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 Base Plan	FY 2024 (TBD)	FY 2025 Request	Change over FY 2023 Base Plan Amount	Percent
$73.57	-	$86.40	$12.83	17.4%

Brief Description

NSF's NOIRLab is a Federally Funded Research and Development Center that integrates into a single center the Vera C. Rubin Observatory operation, the International Gemini Observatory, and the programs and activities that were previously associated with NSF's National Optical Astronomy Observatory. 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 the 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, data collected by NOIRLab telescopes feature in over 700 peer-reviewed scientific papers.

Recognizing an increased need for the characterization and study of transient events found by the 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 has re-commissioned 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 (located at KPNO) and by pursuing continued improvements in Extreme-Precision Radial Velocity instrumentation on both of NOIRLab's Gemini telescopes.

Status of the Facility

NOIRLab operates facilities at 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, WIYN and Mayall, at KPNO in Arizona as well as two 4-meter class telescopes, SOAR and Blanco, at CTIO in Chile. Rubin Observatory, located on the same summit as Gemini-South, is in pre-operations as preparations for the ambitious 10-year imaging survey begin (see the Vera C. Rubin Observatory narrative in the MREFC section of Research Infrastructure).

On June 17-19, 2022, the Contreras wildfire passed through KPNO, destroying three small storage buildings and damaging two NOIRLab dormitories. Due to the heroic efforts of local firefighters and KPNO staff, none of the telescopes or instruments were damaged, though facilities were impacted by smoke and ash. Operations resumed across Kitt Peak after a 3-month period of clean-up and repairs.

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 mirror was repaired and recoated in early 2023, and operations resumed on June 2, 2023.

On August 1, 2023, Gemini-North experienced a cyber-attack that resulted in a pause in operations at both Gemini sites. The incident was thoroughly investigated by external cybersecurity experts, and additional cybersecurity measures were put in place across the whole distributed NOIRLab infrastructure to provide more robust defenses. During the incident recovery period, remote access to NOIRLab facilities was limited as networks were hardened; operations did continue on WIYN, Mayall, Blanco, and SOAR. Both Gemini telescopes returned to operation on September 29, 2023.

The extreme precision radial velocity spectrometer for exoplanet research (NEID), operated in collaboration with NASA on the WIYN telescope, and the 5000-fiber Dark Energy Survey Instrument (DESI), a DOE project on the Mayall telescope, both continue to operate at the cutting edge of their respective fields. NEID and DESI began their surveys in mid-2021. NEID is proving particularly popular with early-career scientists, with over 85% of project leads being graduate students, postdoctoral researchers, or early-career faculty. DESI, meanwhile, has publicly released its first cache of data, with nearly two million objects for researchers to explore. The new Gemini facility instruments GHOST and IGRINS-2 have, in the meantime, been successfully delivered and will be available for broad community use in 2024.

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 BFA's Research Infrastructure Office and Division of Acquisition and Cooperative Support, the Office of the General Counsel, and the Office of Legislative and Public Affairs. 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. 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 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 NOIRLab, Indiana University, and the University of Wisconsin, 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 services provided by NOIRLab on a cost-recovery basis.

Funding

Total Obligations for NOIRLab

(Dollars in Millions)

	FY 2023 Base Plan	FY 2024 (TBD)	FY 2025 Request	ESTIMATES[1] FY 2026	FY 2027	FY 2028	FY 2029	FY 2030
NOIRLab - MSO & CSDC	$28.49	-	$24.82	$25.62	$26.38	$26.38	$26.38	$26.38
Operations and Maintenance	21.13	-	24.82	25.62	26.38	26.38	26.38	26.38
Special Projects [2]	7.36	-	-	-	-	-	-	-
Gemini Observatory	22.98	-	25.49	26.26	27.04	27.04	27.04	27.04
Vera C. Rubin Observatory O&M	22.10	-	36.09	38.25	40.00	40.00	40.00	40.00
TOTAL[3]	**$73.57**	**-**	**$86.40**	**$90.13**	**$93.42**	**$93.42**	**$93.42**	**$93.42**

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

[2] 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 maintenance beyond regular O&M, as well as extraordinary inflationary impacts on O&M.

[3] 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 2025 Request for Gemini 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 2025 Request for MSO & 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. 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 was completed in 2023. In February 2024, NSF will conduct a week-long external review of NOIRLab-wide performance and plans for operations, including planning for possible support of potential future extremely large telescopes.

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 end 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) 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 renewal of funding for the period FY 2023-FY 2027 was approved. 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.