

National Aeronautics and
Space Administration



EXPLORE SOLAR SYSTEM & BEYOND


NASA Astrophysics Update

AAAC Meeting | January 26-27, 2021

Paul Hertz

Director, Astrophysics Division

Science Mission Directorate

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



Highlights of 2020



NASA SCIENCE

AN INTEGRATED PROGRAM



**EARTH
SCIENCE**



HELIOPHYSICS



**PLANETARY
SCIENCE**



ASTROPHYSICS



**BIOLOGICAL &
PHYSICAL SCIENCE**



**JOINT AGENCY
SATELLITE**

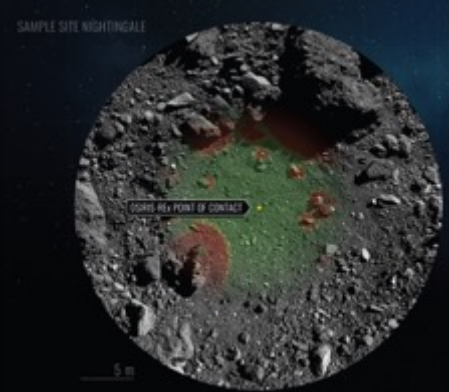
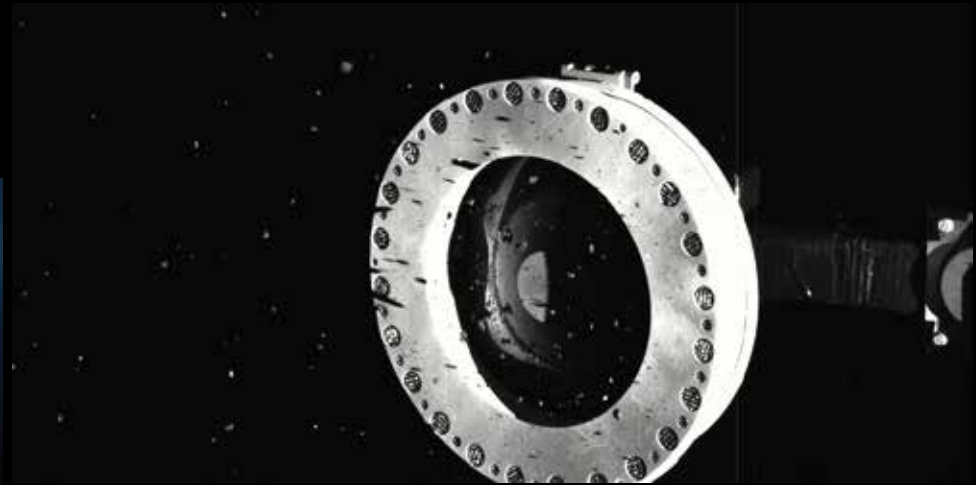


NASA's Mars 2020 Perseverance rover launched on the Atlas V-541 rocket from Launch Complex 41 at Cape Canaveral Air Force Station, Florida on July 30, 2020, at 7:50 a.m. ET. Perseverance (and the Ingenuity Mars helicopter tech demo) will land on Mars on February 18, 2021, around 3:30 pm ET.

OSIRIS-REx



Touch-and-Go Sample Acquisition Mechanism (TAGSAM) Oct 22



Touch-and-Go ('TAG') at Nightingale Crater Oct 20



Sample stowed in Sample Return Capsule Oct 28



The fully assembled and folded James Webb Space Telescope on the vibration table at Northrop Grumman Space Park (September 2020). This is the configuration that Webb will be in when it is mated to the Ariane 5 launch vehicle in 2021.

Nancy Grace Roman Space Telescope



SCIENCE
HIGHLIGHT



February 28, 2020 – NASA confirmed the Wide Field Infrared Survey telescope (WFIRST) for development

May 20, 2020 – NASA named its Wide Field Infrared Survey Telescope (WFIRST), in honor of Nancy Grace Roman, NASA's first chief astronomer, who paved the way for space telescopes focused on the broader universe



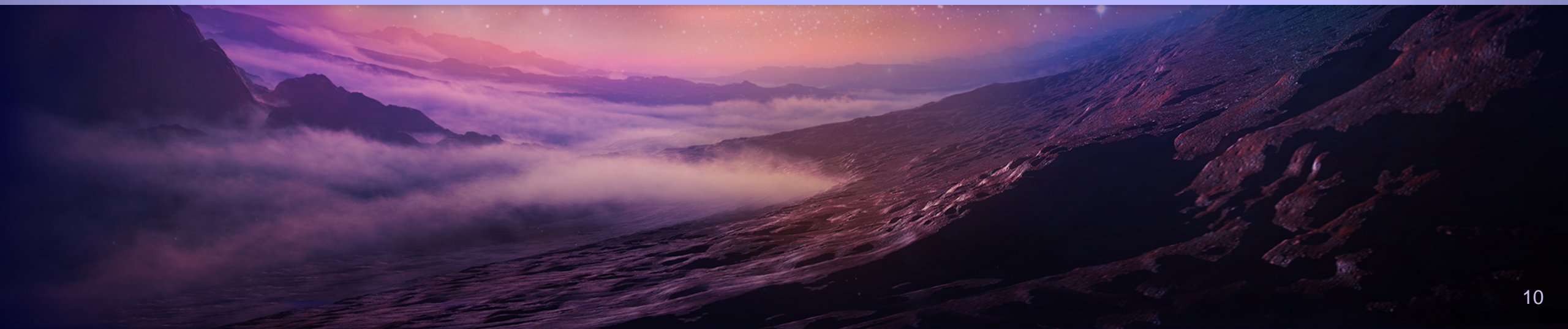
Building Excellent NASA Teams Requires Inclusion and Diversity



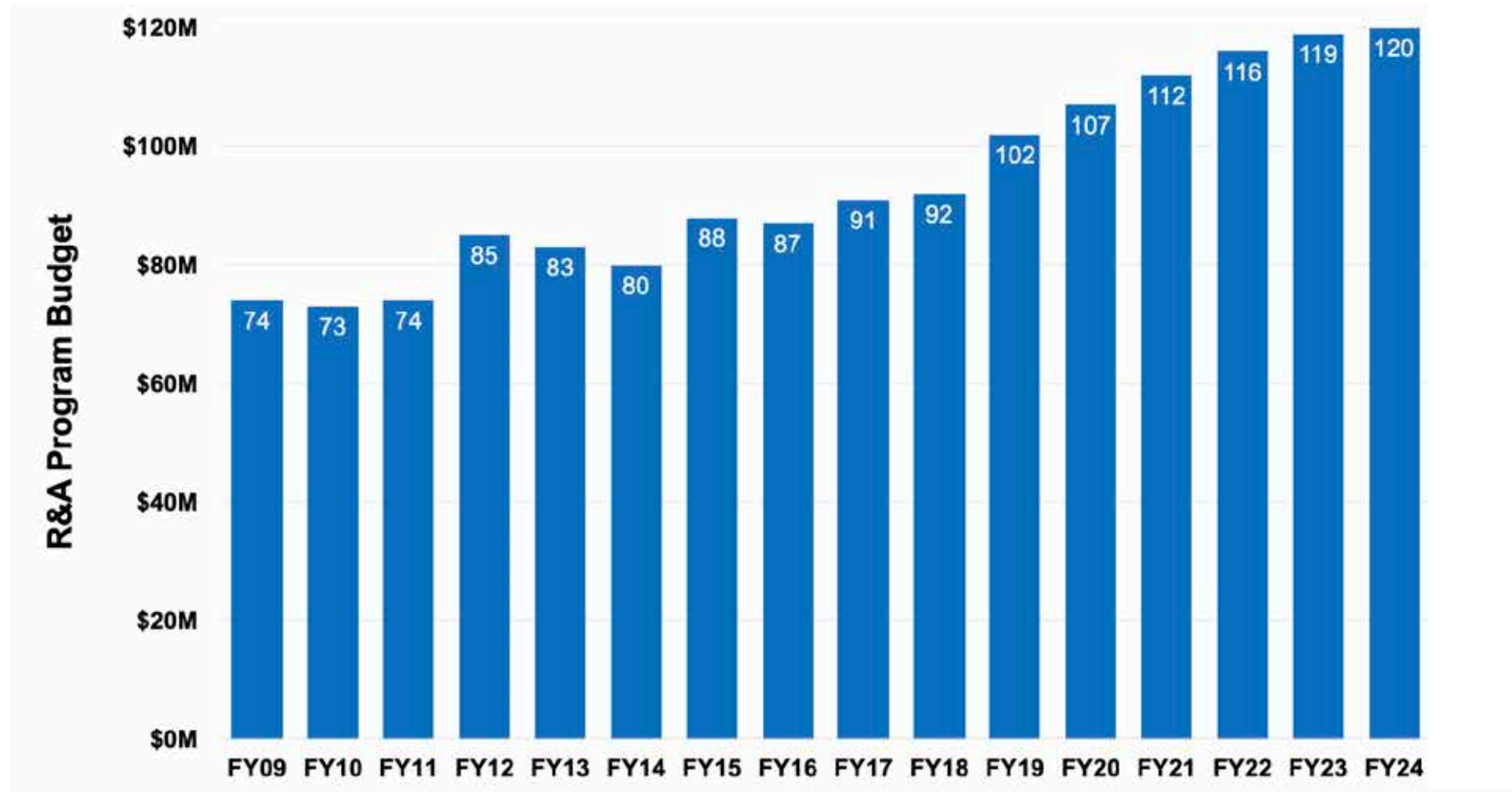
- At NASA, we recognize that excellence is only achieved with inclusive and diverse teams. We are creating a multi-pronged approach.
 - Directorate level: Hosting [incubator workshops](#) and implementing actions from those workshops focused on short-term changes to how we are operating and how we grow our leaders. [Studying barriers to inclusion in mission leadership](#). Standing up a long-term activity focused on sustained engagement, systemic, and lasting changes.
 - Division level: Division task forces working to align division-level practices with the NASA core value and SMD science strategy. Examining the R&A process for better inclusion and diversity. 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. Actively looking into how we can be a model for inclusivity.



Research Program Update



R&A Research Funding



Sustained growth in R&A research funding, increase by 60% over 17 years.

R&A Reviews since the Start of COVID-19

No solicitation was canceled due to COVID-19 and some due dates were postponed to give PIs more time.

R&A Review	Number of Proposals	Selection Rate	New PIs *	PI Notification	Review Format	Comment
FINESST (Graduate Student Awards)	158	13%	N/A	108 days	Virtual	
TESS GI Cycle 3	155	32%	76%	137 days	Virtual	
NuSTAR GO Cycle 6	172	34%	39%	88 days	Virtual + dual anonymous	GO/GI dual anonymous pilot program
Fermi GI Cycle 13	109	38%	24%	126 days	Virtual	
Hubble GO Cycle 28	1,080	18%	33%	86 days	Virtual + dual anonymous	
Chandra GO Cycle 22	520	31%	31%	132 days	Virtual	
Astrophysics SmallSat Studies	32	25%	100%	148 days	Virtual	
TCAN (Theory)	22	18%	100%	97 days	Virtual	
XRP (Exoplanets Research)	153	17%	77%	185 days	Virtual	Cross-Division
ADAP (Data Analysis)	313	13%	82%	141 days	Virtual + dual anonymous	R&A dual anonymous pilot program
Pioneers SmallSat Missions	24	17%	100%	89 days	Virtual	Confirmation gate in 2021

* New PI defined as one who has not been a PI in this program in the past five years



From Open Data to Open Science

All NASA mission science data are public

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

NASA has initiated an open science data initiative that is making targeted investments in cloud computing, open-source software, Artificial Intelligence/Machine Learning, and open data search and discovery services

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

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

- Information produced by NASA Science Missions
- Information produced by NASA research awards: includes, but not limited to, experiments, research on sub-orbital platforms, field campaigns, or citizen science projects
- NASA-funded publications, data, and software created in the pursuit of scientific knowledge

Draft will be released for public comment

COVID-19 Impacts

NASA is focused on continuing our research programs and providing stability

- Virtual review panels for ROSES solicitations and AO mission evaluations are going well
 - All peer reviews until June are conducted virtually with no adverse effect on the quality of the reviews
 - NASA is thinking about continuing virtual review panels, at least in part, even after in-person meetings cease to pose a health hazard
- R&A management and supporting work at NASA HQ continues as normal via telework
 - R&A Program Officers have reached out to currently funded PIs and are working with them to protect the most vulnerable team members (early career, students, postdocs, non-tenured faculty)
 - No ROSES-20 solicitations were canceled, two solicitations had delayed due dates (TCAN, ADAP)
 - PIs are notified and funding is released to PIs just as fast as during previous years
- Since the start of the pandemic, 13 R&A peer reviews have been conducted as virtual reviews
 - NuSTAR Cycle 6 and ADAP were our pilot programs for dual-anonymous peer reviews
 - Going forward, more R&A peer reviews will be dual-anonymous to help mitigate biases

COVID-19 Mitigations

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

This initiative must be 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

First round of Post-COVID Recovery funding requests are being looked over. Received over 100 requests for a total of ~\$13M

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

The March 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 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>



Mission Program Update



Astrophysics and Artemis



Every opportunity for lunar science is open to astrophysics – if you have a great idea, propose it

Artemis enables astrophysics

- All science opportunities enabled by Project Artemis include astrophysics
- Most important criterion for proposals remains the astrophysics science merit

There are many opportunities to propose astrophysics that uses Artemis capabilities

- Lunar surface astrophysics experiments can be proposed to the PRISM program of small landed payloads (in ROSES)
 - PRISM Step 2 proposals are due February 3, 2021
 - Two lunar surface astrophysics experiments have been selected and manifested for 2021:
 - Low-frequency Radio Observations from the Near Side Lunar Surface Instrument (PI: R. MacDowall, GSFC)
 - Next Generation Lunar Retroreflectors (PI: D. Currie, University of Maryland)
- Astrophysics Explorers Mission of Opportunity calls (including 2021 call for Explorers MO) allow proposals for cislunar smallsat missions
- APRA and Pioneers calls (in ROSES) allow proposals for cislunar cubesats and smallsats

Astro2020 Decadal Survey will identify any compelling astrophysics that is both a high priority and enabled by the capabilities being developed within the Artemis program



Interagency MOUs

In October 2020, NASA and DOE signed a [Memorandum of Understanding](#) (MOU)

- The memorandum of understanding highlights potential areas for collaboration
- NASA and DOE also established three working groups that focus on lunar surface infrastructure, space nuclear power and propulsion, and science and innovation
- <https://www.nasa.gov/press-release/nasa-department-of-energy-expand-on-more-than-50-years-of-collaboration>

In January 2021, NASA and NSF signed a Memorandum of Understanding (MOU)

- NASA and NSF will continue working together to advance NASA- and NSF-sponsored science programs in astrophysics, planetary science, astrobiology, quantum technology, heliophysics, and Earth science, with special emphasis on those activities that continue to make use of NSF-managed facilities, including those in the Antarctic
- NASA and NSF are united in their efforts to broaden participation in science and engineering
- <https://www.nasa.gov/press-release/nasa-nsf-sign-agreement-to-advance-space-earth-biological-physical-sciences>

Joint activities still require separate Implementing Arrangements (IAs)

Joint NASA-DOE RFI

On January 21, DOE Office of Science jointly with NASA Science Mission Directorate released a Request for Information (RFI) related to high energy physics and space-based astrophysics

- The RFI is to gather information from the community in three specific, focused areas aligned with the science goals of both of the Agencies including the scientific and technology benefits and obstacles, how to will make use of each agency's capabilities, infrastructure and resources, and other pertinent information.
- The information received will inform DOE and NASA regarding the potential development of mutually beneficial partnerships and collaborative activities.

Three focused areas:

- Sensitive radio telescopes or sensors in the radio quiet environment of the Moon's far side to explore the early eras of the universe or to test the standard cosmological model
- Space-based probes of fundamental physics in the microgravity environment of the International Space Station (ISS)
- Enhance or extend the science reach of the Rubin Observatory, the Roman Space Telescope, and the Euclid mission when considered together, including development of a common library of simulations and/or capabilities to enable joint processing and analysis

<https://www.federalregister.gov/documents/2021/01/21/2021-01236/request-for-information-related-to-high-energy-physics-and-space-based-astrophysics>

This RFI is part of a wider DOE/NASA effort to investigate collaborative activities as part of the MOU signed in October 2020

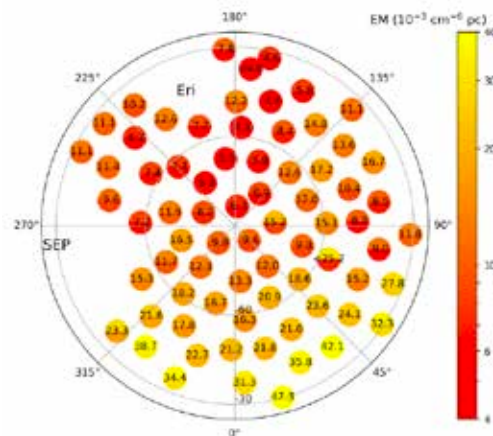
Astrophysics Mission Classes

DECADAL SURVEY	EXPLORER AO	SALMON AO	ROSES	
>\$1B	\$450M	\$80M	\$20B	\$0
<p>>\$1B</p> <p>LARGE CLASS</p> <p>Great Observatory or Flagship</p>	<p>~450M</p> <p>SMALL CLASS</p> <p>Medium Explorer (MIDEX)</p> <p>PICC \$290M*</p>	<p>\$80M</p> <p>SMALL CLASS</p> <p>Standard Mission of Opportunity</p> <p>**</p>	<p>\$20M</p> <p>SMALL CLASS</p> <p>Pioneers SmallSat</p> <p>**</p>	<p>\$20M</p> <p>SUBORBITAL</p> <p>Pioneers Balloon</p>
<p>~\$1B</p> <p>MEDIUM CLASS</p> <p>Probe</p>	<p>~225M</p> <p>SMALL CLASS</p> <p>Small Explorer (SMEX)</p> <p>PICC \$145M*</p>	<p>\$40M</p> <p>SMALL CLASS</p> <p>SmallSat Mission of Opportunity</p> <p>**</p>	<p>\$5M</p> <p>SMALL CLASS</p> <p>APRA CubeSat</p>	<p>\$10M</p> <p>SUBORBITAL</p> <p>APRA Balloon</p>
				<p>\$5M</p> <p>SUBORBITAL</p> <p>APRA Sounding Rocket</p>

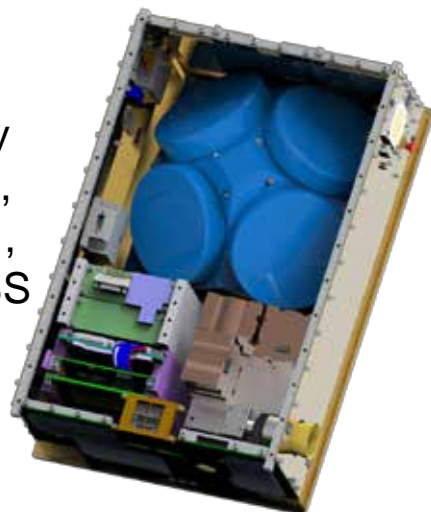
Astrophysics CubeSats

Solicited annually in ROSES/APRA, ~1 new start per year, ~<\$5M each total cost

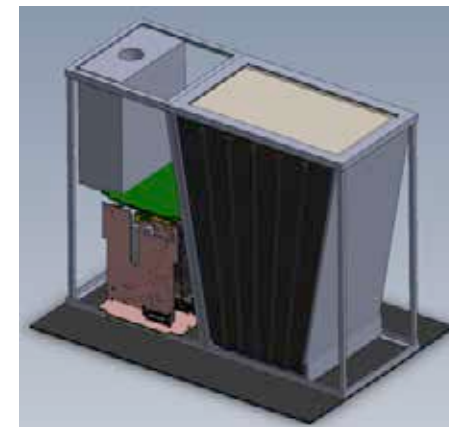
HaloSat: PI Phil Kaaret (U of Iowa),
Launch May 2018, Reentered Jan 2021,
OVII/OVIII lines in Galaxy halo, determine
mass and structure of Galaxy halo



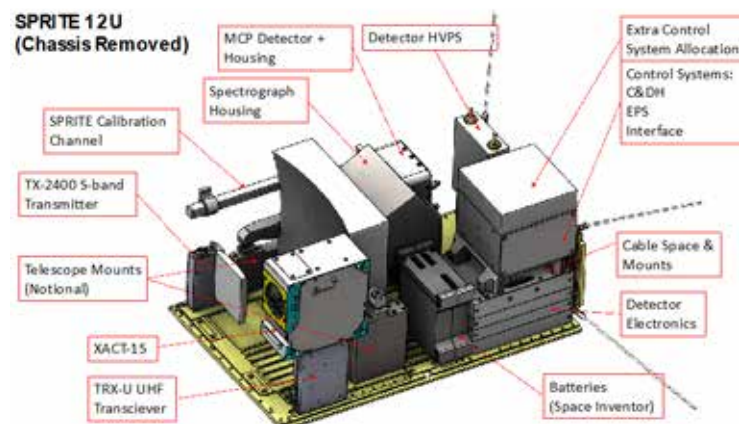
BurstCube: PI Jeremy
Perkins (NASA GSFC),
Launch NET Dec 2021,
GRB monitor w/ TDRSS
real-time event
notification



CUTE: PI Kevin
France (CU),
Launch Sep 2021,
UV Imaging of hot
Jupiter ablation,
(Arika Egan & Ambily
Suresh in lab)



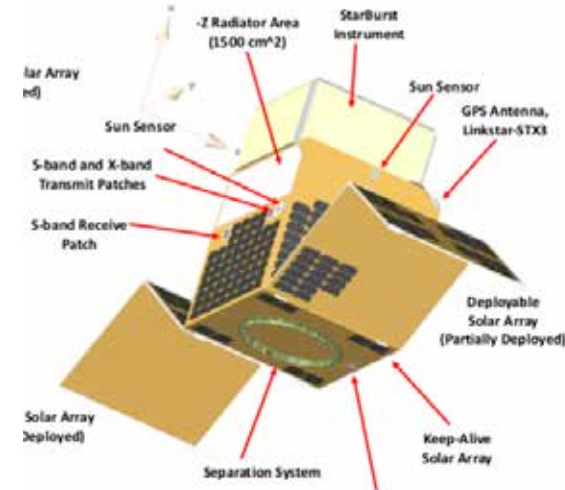
BlackCat: PI Abe
Falcone (Penn St U),
Launch NET Mar 2024,
2-20 KeV wide FOV
localization of X-ray
transients, real-time
'cell phone' downlink



SPRITE, PI Brian Fleming (CU),
Launch NET Jan 2023,
UV spectra of ionizing radiation
from star forming galaxies

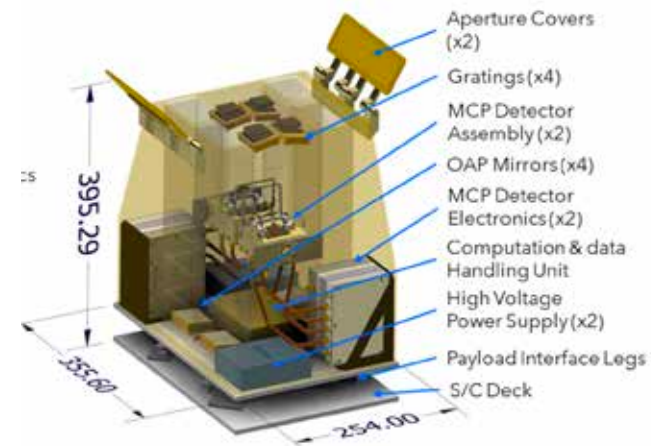
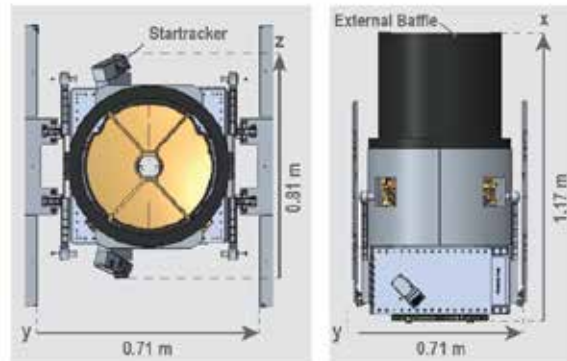
Astrophysics Pioneers-2020 Selections

PUEO: A Long-duration Balloon-borne Instrument for Particle Astrophysics at the Highest Energies (PI Abigail Viereg, U. Chicago)



StarBurst: Gamma-ray ASM, Simultaneous detection of NS/NS mergers with LIGO (PI Daniel Kocevski, NASA MSFC)

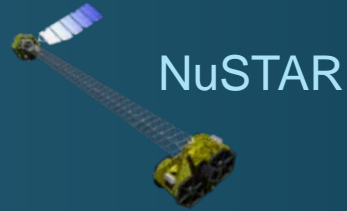
Pandora: Multiwavelength Characterization of Exoplanets and their Host Stars (PI Elisa Quintana, NASA GSFC)



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

<https://www.nasa.gov/feature/nasa-selects-4-concepts-for-small-missions-to-study-universe-s-secrets>

Astrophysics Explorers Program



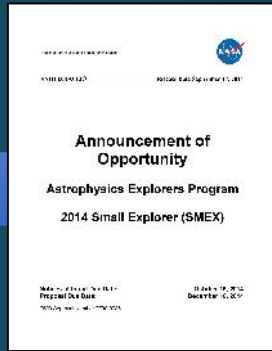
SMEX 2019 Downselect
Phase A Studies due Mar 4, 2021
Downselect decision Fall 2021

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



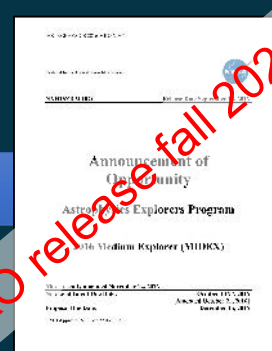
SMEX
2014



MIDEX
2016



SMEX
2019



MIDEX
2021

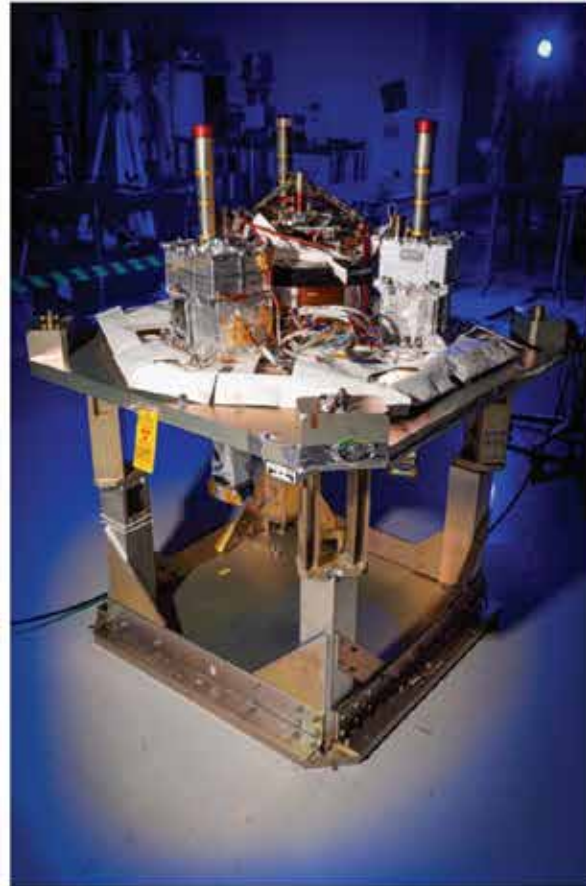
Small and
Mid-Size
Missions



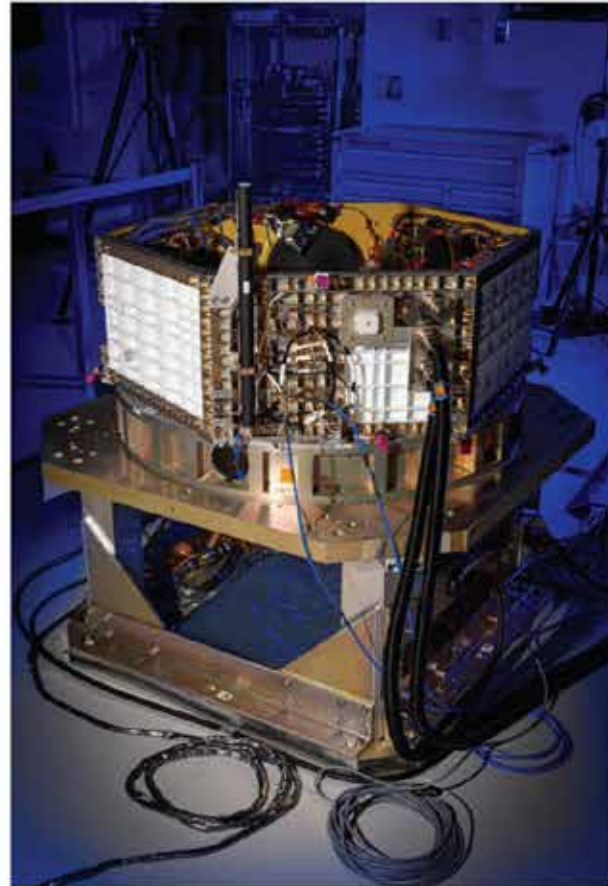
Missions of
Opportunity



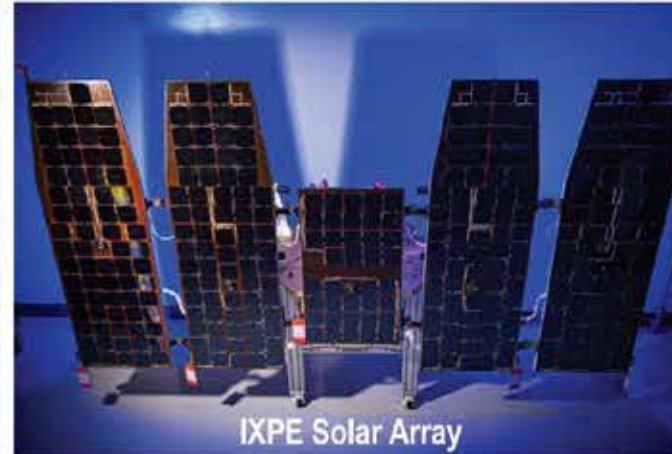
Imaging X-ray Polarimeter Explorer



Instrument & Deployable Boom
Integrated to Top Deck



IXPE Spacecraft



IXPE Solar Array



Mirror Module Assembly (MMAs)
Integrated on MMSS Deck

Flight Hardware Assembly is Near Complete

KDP-D successfully passed on November 2, 2020

All observatory elements have been delivered to Ball Aerospace, Boulder CO

Observatory integration began December 7, 2020

Revised launch date is November 2021

<https://ixpe.msfc.nasa.gov/>

Image credits: Ball Aerospace

Virtual PI Launchpad

Another PI Launchpad is (finally) happening

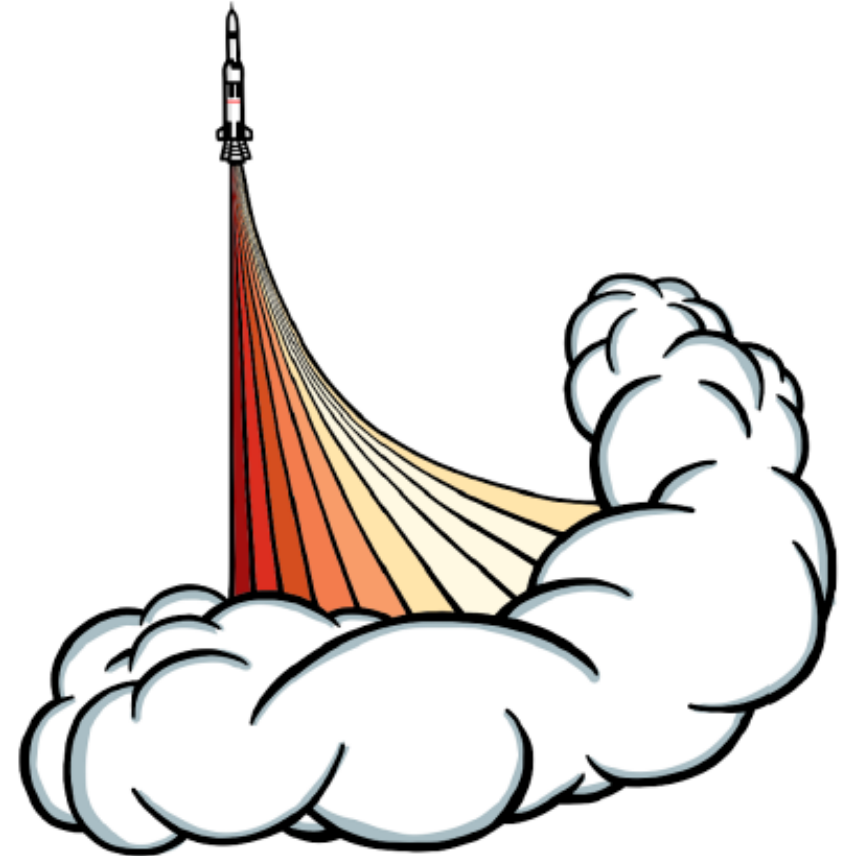
- Virtual sessions over 2 weeks: 1 week asynchronous content, 1 week interactive, ~2-3 hours per day

Key Dates:

- Application posted on NSPIRES in the next week- be on the lookout!
- Deadline for applications is March 22nd
- Notifications by May 3rd
- Launchpad will be From June 14th to Jun 25th

Content from 2019 workshop is online now!

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



James Webb Space Telescope



The final deployment of Webb's sunshield on Earth (December 2020). Webb will undergo folding and stowing before shipment and mating to the Ariane 5 in 2021.

2020 Accomplishments

- Work continues at Northrop Grumman, but at lower efficiency due to social distancing practices required by COVID19 response
- Changed launch date from March 2021 to October 2021
- Conducted several mission rehearsals at the STScI mission operation center
- Completed Observatory-level environmental tests
- Completed Observatory-level post environmental test deployments
- Received ~1200 proposals in the Cycle 1 GO call

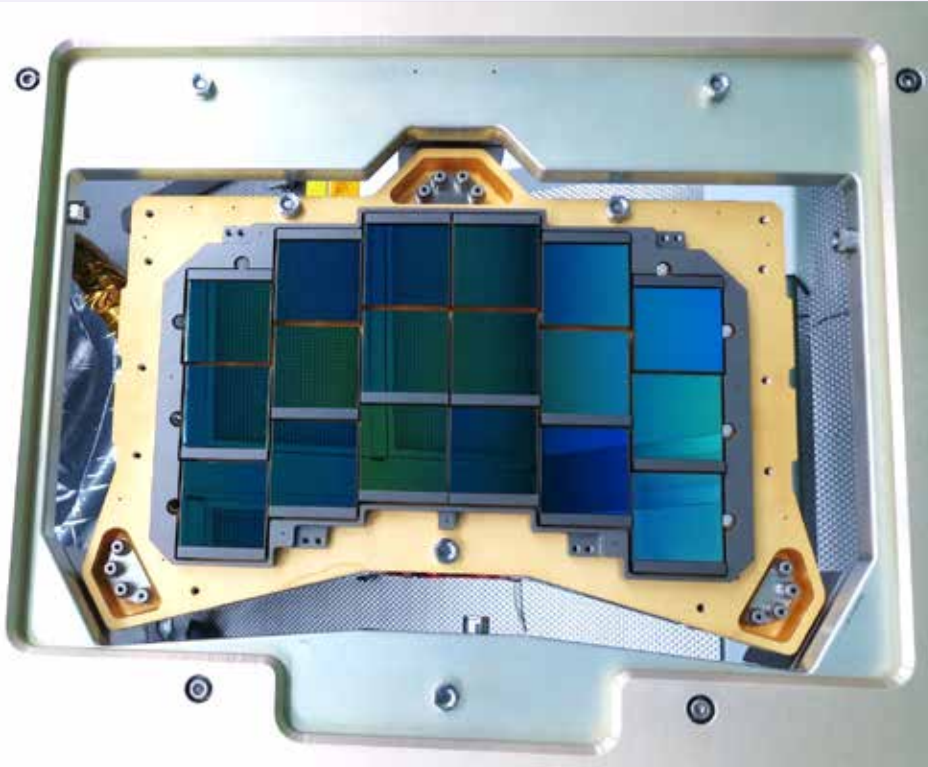
2021 Plans

- Final stow after post environmental deployments
- Ready Observatory for shipping to launch site
- Additional mission rehearsals at STScI
- Launch Webb in October 2021

Roman Space Telescope

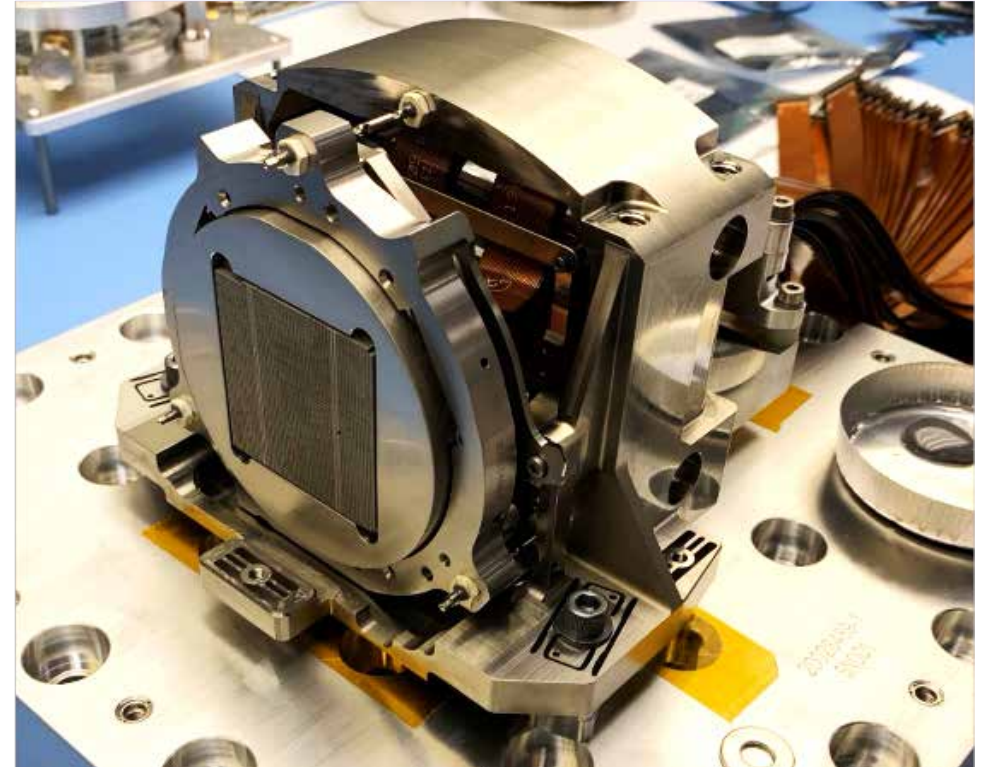
Roman making excellent progress on its most urgent elements; Mission Critical Design Review planned for end of this summer

Roman Wide Field Instrument critical technology:
state-of-the-art infrared detectors



*300 Mpixel Focal Plane Array Test Unit;
Production well underway: 15 of 18 flight
candidate detectors already in hand*

Roman Coronagraph Instrument critical
technology: deformable mirrors



*Deformable Mirror TRL-6 Model; technology has
been demonstrated; two flight candidate
actuators already in hand*

Roman Space Telescope

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

- RSIG documents available at <https://roman.gsfc.nasa.gov/science/rsig.html>

Critical design reviews for telescope, wide field instrument, coronagraph, instrument carrier, spacecraft, and ground system to be completed by July 2021

Mission critical design review (CDR) is September 2021

Complete telescope by the end of 2021

Cost and schedule commitments are unchanged since beginning of Phase B in 2018, but COVID impacts have liened cost and schedule reserves

- Review of COVID impacts to cost and schedule underway in early 2021

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

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

Roman Space Telescope

Opportunities for participation in Roman offered in ROSES-2021

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

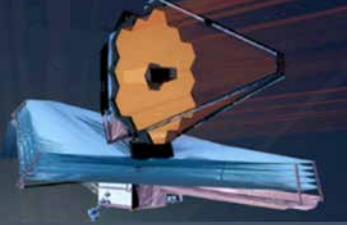
All Roman observing time is available through open processes

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

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

Astrophysics Missions in Development

Webb 2021
NASA Mission



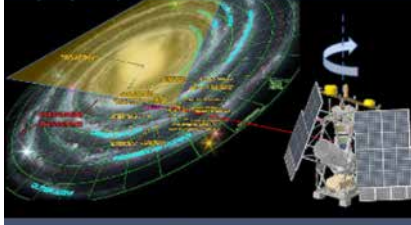
James Webb
Space Telescope

IXPE 2021
NASA Mission



Imaging X-ray
Polarimetry Explorer

GUSTO 2021
NASA Mission



Galactic/ Extragalactic ULDB
Spectroscopic Terahertz Observatory

XRISM 2022
JAXA-led Mission



NASA is supplying the SXS
Detectors, ADRs, and SXTs

Euclid 2022
ESA-led Mission



NASA is supplying the NISP
Sensor Chip System (SCS)

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 2028
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
- In astrophysics, this includes NASA contributions to Euclid and XRISM

Some missions have experienced challenges that affect cost and schedule commitments

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

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

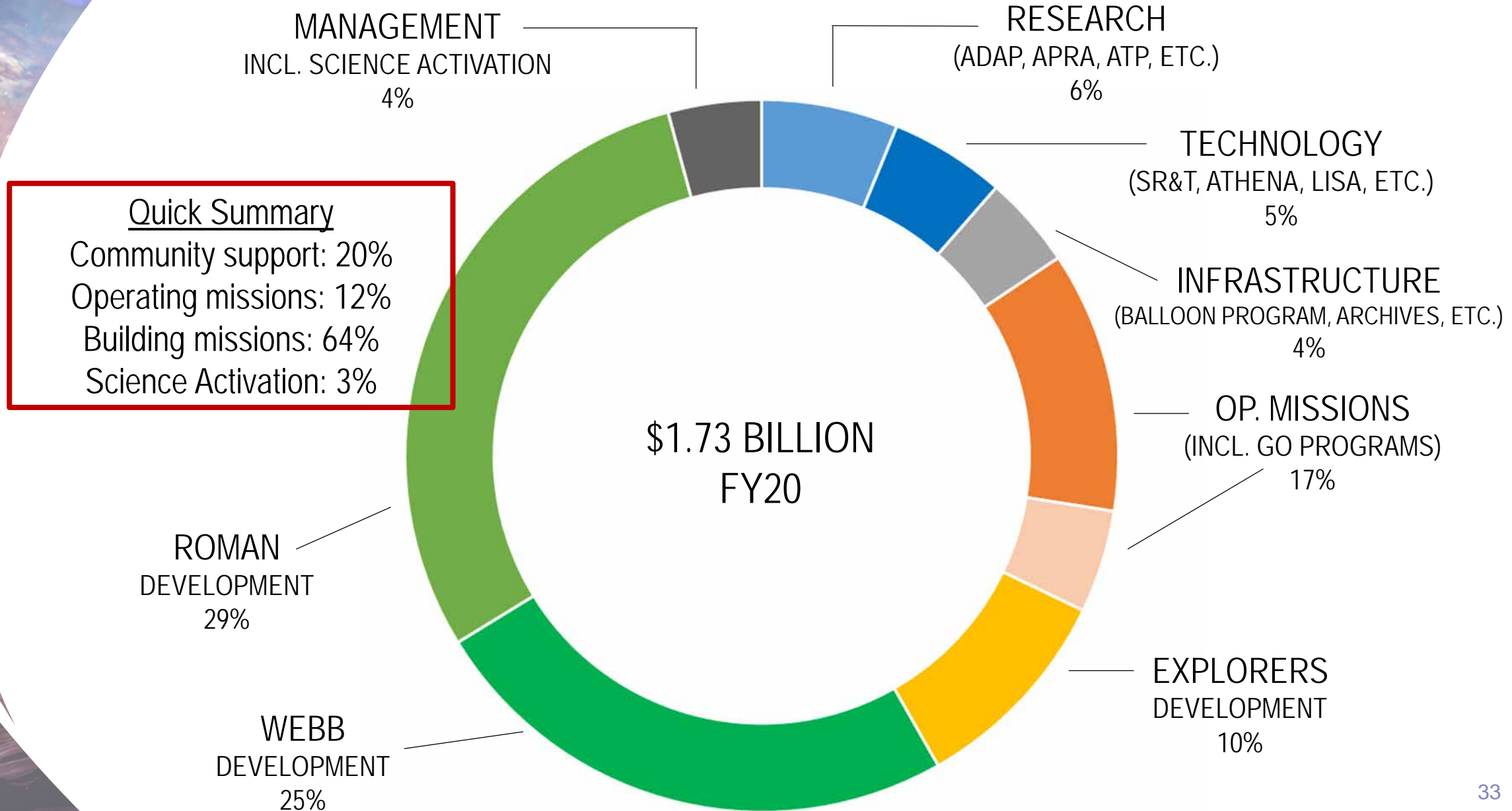
- Challenges to Explorers have been accommodated within the Explorers Program



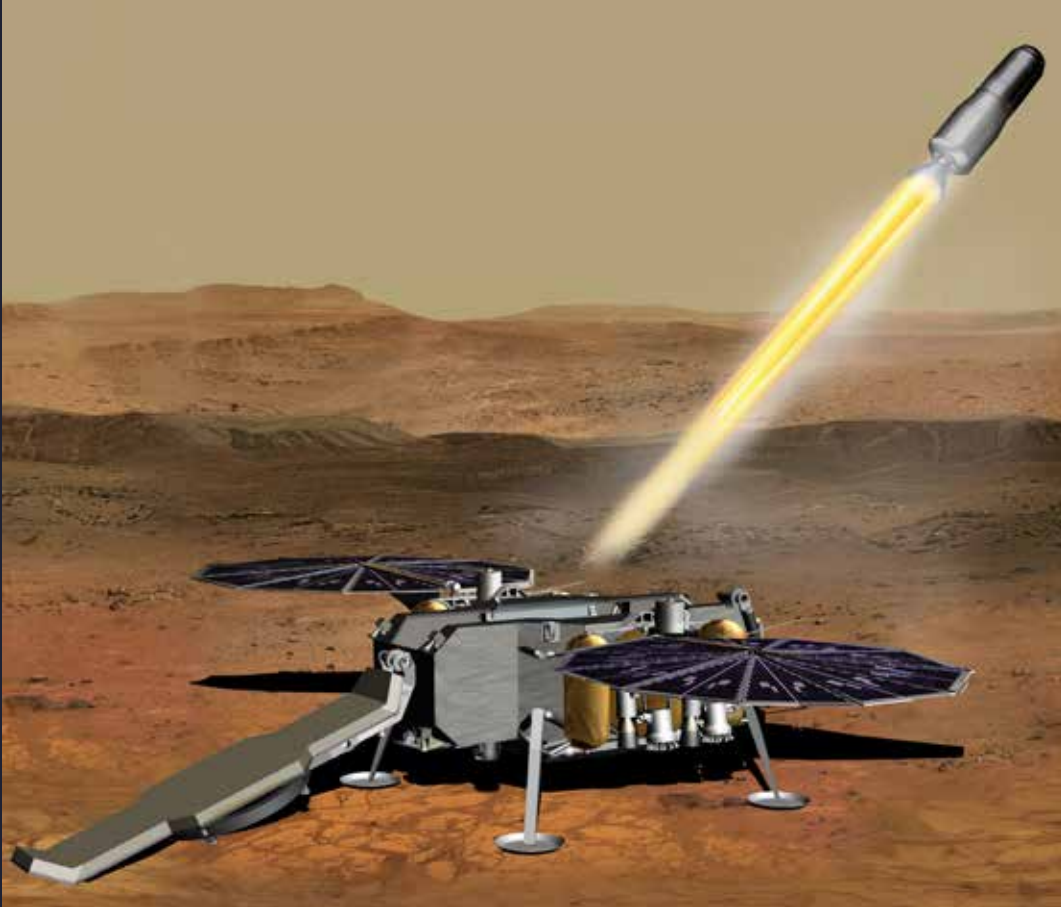
Planning for the Future



Astrophysics Budget – FY20 Actual



FY21 Science Appropriations Highlights



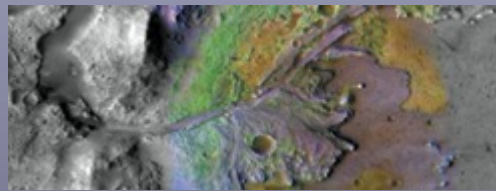
- FY 2021 Consolidated Appropriations Act signed into law December 27, 2020
- Continued strong support for Science with a \$7.3 B budget
 - \$994 M above the FY21 President's Budget request
 - \$162 M above the FY 2020 enacted level
- Continued funding for Roman, PACE, CLARREO PF, SOFIA
- Funding to support decadal priorities such a Mars Sample Return mission, Europa Clipper, and development of new Earth observation missions
- Includes funding for new Biological and Physical Science Division

FY 14-21 Science Appropriations Summary

(\$M)	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY21 Omnibus Bill
Science	5,140.2	5,243.0	5,584.1	5,762.2	6,211.5	6,816.6	7,143.1	7,301.0
Earth Science	1,822.1	1,784.1	1,926.6	1,907.7	1,921.0	1,931.0	1,971.8	2,000.0
Planetary Science	1,342.3	1,446.7	1,628.0	1,827.5	2,217.9	2,746.7	2,712.6	2,700.0
Astrophysics	677.1	730.7	762.4	782.9	850.4	1,121.6	1,306.2	1,356.2
JWST	658.2	645.4	620.0	569.4	533.7	304.6	423.0	414.7
Heliophysics	640.5	636.1	647.2	674.7	688.5	712.7	724.5	751.0
Biological & Physical Science							5.0	79.1

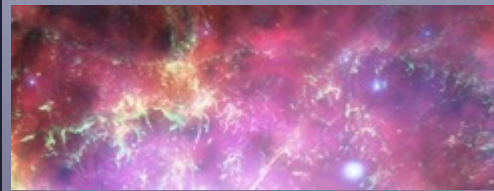
FY21 Science Appropriations Division Highlights

Planetary Science



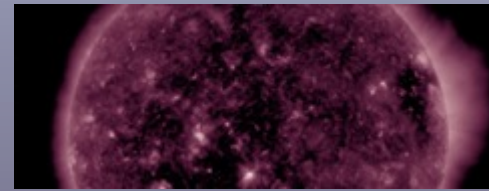
- \$40M above the FY21 Request
- Additional funds for Planetary Defense supporting DART and Near Earth Object Surveillance Mission
- Additional funding for Mars Sample Return and New Frontiers/Dragonfly
- Strong support for Lunar Discovery and Exploration, as well as Commercial Lunar Payload Services
- Europa Clipper given permission to use CLV in the event of SLS incompatibility

Astrophysics



- \$525M above the FY21 Request
- Restores funding to continue development of Nancy Grace Roman Telescope
- Additional funding for SOFIA
- Strong support for Science Activation, an SMD-wide education program

Heliophysics



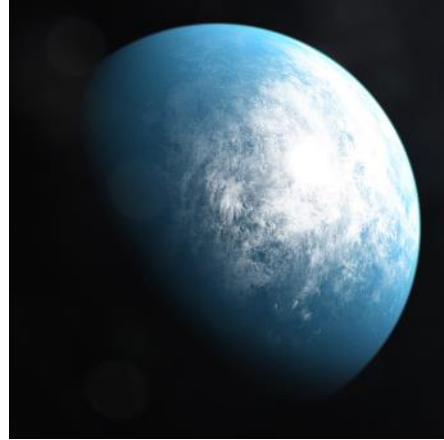
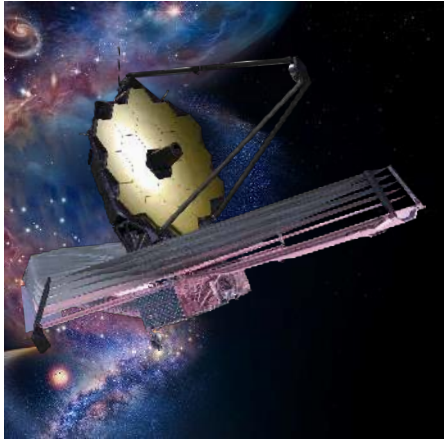
- \$118M above the FY21 Request
- Additional funds for Research
- Increased funding for Living with a Star, including space weather applications and GDC
- Additional funds for Solar Terrestrial Probes, including MMS and DYNAMIC
- Additional funds for Heliophysics Explorers

Earth Science



- \$232M above the FY21 Request
- Strong support for Earth System Science Pathfinder Missions and Venture-class missions, including GLIMR and GeoCARB
- Restores funding for PACE and CLARREO PF
- Additional funds for Research
- Strong support for Designated Observable missions, as recommended by decadal survey

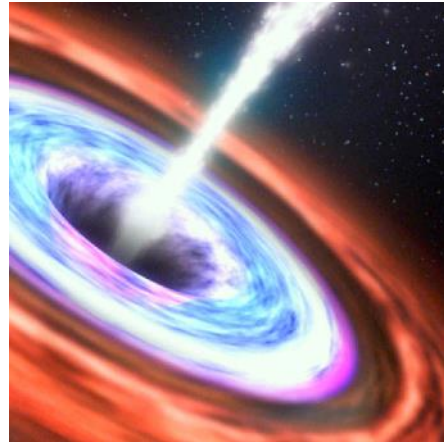
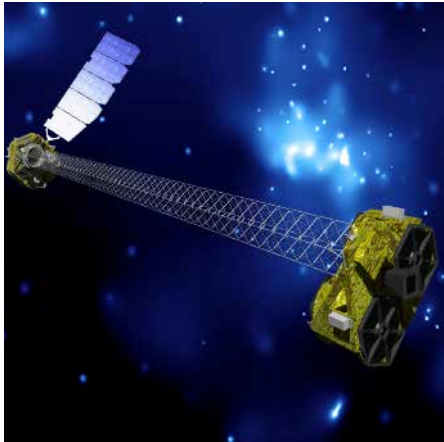
Astrophysics FY21 Appropriation



The FY 2021 NASA Budget Request included no funding (\$0) for the Roman Space Telescope and only close out funding (\$12M) for SOFIA

The FY 2021 Omnibus Appropriation Bill

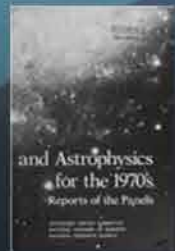
- Provides \$1.77B for Astrophysics (including the James Webb Space Telescope), \$525.2M more than the request
- Directs \$414.7M for Webb, same as the request
- Directs \$505.2M for Roman, \$505.2M more than the request
- Directs \$93.3M for Hubble, \$5M more than the request
- Directs \$85.2M for SOFIA, \$73.2M more than the request
- Directs \$10M for “search for life technology development”



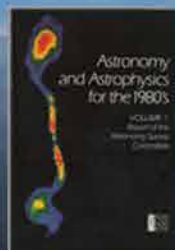
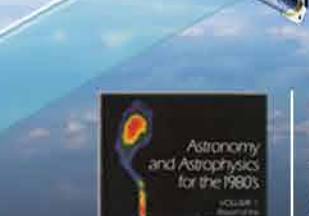
The total funding provided is an increase of \$525.2M over the request.

Astrophysics

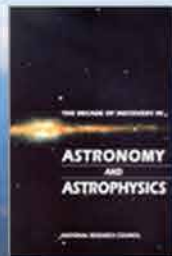
Decadal Survey Missions



1972
Decadal
Survey
Hubble



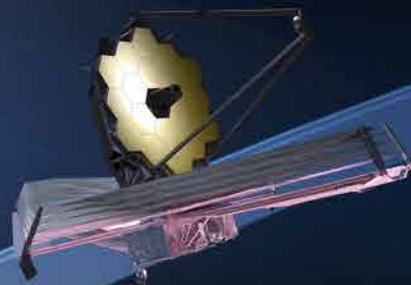
1982
Decadal
Survey
Chandra



1991
Decadal
Survey
Spitzer



2001
Decadal
Survey
Webb



2010
Decadal
Survey
Roman



2021
Decadal
Survey

?

Technology Development and Risk Reduction Activities

Completed

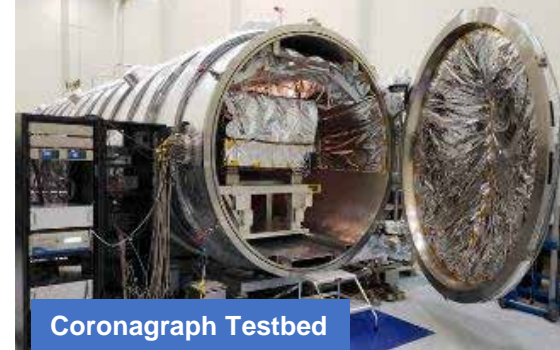
Large Mission Concept Studies / Probe Mission Concept Studies / In-Space Assembly of Telescopes (iSAT) Study / Large Mission Management Study / STMD Technology Collaborations

Ongoing

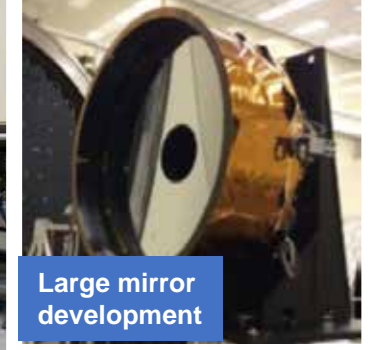
Segmented Mirror Technology Program / Binary Star Coronagraph Technology / Deformable Mirrors / Starshade Technology / Extreme Precision Radial Velocity Research and Technology / Detectors (at all wavelengths) / X-ray Mirrors / Cryocoolers

Testbeds (Coronagraph, Ultrastable, X-ray & Cryogenic)

PI-led Strategic Astrophysics Technology (SAT) Advancements



Coronagraph Testbed



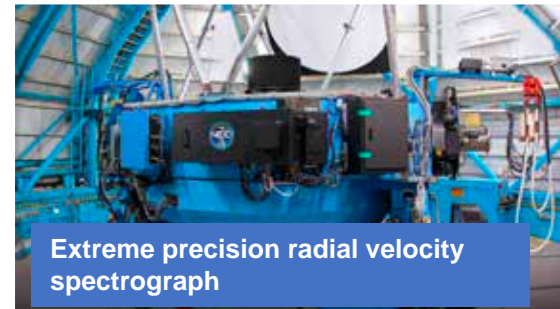
Large mirror development



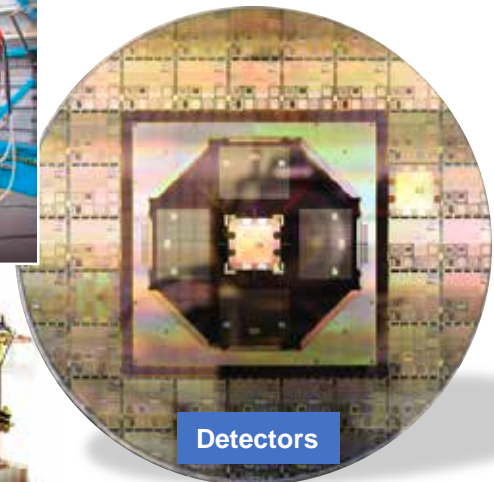
Starshade



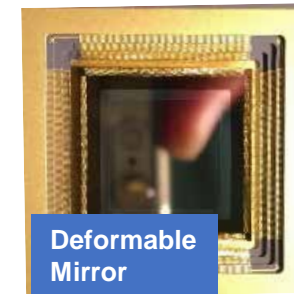
X-ray mirror development



Extreme precision radial velocity spectrograph



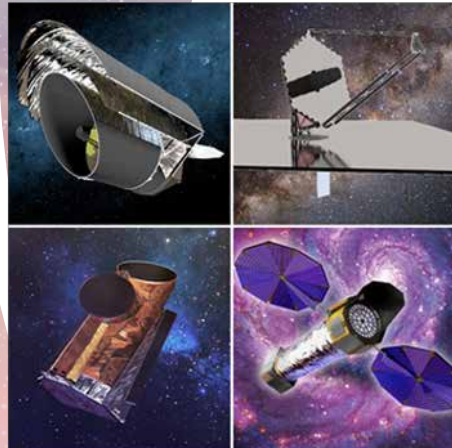
Detectors



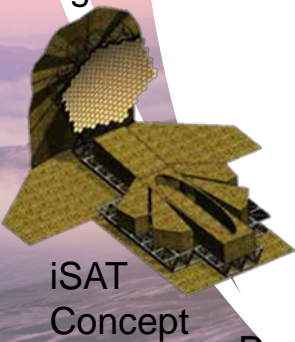
Deformable Mirror



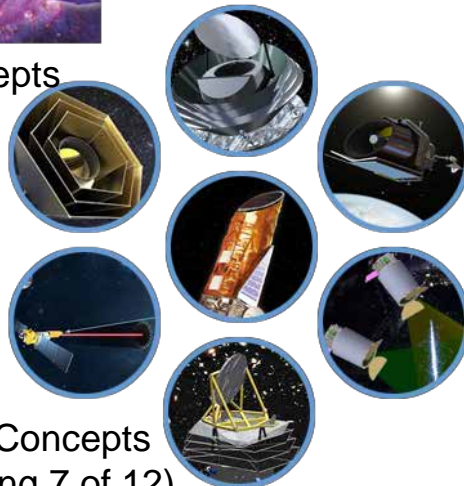
Cryocooler



Large Mission Concepts



iSAT Concept



Probe Concepts (Showing 7 of 12)

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

Astro2020 Decadal Survey Status



- Large Mission Concept Studies presented to Astro2020 in November 2019
- Probe Mission Concept Studies submitted to Astro2020 in November 2019
- Last public meeting of the Steering Committee on August 25, 2020
 - Agencies presented updated programmatic and budget guidance
 - Co-Chairs stated publicly that report will be delivered by Spring 2021
- NASA is planning ahead for implementing the Decadal Survey
 - Reducing risks of large missions via technology development
 - Planning underway for recommendations in R&A, archives, suborbital, etc.
 - Developing options for Probe and flagship pre-formulation management
 - Holding a wedge in out year planning budget for new initiatives



MARS 2020



DART



Landsat 9



Webb



IXPE

2021 – A Year of Science



O-REx



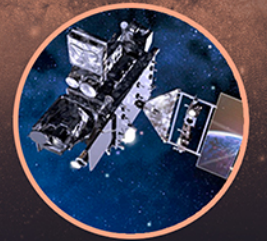
Peregrine



Nova-C



Lucy



GOES-T

- LAUNCH
- LANDING
- DEPARTURE



National Aeronautics and
Space Administration

2021

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