



National Aeronautics and
Space Administration

2023 NASA SCIENCE

SMD Community Townhall: FY24 Budget Review

March 23, 2023

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Associate Administrator


NASA Science Mission Directorate


 @solargirl2018




NASA SCIENCE MISSION DIRECTORATE


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A view of Earth's horizon from the International Space Station

FY24 Agency Budget Highlights

- Builds on the successful launch of Artemis I and paves the way for a long-term presence at the Moon and on to Mars for the U.S. and our partners
- Over \$3.3 billion in investments in Earth Science and Aeronautics to observe, understand, and protect our home planet
- Enables the transition from the International Space Station to Commercial Low-Earth Orbit Destinations
- Invests \$3.9 billion in NASA's workforce and infrastructure



FY24 SMD Budget Priorities

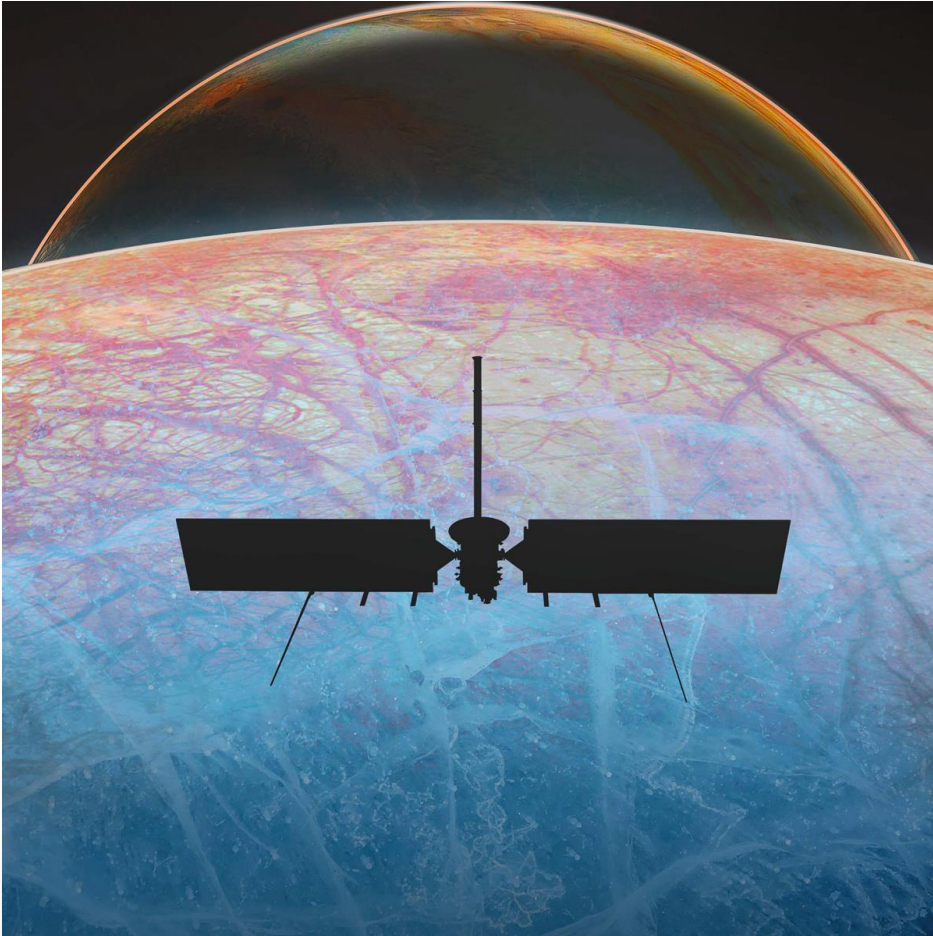
Build an innovative and balanced program driven by the highest national priorities

Advance Moon to Mars objectives and lead Artemis science

Promote US leadership in Earth system science

Broaden participation and increase diversity in science

Advance open science for all and leverage cutting edge data science techniques



Europa Clipper Spacecraft (Illustration)

FY24 BUDGET HIGHLIGHTS

Build an Innovative and Balanced Program Driven by the Highest National Priorities

- Execute program informed by **Decadal Surveys** and other national priorities including wildfire management, planetary defense, orbital debris, space weather, etc.
- Over **56 missions in formulation and development** on a full range of platforms; including Roman Space Telescope, Europa Clipper, Dragonfly, PACE, NISAR and IMAP
- Competitively awarded, **PI-led missions** in all divisions including Astrophysics, Heliophysics, Earth Explorers, Earth Venture, Discovery and New Frontiers
- **Operate over 70 missions**, including James Webb Space Telescope, which conduct leading edge science investigations
- Support **innovative scientists** across the country, turning science mission data into groundbreaking discoveries and economic advancement

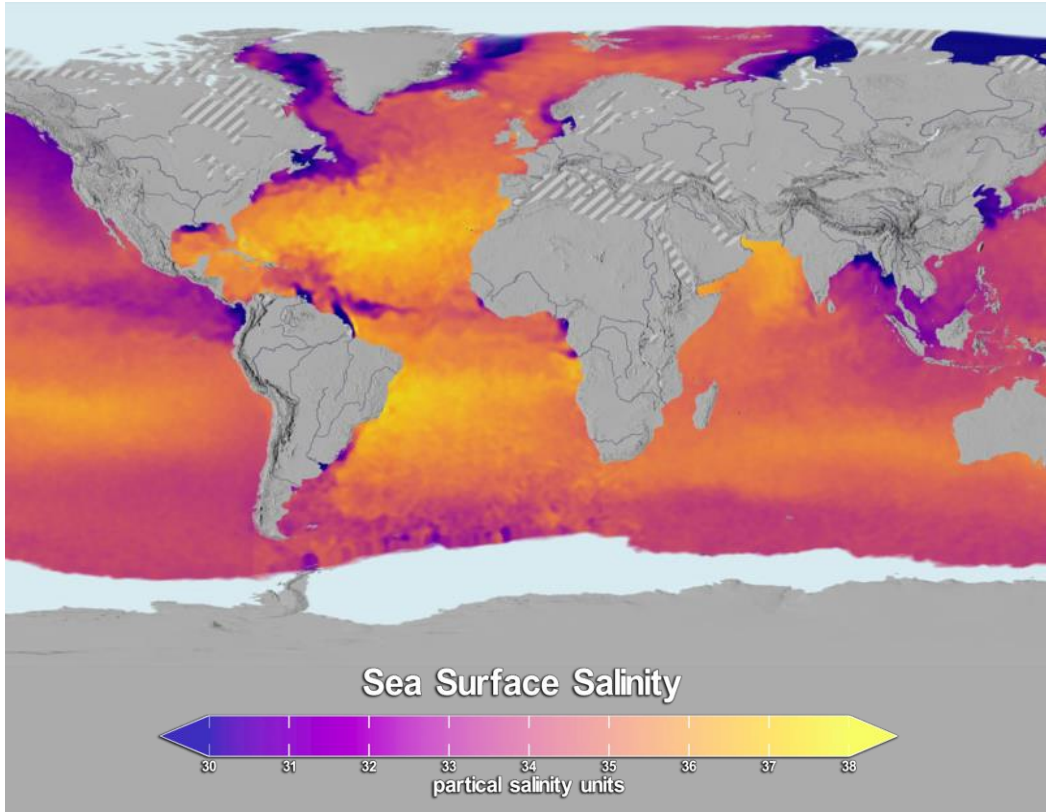


New technologies will support NASA's next era of exploration on the Moon and Mars.

FY24 BUDGET HIGHLIGHTS

Advance Moon to Mars objectives and lead Artemis Science

- Prepare for eventual human missions to Mars by demonstrating the ability to return Martian samples to Earth via the **Mars Sample Return** mission
- Develop SmallSats, instruments, and other payloads that serve science, long-term exploration, and utilization needs via a broad portfolio of lunar and planetary science, heliophysics, and biological and physical **science investigations**
- Conduct lunar science through the innovative Commercial Lunar Payloads Services (**CLPS**) initiative, leveraging commercial partnerships to deliver science, exploration, and technology payloads to the Moon
- Confirm the presence of volatiles/ice early in FY2025 with the Volatiles Investigating Polar Exploration Rover (**VIPER**)
- Continue development of the Heliophysics Environmental and Radiation Measurement Experiment Suite (**HERMES**) space weather investigation to be installed on Gateway



Sea surface salinity (i.e., ocean salt concentration) over a ten year period (2011 to 2021). Warm colors (orange to yellow) are areas of high salinity/hot tropics. Cooler colors (blue to violet) are fresher waters, many of which can be seen coming from rainy/river/wetter tropics.

FY24 BUDGET HIGHLIGHTS

Promote US leadership in Earth System Science

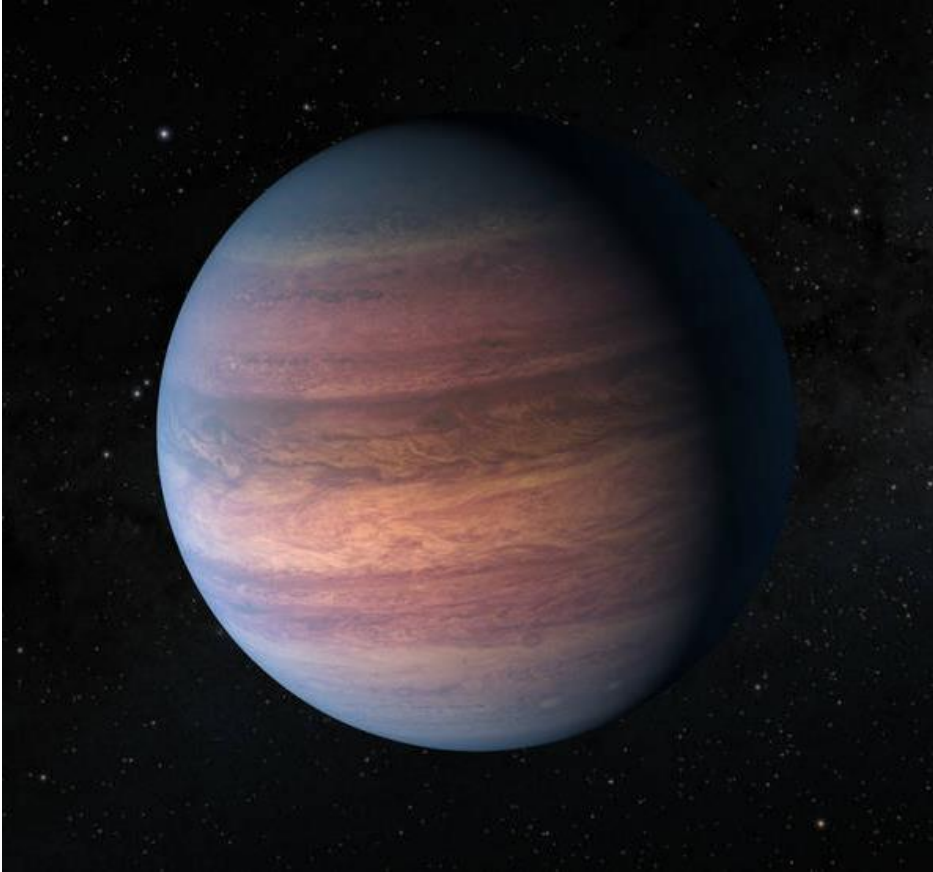
- Build the **Earth System Observatory**—the next generation of integrated decadal missions to advance understanding of the complex Earth system
- Establish a new class of competed **Earth System Explorers** missions to enable innovative approaches and expand the breadth of the Observatory
- Observe Earth’s land, ocean, ice, and atmosphere to understand the drivers and outcomes of the changing climate
- Partner with commercial industry and international collaborators for cost-effective approaches to Earth science observations
- Advance technology, research, models, data systems, and applications to improve our understanding of, and ability to predict, the changing climate and its interactions with human communities
- Deliver **actionable solutions** such as risk assessments, decision support systems, and forecasting, to meet the needs of partners at other federal agencies, local, state, and tribal governments
- Communicate the dynamics of the Earth system to the public via expanded physical and virtual displays of the **Earth Information Center**



FY24 BUDGET HIGHLIGHTS

Broaden Participation and Increase Diversity in Science

- Implement **diversity strategies** in alignment with broader agency plan
 - Increase number of solicitations, both NRAs and AOs, requiring proposals to contain inclusion plans
 - Transition dual-anonymous peer review to be the default review method for all ROSES proposals
 - Prioritize broad use of accessibility tools and multiple languages (e.g., accurate closed-captioning, Spanish literature, etc)
- Implement **Equity Action Plan**
 - Continue SMD Bridge Program to create an environment where underserved communities are better equipped to partner with NASA.
 - Make data available on the cloud and provide free, multi-lingual training on how to use NASA data to address priority needs in underserved communities
- Implement 2023 Plan to Increase Support and Opportunities for Historically Black Colleges and Universities
- Improve psychological and physical safety of science teams by encouraging establishment of statement of principles for team engagements



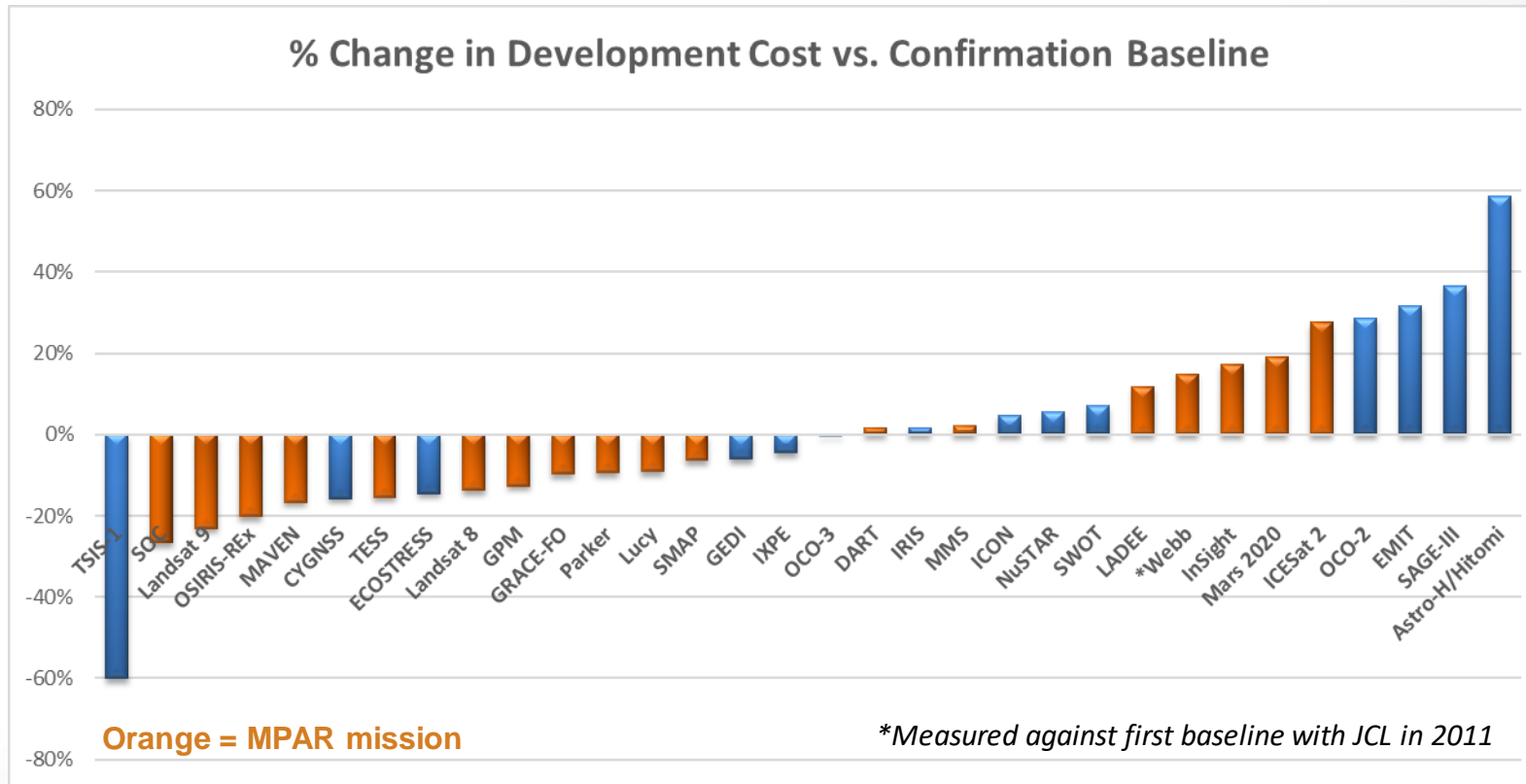
"Citizen Scientists" used data to spot a new planet that's about the size of Jupiter, depicted in this illustration

FY24 BUDGET HIGHLIGHTS

Advance Open Science for All and Leverage Cutting Edge Data Science Techniques

- Initiate the SMD Core Data and Computing Services Program to enable efficient open science using latest capabilities in data and cloud computing
- Advance transparency, inclusivity, access, and reproducibility in scientific data and research
- Implement the data and information policy for SMD to make scientific data, publications and software open
- Execute Transform to Open Science (TOPS) initiative to train 20,000 scientists in open science practices over the next 5 years
- Investments in Artificial Intelligence and Machine Learning techniques which, when applied to NASA mission science datasets, can improve data discovery.

Recent Development Cost Performance

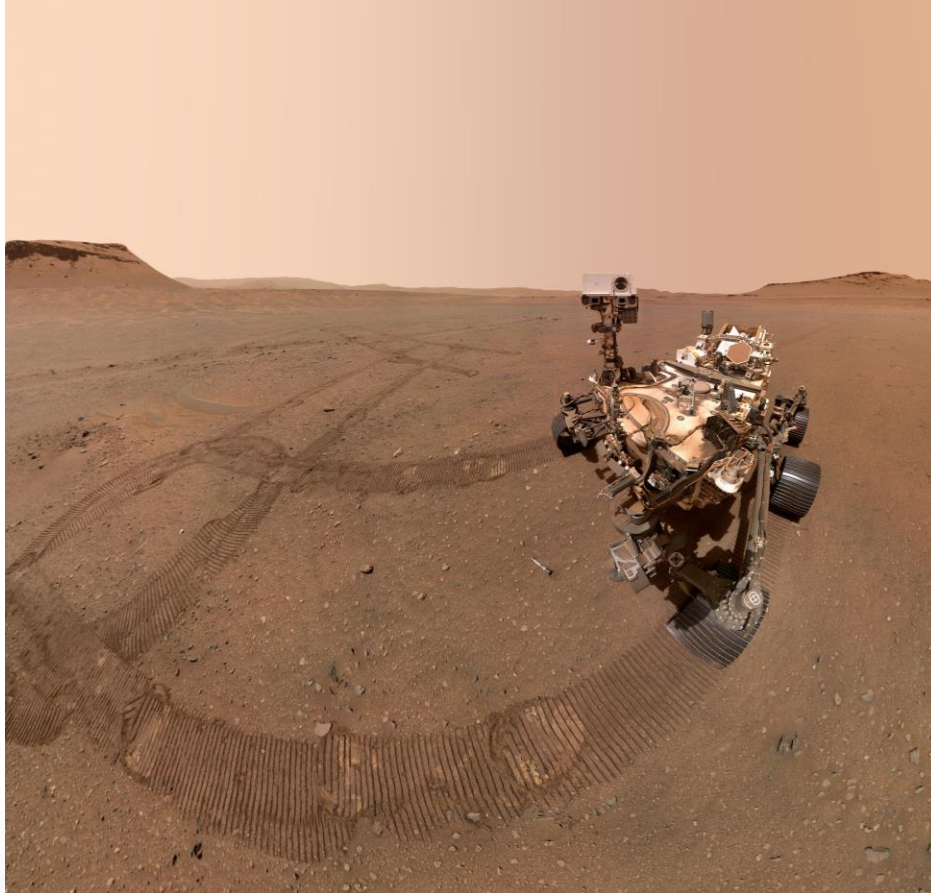


Since the establishment of the 70% JCL requirement for major missions in 2009, SMD has confirmed and launched 32 missions

- Including Webb, these missions have overrun their Phase C/D commitments by a net 3.9%
- Excluding Webb, these missions have underrun their Phase C/D budget commitments by a net 2.5%
- 17 of these missions completed development under their cost commitment
- Recently launched missions now included: EMIT, SWOT

SMD continues to refine its ability to execute missions within cost commitments by implementing improved management techniques (particularly on large strategic missions) and the use of independent review boards and cost estimates, including joint cost and schedule (JCL) estimates.

FY24 SMD Budget Changes



Perseverance's Three Forks Sample Depot Selfie

- \$2.5 B in FY24 for **Earth Science** (\$278M increase over FY23 Enacted) to initiate 4 Earth System Observatory missions, Landsat Next and additional funding for applied sciences
- \$949.3M in FY24 for **Mars Sample Return (MSR)** (\$127M increase over FY23 Enacted) to maintain progress towards earliest possible launch date
 - NASA has delayed MSR confirmation into FY24 while we conduct additional independent assessments of mission design, life cycle costs and schedule. FY25-28 budgets are expected to grow over the current estimates
 - In FY24, reductions have been made in other areas of the Science budget to offset the MSR increase, including a pause to the Geospace Dynamics Constellation (GDC) mission and delays in the Astrophysics Decadal Survey response

FY2024 Science Budget Request Summary (\$M)

	Actual FY22	Enacted FY23	Request FY24	FY25	Out-Years		
					FY26	FY27	FY28
Science	\$7,610.9	\$7,795.0	\$8,260.8	\$8,426.0	\$8,594.5	\$8,766.4	\$8,941.7
Earth Science	\$2,061.2	\$2,195.0	\$2,472.8	\$2,597.5	\$2,730.0	\$2,791.2	\$2,849.0
Earth Science Research	\$541.0		\$577.9	\$590.0	\$602.2	\$618.0	\$629.5
Earth Systematic Missions	\$706.4		\$1,027.1	\$1,073.6	\$1,162.7	\$1,130.3	\$1,091.0
Earth System Explorers	\$2.0		\$27.8	\$20.7	\$43.1	\$109.0	\$166.4
Earth System Science Pathfinder	\$312.7		\$235.6	\$298.6	\$290.5	\$282.5	\$290.3
Earth Science Data Systems	\$339.4		\$411.7	\$389.9	\$408.1	\$423.8	\$439.6
Earth Science Technology	\$86.1		\$105.3	\$113.5	\$117.1	\$118.4	\$120.8
Applied Sciences	\$73.5		\$87.3	\$102.3	\$106.2	\$109.3	\$111.5
Planetary Science	\$3,120.4	\$3,200.0	\$3,383.2	\$3,265.8	\$3,246.1	\$3,350.8	\$3,389.7
Planetary Science Research	\$309.0		\$307.4	\$333.3	\$352.0	\$360.2	\$386.4
Planetary Defense	\$166.0		\$250.7	\$337.7	\$400.5	\$299.6	\$79.0
Lunar Discovery and Exploration	\$478.8		\$458.5	\$459.0	\$460.5	\$472.0	\$483.3
Mars Sample Return	\$653.2		\$949.3	\$700.0	\$600.0	\$612.1	\$627.6
Discovery	\$331.8		\$247.5	\$386.4	\$426.0	\$579.2	\$625.9
New Frontiers	\$283.7		\$407.5	\$447.8	\$386.1	\$367.3	\$337.5
Mars Exploration	\$265.0		\$268.6	\$279.2	\$311.6	\$315.3	\$367.2
Outer Planets and Ocean Worlds	\$484.3		\$318.4	\$121.3	\$134.8	\$178.3	\$321.9
Radioisotope Power	\$148.6		\$175.5	\$201.1	\$174.6	\$166.8	\$160.9

FY2024 Science Budget Request Summary (\$M)

	Actual FY22	Enacted FY23	Request FY24	FY25	Out-Years		
					FY26	FY27	FY28
Science	\$7,610.9	\$7,795.0	\$8,260.8	\$8,426.0	\$8,594.5	\$8,766.4	\$8,941.7
Astrophysics	\$1,568.9	\$1,510.0	\$1,557.4	\$1,622.1	\$1,665.9	\$1,689.6	\$1,749.4
Astrophysics Research	\$267.4		\$289.9	\$299.3	\$374.0	\$384.8	\$384.3
Cosmic Origins	\$364.1		\$342.5	\$358.7	\$348.2	\$428.4	\$454.0
<i>JWST (non-add)</i>	\$175.4		\$187.0	\$187.0	\$187.0	\$187.0	\$187.0
Physics of the Cosmos	\$160.0		\$202.0	\$212.7	\$204.8	\$207.8	\$216.3
Exoplanet Exploration	\$543.0		\$463.7	\$427.1	\$419.4	\$313.0	\$196.9
Astrophysics Explorer	\$234.4		\$259.3	\$324.3	\$319.5	\$355.5	\$497.9
Heliophysics	\$777.9	\$805.0	\$750.9	\$837.4	\$847.3	\$827.4	\$844.0
Heliophysics Research	\$218.4		\$231.3	\$240.1	\$237.2	\$238.3	\$239.3
Living with a Star	\$86.1		\$100.0	\$119.8	\$105.2	\$104.1	\$91.8
Solar Terrestrial Probes	\$229.7		\$194.0	\$128.8	\$82.6	\$65.3	\$55.9
Heliophysics Explorer Program	\$189.2		\$190.7	\$298.6	\$374.0	\$372.0	\$412.6
Heliophysics Technology	\$20.9		\$8.4	\$14.7	\$14.0	\$16.0	\$16.0
Space Weather	\$33.5		\$26.6	\$35.5	\$34.3	\$31.7	\$28.4
Biological and Physical Sciences	\$82.5	\$85.0	\$96.5	\$103.2	\$105.3	\$107.4	\$109.6

An aerial photograph of a coastal region. The top half shows a dense grid of rectangular plots, likely agricultural fields, in shades of light blue and white. A dark, winding path or road cuts through the grid. Below the grid is a large, irregularly shaped body of water, possibly a bay or a large pond, with a dark blue-green hue. The bottom half of the image shows a more rugged, textured landscape with various shades of blue and white, possibly representing a different type of terrain or a different part of the same region.

Science Mission Directorate

Earth Science

Earth Science Budget Features



Image of the San Francisco Bay captured by Landsat 9's Operational Land Imager 2 instrument.



Artist concept of NASA-ISRO SAR (NISAR)



Jennifer Moore (left) and Christian Nairy (right) operating monitors and looking at cloud probe data.



Tropical Storm Ida Passes Over the Southern U.S. (August 2021)

What's Changed

- Initiate four ESO missions with planned launches between 2028 and 2031
- Initiate the Landsat Next mission, a constellation of land imaging satellites to be launched no earlier than Nov 2030
- Increased funding for Open Source Science, to accelerate progress towards open-source science goals across all divisions
- Revised budget & schedule assumptions for Earth Explorers; first AO release in FY23 and Step 1 selections in FY24
- Replanned cost and schedule for NISAR; now holding to new baseline once updated development cost resulted in 30% breach of mission development costs
- New contribution to the ESA Sentinel 6C mission to extend the continuity of sea surface altimetry

What's the Same

- Terra/Aqua/Aura operations beyond FY23 are pending results of Senior Review
- Sustained climate observations through partnerships with ESA, including CRISTAL
- Support for Earth Information Center and interagency greenhouse gas center
- FireSense initiative, in collaboration with ARMD and STMD, to bring an Earth systems approach to improving wildfire and wildland fire management
- Supports balanced Research, Technology, and Applied Sciences programs
- Robust Venture Class missions portfolio and Commercial SmallSat Data Acquisitions



Science Mission Directorate Planetary Science

Planetary Science Budget Features



Computer simulated global view of Venus



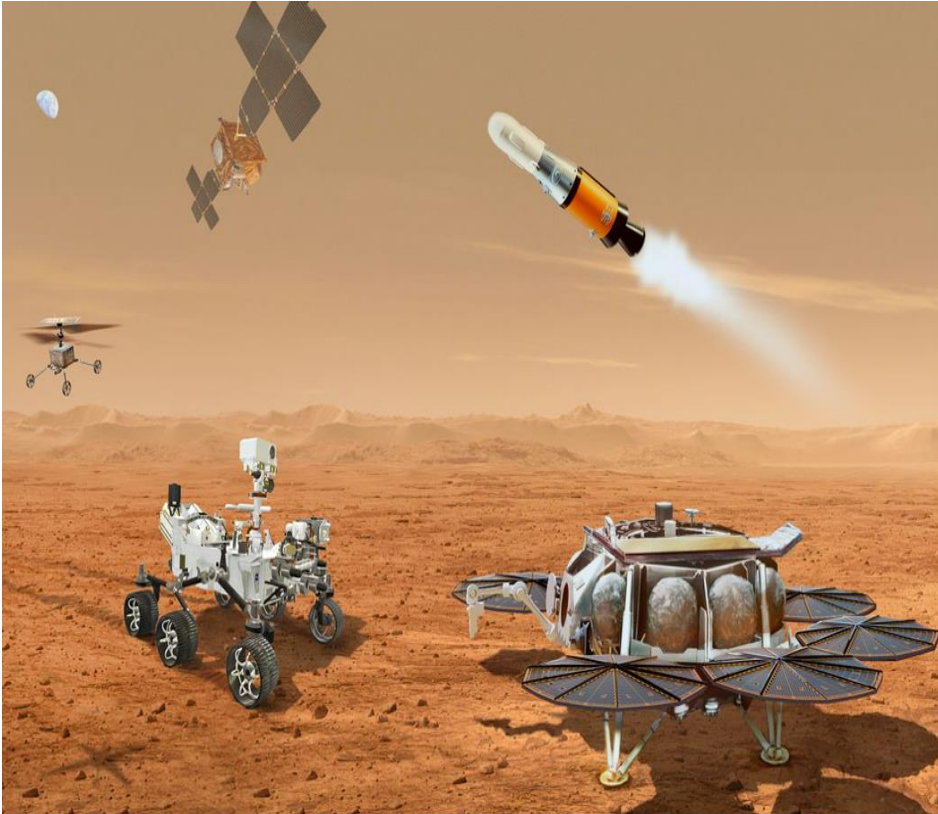
Nightside of Venus taken by the Wide-field Imager on Parker Solar Probe

What's Changed

- Supports NEO Surveyor development for estimated launch in 2028
- Increased R&A budget to make progress towards Decadal recommendation of 10% R&A investment relative to division budget and to improve selection rates
- Additional funding for Dragonfly and Mars Rover 2020 extended operations
- Increased funding for Psyche mission to support October 2023 LRD
- Significantly expanded support for the ESA Rosalind Franklin mission
- Delay of the VERITAS mission by at least three years
- No funding for the Janus mission; demanifested as Psyche rideshare
- SIMPLEX funding reduction supports one selection (with an increased cost cap of \$85M) to fly with the DAVINCI mission in 2030
- InSight mission declared successfully completed in December 2022
- New Horizon extended mission ends in 2024
- OSIRIS-REx spacecraft transition to Apophis Explorer in FY 2024
- Eliminates Dynamic RPS and associated technology investments as there is no future Planetary mission requiring this technology

What's the Same

- NF-5 AO planned for Nov 2023; Discovery AO planned for FY25
- Missions in formulation & development: Europa Clipper, DAVINCI, EnVision
- Sustained support for Near Earth Object Observations
- Funding support for 13 operating missions



This illustration shows a concept for multiple instruments designed to ferry samples of rocks and soil collected from the Martian surface to Earth

Mars Sample Return Budget Features

- To maintain progress in FY24 towards earliest possible launch date, FY24 budget request is \$949.3M, a \$127M increase over the FY23 Enacted
 - NASA has delayed MSR confirmation into Q1 FY24 while we conduct additional independent assessments of mission design, life cycle costs and schedule. FY25-28 budgets are expected to grow over the current estimates
 - NASA will consider potential descopes such as the elimination of one of the mission's two helicopters, in order to improve the cost posture of the mission
- Request supports Sample Retrieval Lander (SRL), Mars Ascent Vehicle (MAV), Capture, Containment and Return System (CCRS) element requirements, and development of 2 helicopters
 - Earth Return Orbiter/CCRS launch NET 2027
 - SRL launch no earlier than 2028
 - Sample return no earlier than 2033
- Assumes contributed elements including
 - ERO and Sample Transfer Arm from ESA
 - Mars sample receiving facility within Mars Exploration Program

Lunar Discovery and Exploration Program Budget Features

What's changed:

- Increased lunar science research for science team, curation work to support Artemis III in 2025
- Accelerated Lunar Trailblazer rideshare launch from 2025 on IMAP to 2023 on IM-2
- Added support for LuSEE-Night instrument development with DOE
- Created an Artemis Instrument line to develop handheld and deployed instruments for crew beyond Artemis III
- Increase to VIPER for delay (2023 to 2024) to accommodate additional propulsion tests to reduce risk for Astrobotic Griffin Lander, as requested by NASA
- Reduced CLPS funding FY24-25 to accommodate delayed VIPER delivery; enhanced systems engineering and technical support to CLPS vendors
- Added Endurance-A mission science objectives / implementation concept studies

What's the same:

- Annual PRISM calls for instruments
- Lunar Reconnaissance Orbiter operations
- Initial Artemis instruments, Lunar Terrain Vehicle (LTV) instruments



Deployed instruments during Apollo 17

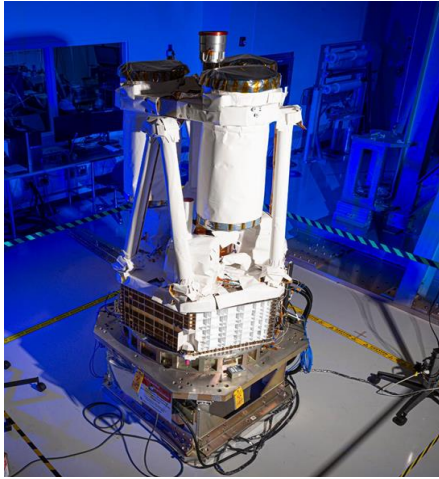


Artist rendition of LTV

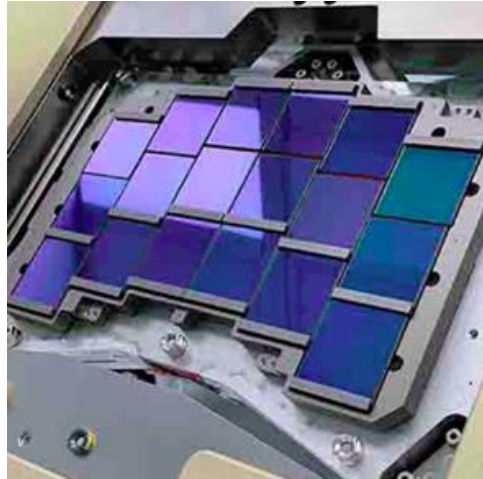


Science Mission Directorate Astrophysics

Astrophysics Budget Features



NASA's Imaging X-ray Polarimetry Explorer Prepares for Environmental Testing



Roman's detectors



NASA's Neutron star Interior Composition Explorer (NICER) tracked brilliant hot spots on the surface of an erupting magnetar – from 13,000 light-years away

What's Changed

- Modest decadal wedge begins in FY24 for technology maturation in support of Decadal Survey-recommended Habitable Worlds Observatory
- Extend operating missions per Senior Review recommendations, including Hubble, Chandra and the Transiting Exoplanet Survey Satellite (TESS)
- SOFIA close out budget FY23-25 permits responsible closeout, dispositioning of assets, data reprocessing and archiving, and career transition for early careers
- Delays in Explorers program up to one year
- Reduction in ATHENA funding pending ESA re-formulation activities

What's the Same

- Operate James Webb Space Telescope with a robust competed science program (Webb Science) to produce groundbreaking science
- Continue excellent progress on the Nancy Grace Roman Space Telescope for launch in 2027
- Release solicitation for the Decadal survey-recommended Probe class mission in FY23
- Partnership with Israel on UltraSat, a Time Domain & Multi-Messenger science mission, as recommended by the Decadal Survey



Science Mission Directorate

Heliophysics

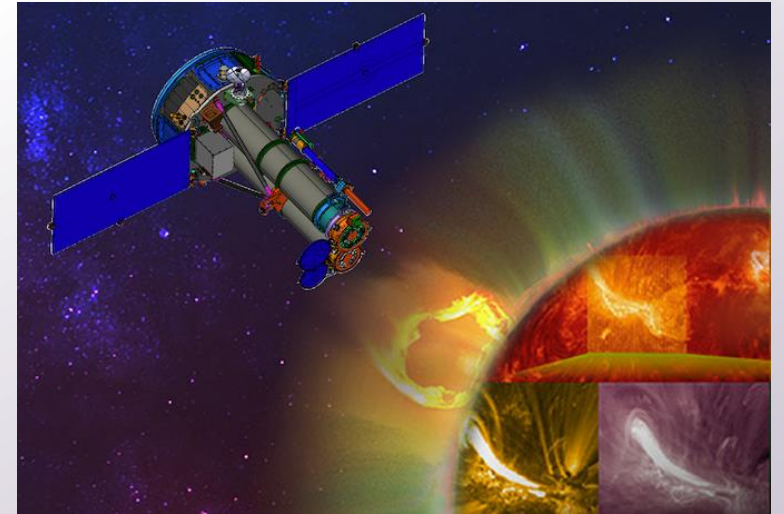
Heliophysics Budget Features

What's Changed

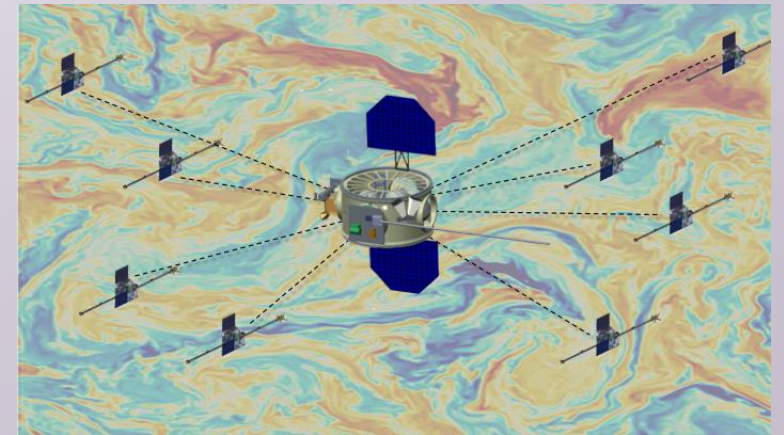
- New Explorers MIDEX selections: MUSE and HelioSwarm
- Active funds management enabled selection of 3rd DRIVE Science center
- Investments to support Heliophysics Digital Resource Library and AI/ML efforts
- Non-confirmation of Solar Cruiser due to schedule and budget concerns
- Because of other budget pressures in the Science portfolio, the budget proposes a pause in GDC development until Decadal Survey recommendations are received

What's the Same

- Explorers solicitations in 2022 (SMEX) and 2025 (MIDEX)
- IMAP on track for launch in 2025
- Orbital Debris and Space Situational Awareness investments to address gaps in orbital object detection and gaps in our scientific understanding of their interactions with the environment
- Space Weather program includes HERMES instruments for Gateway, space weather research and applications, partnership on ESA Vigil mission
- Robust research program, including the DRIVE initiative
- Support for agency capabilities in Research Range and Sounding Rockets used to launch innovative small payloads
- Continued support of 11 missions in development and 18 operating missions
- DYNAMIC AO release scheduled in FY23. Given other priorities within the Science portfolio, there is no funding for DYNAMIC in the FY24 President's budget



The Multi-slit Solar Explorer (MUSE) mission science will reveal the physical processes of the solar corona and the eruptions at the foundation of space weather



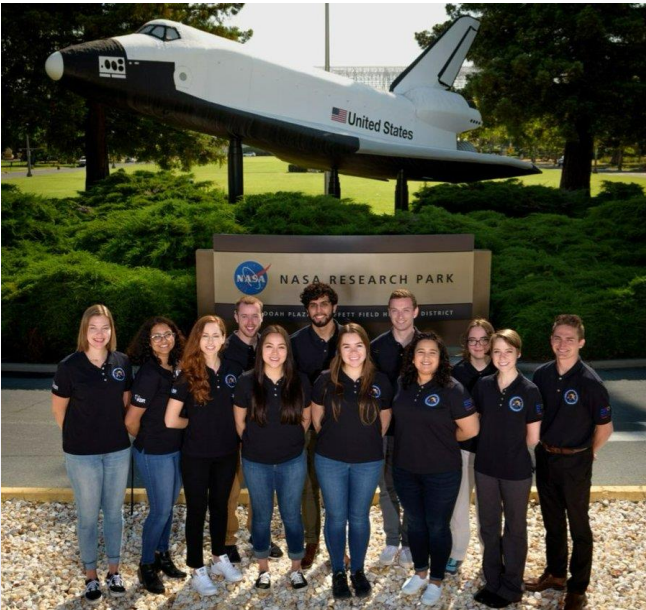
HelioSwarm features a hub spacecraft and eight smaller ones that will work together to measure solar wind turbulence



Science Mission Directorate
Biological & Physical Sciences



Conducting research aboard the Space Station



Space Life Sciences Training Program

BPS Budget Features

What's Changed

- New commercial initiative (CERISS) to develop transformative research capabilities with commercial space industry and to dramatically increase research productivity
- Private Astronaut Mission capability to fly hyper-specialized scientist for up to 30 days to conduct fast-paced transformative research
- Initiate plans for autonomous experiments beyond LEO

What's the Same

- Transformative science in two focus areas: Quantum Science and Thriving in Deep Space
- Sustain core research capabilities and infrastructure



Science Mission Directorate
Joint Agency Satellite Division

JASD FY24 Overview

Mission: To ensure excellence in the Nation's operational weather satellites by applying NASA's expertise in systems engineering and program and project management to satellite and ground system development

Key FY24 Milestones:

- Launch GOES-U satellite to complete deployment of GOES-R series
- Continue Integration and Test of SWFO-L1 satellite
- Complete Integration and Test of JPSS-3 satellite
Continue formulation activities on new programs:
 - Geostationary Extended Operations (GeoXO)
 - Space Weather Next
 - Near Earth Orbit Network (NEON)
 - Includes development of QuickSounder mission



First full-disk image from the GOES-18 Advanced Baseline Imager on May 5, 2022



Ball Aerospace image of the Space Weather Follow On satellite bus (Jan 2023)

EXPLORE



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