

Accelerator R&D and Production

Overview

The mission of the Accelerator R&D and Production (ARDAP) program is to help 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 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, 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 green energy, medicine, security, and new tools to help clean up the environment and safeguard the water supply.

As the lead Office in the Accelerator Science and Technology Initiative, ARDAP will help coordinate accelerator R&D across SC and initiate new partnerships to move technologies from basic R&D into use at U.S. science facilities and into commercial products that benefit all Americans. Support for this initiative will allow the U.S. to continue to provide the world's most comprehensive and advanced accelerator-based facilities for scientific research, strengthen domestic supplies of accelerator technology, and to continue to attract and train the workforce needed to design and operate these facilities.

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, including operating a dedicated user facility for accelerator R&D; and drives a limited number of specific accelerator applications towards practical, testable prototypes in a five-to-seven-year timeframe. The Accelerator Stewardship subprogram also supports curation 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 analytics-based accelerator controls, simulation software, new particle sources, advanced laser technology, and other transformative research. Early-stage collaboration between academia, DOE national laboratories, and U.S. industry will be fostered, reducing the time to commercialization. Research activities will be informed by the requirements of both future SC facilities and the requirements for medical, industrial, energy, environmental, security, and defense applications. R&D investments made for scientific facilities will be leveraged to enable commercial application of advanced accelerator technologies.

Accelerator Production

The Accelerator Production subprogram supports public-private partnerships to develop new accelerator technologies to sufficient technical maturity for use in scientific facilities, commercial products, or both. Increasing the capabilities of domestic accelerator technology suppliers to both innovate and produce components will strengthen the SC mission to conduct world-leading scientific research.

Development activities will support partnerships in advanced superconducting wire and cable, superconducting radiofrequency (RF) cavities, and high efficiency RF power sources for accelerators, among other areas.

Highlights of the FY 2023 Request

The FY 2023 Request for \$27.4 million focuses resources on fundamental research, operation and maintenance of a scientific user facility, and production of accelerator technologies in industry. The FY 2023 Request supports innovative research, development, and deployment of accelerator technology, the implementation of the first center-based approach to accelerator R&D, and workforce development. ARDAP participates 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 minority serving institutions, including attention to underserved and environmental justice regions.

The FY 2023 Request also supports operation of the Brookhaven National Laboratory (BNL) Accelerator Test Facility (ATF) for 1,736 hours (94 percent of optimal). Accelerator Production activities support partnerships to develop technologies that include advanced superconducting wire and cable, superconducting accelerators, and advanced radiofrequency power sources for accelerators.

**Accelerator R&D and Production
FY 2023 Research Initiatives**

Accelerator R&D and Production supports the following FY 2023 Research Initiatives.

	(dollars in thousands)			
	FY 2021 Enacted	FY 2022 Annualized CR	FY 2023 Request	FY 2023 Request vs FY 2021 Enacted
Accelerator Science and Technology Initiative	-	-	6,872	+6,872
Funding for Accelerated, Inclusive Research (FAIR)	-	-	1,500	+1,500
Total, Research Initiatives	-	-	8,372	+8,372

**Accelerator R&D and Production
Funding**

(dollars in thousands)

	FY 2021 Enacted	FY 2022 Annualized CR	FY 2023 Request	FY 2023 Request vs FY 2021 Enacted
	-	10,835	15,554	+15,554
	-	6,100	6,000	+6,000
Total, Accelerator Stewardship	-	16,935	21,554	+21,554
Accelerator Production, Research	-	-	5,882	+5,882
Total, Accelerator Production	-	-	5,882	+5,882
Total, Accelerator R&D and Production	-	16,935	27,436	+27,436

Accelerator R&D and Production

Accelerator Stewardship, Research
Accelerator Stewardship, Facility Operations and
Experimental Support

Total, Accelerator Stewardship

Accelerator Production, Research

Total, Accelerator Production

Total, Accelerator R&D and Production

SBIR/STTR funding:

- FY 2021 Enacted: SBIR \$ — and STTR \$ —
- FY 2022 Annualized CR: SBIR \$542,000 and STTR \$75,000
- FY 2023 Request: SBIR \$878,000 and STTR \$124,000

Accelerator R&D and Production

Activities and Explanation of Changes

(dollars in thousands)		FY 2023 Request	Explanation of Changes FY 2023 Request vs FY 2021 Enacted
Accelerator R&D and Production	\$ —	\$27,436	+\$27,436
Accelerator Stewardship	\$ —	\$21,554	+\$21,554
<i>Research</i>	\$ —	\$15,554	+\$15,554
The Accelerator Stewardship program is part of the High Energy Physics program in FY 2021 with a funding level of \$10,835,000.		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 supports the FAIR initiative to provide focused investment on enhancing research on clean energy, climate, and related topics at minority serving institutions, including attention to underserved and environmental justice regions.	The Accelerator Stewardship program moved from High Energy Physics to ARDAP in FY 2022, and consequently does not appear in the FY 2021 Enacted budget under ARDAP.
			Some R&D projects will roll-off at the end of FY 2022 without being renewed to prioritize Accelerator Production activities. Also, the Request will support participation in the new FAIR initiative.
<i>Facility Operations and Experimental Support</i>	\$ —	\$6,000	+\$6,000
BNL-ATF User Facility operations is part of the High Energy Physics program in FY 2021 with a funding level of \$6,100,000.		The Request will support the BNL-ATF operations at 94 percent of optimal levels.	Funding for the BNL-ATF moved from High Energy Physics to ARDAP in FY 2022, and consequently does not appear in the FY 2021 Enacted budget under ARDAP.
			BNL-ATF User Facility will continue operations at near optimal levels. Retirement of deferred maintenance and facility upgrades will continue at a reduced pace.

(dollars in thousands)

FY 2021 Enacted	FY 2023 Request	Explanation of Changes FY 2023 Request vs FY 2021 Enacted
Accelerator Production Research	\$ — \$ —	+ \$5,882 + \$5,882
Accelerator Production is a new subprogram created when the Office of Science was reorganized, creating ARDAP.	The Request will increase partnerships and collaborative R&D efforts to develop additional suppliers for critical accelerator technologies for SC scientific facilities. Increased investments will 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 will begin.	ARDAP's Accelerator Production subprogram first began in FY 2022 and consequently does not appear in the FY 2021 Enacted budget. Investment in supply-chain risk reduction activities such as technology maturation, strategic materials purchases, and partnerships will ramp-up to ensure an adequate domestic supply of critical accelerator components for scientific facilities and other critical applications.

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.

Basic and Applied R&D Coordination

Accelerator R&D and Production provides the fundamental building blocks of new technological advances in accelerator applications. The Accelerator R&D and Production program was developed based on input from accelerator R&D experts drawn from 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. This program is closely coordinated with Basic Energy Sciences, Fusion Energy Sciences, High Energy Physics, Nuclear Physics, and Isotope R&D and Production programs 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. 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.

Discussions with the NCI, DOD, and NNSA on mission needs and R&D coordination in medical accelerators, laser technology, radioactive source replacement, and particle detector technologies led to a Basic Research Needs Workshop on Compact Accelerators for Security and Medicine^{fff} that was held in May 2019 to establish research priorities for accelerator R&D in this critical area. This workshop was co-sponsored by NNSA, DOD, DHS, and NIH, and has inspired follow-on funding opportunities at those agencies in addition to informing use-inspired basic R&D investments by the Accelerator Stewardship program. 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.

Specific funded examples include 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). Funded R&D awards have resulted in 19 patents, more than 750 publications, and the training of 50 PhDs, and have drawn an average of 20 percent of voluntary cost sharing over the initial years of the subprogram, providing evidence of the potential impact.

^{fff} https://science.osti.gov/-/media/hep/pdf/Reports/2020/CASM_WorkshopReport.pdf

**Accelerator R&D and Production
Funding Summary**

(dollars in thousands)

	FY 2021 Enacted	FY 2022 Annualized CR	FY 2023 Request	FY 2023 Request vs FY 2021 Enacted
Research	-	10,835	21,436	+21,436
Facility Operations	-	6,100	6,000	+6,000
Total, Accelerator R&D and Production	-	16,935	27,436	+27,436

**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.

Definitions for TYPE A facilities:

Achieved Operating Hours – The amount of time (in hours) the facility was available for users.

Planned Operating Hours –

- For Past Fiscal Year (PY), the amount of time (in hours) the facility was planned to be available for users.
- For Current Fiscal Year (CY), the amount of time (in hours) the facility is planned to be available for users.
- For the Budget Fiscal Year (BY), based on the proposed Budget Request the amount of time (in hours) the facility is anticipated to be available for users.

Optimal Hours – The amount of time (in hours) a facility would be available to satisfy the needs of the user community if unconstrained by funding levels.

Percent of Optimal Hours – An indication of utilization effectiveness in the context of available funding; it is not a direct indication of scientific or facility productivity.

Unscheduled Downtime Hours – The amount of time (in hours) the facility was unavailable to users due to unscheduled events. NOTE: For type “A” facilities, zero Unscheduled Downtime Hours indicates Achieved Operating Hours equals Planned Operating Hours.

(dollars in thousands)

	FY 2021 Enacted	FY 2021 Current	FY 2022 Annualized CR	FY 2023 Request	FY 2023 Request vs FY 2021 Enacted
Scientific User Facilities - Type A					
Accelerator Test Facility			6,100	6,410	+6,410
Number of Users	-	-	112	82	+82
Planned Operating Hours	-	-	2,248	1,736	+1,736
Optimal Hours	-	-	2,250	1,850	+1,850
Percent of Optimal Hours	-	-	99.9%	93.9%	+93.9%
Total, Facilities			6,100	6,410	+6,410
Number of Users	-	-	112	82	+82
Planned Operating Hours	-	-	2,248	1,736	+1,736
Optimal Hours	-	-	2,250	1,850	+1,850

Notes:

- Achieved Operating Hours and Unscheduled Downtime Hours will only be reflected in the Congressional budget cycle which provides actuals.
- Funding for the Accelerator Test Facility was funded in the High Energy Physics program prior to FY 2022.
- The Brookhaven ATF User Facility will undergo an Accelerator Readiness Review in FY 2023, necessitating a reduction in availability as extensive preparation and review activities take place.

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

	FY 2021 Enacted	FY 2022 Annualized CR	FY 2023 Request	FY 2023 Request vs FY 2021 Enacted
Number of Permanent Ph.Ds (FTEs)	-	8	14	+14
Number of Postdoctoral Associates (FTEs)	-	3	4	+4
Number of Graduate Students (FTEs)	-	14	23	+23
Number of Other Scientific Employment (FTEs)	-	14	23	+23
Total Scientific Employment (FTEs)	-	39	64	+64

Note:

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