NSF'S NATIONAL OPTICAL-INFRARED ASTRONOMY RESEARCH LABORATORY (NSF'S NOIRLAB)
https://noirlab.edu/public/

NSF's National Optical-Infrared Astronomy Research Laboratory Funding

(Dollars in Millions)

	FY 2023		Change over	
FY 2022	Estimate	FY 2024	FY 2023 Estimate Base	
Actual	Base	Request	Amount	Percent
$56.38	$73.57	$82.21	$8.64	11.7%

Brief Description

Launched on October 1, 2019, NSF's NOIRLab integrates into a single center Vera C. Rubin Observatory operation (excluding the Rubin Observatory construction project), the International Gemini Observatory, and the programs and activities that were previously associated with NSF's National Optical Astronomy Observatory (NOAO). NOIRLab is managed for NSF by the Association of Universities for Research in Astronomy, Inc. (AURA). NOIRLab operates the Kitt Peak National Observatory (KPNO) and the Cerro Tololo Inter-American Observatory (CTIO), now collectively known as the Mid-Scale Observatories (MSO), as well as the Community Science and Data Center (CSDC) in Tucson, Arizona. As a Federally Funded Research and Development Center (FFRDC), NOIRLab coordinates the observational, technical, and data-management capabilities across all these facilities. NOIRLab also develops and sustains domestic and international partnerships with a view to advancing observational astronomy for the entire U.S. community. NOIRLab is a strategic priority for the MPS Division of Astronomical Sciences (AST) to facilitate U.S. leadership in optical-infrared (OIR) astronomy. NOIRLab promotes efficient operations across its observatories and centers and provides a cornerstone for NSF investment in the next generation of OIR facilities.

Meeting Scientific Community Needs

NOIRLab is the hub of U.S. ground-based OIR astronomy in the era of Rubin Observatory, time domain astronomy (TDA), multi-messenger astrophysics (MMA), and data-intensive science. NOIRLab is central to NSF's implementation of recommendations from the Astro2020 decadal survey.[1] By providing public access to a diverse portfolio of telescopes and instruments, NOIRLab enables pursuit of a broad range of modern astrophysical challenges, from studying small bodies in the solar system to characterizing the most distant galaxies and indirectly observing dark matter and dark energy.

NOIRLab's facilities are open to all astronomers regardless of institutional affiliation, with services provided to approximately 1,200 graduate and undergraduate students annually. Each year, NOIRLab telescopes feature in over 700 peer-reviewed scientific papers.

Recognizing an increased need for the characterization and study of transient events found by Rubin Observatory and MMA alerts from NSF's LIGO and IceCube facilities, NOIRLab has developed the Arizona–NOIRLab Temporal Analysis and Response to Events System (ANTARES), a software tool

[1] www.nationalacademies.org/our-work/decadal-survey-on-astronomy-and-astrophysics-2020-astro2020

designed to rapidly process information from many thousands of changing objects. In addition, NOIRLab has set up the Astronomical Event Observatory Network (AEON) for immediate follow-up observations once interesting objects are identified. Through NSF supplemental support, NOIRLab is also constructing a new, state-of-the-art, adaptive optics system for Gemini-North (located atop Maunakea, Hawaii) and is re-commissioning instruments on the Victor M. Blanco and the Southern Astrophysical Research (SOAR) telescopes (both part of the CTIO, located in the Chilean Andes) specifically for TDA and MMA follow-up. NOIRLab is also taking a lead role in studies of planets around other stars, through the NASA-NSF Exoplanet Exploration (NN-Explore) program at the WIYN telescope (at KPNO) and by pursuing continued improvements in Extreme-Precision Radial Velocity instrumentation on NOIRLab's Gemini telescope.

Status of the Facility

NOIRLab operates facilities at four mountaintop sites in Arizona, Hawaii, and Chile. The International Gemini Observatory comprises two 8-meter telescopes: Gemini-North on Maunakea in Hawaii and Gemini-South on Cerro Pachón in northern Chile. The MSO supports two 4-meter class telescopes at KPNO in Arizona, WIYN and Mayall, as well as two 4-meter class telescopes at CTIO in Chile, SOAR and Blanco. Operations after the COVID-19 pandemic have returned to normal at these facilities, with remote observing possible at many NOIRLab telescopes. Rubin Observatory, located on the same summit as Gemini-South, is in pre-operations as it prepares to begin its ambitious 10-year imaging survey (see the Vera C. Rubin Observatory narrative in the MREFC section of Research Infrastructure).

On June 11, 2022, the Contreras wildfire was ignited by a lightning strike on Tohono O'odham Nation land south of KPNO. The fire passed through KPNO the weekend of June 17-19, destroying three small storage buildings (two of which were owned by the University of Arizona), and damaging two NOIRLab dormitories. Due to the heroic efforts of local firefighters and KPNO staff, none of the telescopes or instruments were damaged. However, facilities were impacted by smoke and ash, and guard-rails along the summit access road were destroyed, as were power and internet poles and cables. Operations slowly resumed after a 3-month period of clean-up and repairs to utilities and have now returned to normal.

On October 20, 2022, the 8.1-meter primary mirror of the Gemini-North telescope suffered damage to two areas just outside its light-collecting area while being moved for stripping prior to recoating. Detailed inspections found no evidence of damage elsewhere on the mirror. The telescope has since been unavailable for use while repairs are effected. Operations are anticipated to resume in March 2023.

After COVID-related delays, two major new instruments at Kitt Peak, the extreme precision radial velocity spectrometer for exoplanet research (NEID), operated in collaboration with NASA, and the 5000-fiber Dark Energy Survey Instrument (DESI), a DOE project, were successfully commissioned on the WIYN and Mayall telescopes, respectively. Both began their surveys in mid-2021. DESI has already completed over 20 percent of its survey, obtaining spectroscopic redshift for over 10 million galaxies to-date. The new Gemini facility instrument GHOST has, in the meantime, been safely delivered to Gemini-South and is being commissioned in 2023.

Governance Structure and Partnerships

NSF Governance Structure

NSF oversight is led by four program officers in MPS AST who work cooperatively on an Integrated Program Team (IPT) with staff from the Office of Budget, Finance, and Award Management (BFA), the Office of the General Counsel, the Office of Legislative and Public Affairs and other NSF offices as needed. The team makes use of quarterly and annual programmatic and financial reporting as well as pre-defined key performance indicators to measure performance; these are defined in a Performance Evaluation and Measurement Plan that is updated annually. Within BFA, the Large Facilities Office provides advice and assists with agency oversight and assurance. The MPS facilities team and the Chief Officer for Research Facilities also provide high-level guidance, support, and oversight.

External Governance Structure

AURA and the NOIRLab Director receive advice from AURA's NOIRLab Management Oversight Council. MSO and Gemini have Users' Committees, which advise on science operations. For Rubin, a management board with members from AURA, the lead DOE lab, and the SLAC National Accelerator Laboratory, approves new observing modes and capabilities. Gemini is governed by the Gemini Board, guided by the International Gemini Agreement. The board acts as the primary forum for interactions and decisions among partners and is the body with overall budgetary and policy control for Gemini.

Partnerships and Other Funding Sources

NOIRLab and its component programs support several partnerships on behalf of NSF. The Gemini partnership includes agencies from Canada, Brazil, Argentina, Chile, and the Republic of Korea. Along with NSF, all are signatories to the International Gemini Agreement. The SOAR telescope is supported by Brazil, NOIRLab, the University of North Carolina Chapel Hill, and Michigan State University; WIYN is supported by the University of Wisconsin, Indiana University, and NOIRLab, with other institutions, including NASA, as operational partners. NSF and DOE jointly support Rubin Observatory, as well as major instrumentation and surveys at the Blanco and Mayall telescopes. Many U.S. universities, meanwhile, operate their own telescopes at KPNO and CTIO, with reimbursed services provided by NOIRLab.

Funding

Total Obligations for NOIRLab

(Dollars in Millions)

	FY 2022 Actual	FY 2023 Estimate Base	FY 2024 Request	ESTIMATES[1] FY 2025	FY 2026	FY 2027	FY 2028	FY 2029
Vera C. Rubin Observatory Operations	$5.20	$22.10	$33.80	$38.45	$38.25	$38.22	$38.63	$39.88
Gemini Observatory	25.38	22.98	24.73	25.49	26.26	27.04	27.04	27.04
Operations and Maintenance	*23.32*	*22.98*	*22.98*	*25.49*	*26.26*	*27.04*	*27.04*	*27.04*
Special Projects [2,3]	*2.06*	-	*1.75*	-	-	-	-	-
Mid-Scale Observatories & CSDC	25.80	28.49	23.68	24.59	25.33	25.73	25.73	25.73
Operations and Maintenance	*21.13*	*21.13*	*22.40*	*23.27*	*23.98*	*24.33*	*25.73*	*25.73*
Special Projects [3,4]	*4.67*	*7.36*	*1.28*	*1.32*	*1.35*	*1.40*	-	-
TOTAL[5]	**$56.38**	**$73.57**	**$82.21**	**$88.53**	**$89.84**	**$90.99**	**$91.40**	**$92.65**

[1] Outyear estimates are for planning purposes only. The current cooperative agreement ends September 30, 2027.

[2] Gemini Special Projects includes additional funding of $2.06 in FY 2022 for a new photovoltaic power system for Gemini-South. The FY 2024 Request includes $1.75 million for repairs and maintenance beyond regular O&M.

[3] Funding in FY 2023 and FY 2024 does not include potential additional funding that may be provided by MPS' Office of Strategic Initiatives (formerly Office of Multidisciplinary Activities) for deferred maintenance projects.

[4] MSO Special Projects funding contains support for the Windows on the Universe Center for Astronomy Outreach, ongoing activities at the WIYN telescope, and potential future participation in the U.S. Extremely Large Telescope program. Funding is also included for repairs and maintenane beyond regular O&M, as well as extraordinary inflationary impacts on O&M.

[5] Excluded is $2.50 million in Disaster Relief Supplemental Appropriations Act, 2023 funding designated for "damage to research facilities and scientific equipment in calendar year 2022, including related to the consequences of wildfires".

NOIRLab funding includes support for Rubin pre-operations, Gemini operations, and operations of the NOIRLab Base (MSO and CSDC) along with associated Special Projects under one overarching cooperative agreement with AURA.

- Rubin pre-operations funding began in FY 2018; more information on operations of Rubin (in partnership with DOE) can be found in the Rubin Observatory MREFC construction narrative.
- The FY 2024 Request for Gemini O&M covers NSF's partnership share of O&M costs as well as NSF's contribution to Gemini's Instrument Development Fund. Additional funding is provided under Special Projects for major maintenance and upgrade projects as needed.
- The FY 2024 Request for the Mid-Scale Observatories & CSDC funds the NOIRLab Directorate, supports O&M of KPNO and CTIO not otherwise funded by other entities or partners, and funds user support services, data archiving, and software development at CSDC.
- Special Projects include support of the NN-EXPLORE program at WIYN, refurbishment costs for the Windows on the Universe Center for Astronomy Outreach (renovation of the McMath-Pierce Solar telescope facility to create a new education center on Kitt peak), development of the U.S. ELT Program, and major maintenance and upgrade projects as needed.

Additional funding for deferred maintenance may be provided by MPS' Office of Strategic Initiatives.

Reviews and Reports

NSF has in the past conducted annual reviews of program operating plans, progress reports, and strategic planning documents for NOIRLab's component observatories, and now continues to do so

for the entire NOIRLab enterprise. Quarterly reports outlining progress against milestones and Key Performance Indicators are reviewed by NSF's NOIRLab IPT. In February 2021, NSF conducted its first external review of NOIRLab-wide performance and program operating plans. Audits and reviews of NOIRLab's annual budgets, indirect cost rates, overhead rates, and accounting systems are conducted annually or as needed by BFA. A NOIRLab-wide Business Systems Review is planned for the second half of FY 2023.

Renewal/Recompetition/Disposition

The latest recompetition of the O&M awards for MSO/CSDC and Gemini concluded separately in 2015, resulting in awards through the ends of FY 2020 and CY 2022, respectively. A renewal of funding for MSO, CSDC, and the NOIRLab Directorate for a further two years (FY 2021-FY 2022), authorized by the National Science Board (NSB) in July 2020, allowed NSF to synchronize the award periods for all existing programmatic components of NOIRLab, which also includes Rubin Observatory operations. In February 2022, NSF reviewed a five-year proposal for the renewal of all NOIRLab programs (MSO, CSDC, Gemini and Rubin Observatory operations) and in August 2022, the NSB authorized renewal of funding for the period FY 2023-FY 2027. Currently, there are no plans for disposition of any NOIRLab facilities, although evaluation of the future of current MSO facilities will be considered in the next award cycle.