

MAJOR RESEARCH FACILITIES

Major Research Facilities Funding
(Dollars in Millions)

	FY 2020 Actual	FY 2021 Estimate	FY 2022 Request	FY 2022 Request change over:			
				FY 2020 Actual		FY 2021 Estimate	
				Amount	Percent	Amount	Percent
Total Research and Related Activities	\$921.20	\$952.67	\$961.81	\$40.61	4.4%	\$9.14	1.0%
Operations and Maintenance of Existing Facilities	636.74	664.22	666.03	29.29	4.6%	1.81	0.3%
Federally Funded Research and Development Centers	276.01	278.05	278.98	2.97	1.1%	0.93	0.3%
Operations and Maintenance of Facilities under Construction	0.01	5.00	5.20	5.19	37040.2%	0.20	4.0%
R&RA Design Stage Activities	8.43	5.40	11.60	3.17	37.6%	6.20	114.8%
Major Research Equipment and Facilities Construction	\$153.87	\$240.00	\$248.00	\$94.13	61.2%	\$8.00	3.3%
Total, Major Research Facilities	\$1,075.07	\$1,192.67	\$1,209.81	\$134.74	12.5%	\$17.14	1.4%

NSF investments in major multi-user research facilities (major facilities) provide large, state-of-the-art tools for research and education. These can include instrumentation networks, observatories, accelerators, telescopes, research vessels, aircraft, and simulators. In addition, scientific use of cyber-enabled and geographically distributed facilities continues to increase as a result of rapid advances in computer, information, and communication technologies. NSF's investments are coordinated with those of other organizations, federal agencies, and international partners to ensure they are complementary and well-integrated. Planning, operations, and maintenance of major facilities are funded through the R&RA account. Most construction is funded through the MREFC account.

In FY 2018, NSF created the position of Chief Officer for Research Facilities in the Office of the Director, to enhance oversight of major facilities throughout their complete lifecycle. The individual in that position serves as the senior agency official whose responsibility is oversight of the development, construction, and operations of major facilities across the Foundation, as required by Section 110 of the American Innovation and Competitiveness Act (P.L. 114-329).

The Program Management Improvement and Accountability Act requires an annual NSF portfolio review integrated with an agency Strategic Review. In FY 2019, the NSF Strategic Review evaluated practices in funding NSF's Major Facilities and lessons learned from the FY 2019 lapse in appropriations. Recommendations from the Review resulted in NSF establishing a new practice to have at least three months of funding obligated to the award to span potential periods of funding discontinuity and thus provide financial stability. The FY 2020 Strategic Review assessed options for improving NSF internal processes for the Development and Design Stages. Recommendations included collecting consistent information annually from all Divisions on projects in development to promote strategic awareness, expanding Mid-scale and Major Facility development and design funding opportunities, building capacity in project management expertise for NSF staff and the research community through training opportunities and engagement, and clarifying the Major Facilities Guide on expectations for entering the Design Stage at points beyond the Conceptual Design Phase. These recommendations are in the process of being implemented by the Office of the Director and the Large Facilities Office.

The Facility Operation Transition activity proposed in Integrative Activities (IA) is the third year of a pilot program that reflects NSF's strategic commitment to successful operations and maintenance (O&M) of new major facilities as well as balancing portfolio funding between facilities and investigator research, both of which were emphasized in the NSF's Congressionally requested 2018 report entitled "Study of

Major Multi-User Research Facilities

Operations and Maintenance Costs for NSF Facilities” (NSB-2018-17).¹ The funds in this activity will be used to (1) partially support initial O&M of new facilities so that the full O&M costs can be gradually absorbed into the managing division or directorate, and (2) partially support divestment of lower-priority facilities, the full cost of which may significantly impact individual division or directorate funding. In FY 2020, these funds supported facilities operations and maintenance costs in BIO (\$3.0 million), GEO (\$3.0 million), and MPS (\$4.0 million); in FY 2021, these funds were distributed to BIO (\$7.50 million) and MPS (\$2.50 million).

All NSF’s major facilities were affected by the COVID-19 pandemic. Typically, there were periods of reduced or interrupted scientific operations, revisions of operational procedures to enable social distancing, and slowdowns in upgrade and maintenance projects because of inefficiencies introduced by COVID-19 precautions. NSF and its awardees made use of flexibilities provided by the Office of Management and Budget and the Uniform Guidance in maintaining facility operational readiness throughout the pandemic.

This chapter provides descriptions of each major facility supported through the R&RA account and provides funding information by lifecycle phase for each facility. The information presented for each facility follows the overall framework established by NSF for major facility projects. Information on projects under construction and funded through NSF’s MREFC account is provided in the MREFC chapter. The following pages contain information on the budget requests for NSF’s major facilities in FY 2022.

¹ National Science Board, *Study of Operations and Maintenance Costs for NSF Facilities* (NSB-2018-17), May 2018, www.nsf.gov/pubs/2018/nsb201817/nsb201817.pdf. FY 2021 Budget Request to Congress.

**NATIONAL SCIENCE FOUNDATION
FY 2022 BUDGET REQUEST TO CONGRESS
MAJOR RESEARCH FACILITIES FUNDING, BY PROJECT**

(Dollars in Millions)

	FY 2020 Actual	FY 2021 Estimate	FY 2022 Request	FY 2022 Request change over:			
				FY 2020 Actual		FY 2021 Estimate	
	Amount	Percent	Amount	Percent	Amount	Percent	
Operations and Maintenance of Major Facilities	\$912.77	\$947.27	\$950.21	\$37.44	4.1%	\$2.94	0.3%
Biological Sciences	\$65.00	\$65.00	\$70.00	\$5.00	7.7%	\$5.00	7.7%
National Ecological Observatory Network (NEON)	65.00	65.00	70.00	5.00	7.7%	5.00	7.7%
Geosciences	\$333.24	\$339.18	\$354.30	\$21.06	6.3%	\$15.12	4.5%
Academic Research Fleet ¹	106.17	107.38	117.88	11.71	11.0%	10.50	9.8%
Geodesy Advancing Geosciences and EarthScope (GAGE)	13.90	13.95	14.05	0.15	1.1%	0.10	0.7%
International Ocean Discovery Program (IODP)	48.00	48.00	48.00	-	-	-	-
National Center for Atmospheric Research (NCAR) FFRDC	99.70	104.00	104.00	4.30	4.3%	-	-
Ocean Observatories Initiative (OOI)	43.97	44.00	48.50	4.53	10.3%	4.50	10.2%
Seismological Facilities for the Advancement of Geoscience & EarthScope (SAGE)	21.50	21.85	21.87	0.37	1.7%	0.02	0.1%
Mathematical and Physical Sciences	\$304.42	\$330.59	\$310.59	\$6.17	2.0%	-\$20.00	-6.0%
Arecibo Observatory ²	6.51	45.06	26.00	19.49	299.2%	-19.06	-42.3%
Green Bank Observatory (GBO) FFRDC ³	9.42	8.90	9.12	-0.30	-3.2%	0.22	2.5%
Large Hadron Collider (LHC) - ATLAS and CMS	20.00	20.00	20.50	0.50	2.5%	0.50	2.5%
Laser Interferometer Gravitational Wave Observatory (LIGO)	45.00	45.00	45.00	-	-	-	-
National High Magnetic Field Laboratory (NHMFL) ⁴	34.59	25.98	38.91	4.33	12.5%	12.93	49.8%
National Radio Astronomy Observatory (NRAO) FFRDC	89.25	88.13	91.16	1.91	2.1%	3.03	3.4%
NRAO O&M ⁵	41.98	39.45	40.53	-1.45	-3.5%	1.08	2.7%
Atacama Large Millimeter Array (ALMA) O&M	47.27	48.68	50.63	3.36	7.1%	1.95	4.0%
National Solar Observatory (NSO) FFRDC	21.79	24.09	25.46	3.67	16.8%	1.37	5.7%
NSO O&M	4.78	4.55	5.88	1.10	23.0%	1.33	29.2%
Daniel K. Inouye Solar Telescope (DKIST) ⁶	17.01	19.54	19.58	2.57	15.1%	0.04	0.2%
National Superconducting Cyclotron Laboratory (NSCL) ⁷	22.00	15.50	-	-22.00	-100.0%	-15.50	-100.0%
NSF's National Optical-Infrared Astronomy Research Laboratory (NOIRLab) FFRDC	55.86	57.93	54.44	-1.42	-2.5%	-3.49	-6.0%
NOIRLab O&M (Mid-Scale Observatories & Community Science and Data Center) ⁸	33.54	29.95	26.26	-7.28	-21.7%	-3.69	-12.3%
Gemini Observatory O&M	22.31	22.98	22.98	0.67	3.0%	-	-
Vera C. Rubin Observatory O&M	0.01	5.00	5.20	5.19	37040.2%	0.20	4.0%
Office of Polar Programs	\$210.10	\$212.50	\$215.32	\$5.22	2.5%	\$2.82	1.3%
Antarctic Facilities and Operations (AFO) ⁹	203.09	205.50	208.02	4.93	2.4%	2.52	1.2%
IceCube Neutrino Observatory (ICNO)	7.00	7.00	7.30	0.30	4.2%	0.30	4.3%
Major Research Facilities Construction Investments	\$162.30	\$245.40	\$259.60	\$97.30	60.0%	\$14.20	5.8%
R&RA Design Stage Activities¹⁰	\$8.43	\$5.40	\$11.60	\$3.17	37.6%	\$6.20	114.8%
Major Research Equipment and Facilities Construction (MREFC)	\$153.87	\$240.00	\$248.00	\$94.13	61.2%	\$8.00	3.3%
Total, Major Research Facilities	\$1,075.07	\$1,192.67	\$1,209.81	\$134.74	12.5%	\$17.14	1.4%

Major Multi-User Research Facilities

FFRDC is an acronym for Federally-Funded Research and Development Center.

¹ ARF: Includes ship operations and upgrade support. Regional Class Research Vessels (RCRV) began construction in FY 2017 and the final year of MREFC funding was FY 2019, with additional COVID-19 contingency funds for FY 2022 included in the MREFC line below. Operations and maintenance of RCRV is not anticipated to begin until FY 2023.

² Arecibo: Includes \$28.88 million in FY 2021 and \$15.0 million in FY 2022 in supplemental funding for cleanup of the Arecibo site.

³ GBO: FY 2020 Actual includes \$1.75 million from a technical deobligation/reobligation action from a previous award.

⁴ NHFML: The FY 2020 Actual includes \$12.0 million to fund part of FY 2021 operations costs, and excludes \$14.20 million obligated in FY 2019 for FY 2020 operations.

⁵ NRAO O&M: FY 2020 Actual includes one-time funding of \$3.50 million for a special project associated with NSF's Spectrum Innovation Initiative.

⁶ DKIST: The FY 2021 Estimate excludes funding of \$2.0 million for cultural mitigation activities as agreed to during the compliance process.

⁷ NSCL: FY 2021 is the final year of NSF stewardship of NSCL, after which NSCL will transition into the Department of Energy's Facility for Rare Isotope Beams.

⁸ NOIRLab: Includes \$2.0 million in FY 2020 for transition activities associated with the creation of NOIRLab, as well as special projects funding of \$13.63 million in FY 2020, \$9.44 million in FY 2021, and \$5.13 million in FY 2022.

⁹ Funding for Antarctic Facilities and Operations excludes support for the Antarctic Infrastructure Modernization for Science (AIMS) project of the Antarctic Infrastructure Recapitalization (AIR) program in FY 2020 (\$4.93 million), and \$1.80 million in FY 2021 and \$8.0 million in FY 2022 for the Antarctic Research Vessel (ARV), which is captured under Design Stage Activities below.

¹⁰ Design Stage Activities include support for potential next generation multi-user facilities. This line reflects FY 2020 funding of \$3.50 million and \$3.60 million in FY 2021 and FY 2022 for the potential Leadership Class Computing Facility, and \$4.93 million in FY 2020 for the Antarctic Infrastructure Modernization for Science (AIMS) project of the Antarctic Infrastructure Recapitalization (AIR) program, and \$1.80 million in FY 2021 and \$8.0 million in FY 2022 for the Antarctic Research Vessel (ARV).