FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS (FFRDCS)

GREEN BANK OBSERVATORY (GBO) **$7,300,000**
-$2,960,000 / -28.8%

Green Bank Observatory Funding
(Dollars in Millions)

FY 2019 Actual[1]	FY 2020 (TBD)	FY 2021 Request	Change over FY 2019 Actual Amount	Percent
$10.26	-	$7.30	-$2.96	-28.8%

[1] Includes $2.17 million for continuity of operations into FY 2020.

GBO is a major NSF research facility and a Federally Funded Research and Development Center (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 all radio transmissions are limited. Having telescopes within this quiet zone allows detection of faint astronomical signals that would otherwise be overwhelmed by anthropogenic radio signals.

The main scientific instrument at GBO is the 100-m Robert C. Byrd Green Bank Telescope (GBT), which became fully operational in 2002. The GBT 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 which enables advances in virtually all areas of modern astrophysics. The GBT offers excellent complementarity and synergy with interferometric arrays, such as the Very Large Array, the Very Long Baseline Array, and the Atacama Large Millimeter/submillimeter Array. 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.

As recommended by the National Academies of Science, Engineering and Medicine's 2010 Decadal Survey of astronomy and astrophysics, the MPS Division of Astronomical Sciences (AST) conducted a community-based review of its portfolio in 2012. The Portfolio Review Committee recommended divestment of the GBT from AST funding because the strengths of the GBT were less aligned with the scientific priorities of the 2010 Decadal Survey compared to several other facilities. While affirming the need for divestment, subsequent reviews (e.g., the March 2016 and March 2017 reports of the Astronomy and Astrophysics Advisory Committee,[1] and the August 2016 mid-decadal report of the National Academies[2]) acknowledged the adverse impact of the potential loss of facilities like the GBT on the scientific community and suggested that NSF first consider collaborations with interested partners rather than complete closure of its facilities. NSF's response to this broad community input, starting with the 2012 Portfolio Review, included a multi-year comprehensive environmental review to assess the impact of various divestment options, as well as steps to allow greater flexibility for exploring cost-efficient operational models and sustainable partnerships for GBO.

In July 2019, after considering scientific priorities, budgetary constraints, viability of potential partnerships,

[1] www.nsf.gov/mps/ast/aaac/archived_aaac_annualreports.jsp
[2] www.nap.edu/catalog/23560/new-worlds-new-horizons-a-midterm-assessment

and the results of a comprehensive environmental review, NSF issued a Record of Decision (ROD) that included continued GBO operations with reduced NSF funding and increased partner contributions. Following issuance of the ROD and merit review of a proposal for operations and management of GBO, NSF awarded a new five-year cooperative agreement to AUI for the period FY 2020-FY 2024. Combined support from NSF, external partnerships, and other funding sources will keep GBO vital for scientific progress.

Total Obligations for Green Bank Observatory

(Dollars in Millions)

	FY 2019 Actual[1]	FY 2020 (TBD)	FY 2021 Request	ESTIMATES[2] FY 2022	FY 2023	FY 2024	FY 2025	FY 2026
Operations & Maintenance	$10.26	-	$7.30	$7.12	$7.33	$7.55	$7.55	$7.55

[1] Includes $2.17 million for continuity of operations into FY 2020.

[2] Outyear funding estimates are for planning purposes only. The current cooperative agreement ends in FY 2024.

For information on continuity of operations funding, see the opening narrative of this chapter.

GBO Operations and Maintenance

The FY 2021 Request of $7.30 million 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.

Partnerships and Other Funding Sources

In FY 2019, GBO received approximately $4.30 million from other sources, mostly from non-federal partners, including Breakthrough Listen, West Virginia University, and the NSF-funded North American Nanohertz Observatory for Gravitational Waves (NANOGrav) consortium. External (non-NSF) contributions represented approximately 35 percent of the total operations budget of GBO. These long-standing partnerships are anticipated to continue over the period FY 2020-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.

Management and Oversight

- NSF Structure: An AST program officer carries out continuing oversight and assessment for GBO by making use of detailed annual program plans, technical and financial reports, and annual reports submitted to NSF. The AST program officer attends AUI governance and advisory committee meetings. To address issues as they arise, NSF has an Integrated Project Team for GBO, which includes representatives from other NSF offices, such as the Office of General Counsel, as well as 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.
- External Structure: Management is through a cooperative agreement with AUI. 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.

- Reviews: NSF conducts annual reviews of the program operating plan and reports, including external advice from community representatives. The first review under the new cooperative agreement is scheduled for Fall 2020.

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

Renewal/Recompetition/Termination

GBO is currently supported through a cooperative agreement. NSF received a proposal from AUI in March 2019 for the operations of GBO for a five-year period. The proposal was reviewed by an external review panel and the award was made October 1, 2019. The award enables continued operations and further development of GBO from FY 2020 to FY 2024.