NATIONAL HIGH MAGNETIC FIELD LABORATORY (NHMFL)
https://nationalmaglab.org/

National High Magnetic Field Laboratory Funding

(Dollars in Millions)

FY 2023 Base Plan	FY 2024 (TBD)	FY 2025 Request	Change over FY 2023 Base Plan Amount	Percent
$39.91	-	$39.13	-$0.78	-2.0%

Brief Description

NHMFL is the world's premier high-magnetic-field laboratory, featuring an extensive collection of unique magnet systems and comprehensive support services. The laboratory is an internationally recognized leader in magnet design, development, and construction, including the development of new high-field superconducting magnets. NHMFL offers its users consistent and reliable high magnetic fields, such as the 45-tesla continuous-field magnet, the 100-tesla non-destructive pulsed-field magnet, the 36-tesla magnet for Nuclear Magnetic Resonance, the highest-field superconducting magnet for Fourier Transform-Ion Cyclotron Resonance mass spectrometry (21 tesla), and the highest field for magnetic resonance imaging studies of living animals (21.1 tesla). These unique facilities are available to thousands of users each year and help define and advance the science frontiers in many disciplines through measurements made with state-of-the-art resolution and accuracy. NHMFL is operated by a consortium of three institutions, each of which house some of the NHMFL facilities: Florida State University (FSU), University of Florida (UF), and Los Alamos National Laboratory (LANL).

Meeting Scientific Community Needs

NHMFL is the only high-magnetic-field user facility in the U.S., and currently is the largest magnet laboratory in the world, providing the highest magnetic fields and necessary services for scientific research conducted by users from a wide range of disciplines, including physics, chemistry, biology, biochemistry, neuroscience, energy, and environmental sciences. The laboratory serves roughly 2,000 users annually, including senior investigators, postdoctoral researchers, and students, both domestic and international. The user base continues to grow, with about 20 percent each year being new users.

Research conducted by users of NHMFL covers topics that include quantum phenomena in many classes of materials; electron and nuclear spins of solid, molecular, and biological materials; the structure and dynamics of the macromolecular components of life; and properties and functionalities of various materials essential in energy production, storage, and use. Major scientific impacts attributable to NHMFL result from research on quantum materials, allowing the creation, identification, and visualization of new and unusual quantum effects that lead to deeper understanding of quantum materials and enable the discovery of new ones. Over the last several decades, NHMFL has contributed to major scientific accomplishments in superconductivity and the frontier field of topological materials.

NHMFL trains the next generation of scientists through direct support for postdoctoral scholars, graduate and undergraduate students, and by holding annual summer schools for junior scientists,

as well as through its user program. NHMFL is committed to increasing diversity in the STEM workforce, both at the facility and in the broader community, through a wide range of education, outreach, and mentoring programs. Its Center for Integration of Research and Learning reaches more than 10,000 K-12 students annually via classroom outreach and laboratory tours.

Status of the Facility

NHMFL includes seven high-magnetic-field user facilities as well as a center for the development of materials for magnets, a division for advancing magnet technologies, and an education center. Each facility is built around unique magnetic-field capabilities and is supported by a world-class scientific and technical staff. The facilities of NHMFL are open to all scientists based on a competitive proposal review process.

In 2024, after a project delay in 2023, NHMFL will provide a formal Condition Assessment report across all three sites, accompanied by an Asset Management Plan, to inform NSF and the facility management of anticipated major and infrequent maintenance expenses that could cause a significant departure from the routine funding profile.

As part of the planning for the future of NHMFL, NSF has continuously obtained community input about science and technical opportunities for high magnetic fields. Community input has included the 2013 report by the National Academies of Sciences, Engineering, and Medicine (the National Academies), *High Magnetic Field Science and Its Application in the United States: Current Status and Future Directions*.[1] The report provided several recommendations with respect to specific scientific priorities for new magnet development. In direct response to one of these recommendations, NSF has provided funding[2] for the development and design of a 40-tesla all-superconducting magnet, capitalizing on recent advances in high-temperature superconducting-magnet technology. The 2013 report, alongside several other community reports, also highlighted the need to combine high magnetic fields with synchrotron facilities. To this end, NHMFL is partnering with the Cornell High Energy Synchrotron Source on the construction of a new High Magnetic Field Beamline (HMF) that will offer the highest magnetic fields at any synchrotron facility in the world. The HMF project, led by Cornell University, is being implemented through an NSF Mid-scale Research Infrastructure Track 2 award.

A new National Academies study on the long-term opportunities for the Nation's high magnetic field science and technology development was initiated in CY 2022. The resulting report, anticipated in CY 2024, along with the outcomes of the facility condition assessment and progress of current NSF investments in the development of high-field magnets, will inform NSF's plans for leading NHMFL into a robust next-generation national facility based on new cost-effective and energy-efficient magnets.

Governance Structure and Partnerships

NSF Governance Structure

NSF oversight is led by a program officer in the MPS Division of Materials Research (DMR), who works

[1] www.nap.edu/catalog/18355/high-magnetic-field-science-and-its-application-in-the-united-states

[2] Funding was provided through the NHMFL O&M award ($4.20 million in FY 2018) and through two separate awards: $4.20 million in FY 2020 for conceptual design from DMR and $15.82 million in FY2021 for final design from the Mid-scale Research Infrastructure Track 1 program.

cooperatively 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 MPS facilities team and the Chief Officer for Research Facilities also provide high-level guidance, support, and oversight.

External Governance Structure

NHMFL is operated under a cooperative agreement by a consortium of three institutions: FSU, UF, and LANL. FSU, as the primary awardee, is responsible for administrative and financial oversight and for ensuring that laboratory operations are consistent with the terms and conditions of the cooperative agreement. The principal investigator, the NHMFL director, reports to the FSU Vice President for Research. The NHMFL director receives guidance primarily from the NHMFL executive committee, the NHMFL science council, and the NHMFL diversity committee, together with recommendations from an external advisory committee and the users' executive committee. In 2024, the NHMFL director will be stepping down after a highly successful term. FSU, in consultation with NSF, is finalizing a search for a new director.

Partnerships and Other Funding Sources

The State of Florida contributes approximately $12 million per year to support NHMFL. While there is no formal partnership at the federal agency level, the Department of Energy supports NHMFL through LANL by contributing approximately $2 million per year.

Funding

Total Obligations for NHMFL

(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
Operations & Maintenance (DMR)	$37.81	-	$37.03	$37.27	$38.06	$38.06	$38.06	$38.06
Operations & Maintenance (CHE)	2.10	-	2.10	2.10	2.10	2.10	2.10	2.10
Total	**$39.91**	**-**	**$39.13**	**$39.37**	**$40.16**	**$40.16**	**$40.16**	**$40.16**

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

The current NSF award for the operation of NHMFL spans CY 2023-2027. Operations & Maintenance support is provided by DMR and CHE with DMR's contribution escalated approximately one percent annually and CHE providing a flat $2.10 million. Additional funding for deferred maintenance may be provided by MPS' Office of Strategic Initiatives.

Reviews and Reports

NSF monitors annual plans and reports, including user metrics, and holds regular monthly teleconferences with the NHMFL director along with numerous ad hoc communications. NSF conducts annual external site-visit reviews to assess operations, maintenance, and new facility development as well as the user programs, in-house research, and long-term plans to contribute significantly to science and technology development both nationally and internationally. Annual reviews also assess the status of education, training and outreach, and diversity initiatives. Recommendations from annual reviews are used to inform NHMFL's operations planning and NSF's oversight thereof. The next site visit review will take place in the second half of FY 2024.

Renewal/Recompetition/Disposition

The current award for the operation of NHMFL started on January 1, 2023, and will end on December 31, 2027. Currently, there are no plans for disposition of this facility.