Accelerator R&D and Production

Overview

Formed in FY 2020, the Office of Accelerator R&D and Production's (ARDAP's) mission is to help coordinate Office of Science (SC) accelerator R&D, foster public-private partnerships to develop and deploy accelerator technology, support workforce development and improve its diversity, and provide resources for accelerator design and engineering. The overarching goal is to ensure a robust pipeline of innovative accelerator technology, train an expert workforce, and reduce significant supply chain risks by re-shoring critical accelerator technology.

Building on the successful High Energy Physics (HEP) Accelerator Stewardship subprogram, ARDAP will continue innovative accelerator science & technology (AS&T) R&D activities of broad benefit to SC programs, other federal agencies, and U.S. industry. The new program will develop a strategy and plans to invest in public-private production partnerships in key accelerator technology areas; operate scientific user facilities to support cross-cutting accelerator R&D; use a center-based approach to pursue focused, basic R&D on specific technologies; provide support to address workforce shortages and improve its diversity; and curate material databases, accelerator simulation software, and engineering knowledge for use by the accelerator community.

As the lead Office in the Accelerator Science and Technology Initiative, ARDAP will help coordinate accelerator R&D across SC and initiate new public-private partnerships to move technologies from basic R&D into use at U.S. science facilities and into commercial products that benefit all Americans.

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 will support database curation services.

Accelerator Production

The Accelerator Production subprogram supports public-private partnerships to advance 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.

Highlights of the FY 2022 Request

The FY 2022 Request for $24.0 million focuses resources on fundamental research, operation and maintenance of a scientific user facility, and production of accelerator technologies in industry. The FY 2022 Request supports innovative R&D and deployment of accelerator technology, the strategy and development of the first center-based approach to accelerator R&D, and workforce development. The FY 2022 Request supports operation of the Brookhaven National Laboratory (BNL) Accelerator Test Facility (ATF) for 2,500 hours (100 percent of optimal). Accelerator Production activities support public-private partnerships to develop advanced superconducting wire and cable, superconducting accelerators, and advanced radiofrequency power sources for accelerators.

Accelerator R&D and Production
FY 2022 Research Initiatives

Accelerator R&D and Production supports the following FY 2022 Research Initiatives.

(dollars in thousands)

	FY 2020 Enacted	FY 2021 Enacted	FY 2022 Request	FY 2022 Request vs FY 2021 Enacted
Accelerator Science and Technology Initiative	–	–	5,183	+5,183
Total, Research Initiatives	**–**	**–**	**5,183**	**+5,183**

Accelerator R&D and Production Funding

(dollars in thousands)

	FY 2020 Enacted	FY 2021 Enacted	FY 2022 Request	FY 2022 Request vs FY 2021 Enacted
Accelerator R&D and Production				
Accelerator Stewardship, Research	–	–	15,457	+15,457
Accelerator Stewardship, Facility Operations and Experimental Support	–	–	6,797	+6,797
Total, Accelerator Stewardship	**–**	**–**	**22,254**	**+22,254**
Accelerator Production, Research	–	–	1,746	+1,746
Total, Accelerator Production	**–**	**–**	**1,746**	**+1,746**
Total, Accelerator R&D and Production	**–**	**–**	**24,000**	**+24,000**

SBIR/STTR funding:

- FY 2020 Enacted: SBIR $ — and STTR $ —
- FY 2021 Enacted: SBIR $ — and STTR $ —
- FY 2022 Request: SBIR $768,000 and STTR $108,000

Activities and Explanation of Changes

(dollars in thousands)

FY 2021 Enacted	FY 2022 Request	Explanation of Changes FY 2022 Request vs FY 2021 Enacted
Accelerator R&D and Production $ —	**$24,000**	**+$24,000**
Accelerator Stewardship $ —	$22,254	+$22,254
Research $ —	*$15,457*	*+$15,457*
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.	Funding will support the start of the Accelerator Science and Technology Initiative to advance basic R&D on accelerator technologies that define the U.S. competitive advantage in physical sciences research. R&D will initiate cross-cutting accelerator technology areas identified to provide new facility capabilities and/or posing significant supply chain risk to Office of Science programs.
Facility Operations and Experimental Support $ —	*$6,797*	*+$6,797*
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 100 percent of optimal levels.	BNL-ATF User Facility will continue operations at optimal levels.
Accelerator Production $ —	$1,746	+$1,746
Research $ —	*$1,746*	*+$1,746*
Accelerator Production is a new subprogram created when the Office of Science was reorganized, creating ARDAP.	The Request will support public-private partnerships to develop advanced superconducting wire and cable, superconducting RF cavities, and high efficiency radiofrequency power sources for accelerators.	Public-private partnerships will initiate to mature accelerator technology and ensure adequate domestic sources of critical accelerator components.

Note: Funding for the subprogram above, includes 3.65% 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, including advanced proton and ion beams for the treatment of cancer, in coordination with the National Institutes of Health (NIH). 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 BES, FES, HEP, and NP 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 NIH/National Cancer Institute (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 DOD, the Department of Homeland Security's Domestic Nuclear Detection Office in the Countering Weapons of Mass Destruction Office (DHS/CWMD), the NSF/Chemical, Bioengineering, Environmental and Transport (CBET) Systems Division; and the DOE's Office of Environmental Management.

Discussions with the NCI, DOD, and National Nuclear Security Administration (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[a] 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 600 publications, and the training of 45 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.

[a] https://science.osti.gov/-/media/hep/pdf/Reports/2020/CASM_WorkshopReport.pdf

Accelerator R&D and Production
Funding Summary

(dollars in thousands)

	FY 2020 Enacted	FY 2021 Enacted	FY 2022 Request	FY 2022 Request vs FY 2021 Enacted
Research	–	–	17,203	+17,203
Facility Operations	–	–	6,797	+6,797
Total, Accelerator R&D and Production	**–**	**–**	**24,000**	**+24,000**

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 2020 Enacted	FY 2020 Current	FY 2021 Enacted	FY 2022 Request	FY 2022 Request vs FY 2021 Enacted
Scientific User Facilities - Type A					
Accelerator Test Facility	**–**	**–**	**–**	**6,797**	**+6,797**
Number of Users	–	–	–	116	+116
Planned Operating Hours	–	–	–	2,500	+2,500
Optimal Hours	–	–	–	2,500	+2,500
Percent of Optimal Hours	–	–	–	100.0%	+100.0%
Total, Facilities	**–**	**–**	**–**	**6,797**	**+6,797**
Number of Users	–	–	–	116	+116
Planned Operating Hours	–	–	–	2,500	+2,500
Optimal Hours	–	–	–	2,500	+2,500

Note: Achieved Operating Hours and Unscheduled Downtime Hours will only be reflected in the Congressional budget cycle which provides actuals.

Accelerator R&D and Production
Scientific Employment

	FY 2020 Enacted	FY 2021 Enacted	FY 2022 Request	FY 2022 Request vs FY 2021 Enacted
Number of Permanent Ph.Ds (FTEs)	–	–	12	+12
Number of Postdoctoral Associates (FTEs)	–	–	4	+4
Number of Graduate Students (FTEs)	–	–	20	+20
Number of Other Scientific Employment (FTEs)	–	–	19	+19

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