

National Aeronautics and  
Space Administration



# EXPLORE SOLAR SYSTEM & BEYOND

## NASA Town Hall

AAS 236th Meeting | June 1, 2020

**Paul Hertz**

Director, Astrophysics Division

Science Mission Directorate

@PHertzNASA

Slides posted at <http://science.nasa.gov/astrophysics/documents>



# NASA Events at the



## Monday, June 1

115 NASA Town Hall – 1:40 pm EDT; Annie Jump Cannon Meeting Room

## Tuesday, June 2

201 Dual-Anonymous Peer Review for NASA Astrophysics Proposals – 11:00 am EDT Annie Jump Cannon Meeting Room

216 STScI Town Hall – 1:40 pm EDT; Annie Jump Cannon Meeting Room

## Wednesday, June 3

315 NASA-NSF Exoplanet Observational Research (NN-EXPLORE) Program at the WIYN Observatory – 2:50 pm EDT; Maria Mitchell Room

## Monday, June 1 – Wednesday, June 3

Visit the NASA Virtual Booth in the Exhibit Hall

Exhibit webinars 10 times daily at

11:00, 11:30, 12:00, 1:30, 2:00, 2:30, 3:00, 3:30, 4:00, 6:00 EDT



# NASA Astrophysics Division

## Division Director



**Paul Hertz**  
Astrophysics Division  
Director



**Jeff Volosin**  
Astrophysics Division  
Deputy Director



## Program Executives



**E. Lucien Cox**  
SOFIA, GUSTO, XRISM



**Shahid Habib**  
COR, ExEP, PCOS  
ARIEL, Athena, Euclid,  
LISA



**Jeff Hayes**  
Astrophysics Operating  
Missions



**David Jarrett**  
Roman



**Mark Sistilli**  
Explorers Program  
IXPE, SPHEREx  
Balloons

## Cross Cutting



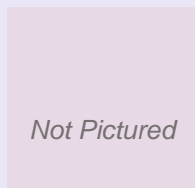
**Eric Smith**  
Chief Scientist  
Webb



**Jeanne Davis**  
Assoc Dir for Flight  
ASM Program Manager



**Mario Perez**  
Chief Technologist  
SAT, RTF

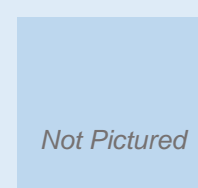


**Lisa Wainio**  
Information Manager,  
Public Affairs Liaison

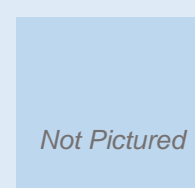
## Administrative Support



**Kelly Johnson**  
Administrative Assistant



**Mathew Riggs**  
Administrative Assistant



**Jackie Mackall**  
Program Support  
Specialist



**Ingrid Farrell**  
Program Support  
Specialist

## Program Scientists



**Dominic Benford**  
APRA Lead  
Roman



**Valerie Connaughton**  
APRA (High Energy)  
XRISM



**Dan Evans**  
PCOS Program  
NICER  
Dual Anon.PR



**Michael Garcia**  
APRA (UV/Optical),  
CubeSats/SmallSats  
Hubble, Athena



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



**Hashima Hasan**  
Education/Comms  
Citizen Science, Archives  
Astro. Advisory Cmte.



**Douglas Hudgins**  
ExEP Program  
ADAP Lead  
TESS, ARIEL



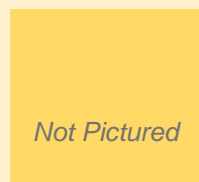
**Stefan Immler**  
Astrophysics Research  
Program Manager  
Chandra, XMM



**Patricia Knezek**  
Hubble Fellows  
SOFIA



**William Latter**  
APRA (Lab Astro)  
Spitzer, SPHEREx, Fermi



**Pamela Marcum**  
Exoplanet Research  
Program (XRP)



**Aki Roberge**  
ASMP, Roman



**Rita Sambruna**  
GSFC  
(on detail)



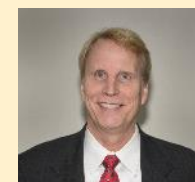
**Evan Scannapieco**  
ATP / TCAN Lead  
FINNIST, Swift



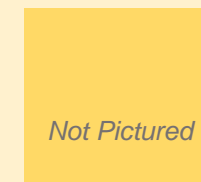
**Kartik Sheth**  
COR Program



**Linda Sparke**  
Astrophysics Explorers  
Program



**Eric Tollestrup**  
APRA (IR/Submm)  
Euclid, IXPE



**Future**





# Join the Team at NASA Headquarters

One or more program scientists will be hired this summer

Job opening starting June 15 (planned) for 5 days at <https://usajobs.gov>

Due to hiring authority used, applications will only be accepted during a 5-day window

AAS Job Register: <https://jobregister.aas.org/ad/8d061472>

Work as part of a diverse and agile team whose core values include excellence, integrity, transparency, teamwork and a growth mindset toward stewarding the nation's space-based astrophysics program

NASA encourages applications from candidates with non-traditional career paths, or individuals who are at earlier stages of their careers may have demonstrated experience in different ways.

Candidates are encouraged to contact NASA so they can make a well informed decision on submitting an application during the very short (5 day) window when the job opportunity will be open for applications

Questions about this anticipated opening for an Astrophysics Program Scientist at NASA Headquarters may be directed to Eric Smith, Chief Scientist, Astrophysics Division, [eric.p.smith@nasa.gov](mailto:eric.p.smith@nasa.gov)





# NASA Astrophysics Celebrate Accomplishments



# NASA Science Plan Released



Science 2020-2024: A Vision for Scientific Excellence at <https://science.nasa.gov/about-us/science-strategy>

- Implement recommendations of Decadal Surveys in concert with national priorities and needs through creative partnership models that go beyond traditional ways of developing and executing missions
- Challenge assumptions about what is technically feasible and enable revolutionary scientific discovery through a deliberate focus on innovation, experimentation, and cross-disciplinary research
- Create a more collaborative culture within SMD and across science community, encouraging diversity of thought, sharing best practices, and informed risk-taking to improve operations
- Develop future leaders and inspire learners of all ages through new opportunities and hands-on experiences



Hubble Space Telescope at 30: Awesome  
ies and Innovation", Jennifer Wiseman, Senior  
Project Scientist (GSFC), AAS webinar: Monday  
June 1 @ 2:00 pm EDT, Exhibit Hall

Next for Hubble?", Rachel Osten (STScI), AAS  
Wednesday June 3 @ 2:00 pm EDT, Exhibit Hall



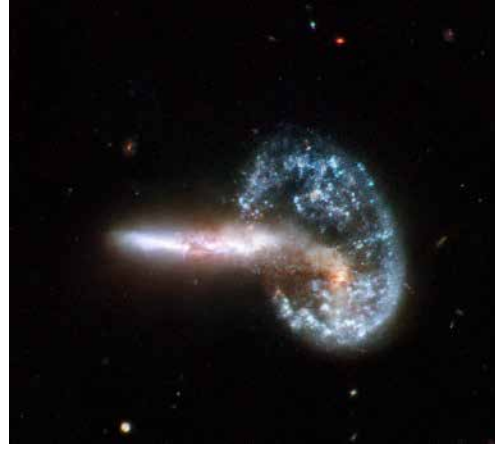
<https://www.nasa.gov/content/hubbles-30th-anniversary>



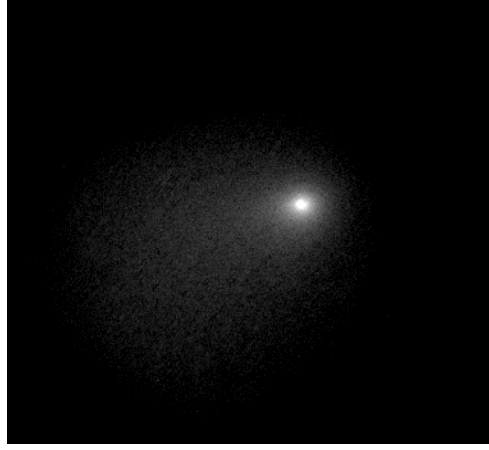
# What did Hubble see on your birthday?



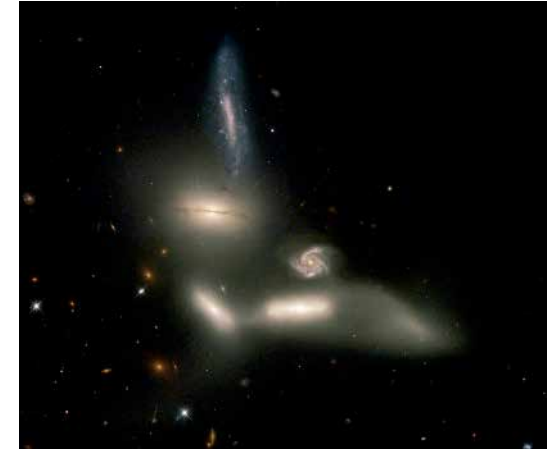
Galileo  
Zwicky 18



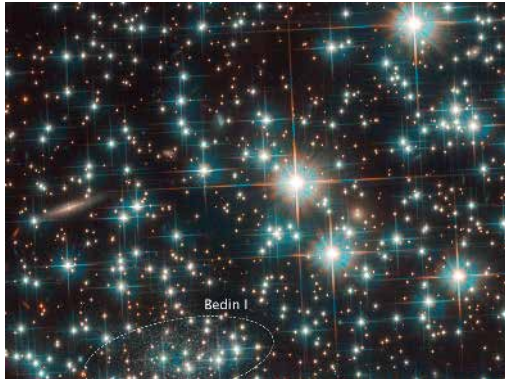
Edwin Hubble  
Arp 148



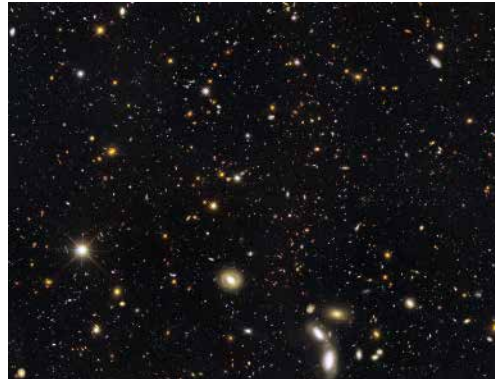
S. Chandrasekhar  
Comet Siding Spring



Lyman Spitzer  
Seyfert's Sextet



Arthur Compton  
NGC 6752



James Webb  
GOODS South

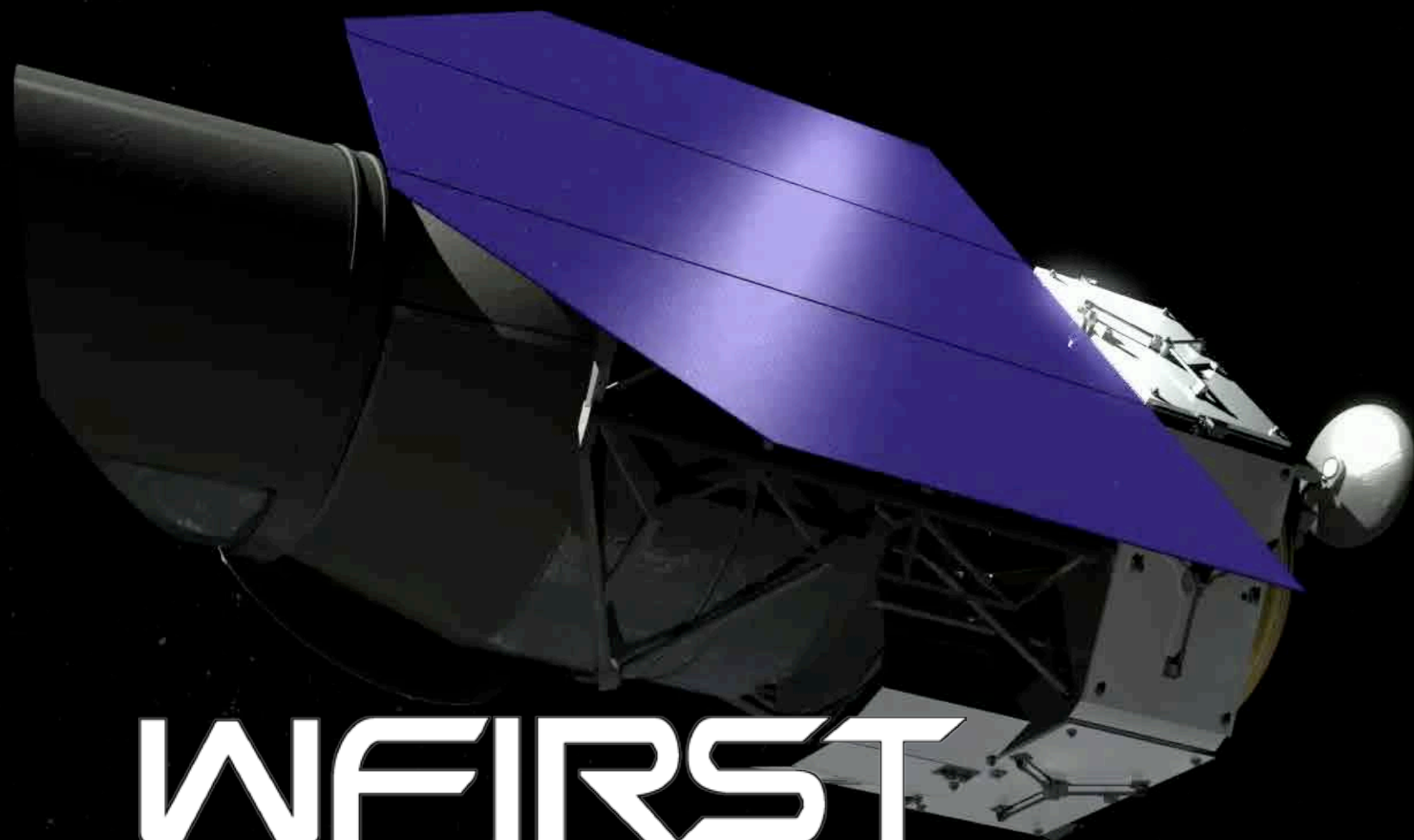


Nancy Grace Roman  
Hickson Group 90



Vera Rubin  
Jupiter





WFIRST

A 3D rendering of the Nancy Grace Roman Space Telescope in space. The telescope features a large, black, cylindrical primary mirror at the front. Behind it is a large, blue, rectangular sunshield. The telescope is oriented diagonally across the frame. The background is a dark, star-filled space.

# The NANCY GRACE ROMAN SPACE TELESCOPE

"Your Next Flagship: the Roman Space Telescope", led by Dominic Benford, Roman Program Scientist, AAS webinar: Monday June 1 @ 3:30 pm EDT, Exhibit Hall





# COVID-19: Bottom Line Up Front

Operating Missions & Data Archives: All performing nominally  
Except SOFIA, which is currently not flying

R&A: NASA continues to solicit, review, select, and fund ROSES  
and GO proposals through telework and virtual reviews

OMB has provided Agencies with flexibilities to better support proposers and  
grantees, including soft money researchers and early career researchers

ADAP-21 is cancelled, ADAP-20 is doubled

XRP and TCAN proposal due dates are delayed

Missions in development: Each project is impacted differently

Project teams are doing as much as they can virtually right now

James Webb Space Telescope continues to be a priority

Work on NASA missions is being restarted safely at NASA Centers on a  
case-by-case basis

Many of NASA's contractors and partners have continued to work



# NASA Astrophysics Committed to Improving





# Inspiring Future Leaders



Achieve excellence by relying on diverse teams, both within and external to NASA, to most effectively perform SMD's work

Attract and retain talent by promoting a culture that actively encourages diversity and inclusion and removes barriers to participation

Encourage development of future leaders, including the next generation of mission principal investigators, through targeted outreach and hands-on opportunities

Support early-career scientists to build careers working with NASA

Engage the general public in NASA Science, including opportunities for citizen scientists



# Mission PI Development

Seek to increase the diversity of mission principal investigators and develop the next generation of mission leaders to ensure that new ideas and mission concepts are brought forward

NASA Science has:

Developed a consolidated PI resources webpage at <https://science.nasa.gov/researchers/new-pi-resources>, which also includes SMD presentation on lessons learned from past selections

Introduced a pre-reviews of mission peer review panels to ensure diversity and reduce conflicts of interest

Included career development positions and associated evaluation criteria as part of AOs

Held first “PI Launchpad”

Hosted “So You Think You Want To Be A NASA Mission PI” town halls

# First PI Launchpad



Aimed at researchers and engineers who would like to submit a NASA space mission proposal in the next few years but don't know where to start

<https://science.nasa.gov/researchers/pi-launchpad>



# Nancy Grace Roman Technology Fellows

**2019:**

**Regina Caputo**, NASA GSFC (cosmic rays/gamma-ray)

**Sarah Heine**, MIT (optics and gratings for polarimeters)

**Gregory Mace**, UT Austin (optics and spectroscopy)

**2018:**

**Manel Errando**, Washington University, St. Louis

**Adam McCaughan**, NIST/Boulder

**Varun Verma**, NIST/Boulder

**2017:**

**Abigail Vieregg**, University of Chicago

**Omid Noroozian**, NRAO

**2016:**

**Erika Hamden**, California Institute of Technology

**Daniel Cunnane**, NASA Jet Propulsion Lab

**Eric Schindhelm**, Southwest Research Institute

**2015:**

**John Conklin**, University of Florida

**Brian Fleming**, University of Colorado

**Tyler Groff**, Princeton University

**2014:**

Not solicited

**2013:**

**Cullen Blake**, University of Pennsylvania

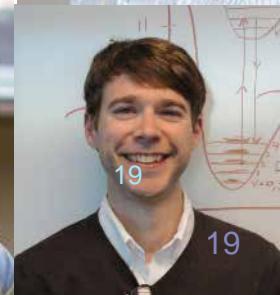
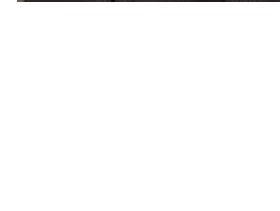
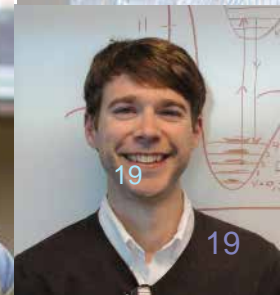
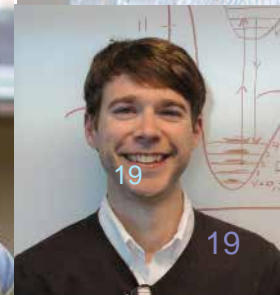
**Kevin France**, University of Colorado

**2012:**

**Judd Bowman**, Arizona State University

**Michael McElwain**, NASA GSFC

**Randall McEntaffer**, University of Iowa





# 2020 NASA Hubble Fellows



How does the universe work?  
Einstein Fellows

How did we get here?  
Hubble Fellows

Are we alone?  
Sagan Fellows

<https://hubblesite.org/contents/news-releases/2020/news-2020-20>

<http://www.stsci.edu/stsci-research/fellowships/nasa-hubble-fellowship-program/2020-nhfp-fellows>





# NASA Hubble Fellowship Program

Fellows are asking for the assurance of parental leave and the option of saving for their eventual retirement with the assistance of their employer.

Fellows who are employees of their host institutions typically have these benefits.

Stipendiary fellows do not receive employee benefits even though the NHFP is willing to pay the full cost of the employee benefits package.

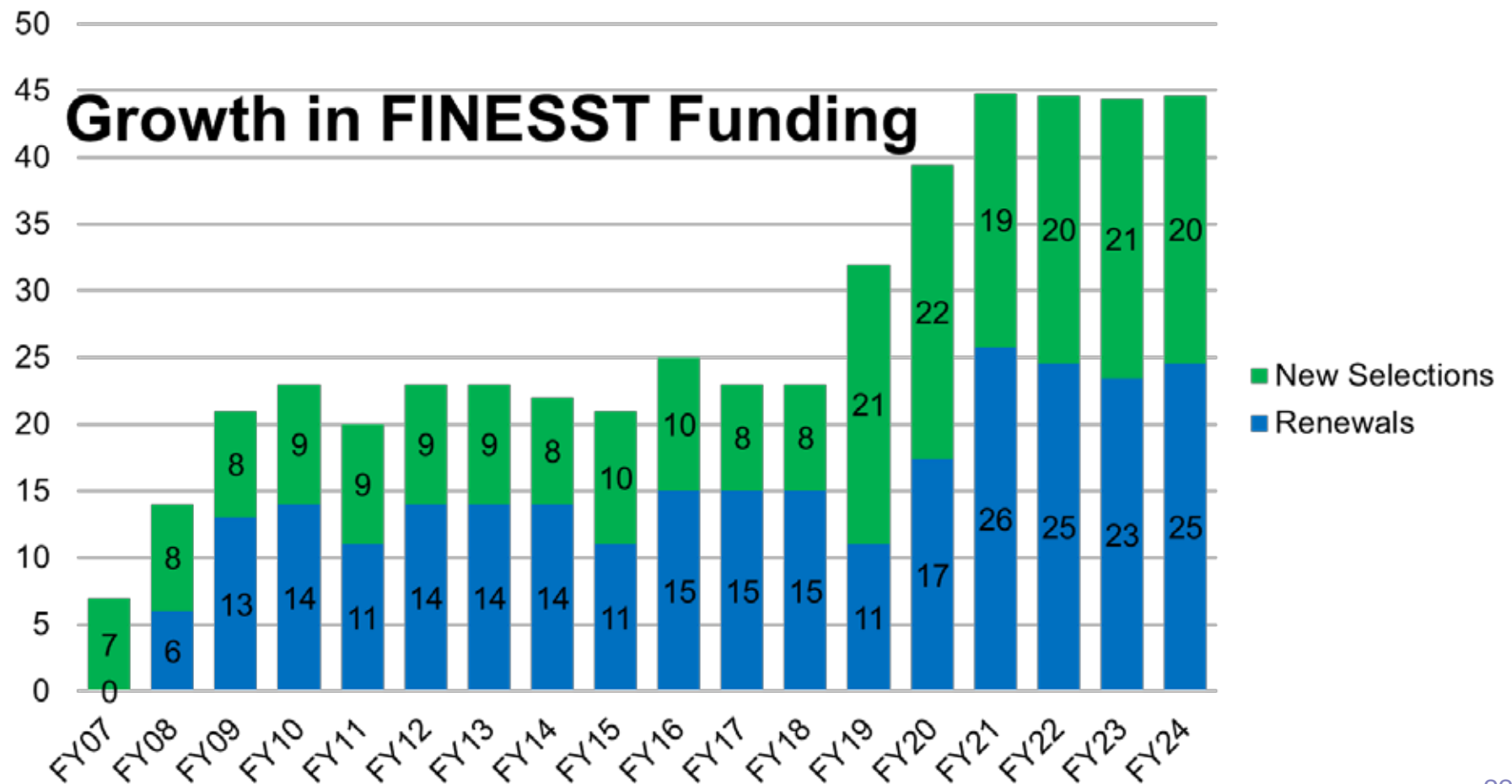
The Space Telescope Science Institute (STScI) has approved a change to the requirements for NHFP host institutions.

Starting with academic year 2022-2023, host institutions must offer their NHFP Fellows the opportunity to be employees. Employee status is being required to afford NHFP Fellows the same leave, vacation, retirement and health benefits (as applicable) given by these institutions to their postdoctoral fellows hired on grants or contracts as employees.

Direct any questions or comments on this policy to [nhfp@stsci.edu](mailto:nhfp@stsci.edu)

# Graduate Student Research Awards

NASA Earth and Space Science Fellowship (NESSF) program name changed to Future Investigators in NASA Earth and Space Science and Technology (FINESST) in 2019 to more accurately capture the nature of awards.





# Dual-Anonymous Peer Reviews in Astrophysics

NASA is strongly committed to ensuring that the review of proposals is performed in an equitable and fair manner that reduces or eliminates unconscious bias.

To this end, motivated by a successful pilot program conducted for the Hubble Space Telescope, all Astrophysics General Observer / General Investigator (GO/GI) proposals will be evaluated using dual-anonymous peer review.

In addition, the NASA Science Mission Directorate will conduct pilot programs in dual-anonymous peer review for non-GO/GI ROSES program elements in 2020.

- One ROSES program element from each Division will be conducted in 2020 using dual-anonymous peer review.
- Proposals submitted to the Astrophysics Data Analysis Program and the Habitable Worlds Program in 2020 will be evaluated using dual-anonymous peer review.

Dual Anonymous Peer Review  
Special Session  
Tuesday June 2 @ 11:00 am EDT  
Annie Jump Cannon Meeting Room



# Why Volunteer to Serve on a NASA Peer Review Panel?

## Personal professional development:

- See how the whole review process works

- Learn what constitutes excellent proposals

- Network with your professional colleagues and NASA scientific staff

## Institutional achievement:

- Improve at competing for NASA money

- Increase knowledge of NASA's educational programs and research technology

## Investment in the future:

- Help select the most transformative science

- Ensure that all proposals receive a fair and competent review

## Sign up to be a panel reviewer:

<https://science.nasa.gov/researchers/volunteer-review-panels>





# Keep Informed about NASA

NSPIRES mailing list – information about NASA solicitations

<https://nspires.nasaprs.com/>

Cosmic Origins mailing list, Exoplanet Exploration mailing list, Physics of the Cosmos mailing list – information about NASA missions and science

<https://cor.gsfc.nasa.gov/cornews-mailing-list.php>

<https://exoplanets.nasa.gov/exep/exopag/announcementList/>

<https://pcos.gsfc.nasa.gov/pcosnews-mailing-list.php>

NASA Astrophysics Federal Advisory Committees

Astrophysics Advisory Committee (APAC)

<https://science.nasa.gov/researchers/nac/science-advisory-committees/apac>

NAS Committee on Astronomy and Astrophysics (CAA)

[http://sites.nationalacademies.org/bpa/bpa\\_048755](http://sites.nationalacademies.org/bpa/bpa_048755)

Astronomy and Astrophysics Advisory Committee (AAAC)

<https://www.nsf.gov/mps/ast/aaac.jsp>

Sign up to be a panel reviewer:

<https://science.nasa.gov/researchers/volunteer-review-panels>



# NASA Astrophysics Research Program Update





## R&A PROGRAMS

**>1,000** Proposals Received  
**26%** Success Rate  
**~\$100M** Awarded Annually

## TECHNOLOGY DEVELOPMENT

**~\$140M** Invested Annually

## NEW PIs

**>180** Per Year in R&A Prog  
**>120** Per Year in GO Prog

## GO PROGRAMS

**>2,000** Proposals Received  
**19%** Success Rate  
**~\$70M** Awarded Annually

## CUBESATS

**6** Current Programs  
**~1** Launch Per Year

## SOUNDING ROCKETS

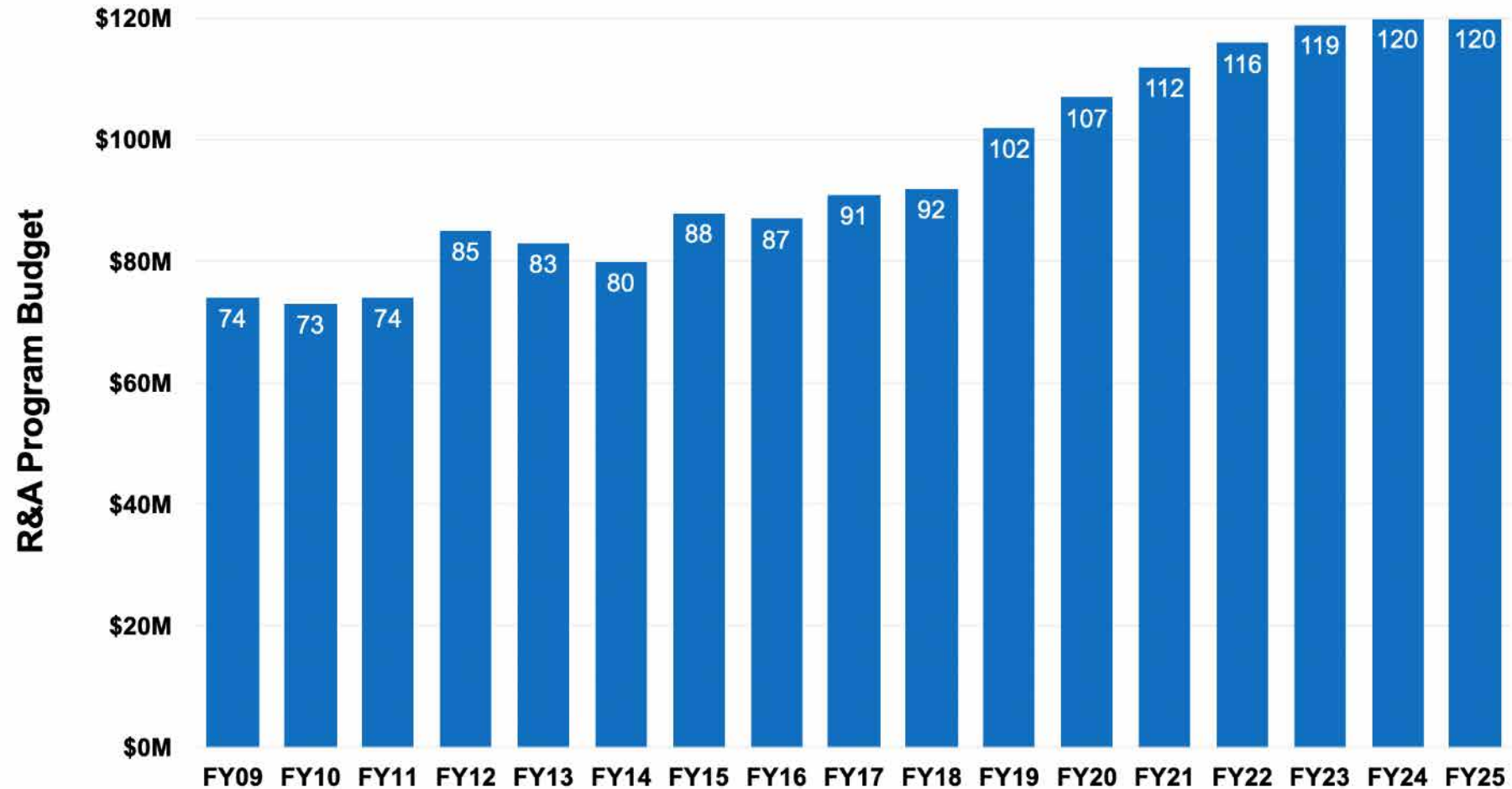
**9** Current Programs  
**3-4** Launches Per Year

## BALLOONS

**18** Current Programs  
**3-6** Launches Per Year

Astrophysics Research  
by the  
**NUMBERS**

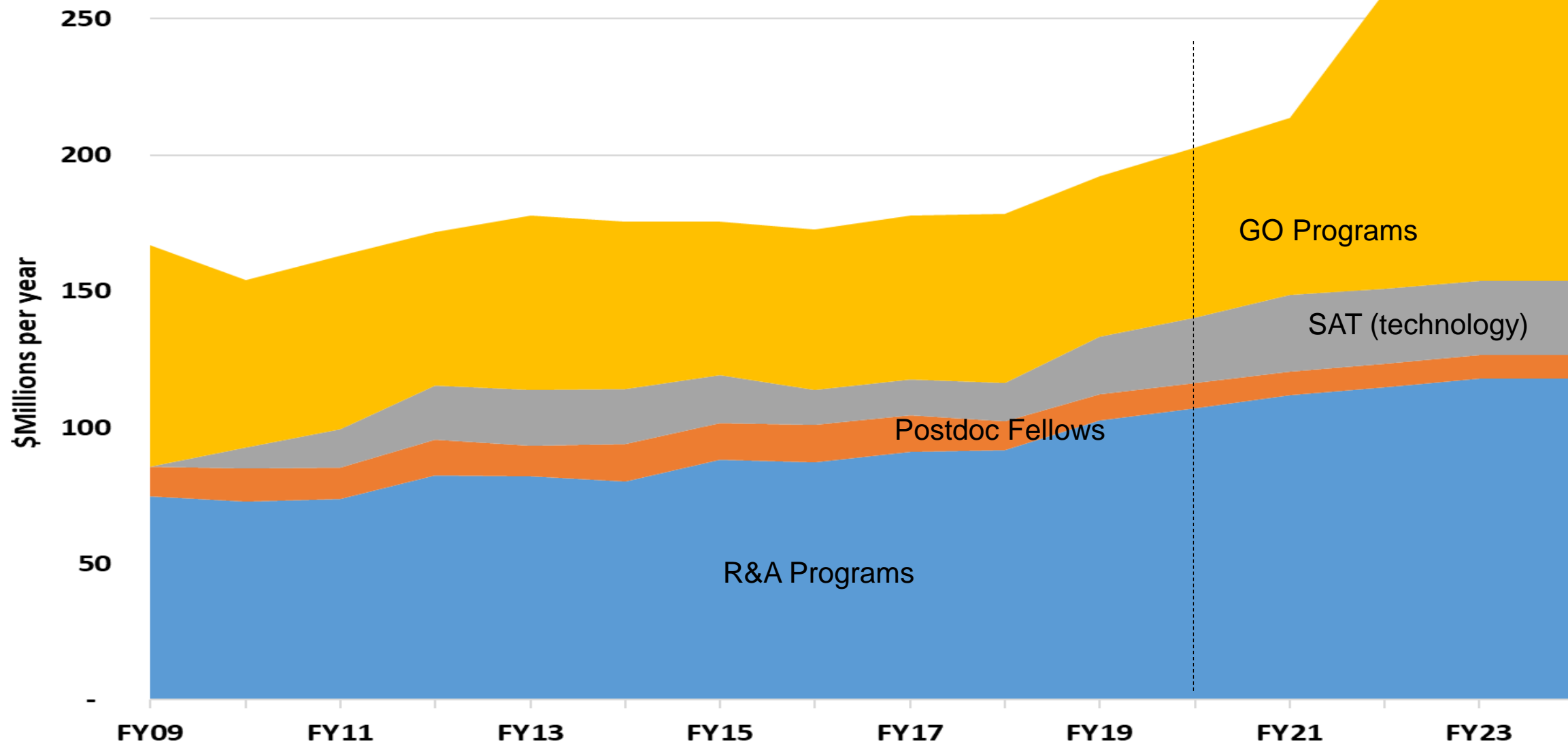
# R&A Research Funding



- R&A research funding increases by 54% over 17 years.



# Astrophysics Community Funding



# ROSES-2020 Program Elements

## Supporting Research and Technology

- Astrophysics Research & Analysis (APRA), **includes Lab Astro equipment**
- ~~Strategic Astrophysics Technology (SAT)~~ **Canceled this year**
- Roman Technology Fellowships (RTF)
- Astrophysics Theory Program (ATP) (biennial, not this year)
- Theoretical and Computational Astrophysics Networks (TCAN) (triennial, this year)
- Exoplanet Research Program (XRP) (cross-div)
- **Topical Workshops, Symposia, and Conferences (TWSC)**

## Data Analysis

- Astrophysics Data Analysis (ADAP)
- GO/GI programs for:
  - Fermi
  - Swift
  - NuSTAR
  - TESS
  - NICER

## Mission Science and Instrumentation

- Sounding rocket, balloon, cubesat, and ISS payloads solicited through APRA
- **XRISM Guest Scientists**
- **LISA Preparatory Science**
- **Astrophysics Explorers U.S. Participating Investigators (triennial, this year)**
- **Astrophysics Pioneers**

## Separately Solicited

- GO/GI/Archive/Theory programs for:
  - Chandra
  - Hubble
  - SOFIA
  - Webb
- NASA Hubble Fellowship Program
- NASA Postdoctoral Program
- FINESST Graduate Student Research Awards

## New in ROSES-2020:

- SAT canceled in anticipation of the 2020 Decadal Survey
- Lab Astro equipment in APRA (see separate slide)
- Exoplanet Research Program consolidates exoplanet proposals (see separate slide)
- Astrophysics Pioneers (see separate slide)
- Astrophysics participates in cross-divisional TWSC
- XRISM Guest Scientist Program (one time)
- LISA Preparatory Science (one time)
- Astrophysics Explorers U.S. Participation Investigators (APEX USPI)
- Data Management Plan will be evaluated as part of the intrinsic merit of proposals



# R&A Accommodation due to COVID-19

SMD is finalizing a process to provide limited adjustments to existing grants.  
Not all grants can be made whole, however

The focus will be on mitigating the impacts of the COVID-19 epidemic on the most vulnerable of us: graduate students, post-docs, and early career researchers in soft money positions

SMD does not want the COVID-19 epidemic to massively derail the careers of future leaders

Details will be made public by the end of June

SMD is considering options for helping SMD-funded, recently graduated PhDs and post-docs whose appointments are ending to weather the expected freeze in hiring by many research institutions

Review panels have all been converted to virtual events and are functioning well albeit in many cases taking longer than originally planned

This will be the norm until at least September

# R&A Accommodation due to COVID-19

OMB has issued guidance; NASA has instituted a number of grant administration flexibilities to ease the burden on grant recipients during the COVID-19 emergency.

- Allows NASA to remove barriers for faster funding of grantees

- Allows for paying soft-money researchers as well as graduate students, post-docs, and other lab staff during the COVID-19 epidemic, if the institution's own policies allow for it

- Allows for institutions to charge restart costs to their grants

- Provides agencies flexibility with regard to the submission of proposals, including accepting late proposals

FAQs to help you navigate:

- SMD COVID-19 Grants FAQ: <https://science.nasa.gov/researchers/sara/library-and-useful-links>

- NASA FAQ on Grants and Research during the COVID-19 Epidemic:

- <https://www.nssc.nasa.gov/grants>

- OMB guidance in Memo M-20-17: <https://www.whitehouse.gov/wp-content/uploads/2020/03/M-20-17.pdf>

- NRESS Virtual Panel Meetings Support:

- <https://nspires.nasaprs.com/tutorials/infoPage/virtualSupport.html>

Watch the NSPIRES email lists for up-to-the-minute changes in due dates or policies



# R&A Accommodation due to COVID-19

R&A management at NASA HQ continues via telework

No ROSES-20 astrophysics solicitations have been canceled due to COVID-19

ADAP will not be offered in 2021 to reduce the community workload next year as we recover from the impacts of COVID-19

Two ROSES-20 solicitations (TCAN, ADAP) have moved proposal due dates into late June to provide proposers additional preparation time

Five Astrophysics R&A peer reviews have already been conducted as virtual reviews since March, with no adverse effect on quality of reviews

All peer reviews until at least September are being conducted virtually

# Astrophysics Data Analysis Program

ADAP will not be offered in 2021 to reduce the community workload next year as we recover from the impacts of COVID-19: focus our efforts without reducing opportunity space

- All of the funding planned for selections in both 2020 and 2021 will be committed in 2020 – no reduction in funding to the community
- The number of selected proposals will approximately double
- This allows more awardees to be assured of funding this year
- This reduces the work for both NASA and the community without reducing the opportunity space for community funding
- No change to plan for ADAP to be dual anonymous this year

Proposals due June 30, 2020

Community comment is sought

- COPAG conducted a survey (<https://forms.gle/hyxrTzHi8z5UCQGP8> by June 5)
- APAC will discuss at their June 23-24 meeting





# Lab Astro Equipment Initiative

Updating and maintaining existing laboratories is a critical need:

- New science requires new and improved laboratory systems.
- The number, complexity, and energy range of NASA lab astro programs and their associated data needs continue to grow.

Starting in ROSES-20, a new Lab Astro Equipment Initiative provides additional funding to support lab equipment proposals.

- This initiative is not intended to support building of new complete labs. The goal is to:
  - Enable new science with new equipment
  - Replace and/or upgrade failing equipment
- Proposals that request Lab Astro equipment upgrades can be submitted through APRA with proposals due on December 17
  - ROSES-20 D.3 APRA will be amended within the next few weeks



# Exoplanet Research Program Consolidation

Purpose: combine skills and disciplines from across divisional boundaries and scientific cultures to make the most impact upon strategic and solicited exoplanet science

- Starting in ROSES-20, the scope of Astrophysics ROSES Appendix D is changing to exclude exoplanet research elements from ADAP, ATP, and the Lab Astro component of APRA. Technology development within APRA will not be affected.
- Historical levels of APD exoplanet research funded through ADAP, ATP, and APRA will be maintained, but distributed through XRP.
- In addition to Planetary Science Division, Heliophysics Division and Earth Science Division are now financial partners in XRP, increasing the total funding available to the program.
- As a result, the funding allocation for XRP increases substantially

FY20	FY21	FY22	FY23
\$8.9M	\$10.2M	\$11.6M	\$12.7M
	+15%	+30%	+43%





# Citizen Science

Citizen Science (CS) is a form of open collaboration in which individuals participate voluntarily in the scientific process

Current projects at <https://science.nasa.gov/citizenscience>

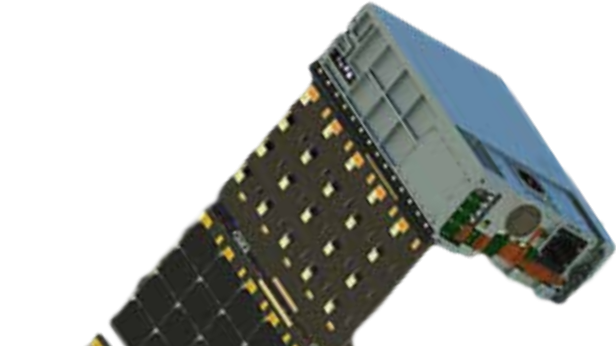
Proposers to any ROSES program element may incorporate citizen science and crowdsourcing methodologies into proposals, where such methodologies advance the proposed investigation

NASA Citizen Science Community Workshop series online every other Wednesday until September 30, 2020, at <https://nasacitsci2020.gmri.org/home>

NASA's Astrophysics, Heliophysics, and Planetary Science Divisions will release a joint ROSES-20 program element for a Citizen Science Seed Funding Program to fund prototyping of citizen science projects relevant to the three Divisions

# NASA Astrophysics CubeSats

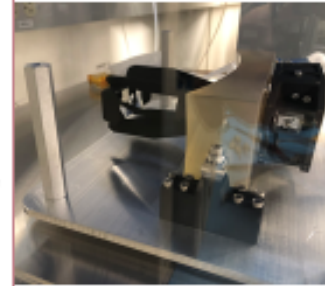
The Astrophysics Division is investing approximately \$5M per year in a CubeSat initiative.



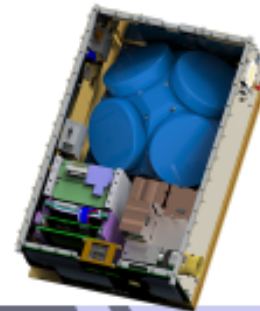
- **HaloSat**, PI: Phil Kaaret, U. Iowa
- **Science Objectives:** HaloSat is mapping soft X-ray oxygen line emission across the sky in order to constrain the mass and spatial distribution of hot gas in the Milky Way.
- **Technologies:** BCT S/C, COTS detectors, collimators with no optics.
- **Deployed:** Jul 13, 2018, from ISS

## Astrophysics CubeSats in Development

- **CUTE**, PI: Kevin France, CU
- **Science Objectives:** The Colorado Ultraviolet Transit Experiment (CUTE) will take medium resolution UV spectra of 14 hot Jupiters during transit, in order to measure atmosphere being ablated away.
- **Technologies:** BCT S/C, COTS telescope and camera.
- **Launch:** 2021 on LandSat-9

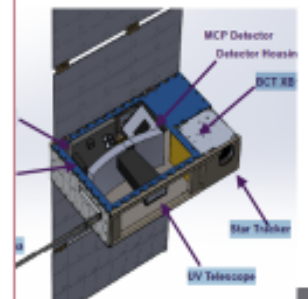


- **BlackCat**, PI: Abe Falcone, Penn St.
- **Science Objectives:** GRB/Transient detection in 0.2-20keV with coded mask.
- **Technologies:** CMOS x-ray CCD
- **Launch:** FY2024



- **BurstCube**, PI: Jeremy Perkins (GSFC)
- **Science Objectives:** Rapid localizations for LIGO/Virgo detections with short GRBs; Search of g-ray transients.
- **Technologies:** Dillinger derived bus, Fermi-GBM like detectors.
- **Launch:** Fall 2021

- **SPRITE**, PI: Brian Fleming, CU
- **Science Objectives:** Determine ionization rate of IGM from galaxies and AGN, trace feedback within galaxies driven by star-forming regions, using low-resolution imaging UV spectrograph.
- **Technologies:** in house S/C, UV coatings, next-gen MCP.
- **Launch:** Fall 2022



CubeSat proposals may be submitted to APRA, due date December 17





# Astrophysics Pioneers

The FY21 President's Budget Request contains a new initiative for Astrophysics – Astrophysics Pioneers: A new class of small missions

Fills the gap between existing ROSES investigations (<\$10M for APRA) and existing Explorers MO investigations (<\$35M for SmallSats)

Includes SmallSats, Large CubeSats (> 6U), CubeSat constellations (all as rideshare/secondary payloads), major balloon missions, and ISS attached payloads with a \$20M cost cap, not including launch

Managed as Research and Analysis projects with enhanced oversight, defined gates, and light touch management from NASA, rather than flight project processes appropriate for a SMEX

NASA will no longer solicit ISS attached payloads within APRA

NASA will no longer solicit balloon payloads within Explorers MO

Draft released May 14, Comments due June 15 via email to

[Michael.R.Garcia@nasa.gov](mailto:Michael.R.Garcia@nasa.gov)



# NASA Astrophysics Missions Program Update





# Coronavirus (COVID-19) Response – Missions

- Missions in operation continue nominally
  - Most MOC and SOC staff working virtually
  - SOFIA currently grounded, but planned maintenance has resumed
  - Space Communications Program continues to support uplinks/downlinks and has a plan in place if local conditions at network sites affect communications capabilities
- Missions in development are doing as much as they can virtually right now
  - Suspended most hands-on work within NASA, including suborbital research
  - Work is being restarted at NASA Centers on a case-by-case basis when it can be done safely
  - Many of NASA's contractors and partners have continued to work safely
- Prioritizing Mars 2020 as it is close to launch
  - James Webb Space Telescope also continues to be a priority
  - Although the NASA portion of the NASA/NGSS team returned home mid-March, and I&T at NGSS had reduced shifts, NASA staff have now returned to NGSS and two shifts will be started soon; Observatory I&T continues making progress

# TESS

Transiting Exoplanet  
Survey Satellite

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



Observation Sector 25

Orbit 57: May 14 - May 26

Orbit 58: May 27 - June 8

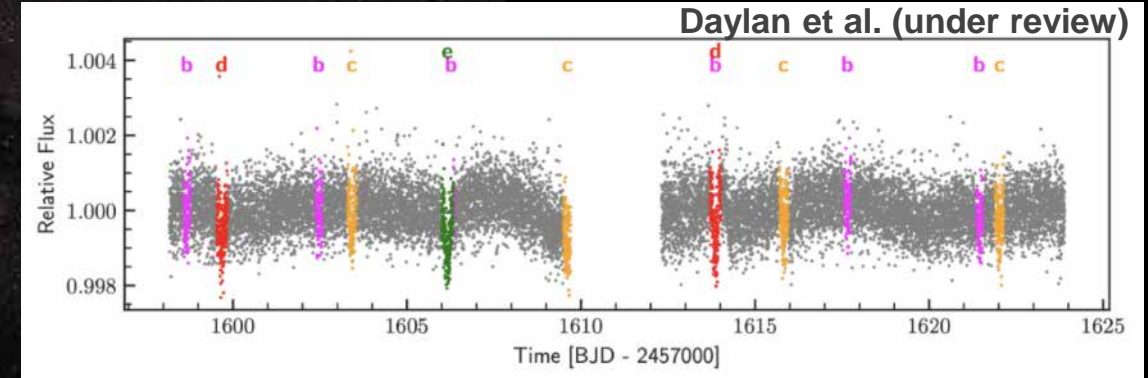
**47 confirmed planets**  
**1837 planet candidates**

280 publications submitted, 214 peer-reviewed  
(53% exoplanets, 47% astrophysics)

Last update: May 22, 2020

## Four-planet system orbiting a bright Sun-like star

HD 108236 (TOI-1233)

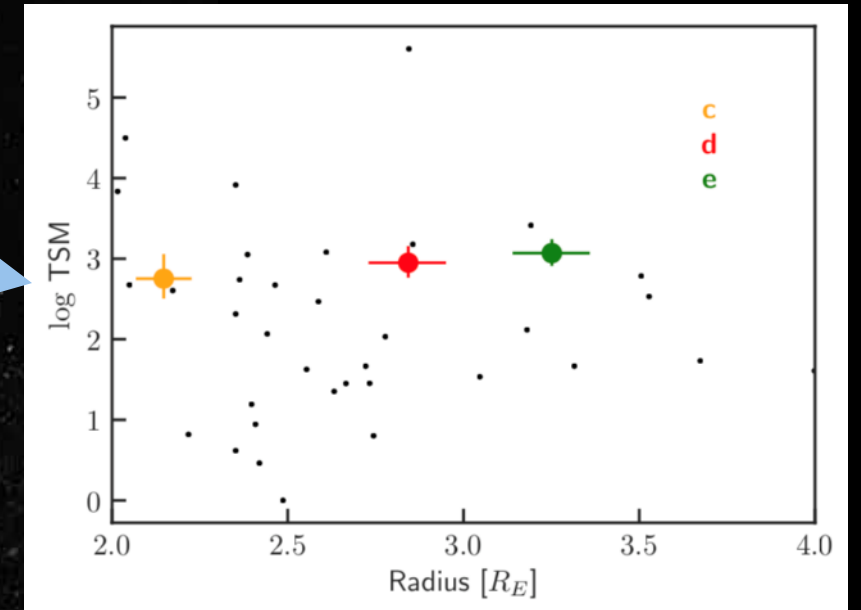


Brightest sun-like star to host 4 transiting planets. Three outer planets are among the best JWST sub-Neptunes for spectroscopy:

Transmission  
Spectrum Metric  
TSM

High TSM = great  
JWST target

Daylan et al.  
(2020)





# SOFIA Stratospheric Observatory for Infrared Astronomy



SOFIA began its extended mission in October 2019, and suspended flight operations in March 2020 due to COVID-19

SOFIA Project has implemented major initiatives to improve scientific productivity and impact

Legacy programs are larger fraction of the total observing time

Two legacy programs scheduled in Summer 2020 from New Zealand

Joint project and synergies implemented with other NASA missions and observatories:

- Mapping water on Moon in support of VIPER/Artemis mission
- SOFIA Cycle 9 to support JWST ERS programs
- Joint Hubble-SOFIA pilot demonstration program (exploring)
- Joint Green Bank Observatory – SOFIA proposals (under final review)

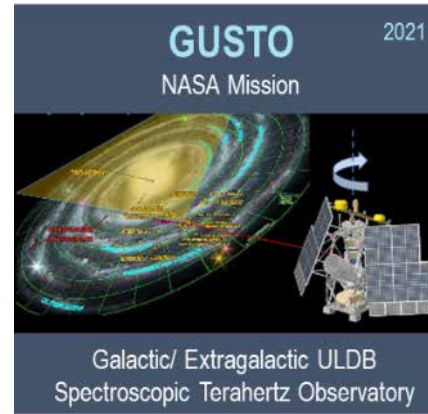
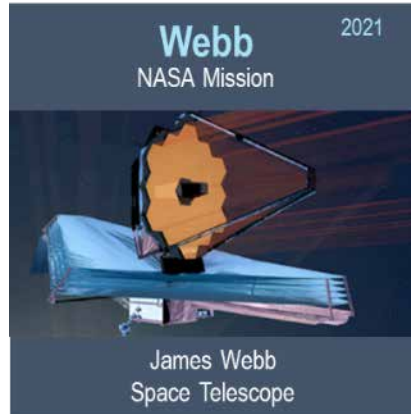
More strategic use of the Director's Discretionary Time

- e.g., recent Betelgeuse observing campaign using four SOFIA instruments; Moon pilot legacy program

Higher program completion rate by moving to a two-year scheduling cycle; potentially increasing observing opportunities

"Community Update", led by Margaret Meixner, Director of SOFIA Science Mission Operations, AAS webinar: Tuesday June 2 @ 3 pm EDT

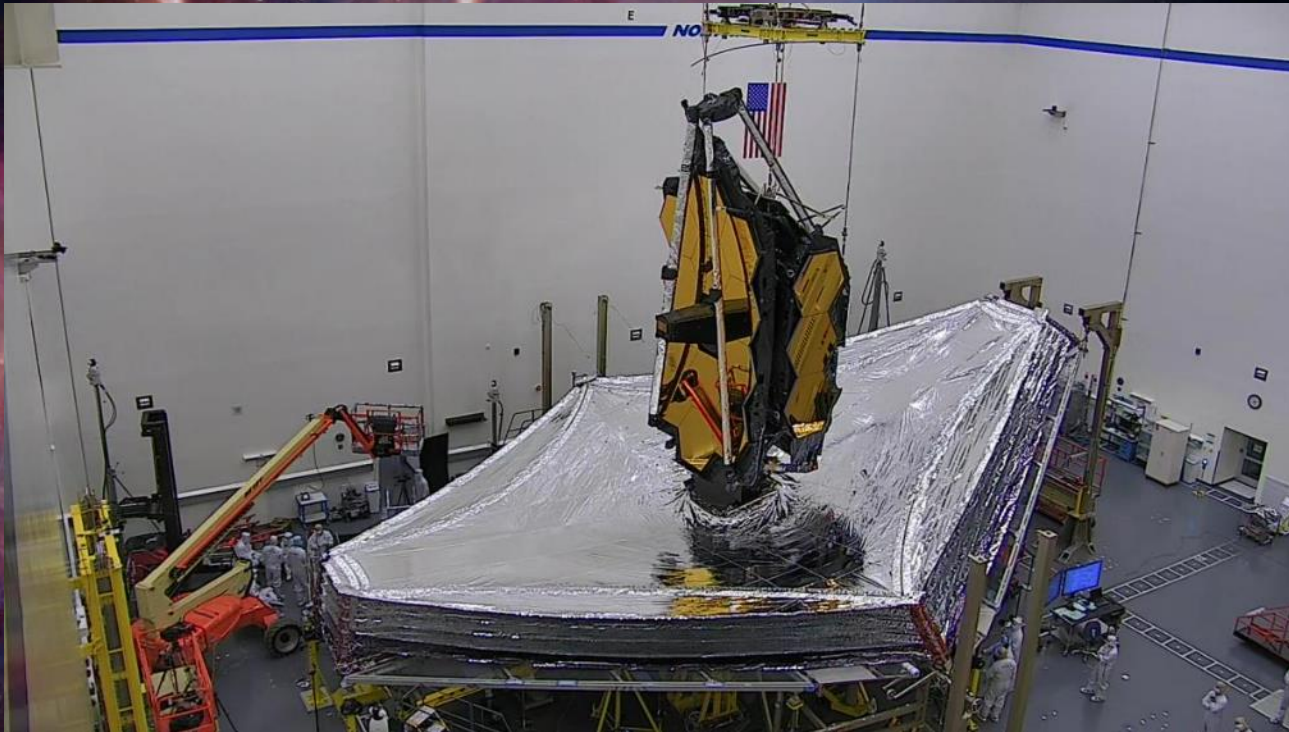
# Astrophysics Missions in Development



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



"James Webb Space Telescope Overview",  
led by Jonathan Gardner (GSFC) and Klaus Pontoppidan  
(STScI), AAS webinar:  
Tuesday June 2 @ 2:00 pm EDT, Exhibit Hall



*The Webb observatory in the clean room in Redondo Beach, CA in August 2019*

# Webb

## The James Webb Space Telescope



### 2020 Accomplishments

- Work continuing at Northrop, but at lower efficiency due to social distancing practices required by COVID19 response.
- Completing deployment test in preparation for Observatory-level environmental tests
- Conducted several mission rehearsals at the mission operation center (STScI)

### 2020 Remaining Plans

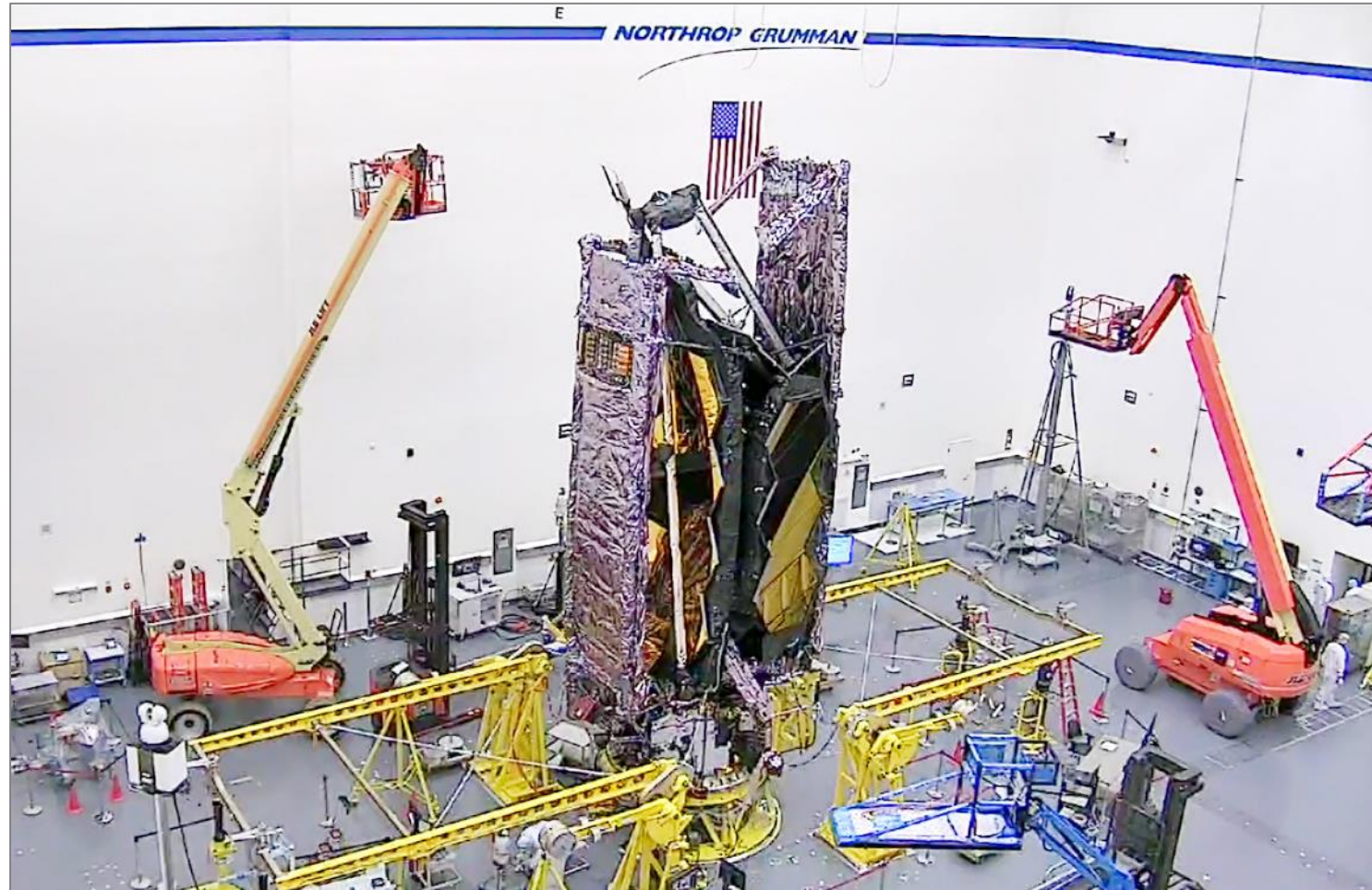
- After coming out of COVID19 response restrictions project will formally evaluate schedule
- Observatory-level environmental testing
- Post Observatory-level environmental testing deployments
- Additional mission rehearsals at STScI
- Release of Cycle 1 General Observer call



# Webb Final Assembly

Space Telescope Science Institute (STScI) Town Hall: Tuesday June 2 @ 1:40 pm, Annie Jump Cannon Meeting Room

- No schedule for Webb Cycle 1 GO/AR proposals has been announced.
- An update on the schedule will be announced in mid- to late-July.
- At least 12 weeks notice of the proposal deadline will be provided.



The fully assembled and folded observatory at Northrop Grumman, Space Park (May 2020). This is the configuration that Webb will be in when it is mated to the Ariane 5 launch vehicle in 2021. After environmental testing in this configuration it undergoes one more set of deployment testing (primary mirror and sunshield) before a final fold back into this configuration.

# Roman Space Telescope

## (formerly Wide-Field Infrared Survey Telescope)

Confirmed and entered  
Phase C on Feb 28, 2020

<https://www.nasa.gov/feature/nasa-approves-development-of-universe-studying-planet-finding-mission>

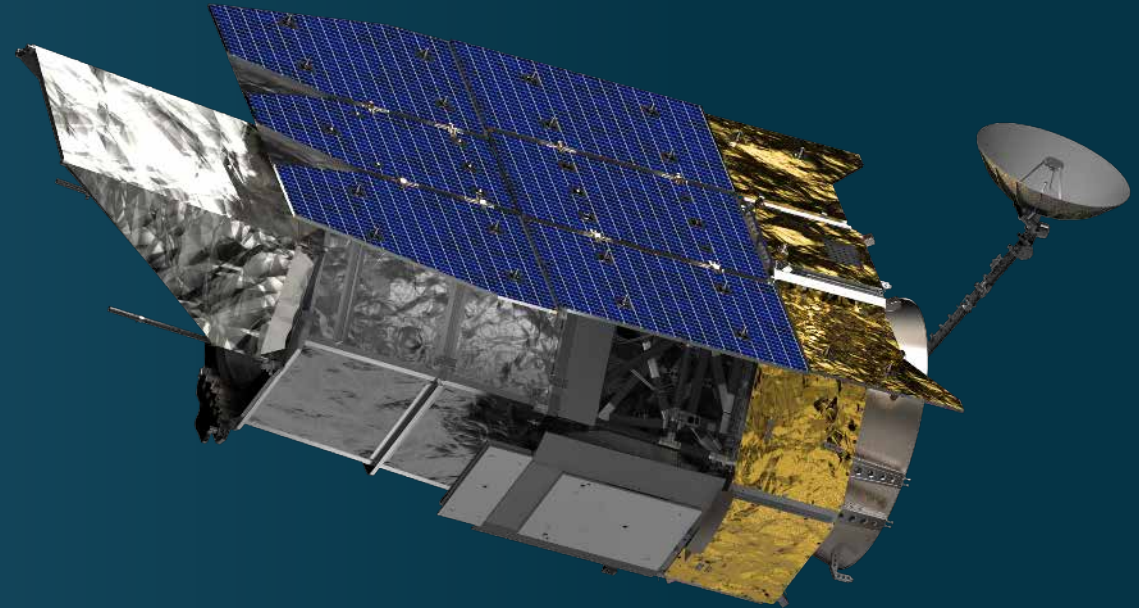
*Roman* is fully funded in FY20

2020: Flight hardware being developed:  
mirror being figured, detectors being  
fabricated, spacecraft subsystems being  
delivered, coronagraph demo unit in  
testbed

2021 – Complete Critical Design Reviews

c.2026 – Launch

<https://www.nasa.gov/press-release/nasa-telescope-named-for-mother-of-hubble-nancy-grace-roman>



*Roman* field-of-view is 100× *Hubble* field-of-view

*Roman* is 100 to 1500 times faster than *Hubble* for large  
surveys at equivalent area and depth

“Your Next Flagship: the Roman Space Telescope”, led  
by Dominic Benford, Roman Program Scientist, AAS  
webinar: Monday June 1 @ 3:30 pm EDT, Exhibit Hall



### Evolution of the Universe



### Universe of galaxies



### Mapping dark matter



### Precision Astrometry



### How galaxies assemble



### Mapping the Kuiper Belt



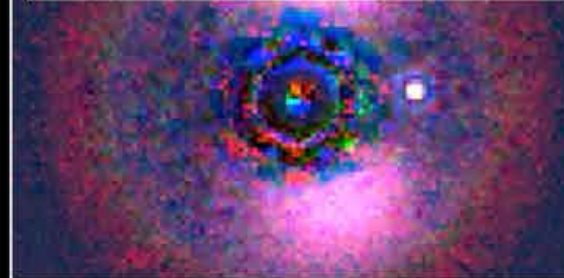
### Gravitational Wave Counterparts



### Planetary system diversity



### Exoplanet Direct Imaging



### Asteroseismology



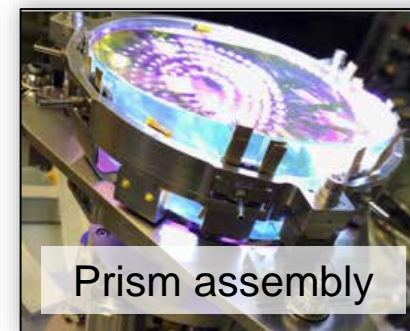
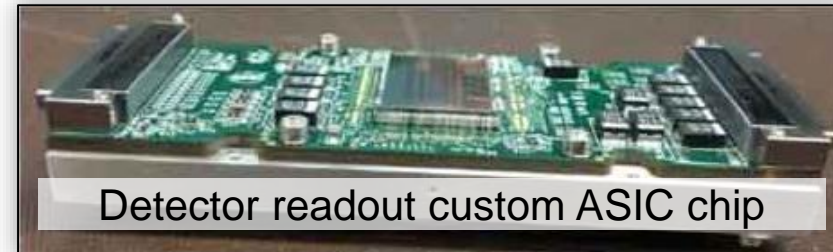
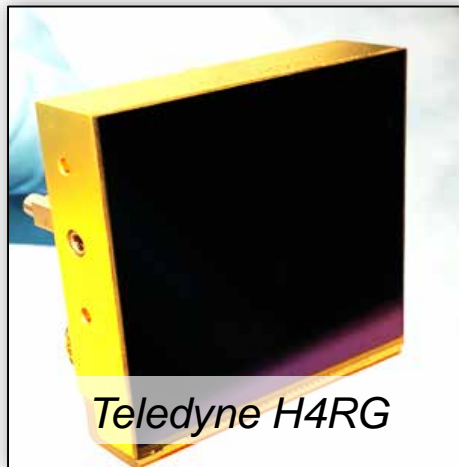
***Roman* will impact almost every area of astrophysics for almost every astronomer**



# Roman Hardware Progress



**Telescope**



**Instruments**



# *Roman* is for You

All *Roman* observing time is available through open processes

- Major Legacy Surveys defined using a community-driven open process in the coming year
- Key Projects – science investigations using these surveys – will be openly competed
- *Roman* observing time also available for GO projects using *Roman*'s unique wide-field imaging, spectroscopic, and time domain capabilities
- All data will be available to the community with no period of limited access

*Roman* observing program will be based on community input

- NASA and STScI have convened community groups to provide input on balance among observing programs and on trades during development, integration, and test

*Roman* General Observers / Archival Researchers Program

- Use *Roman* for conducting wide-field infrared surveys of the universe
- Use data from *Roman* Legacy Surveys for compelling astrophysics investigations
- Calls for proposals to be issued before launch and subsequently

*Roman* Coronagraph Participating Scientist Program

- Develop observing plans for demonstrating coronagraph capabilities
- Work with instrument team to process data from tech demo observations
- Call for proposals anticipated in the coming year

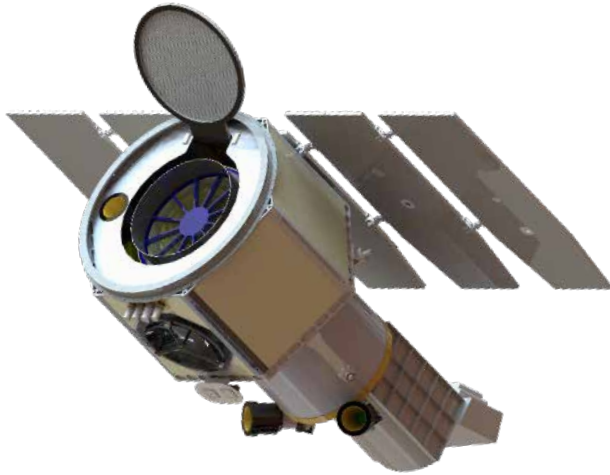


# Astrophysics Explorers in Competitive Phase A

## Small Explorers

### ESCAPE

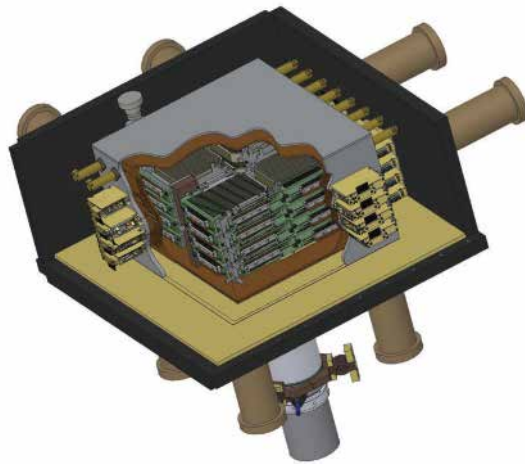
PI: K. France, U Colorado



Do extreme ultraviolet stellar flares zap atmospheres of exoplanets in the habitable zone?

### COSI

PI: J. Tomsick/UC Berkeley

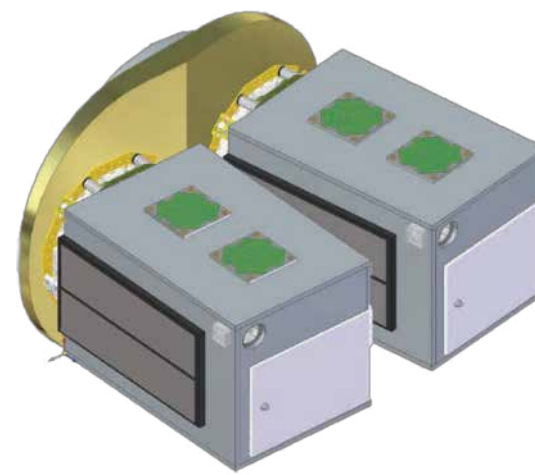


MeV gamma-rays trace Milky Way's supernova activity, positron production; polarization in gamma-ray bursts

## Missions of Opportunity

### Dorado

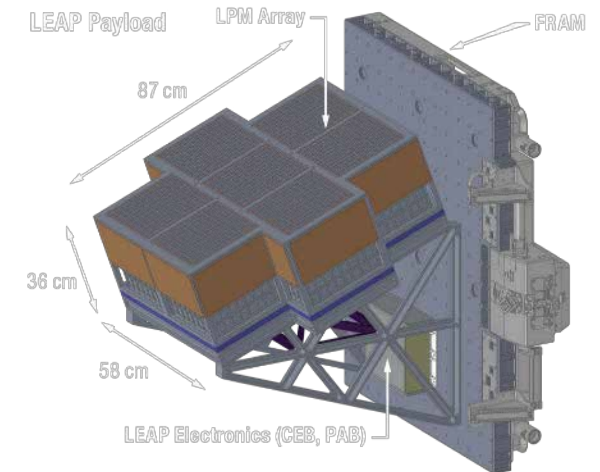
PI: B Cenko/GSFC



Two 12U CubeSats watch for UV light when neutron stars merge

### LEAP (on ISS)

PI: M. McConnell/ U New Hampshire



Polarization of gamma-ray bursts sheds light on jet structure

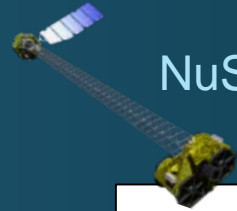
March 16, 2020: <https://www.nasa.gov/press-release/nasa-selects-proposals-to-study-volatile-stars-galaxies-cosmic-collisions>



# Astrophysics Explorers Program



Swift



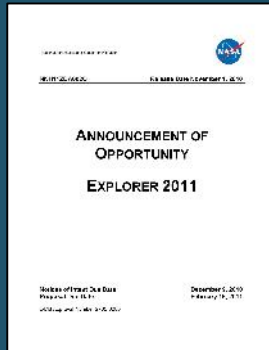
NuSTAR



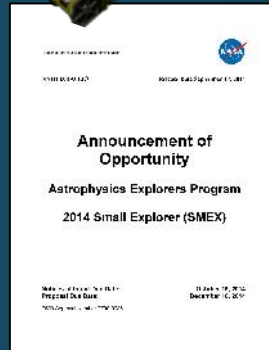
NICER



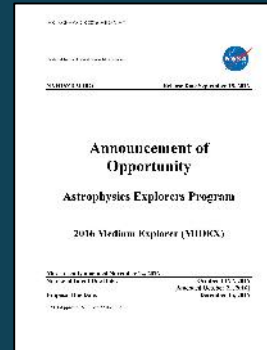
TESS



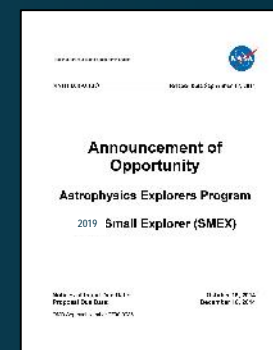
MIDEX  
2011



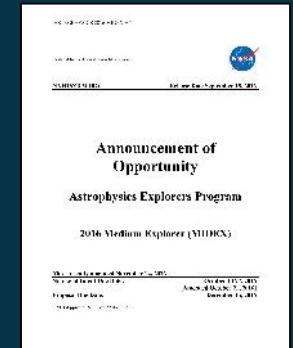
SMEX  
2014



MIDEX  
2016



SMEX  
2019



MIDEX  
2021

Small and  
Mid-Size  
Missions



TESS



IXPE



SPHEREx

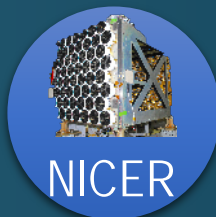
ESCAPE  
COSI

Directed  
2013



Euclid

Missions of  
Opportunity



NICER



GUSTO



ARIEL

Dorado  
LEAP

Directed  
2017



XRISM



# Explorers Policy Update

NASA establishes partnerships with international space agencies to advance its strategic objectives in science

PI proposed partnerships have not been an effective manner of establishing NASA contributions to partner-led missions

- These are “Partner Mission of Opportunity” (PMO) proposals
- Over the past 10 years, we received 17 PMO proposals, selected only 3 for Phase A, and downselected only 1 for flight (ARIEL)
- Of those 3, all could have been initiated strategically instead of PI-proposed
- Of the other 14, most could have been declined without receiving a proposal
- We have concluded that the PMO process is not a successful or efficient process for establishing partnerships

SMD will no longer solicit PMO proposals

- SMD will still allow PI-led Explorers missions to be proposed that include a partner contribution, generally limited to be  $<1/3$  of the mission per the AO

SMD will continue to seek community input on potential partnerships





# NASA Astrophysics Planning for the Future







Quick Summary  
Community support: 20%  
Operating missions: 12%  
Building missions: 64%  
Management: 4%

ROMAN  
DEVELOPMENT  
29%

WEBB  
DEVELOPMENT  
25%

MANAGEMENT  
INCL. STEM ACTIVATION  
4%

\$1.73 BILLION  
FY20

RESEARCH  
(ADAP, APRA, ATP, ETC.)  
6%

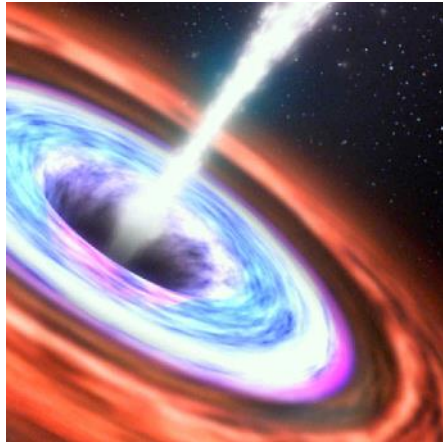
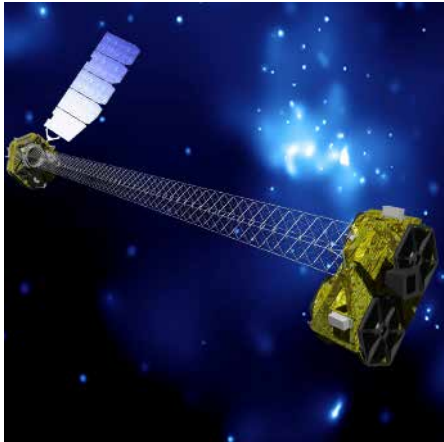
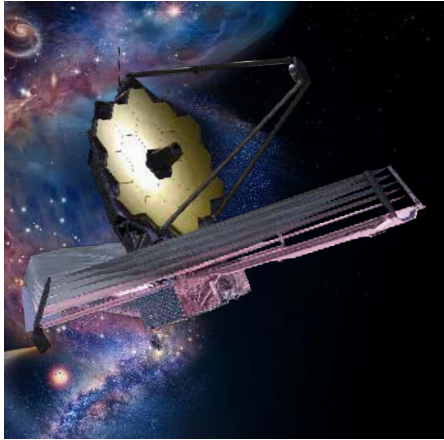
TECHNOLOGY  
(SR&T, ATHENA, LISA, ETC.)  
5%

INFRASTRUCTURE  
(BALLOON PROGRAM, ARCHIVES, ETC.)  
4%

OP. MISSIONS  
(INCL. GO PROGRAMS)  
17%

EXPLORERS  
DEVELOPMENT  
10%

# Astrophysics FY21 Budget Request



Supports Webb launch in 2021

Maintains decadal cadence of four AOs per decade for Astrophysics Explorers and Missions of Opportunity

Maintains healthy research program including CubeSats, suborbital missions, technology development, data analysis, theoretical and computational investigations, and laboratory astrophysics

Initiates new class of Astrophysics Pioneers: SmallSats and major balloon missions with reduced management overhead compared to traditional Astrophysics Explorers

Extends operating missions beyond FY20 with GO programs following 2019 Senior Review

Supports formulation of a probe mission as early as 2022

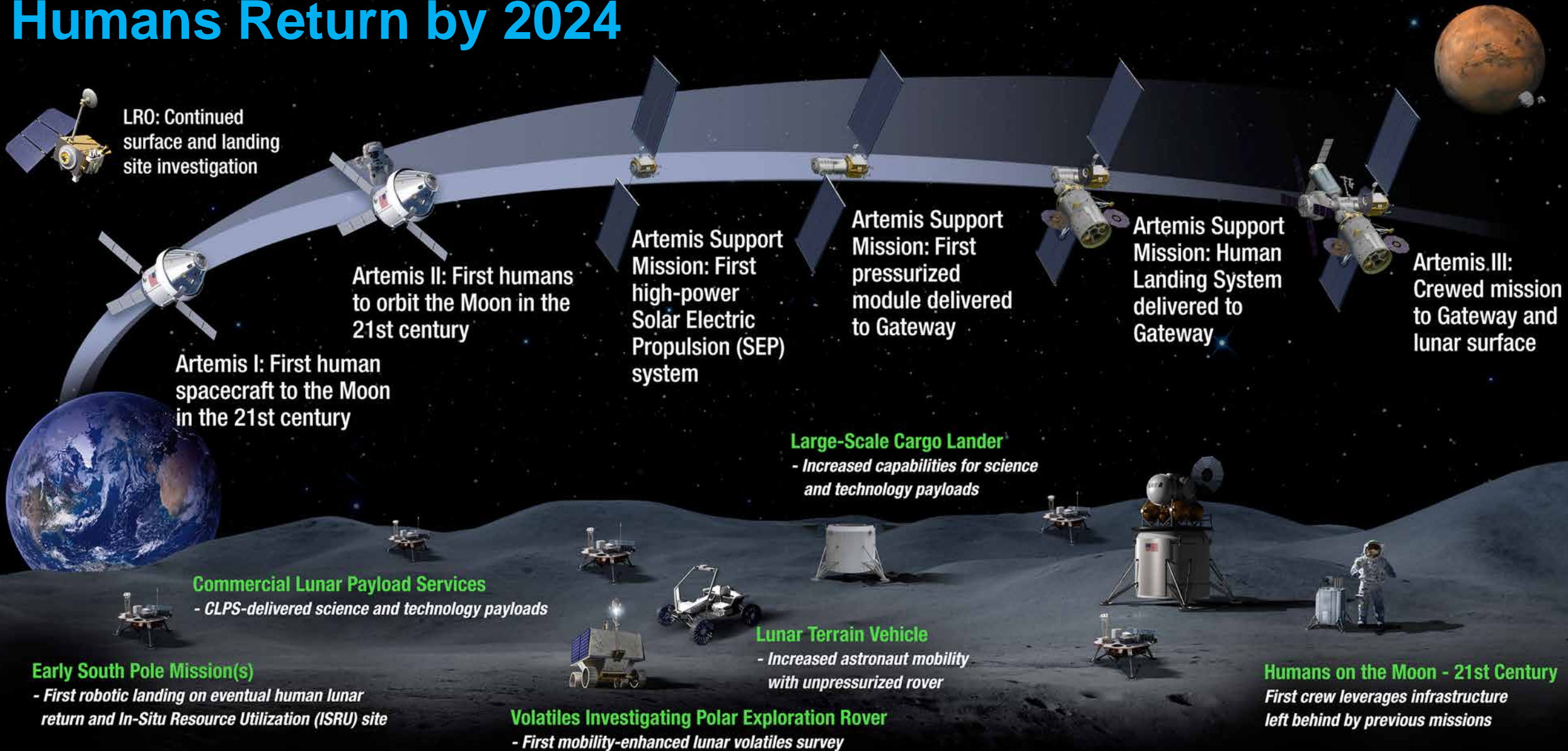
Supports mission concept studies and technology investments to implement Astrophysics Decadal Survey priorities starting in 2022

Terminates SOFIA due to high operating costs and lower science productivity to date

Given its significant cost and competing priorities within NASA, provides no funding for Roman Space Telescope



# Humans Return by 2024



## LUNAR SOUTH POLE TARGET SITE

2020

2024

# Astrophysics and Artemis



All science opportunities enabled by Project Artemis will include astrophysics

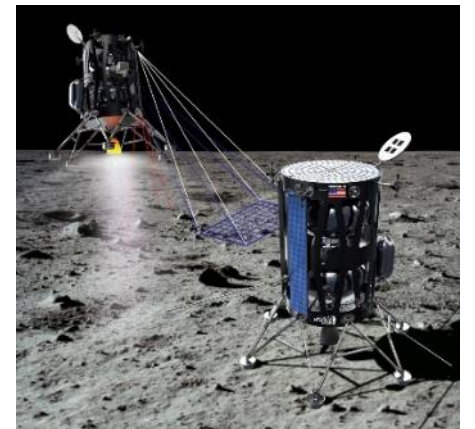
## Commercial Lunar Payload Services (CLPS)

- All payload calls include astrophysics; two astrophysics payloads selected
  - Internal NASA call: Low-frequency Radio Observations from the Near Side Lunar Surface instrument (PI: Robert MacDowall, GSFC); manifest through CLPS Task Order 2 on Intuitive Machines Lander for NET October 2021
  - ROSES call: Next Generation Lunar Retroreflectors (PI: Douglas Currie, University of Maryland); to be manifest through CLPS Task Order 19D for ~2022

## Astrophysics Explorers 2019 Missions of Opportunity

- 2019 AO included opportunities enabled by Project Artemis.
- Future calls will solicit proposals that leverage Artemis capabilities, such as Gateway as a platform and cis-lunar communications infrastructure, to conduct compelling astrophysics investigations.

Most important criterion for all proposals that leverage Artemis remains the astrophysics science merit.



*Intuitive Machines Lander*

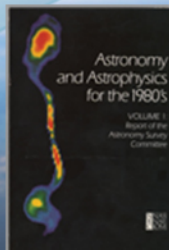
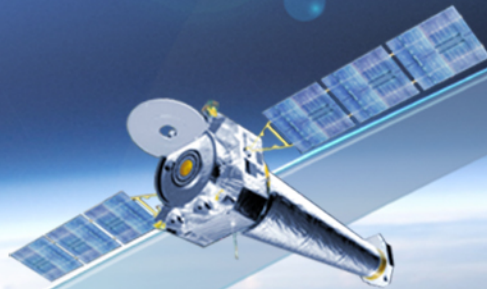


# Astrophysics

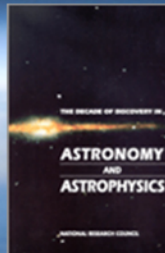
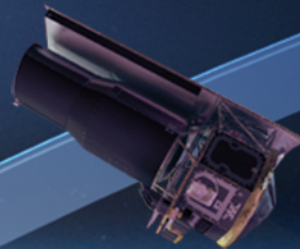
## Decadal Survey Missions



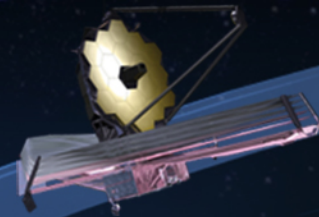
**1972**  
Decadal  
Survey  
*Hubble*



**1982**  
Decadal  
Survey  
*Chandra*



**1991**  
Decadal  
Survey  
*Spitzer*



**2001**  
Decadal  
Survey  
*JWST*



**2010**  
Decadal  
Survey  
*WFIRST*

# Astro 2020

Decadal Survey on Astronomy and Astrophysics

*The National  
Academies of* | SCIENCES  
ENGINEERING  
MEDICINE





# Decadal Survey Goal

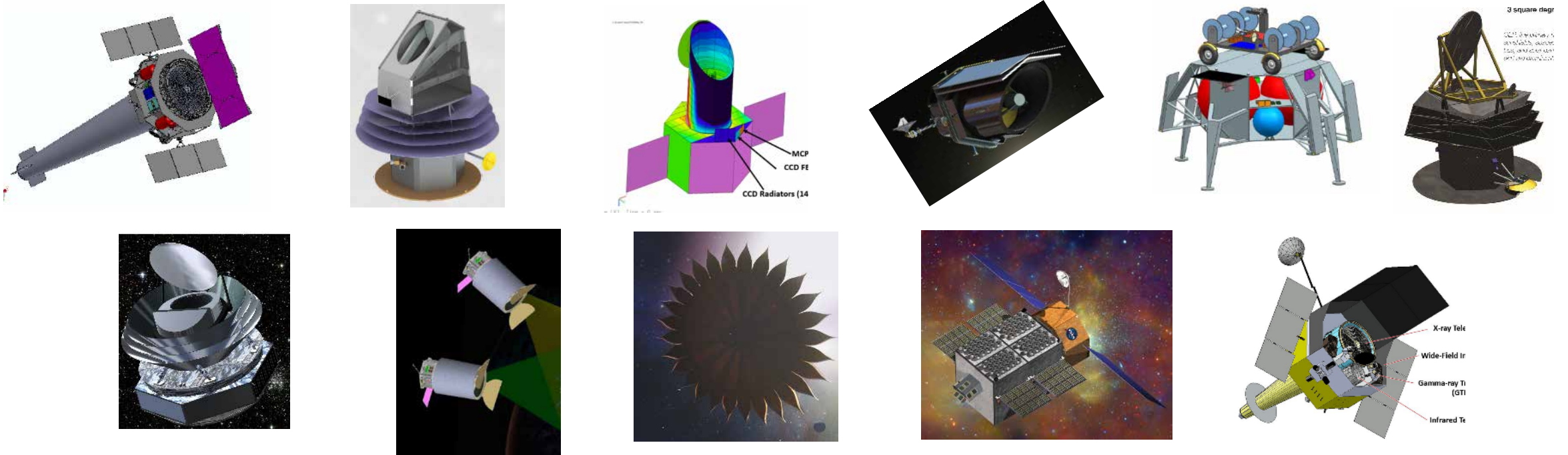
NASA's highest aspiration for the 2020 Decadal Survey is that it be ambitious

- The important science questions require new and ambitious capabilities
- Ambitious missions prioritized by previous Decadal Surveys have always led to paradigm shifting discoveries about the universe



# Probe (Medium Mission) Concepts

Probes are strategic missions that have had a strong impact on astrophysics, either through a focused investigation or as a broadly-capable observatory

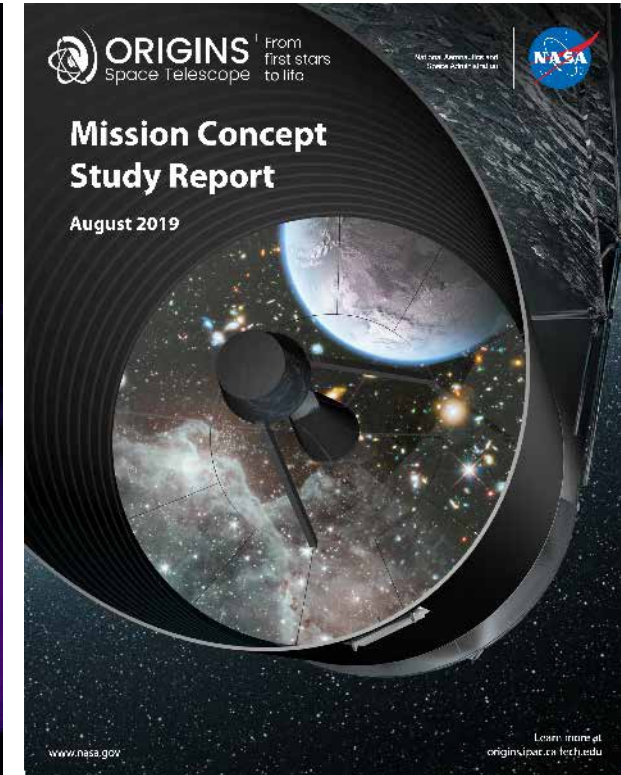
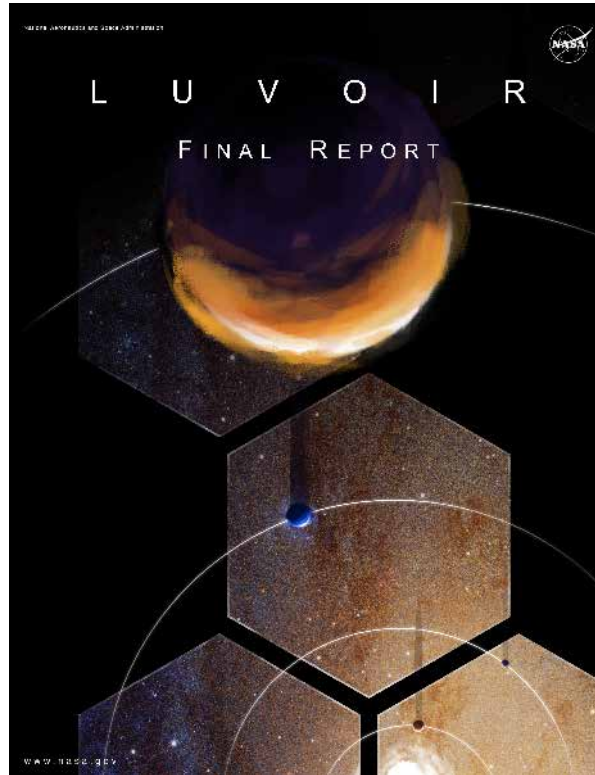
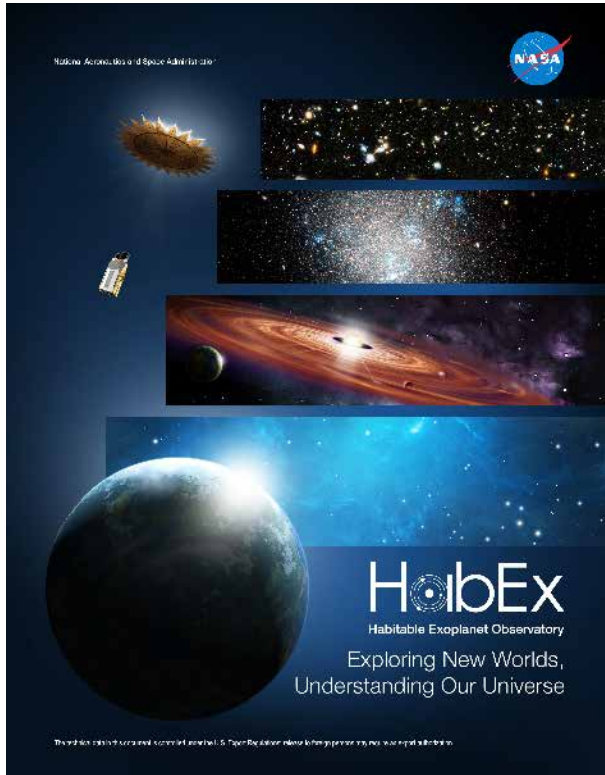


NASA funded probe studies are available at <https://science.nasa.gov/astrophysics/2020-decadal-survey-planning>

NASA's independent assessment of probe studies by the Probes Cost Assessment Team (PCAT) is available at <https://science.nasa.gov/astrophysics/2020-decadal-survey-planning>



# Large Mission Concepts



NASA's independent assessment by the Large Mission Concept Independent Assessment Team (LCIT) is available at <https://science.nasa.gov/astrophysics/2020-decadal-survey-planning>

Links to the concept study reports are posted at <https://science.nasa.gov/astrophysics/2020-decadal-survey-planning> and at <https://www.greatobservatories.org/>

# Decadal Survey Goal

NASA's highest aspiration for the 2020 Decadal Survey is that it be ambitious

- The important science questions require new and ambitious capabilities
- Ambitious missions prioritized by previous Decadal Surveys have always led to paradigm shifting discoveries about the universe



If you plan to a diminishing budget, you get a diminishing program

- Great visions inspire great budgets

## Carpe Posterum





# The Future

This is an exciting time for Astrophysics – we are pursuing the answers to the biggest questions

- How did the universe begin and evolve?
- How did galaxies, stars, and planets come to be?
- Are we alone?

Astrophysics is multiwavelength and multimessenger

- NASA has 10 operating astrophysics missions\*
- NASA is developing 10 astrophysics missions\* and studying 4 for downselect

The community will select NASA's future observatories through the 2020 Decadal Survey and through peer review of competed missions (like Explorers)

NASA is ready to realize the community's priorities

\* includes partner-led missions



Slides posted at  
<http://science.nasa.gov/astrophysics/documents>







BACKUP





+ SMEX/MO (2025),  
MIDEX/MO (2028), etc.

■ Formulation

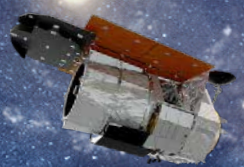
■ Implementation

■ Primary Ops

■ Extended Ops



Spitzer  
8/25/2003  
1/30/2020



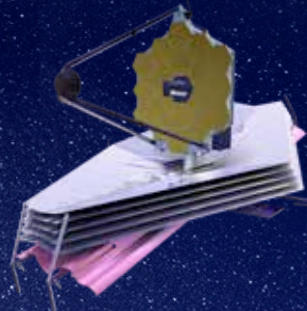
Roman  
2025/2026



Euclid (ESA)  
2022



SXG (RSA)  
7/13/2019



Webb  
2021



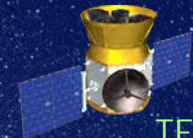
Ariel (ESA)  
2028



Chandra  
7/23/1999



XMM-Newton (ESA)  
12/10/1999



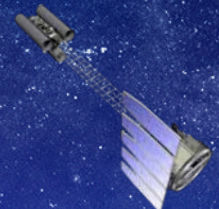
TESS  
4/18/2018



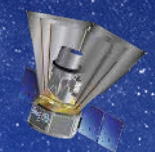
NuSTAR  
6/13/2012



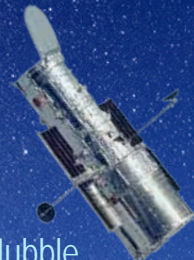
Fermi  
6/11/2008



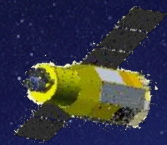
IXPE  
2021



SPHEREx  
2023



Hubble  
4/24/1990



XRISM (JAXA)  
2022



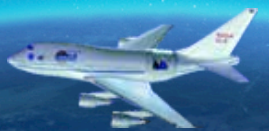
Swift  
11/20/2004



ISS-NICER  
6/3/2017



GUSTO  
2021



SOFIA  
Full Ops 5/2014

+ Athena (early 2030s),  
LISA (early 2030s)



# Science Budget Request Summary (\$M)

	Actual FY 19	Request FY 20	Enacted FY 20	Request FY 21	Out-years			
					FY 22	FY 23	FY 24	FY 25
<b><u>Science</u></b>	<b><u>6,886.6</u></b>	<b><u>6,393.7</u></b>	<b><u>7,138.9</u></b>	<b><u>6,306.5</u></b>	<b><u>6,553.5</u></b>	<b><u>6,575.7</u></b>	<b><u>6,705.2</u></b>	<b><u>6,766.9</u></b>
<b><u>Earth Science</u></b>	<b><u>1,931.0</u></b>	<b><u>1,779.8</u></b>	<b><u>1,971.8</u></b>	<b><u>1,768.1</u></b>	<b><u>1,878.2</u></b>	<b><u>1,846.1</u></b>	<b><u>1,834.5</u></b>	<b><u>1,984.6</u></b>
Earth Science Research	454.1	447.9		447.3	471.9	494.1	528.5	530.3
Earth Systematic Missions	932.7	719.2		608.3	706.1	695.6	640.7	797.3
Earth System Science Pathfinder	223.8	275.4		338.9	301.2	251.6	241.8	234.4
Earth Science Data Systems	202.0	214.4		245.4	259.9	263.2	278.7	277.7
Earth Science Technology	63.4	69.6		74.2	82.8	84.6	86.4	86.4
Applied Sciences	55.1	53.3		53.9	56.3	57.0	58.5	58.5
<b><u>Planetary Science</u></b>	<b><u>2,746.7</u></b>	<b><u>2,712.1</u></b>	<b><u>2,713.4</u></b>	<b><u>2,659.6</u></b>	<b><u>2,800.9</u></b>	<b><u>2,714.9</u></b>	<b><u>2,904.8</u></b>	<b><u>2,830.7</u></b>
Planetary Science Research	276.6	266.2		305.4	288.6	285.1	295.2	286.7
Planetary Defense	150.0	150.0	160.0	150.0	147.2	97.6	98.0	98.0
Lunar Discovery and Exploration	188.0	300.0	300.0	451.5	517.3	491.3	458.3	458.3
Discovery	409.5	502.7		484.3	424.4	434.8	570.1	505.8
New Frontiers	93.0	190.4		179.0	314.3	332.8	326.9	285.0
Mars Exploration	712.7	546.5	570.0	528.5	588.4	671.2	798.7	855.3
Outer Planets and Ocean Worlds	793.6	608.4		414.4	370.7	239.4	192.3	171.7
Radioisotope Power	123.3	147.9	147.9	146.3	150.1	162.8	165.4	169.8
<b><u>Astrophysics</u></b>	<b><u>1,191.1</u></b>	<b><u>844.8</u></b>	<b><u>1,306.2</u></b>	<b><u>831.0</u></b>	<b><u>891.2</u></b>	<b><u>1,000.9</u></b>	<b><u>959.7</u></b>	<b><u>975.5</u></b>
Astrophysics Research	222.8	250.7		269.7	279.1	327.2	314.9	331.1
Cosmic Origins	222.8	185.3		124.0	123.2	120.0	122.4	122.4
Physics of the Cosmos	151.2	148.4		143.9	160.8	155.3	169.8	154.1
Exoplanet Exploration	367.9	46.4		47.2	50.4	47.6	51.6	52.2
Astrophysics Explorer	226.5	214.1		246.2	277.7	350.8	301.0	315.6
<b><u>James Webb Space Telescope</u></b>	<b><u>305.1</u></b>	<b><u>352.6</u></b>	<b><u>423.0</u></b>	<b><u>414.7</u></b>	<b><u>175.4</u></b>	<b><u>172.0</u></b>	<b><u>172.0</u></b>	<b><u>172.0</u></b>
<b><u>Heliophysics</u></b>	<b><u>712.7</u></b>	<b><u>704.5</u></b>	<b><u>724.5</u></b>	<b><u>633.1</u></b>	<b><u>807.8</u></b>	<b><u>841.8</u></b>	<b><u>834.1</u></b>	<b><u>804.1</u></b>
Heliophysics Research	248.9	237.0		230.5	218.7	225.2	224.0	224.5
Living with a Star	135.3	107.6		127.9	134.5	246.4	225.5	233.3
Solar Terrestrial Probes	180.5	177.9	183.2	126.3	262.2	202.6	195.6	115.5
Heliophysics Explorer Program	147.9	182.0	182.0	148.4	192.4	167.6	189.0	230.8

# Astrophysics Program Content

	Actual FY 19	Request FY 20	Enacted FY 20	Request FY 21	Out-years			
					FY 22	FY 23	FY 24	FY 25
<b>Astrophysics</b>	<b>1,191.1</b>	<b>844.8</b>	<b>1,306.2</b>	<b>831.0</b>	<b>891.2</b>	<b>1,000.9</b>	<b>959.7</b>	<b>975.5</b>
<u>Astrophysics Research</u>	<u>222.8</u>	<u>250.7</u>	<u>250.7</u>	<u>269.7</u>	<u>279.1</u>	<u>327.2</u>	<u>314.9</u>	<u>331.1</u>
Astrophysics Research and Analysis	83.4	86.6		90.2	92.2	94.2	94.2	94.2
Balloon Project	40.2	44.8		44.8	45.8	45.7	46.3	46.3
Science Activation	45.0	45.6	45.6	45.6	45.6	45.6	45.6	45.6
<u>Other Missions and Data Analysis</u>	<u>54.2</u>	<u>73.7</u>		<u>89.1</u>	<u>95.5</u>	<u>141.7</u>	<u>128.8</u>	<u>145.0</u>
Astrophysics Data Curation and Archival	17.9	21.2		24.5	26.3	26.4	28.5	28.7
Astrophysics Data Program	19.1	20.4		21.6	22.6	23.6	23.6	23.6
Astrophysics Senior Review		-				51.2	50.4	49.9
Contract Administration, Audit & QA Svcs	12.7	12.7		17.3	17.3	17.3	17.3	17.3
Astrophysics Directed R&T	4.5	19.4		25.7	29.4	23.3	9.0	25.5
<u>Cosmic Origins</u>	<u>222.8</u>	<u>185.3</u>		<u>124.0</u>	<u>123.2</u>	<u>120.0</u>	<u>122.4</u>	<u>122.4</u>
Hubble Space Telescope	98.3	83.3	90.8	88.3	98.3	98.3	98.3	98.3
SOFIA	85.2	73.0	85.2	12.0				
<u>Other Missions and Data Analysis</u>	<u>39.3</u>	<u>29.0</u>		<u>23.7</u>	<u>24.9</u>	<u>21.7</u>	<u>24.1</u>	<u>24.1</u>
(development / formulation / technology)								
Cosmic Origins SR&T	24.8	17.1		18.4	18.4	18.4	18.4	18.4
Cosmic Origins Future Missions	0.8	2.2		2.7	4.6	1.6	3.8	3.8
(operating)								
Spitzer	13.2	8.5		1.0				
(research and management)								
Astrophysics Strategic Mission Prog Mgmt	0.4	1.2		1.6	1.9	1.7	1.9	2.0



# Astrophysics Program Content

	Actual FY 19	Request FY 20	Enacted FY 20	Request FY 21	Out-years			
					FY 22	FY 23	FY 24	FY 25
<u>Physics of the Cosmos</u>	<u>151.2</u>	<u>148.4</u>		<u>143.9</u>	<u>160.8</u>	<u>155.3</u>	<u>169.8</u>	<u>154.1</u>
(development / formulation / technology)								
Euclid	17.2	13.7		11.0	8.9	9.9	10.3	9.5
Physics of the Cosmos SR&T	45.7	50.9		45.9	61.2	75.2	87.0	72.1
Physics of the Cosmos Future Missions	0.0	2.0		1.6	4.6	2.0	3.7	3.7
(operating)								
Chandra X-Ray Observatory	61.7	58.4		62.3	62.8	62.8	62.8	62.8
Fermi Gamma-ray Space Telescope	16.5	14.0		13.8	13.9			
XMM	4.5	3.5		3.5	3.5			
(research and management)								
PCOS/COR Technology Office Management	5.6	5.9		5.9	6.0	5.4	6.0	6.0
<u>Exoplanet Exploration</u>	<u>367.9</u>	<u>46.4</u>		<u>47.2</u>	<u>50.4</u>	<u>47.6</u>	<u>51.6</u>	<u>52.2</u>
(development / formulation / technology)								
WFIRST	312.2		510.7					
Exoplanet Exploration SR&T	32.1	29.1		31.5	32.0	31.3	30.5	31.2
Exoplanet Exploration Future Missions	0.7	2.8		1.7	3.5	1.6	5.4	5.4
(operating)								
Keck Operations	6.5	6.7		6.9	7.0	7.2	7.4	7.4
Kepler	8.9	1.3						
(research and management)								
Exoplanet Exploration Technology Off Mgmt	7.5	6.5		7.1	7.8	7.4	8.2	8.1

# Astrophysics Program Content

	Actual FY 19	Request FY 20	Enacted FY 20	Request FY 21	Out-years			
					FY 22	FY 23	FY 24	FY 25
<b><u>Astrophysics Explorer</u></b>	<b><u>226.5</u></b>	<b><u>214.1</u></b>		<b><u>246.2</u></b>	<b><u>277.7</u></b>	<b><u>350.8</u></b>	<b><u>301.0</u></b>	<b><u>315.6</u></b>
(development / formulation / technology)								
SPHEREx	22.2			90.8	109.1	87.7	28.4	13.0
Imaging X-Ray Polarimetry Explorer	57.0	70.2		45.3	7.4	4.5	0.5	
X-Ray Imaging and Spectroscopy Mission	23.2	29.7		25.1	36.3	17.7	15.9	14.4
CASE				11.9	10.2	10.0	6.4	1.0
GUSTO	19.9	11.1		7.8	5.8	1.0		
Astrophysics Explorer Future Missions	2.3	84.8		10.6	58.0	219.2	241.5	278.1
Universe Explorer Prior Hist Projects	70.0							
(operating)								
Transiting Exoplanet Survey Satellite	7.7	5.0		14.7	14.1			
Nuclear Spectroscopic Telescope Array	8.5	7.8		8.6	8.6			
Neil Gehrels Swift Observatory	7.0	5.5		5.8	5.8			
NICER	3.8			4.8	4.4			
(research and management)								
Astrophysics Explorer Program Management	4.9			20.7	18.0	10.7	8.3	9.1
<b><u>James Webb Space Telescope</u></b>	<b><u>305.1</u></b>	<b><u>352.6</u></b>	<b><u>423.0</u></b>	<b><u>414.7</u></b>	<b><u>175.4</u></b>	<b><u>172.0</u></b>	<b><u>172.0</u></b>	<b><u>172.0</u></b>
<b><u>Astrophysics + Webb Total</u></b>	<b><u>1,496.2</u></b>	<b><u>1,197.3</u></b>	<b><u>1,729.2</u></b>	<b><u>1,245.7</u></b>	<b><u>1,066.6</u></b>	<b><u>1,172.9</u></b>	<b><u>1,131.7</u></b>	<b><u>1,147.5</u></b>



# SMD Organization Chart

