

National Aeronautics and  
Space Administration




# EXPLORE SOLAR SYSTEM & BEYOND

## **NASA Astrophysics Update**

**AAAC Meeting | June 2, 2021**

**Paul Hertz**

Director, Astrophysics Division  
Science Mission Directorate

 [@NASAUniverse](#) [@NASAExoplanets](#)



# 2021 – A Year of Science



# Administrator Bill Nelson

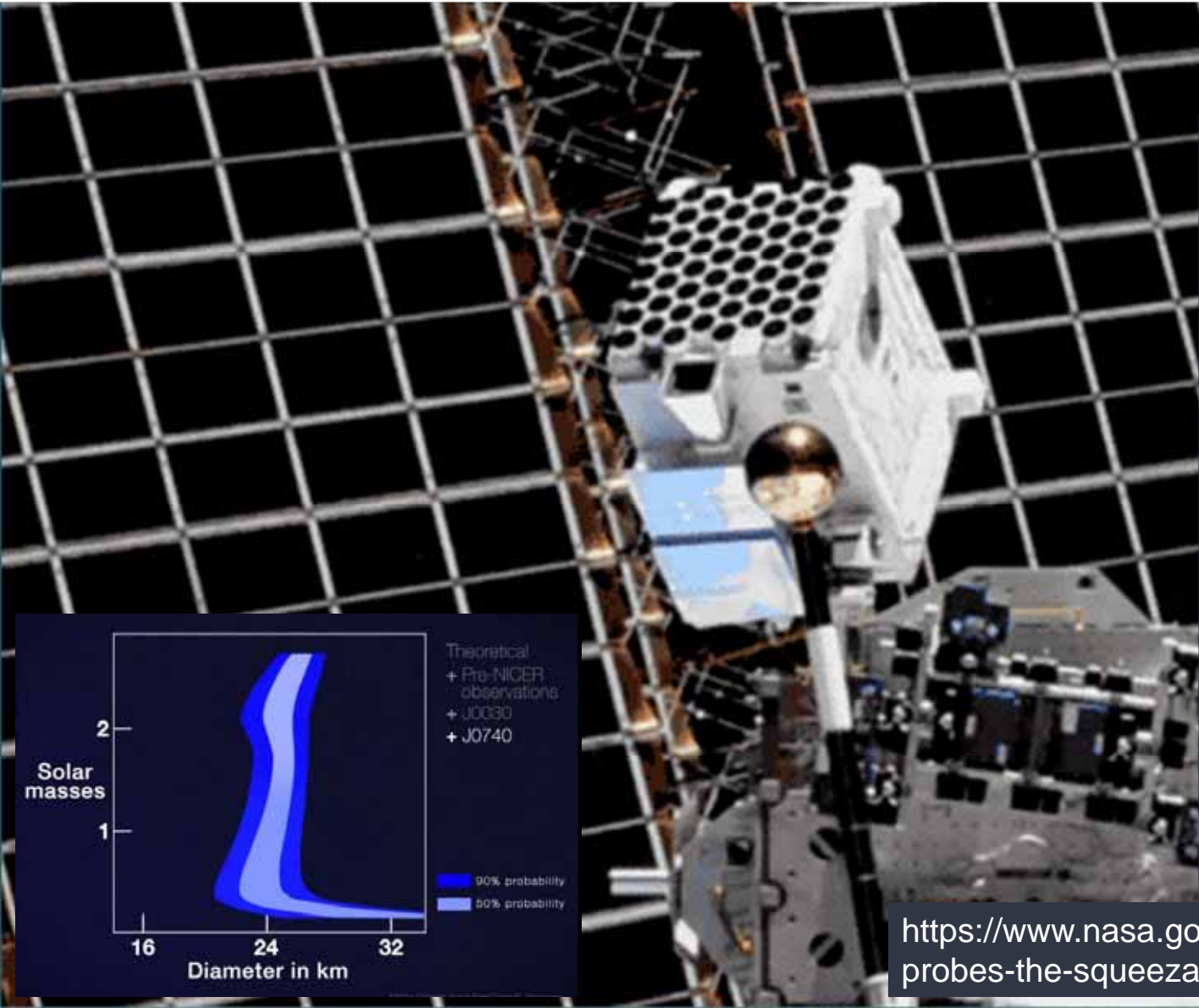


Sen. Bill Nelson was sworn in as the 14th NASA administrator on May 3, 2021, tasked with carrying out the Biden-Harris administration's vision for the agency. Nelson served in the U.S. Senate for 18 years from Florida and as a payload specialist on space shuttle mission 61-C in 1986.



In this May 20, 2021 photo, Pam Melroy addresses members of the Senate Commerce, Science and Transportation Committee during her confirmation hearing at the Hart Senate Office Building in Washington. Melroy, a former astronaut, was nominated by President Biden to serve as the next deputy administrator of NASA.

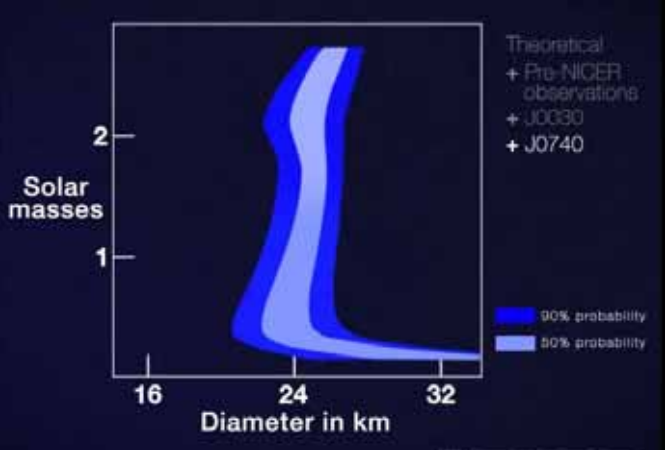




## NICER Probes the Squeezability of Neutron Stars

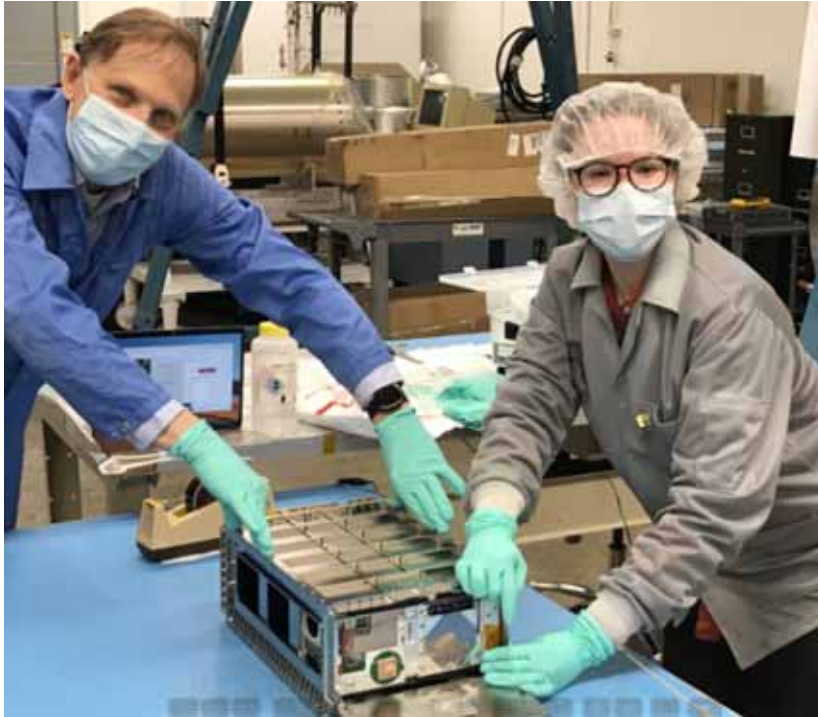
Apr. 17, 2021 – NASA's Neutron star Interior Composition Explorer (NICER), an X-ray telescope on the International Space Station, revealed that matter in the hearts of neutron stars – dense remnants of exploded massive stars – is less squeezable than some physicists predicted.

This showed that neutron stars are neutrons all the way down, and that the neutrons do not break into their own constituent parts, called quarks.

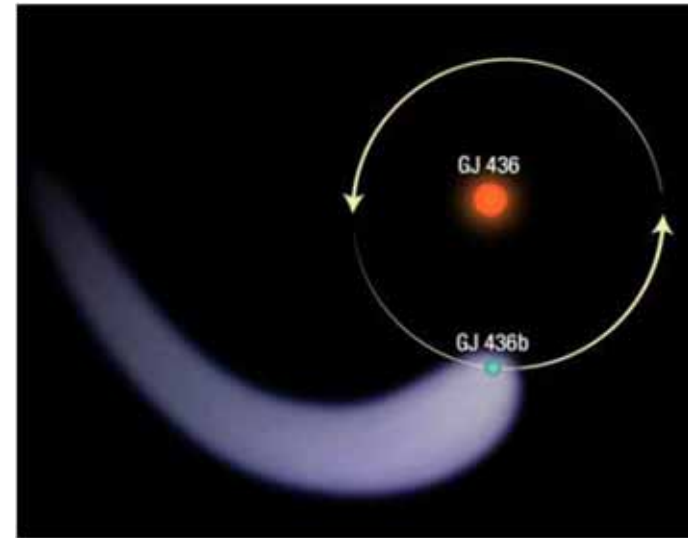


<https://www.nasa.gov/feature/goddard/2021/nasa-s-nicer-probes-the-squeezability-of-neutron-stars>

# Colorado Ultraviolet Transit Experiment (CUTE)



Rick Kohnert (CUTE PM) and Arika Egan (CUTE lead grad student) fit check the assembled CUTE in deployment canister. Courtesy K. France



**Science Objectives:** The Colorado Ultraviolet Transit Experiment (CUTE) will take multiple medium resolution UV spectra of hot Jupiters during transit, in order to measure the composition of the atmosphere being ablated away. Magnetic fields may be detected via the presence of tori or bow shocks.

Launch scheduled for Sept 16, 2021, on ride share with Landsat-9 primary payload



- Observatory integration and testing (I&T) ongoing at Ball Aerospace
- Observatory vibration, shock, and acoustic testing planned for late May / June 2021
- Observatory thermal/vacuum test planned for July 2021
- Observatory I&T completion planned for mid-Sept 2021
- Ship to Kennedy Space Center planned for mid-October 2021
- Current launch readiness date is November 17, 2021

# Imaging X-ray Polarimetry Explorer (IXPE)

Credit: Ball Aerospace

# Webb Final Primary Mirror Wing Deployment



An image sequence showing the observatory completing its final deployment test in May of 2021. The primary mirror wings are gravity-offloaded for deployment tests on Earth.



# Improving Inclusion at NASA



**Inclusion** – NASA is committed to a culture of diversity, inclusion, and equity, where all employees feel welcome, respected, and engaged. To achieve the greatest mission success, NASA embraces hiring, developing, and growing a diverse and inclusive workforce in a positive and safe work environment where individuals can be authentic. This value will enable NASA to attract the best talent, grow the capabilities of the entire workforce, and empower everyone to fully contribute.



Strategy 4.1: Increase the diversity of thought and backgrounds represented across the entire SMD portfolio through a more inclusive and accessible environment.

ROSES: SMD's goals are to develop a workforce and scientific community that reflects the diversity of the country and to instill a culture of inclusion across its entire portfolio.



# Building Excellent NASA Teams Requires Inclusion and Diversity



- At NASA, we recognize that excellence is only achieved with inclusive and diverse teams. We are creating a multi-pronged approach.
  - Directorate level: Standing up a long-term activity focused on sustained engagement, systemic, and lasting changes. Hosting [incubator workshops](#) and implementing actions from those workshops focused on short-term changes to how we are operating and how we grow our leaders. [National Academies study of barriers to inclusion in mission leadership. Adopting a Code of Conduct to improve the inclusion and process of our panels and teams.](#)
  - Division level: Division task forces working to align division-level practices with the NASA core value and SMD science strategy. Examining the R&A process for better inclusion and diversity. [Piloting inclusion plans as an evaluation criterion for R&A programs.](#) Workshop to increase interactions with Minority Serving Institutions.
- Proposal Processes: Recognizing we have influence through our calls for proposals and what we reward in our selections. [Piloting dual-anonymous peer review and seeking to expand that.](#) Actively looking into how we can be a model for inclusivity. Working group modifying requirements for AOs to align with NASA's new core value of Inclusion.



# COVID Impacts: Status of SMD Programs

NASA has been in a mandatory telework posture due to COVID-19 for over one year now; NASA work has continued though there have been impacts

## COVID Impacts on Missions:

- Projects continue to respond and replan due to changes due to COVID-caused issues; replans (including changes in cost and schedule estimates) continue to be reviewed and approved through the SMD Program Management Council process
- NASA Centers are planning for ramping up onsite activities
- SMD COVID assumptions have been updated, which allows our missions to more effectively plan for operating over the next 12 months

## COVID Impacts on R&A:

- No R&A solicitations or selections have been cancelled due to COVID; notifications and funding have continued at the pre-pandemic pace
- Virtual peer review panels will continue through December 2021, and likely beyond

## How this affects the community:

- As vaccinations increase within the community, we will be able to enact more with our project teams, partners, and vendors by increasing on-site work and travel
- SMD is working toward multiple launches scheduled for the fall and winter of this year, including Webb, Lucy, Landsat-9, DART, IXPE, and GOES-T



# Supporting Work-Life Balance

- SMD recognizes the importance of balancing one's work with the requirements of one's family, friends and personal physical and mental health
- We have created a web page to inform SMD-funded researchers about NASA-provided wellness resources and leave options that may be available

<https://science.nasa.gov/researchers/work-life-balance>

- The web page discusses resources and flexibilities for
  - Recipients of NASA grants and cooperative agreements
  - NASA Civil Servant Scientists
  - NASA on-site contractors
  - NASA Postdoctoral Program Fellows
- The resources that one may access depend on one's relationship with NASA (above) and one's institution's policies
- One's first step, regardless of your relationship to NASA, should be to contact your institution's Office of Sponsored Programs, Human Resources or Human Capital Office to determine your employer's policies
  - NPP Fellows should contact their NPP Center Representative
- Please help us improve this webpage by sending suggestions, questions and feedback to [sara@nasa.gov](mailto:sara@nasa.gov)





# Research Program Update





# COVID-19 Mitigations (R&A)

NASA does not want the pandemic to derail careers of future leaders; we are focused on mitigating impacts

Within current funding constraints, NASA will prioritize augmentations and funded extension requests for existing awards

NASA issued a ROSES call for funded extensions (ROSES-20, Appendix E.10)

This initiative is funded from the current R&A Program; size of commitment is approximately 15% of funding available for new awards in FY21. There will be 15% fewer new awards in FY21

Received ~170 COVID recovery funding extension requests for a total of ~\$20M. Proposals are being reviewed.

Within current funding constraints, SMD will continue to support 124 NASA Postdoctoral Program (NPP) fellowships

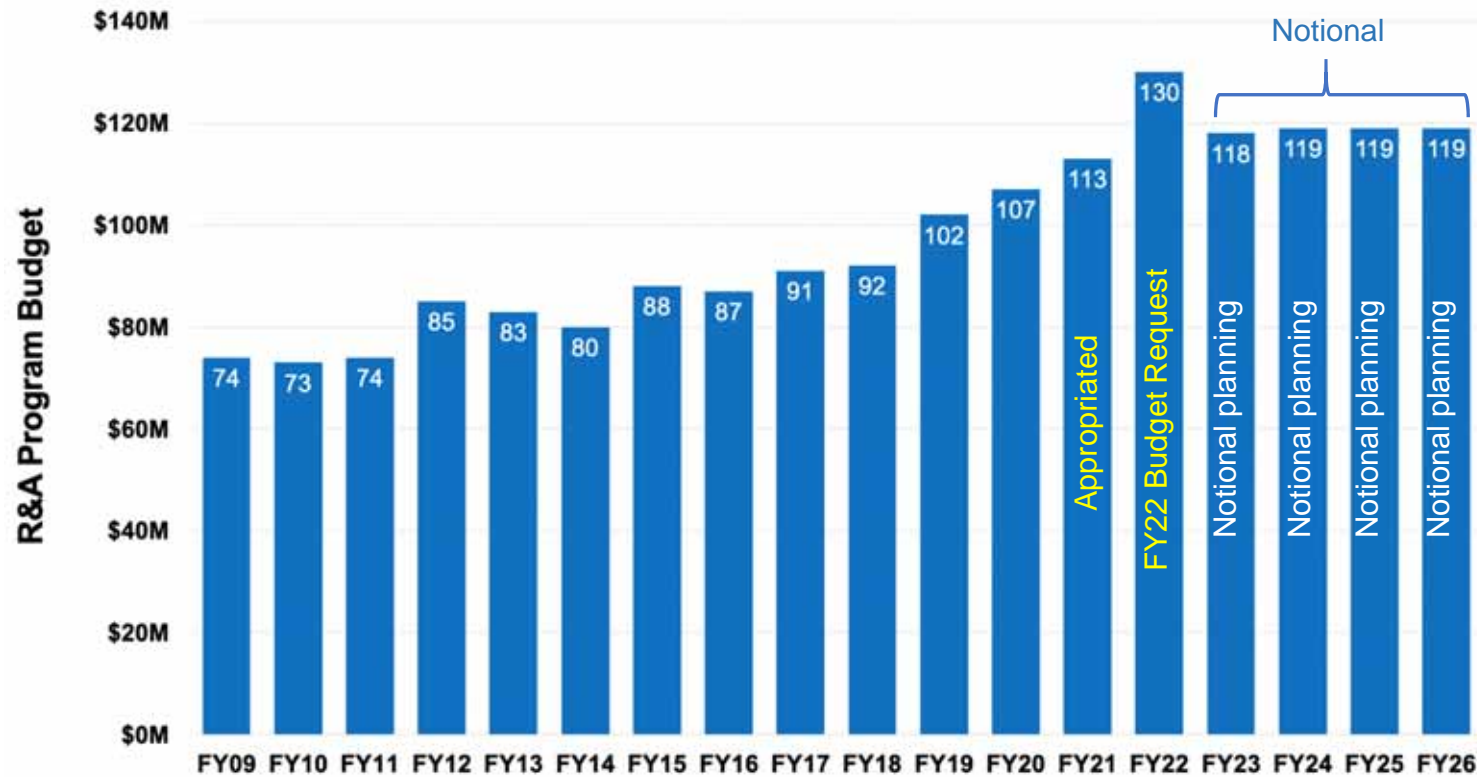
The July 2021 call is limited to applicants who already have permission to work in the US because of the inaccessibility of J-1 visas

Since some slots will be used to extend current Fellows, SMD will supplement the funding for the NPP to maintain the pre-existing competitive level

Government-wide flexibility for paying salaries of researchers, even if they could not work because of COVID, expired on September 30. NASA has established a process to consider extending this flexibility to pay salaries on a case-by-case basis

<https://science.nasa.gov/researchers/covid-and-awards>

# R&A Research Funding



Since the last Decadal Survey:  
+38% R&A funding growth

Notional Planning:  
+60% over 17 years.

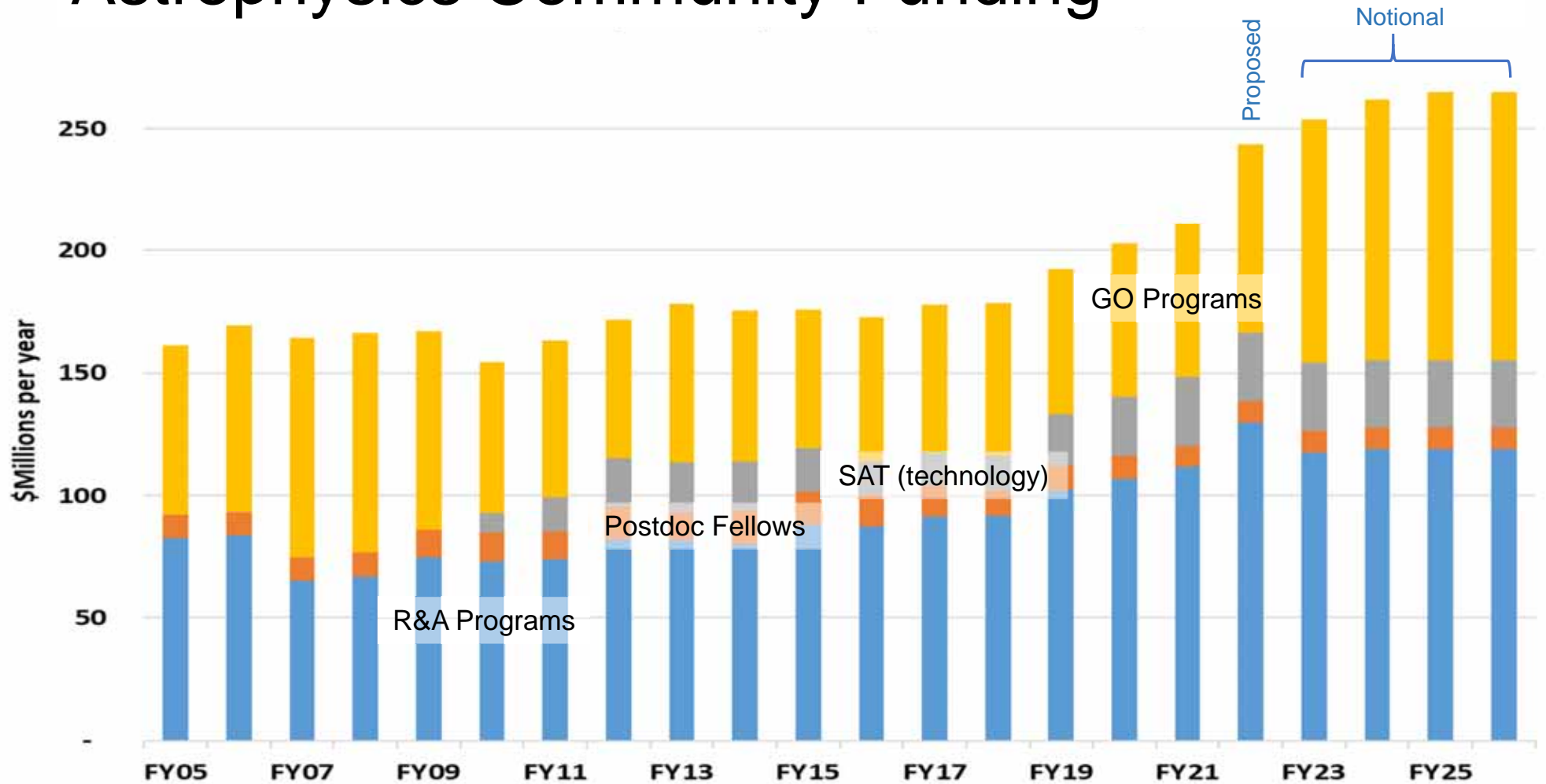
Includes:  
APRA, ADAP, XRP, ATP, TCAN,  
FINESST, RTF, CubeSats,  
SmallSat studies

+ GO/GI Programs for missions

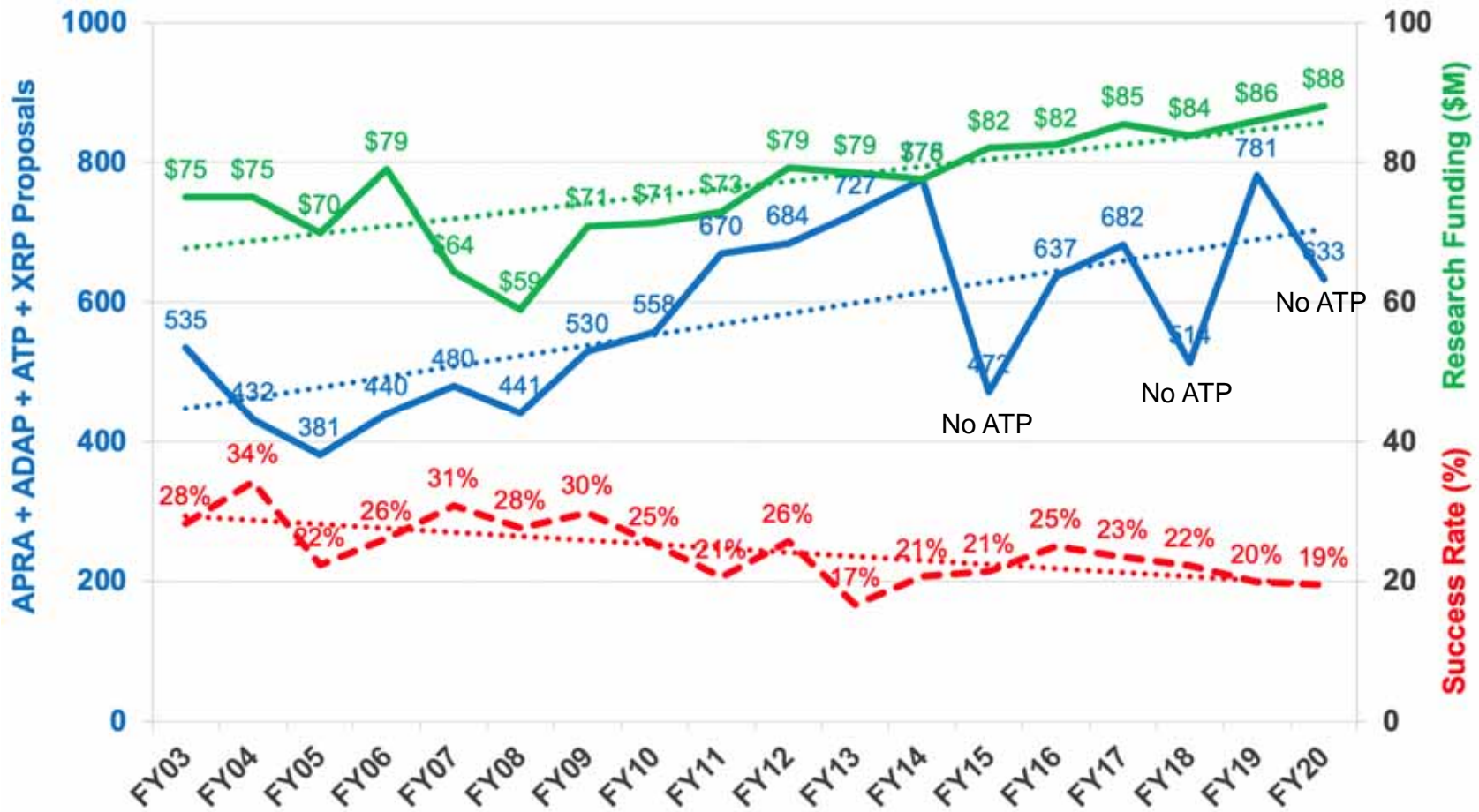
Sustained growth in R&A research funding since the 2010 Decadal Survey



# Astrophysics Community Funding



# R&A Proposals, Research Funding, Success Rate



# Recent R&A Initiatives

- Pioneers: Established new program for <\$20M SmallSats, balloons, ISS payloads
- Exoplanet Research Program (XRP) Consolidation: All exoplanet investigations under XRP, ramping up funding
- Laboratory Astrophysics: Capital equipment purchases eligible for APRA starting in ROSES-20
- FINESST: Doubled funding and selection rate for graduate student program
- Diversity of Proposing Teams: Pilot program for this year's Astrophysics Theory Program (ATP) to require an inclusion plan
- Citizen Science: SMD solicitation for Citizen Science seed funding
- Data Management Plan: Now part of the intrinsic merit evaluation of proposals
- High Risk / High Impact: Assessed for all proposals and forwarded to SMD blue ribbon panel
- Code of Conduct for Peer Reviews: Astrophysics code is now adopted for all SMD reviews
- Inclusion, Diversity, Equity, and Accessibility: Established IDEA taskforce for Astrophysics R&A, implementing recommendations of SMD's Anti-Racism Action Group





# From Open Data to Open Science

All NASA mission science data are public

Publications funded by NASA, including peer review journal articles, are open access and freely available to the public

NASA has initiated an open science data initiative with targeted investments in cloud computing, open-source software, Artificial Intelligence/Machine Learning, etc.

- Includes ROSES calls targeted at supporting open-source tool development and the opening of legacy software

NASA is developing a policy to ensure that the results of its Federally funded scientific research and technology development are shared openly; this policy will cover:

- Information produced by NASA Science Missions
- Information produced by NASA research awards
- NASA-funded publications, data, and software

Draft will be released for public comment



# Mission Program Update



# COVID-19 Impacts – Missions

Many missions are expected to stay within their cost commitments (known as the ABC or Agency Baseline Commitment, which includes HQ held reserves above project budget)

- ABC is set at Confirmation Review

Some missions have experienced challenges that affect cost and schedule commitments

- In astrophysics, this includes Webb, Roman, and IXPE
- Missions that have been Confirmed since COVID began (e.g., SPHEREx), or will be Confirmed in the future (e.g., future Explorers) have assumed impacts from COVID included within their cost and schedule commitments

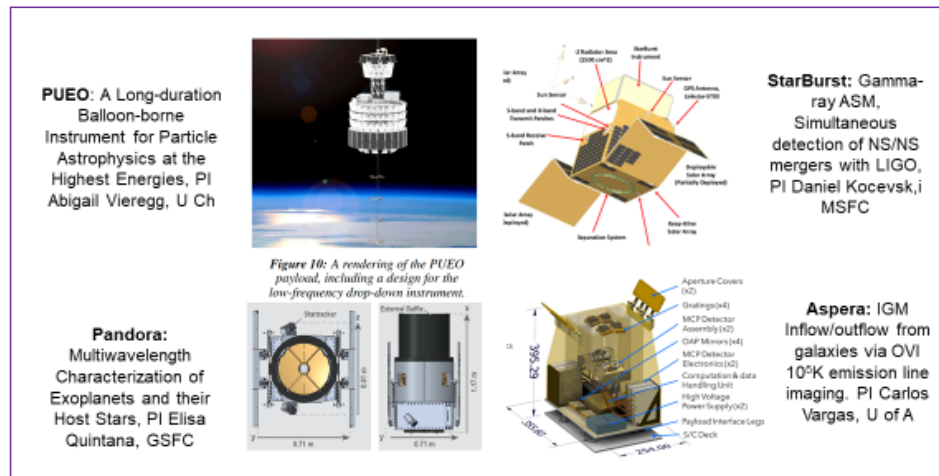
To date, challenges to Flagships (Webb, Roman) have been accommodated with no impact to Explorers or R&A

- Challenges to Explorers are accommodated within the Explorers Program

<b>Mission impacts to commitments due to COVID (only missions with commitments)</b>			
Webb	Exceeds schedule	XRISM	Does not exceed
IXPE	Exceeds cost and schedule	SPHEREx	Included in commitment
GUSTO	Does not exceed	Roman	Exceeds cost and schedule
Euclid	Does not exceed		

# Astrophysics Pioneers

- A new class of small missions offered for first time in ROSES-2020. Include SmallSats, CubeSats >6U, major balloon payloads, modest ISS attached payloads, and lunar surface CLPS payloads. \$20M maximum PI cost cap.
- Fills in the gap between existing ROSES investigations (<\$10M for APRA) and existing Explorers MO investigations (~\$35M for SmallSats).
- Solicited through ROSES; relieves burden of writing full Explorers MO proposal (ROSES 2021 Amendment D.15).

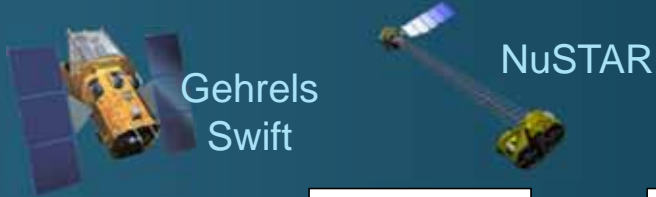


- First four selections in January 2020.
- Teams working on Concept Study Report; first gate decision to proceed will be in January 2022.

- ROSES-2021 due date NET March 2022



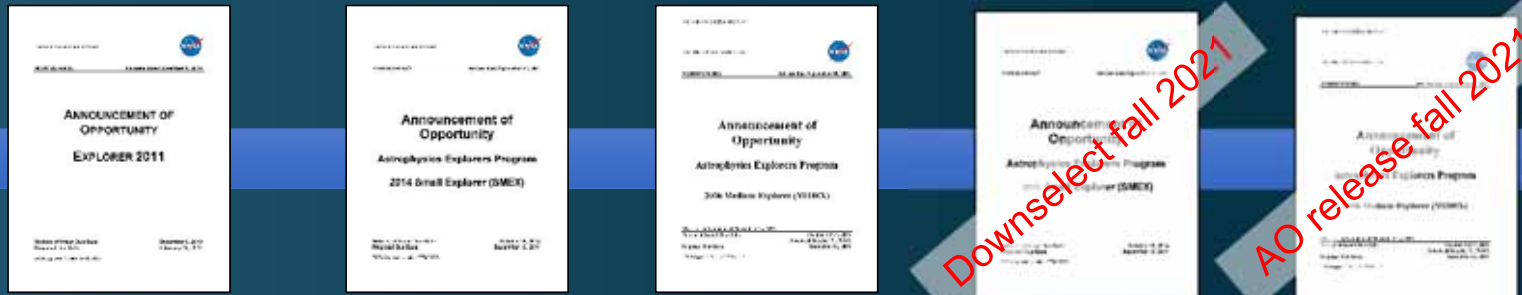
# Astrophysics Explorers Program



MIDEX 2021  
 Comm Ann release Sep 29, 2020  
 Draft AO release Jan 6, 2021  
 Comments due Feb 25, 2021  
 Final AO release August 2021  
 NOIs due October 2021  
 Proposals due December 2021  
 ALL FUTURE DATES TARGETS

SMEX 2019 Downselect  
 Phase A Studies due Mar 4, 2021  
 Downselect decision Fall 2021

4 AOs per decade



MIDEX  
2011

SMEX  
2014

MIDEX  
2016

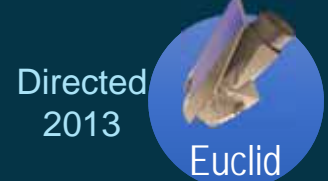
SMEX  
2019

MIDEX  
2021

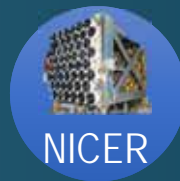
Small and  
Mid-Size  
Missions



ESCAPE  
COSI



Missions of  
Opportunity



Dorado  
LEAP



# James Webb Space Telescope

## 2021 Accomplishments

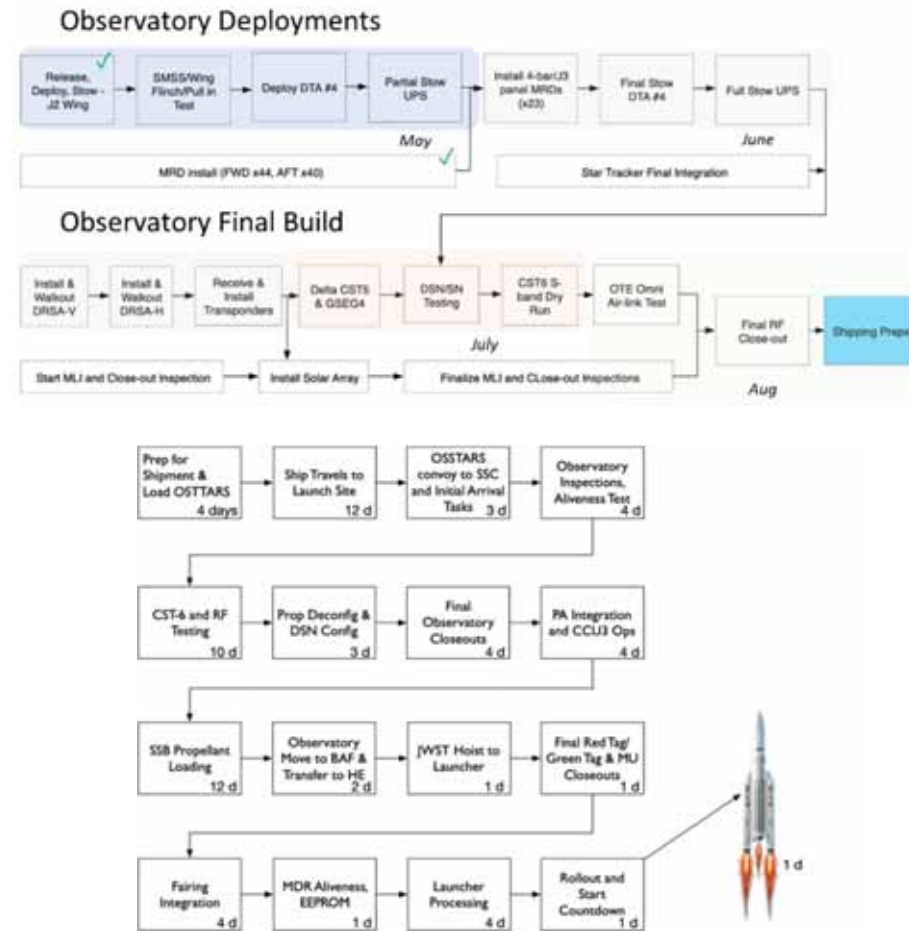
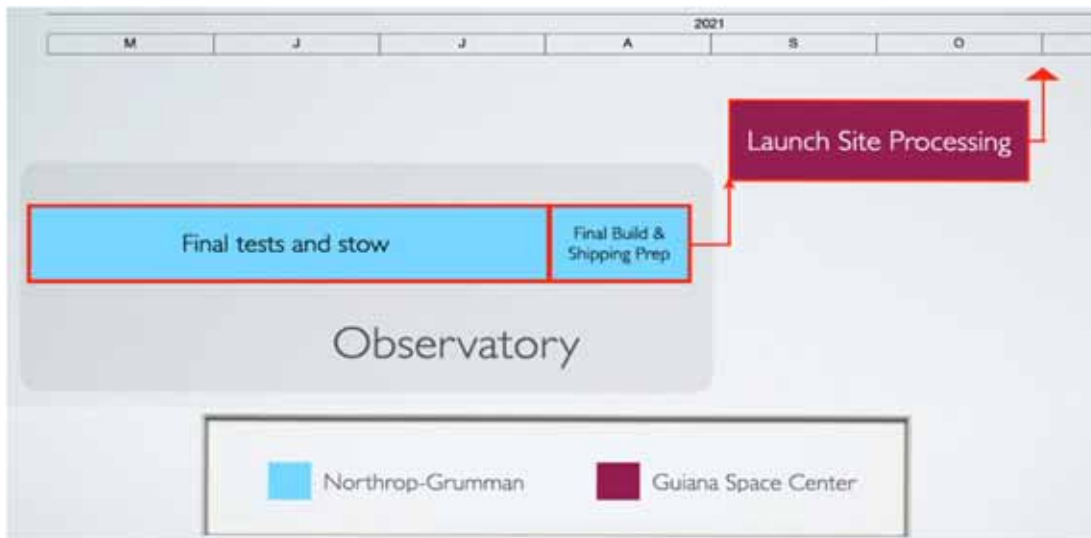
- All Observatory deployments – post launch environmental testing – successfully completed.
- Selected Webb Cycle 1 GO observing program
- Continued conducting mission rehearsals at the mission operation center (STScI) of greater length and fidelity

## 2021 Plans

- Reinstall repaired S-band transponders at the end of June and regression test them
- Complete final stow for launch steps
- Pack observatory for shipping to launch site
- Launch October 2021



# Webb Schedule



# Nancy Grace Roman Space Telescope

Roman Science Interest Group (RSIG) formed to provide broad-based community input to the Roman project and NASA Headquarters

Good technical progress has been made in spite of COVID inefficiencies and supply chain impacts

Critical design reviews (CDR) for telescope, wide field instrument, coronagraph, and instrument carrier have been completed; ground system CDR to be completed by July 2021

Mission CDR to be completed by September 2021

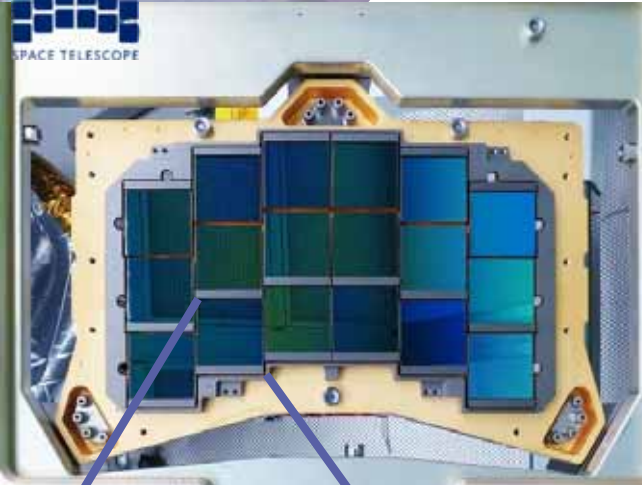
Complete telescope by the end of 2021

Replan to adjust cost and schedule commitments was completed in late May 2021

Opportunities for participation in Roman Space Telescope research and support will be offered in ROSES-2021



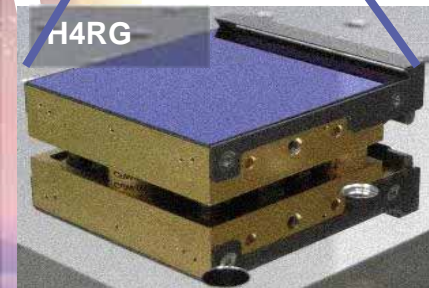
# Roman Hardware Progress



All 18 flight certified plus 6 flight spare H4RG Sensor Chip Assemblies (SCAs) are in hand. The Mosaic Plate Assembly Engineering Test Unit (ETU) is assemble with SCAs integrated and testing is underway.



Solar Array Sun Shield EDU in Thermal/Vacuum Chamber



Inspection of the Grating Prism (grism) takes place in the lab at Goddard Space flight Center.

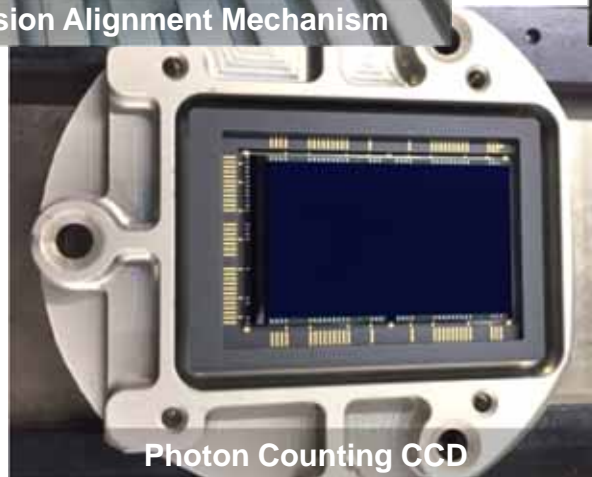
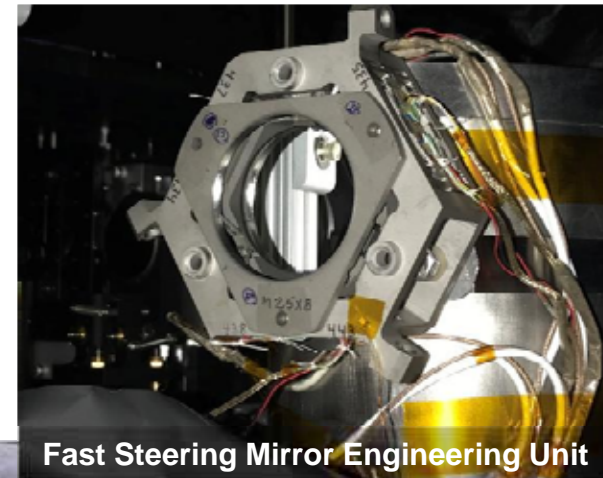
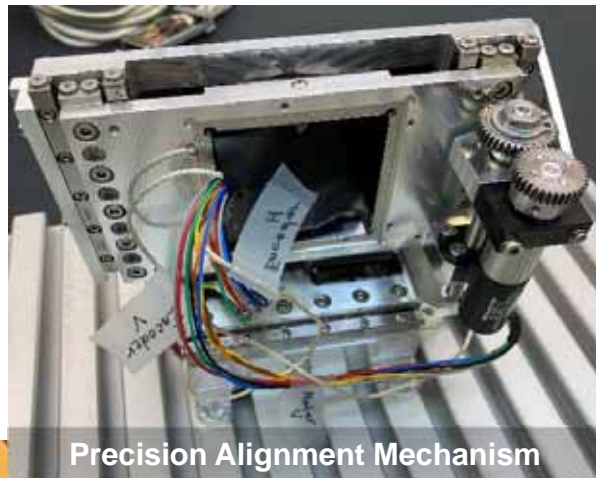


Deployable Aperture Cover EDU



Spacecraft Deployable Engineering Development Units (EDUs) and Mock-ups aid in maturing designs and assembly processes.

# Coronagraph Instrument Technology Demonstration Hardware Progress





# Roman Space Telescope

Opportunities for participation in Roman offered in ROSES-2021

- Key Project Teams: Science teams to conduct scientific investigations using the data from the major surveys identified by the Astro2010 Decadal Survey
- Coronagraph Community Participation Program: Investigators to work with the coronagraph instrument team to plan and execute tech demo observations
- Wide Field Instrument Preparatory Science: Investigators to work on science preparation activities related to mission performance verification and science operations preparation

All Roman observing time is available through open processes

- Major Legacy Surveys will be defined using a community-driven open process
- Key Projects – funded science investigations using these surveys –openly competed
- Roman observing time will be available for General Observer (GO) projects
- All data will be available to the community with no period of limited access

<https://roman.gsfc.nasa.gov/>

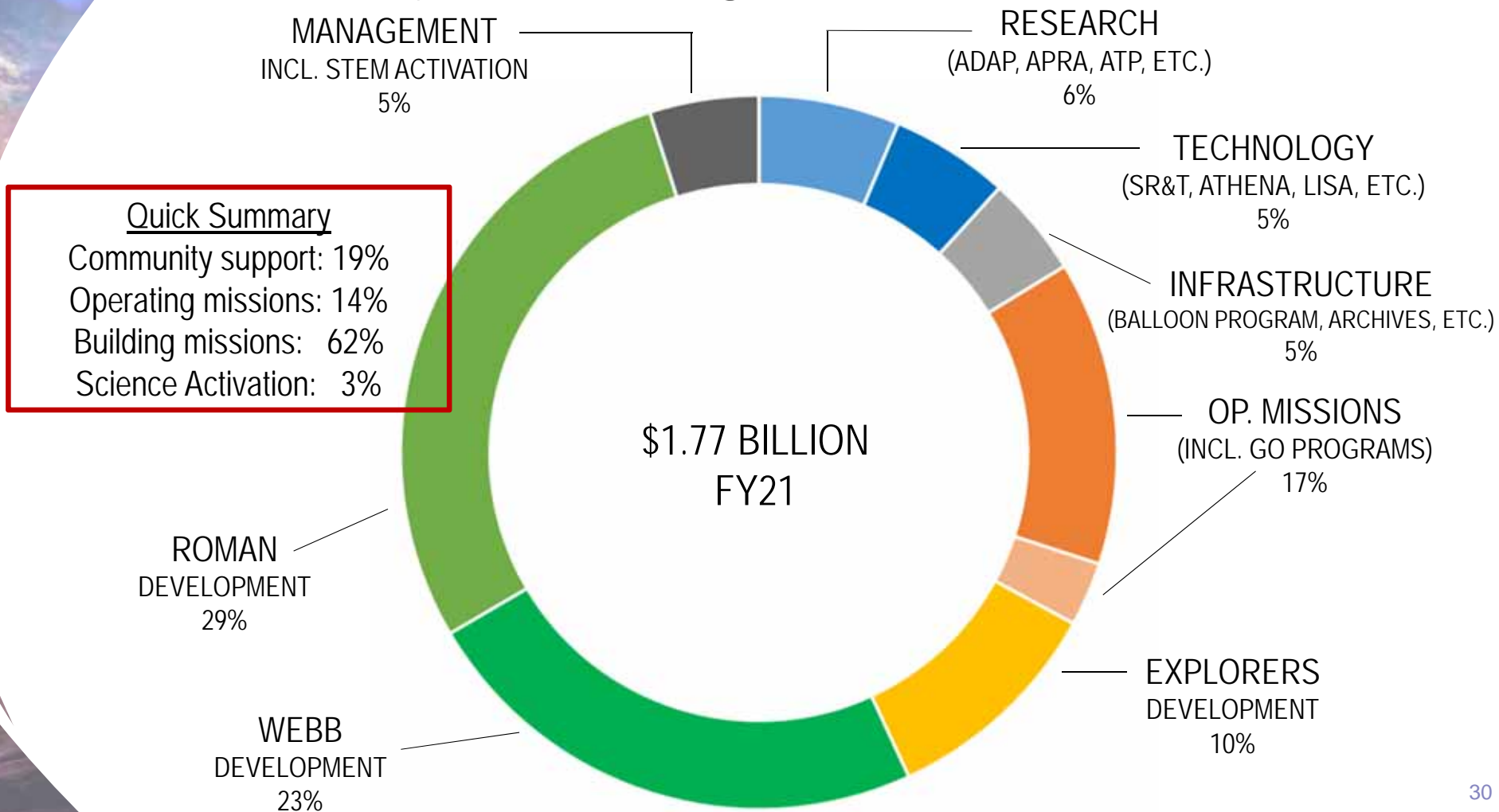


# Planning for the Future





# Astrophysics Budget – FY21 Op Plan





## Agency FY22 Budget Highlights

- A strong NASA budget investing \$24.7 billion dollars for America's future in space; funding proposed represents an increase of 6% over the previous year
- Building the Earth Systems Observatory to enhance and integrate Earth system science and applications to increase the nation's preparation, mitigation and resilience in the face of climate change
- Keeps NASA on the path to land the first woman and the first person of color on the Moon
- Supports NASA efforts to strengthen Inclusion, Diversity, Equity and Accessibility both within NASA and among the space community



# SMD FY22 Budget Strategy

*Advance Earth System Science and Applications  
to Address the Climate Crisis*

*Promote Diversity and Equity in Science*

*Lead Artemis Science*

*Lead a Balanced, Innovative and Open Science  
Program driven by the Highest National Priorities*

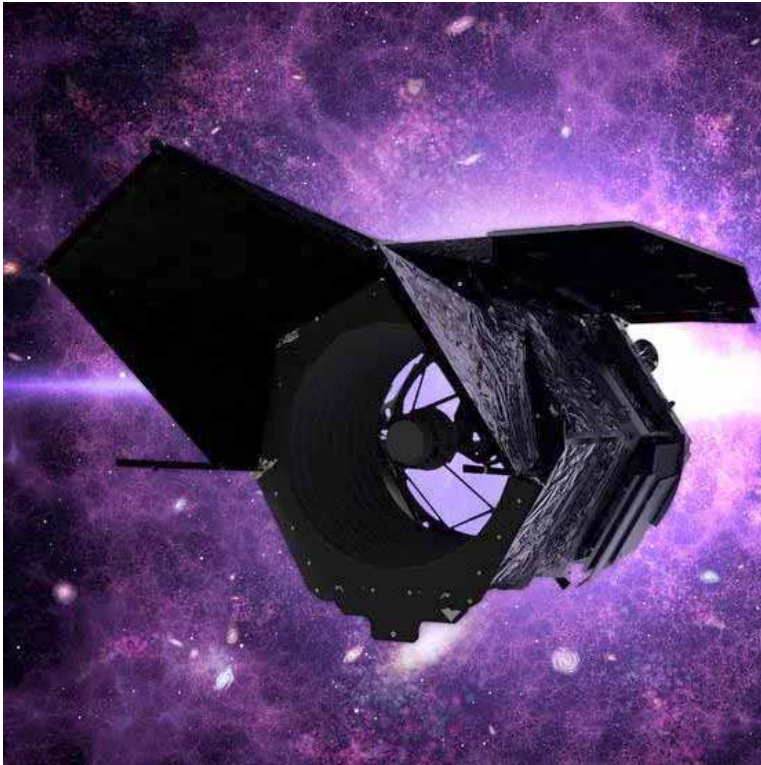


## FY22 BUDGET HIGHLIGHTS

# Promote Diversity, Equity and Inclusion in Science

- Diversity of thought, backgrounds and perspectives continue to be welcomed and celebrated as critical to SMD mission success
- Supports systems in place to proactively expand participation of Minority Serving Institutions and Historically Black Colleges and Universities through bridge partnerships and SMD Science Activation Program
- Implementing policy changes to systemically value inclusion such as modifying requirements for Announcements of Opportunities and implementing Dual Anonymous Peer Reviews
- Continually addressing the impact of COVID on diversity





## FY22 BUDGET HIGHLIGHTS

### Lead a Balanced, Innovative and Open Science Program driven by the Highest National Priorities

- Over 40 missions in formulation and development in FY 2022, including over 25 small missions and a balance of competed and directed missions
- Execute program informed by Decadal Surveys and other National Priorities
- Fund development of Roman Space Telescope, Europa Clipper and Mars Sample Return; Launch and operate Webb Space Telescope
- Expand competed missions with new Earth System Explorers; Enhance Explorers Program in Astrophysics and Heliophysics; Start development of new Discovery Missions
- Establish Open Source Science Initiative to advance transparency, inclusivity, access, and reproducibility in scientific data and research

# Astrophysics Budget Features

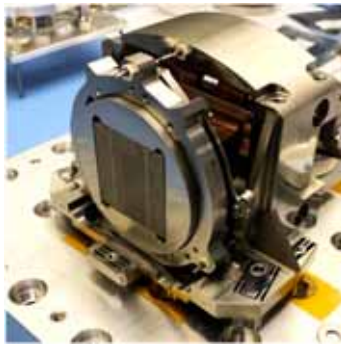
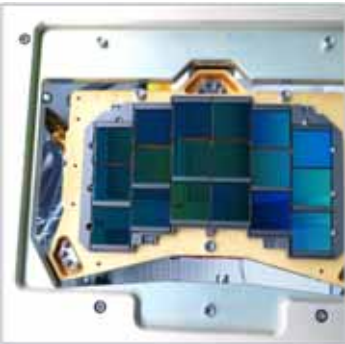
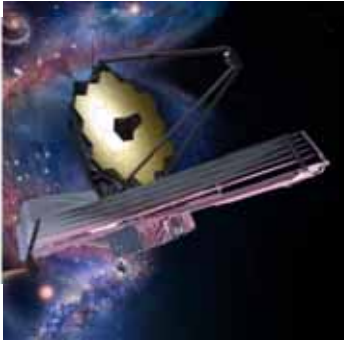
**Requests \$1,575.5 M for NASA Astrophysics in FY 2022**

## **What's Changed compared to one year ago (previous budget request)**

- Funds continued development of the Nancy Grace Roman Space Telescope and estimated COVID impacts
- Plans for an Astrophysics Probe-class mission and other initiatives pending receipt of the Decadal Survey
- Four Astrophysics Pioneers conducting mission concept studies
- Enhanced facilities and open science initiatives within research program (e.g., laboratory equipment upgrades, extreme precision radial velocity program, formulation for integrating data archives with cloud computing)
- Science activation increases to support diversity and inclusion initiatives
- Astrophysics Strategic Mission Program management funding to support the management of Roman and upcoming probe-class missions in recognition of the enhanced management requirements of these missions

## **What's the Same compared to one year ago (previous budget request)**

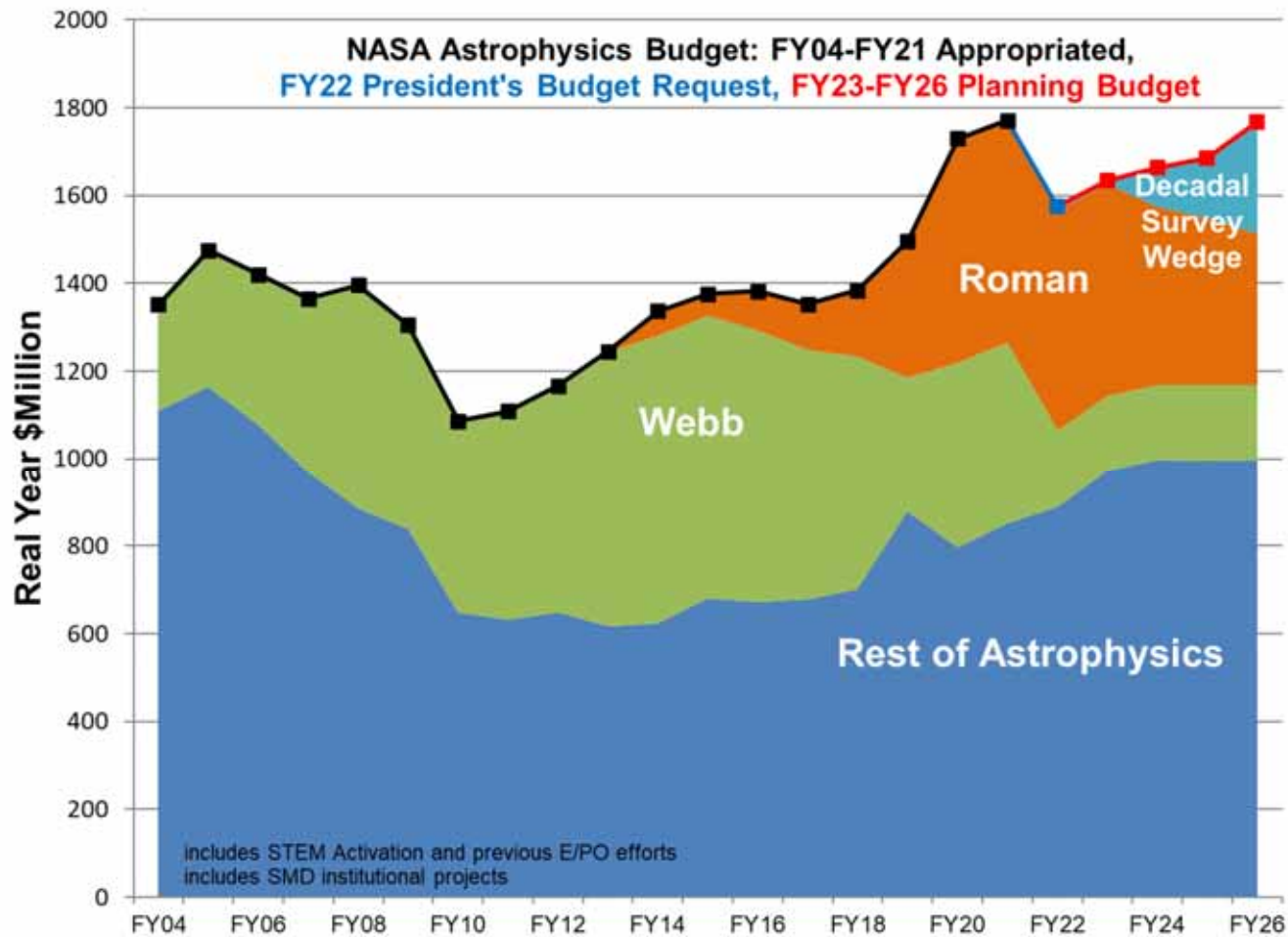
- Webb on track to launch in October 2021 within development cap
- Proposes termination of SOFIA due to its high cost and lower scientific productivity than other missions
- Hubble, Chandra, and other operating missions continue
- Supports development of IXPE, GUSTO, XRISM, Euclid, SPHEREx, and ARIEL
- Maintains Astrophysics Explorers cadence including SMEX downselect and MIDEX AO in 2021
- CubeSat initiative and balloon campaigns within healthy research program



## Planned Milestones FY21-22

- Complete integration and launch Webb in 2021
- Complete integration and test for IXPE and launch by early 2022
- Achieve Roman Space Telescope critical design review in 2021
- Achieve SPHEREx critical design review in 2021
- Maintain decadal cadence of four AOs per decade for Astrophysics Explorers and Missions of Opportunity with a SMEX downselect and a MIDEX AO in 2021
- Generate world-class science from operating missions including Hubble Space Telescope and Chandra X-ray Observatory
- Conduct Senior Review of Operating Missions in 2022
- Maintain healthy research program including suborbital-class missions, technology development, data analysis, theoretical and computational investigations, and laboratory astrophysics
- Receive Astrophysics Decadal Survey in 2021
- Plan formulation or solicitation for a Probe mission
- Support mission concept studies and technology investments to implement Astrophysics Decadal Survey priorities starting in 2022

# Astrophysics Budget – FY22 Request





# NASA Planning for Astro2020



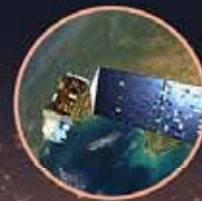
- NASA is planning ahead for implementing the Decadal Survey
  - Reducing risks of large missions via technology development and through studying lessons learned from prior large missions
  - Developing options for recommendations in R&A, archives, suborbital, Explorers, Probes
  - Developing options for flagship risk reduction activities; stay focused on Webb and Roman
  - Holding a wedge in out year planning budget for new initiatives
- NASA hopes to provide an initial response to the community within a few months of receiving the Astro2020 Decadal Survey Report
  - Announce implementation of recommendations that can be implemented immediately (within budget, within authority)
  - Announce plans for developing responses to long-term recommendations
  - Communicate and engage with the community throughout



MARS 2020



DART



Landsat 9

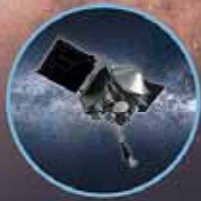


Webb



IXPE

2021 – A Year of Science



O-REx



Peregrine



Nova-C



Lucy



GOES-T

- LAUNCH
- LANDING
- DEPARTURE