NASA Astrophysics Update

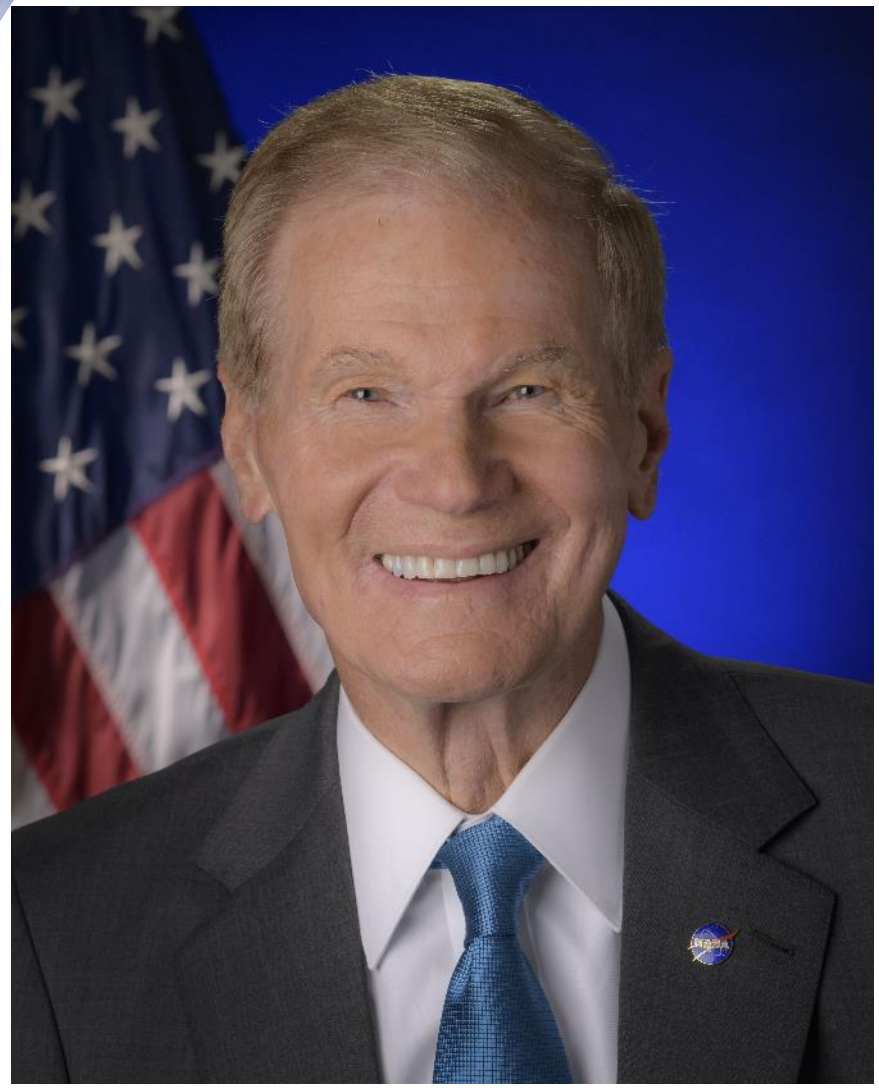
Astrophysics Meeting of Experts | June 29, 2021

Paul Hertz
Director, Astrophysics Division
Science Mission Directorate

@NASAUniverse @NASAExoplanets

Astrophysics Program Highlights

Administrator Sen. Bill Nelson



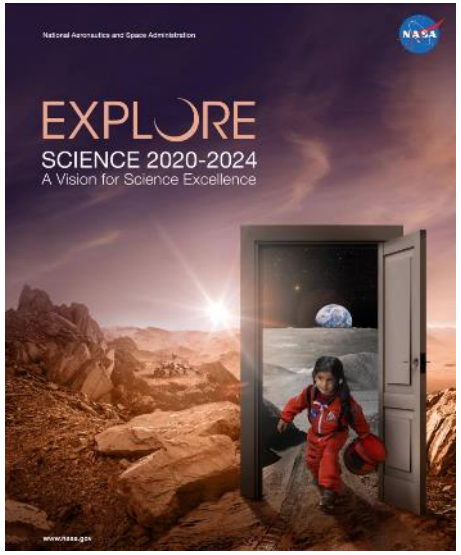
Sen. Bill Nelson was sworn in as the 14th NASA administrator on May 3, 2021, tasked with carrying out the Biden-Harris administration's vision for the agency. Nelson served in the U.S. Senate for 18 years from Florida and as a payload specialist on space shuttle mission 61-C in 1986.

Deputy Administrator Pam Melroy

Col. Pam Melroy was sworn in as the NASA deputy administrator on June 21, 2021. Melroy flew three space shuttle missions, piloting STS-92 in 2000 and STS-112 in 2002 and commanding STS-120 in 2007.

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.

NASA's Mission Equity

Mission Equity is a comprehensive effort to assess expansion and modification of agency programs, procurements, grants, and policies, and examine what potential barriers and challenges exist for communities that are historically underrepresented and underserved.

NASA issued a RFI, entitled Advancing Racial Equity and Support for Underserved Communities in NASA Programs, Contracts and Grants, on June 15, 2021. The agency is seeking public feedback as it conducts a thorough review of its programs, practices, and policies to assess:

- Potential barriers that underserved and underrepresented communities and individuals may face in agency procurement, contract, and grant opportunities.
- Whether new policies, regulations, or guidance may be necessary to advance equity and opportunities in agency actions and programs.
- How agency resources and tools can assist in enhancing equity, including advancing environmental justice.

Areas in which the agency would like to receive comments include:

- Diversity and Equal Opportunity at NASA and in the STEM Community
- Opportunities for NASA to Leverage its Data, Expertise, and Missions to Help Underserved Communities
- Barriers/Gaps to Accessing Current NASA Grants, Programs, and Procurements
- Engagement and Outreach with Organizations and Individuals from Underserved and Underrepresented Communities

Through the RFI process, NASA hopes to initiate vibrant, meaningful, and ongoing dialogues that will help the agency build and improve current agency policies, practices, and programs.

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.

- Standing up a long-term activity focused on sustained engagement, systemic, and lasting changes (see separate chart).
- 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.
- Asked for a 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.
- 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.
  - Working group modifying requirements for AOs to align with NASA's new core value of Inclusion.
- Partnering with OSTEM on MSI fellowships.
- Astrophysics Division task force 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.
  - Individual listening sessions with HBCU and MSI faculty over the summer leading to a workshop with proposals for new sustainable and impactful Astrophysics Division initiatives for meaningful long term partnerships.

Building Excellent NASA Teams Requires Inclusion and Diversity

The NASA FY22 budget request promotes 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

SMD Anti-Racism Action Group

Propose, collect & implement new and innovative ideas with well-defined and measurable outcomes

- Co-led by SMD AA Thomas Zurbuchen and Kartik Sheth
- Update all supervisor performance plans to require meaningful progress in IDEA-relevant performance goals
- Establish an engagement committee to build relationships with under-represented groups.
- Initiate series of internal culture surveys to baseline and measure progress in diversity and inclusion across SMD
- Collect and publicize current and historic aggregate demographic data of ROSES awardees
- Require that all panel reviews adopt code of conduct that reflects commitment to a diverse and inclusive working environment
- Set a goal for each SMD division to increase the aggregate demographic diversity of its reviewers in ROSES panels by the end of 2022

SMD Long-Term IDEA Working Group

Align outcomes and activities with NASA core value of inclusion and Science Strategy 4.1

- Lead by SMD Deputy AA for Management
- More than 50 SMD staff members (civil servants, IPAs, and contractors) in smaller groups
  - IDEA Programming, Outreach and Engagement
  - Missions/Projects/Programs
  - Leadership Development & Growth
  - Inclusion/Culture
  - Recruitment/Hiring/Promotion/Retention
  - Research & Analysis

Anti-Harassment Statement

At NASA we are fully committed to assuring the safety and effectiveness of our workforce and our missions. Consequently, NASA strictly prohibits harassment and is fully committed to providing a safe and harassment-free work environment.

NASA encourages all employees to report and help prevent workplace harassment, and NASA strictly prohibits retaliation for raising allegations of harassment or providing information related to such allegations. The Agency's Anti-Harassment Program provides for prompt, thorough, and impartial investigations of harassment complaints, and individuals reporting harassment are assured that NASA will protect the confidentiality of harassment complaints to the fullest extent possible. The Agency will take immediate and appropriate corrective action in situations involving harassment and proactively in other situations to reasonably prevent harassment from occurring.

Reporting from grant recipients: Recipient institutions are required to notify NASA of any findings/determinations of sexual harassment, other forms of harassment, or sexual assault regarding a NASA-funded Principal Investigator (PI) or co-I, or of the placement of the PI or co-I on administrative leave, or the imposition of any administrative action relating to harassment or sexual assault finding or investigation.

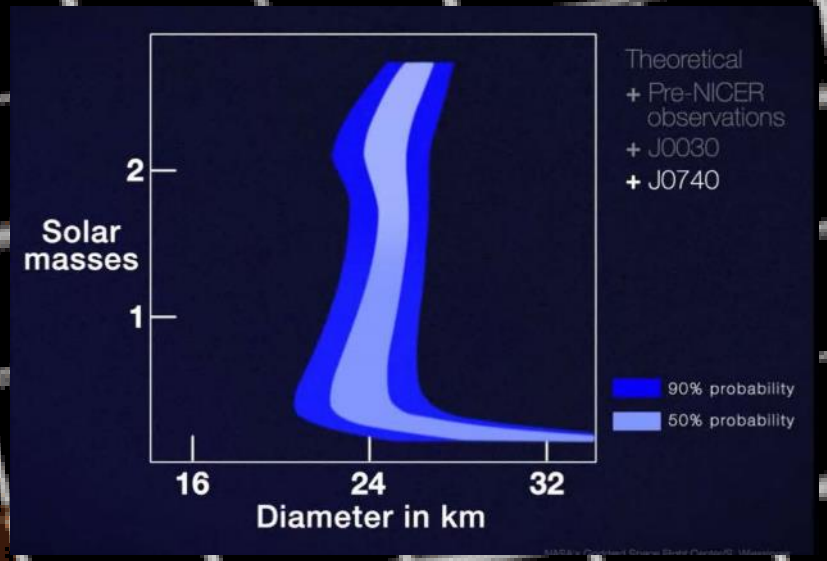
https://www.nasa.gov/offices/odeo/policy-and-publications

https://missionstem.nasa.gov/term-condition-institutional-harassment-discr.html

NICER Probes the Squeezability of Neutron Stars

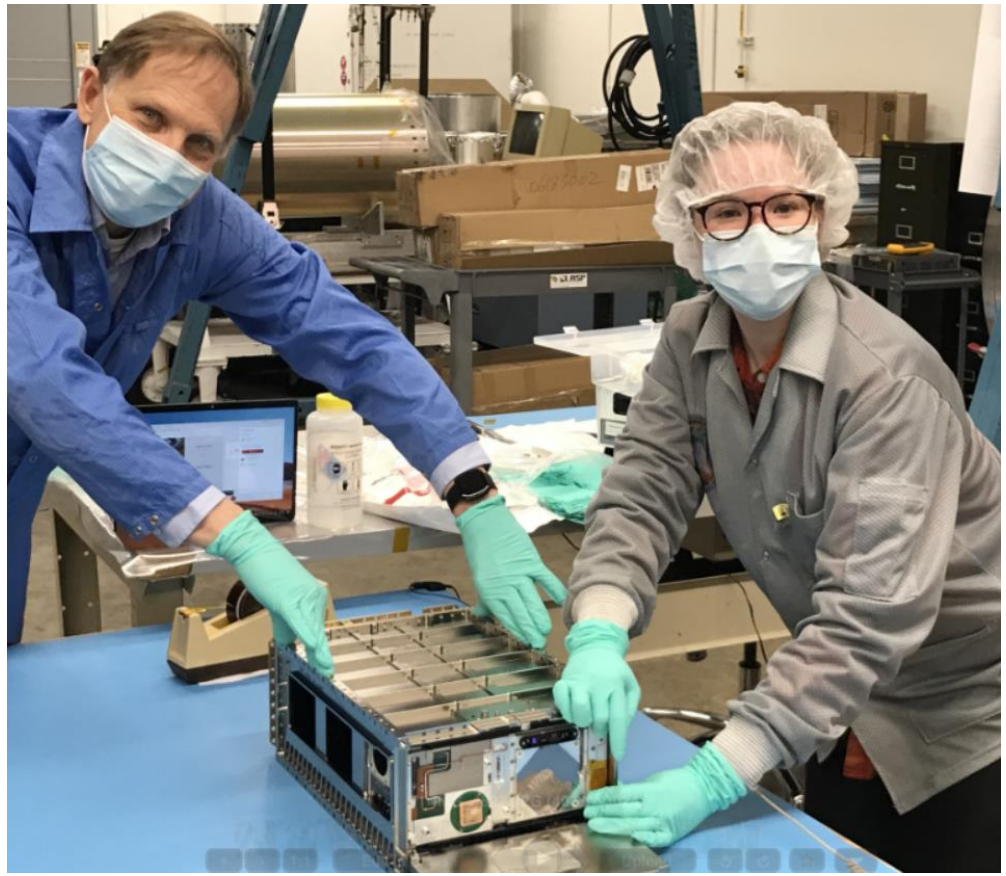
Apr. 17, 2021 – NASA's Neutron star Interior Composition Explorer (NICER), an X-ray telescope on the International Space Station, revealed that matter in the hearts of neutron stars – dense remnants of exploded massive stars – is less squeezable than some physicists predicted.

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.

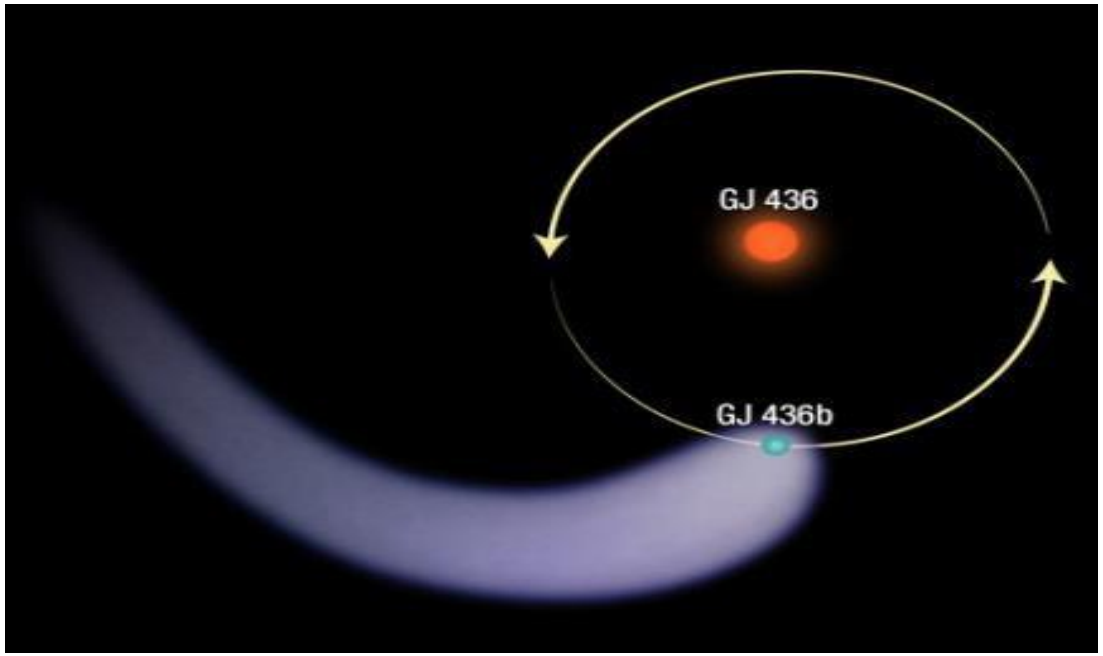


https://www.nasa.gov/feature/goddard/2021/nasa-s-nicer-probes-the-squeezability-of-neutron-stars

Colorado Ultraviolet Transit Experiment (CUTE)



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

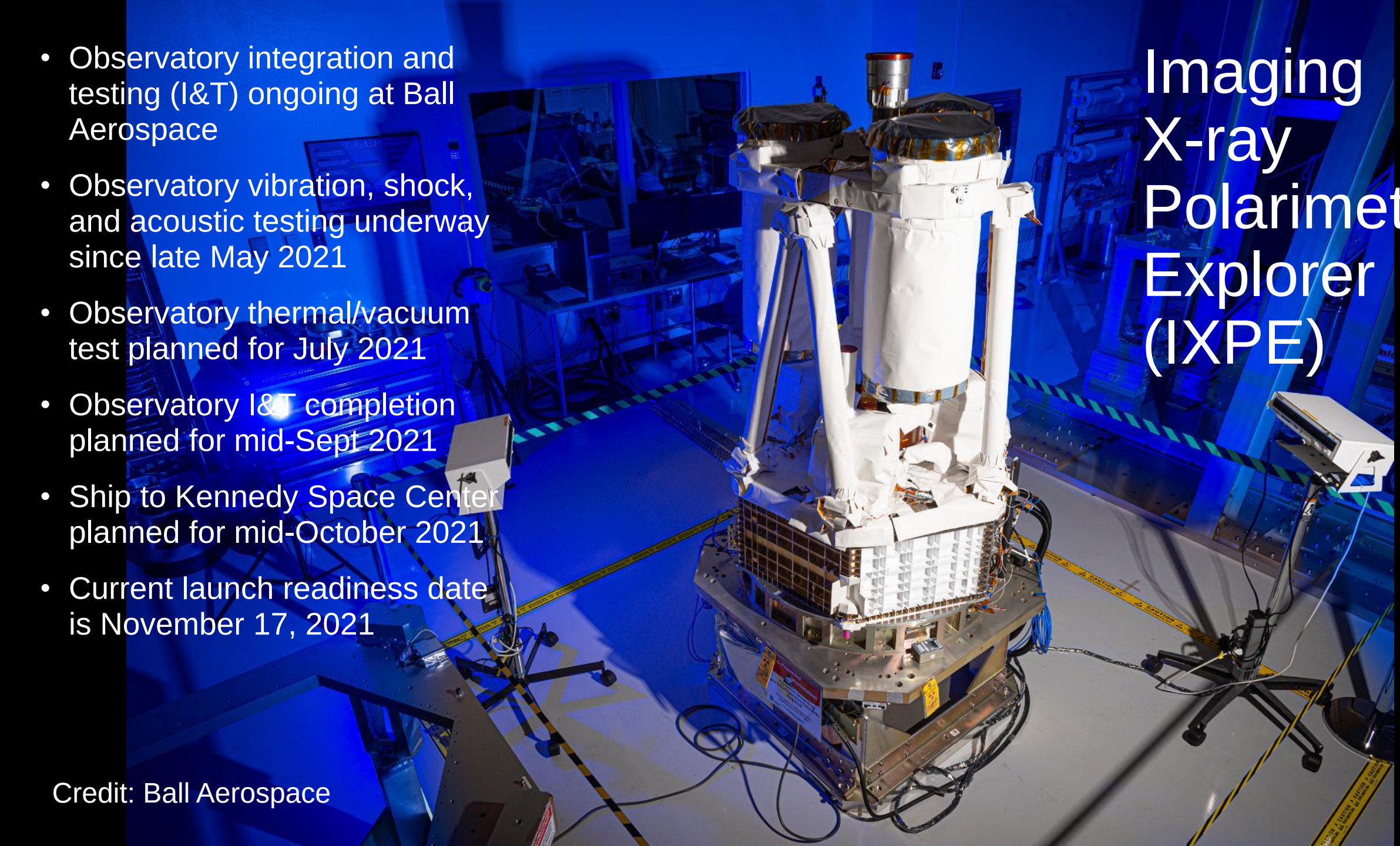


Science Objectives: The Colorado Ultraviolet Transit Experiment (CUTE) will take multiple medium resolution UV spectra of hot Jupiters during transit, in order to measure the composition of the atmosphere being ablated away. Magnetic fields may be detected via the presence of tori or bow shocks.

Launch scheduled for September 2021 as rideshare with Landsat-9 primary payload

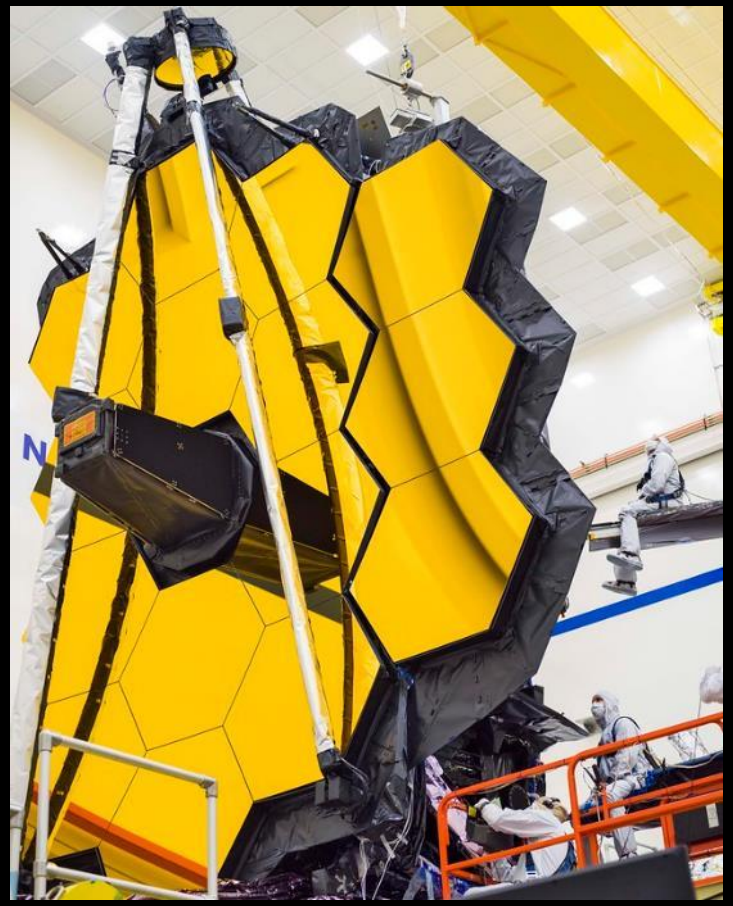
Imaging X-ray Polarimetry Explorer (IXPE)

- Observatory integration and testing (I&T) ongoing at Ball Aerospace
- Observatory vibration, shock, and acoustic testing underway since late May 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



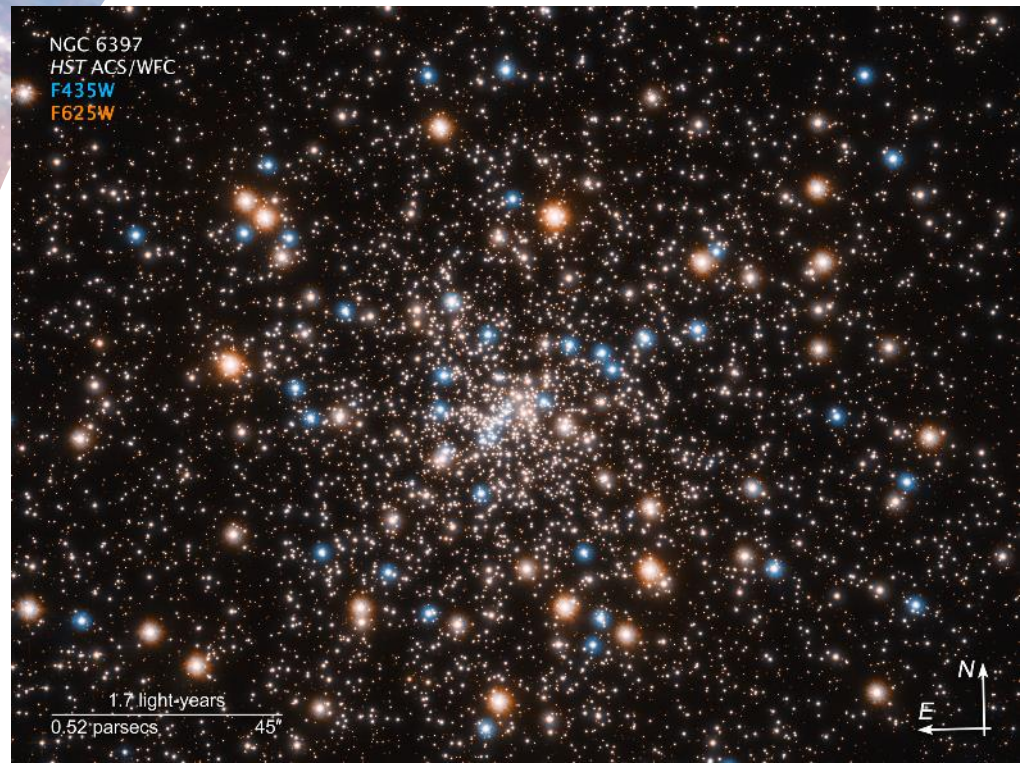
Credit: Ball Aerospace

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.

Hubble finds a ‘crush’ of black holes



Astronomers found something they weren't expecting at the heart of the globular cluster NGC 6397: a concentration of smaller black holes lurking there instead of one massive black hole.

W. Vitral and G. Mamon, A&A, 646, A63 (2021)
https://doi.org/10.1051/0004-6361/202039650

What is the collective noun for black holes?
https://www.nytimes.com/2021/05/27/science/black-hole-names-holley-bockelmann.html

Hubble news:

- Latest solar analysis predicts Hubble orbit decay NET 2036
- New on-board software has reduced pointing jitter and reduced slew time
- Hubble instruments are in safe mode (as of June 13, 2021)

Hubble Update

Operations Continue to Restore Payload Computer on NASA's Hubble Space Telescope
(updated June 18, 2021) https://go.nasa.gov/3gB8SL6

NASA continues to work on resolving an issue with the payload computer on the Hubble Space Telescope.

- The operations team will be running tests and collecting more information on the system to further isolate the problem.
- The science instruments will remain in a safe mode state until the issue is resolved.
- The telescope itself and science instruments remain in good health.

The computer halted on Sunday, June 13.

- An attempt to restart the computer failed on Monday, June 14. Initial indications pointed to a degrading computer memory module as the source of the computer halt.
- When the operations team attempted to switch to a back-up memory module, however, the command to initiate the backup module failed to complete. Another attempt was conducted on both modules Thursday evening, June 17, to obtain more diagnostic information while again trying to bring those memory modules online. However, those attempts were not successful.

The payload computer is a NASA Standard Spacecraft Computer-1 (NSSC-1) system built in the 1980s that is located on the Science Instrument Command and Data Handling unit.

- The computer's purpose is to control and coordinate the science instruments and monitor them for health and safety purposes. It is fully redundant in that a second computer, along with its associated hardware, exists on orbit that can be switched over to in the event of a problem.
- Both computers can access and use any of four independent memory modules, which each contain 64K of Complementary Metal-Oxide Semiconductor (CMOS) memory. The payload computer uses only one memory module operationally at a time, with the other three serving as backups.

Launched in 1990, Hubble has contributed greatly to our understanding of the universe over the past 30 years.

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 as 25% occupancy limit is lifted
- 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 interact 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

APAC Recommendations & Questions

APAC Recommendations

	APAC Recommendation – March 2021	NASA Response
1	The APAC requests continued updates on DEI initiatives in APD*, in particular on the DAPR process and the addition of an inclusion plan for ATP proposals, as well as the status of actions under consideration, such as externships, research initiation award models, and mentee feedback during project reports.	Updates on DEI initiatives included in all APAC meetings. Presentations by Paul Hertz and Torry Johnson on Day 1 of this meeting.
2	The APAC requests that APD consider adding language to the DAPR process that encourages proposing teams to acknowledge their intent to follow ethical research best practices and to confirm that key members of their team are not encumbered by known (best available public knowledge) incidents that violate community-accepted codes of professional conduct.	To be discussed at SMD level. (OPEN)
3	The APAC requests that all mission updates at future APAC meetings contain updates on leadership demographics and efforts to support the 5th NASA pillar.	All NASA personnel actions are taken with the principles of inclusion and diversity in mind. Updates on supporting the core principle of inclusion included in all APAC meetings.
4	The APAC requests the APD present an overview of their initial response to the 2020 Decadal Survey priorities of missions and portfolio balance at its 2021 June meeting, if the report is issued in time for this request to be practical.	To be presented at a future APAC meeting. (OPEN)

* APD is the NASA Astrophysics Division at NASA Headquarters

APAC Recommendations

	APAC Recommendation – March 2021	NASA Response
5	The APAC request an update on the Sci Act 2.0 following the implementation of recommendations from its recent review at its 2021 October meeting.	Presentation by Kristen Erickson on Day 2 of this meeting.
6	The APD should critically review the virtual review environment for value-add and report out to the APAC their conclusions of whether such arrangements offer benefits.	Assessment will be conducted by SMD. Update to be reported at October 2021 APAC meeting. (OPEN)
7	The APAC requests two selected 2020 Pioneer mission presentations at its 2021 June meeting and two at the committee's fall 2021 October meeting.	Presentations by Abigail Vieregg (PUEO) and Daniel Kocevski (StarBurst) on Day 1 of this meeting. Aspera and Pandora to be presented at October 2021 APAC meeting.
8	The SOFIA Project and SOFIA Mission Office should track developments of the ASTHROS balloon effort to look for scientific and collaborative synergies.	SOFIA is concentrating on increasing science productivity and preparing for the Senior Review. ASTHROS is still years from first flight. When ASTHROS is approaching operational capability, then it will be appropriate for SOFIA to consider synergies.
9	The APAC encourages SOFIA to continue to pursue alternative deployment sites to enhance flight opportunities for the community.	APD concurs. SOFIA is continuing to pursue alternative deployment sites and will be deploying to French Polynesia in July 2021 because it was not possible to deploy to New Zealand due to COVID restrictions.

APAC Recommendations

	APAC Recommendation – March 2021	NASA Response
10	The APAC requests an update on the instrument roadmap schedule and funding mechanisms at the 2021 October meeting of the committee.	APD declines. By October 2021, the Senior Review will be underway. It would be inappropriate to provide differential treatment by the APAC to the missions in the Senior Review.
11	The APAC requests an update on early IXPE science at a future meeting.	To be presented at a future APAC meeting. (OPEN)
12	The APAC asks that APD consider the recommendations outlined in the Balloon roadmap.	APD concurs. The Balloon Program Office also accepted the recommendation of the Balloon Roadmap and is incorporating the recommendations into the operations implementation and future planning.
13	The APAC suggests that BPS be included in future Balloon roadmaps	APD concurs. Near term, APD and BPO will include candidates from BPS community on the Balloon Working Group.
14	The APAC suggests that APD consider opportunities for guest observer as they become available through the development of balloon-based observatories and facilities.	When ASTHROS is approaching operational capability, then it will be appropriate for APD to consider opportunities for guest observers.

APAC Recommendations

	APAC Recommendation – March 2021	NASA Response
15	The APAC recommends that APD consider increasing accessibility and awareness of piggyback payload opportunities. These opportunities are more accessible to institutions/groups that do not traditionally have access to hardware or facilities to carry out full balloon missions.	APD concurs. The availability of piggyback payload opportunities and the process for requesting them will be communicated more transparently to the community. In addition to calling out piggyback payload in the ROSES/APRA solicitation, the Balloon Program Office is working on updating its website, which will include a How To for new PIs, including piggyback payloads.
16	The APAC suggests that APD investigate the viability of storing processed balloon data that has been published in public archives.	APD concurs. The SMD Information Policy will make archiving of data from suborbital projects a requirement. The FY22 budget request includes funding to ensure that the astrophysics archives can ingest and serve suborbital project data.
17	The APAC advises the APD proactively engage University sponsored projects and institutional research offices to clearly inform them of the SMD Information requirements.	Response provided by SMD: The written policies have not yet been released to the public. Once they have been released, SMD will be releasing a request for information to help gather how best to support the community in a successful implementation of the policy. The RFI will be distributed as widely as possible, and responses from sponsored project offices would be helpful in determining future actions with respect to the policy. Training related to the policy is included in the longer term plans related to the policy, and details for the engagement and training with University sponsored project offices will be determined after the RFI responses are received.

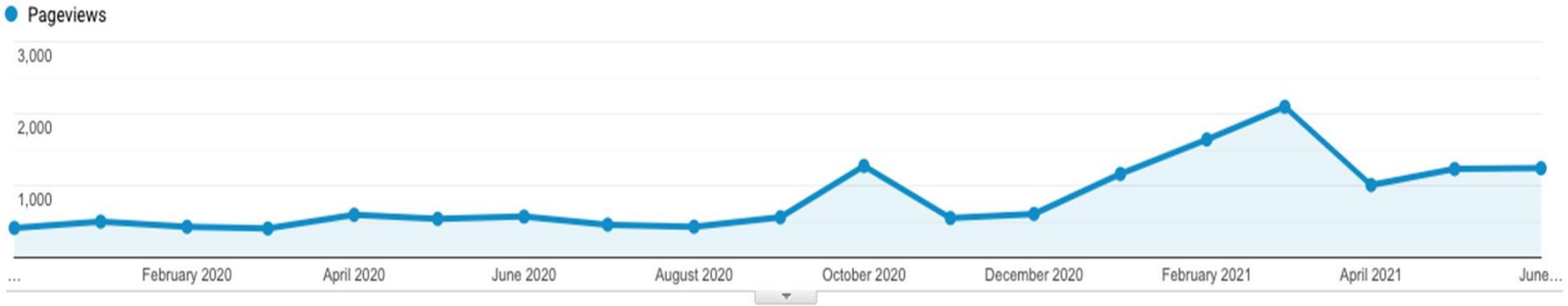
APAC Recommendations

	APAC Recommendation – March 2021	NASA Response
18	The APAC request a full briefing the new SMD policies, including the text of the proposed document, at the 2021 June meeting.	Presentation by Steve Crawford on Day 2.
19	The APAC recommends the APD consider supporting a long-term extension of the PI Launchpad and to continue outreach to scientists from groups that have previously not been represented among NASA mission PIs	APD has requested SMD to consider this.
20	The APAC requests APD track and report back to the committee at the 2021 October meeting on download statistics and other activity related to accessing PI Launchpad materials.	SMD has provided the data on the following chart.
21	The APAC challenges the PhysPAG to have terms-of-reference for the Cross-PAG-SAG under development to consider barriers to participation of under-represented groups and under-resourced institutions in NASA space science (see Chart17 PhysPAG presentation) solidified by the June 2021 meeting for committee consideration.	Presentation by Ryan Hickox on Day 1 of this meeting.
22	The APAG requests an update from the PAGS on the status of, and any potential actions arising from, their discussions of cross-cutting technologies and data analysis framework at the 2021 October meeting.	Presentations by PAG EC Chairs on Day 1 of this meeting.
23	The APAC requests an update on the Roman schedule and budget resulting from replan activities stemming from COVID19 impacts.	Replan has been completed and results are being conveyed to stakeholders. (OPEN)

Download statistics and other activity related to accessing PI Launchpad materials

Stats are for the date range: Dec 1, 2019 – June 14, 2021. Data includes number of pageviews and PDF downloads.

Pageview activity for all PI Launchpad & PI Resources pages: **Total Pageviews: 14,870**



Pageviews:

Partial URL	Page Title	Views
/researchers/new-pi-resources	New Principal Investigator (PI) Resources	7,564
/researchers/pi-launchpad	PI Launchpad Workshop Content	4,430
/researchers/pi-launchpad-sessions	PI Workshop Sessions	935
/researchers/pi-launchpad-resources	Resources	670
/researchers/pi-launchpad	PI Launchpad	529
/researchers/pi-launchpad/2021-virtual-workshop	2021 Virtual Launchpad Information	353
/researchers/pi-launchpad/questions-and-answers	Questions and Answers about the PI Launchpad 2021 Virtual Workshop	141
/researchers/pi-launchpad/networking-sessions	PI Launchpad: Networking Sessions	124
/researchers/pi-launchpad/accessibility	Accessibility Statement	106
/researchers/new-pi-resources/resources	Resources	18

Roman Post-COVID Schedule Impact

- Roman confirmed by NASA on February 28, 2020. Formally established project with a maximum budget & schedule (the “Agency Baseline Commitment”). Then COVID hit.
- At that point, rate of work at its peak. Project efficiency ~30% for a couple of months, returning rapidly to ~70% efficiency; extrapolating taper back to normal work.
- Roman project replan review conducted in May 2021 accounting for *only* COVID impacts.
- All other challenges to project development are being handled within reserves.
- Net impact is several months of slip to launch date with concomitant cost increase.
- A cost breach is unlikely, and an estimate of the cost increases is included in the FY22 Congressional Justification.
- We are currently completing the replan process, including communicating the replan and new cost/schedule estimates to our stakeholders in the Executive Branch and in the Congress.

APAC Recommendations

	APAC Recommendation – March 2021	NASA Response
24	APAC requests an update from the Webb project at the 2021June meeting, specifically the NASA historian (or appropriate designee), on the status of the Webb investigation and the historical lens through which to evaluate the context of past activities within the current framework of NASA's five-key Agency goals, including the NASA 5th pillar.	NASA is aware of concerns that have arisen about James E. Webb, and we are working with historians to examine his role in government. NASA named its next generation observatory, the James Webb Space Telescope, after its second administrator, who helped establish the Apollo Program that landed humans on the Moon. The agency made the naming decision in recognition of Webb's role in retaining an active science program at NASA in the agency's early years. Webb's work as administrator laid the groundwork for today's accomplishments, and science remains a critical part of NASA's work: to understand the universe, advance exploration, and inspire the next generation.
25	The APAC recommends that Webb continue or expand the Master Class series for proposers.	STScI will be devoting more time/staff to working with people who have data and the help desk activities rather than additional Master Classes. They may plan additional ones, but not at the same scale as before.
26	The APAC suggests that APD consider the utility of continuing virtual proposal reviews post-pandemic.	Assessment will be conducted by SMD. Update to be reported at October 2021 APAC meeting. Peer reviews will continue to be conducted virtually for all ROSES-2021 reviews. SMD anticipates that numerous review panels will be run virtually post-pandemic. (OPEN)

APAC Recommendations (Nov 2020)

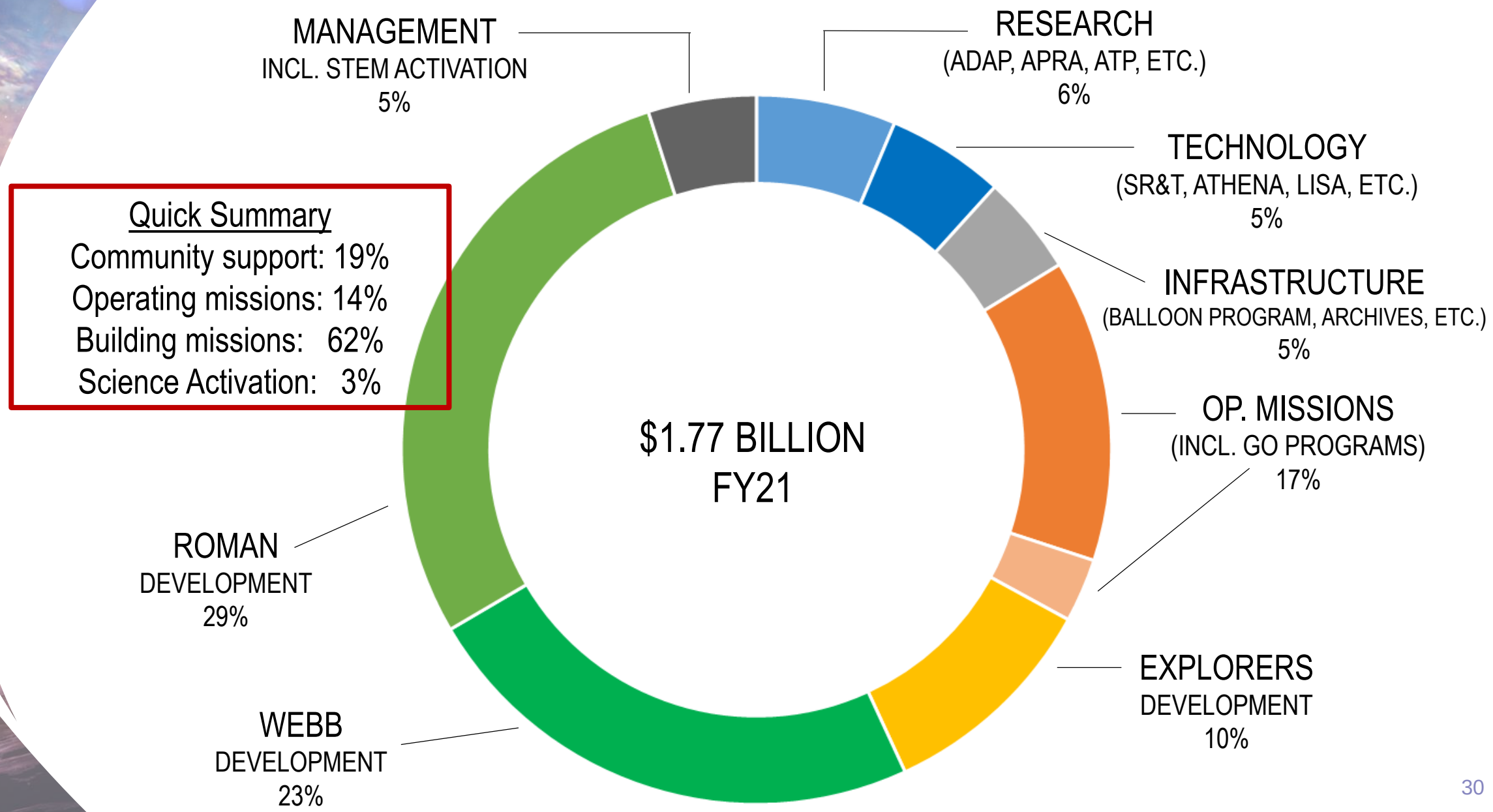
	APAC Recommendation – November 2020	NASA Response
4	The APAC looks forward to a more detailed report on the impact of the Dual Anonymous Peer Review (DAPR) process in Research Opportunities in Space and Earth Sciences (ROSES) on early career scientists, first-time proposers, first-time institutions, and any other community or demographic type information that can be legally gathered.	Presentation at a future meeting. (OPEN)
8	The APAC requests that APD and SMD undertake internal discussion to explore and understand what a stand-up of a Cultural Ethics/Protocol Office that includes BIPOC from inception might entail and report out at the next APAC status of the profession session.	APD and SMD decline. Any such Office should be established at the Agency level.
21	The APAC desires to continue discussion with Astrophysics Division management about programmatic balance across the Exoplanet Research Program (XRP) in light of the forthcoming Decadal Survey priorities.	Discussion at a future APAC meeting after receipt of the 2020 Decadal Survey. (OPEN)

APAC Questions

APAC Questions	NASA Response
How are the R&A budgets for investigator teams determined as a fraction of the overall mission operations and support budgets (i.e., for Hubble, Chandra, etc.)?	See charts on “GO Budgeting”
Are there concise numbers available on the total R&A in each annual budget, and how is mission specific R&A opportunities balanced against those in ROSES calls?	See charts on “GO Budgeting”
Is there a standard metric or guidance provided by the Division to mission centers on the dollar cost per awarded hour (or similar denominator), or does each mission have their own internal assessment formula (or free-range speculation)?	See charts on “GO Budgeting”
It seems that the Cycle 1 JWST requested budgets from successful teams outstrips the notionally allocated resources envisaged by STScI by potentially a significant margin. To fully exploit the potential of a new, complex mission was there any pre planning discussions within the Division to anticipate and/or scope the community’s assessment of the required resources or was this an exercise left to the mission science operations folks to "as guesstimate?" What is the pass-back process?	See chart on “Webb Cycle 1 Budgeting”
The community was not very happy with the budget request process from the Institute regarding JWST Cycle 1, which was very ill-defined, poorly communicated to the community (especially new early career investigator), with no guidelines. Has there been an after-action assessment of why this was so poorly rolled out?	See chart on “Webb Cycle 1 Budgeting”
With the decadal report release uncertain, I'd be curious to know what the plans are for the next budget cycle, since the OMB budgeting process for FY23 will start in the fall and so NASA may not have much if any time to ingest the decadal priorities. It would be helpful to hear what the expected approach is at this point.	See chart on “Decadal Survey Response Budgeting”

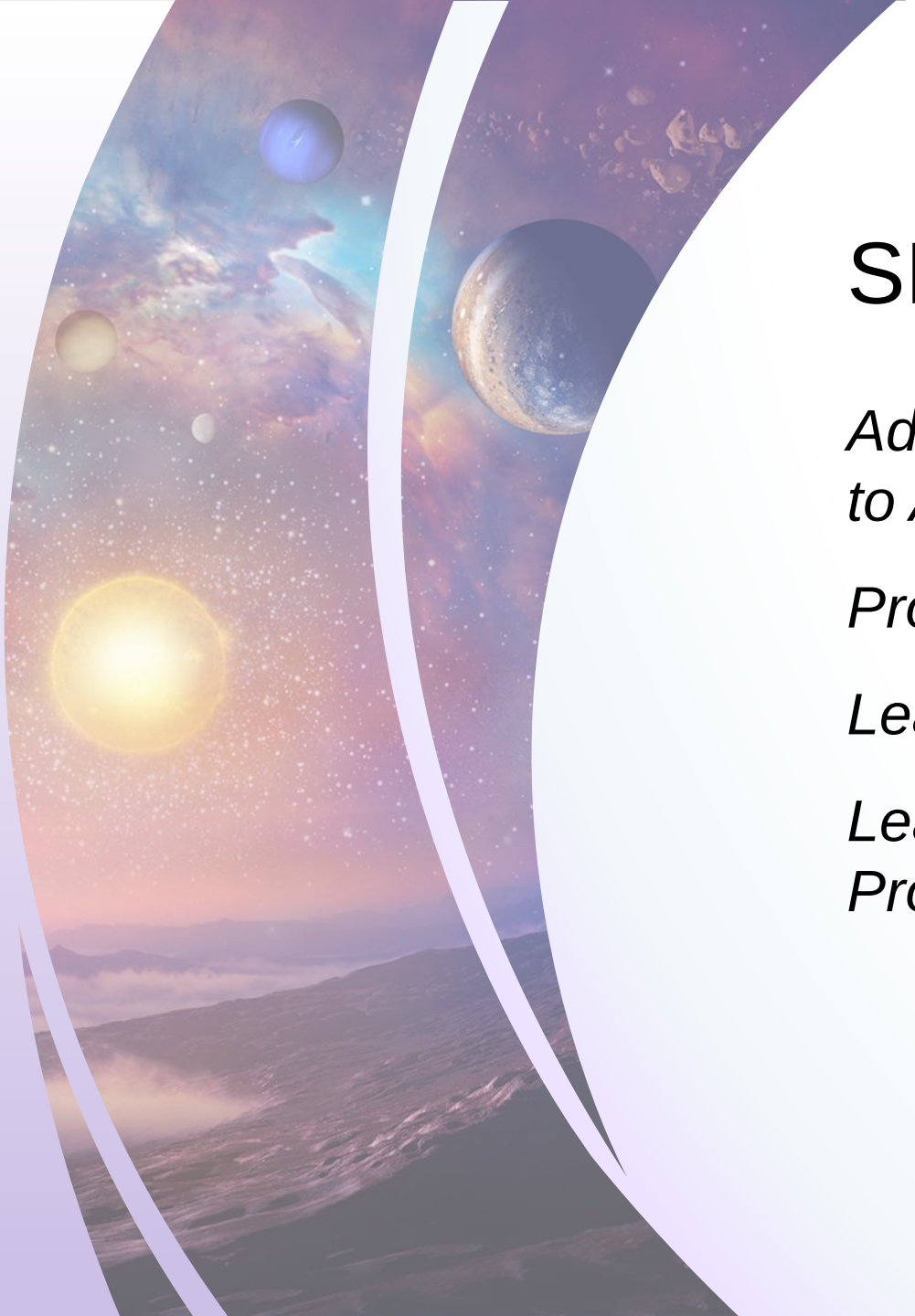
FY22 President's Budget Request

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



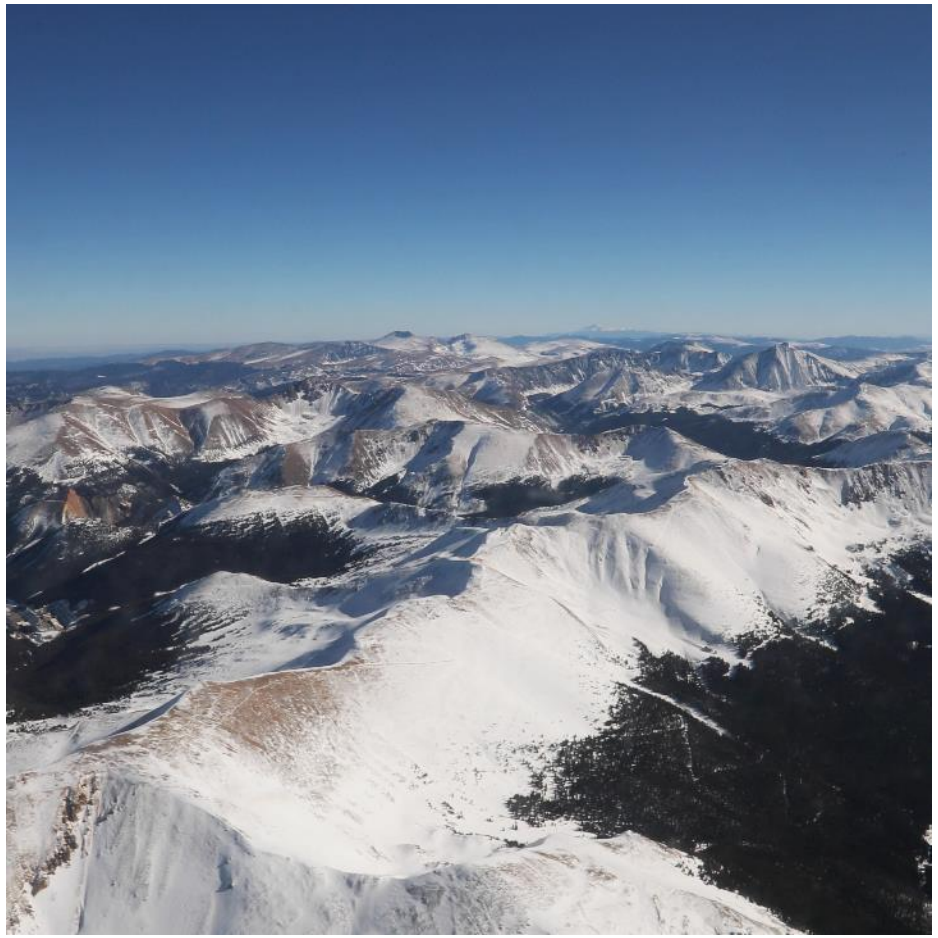
SMD FY22 Budget Strategy

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

Advance Earth System Science and Applications to Address the Climate Crisis

- Build the Earth Systems Observatory to enhance and integrate research, data and applications to support near-term and long-range decisions by local, state, tribal and federal government officials.
- Address the top technological and science challenges with innovative tools, explorer missions, technology programs, and increased commercial partnerships
- Observations of Earth’s land, ocean, ice, and atmosphere to understand the drivers and results of the changing climate
- Research and models advance our understanding of, and ability to predict, the changing climate and its interactions with human communities

FY22 BUDGET HIGHLIGHTS

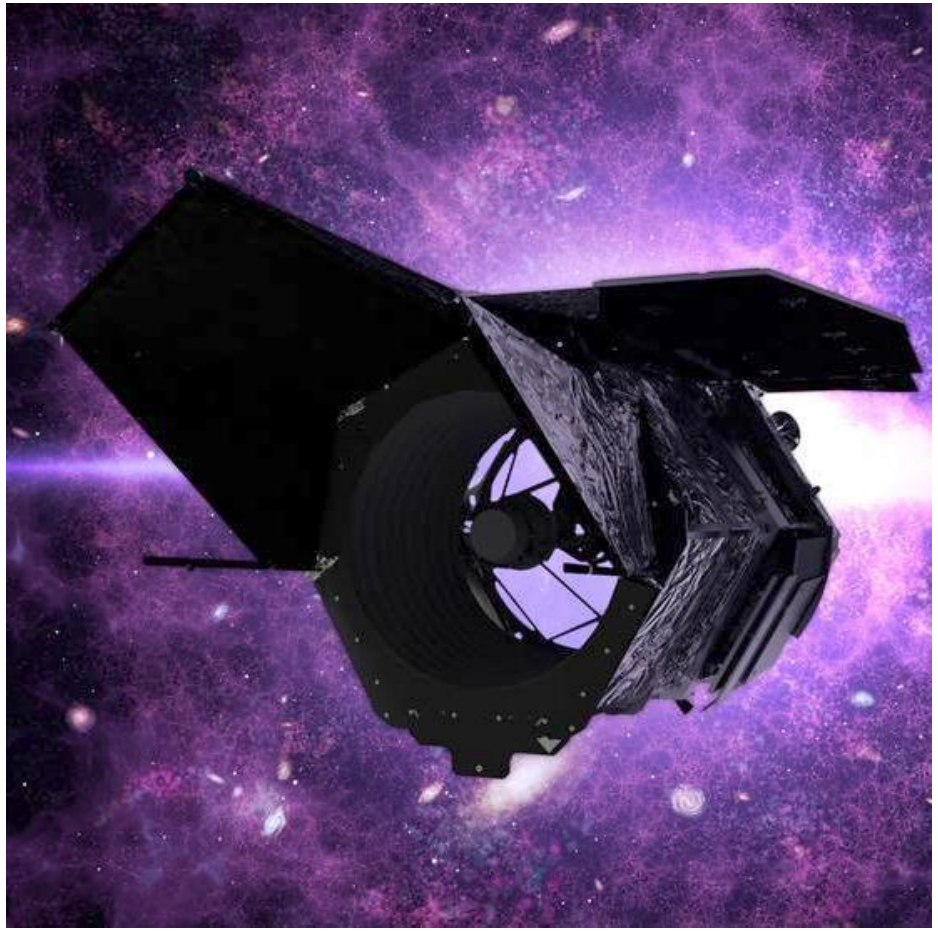
Promote Diversity, Equity and Inclusion in Science

- 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 Artemis Science

- Be a critical part of the Artemis program with enhanced lunar science and technology demos, and a strong collaboration between science and human exploration
- Enable development of more than 15 missions (including lunar, Mars, and Heliophysics) that inform and enable Artemis work
- Bolster crucial lunar science with Commercial Lunar Payload Services (CLPS) initiative, leveraging commercial partnerships to deliver science and tech payloads beginning in FY2022 to virtually anywhere on the Moon, including the poles and far side
- Begin the search for polar ice early in FY2024 with Volatiles Investigating Polar Exploration Rover (VIPER)



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

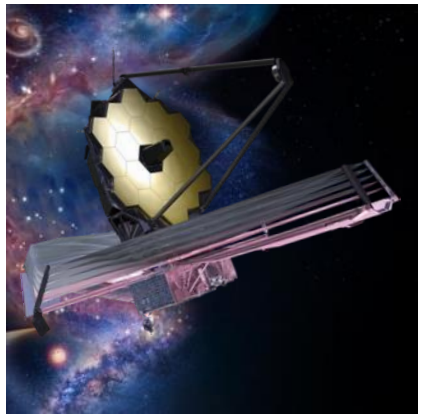
Requests $1,575.5 M for NASA Astrophysics in FY 2022

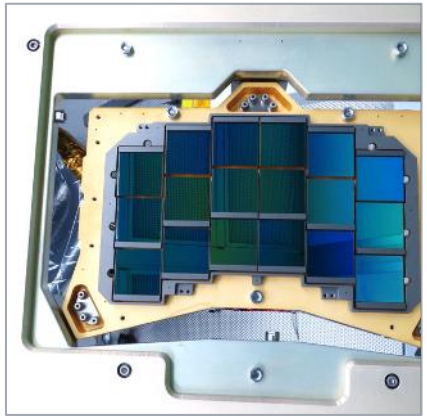
What's Changed compared to one year ago (previous budget request)

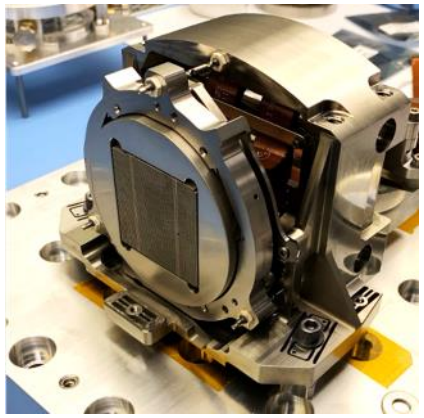
- Funds continued development of the Nancy Grace Roman Space Telescope and estimated COVID impacts
- Plans for an Astrophysics Probe-class mission and other initiatives pending receipt of the Decadal Survey
- Four Astrophysics Pioneers conducting mission concept studies
- Enhanced facilities and open 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



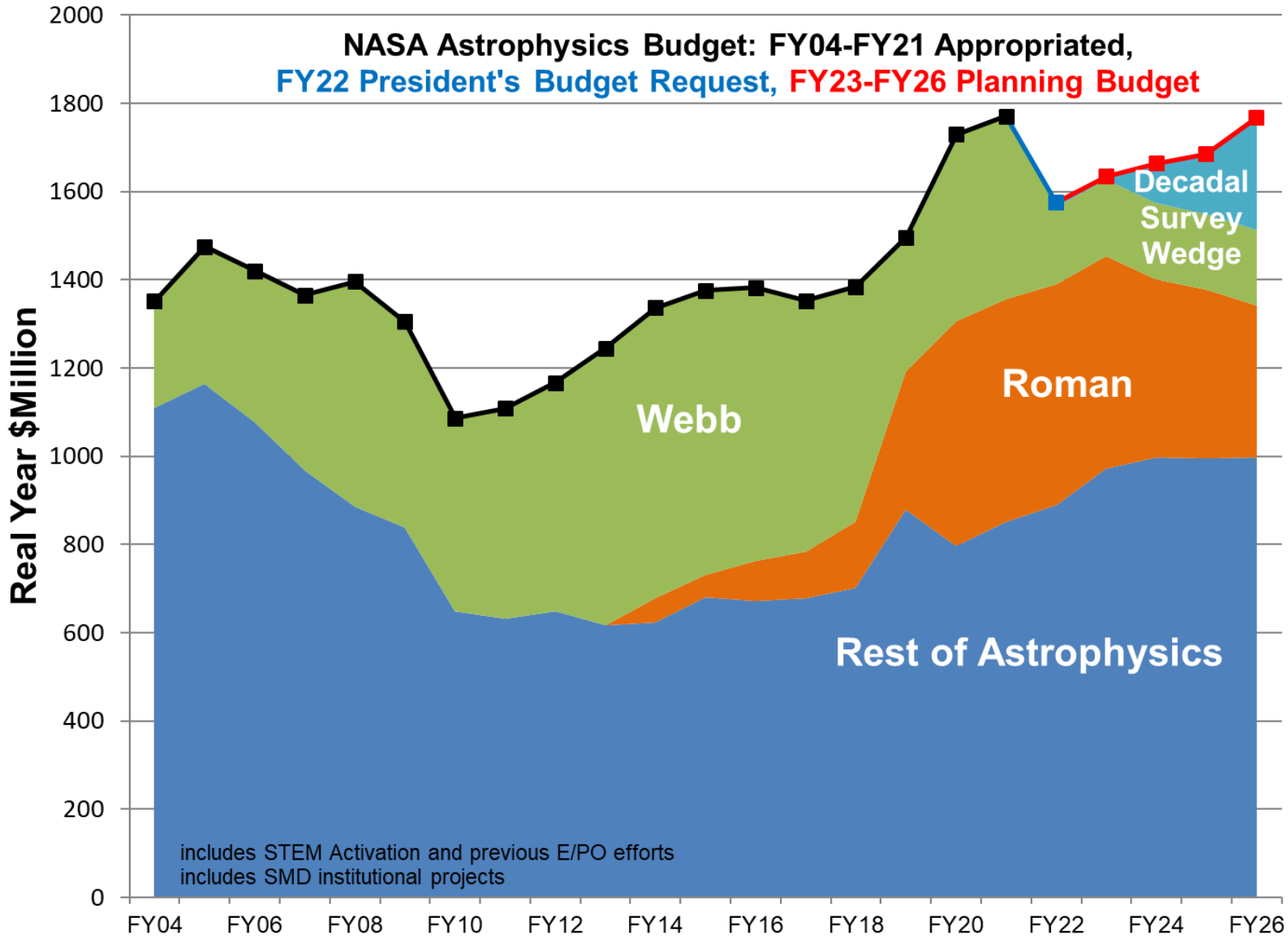




Planned Milestones FY21-22

- 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

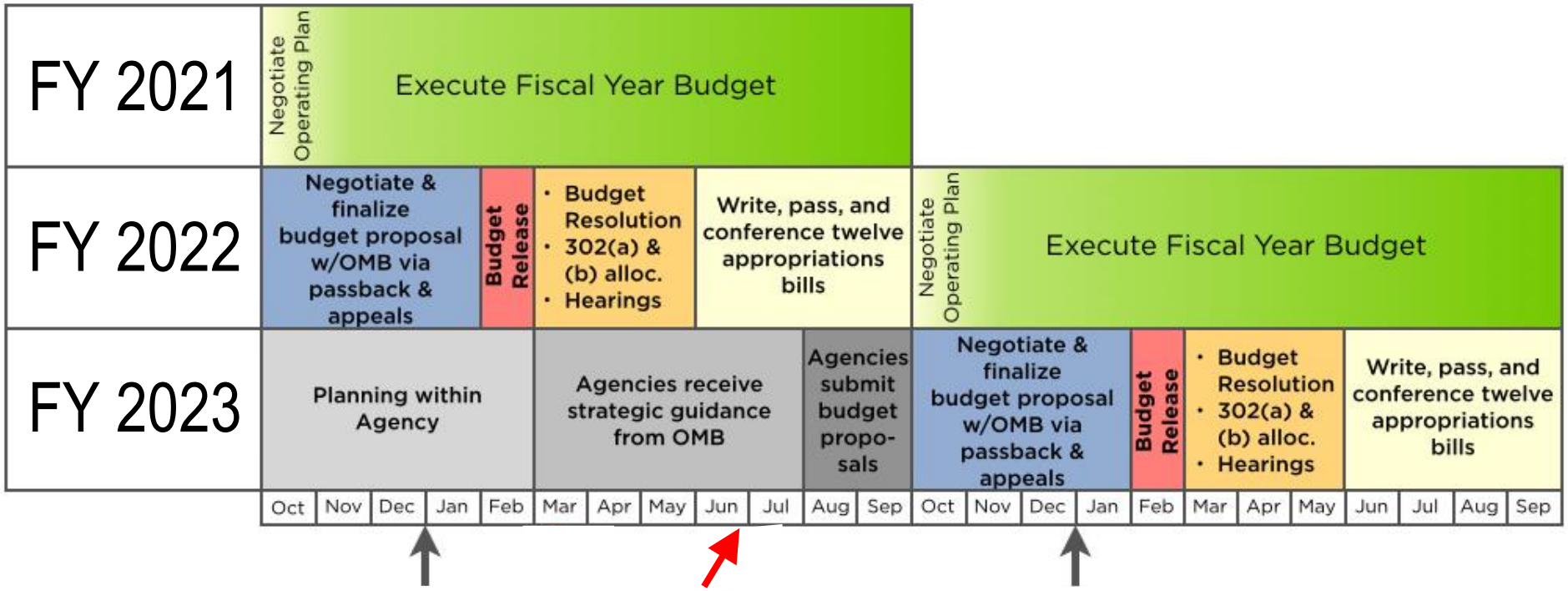
Astrophysics Budget – FY22 Request



Decadal Survey Response Budgeting

With the decadal report release uncertain, I'd be curious to know what the plans are for the next budget cycle, since the OMB budgeting process for FY23 will start in the fall and so NASA may not have much if any time to ingest the decadal priorities. It would be helpful to hear what the expected approach is at this point.

Federal Budget Cycle



Internal astrophysics schedule	
May	Projects to APD
Early July	APD to SMD
Summer	SMD to NASA
Early Sept	NASA to OMB

Adapted by Kevin Marvel (AAS)
https://aas.org/files/budgetprocess_adaptedfromaaas.jpg
from budget presentation by Matt Hourihan (AAAS)
http://www.aaas.org/page/presentations

Decadal Survey Response Budgeting

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- The Federal budget cycle is lengthy and complex (as it should be). It is summarized in the next chart.
  - Astrophysics is formulating its FY23 budget request now, and is submitting its request to SMD in early July.
  - Astrophysics must submit a budget that is “in guide.” All new initiatives and augmentations must fit within the planning guidelines provided to Astrophysics.
- As discussed, Astrophysics is prioritizing unprogrammed budget wedges that can be used to respond to the Decadal Survey in FY23. “Prioritizing” means that other issues and opportunities will not receive funding.
  - If Astro2020 is received in time, and if the blind prioritizing needs adjusting, there may be an opportunity to discuss adjustments in the FY23 request within NASA (before submission to OMB in early September) or with OMB (before FY23 budget request is finalized following passback in late November).
  - If Astro2020 is received before Congress sets the FY22 budget, then Congressional appropriators could include funding in the FY22 budget for implementing Decadal Survey priorities.
  - If the FY22 appropriation for Astrophysics includes flexibility, then Astrophysics could use some of its FY22 appropriation to advance Astro2020 priorities. Other issues and opportunities would not receive appropriated funding. NASA’s FY22 operations plan will be due to Congress 6 weeks after it receives its FY22 appropriation.

Research Program Update

COVID-19 Mitigations for 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 32 COVID recovery funding extension requests in Astrophysics for a total of ~$5.7M. Selected 26 for $3.2M, with 2 requests pending.

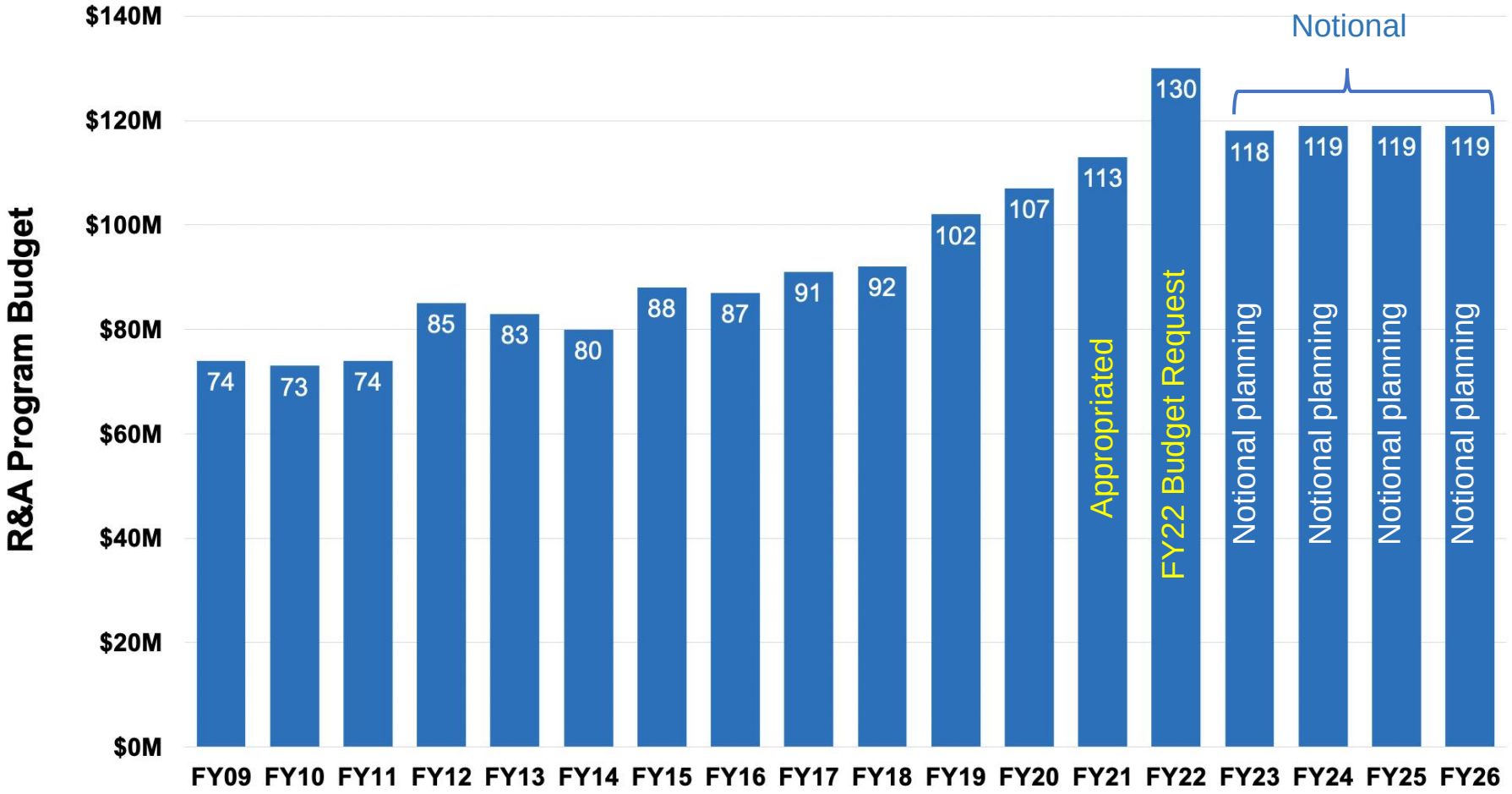
Within current funding constraints, SMD will continue to support 124 NASA Postdoctoral Program (NPP) fellowships

- 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



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

Since the last Decadal Survey:

+38% R&A funding growth

Notional Planning:

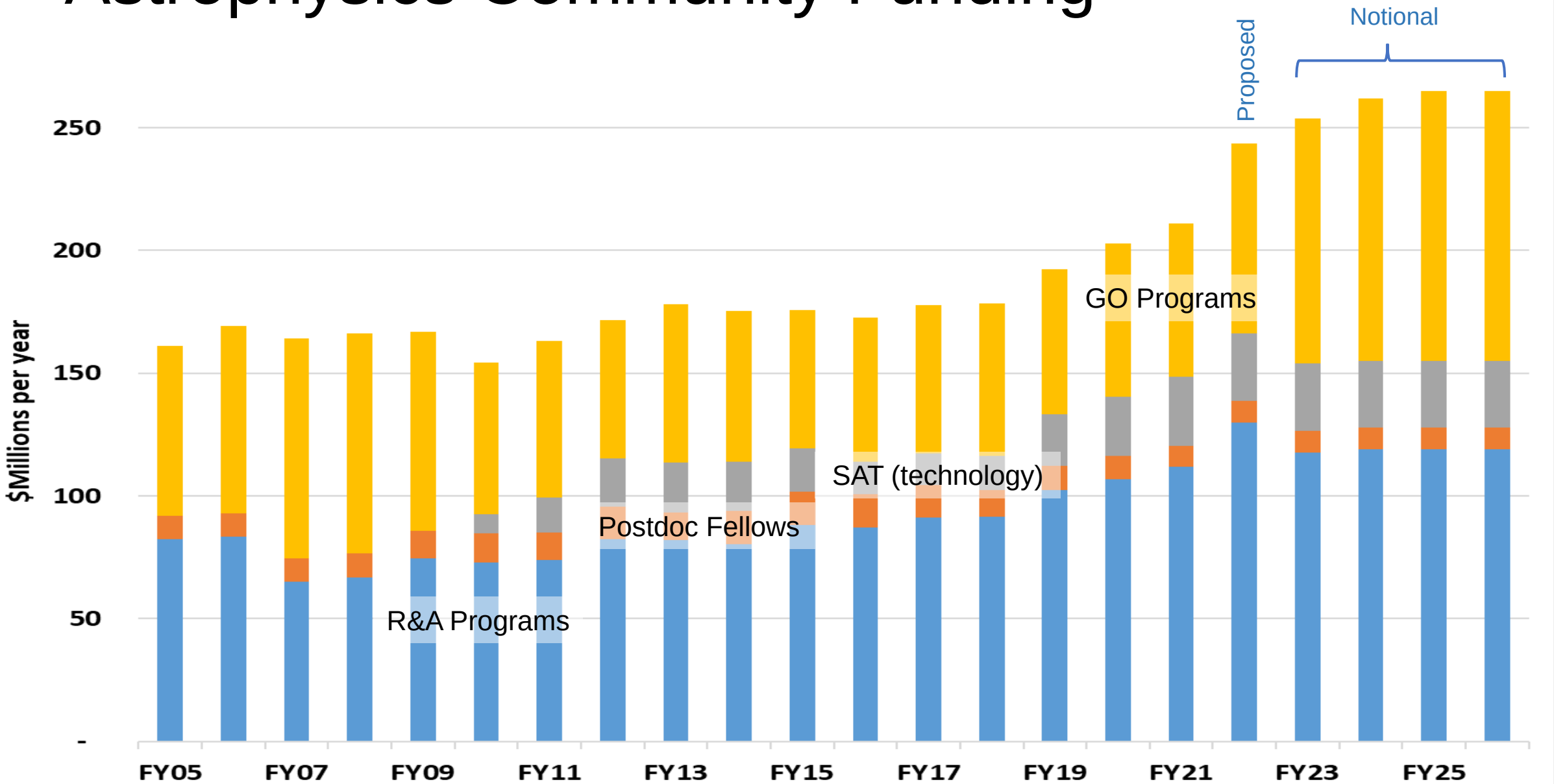
+60% over 17 years.

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

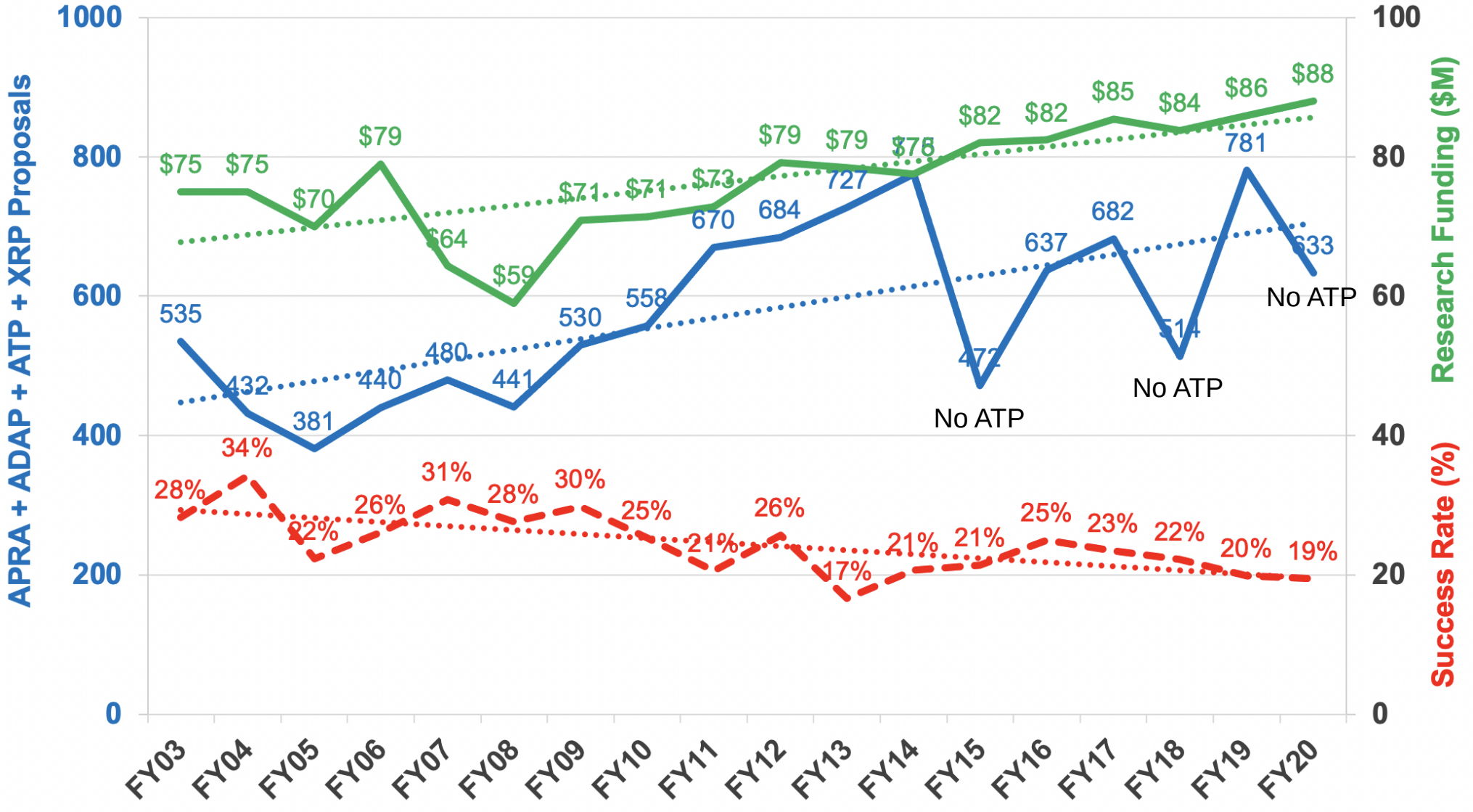
Not included in this plot:

- GO/GI Programs for missions
- Strategic Astrophysics Technology (SAT)

Astrophysics Community Funding



R&A Proposals, Research Funding, Success Rate



Recent R&A Initiatives

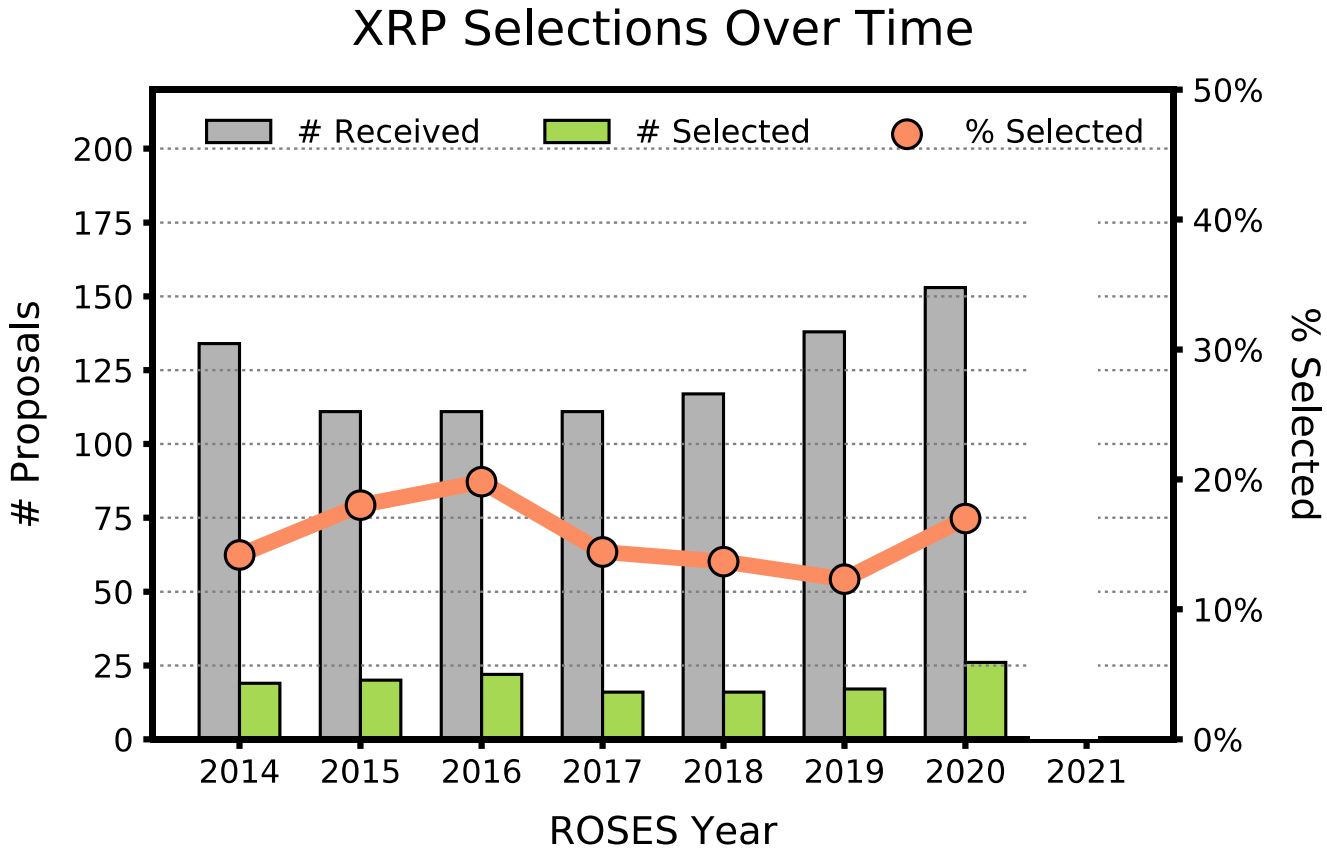
- Code of Conduct for Peer Reviews: Astrophysics code is now adopted for all SMD reviews
- Inclusion, Diversity, Equity, and Accessibility: Established IDEA taskforce for Astrophysics R&A, implementing recommendations of SMD's Anti-Racism Action Group
- Pioneers: Established new program for <$20M SmallSats, balloons, ISS payloads
- Exoplanet Research Program (XRP) Consolidation: All exoplanet investigations under XRP, ramping up funding (see next chart)
- 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

Exoplanet Research Program Updates

- Beginning with ROSES-2020, exoplanet research elements from ADAP, ATP, & APRA-Lab Astro have been moved into XRP.
- Exoplanet technology development remains in APRA
- Selection rates last year went up
- New this year: Dual-Anonymous Peer Review (DAPR)

Possible causes for growth in number of proposals:

- Growth in exoplanets as a field in general
- Delayed growth due to COVID-19
- Delayed growth because ATP not solicited last year



Citizen Science

Citizen Science is a form of open collaboration in which individuals participate voluntarily in the scientific process – Citizen Science is a science investigation that relies on volunteers

Current astrophysics projects at https://science.nasa.gov/citizenscience include

- Backyard Worlds: Planet 9 project at https://backyardworlds.org
- Disk Detective at https://www.zooniverse.org/projects/ssilverberg/disk-detective
- Planet Hunters TESS at https://www.zooniverse.org/projects/nora-dot-eisner/planet-hunters-tess
- Planet Patrol at https://exoplanetpatrol.org

Proposers to any ROSES program element may incorporate citizen science and crowdsourcing methodologies into proposals

- XRP proposal selected: A Uniform Catalog of Planets from TESS Full Frame Images

Citizen Science Seed Funding Program in ROSES funds prototyping of citizen science projects offered. Four astrophysics citizen science proposals selected from ROSES-20

- Disk Detective v2.0: Identifying Unusual Circumstellar Disks Via Citizen Science
- 'Backyard Worlds: Cool Neighbors' - Discovering Brown Dwarfs through Citizen Science
- Redshift Wrangler: Citizen Science Analysis of Extragalactic Spectroscopy
- Leveraging a Zooniverse Discovery to Diagnose a Dominant Mode of Star Formation and Provide a CURE for Introductory Astronomy Students

Citizen Seed Funding proposals in ROSES-21 due December 15, 2021

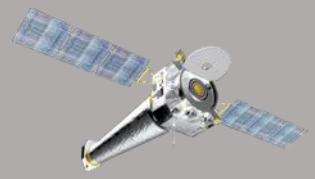
Mission Program Update

Astrophysics Missions in Operations

Hubble 4/90
NASA Strategic Mission

Operations Nominal

Chandra 7/99
NASA Strategic Mission



Operations Nominal

XMM-Newton 12/99
ESA-led Mission

Operations Nominal (ESA)

Gehrels Swift 11/04
NASA MIDEX Mission

Operations Nominal

Fermi 6/08
NASA Strategic Mission

Operations Nominal

NuSTAR 6/12
NASA SMEX Mission

Operations Nominal

SOFIA 5/14
NASA Strategic Mission

Operations Nominal

ISS-NICER 6/17
NASA Explorers Miss. of Oppty

Operations Nominal

TESS 4/18
NASA MIDEX Mission

Operations Nominal

Balloon Program
Four Campaigns per Year

Operations Resumed Spring 2021

Sounding Rockets
Worldwide Campaigns

Operations Nominal

Data Archives
HEASARC, IPAC, MAST, etc.

Operations Nominal

Next Senior Review is in 2022

Senior Review 2022

Senior Review timeline will be standard (note that 2019 was impacted by Government shutdown)

August 2021	Draft call for proposals
November 2021	Final call for proposals
January 2022	Proposals due
March 2022	Panel meetings
April 2022	Report due (in time to impact FY24 budget formulation)

Missions expected to be in the Senior Review include

- Hubble
- Chandra
- XMM-Newton (ESA-led)
- Gehrels Swift
- Fermi
- NuSTAR
- SOFIA
- NICER
- TESS

GO Budgeting

How are the R&A budgets for investigator teams determined as a fraction of the overall mission operations and support budgets (i.e., for Hubble, Chandra, etc.)?

- The grants programs associated with missions are called “General Observer or Guest Investigator (GO/GI) programs. The difference is whether you get telescope time (GO) or just data/funding (GI).
- GO/GI budgets are initially set for missions at Confirmation, when NASA makes the Agency Baseline Commitment for the life cycle cost of the mission. For strategic (directed) missions, the LCC includes operations (Phase E) through the end of the prime mission, and operations includes the GO/GI program.
  - For PI-led (competed) missions, GO/GI programs are added in the extended mission. GI programs during the prime mission are generally funded through ADAP.
  - GO/GI funding levels can be adjusted through the Senior Review process. GO/GI budgets are discussed explicitly during the Senior Review process.
- There is no single formula, as every mission is different.
  - GO/GI budgets are not set as fractions of the overall mission operations budgets.
  - Each is set independently based on the known (or estimated) requirements.

GO Budgeting

Are there concise numbers available on the total R&A in each annual budget, and how is mission specific R&A opportunities balanced against those in ROSES calls?

- R&A and mission GO/GI budgets are set independently. Both contribute to the overall programmatic balance in astrophysics.
- Following each Senior Review, direction is provided by NASA Headquarters to each project on its planning budget for the next three years. The operations budget and the GO/GI budget are specified separately in this direction.
- The amount of GO/GI funding available should be stated clearly in the GO/GI call for proposals.
  - For NASA-managed programs, the call for proposals is a ROSES element, and the available funding is always stated in the Summary of Key Information table at the end of the ROSES element.
  - For contractor-managed programs (Hubble, Chandra, SOFIA, Webb), funding should be stated clearly in both the Step 1 (observing) call and the Step 2 (funding) call.

Is there a standard metric or guidance provided by the Division to mission centers on the dollar cost per awarded hour (or similar denominator), or does each mission have their own internal assessment formula (or free-range speculation)?

- There is no standard metric.
  - Not all investigators receive observing time.
- The total GO/GI budget is set by NASA Headquarters (first at Confirmation, and adjusted during Senior Reviews).
  - The project allocates this funding among the GO/GI investigators.
  - Some projects use formulas, some do not.

Webb Cycle 1 Budgeting

It seems that the Cycle 1 JWST requested budgets from successful teams outstrips the notionally allocated resources envisaged by STScI by potentially a significant margin. To fully exploit the potential of a new, complex mission was there any pre planning discussions within the Division to anticipate and/or scope the community's assessment of the required resources or was this an exercise left to the mission science operations folks to "as guesstimate?" What is the pass-back process?

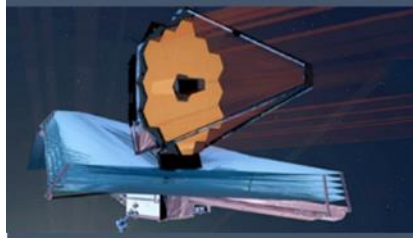
- There was extensive discussion within the project, including community input, and between the project and Headquarters, when the Webb budget was set at Confirmation (2008) and again at Replan (2011).
- The planned GO/GI budget for Webb is included in the current $9.663B Agency Baseline Commitment for Webb life cycle cost.

The community was not very happy with the budget request process from the Institute regarding JWST Cycle 1, which was very ill-defined, poorly communicated to the community (especially new early career investigator), with no guidelines. Has there been an after-action assessment of why this was so poorly rolled out?

- STScI used a process similar to that for Hubble to solicit budgets for Webb. The total budget request from the community exceeded any previous budget requests for a NASA astrophysics mission. A review of the budgets will occur this summer, with a final cycle value to be determined by the Webb project in the near future. Based upon the outcome of that review, STScI will work with the JSTUC to address how this process should be modified for Cycle 2.

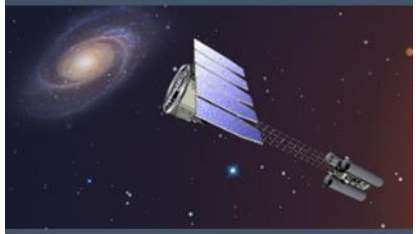
Astrophysics Missions in Development

Webb — 2021
NASA Mission



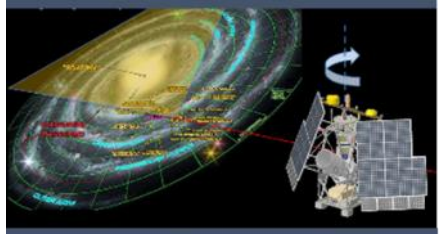
James Webb
Space Telescope

IXPE — 2021
NASA Mission



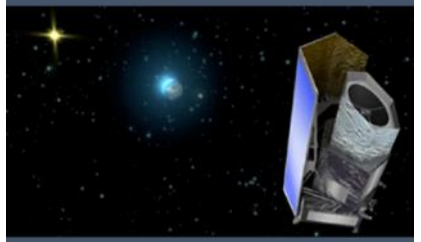
Imaging X-ray
Polarimetry Explorer

GUSTO — 2022
NASA Mission



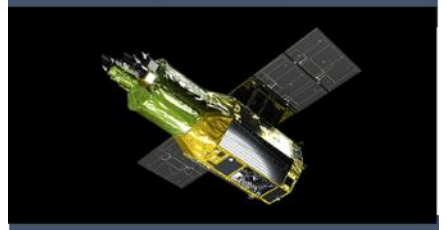
Galactic/ Extragalactic ULDB
Spectroscopic Terahertz Observatory

Euclid — 2022
ESA-led Mission



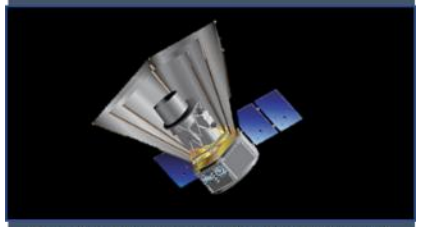
NASA is supplying the NISP
Sensor Chip System (SCS)

XRISM — 2023
JAXA-led Mission



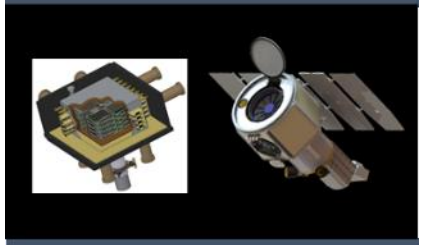
NASA is supplying the SXS
Detectors, ADRs, and SXTs

SPHEREx — 2024
NASA Mission



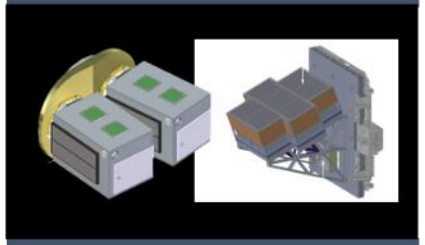
Spectro-Photometer for the History of
the Universe, Epoch of Reionization,
and Ices Explorer

SMEX — ~2025
NASA Mission



COSI or ESCAPE

Mission of Opportunity — ~2025
NASA Mission



Dorado or LEAP

Roman — 2026
NASA Mission

Nancy Grace Roman
Space Telescope

ARIEL — 2029
ESA-led Mission

NASA is supplying the CASE
fine guidance instrument

Launch dates are current project working dates; Agency Baseline Commitment launch date could be later; impacts of COVID-19 not yet known

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, NASA contributions to ARIEL, Athena, LISA), 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

Mission impacts to commitments due to COVID (only missions with commitments)			
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 Mission Classes

Updated January 28, 2021

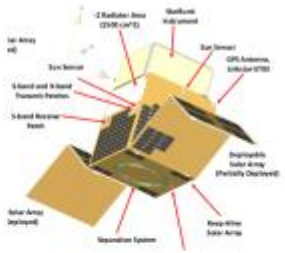
*PI Cost Cap **Includes ISS-attached Experiments

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).

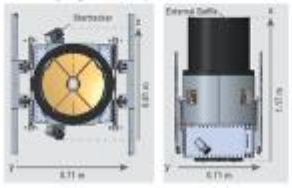
PUEO: A Long-duration Balloon-borne Instrument for Particle Astrophysics at the Highest Energies, PI Abigail Vieregg, U Ch

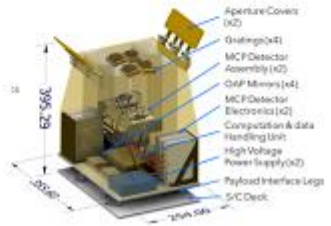
Figure 10: A rendering of the PUEO payload, including a design for the low-frequency drop-down instrument.



StarBurst: Gamma-ray ASM, Simultaneous detection of NS/NS mergers with LIGO, PI Daniel Kocevsk,i MSFC

Pandora: Multiwavelength Characterization of Exoplanets and their Host Stars, PI Elisa Quintana, GSFC



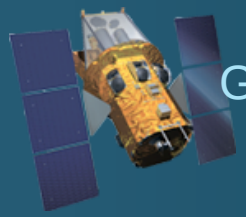


Aspera: IGM Inflow/outflow from galaxies via OVI 10^5K emission line imaging. PI Carlos Vargas, U of A

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

Presentations by
Erika Hamden &
Daniel Kocevski
on Day 1 of this meeting

Astrophysics Explorers Program



Gehrels
Swift

NuSTAR

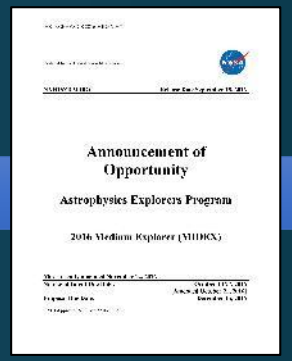
SMEX 2019 Downselect
Phase A Studies due Mar 4, 2021
Downselect decision Fall 2021

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

4 AOs per decade

MIDEX
2011

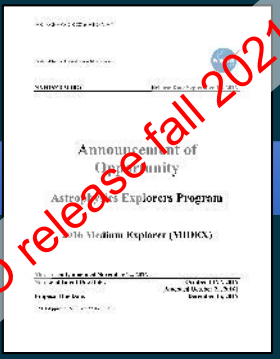
SMEX
2014



MIDEX
2016

Downselect fall 2021

SMEX
2019



AO release fall 2021

MIDEX
2021

Small and
Mid-Size
Missions

TESS

IXPE

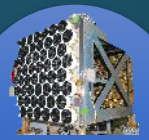
SPHEREx

ESCAPE
COSI

Directed
2013

Euclid

Missions of
Opportunity



NICER

GUSTO

ARIEL

Dorado
LEAP

Directed
2017

XRISM

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

Presentation by
Eric Smith
on Day 2 of this meeting

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 planned for July 2021
- Mission CDR planned for September 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

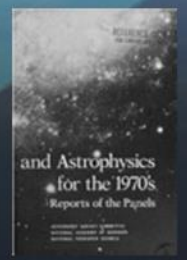
Presentation by
Julie McEnery
on Day 2 of this meeting

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

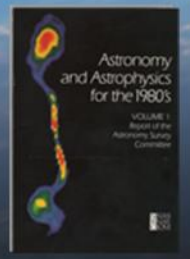
Planning for the Future

Astrophysics

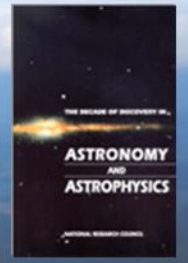
Decadal Survey Missions



1972
Decadal Survey
Hubble



1982
Decadal Survey
Chandra



1991
Decadal Survey
Spitzer

2001
Decadal Survey
Webb

2010
Decadal Survey
Roman

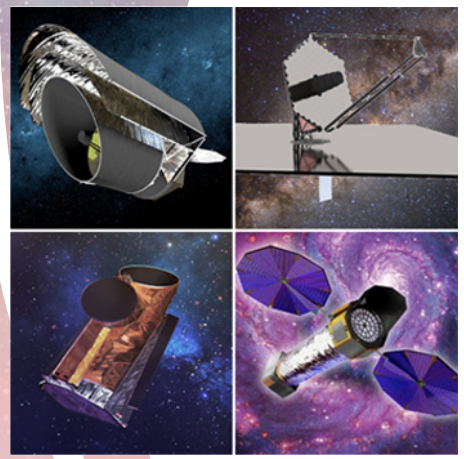
2021
Decadal Survey

Astro2010 Scorecard

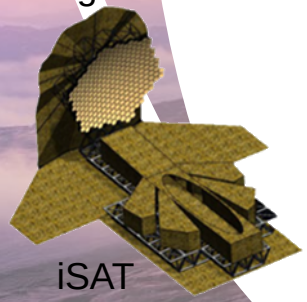
Recommendation		Response / Status	
L	WFIRST	Roman Space Telescope in Phase C, launch by 2027	☑
L	Explorers: 4 AOs / decade	AOs in 2011, 2014, 2016, 2019, 2021, 2024	☑
L	LISA	Partnered with ESA on LISA, launch in mid-2030s	☑
L	IXO	Partnered with ESA on Athena, launch in early 2030s	☑
M	New worlds technology	Matured coronagraphs & starshades, CGI tech demo on Roman, precursor science (LBTI, NEID, EPRV, etc.)	☑
M	Inflation probe technology	Matured detectors in labs and on balloons	☑
S	R&A augmentations	R&A up 60% from FY10 to FY24; added RTF, TCAN, evolved XRP	☑
S	Mid-TRL technology	Initiated SAT, competed and directed technologies	☑
S	Suborbital-class missions	Added New Zealand, developed super-pressure balloon, added CubeSats, added Pioneers	☑
S	SPICA	Elected not to participate	☒

Preparing for the Decadal Survey: Technology Development and Risk Reduction Activities

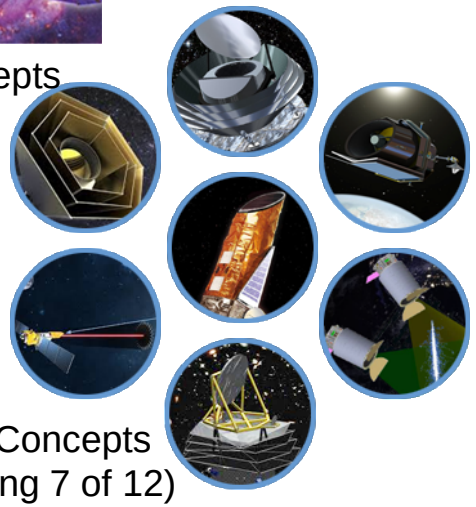
Completed
Large Mission Concept Studies / Probe Mission Concept Studies / In-Space Assembly of Telescopes (iSAT) Study / Large Mission Management Study / STMD Technology Collaborations
Ongoing
Segmented Mirror Technology Program / Binary Star Coronagraph Technology / Deformable Mirrors / Starshade Technology / Extreme Precision Radial Velocity Research and Technology / Detectors (at all wavelengths) / X-ray Mirrors / Cryocoolers
Testbeds (Coronagraph, Ultrastable, X-ray & Cryogenic)
PI-led Strategic Astrophysics Technology (SAT) Advancements



Large Mission Concepts



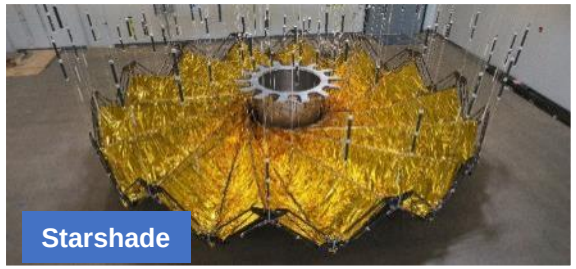
iSAT Concept



Probe Concepts (Showing 7 of 12)

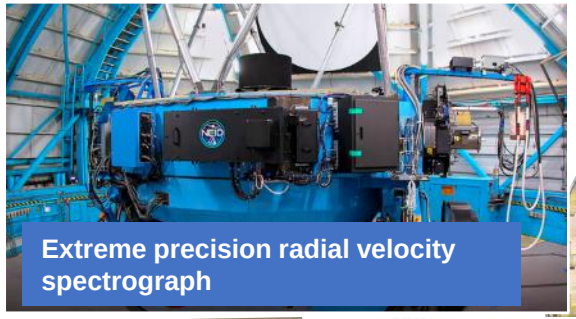
Coronagraph Testbed

Large mirror development

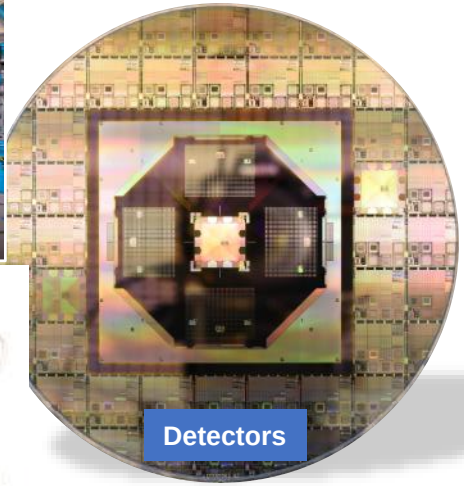


Starshade

X-ray mirror development



Extreme precision radial velocity spectrograph



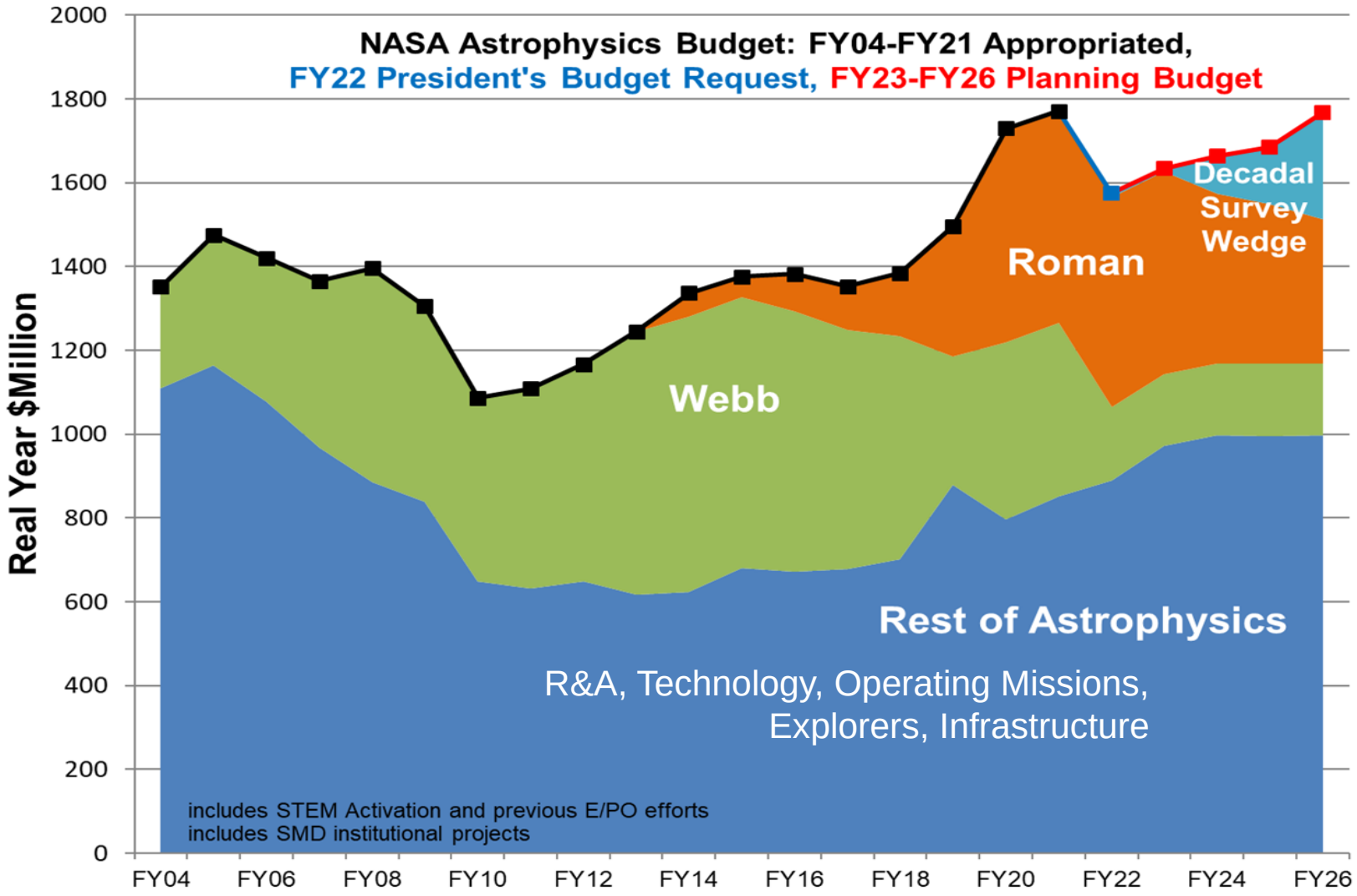
Detectors

Deformable Mirror

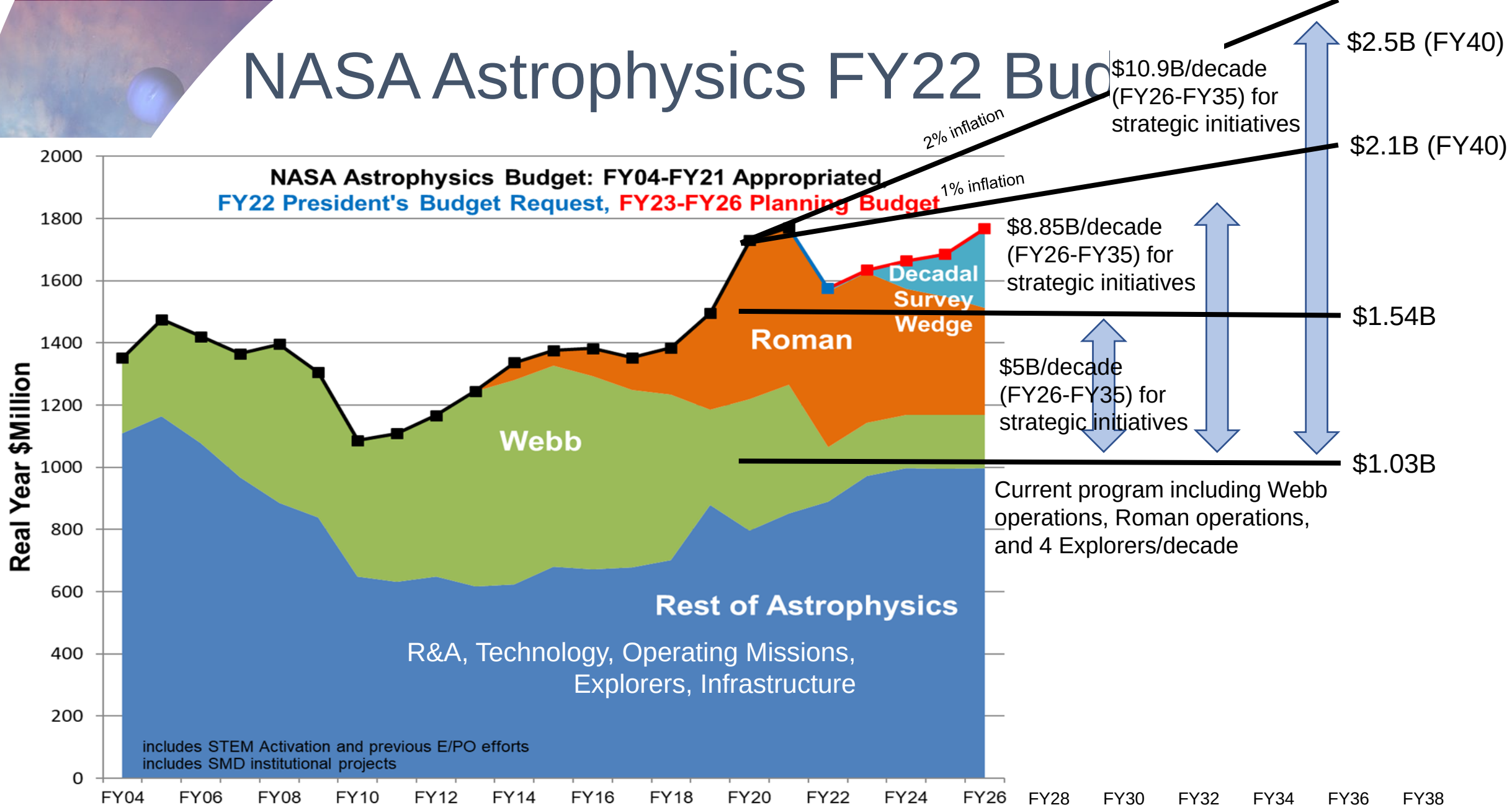
Cryocooler

For more information on technology development activities, see the Astrophysics Technology Development Database (http://www.astrostrategictech.us/)

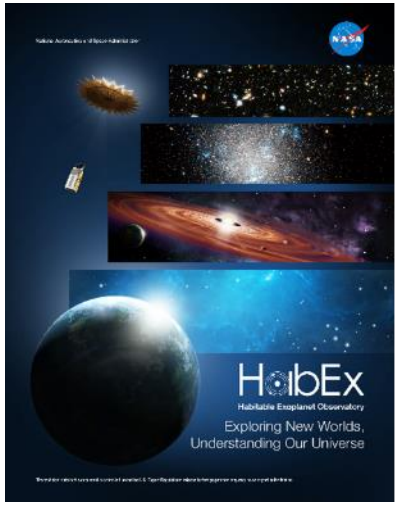
NASA Astrophysics FY22 Budget

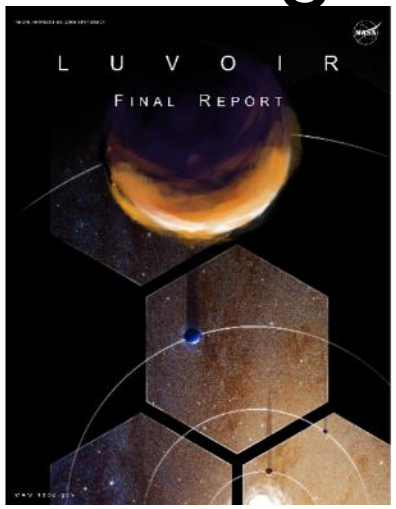


NASA Astrophysics FY22 Buc



NASA Planning for Astro2020






- NASA is planning 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 plans 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

Astrophysics is Looking Up

Webb is launching, Roman is on track

Explorers are being competed and selected regularly

Smaller missions (e.g., CubeSats, Pioneers) are being competed and selected annually

International partnerships are strong

R&A budgets are up, suborbital capabilities are expanding

Technology investments are being made for future missions

NASA is prioritizing an inclusive and diverse astrophysics community, and is initiating changes to address systemic failures that limit accessibility

The FY22 budget request supports all this PLUS contains a funding wedge for a Probe mission and other Decadal Survey priorities