

NATIONAL OPTICAL ASTRONOMY OBSERVATORY (NOAO)

\$22,910,000
-\$3,850,000 / -14.4%

National Optical Astronomy Observatory Funding
(Dollars in Millions)

FY 2018 Actual ¹	FY 2019 (TBD)	FY 2020 Request	Change Over	
			FY 2017 Actual Amount	Percent
\$26.76	-	\$22.91	-\$3.85	-14.4%

¹ The FY 2018 Actual includes \$7.08 million in additional one-time FY 2018 funding above the requested amount.

NOAO was established in 1984 by uniting operations of the Kitt Peak National Observatory (KPNO) in Arizona and the Cerro Tololo Inter-American Observatory (CTIO) in Chile. As a Federally Funded Research and Development Center sponsored by NSF, the primary purpose of NOAO is to serve as the U.S. national center for ground-based optical and infrared (OIR) astronomy to coordinate, integrate, and operate observational, technical, and data-oriented capabilities available throughout the U.S. OIR system of federal and non-federal assets.

NOAO’s mission is to enable discovery in ground-based OIR astronomy. In pursuit of this mission, NOAO facilitates access for all qualified professional researchers to state-of-the-art observational capabilities and databases in OIR astronomy. NOAO enables the U.S. research community to pursue a broad range of modern astrophysical challenges from small bodies within the Solar System, to the most distant galaxies in the early universe, to indirect observations of dark energy and dark matter. NOAO is the gateway for the U.S. astronomical community to the Gemini Observatory through the U.S. National Gemini Office. NOAO coordinates community access to telescopes throughout the U.S. OIR system, and it facilitates connecting the scientific user to data archives by developing and maintaining data management capabilities. NOAO integrates community planning for future facilities and instrumentation projects under a national organization. In partnership with the community and NSF, NOAO works with colleges and universities to train the next generation of scientists and engineers and promotes accomplishments to strengthen education and public awareness of the astronomical sciences.

NOAO facilities, telescopes, and data systems are open to all qualified astronomers regardless of institutional affiliation. They serve nearly 1,200 U.S. and foreign scientists annually. Doctoral dissertation students and non-thesis graduate students from U.S. institutions use NOAO facilities for research projects. In FY 2018, NOAO employed 300 personnel in Arizona and Chile, including 45 support scientists and 10 postdoctoral fellows.

Total Obligations for NOAO

(Dollars in Millions)

	FY 2018	FY 2019	FY 2020	ESTIMATES ¹				
	Actual	(TBD)	Request	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025
NOAO Base O&M (AST)	\$20.31	-	\$19.70	\$20.29	\$20.90	\$21.56	\$22.24	\$22.94
<i>Tucson Operations</i> ²	10.76	-	9.58	9.87	10.16	10.47	10.78	11.11
<i>Chilean Operations</i>	8.49	-	9.00	9.27	9.55	9.86	10.20	10.54
<i>Kitt Peak Operations</i>	1.06	-	1.12	1.15	1.19	1.23	1.26	1.30
Special Projects (AST) ²	3.78	-	3.21	1.00	1.00	1.00	1.00	1.00
Special Projects (OMA) ²	1.66	-	-	-	-	-	-	-
Facility Upgrades ²	1.00	-	-	-	-	-	-	-
Total	\$26.76	-	\$22.91	\$21.29	\$21.90	\$22.56	\$23.24	\$23.94

¹ Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in FY 2020.

² The FY 2018 Actual includes additional one-time FY 2018 funding above the requested amount: \$1.76 million under Tucson Operations; \$4.32 million under Special Project support; and \$1.0 million under Facility Upgrades.

Additional one-time FY 2018 Funding, \$7.08 million: FY 2018 included one-time support for the following activities:

- \$1.76 million under Tucson Operations to support development of user data tools and the U.S. Extremely Large Telescope initiative;
- \$4.32 million under Special Projects for upgrades (\$1.0 million) of the Mayall 4-m Telescope on Kitt Peak in preparation for DOE dark energy observations and \$3.32 million for the Astronomy Outreach Center at Kitt Peak, consisting of \$1.66 million each from the MPS Division of Astronomical Sciences (AST) and the MPS Office of Multidisciplinary Activities (OMA); and
- \$1.0 million for facilities upgrades on Kitt Peak and Cerro Tololo, primarily for road refurbishment.

Partnerships and Other Funding Sources: The managing organization for NOAO is the Association of Universities for Research in Astronomy, Inc. (AURA), which is comprised of 46 U.S. member institutions and four international affiliate members.

In a key NOAO partnership with the Department of Energy (DOE), a major imaging survey of approximately one-quarter of the southern sky was recently completed (February 2019) using the purpose-built Dark Energy Camera on the CTIO 4-meter Blanco telescope. Over the past six years more than 400 scientists from over 25 institutions have collected a rich trove of data—50 terabytes worth, mapping nearly a billion galaxies. The survey’s primary goal is to probe the nature of dark energy and, although the survey is ending, both the camera used and the survey data themselves are expected to continue to yield abundant new discoveries.

Another related partnership with DOE involves installation of the Dark Energy Spectroscopic Instrument on the Mayall telescope on Kitt Peak in February 2018 for a five-year dark energy science program. In FY 2019, DOE assumed full operations funding of the Mayall Telescope.

NOAO is also a partner in the 4.1-meter SOUTHERN Astrophysical Research (SOAR) telescope at CTIO. SOAR partners include the University of North Carolina, Chapel Hill; Michigan State University; and the Ministério da Ciência, Tecnologia, Inovações e Comunicações do Brasil.

A large number of universities and institutions (mostly from the U.S.) support their own astronomical facilities at KPNO and CTIO with services provided by NOAO and access to NOAO maintained infrastructure in exchange for payment of the facility’s share of site and operations costs. Development of

Major Multi-User Research Facilities

new telescopes, instrumentation, and sensor techniques is done in partnership with universities and with industry through subawards to aerospace, optical fabrication, and information technology companies. NOAO leverages NSF support with funding from other federal agencies and non-federal sources. NOAO typically receives approximately \$10 million each year for reimbursed services from partnerships and tenant observatory support, from the Kitt Peak Visitors Center, and from grants from other federal agencies.

Education and Public Outreach: NOAO supports U.S. education goals by promoting public understanding and support of science and by providing education and training at all levels. Over 200 U.S. and foreign graduate students observe on NOAO telescopes yearly and a significant fraction of the observations contribute to Ph.D. dissertations. The observatories introduce undergraduate students to scientific research by providing stimulating environments for basic astronomical research and related technologies through NSF's Research Experiences for Undergraduates program. NOAO has a diverse education program, visitor centers, and a web-based information portal.¹

NOAO Base Operations and Maintenance, \$19.70 million:

- Tucson Operations: \$9.58 million: This covers the cost for headquarters, offices, laboratories, and workshops in Tucson, Arizona. The FY 2018 Actual included special support for development of user data tools.
- Chilean Operations: \$9.0 million: This supports the administration office and labs in La Serena, Chile and mountain operations on Cerro Tololo and Cerro Pachón.
- Kitt Peak Operations: \$1.12 million: This funds basic infrastructure for all facilities on the mountain which are accounted as tenants.

Special Projects, \$3.21 million:

- In FY 2020 Special Projects includes \$1.21 million for continuing operational support of the NASA-NSF cooperative exoplanet observing program on the WIYN 3.5-m telescope on Kitt Peak.
- Special Projects also includes \$2.0 million to support transition planning for a new National Center for Optical-Infrared Astronomy. With NSF guidance, AURA is currently developing a detailed plan that would fold NOAO, Gemini, and LSST operations into a single administrative element through the scope of the NOAO Federally Funded Research and Development Center. If implemented, the resulting organization would provide a modern management structure for U.S. optical-infrared nighttime telescope assets without reducing commitments to flagship facilities or national/international partnerships.

Management and Oversight

- NSF Structure: An NSF program officer in AST provides continuing oversight, including consultation with an NSF panel of external program reviewers that meets once a year. The program officer reviews detailed annual program plans, annual long-range plans, quarterly technical and financial reports, and annual reports submitted by NOAO. The NSF program officer also attends AURA governance committee meetings. Governance committees are formed from the national astronomical community and provide additional avenues for input of community priorities and concerns. To address issues as they arise, AST has a dedicated Integrated Project Team which includes representatives from other NSF offices, such as the Office of General Counsel, OISE, and the Division of Acquisition and Cooperative Support and the Large Facilities Office in BFA. The MPS Facilities team, together with the NSF Chief Officer for Research Facilities, also provide high-level guidance, support, and oversight.
- External Structure: AURA is the managing organization for NOAO. The NOAO director reports to the president of AURA, who is the principal investigator on the NSF cooperative agreement that began in FY 2016. AURA receives management advice from an observatory council composed of members of

¹ www.noao.edu

its scientific and management communities. NOAO uses a Users' Committee, comprised of community scientists, to advise the NOAO director on all aspects of user experiences at the Observatory.

- **Reviews:** In addition to reviews at the midpoint of all cooperative agreements, NSF conducts both periodic and ad hoc external reviews of AURA management. A comprehensive review of AURA's performance is planned for FY 2019, the fourth year of the five-year cooperative agreement.

Renewal/Recompetition/Termination

The last competition for management and operation of NOAO was completed with the issuance of a new cooperative agreement with AURA starting October 2015 and ending September 2020. Following September 2020 and depending on the outcome of the FY 2019 review mentioned above, this cooperative agreement may be extended, re-competed, or re-cast as a new cooperative agreement for a National Center for Optical-Infrared Astronomy, described earlier.