

Accelerator R&D and Production

Overview

The Accelerator R&D and Production (ARDAP) program's mission is to coordinate Office of Science (SC) accelerator R&D; advance accelerator science and technology relevant to the Department, other Federal Agencies, and U.S. industry; foster public-private partnerships and other collaborative R&D activities to develop, demonstrate, and enable the commercial deployment of accelerator technology; support the development of a skilled, diverse, and inclusive workforce; and provide access to accelerator design and engineering resources. The overarching goal is to ensure a robust pipeline of innovative accelerator technology, train an expert and diverse workforce representative of the Nation, and reduce significant supply chain risks by reshoring critical accelerator technology. By ensuring the supply of leading accelerator technology and facilities, ARDAP supports physical science research that provides the foundations for innovative technologies for clean energy, medicine, security, and new tools to help clean up the environment and safeguard our water and food supplies.

As the lead office in the Accelerator Science and Technology Initiative, ARDAP coordinates accelerator R&D across SC and initiates new partnerships to move technologies from basic R&D into use at U.S. science facilities and into commercial products that benefit all Americans. These activities allow the U.S. to continue to provide the world's most comprehensive and advanced scientific research facilities and stimulate high technology sectors of the U.S. economy.^a

The ARDAP program is organized into two subprograms: Accelerator Stewardship, and Accelerator Production.

Accelerator Stewardship

The Accelerator Stewardship subprogram supports cross-cutting basic R&D; facilitates access to unique state-of-the-art SC accelerator R&D infrastructure for the private sector and other users to operate a dedicated user facility for accelerator R&D and train new generations of scientists and engineers; and supports use-inspired accelerator technology R&D aimed at discovery science, medical, industrial, security, and environmental applications. The Accelerator Stewardship subprogram also supports development of software and material properties databases commonly used for accelerator design.

Research activities in cross-cutting accelerator technologies include superconducting magnets and accelerators, beam physics, data science-based accelerator controls, simulation software, new particle sources, advanced laser technology, and other transformative research. The Accelerator Stewardship subprogram will foster early-stage collaboration among academia, DOE national laboratories, and U.S. industry, reducing the time to commercialization. Research activities are informed by the requirements of both future SC facilities and the requirements for other applications.

Accelerator Production

The Accelerator Production subprogram supports public-private partnerships and other collaborative arrangements among academia, industry, and the DOE national laboratories to address targeted supply chain risk areas for SC scientific facilities. Increasing the capabilities of domestic accelerator technology suppliers to produce components and innovate will in turn strengthen the SC mission to conduct world-leading scientific research. Focus areas include advanced superconducting wire and cable, superconducting radiofrequency (RF) cavities, and high efficiency RF power sources for accelerators.

^a Broadly speaking, the impact of particle accelerator technology is discussed in "Accelerators for America's Future", ed. W. Henning, C. Shank, (2010), available at <https://science.osti.gov/-/media/hep/pdf/accelerator-rd-stewardship/Report.pdf>. A detailed listing of the awards made by the Accelerator Stewardship program and their goals may be found at <https://science.osti.gov/ardap/Funding-Opportunities/Awarded-RD-Activities>.

Highlights of the FY 2025 Request

The FY 2025 Request for \$31.3 million is an increase of \$3.8 million over the FY 2023 Enacted, and will focus resources on fundamental research, operation and maintenance of a scientific user facility, and production of accelerator technologies in domestic industry. The FY 2025 Request will support:

- Innovative research, development, and deployment of accelerator technology, the implementation of the first consortium-based approach to accelerator R&D, and workforce development;
- Public-private partnerships to develop technologies that include advanced superconducting wire and cable, superconducting accelerators, and advanced radiofrequency power sources for accelerators;
- An increase in the Funding for Accelerated, Inclusive Research (FAIR) initiative, which will provide focused investment on enhancing research on clean energy, climate, and related topics at emerging research institutions, Historically Black Colleges and Universities (HBCUs), Minority Serving Institutions (MSIs) and underserved communities and regions.
- ARDAP's participation in the Reaching a New Energy Sciences Workforce (RENEW) initiative, which will expand targeted efforts, including a RENEW graduate fellowship, to broaden participation, especially in underserved communities, and advance equity and inclusion in SC-sponsored research.

The FY 2025 Request will support operations of the Brookhaven National Laboratory (BNL) Accelerator Test Facility (ATF) for 2,100 hours.

**Accelerator R&D and Production
Funding**

(dollars in thousands)

	FY 2023 Enacted	FY 2024 Annualized CR	FY 2025 Request	FY 2025 Request vs FY 2023 Enacted
Research	21,436	21,241	23,508	+2,072
Facility Operations	6,000	7,934	7,765	+1,765
Total, Accelerator R&D and Production	27,436	29,175	31,273	+3,837

SBIR/STTR funding:

- FY 2023 Enacted: SBIR \$686,000 and STTR \$96,000
- FY 2024 Annualized CR: SBIR \$667,000 and STTR \$94,000
- FY 2025 Request: SBIR \$608,000 and STTR \$86,000

Basic and Applied R&D Coordination

The ARDAP program advances cross-cutting accelerator technology R&D and supply chain risk reduction efforts that support the mission of multiple SC programs and other federal agencies. The ARDAP program was developed based on input from accelerator R&D experts from DOE, other federal agencies, universities, national laboratories, and the private sector to help identify specific research areas and supply chain gaps where investments would have sizable impacts beyond the SC research mission.^b This program is closely coordinated with Basic Energy Sciences, Fusion Energy Sciences, High Energy Physics, Nuclear Physics, the Isotope R&D and Production program, and partner agencies to ensure federal stakeholders have input in crafting funding opportunity announcements, reviewing applications, and evaluating the efficacy and impact of funded activities. These R&D and facility investments are guided through the participation of applied agencies in merit and facility operations reviews. In addition, to ensure R&D is aimed at a commercially viable product, accelerator R&D collaborations are expected to involve a U.S. company to guide the early-stage R&D.

Use-inspired accelerator R&D for medical applications has been closely coordinated with the National Institutes of Health/National Cancer Institute (NIH/NCI); ultrafast laser technology R&D with the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA); and microwave and high power accelerator R&D coordinated with the National Nuclear Security Administration (NNSA) and DOD, the Department of Homeland Security's Domestic Nuclear Detection Office in the Countering Weapons of Mass Destruction Office (DHS/CWMD), and the National Science Foundation/Mathematical and Physical Sciences (NSF/MPS) Division.

Compact accelerator technology is widely used in medical and security applications, and in May 2019 DOE, NCI, DOD, DHS, and NNSA co-sponsored a Basic Research Needs Workshop on Compact Accelerators for Security and Medicine^c to establish research priorities for accelerator R&D in this critical area. This workshop has inspired follow-on funding opportunities at those agencies in addition to informing use-inspired basic R&D investments by ARDAP.

Laser technology is widely used in scientific research and applications, and in August 2023 DOE, NSF, and DOD co-sponsored a Basic Research Needs Workshop on Laser Technology to identify priority research directions and synergies amongst federal programs and with the private sector. The report, due in early 2024, will help inform laser technology R&D for years to come.

Program Accomplishments

In FY 2023, the Accelerator Stewardship and Accelerator Development subprograms funded 70 institutions, including 29 private companies, and nine DOE national laboratories. The funded R&D efforts resulted in seven patents, five PhDs, more than 44 publications, and more than 65 conference papers.

Technology translation activities have included collaborative R&D on proton therapy delivery systems (joint with Varian Medical Systems), advanced proton sources for therapy (joint with ProNova Solutions), advanced detectors for cancer therapy (joint with Best Medical International), advanced microwave source development (joint with Communications & Power Industries, L3Harris, and General Atomics), advanced laser technology development (with IPG Photonics and General Atomics), and technical design studies for high power accelerators for wastewater treatment (joint with Metropolitan Water Reclamation District of Greater Chicago, the Air Force Research Laboratory, and General Atomics). Public-private partnerships have begun with U.S. companies Radiation Monitoring Devices and Communications & Power Industries to strengthen key domestic suppliers of accelerator technology.

The BNL-ATF user facility provided 2,021 user hours in FY 2023, supporting a range of basic R&D and commercial technology development, and providing a training ground for the next generation of scientists. The facility supported 21 active experiments. Since 2014, BNL-ATF has provided more than 22,804 user beamtime hours.

^b <https://www.osti.gov/servlets/purl/1863553>

^c https://science.osti.gov/-/media/hep/pdf/Reports/2020/CASM_WorkshopReport.pdf

Accelerator R&D and Production

Activities and Explanation of Changes

(dollars in thousands)			
FY 2023 Enacted	FY 2025 Request	Explanation of Changes FY 2025 Request vs FY 2023 Enacted	
Accelerator R&D and Production	\$27,436	\$31,273	+\$3,837
Accelerator Stewardship	\$21,554	\$26,191	+\$4,637
<i>Research</i>	<i>\$15,554</i>	<i>\$18,426</i>	<i>+\$2,872</i>
Funding supports new research activities at laboratories, universities, and in the private sector on cross-cutting accelerator technologies such as superconducting magnets and accelerators, beam physics, data analytics-based accelerator controls, new particle sources, advanced laser technology R&D, and transformative R&D. Funding also supports the FAIR initiative to provide focused investment on enhancing research and workforce development at HBCUs, MSIs and emerging research institutions.	The Request will support new research activities at laboratories, universities, and in the private sector on cross-cutting accelerator technologies such as superconducting magnets and accelerators, beam physics, data analytics-based accelerator controls, new particle sources, advanced laser technology R&D, and transformative R&D. The Request will increase support for the FAIR initiative and ramps up support for the RENEW initiative, providing focused investment on enhancing research capabilities and workforce development at HBCUs, MSIs, and emerging research institutions.	The funding will increase the RENEW and FAIR initiatives, which will support workforce development and research capacity building in accelerator science and engineering, focusing resources on HBCUs, MSIs, and emerging research institutions to diversify the workforce. A robust program of cross-cutting basic R&D in accelerator and laser technology will continue. This R&D will continue to provide new accelerator technologies for science, medicine, security, and industry, and strengthen U.S. competitiveness in these areas.	
<i>Facility Operations and Experimental Support</i>	<i>\$6,000</i>	<i>\$7,765</i>	<i>+\$1,765</i>
Funding supports the BNL-ATF operations at optimal levels.	The Request will support the BNL-ATF operations for the maximum number of user hours and permit progress addressing deferred maintenance issues that adversely impact facility availability.	Funding will support 2,100 hours.	

(dollars in thousands)			
FY 2023 Enacted		FY 2025 Request	Explanation of Changes FY 2025 Request vs FY 2023 Enacted
Accelerator Production	\$5,882	\$5,082	-\$800
Research	\$5,882	\$5,082	-\$800
Funding supports increase for partnerships and collaborative R&D efforts to develop additional suppliers for critical accelerator technologies for SC scientific facilities. Increased investments allow technology transfer to proceed faster and across a broader range of component and subsystem technologies. Critical areas include advanced superconducting wire and cable, superconducting RF cavities and associated components, and high efficiency radiofrequency power sources for accelerators. Research partnerships to industrialize technologies for water purification, groundwater decontamination, and wastewater treatment begin.		The Request will support public private partnerships and collaborative R&D efforts to work with and strengthen domestic suppliers for critical accelerator technologies for SC scientific facilities. Critical areas supported will include advanced superconducting wire and cable, superconducting RF cavities and associated components, and high efficiency RF power sources for accelerators.	
		A robust program of business sector studies, partnerships, and collaborative R&D efforts will continue, providing strategic insights into how to advance accelerator technology for both public and private industry benefit. Some awards will not renew and new partnerships and collaborations will be added if turnover allows.	

Note:

- Funding for the subprogram above, includes 3.65 percent of research and development (R&D) funding for the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Programs, excluding facility operations.

**Accelerator R&D and Production
Scientific User Facility Operations**

The treatment of user facilities is distinguished between two types: TYPE A facilities that offer users resources dependent on a single, large-scale machine; TYPE B facilities that offer users a suite of resources that is not dependent on a single, large-scale machine.

(dollars in thousands)

FY 2023 Enacted	FY 2023 Current	FY 2024 Annualized CR	FY 2025 Request	FY 2025 Request vs FY 2023 Enacted
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Scientific User Facilities - Type A

Accelerator Test Facility	6,410	7,028	8,344	8,175	+1,765
Number of Users	87	90	112	88	+1
Achieved Operating Hours	—	2,021	—	—	—
Planned Operating Hours	1,900	1,900	2,100	2,100	+200
Unscheduled Down Time Hours	—	350	—	—	—
Total, Facilities	6,410	7,028	8,344	8,175	+1,765
Number of Users	87	90	112	88	+1
Achieved Operating Hours	—	2,021	—	—	—
Planned Operating Hours	1,900	1,900	2,100	2,100	+200
Unscheduled Down Time Hours	—	350	—	—	—

Notes:

- *Achieved Operating Hours and Unscheduled Downtime Hours will only be reflected in the Congressional budget cycle which provides actuals.*
- *The Accelerator Test Facility will undergo an Accelerator Readiness Review in FY 2023, necessitating a reduction in planned operating hours as extensive preparation and review activities take place.*
- *Percent optimal operations defines what is achieved at this funding level. This includes staffing, up-to-date equipment and software, operations and maintenance, and appropriate investments to maintain world leadership.*

**Accelerator R&D and Production
Scientific Employment**

	FY 2023 Enacted	FY 2024 Annualized CR	FY 2025 Request	FY 2025 Request vs FY 2023 Enacted
Number of Permanent Ph.Ds (FTEs)	14	14	15	+1
Number of Postdoctoral Associates (FTEs)	4	5	5	+1
Number of Graduate Students (FTEs)	23	25	26	+3
Number of Other Scientific Employment (FTEs)	23	24	26	+3
Total Scientific Employment (FTEs)	64	68	72	+8

Note:

- *Other Scientific Employment (FTEs) includes technicians, engineers, computer professionals and other support staff.*