Astronomy Budget Outlook

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American Institute of Physics

9/19/2023

Outline

- Info on AIP's science policy news service, called FYI
- Macro budget outlook
- Key members of Congress for science funding
- FY24 science budget proposals
- Historical budget data

FYI: Science Policy News

FYI / NEWSLETTER

The Week of September 18, 2023

- CHIPS Initiatives Get Checkup
- Fusion Panel Reviews International 'Benchmarking' Study
- SLAC X-ray Laser Completes Major Upgrade
- Plus Much More

Learn more →

Macro budget outlook

- Recent special appropriations measures included huge amounts of money for R&D, though mostly for applied research and technology development:
  - Pandemic response and recovery legislation (mainly NIH)
  - Infrastructure Investment and Jobs Act (mainly DOE and NOAA)
  - Inflation Reduction Act (again mainly DOE and NOAA)
  - CHIPS and Science Act ($54 billion for semiconductor initiatives)
- These measures have contributed to renewed concerns about federal deficits and debt

Macro budget outlook

- President Biden and House Speaker Kevin McCarthy (R-CA) negotiated budget caps for FY24 and FY25 that hold non-defense spending roughly flat
- House Republicans then advanced spending proposals that undershoot the FY24 cap significantly
- Meanwhile, the Senate advanced bipartisan spending bills that exceed the cap
- No clear path forward yet, shutdown fears increasing

https://rollcall.com/2023/05/27/deal-reached-on-debt-limit/

https://rollcall.com/2023/09/18/house-stopgap-bill-falters-with-no-senate-backup-plan-in-sight/

Macro budget outlook

- A primary motivator for increasing R&D budgets is US-China competition
- Main interest is in strategic technology areas (semiconductors, AI, biotechnology, etc.)
- Yet Congress seems unlikely to meet the science budgets targets set in the CHIPS in Science Act
- Senate Majority Leader Chuck Schumer (D-NY) has expressed interest in crafting a follow-on to the CHIPS and Science Act that would focus on other technology areas

FY24 budget outlook

- DOE Office of Science budget proposals relatively favorable given the tight budget outlook
  - House proposing flat funding, Senate a 4% increase
- NSF managed to retain much of the supplemental appropriation it received in FY23, but topline slated for cuts
  - House proposing 2% cut, Senate a 4% cut
- NASA Science Mission Directorate has the worst outlook among these three agencies
  - House proposing 5% cut, Senate a 6% cut
  - Mars Sample Return cost overrun diverting funds from other missions

Congressional Leaders

PROFILE

Hal Rogers

Chair

House Commerce-Justice-Science Appr…

PROFILE

Matt Cartwright

Ranking Member

House Commerce-Justice-Science Appr…

PROFILE

Jeanne Shaheen

Chair

Senate Commerce-Justice-Science Appr…

PROFILE

Jerry Moran

Ranking Member

Senate Commerce-Justice-Science Appr…

PROFILE

Frank Lucas

Chair

House Science, Space, and Technology …

PROFILE

Zoe Lofgren

Ranking Member

House Science, Space, and Technology …

PROFILE

Maria Cantwell

Chair

Senate Commerce, Science, and Transp…

PROFILE

Ted Cruz

Ranking Member

Senate Commerce, Science, and Transp…

https://ww2.aip.org/national-science-foundation

https://ww2.aip.org/nasa

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Congressional Leaders

PROFILE

Chuck Fleischmann

Chair

House Energy-Water Development Appr…

PROFILE

Marcy Kaptur

Ranking Member

House Energy-Water Development Appr…

PROFILE

Dianne Feinstein

Chair

Senate Energy-Water Development Appr…

PROFILE

John Kennedy

Ranking Member

Senate Energy-Water Development Appr…

PROFILE

Frank Lucas

Chair

House Science, Space, and Technology …

PROFILE

Zoe Lofgren

Ranking Member

House Science, Space, and Technology …

PROFILE

Joe Manchin

Chair

Senate Energy and Natural Resources C…

PROFILE

John Barrasso

Ranking Member

Senate Energy and Natural Resources C…

https://ww2.aip.org/department-of-energy

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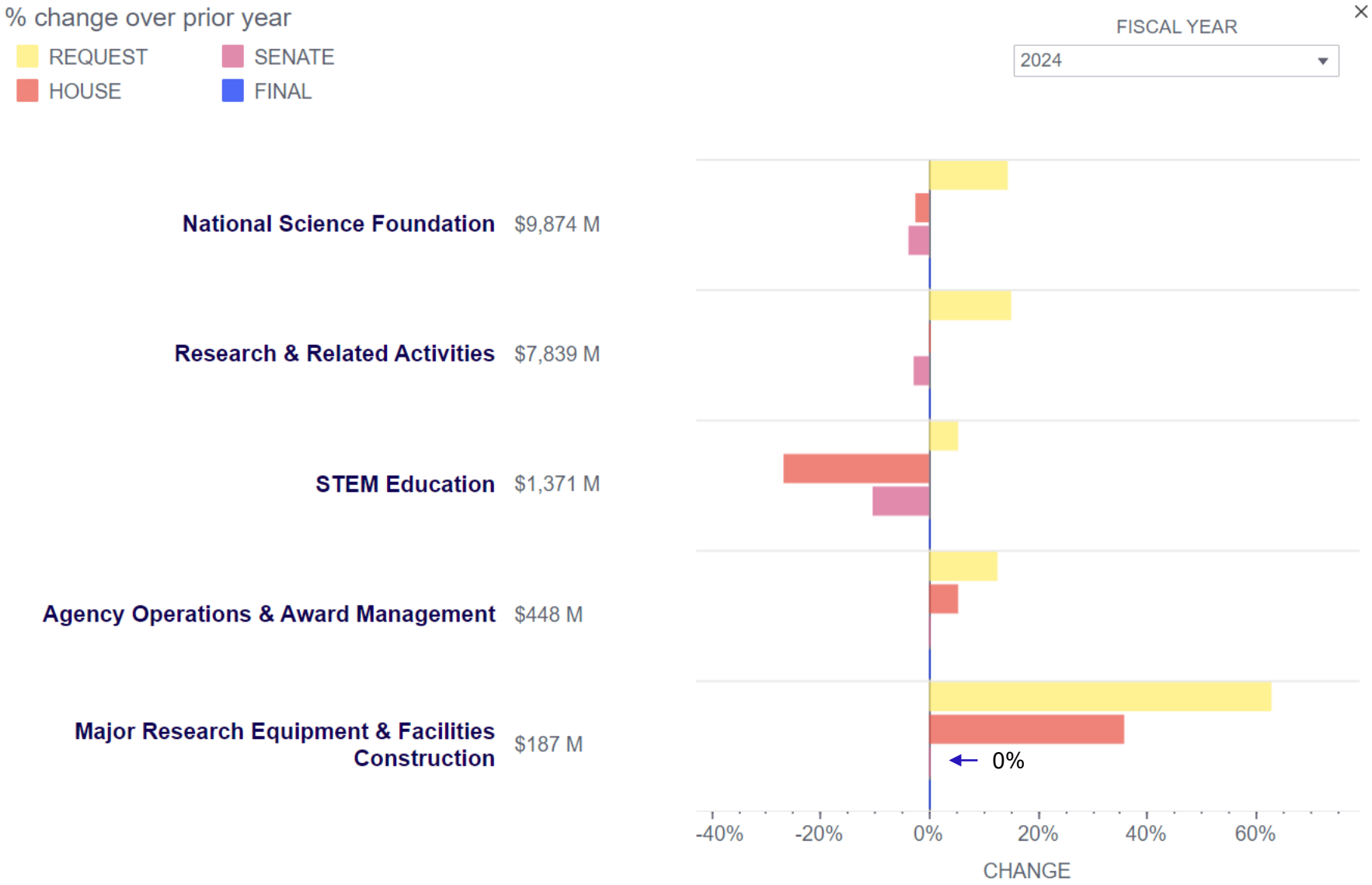
FY2024 Appropriations: National Science Foundation



https://ww2.aip.org/fyi/fy2024-national-science-foundation

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FY2024 Budget Details: National Science Foundation

Selected programs ($, millions)
% change over prior year enacted

Click rows for subprogram details

FISCAL YEAR

2024

Show summary view
Show all subprograms

PROGRAM	ENACTED	REQUEST	HOUSE	SENATE	FINAL
National Science Foundation	$9,874	$11,315	$9,630	$9,500	
Research & Related Activities	$7,839	$9,030	$7,867	$7,608	
STEM Education	$1,371	$1,444	$1,006	$1,228	
Agency Operations & Award Management	$448	$504	$472	$448	
Major Research Equipment & Facilities Constructio	$187	$305	$254	$187	
Mid-Scale Research Infrastructure	$76	$105		$95	
Antarctica Infrastructure Modernization Project	$60	$60			
High Luminosity LHC Upgrade	$33	$38			
Vera C. Rubin Observatory	$15	$8			
Leadership-Class Computing Facility		$93		$0	
NSF Office of Inspector General	$23	$27	$27	$23	
National Science Board	$5	$5	$5	$5	

CHANGE

-100% 100%

https://ww2.aip.org/fyi/fy2024-national-science-foundation

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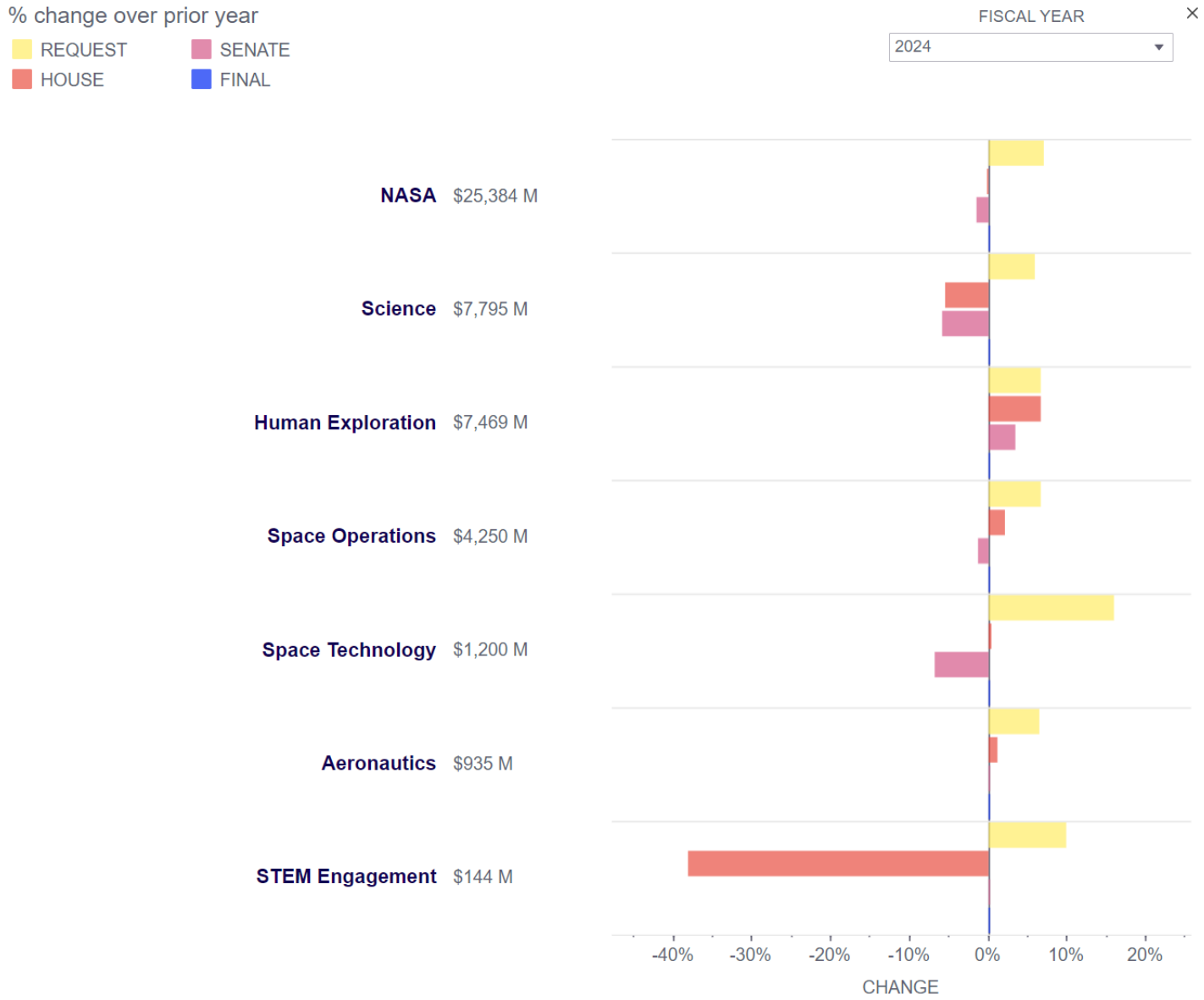
FY2024 Appropriations: National Aeronautics and Space Administration



https://ww2.aip.org/fyi/fy2024-national-aeronautics-and-space-administration

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FY2024 Budget Details: National Aeronautics and Space Administration

Selected programs ($, millions)
% change over prior year enacted

Click rows for subprogram details

FISCAL YEAR

2024

(•) Show summary view
( ) Show all subprograms

PROGRAM	ENACTED	REQUEST	HOUSE	SENATE	FINAL
NASA	$25,384	$27,185	$25,366	$25,000	
Science Mission Directorate	$7,795	$8,261	$7,380	$7,341	
Astrophysics	$1,510	$1,557		$1,544	
Biological and Physical Sciences	$85	$97		$90	
Earth Science	$2,195	$2,473		$2,219	
Heliophysics	$805	$751		$805	
Planetary Science	$3,200	$3,383		$2,683	
Human Exploration	$7,469	$7,971	$7,971	$7,736	
Space Operations	$4,250	$4,535	$4,345	$4,200	
Safety, Security, and Mission Services	$3,129	$3,369	$3,135	$3,100	
Space Technology	$1,200	$1,392	$1,205	$1,118	
Aeronautics	$935	$996	$946	$935	
Construction and Environmental Compliance and R	$414	$454	$248	$379	
STEM Engagement	$144	$158	$89	$144	
Inspector General	$48	$50	$48	$48	

CHANGE

-100% 100%

https://ww2.aip.org/fyi/fy2024-national-aeronautics-and-space-administration

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https://ww2.aip.org/fyi/fy2024-doe-office-of-science

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MREFC Account Funding, by Project

(Dollars in Millions)

	FY 2022 Actual[1]	FY 2023 Estimate	FY 2024 Request	FY 2025 Estimate	FY 2026 Estimate	FY 2027 Estimate	FY 2028 Estimate	FY 2029 Estimate
Antarctic Infrastructure Recapitalization (AIR)	$55.20	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00	$60.00
HL-Large Hadron Collider Upgrade	10.58	33.00	38.00	-	-	-	-	-
Leadership-Class Computing Facility (LCCF)	-	-	93.00	247.00	147.00	33.00	-	-
Mid-scale Research Infrastructure, Track 2[2]	36.67	76.25	105.06	85.00	90.00	100.00	100.00	100.00
Regional Class Research Vessel (RCRV)[3]	-	1.98	-	-	-	-	-	-
Vera C. Rubin Observatory (Rubin)	17.49	15.00	7.61	-	-	-	-	-
Dedicated Construction Oversight	0.65	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total	**$120.60**	**$187.23**	**$304.67**	**$393.00**	**$298.00**	**$194.00**	**$161.00**	**$161.00**

[1] A total of $330.73 million was carried over from FY 2022 to FY 2023: $98.34 million for Mid-scale; $150.65 million for AIR; $6.50 millon for RCRV; $20,467 for the Daniel K. Inouye Solar Telescope (DKIST); $29.68 million for HL-LHC, and $40.0 million for Rubin, $1.18 million for Dedicated Construction Oversight. THe remaining $4.36 million consists of funds from recoveries from old projects not funded in FY 2022.

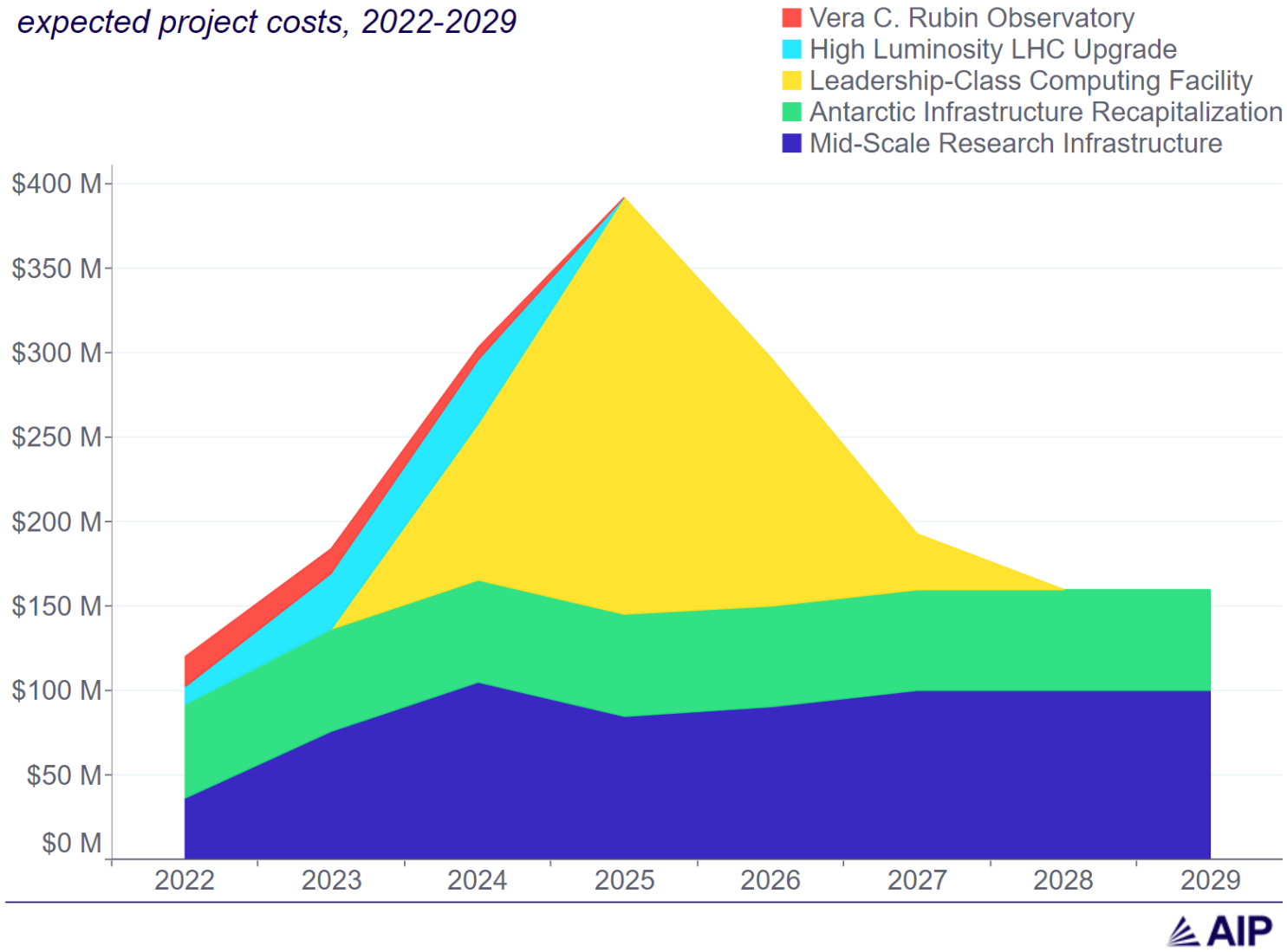
[2] Outyear amounts are for planning purposes only. NSF will evaluate Mid-scale RI in the context of agency priorities for future budget submissions.

[3] FY 2022 Actual excludes $25.0 million in one-time funding for necessary expenses related to RCRV construction impacted by Hurricane Ida as provided in P.L. 117-43, the "Extending Government Funding and Delivering Emergency Assistance Act."

https://nsf-gov-resources.nsf.gov/2023-08/NSF%20FY24%20CJ_Entire%20Rollup_web_%28ERRATA%20v4%29.pdf

NSF Major Research Equipment and Facilities Construction

expected project costs, 2022-2029



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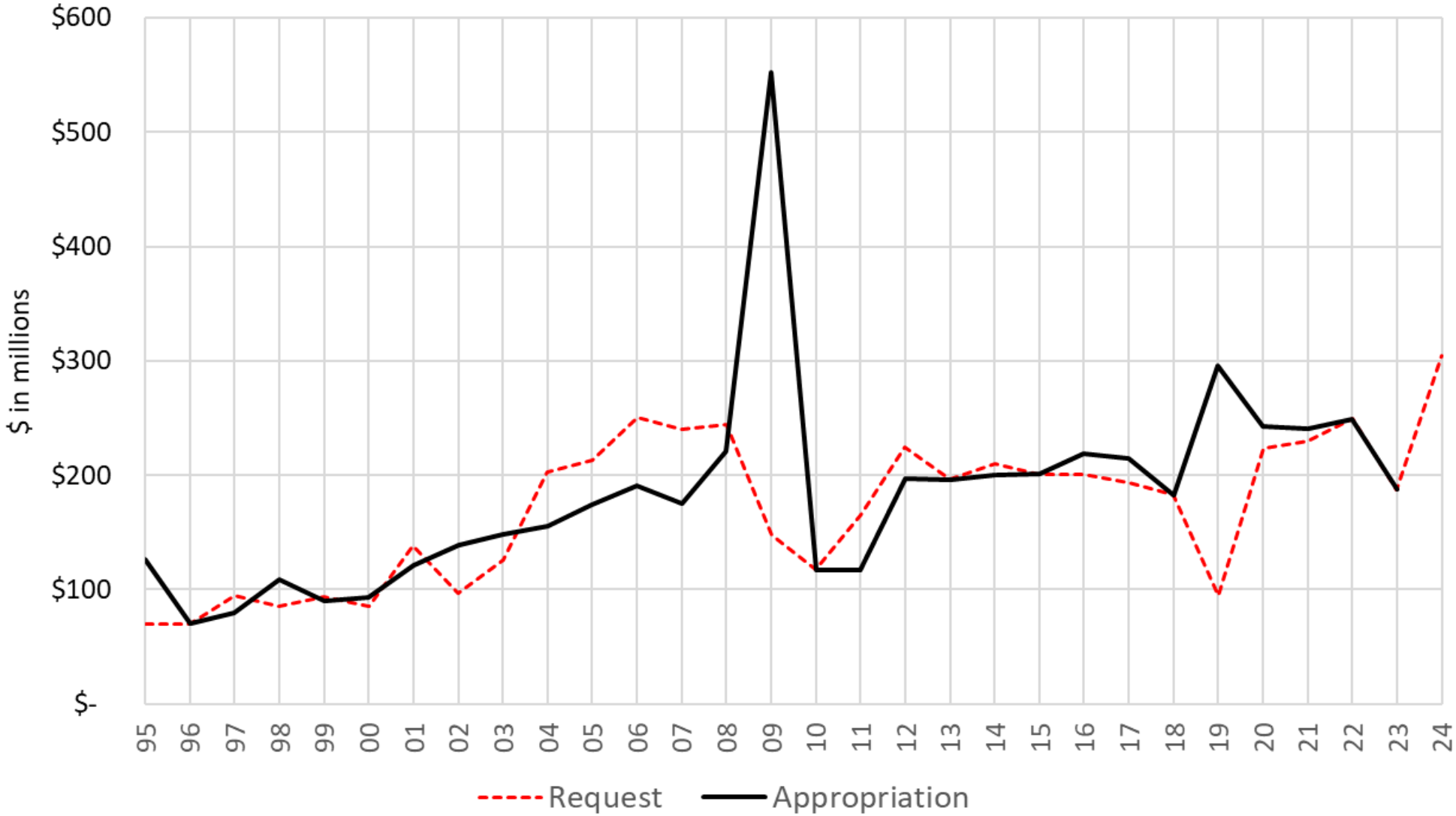
NSF MREFC Appropriations History, 1995-2023



https://dellweb.bfa.nsf.gov/NSFRqstApproHist/NSFRequestsandAppropriationsHistory.pdf

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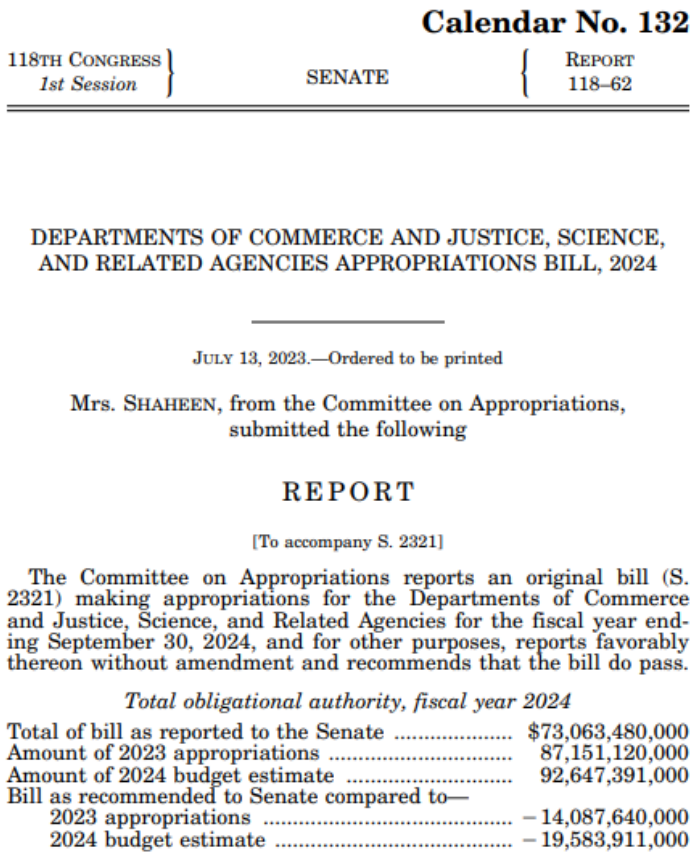
Pending Appropriations Direction for NSF/NASA



Calendar No. 132

118TH CONGRESS, 1st Session | SENATE | REPORT 118–62

DEPARTMENTS OF COMMERCE AND JUSTICE, SCIENCE, AND RELATED AGENCIES APPROPRIATIONS BILL, 2024

JULY 13, 2023.—Ordered to be printed

Mrs. SHAHEEN, from the Committee on Appropriations, submitted the following

REPORT

[To accompany S. 2321]

The Committee on Appropriations reports an original bill (S. 2321) making appropriations for the Departments of Commerce and Justice, Science, and Related Agencies for the fiscal year ending September 30, 2024, and for other purposes, reports favorably thereon without amendment and recommends that the bill do pass.

Total obligational authority, fiscal year 2024

Total of bill as reported to the Senate	$73,063,480,000
Amount of 2023 appropriations	87,151,120,000
Amount of 2024 budget estimate	92,647,391,000
Bill as recommended to Senate compared to—	
2023 appropriations	−14,087,640,000
2024 budget estimate	−19,583,911,000

- Senate report available
- House report still not released

https://www.congress.gov/118/crpt/srpt62/CRPT-118srpt62.pdf

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Senate undershoots MREFC request

The Committee appreciates that Congress has historically fully funded the MREFC request. However, the Committee understands that significant amounts of prior year funding still remain for the Antarctic Infrastructure Recapitalization. The Committee's recommendation supports the continued construction of the Vera C. Rubin Observatory, the Antarctic Infrastructure Recapitalization, and the High Luminosity-Large Hadron Collider Upgrade. The Committee encourages NSF and the National Science Board to continue planning and budgeting for the next generation of major facilities needed to ensure the United States maintains its scientific leadership, and to resubmit the proposal for the Leadership-Class Computing Facility as part of the fiscal year 2025 budget request.

-Senate proposes flat funding of $187 million
-House proposes increase to $254 million
-Request was for increase to $305 million

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Senate support for Facility Operations Transition program

As major research facilities transition from construction, funded in the Major Research Equipment and Facilities Construction account, to science operations and maintenance, funded in R&RA, it is necessary for NSF to accommodate this shift without impacting the existing scientific activities. The Committee notes that as a result of the National Science Board's "Study of Operations and Maintenance Costs for NSF Facilities" the agency created the Facility Operation Transition pilot to enable this shift. The Committee expects that as major research facilities, such as the Vera C. Rubin Observatory, move from construction into science operations NSF will continue to use the Facility Operation Transition to allow the ongoing operations and maintenance costs to gradually be absorbed into the managing division or directorate. Further, as part of the fiscal year 2025 budget request, NSF shall provide a 5-year operations and maintenance budget outlook for facilities that have recently graduated from the Major Research Equipment and Facilities Construction account.

Senate support for decadal planning

Astronomy.—NSF is encouraged to provide appropriate levels of support for operating its current facilities, developing instrumentation, and preparing for investments in future world-class scientific research facilities. As such, the agreement provides up to $30,000,000 for NSF to support the design and development of next generation astronomy facilities recommended in the ''Decadal Survey on Astronomy and Astrophysics 2020'' (Astro2020). NSF is also expected to support a balanced portfolio of astronomy research grants by scientists and students engaged in ground-breaking research. As NSF develops plans for realizing Astro2020, the Foundation shall provide regular briefings to the Committees on its progress.

Final FY23 Direction

Astronomy.—The Committee expects NSF to provide appropriate levels of support for operating its current facilities, developing instrumentation, and preparing for investments in future world-class scientific research facilities. The National Academies of Sciences, Engineering, and Medicine [NAS] Decadal Survey on Astronomy and Astrophysics 2020 [Astro2020] outlines a comprehensive research strategy and vision to maintain U.S. science and technology leadership at the frontiers of astronomy and astrophysics for ground-based instruments and observatories. The Committee therefore provides not less than $30,000,000 for NSF to support the development of next generation astronomy facilities recommended in Astro2020. NSF is expected to include a robust user support system and data archive in the development of any Astro2020-recommended facility to ensure community access to world class telescopes. NSF is also expected to support a balanced portfolio of astronomy research grants by scientists and students engaged in ground-breaking research. Not later than 90 days after enactment of this act, NSF shall provide the Committee with a briefing regarding the Foundation's progress for realizing Astro2020. Further, the Committee expects that NSF will request sufficient funding in the fiscal year 2025 budget request to continue to advance the projects recommended in the Astro2020 as quickly as practicable and without delay.

Senate FY24 Proposal

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Senate support for decadal planning, p2

Habitable Worlds Observatory.—The Committee supports the Great Observatory Maturation Program [GOMAP] as recommended by the Decadal Survey on Astronomy and Astrophysics, "Pathways to Discovery in Astronomy and Astrophysics for the 2020s" [Astro2020]. GOMAP will mature science and technologies needed for future flagship missions starting with the Habitable Worlds Observatory to observe habitable exoplanets. In order to cement continued American leadership in astronomy, the Committee provides the requested level for GOMAP to implement the Astro2020 recommendations. NASA is encouraged to articulate funding for GOMAP separately in future budget requests.

Pending Appropriations Direction for DOE

HIGH ENERGY PHYSICS

The High Energy Physics program supports fundamental research into the elementary constituents of matter and energy and ultimately into the nature of space and time. The program focuses on particle physics theory and experimentation in three areas: the energy frontier, which investigates new particles and fundamental forces through high-energy experimentation; the intensity frontier, which focuses on rare events to better understand the fundamental model of the universe's elementary constituents; and the cosmic frontier, which investigates the nature of the universe and its form of matter and energy on cosmic scales.

The recommendation provides not less than $35,000,000 for the Sanford Underground Research Facility, $10,000,000 for the Cosmic Microwave Background-Stage 4, and $5,000,000 for the Accelerator Controls Operations Research Network.

https://www.congress.gov/118/crpt/hrpt126/CRPT-118hrpt126.pdf

HIGH ENERGY PHYSICS

Research.—The Committee recommends not less than $33,300,000 for the Sanford Underground Research Facility; not less than $35,700,000 for the HL–LHC Upgrade projects;

The Committee supports the Cosmic Microwave Background-Stage 4.

For other project costs, the recommendation provides not less than $1,990,000 for the Accelerator Controls Operations Research Network and $4,000,000 for the Long Baseline Neutrino Facility/Deep Underground Neutrino Experiment.

The Committee encourages the Department to fund facility operations at levels for optimal operations. The Committee encourages the Department to fund facility operations and MIEs at optimal levels.

https://www.congress.gov/118/crpt/srpt72/CRPT-118srpt72.pdf

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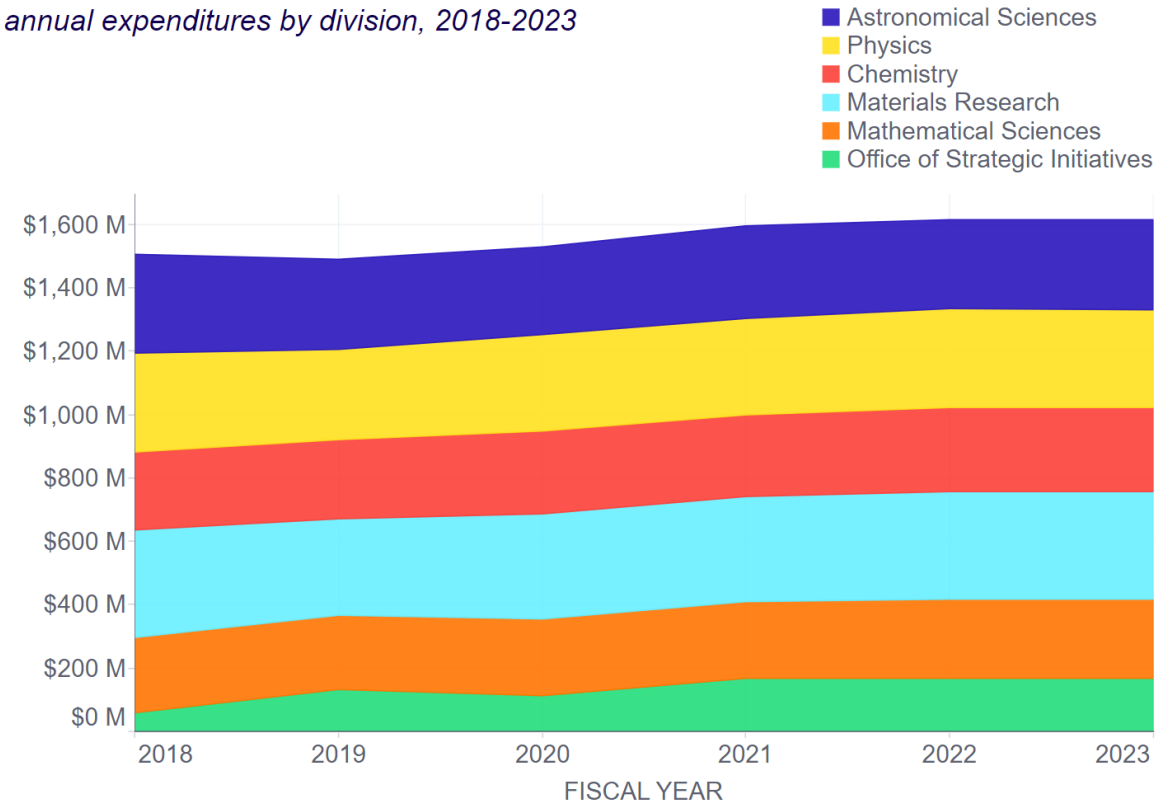
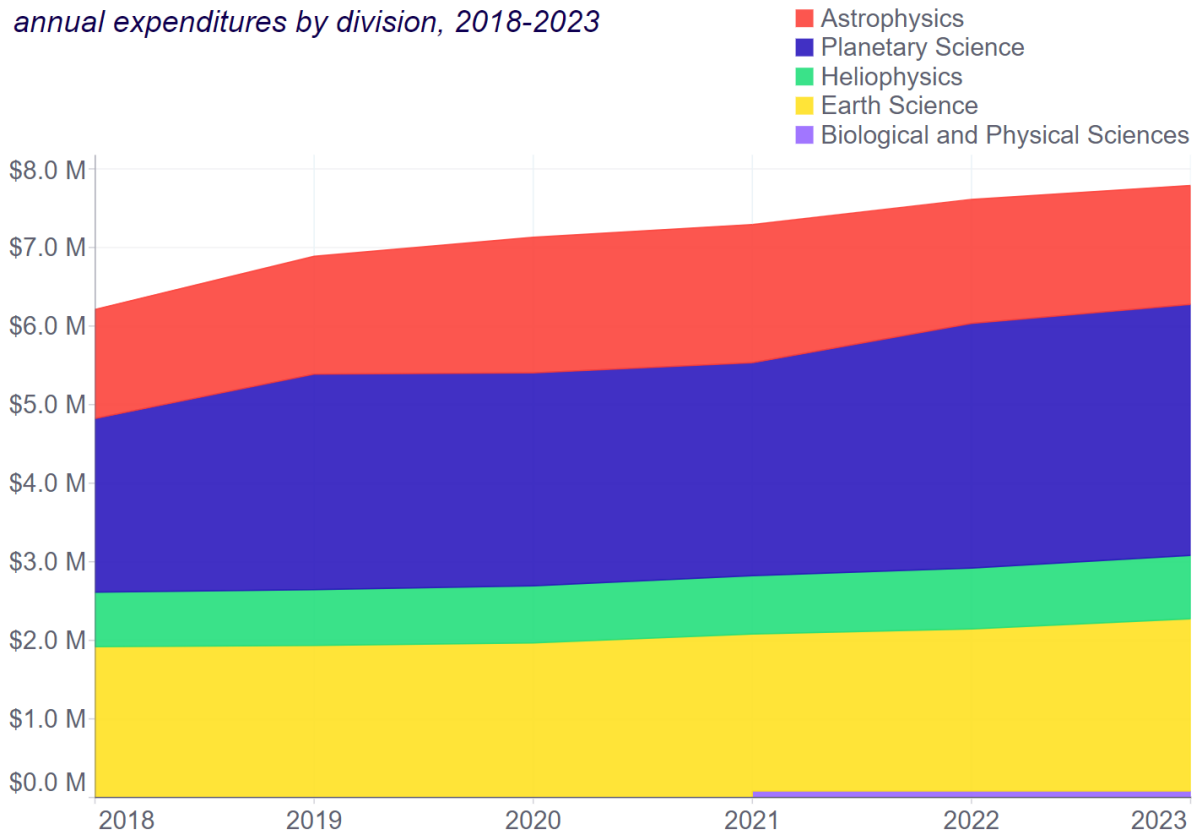
NSF Mathematical and Physical Sciences Directorate

annual expenditures by division, 2018-2023



NASA Science Mission Directorate

annual expenditures by division, 2018-2023



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NSF Research Budget by Directorate ($ in millions)	FY21	FY22 Actual		FY23 Estimate		FY24 Request	
NSF Total	8,440	8,676	3%	9,874	14%	11,315	15%
Technology, Innovation, & Partnerships	369	413	12%	880	113%	1,186	35%
Math & Physical Sciences	1,593	1,615	1%	1,686	4%	1,836	9%
Geosciences (incl. Polar Programs)	1,488	1,580	6%	1,613	2%	1,802	12%
Computer & Information Sciences & Engineering	1,007	1,015	1%	1,051	4%	1,172	12%
Engineering	764	775	1%	809	4%	970	20%
Biological Sciences	817	832	2%	857	3%	972	13%
Social, Behaviorial, & Economic Sciences	282	286	1%	313	10%	361	15%

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FYI Science Policy | aip.org/fyi

NSF Math and Physical Sciences Directorate Budget ($ in millions)	FY21	FY22 Actual		FY23 Estimate		FY24 Request	
NSF Total	8,440	8,676	3%	9,874	14%	11,315	15%
Math & Physical Sciences Directorate	1,593	1,615	1%	1,686	4%	1,836	9%
Astronomy Division	289	284	-2%	292	3%	303	4%
Chemistry Division	260	265	2%	269	1%	280	4%
Materials Research Division	330	339	3%	339	0%	350	3%
Mathematical Sciences Division	244	248	2%	252	1%	263	4%
Physics Division	304	310	2%	313	1%	324	4%
Office of Multidisciplinary Activities	166	170	2%	220	30%	315	43%

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https://ww2.aip.org/fyi/2023/nsf-details-plans-spend-1-billion-budget-increase

Questions?

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