

FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS (FFRDCS)

GREEN BANK OBSERVATORY (GBO)

www.greenbankobservatory.org

Green Bank Observatory Funding

(Dollars in Millions)

	FY 2023		Change over	
FY 2022	Estimate	FY 2024	FY 2023 Estimate Base	
Actual	Base	Request	Amount	Percent
\$15.53	\$10.83	\$9.55	-\$1.28	-11.8%

Brief Description

GBO is a major NSF research facility and FFRDC located in Green Bank, West Virginia. It is operated by Associated Universities, Inc. (AUI) under a cooperative agreement with NSF. GBO enables leading ground-based research at radio wavelengths by offering access to telescopes, facilities, and advanced instrumentation to the U.S. scientific community, and it conducts an active program of education and public outreach. GBO is also the administrative site of the 13,000-square-mile National Radio Quiet Zone, where radio transmissions are restricted by law. Having telescopes within this quiet zone allows detection of faint astronomical signals that would otherwise be overwhelmed by anthropogenic radio signals.

Meeting Scientific Community Needs

The main scientific instrument at GBO is the 100-meter Robert C. Byrd Green Bank Telescope (GBT), which is the world's largest fully steerable single-dish radio telescope, operating at frequencies from 0.2 GHz to 116 GHz. Its large sky coverage, very high sensitivity, and extensive suite of instruments make it a powerful and versatile telescope that continues to enable important advances in virtually all areas of modern astrophysics, including solar system and planetary astronomy; star formation and evolution; interstellar physics and chemistry; pulsar studies of long-wavelength gravitational waves; physics of black holes, neutron stars, and other compact objects; and galaxy formation and evolution. The GBT is complementary to and synergistic with interferometric arrays that are part of the National Radio Astronomy Observatory. It also plays a critical supporting role as a highly sensitive element of very long baseline interferometry as well as a bistatic radar receiver for rapid and sensitive imaging of near-Earth objects and asteroids. The GBT's focal plane is ideal for rapid, wide-field imaging using multi-pixel cameras.

Approximately 500 scientists use the GBT each year for research that spans virtually every field of modern astrophysics. Graduate students using the GBT gain vital hands-on experience with a major telescope, an increasingly rare opportunity but critical for their training. Further, there are opportunities for university groups to build and install new instruments (e.g., receivers and backends) on GBT, as well as prototype telescopes on the GBO site.

GBO also conducts a variety of education and public outreach programs and activities that have impact regionally and across North America. The Green Bank Science Center enables these programs and activities with its auditorium, classrooms, and large exhibit hall, visited by nearly 50,000 people every year. Thousands of K-12 teachers and students participate in educational programs using the

variety of radio telescopes available at GBO.

Status of the Facility

The GBT is currently used for observations approximately 6,500 hours per year. Of these, approximately 4,500 hours are available as Open Skies, or NSF-sponsored observing time, and are allocated through community-based peer review. The “oversubscription rate”, or the ratio of the Open Skies time requested to the time granted, has been in the range of 2 to 3 since FY 2015. Non-open-skies time (about 2,000 hours) on the GBT is provided exclusively to GBO partners (see Partnerships section below) who make significant financial contributions to facility operations.

GBO conducts regular inspections of and maintenance on numerous components of its telescopes and site infrastructure. The last full structural inspection of the GBT by an independent engineering firm was completed in 2021. The report from that inspection identified key areas for future maintenance work and upgrades. Additional inspections are scheduled in 2024. Significant maintenance is underway including repairs to the track and foundation as well as replacement of damaged azimuth wheels of the GBT. A comprehensive plan to address major necessary maintenance due to the aging infrastructure of the GBT is also being developed.

The scientific direction and operations of the Observatory are assessed through regular NSF reviews, input from various community workshops, and AUI governance and external advisory committee meetings. Development and upgrade efforts are driven by community needs and priorities, address certain key recommendations of the NSF external merit review panel that evaluated the most recent renewal proposal, and align with strategic initiatives such as the NSF Windows on the Universe Big Idea. Thus, GBO is poised to address community needs and enable important advances in astronomy in the coming years.

Governance Structure and Partnerships

NSF Governance Structure

Oversight from NSF is led by a program officer in the Division of Astronomical Sciences (AST) who works cooperatively with staff from the Office of Budget, Finance and Award Management (BFA), the Office of the General Counsel, and the Office of Legislative and Public Affairs. 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

GBO is managed and operated through a cooperative agreement with AUI, a non-profit research management organization consisting of an Executive office overseen by a Board of Trustees, with input from several internal and external committees. AUI manages GBO through its own community-based oversight and users committees. The GBO Director reports directly to the AUI Vice President for Radio Astronomy.

Partnerships and Other Funding Sources

External contributions represent approximately 30-35 percent of the total operations budget of GBO. These contributions come mostly from non-federal partners, including Breakthrough Listen (BL),¹ the

¹ www.breakthroughinitiatives.org/initiative/1

Major Facilities

Gordon and Betty Moore Foundation,² and individual contracts for GBT observing time. The NSF-funded North American Nanohertz Observatory for Gravitational Waves (NANOGrav) Physics Frontiers Center also contributes to annual operations costs. Partnerships with BL and NANOGrav are anticipated to continue through FY 2024. Many of the GBO partnerships involve guaranteed allocations of observing time on the GBT in exchange for operations funding. Other partnership development efforts are continuing.

Funding

Total Obligations for GBO								
(Dollars in Millions)								
	FY 2023			ESTIMATES ¹				
	FY 2022 Actual	Estimate Base	FY 2024 Request	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029
Operations & Maintenance	\$9.12	\$9.12	\$9.12	\$9.55	\$9.55	\$9.55	\$9.55	\$9.55
Special Projects ^{2,3}	6.41	1.71	0.43	-	-	-	-	-
TOTAL	\$15.53	\$10.83	\$9.55	\$9.55	\$9.55	\$9.55	\$9.55	\$9.55

¹ Outyear estimates are for planning purposes only. The current cooperative agreement ends on September 30, 2024.

² Special projects reflects funding 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.

The FY 2024 O&M request encompasses support for direct telescope operations at GBO, including maintenance, infrastructure upgrades, and telescope management, as well as funds allocated for education and public outreach. Additional funding for major maintenance identified as part of a midterm review of the GBT infrastructure is included under special projects. Additional funding for deferred maintenance may be provided by MPS' Office of Strategic Initiatives.

Reviews and Reports

In November 2021, the Decadal Survey of Astronomy and Astrophysics, "Pathways to Discovery (Astro2020),"³ identified the need for three key capabilities to advance radio astronomy: long term timing of pulsars, development of new instrumentation, and mitigation of radio-frequency interference. The GBT is involved in each of these activities and is poised to play a key role in all three. The report recommended continuing operations of the GBT, particularly for pulsar-timing observations, as well as the development of radio cameras.

NSF conducts annual reviews of the program operating plan and reports, including external advice from community representatives. Recommendations from these reviews are used to inform GBO's operations planning and NSF's oversight.

Renewal/Recompetition/Disposition

NSF's current cooperative agreement with AUI for operations and management of GBO spans the five-year period October 1, 2019 – September 30, 2024. In accordance with standard procedures, NSF is assessing options regarding renewal, competition, or disposition of the facility beyond FY 2024 based

² www.moore.org/

³ www.nationalacademies.org/our-work/decadal-survey-on-astronomy-and-astrophysics-2020-astro2020

on the November 2022 comprehensive review, as well as key scientific, strategic, and administrative considerations.



Views showing the Green Bank Telescope in the Fall (left) as well as the unblocked aperture and fully steerable structure (right). *Credit: GBO/AUI.*