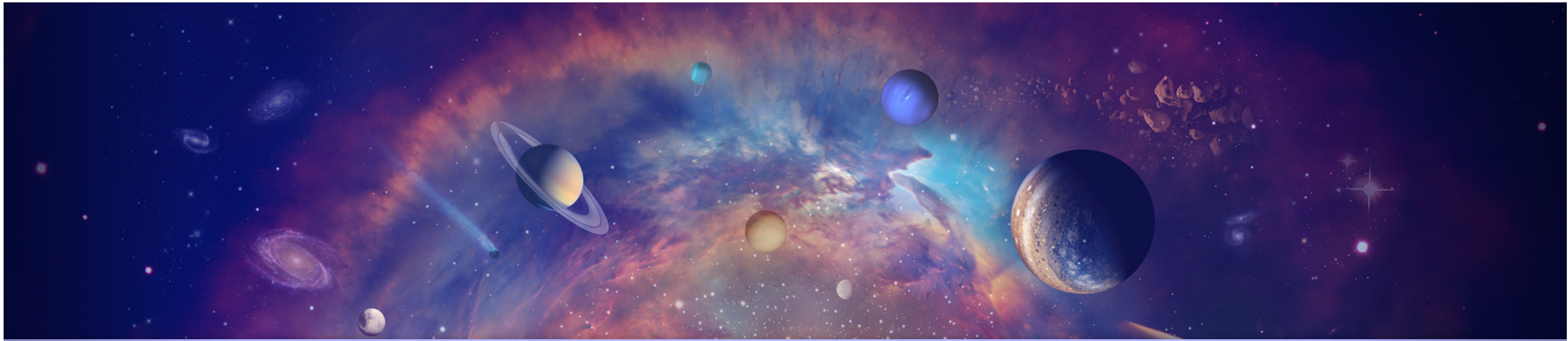
Recommendation	Preliminary response
IDEA Incentives pg. 3-14	<ul style="list-style-type: none"> • Under study by the Astrophysics Division IDEA task force
IDEA Workforce pg. 3-22	<ul style="list-style-type: none"> • NASA has received funding to start a Bridge Program within the Science Mission Directorate in FY22, with \$5M for FY22 and increasing amounts planned for in future years • Partnerships with NASA's Office of STEM Engagement to increase support of HBCUs, TCUs, and other MSIs • Presentation by Padi Boyd at Fall APAC meeting
Traineeship Funding pg. 3-23	<ul style="list-style-type: none"> • Under study by the Astrophysics Division IDEA task force • Astrophysics mission design summer school, to help train new PIs, in 2023
Postdoc Fellowships pg. 3-23	<ul style="list-style-type: none"> • NASA conducted an independent review of the NASA Hubble Fellowship Program in 2021 to assist NASA in increasing the effectiveness of the program and bolstering its excellence, with a focus on diversity, equity, and inclusion of the program. NASA is working on an implementation plan that is responsive to its 32 recommendations
Address Harassment & Discrimination pg. 3-27	<ul style="list-style-type: none"> • A working group has been established including the Science Mission Directorate, Office of Chief Scientist, and Office of General Counsel

Preliminary Response to Astro2020

Recommendation	Preliminary response
Proposal Demographics pg. 3-29	<ul style="list-style-type: none">• NASA is collecting self-reported demographic data through NSPIRES on proposers, co-investigators, awardees, and reviewers• NASA has charged the National Academies with conducting a study that will enumerate the types of data that NASA should be collecting• NASA, NSF, and DOE have engaged with the AAAC to assess the Agencies' current practices in collecting, evaluating, and publicly reporting demographic data
IDEA Evaluation Criterion pg. 3-30	<ul style="list-style-type: none">• NASA's ROSES Inclusion Plan initiative started in 2021• Diversity and inclusion of teams in evaluation of AO proposals starting in 2022
Satellite Interference pg. 3-38	<ul style="list-style-type: none">• Impacts of satellite interference on NASA includes space traffic management risk, orbital debris risk, and interference to NASA operations risk• These risks are managed at the Agency level, and mitigations are developed and implemented by OSMA and OCE• Mitigations include agreements with (some) satellite providers that reduce impacts to NASA
Climate Change Actions pg. 3-42	<ul style="list-style-type: none">• TBD

Preliminary Response to Astro2020

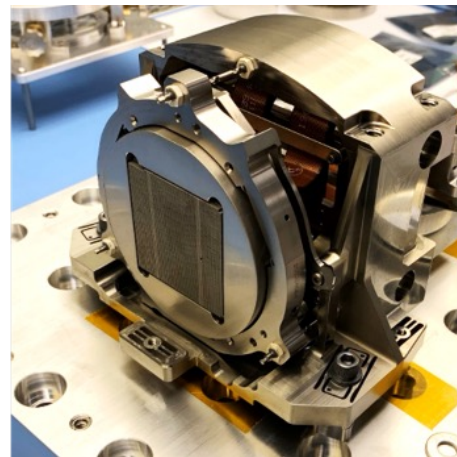
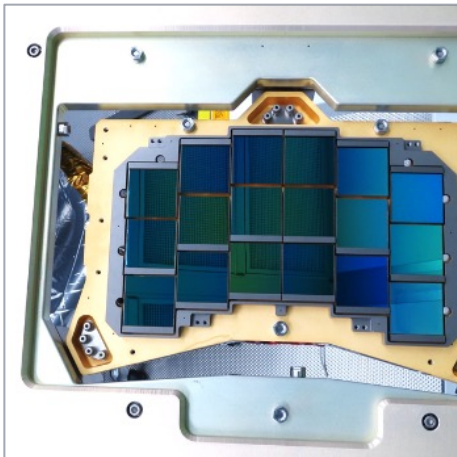
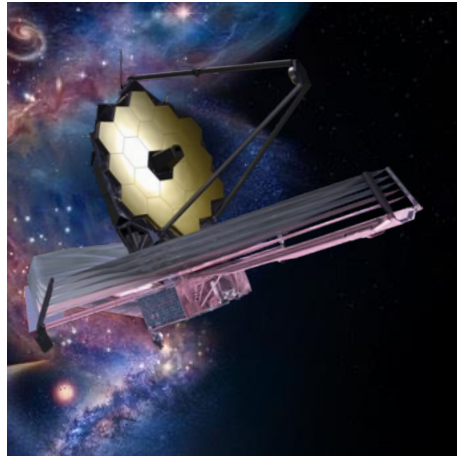
Recommendation	Preliminary response
Proposal Success Rates pg. 4-3	<ul style="list-style-type: none">NASA will continue to release data on proposal success rates, both aggregated and by program element, at every AAS Town Hall and at meetings of the Astrophysics Advisory Committee
Theory Funding pg. 4-10	<ul style="list-style-type: none">Astrophysics Theory Program (ATP) has a 22% selection rate with biannual calls; increasing the budget by 30% would result in a 28% selection rate for biannual calls, but only a 14% selection rate for annual calls; keeping in mind that the Decadal Survey states that a 22% success rate “remains low,” NASA will consider options for restoring an annual cadence for ATP
Archive Coordination pg. 4-20	<ul style="list-style-type: none">NASA, NSF, and DOE have established a cross-agency working group to improve coordination among U.S. archive centersSMD has established an Open Source Science Initiative to improve coordination among NASA science archives
Lab Astrophysics Review pg. 4-28	<ul style="list-style-type: none">NASA and NSF have discussed with the AAAC plans to establish a task force of the AAAC to report on prioritized needs for laboratory astrophysics as well as appropriate funding mechanisms for addressing those priorities



FY23 Budget Update

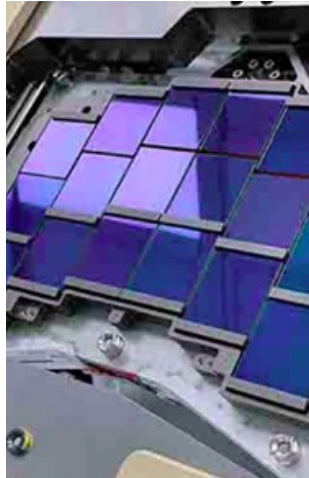


Planned Milestones FY22-23



- ✓ Conduct Senior Review of Operating Missions in FY 2022
- ✓ Initiate Webb Telescope science in FY 2022
- ✓ Conduct sounding rocket campaign in Australia in FY 2022
- Select MDEX missions for competitive Phase A studies in FY 2022
- ✓ Conduct four scientific balloon campaigns in FY 2022 and four campaigns in FY 2023
- Release Astrophysics Probe AO in FY 2023
- Select Webb Cycle 2 science observations in FY 2023
- Begin integration and test of the Roman Space Telescope instruments and telescope in FY 2023
- Initiate precursor science program to advance Astrophysics Decadal Survey priorities in FY 2023
- Participate in launch of JAXA's XRISM mission and ESA's Euclid mission in FY 2023

Astrophysics FY23 Budget Features



Increased funding planned compared to a year ago

- Additional Webb General Observer funding
- Roman adjusted for COVID impacts
- Additional Pioneer selections & increased Pioneers cadence
- Support Great Observatory Precursor Science and Time Domain Astrophysics infrastructure systems for Decadal Survey
- Includes bridge partnerships focused on minority serving institutions and Decadal Survey recommendations for increased inclusion
- SOFIA close out in FY23 per Decadal Survey recommendation

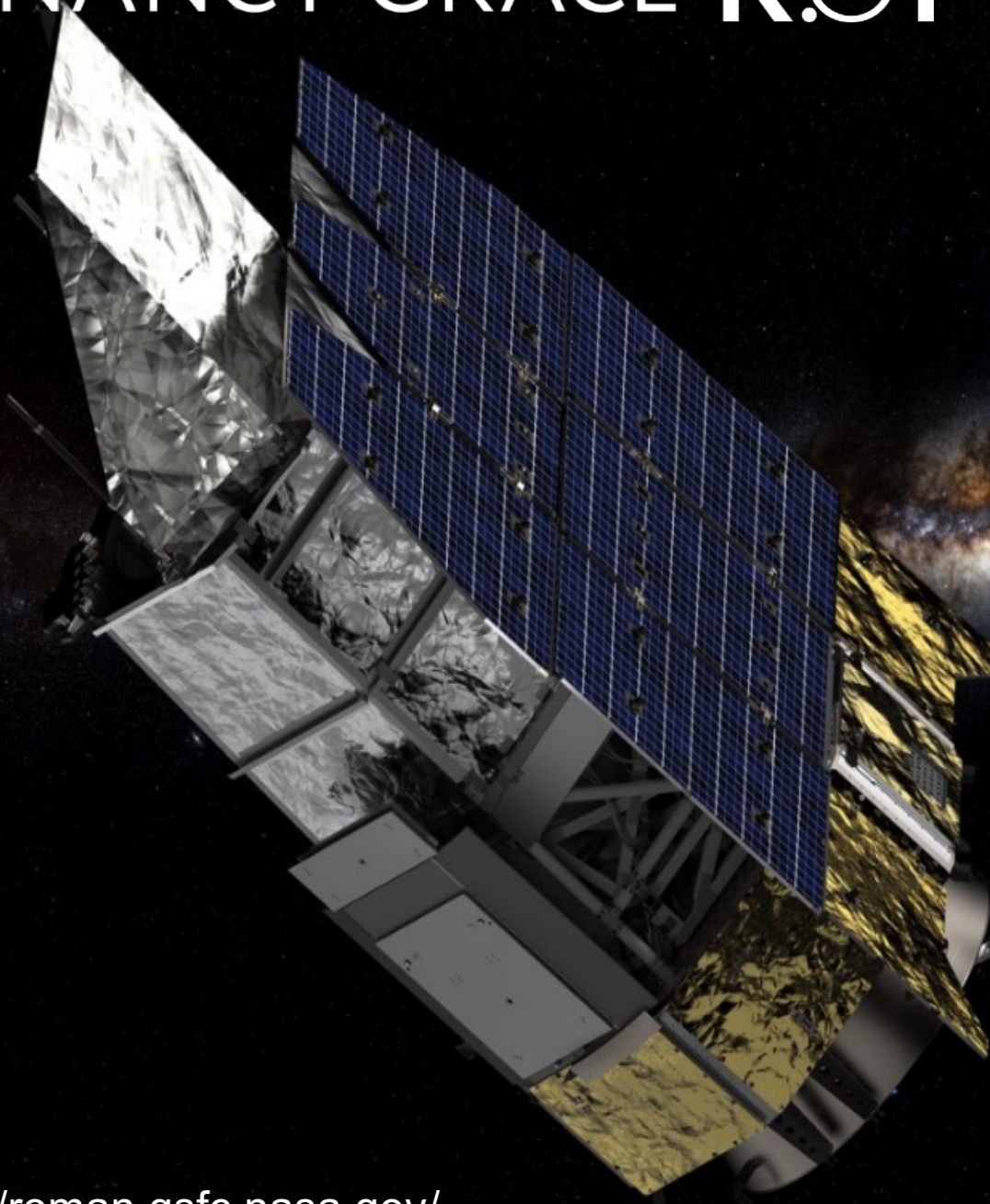
Same funding planned compared to a year ago

- Healthy R&A program
- Development of Astrophysics Explorers GUSTO and SPHEREx
- Development of contributions for JAXA-, ISA-, and ESA-led missions XRISM, ULTRASAT, Euclid, Ariel, Athena, and LISA
- Funded operating missions per Senior Review

Decreased funding planned compared to a year ago

- Extended Phase B for COSI, delayed development for next MIDEX
- Compared to the FY 2022 Budget request, delays a future Astrophysics Probe mission; AO release delayed from January 2023
- Delayed implementation of Decadal Survey recommendations

NANCY GRACE R.ÖMAN SPACE TELESCOPE



All major flight hardware procurements complete;
substantial flight hardware completed
– Heritage Telescope completion expected late 2022.
Transitioning to assembly & test: Coronagraph late
2022; Wide Field Instrument early 2023; Spacecraft
late 2023. Launch Vehicle selection imminent.

NASA launch commitment date remains May 2027.

NASA has asked the CAA to conduct a non-advocate
review of the Roman Space Telescope science
program and observing plan, as per Astro2020.

Opportunities for participation in Roman Space
Telescope research and support are offered in
ROSES-2022

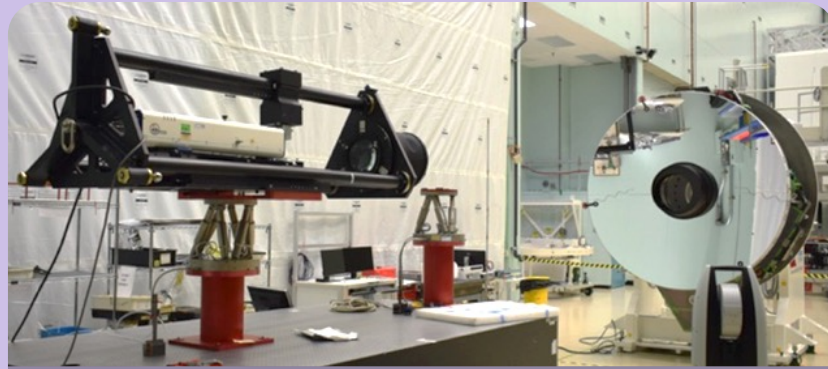
Optical Telescope Assembly Hardware



Tertiary Optical Mirror Assembly



Secondary Mirror Support Tube

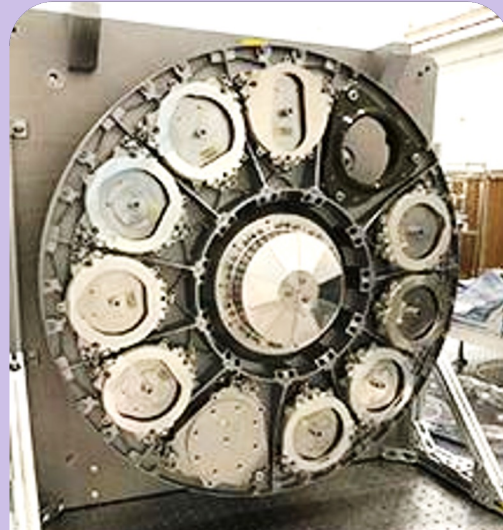


Primary Mirror horizontal optical test



Forward Metering Shell w/thermal control hardware installed

Wide Field Instrument Hardware

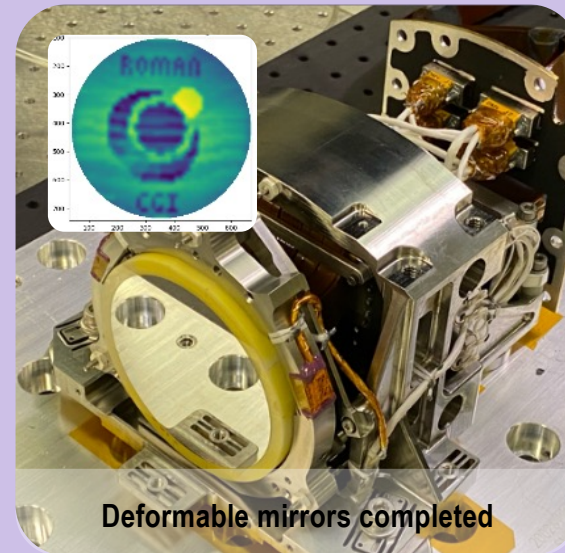


Flight Element Wheel Assembly completed; done thermal vac test

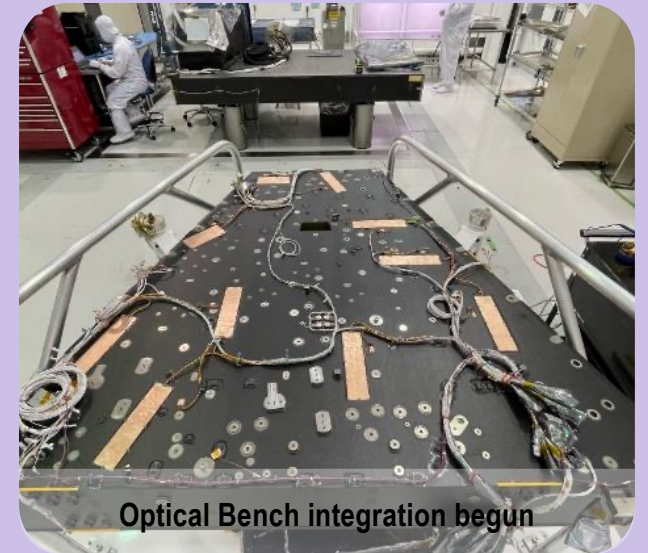


Flight Structure Arrangement Assembly (optical bench, enclosure, etc.) integrated

Coronagraph Instrument Technology Demonstration Hardware



Deformable mirrors completed



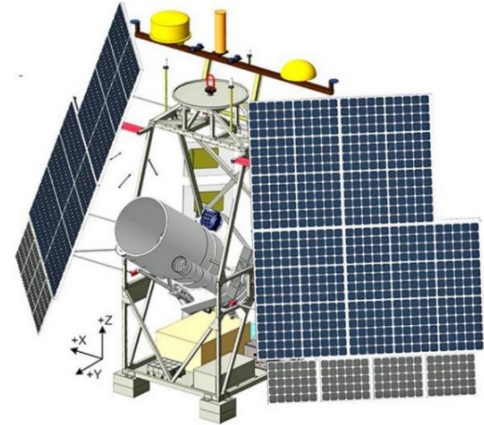
Optical Bench integration begun



SOFIA

- The Decadal Survey recommended NASA end the SOFIA mission after its current mission extension.
 - On April 28, NASA and DLR (the German Space Agency) jointly announced that they will conclude the SOFIA mission, after a successful eight years of science.
 - SOFIA will finish out its scheduled operations for the 2022 fiscal year, followed by an orderly shutdown.
- During FY 2022, SOFIA will carry out a full program of science operations including multiple deployments to the southern hemisphere.
- Proposals for Cycle 10 (FY 2023) were received earlier this year; no selections will be made from the Cycle 10 proposals.
- The SOFIA project has been directed to develop a project closeout plan for FY 2023.
 - The closeout plan will include processing and archiving all SOFIA data at IRSA.
- Discussions have begun regarding disposition of Government property associated with SOFIA.

GUSTO Mission Overview

Science Description			
<p>GUSTO will provide the first complete study of all phases of the stellar life cycle, from the formation of molecular clouds, through star birth and evolution, to the formation of gas clouds and the re-initiation of the cycle. GUSTO provides 500 times the angular and 1,000 times the velocity resolution of previous surveys of the Galaxy in [CII], [OI], and [NII].</p>			
Project Description	Key Information	Payload	Partners
<p>Sub-orbital Balloon-borne 0.9 m Cassegrain telescope launched from Antarctica to study the Milky Way and the Large Magellanic Cloud.</p>	<p>Mission Phase: C Launch Date: 12/2023 Mission Life: 75 days Category: 3 Class: D Streamlined Launch Vehicle: Zero Pressure Balloon</p>	<ul style="list-style-type: none"> • 0.9M Cassegrain telescope • TeraHertz heterodyne array receivers at 1.4, 1.7, and 4.7 THz • Payload provided by University of Arizona (UA) 	<p>Partners:</p> <ul style="list-style-type: none"> • Principle Investigator: Christopher Walker (UA) • Project Management: JHU/APL • Payload: UA • Gondola: JHU/APL • Mission Ops: JHU/APL • Science Ops: UA



GUSTO Update & Path Forward

- GUSTO removed from the 2022/2023 NASA Antarctic Long Duration Balloon (LDB) Campaign due to a launch readiness schedule breach by the GUSTO payload team.
- The GUSTO Project directed to present a delayed launch plan to NASA that includes a credible schedule, test plan, and a minimum budget that would result in a completed observatory fully capable of producing robust science return
- The NASA SMD Astrophysics Division conducted a Continuation/Termination Review on May 19, 2022, to assess the GUSTO Project's replan and request to receive an additional one-year extension to the 2023/2024 NASA Antarctica LDB Campaign

Decision: The GUSTO Project was approved for an extension provided critical launch readiness milestones are met:

1. Complete the GUSTO payload and meet the success criteria for an instrument TVAC Pre-Ship Review in early August 2022;
2. Conduct the instrument TVAC test and pass the instrument TVAC Review based on criteria set by the GUSTO SRB/IRT in August 2022; failure to meet and pass these milestones will result in mission termination.
3. The GUSTO Team will plan to integrate the completed payload and telescope before the planned storage period and will use air shipment to deliver the complete, integrated observatory to Antarctica in 2023.




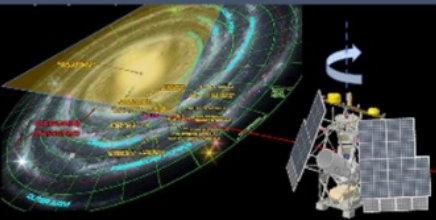
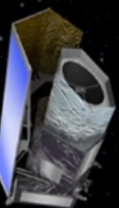
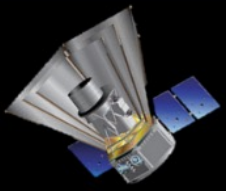
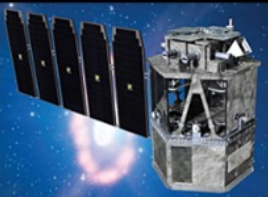
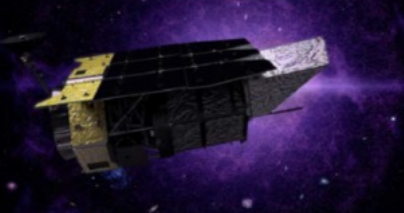


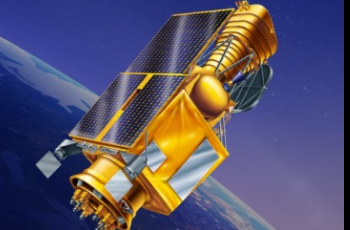
Review of Balloon Program

- Balloon Program Independent Review Subcommittee (BPIRS) of the Astrophysics Advisory Committee (APAC) has been established
- NASA will use the findings from this Review to assess the funding and mission model of the Balloon Program.
- NASA will also use the findings from this Review to:
 - Define an implementation approach and mission model to achieve SMD science goals and astrophysics strategic objectives;
 - Prioritize the activities of the Balloon Program to maximize flight rates and science return;
 - Leverage the capabilities of commercial suborbital platform and system providers; and
 - Issue initial funding guidelines for the Balloon Project and payload development programs including the suborbital investigations elements within the APRA program.
- The Subcommittee will prepare a report that includes findings and recommendations to assist the Astrophysics Division implement a more effective Balloon Program:
 - Prioritized list of balloon technologies/capabilities needed to enable science investigations and technology maturations for future missions;
 - Prioritized list of launch site requirements and what constitutes a healthy campaign cadence and expected number of launches per campaign;
 - For the Astrophysics Research and Analysis Program, a healthy number of balloon investigations and notional funding;
 - Capabilities of commercial suborbital flight providers and efficiency gains to be leveraged; and
 - Ways to reduce barriers to entry, particularly for new PIs and new (to the Balloon Program) organizations, including underrepresented people and organizations.
- Report due in 18 months

Astrophysics Missions in Operations Outcome of Senior Review

<p>Hubble ^{4/90} NASA Strategic Mission</p>  <p>EXTENDED</p> <p>Hubble Space Telescope</p>	<p>Chandra ^{7/99} NASA Strategic Mission</p>  <p>EXTENDED</p> <p>Chandra X-ray Observatory</p>	<p>XMM-Newton ^{12/99} ESA-led Mission</p>  <p>EXTENDED</p> <p>X-ray Multi Mirror - Newton</p>	<p>Gehrels Swift ^{11/04} NASA MIDEX Mission</p>  <p>EXTENDED</p> <p>Neil Gehrels Swift Gamma-ray Burst Explorer</p>	<p>Fermi ^{6/08} NASA Strategic Mission</p>  <p>EXTENDED</p> <p>Fermi Gamma-ray Space Telescope</p>	<p>NuSTAR ^{6/12} NASA SMEX Mission</p>  <p>EXTENDED</p> <p>Nuclear Spectroscopic Telescope Array</p>
<p>SOFIA ^{5/14} NASA Strategic Mission</p>  <p>Ending 2022</p> <p>Stratospheric Observatory for Infrared Astronomy</p>	<p>ISS-NICER ^{6/17} NASA Explorers Miss. of Oppty</p>  <p>EXTENDED</p> <p>Neutron Star Interior Composition Explorer</p>	<p>TESS ^{4/18} NASA MIDEX Mission</p>  <p>EXTENDED</p> <p>Transiting Exoplanet Survey Satellite</p>	<p>IXPE ^{12/21} NASA SMEX Mission</p>  <p>EXTENDED</p> <p>Imaging X-ray Polarimetry Explorer</p>	<p>Webb ^{12/21} NASA Strategic Mission</p>  <p>EXTENDED</p> <p>James Webb Space Telescope</p>	<p>Balloon Program Four Campaigns per Year</p>  <p>Managed by the Astrophysics Division</p>

Astrophysics Missions in Development

<p>XRISM 2023 JAXA-led Mission</p>  <p>NASA is supplying the SXS Detectors, ADRs, and SXTs</p>	<p>GUSTO 2023 NASA Mission</p>  <p>Galactic/ Extragalactic ULDB Spectroscopic Terahertz Observatory</p>	<p>Euclid 2023 ESA-led Mission</p>  <p>NASA is supplying the NISP Sensor Chip System (SCS)</p>	<p>SPHEREx 2025 NASA Mission</p>  <p>Spectro-Photometer for the History of the Universe, Epoch of Reionization, and Ices Explorer</p>	<p>COSI 2025 NASA Mission</p>  <p>Compton Spectrometer and Imager</p>
<p>Roman 2027 NASA Mission</p>  <p>Nancy Grace Roman Space Telescope</p>	<p>MIDEX/MO 2028 NASA Missions</p>  <p>Medium-class Explorer Explorer Mission of Opportunity</p>	<p>ARIEL 2029 ESA-led Mission</p>  <p>NASA is supplying the CASE fine guidance instrument</p>	<p>Ultramat Israeli-led Mission</p>  <p>NASA providing the Launch</p>	

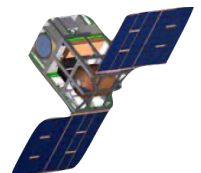
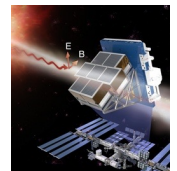
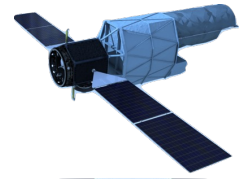
Launch dates are current project working dates through XRISM; Agency Baseline Commitment launch date could be later

Does not include Pioneers or CubeSats

2022 Explorer Step1 Selections

- Midex/MO selections

- **UltraViolet EXplorer (UVEX):** Deep survey of the sky in two bands of ultraviolet light, to provide new insights into galaxy evolution and the lifecycle of stars.
MIDEX Principal investigator: Fiona Harrison (Caltech)
- **Survey and Time-domain Astrophysical Research Explorer (STAR-X):** STAR-X turns rapidly to point wide-field X-ray and UV telescopes at transient cosmic sources.
MIDEX Principal investigator: William Zhang (GSFC)
- **Moon Burst Energetics All-sky Monitor (MoonBEAM):** MoonBEAM sees almost the whole sky at any time, watching for bursts of gamma rays from distant cosmic explosions and providing rapid alerts.
MO Principal investigator: Chiumun Michelle Hui (MSFC).
- **LargE Area burst Polarimeter (LEAP):** Mounted on the ISS, LEAP studies gamma-ray bursts from the energetic jets launched during the formation of a black hole after the explosive death of a massive star, or in the merger of compact objects.
MO Principal investigator: Mark McConnell (University of New Hampshire)



Astrophysics Missions in Development

<p>XRISM 2023 JAXA-led Mission</p> <p>I&T in Japan Guest Sci call open Launch in 2023</p> <p>NASA is supplying the SXS Detectors, ADRs, and SXTs</p>	<p>GUSTO 2023 NASA Mission</p> <p>Deferred from 2022 Held C/T review Replanned for 2023</p> <p>Galactic/ Extragalactic ULDB Spectroscopic Terahertz Observatory</p>	<p>Euclid 2023 ESA-led Mission</p> <p>I&T in Italy Launch in TBD</p> <p>NASA is supplying the NISP Sensor Chip System (SCS)</p>	<p>SPHEREx 2025 NASA Mission</p> <p>CDR in Jan 2022 Managing supply chain issues</p> <p>Photometer for the History of the Universe, Epoch of Reionization, and Ices Explorer</p>	<p>COSI 2025 NASA Mission</p> <p>SRR in Oct 2022 Extended Phase B</p> <p>Compton Spectrometer and Imager</p>
<p>Roman 2027 NASA Mission</p> <p>CDR in Sep 2021 SIR in late 2023</p> <p>Nancy Grace Roman Space Telescope</p>	<p>MIDEX/MO 2028 NASA Missions</p> <p>Selected Step-1 FY22 Extended Phase B</p> <p>Medium-class Explorer Explorer Mission of Opportunity</p>	<p>ARIEL 2029 ESA-led Mission</p> <p>PDR summer 2022 Confirm fall 2022</p> <p>NASA is supplying the CASE fine guidance instrument</p>	<p>Ultrastat Israeli-led Mission</p> <p>Launch TBD</p> <p>NASA providing the Launch</p>	

Launch dates are current project working dates through XRISM; Agency Baseline Commitment launch date could be later

Does not include Pioneers or CubeSats



Pioneers Selections

Aspera: SmallSat mission that will study galaxy evolution.

Phase Implementation (7120.8)

Cost Cap \$20M, LRD ~2025

Pandora: SmallSat that will study 20 stars and their 39 exoplanet in Optical/IR

Phase Implementation (7120.8)

Cost Cap \$20M, LRD ~2025

PUEO: Balloon mission designed to detect signals from ultra-high energy neutrinos

Phase Implementation (7120.8)

Cost Cap \$20M, LRD ~2024 / 2025 (Balloon)

StarBurst: SmallSat that will detect high-energy gamma rays from extreme events

Phase Implementation (7120.8)

Cost Cap \$20M. LRD ~2025

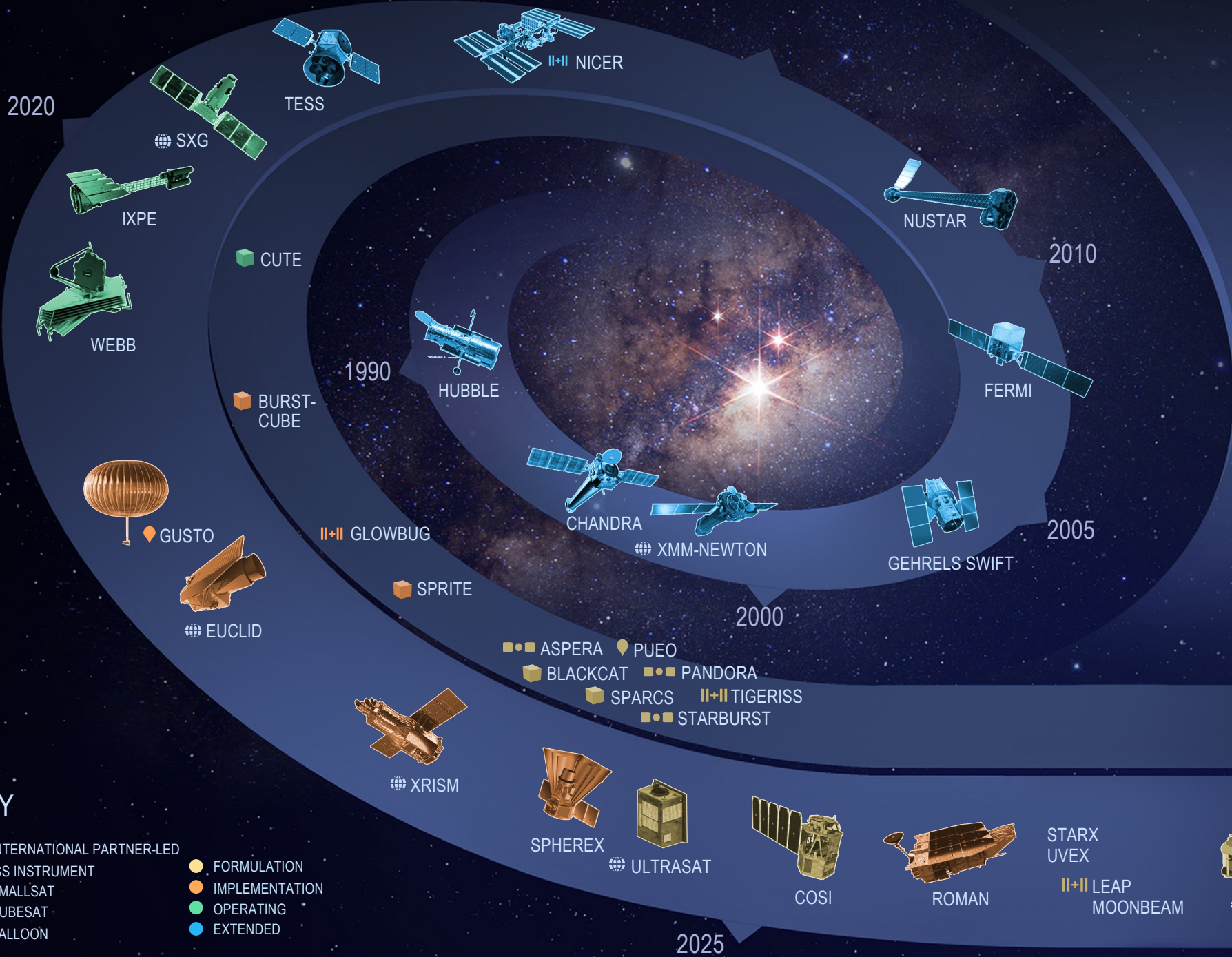
TIGERISS: Space Station Experiment To Probe Origins of Elements

Phase Implementation (7120.8)

Cost Cap \$20M. LRD ~2026



ASTROPHYSICS FLEET



PRE-FORMULATION

- MIDEX/MO
- PROBE ~2030
- ATHENA EARLY 2030s
- ISA MID 2030s ?

VERY SMALL MISSIONS

TRADITIONAL MISSIONS

KEY

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

2025



Partnering with US Agencies

- NSF
 - NNEXPLORE
 - NEID
 - Lab Astro review
 - R&A coordination including Theory
 - Archives coordination
 - TDAMM alert coordination
- DOE
 - Fermi
 - LUSEE-Night (ESSIO)
 - AMS operations (SOMD)
 - AMS archiving (APD & SOMD)
- California Association for Research In Astronomy (CARA)
 - Keck Observatories



Partnering with International Agencies

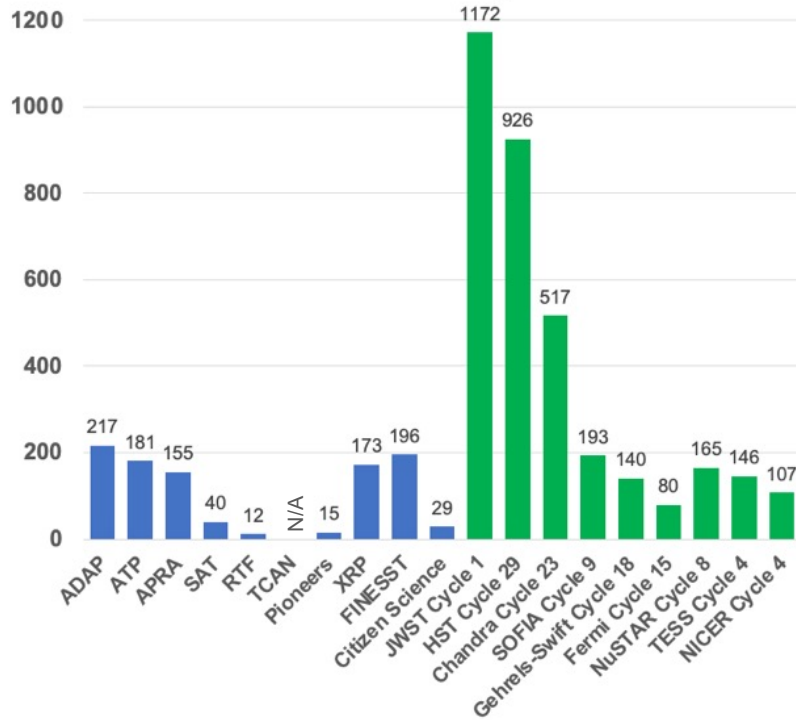
Operational Facilities only

- European Space Agency
 - Hubble, XMM-Newton, Webb
- Japan Aerospace Exploration Agency (JAXA)
 - FERMI
- Canadian Space Agency
 - Webb
- Deutsches Zentrum für Luft und Raumfahrt (DLR)
 - FERMI, SOFIA
- Centre National d'Etudes Spatiales (CNES)
 - FERMI
- Agenzia Spaziale Italiana (ASI)
 - Fermi, NuSTAR, Swift, IXPE
- United Kingdom Space Agency (UKSA)
 - SWIFT
- Space Research Organisation Netherlands (SRON)
 - FERMI

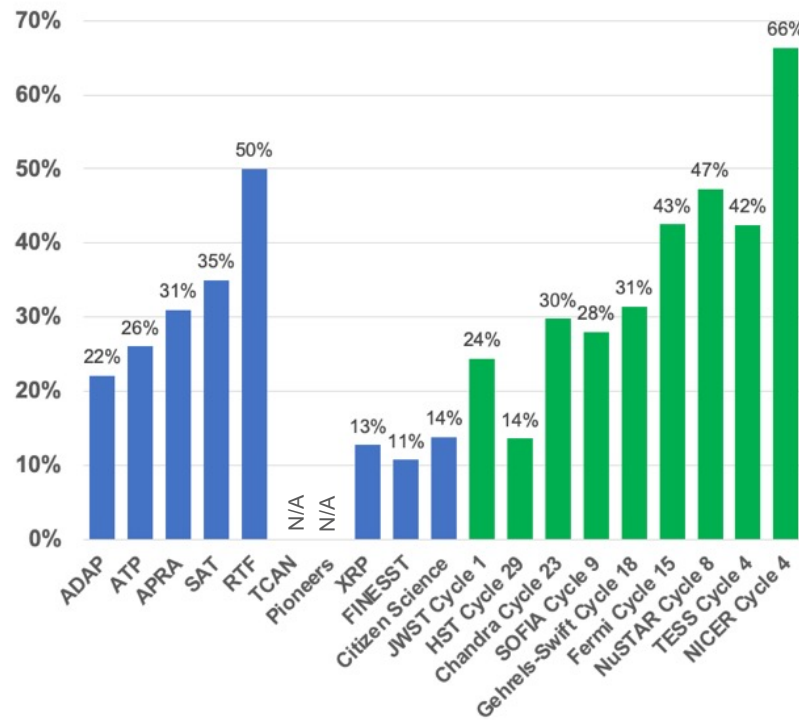
Astrophysics R&A Selection Rates

June 2021-2022

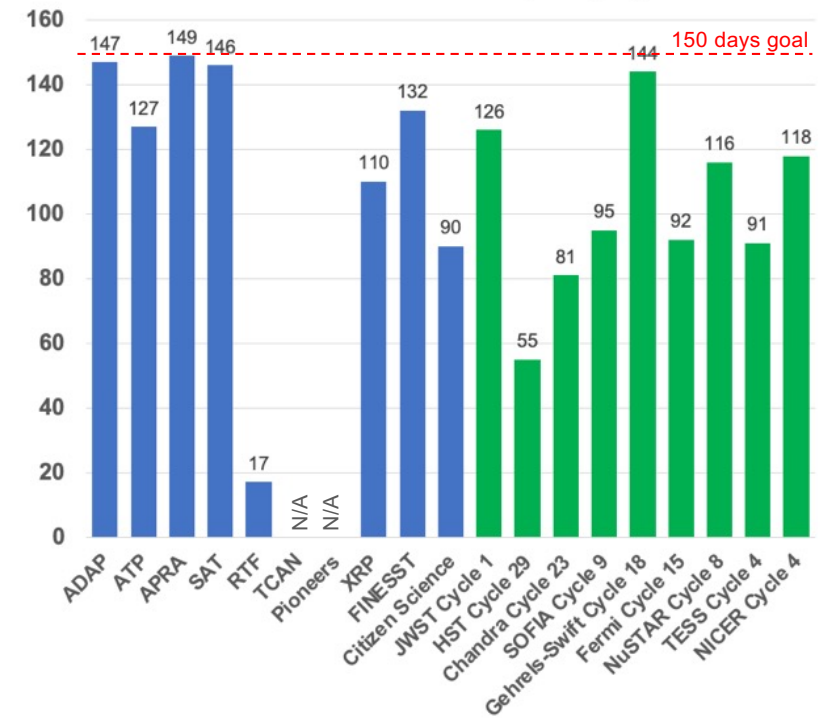
Number of Proposals



Selection Rates



PI Notification (Days)



R&A: 1,018 proposals
 GO/GI: 3,446 proposals
 Total: 4,464 proposals

R&A: 20%
 GO/GI: 27%
 Average: 25%

80% of PI notification:
 R&A: 147 days
 GO/GI: 122 days