

NATIONAL OPTICAL ASTRONOMY OBSERVATORY (NOAO) **\$20,130,000**
-\$2,860,000 / -12.4%

National Optical Astronomy Observatory Funding
(Dollars in Millions)

FY 2017	FY 2018	FY 2019	Change Over	
			FY 2017 Actual	Percent
Actual	(TBD)	Request	Amount	
\$22.99	-	\$20.13	-\$2.86	-12.4%

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 2017, NOAO employed 300 personnel in Arizona and Chile, including 45 support scientists and 10 postdoctoral fellows.

Total Obligations for NOAO
(Dollars in Millions)

	FY 2017	FY 2018	FY 2019	ESTIMATES ¹				
	Actual	(TBD)	Request	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
NOAO Base O&M	\$19.19	-	\$19.13	\$19.70	\$20.29	\$20.90	\$21.53	\$22.18
<i>Tucson Operations</i>	9.92	-	9.30	9.58	9.86	10.16	10.46	10.78
<i>Chilean Operations</i>	8.24	-	8.74	9.00	9.27	9.55	9.84	10.14
<i>Kitt Peak Operations</i>	1.03	-	1.09	1.12	1.16	1.19	1.23	1.26
Special Projects: WIYN, Mayall	3.80	-	1.00	1.00	1.00	1.00	1.00	1.00
Total	\$22.99	-	\$20.13	\$20.70	\$21.29	\$21.90	\$22.53	\$23.18

¹ The current cooperative agreement ends in September 2020.

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 44 U.S. member institutions

Major Multi-User Research Facilities

and four international affiliate members. A key NOAO partnership is ongoing with the Department of Energy (DOE) to conduct a survey of the southern sky to investigate the nature of dark energy. The five-year Dark Energy Survey began operation in 2013 on the CTIO 4-meter Blanco telescope, and is now scheduled for a one year extension, due to poor weather conditions at the observing site in Chile. The extended survey is expected to end in February 2019.

NOAO is 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.

Another 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 is scheduled to fully assume Mayall operations funding.

A large number of U.S. universities support their own astronomical facilities at KPNO and CTIO with reimbursed services provided by NOAO. Development of 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 \$10.0 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 Undergraduate Students program. NOAO has a diverse education program, visitor centers, and a web-based information portal at www.nao.edu.

NOAO Base O&M: \$19.13 million, \$60,000 below the FY 2017 actual.

- Tucson Operations: \$9.30 million, \$620,000 below the FY 2017 Actual: This covers the cost for headquarters, offices, laboratories, and workshops in Tucson, Arizona.
- Chilean Operations: \$8.74 million, \$500,000 above the FY 2017 Actual: This supports the administration office and labs in La Serena, Chile and mountain operations on Cerro Tololo and Cerro Pachón.
- Kitt Peak Operations: \$1.09 million, \$60,000 above the FY 2017 Actual: This funds basic infrastructure for all facilities on the mountain, which are accounted as tenants.

Special Projects (Wisconsin, Indiana, Yale, NOAO consortium (WIYN) and Mayall): \$1.0 million, \$2.80 million below the FY 2017 Actual: This decrease is due to Mayall operations being fully supported by the DOE in FY 2019.

Potential Future Projects - Data Science Support: NOAO currently provides data scientific support for U.S. community observations with the Gemini telescopes. In addition, proposals are under consideration for NOAO to maintain an ongoing management role for Gemini and LSST operations through the scope of its Federally Funded Research and Development Center. Potential future funding (FY 2020 and beyond) would provide the option for a modern management structure for U.S. Optical/IR nighttime telescope assets

without reducing commitments to flagship facilities.

Management and Oversight

- **NSF Structure:** An NSF program officer in the MPS Division of Astronomical Sciences (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. The AST program officer works closely with other offices at NSF, particularly the Office of General Counsel, and the Division of Acquisition and Cooperative Support and the Large Facilities Office in the NSF Office of Budget, Finance, and Award Management.
- **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 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 midway through 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 1, 2015 and ending September 30, 2020.