Accelerator R&D and Production

Overview

The mission of the Accelerator R&D and Production (ARDAP) program 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, 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 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.

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; operates a dedicated user facility for accelerator R&D and training new generations of scientists; and supports use-inspired accelerator technology R&D aimed at discovery science, medical, industrial, security, and environmental applications. 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 science-based accelerator controls, simulation software, new particle sources, advanced laser technology, and other transformative research. Early-stage collaboration among academia, Department of Energy national laboratories, and U.S. industry will be fostered, 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 develop and mature accelerator technologies to address targeted supply chain risk areas for SC scientific facilities and to strengthen the domestic accelerator technology industry with new commercial products. Increasing the capabilities of domestic accelerator technology suppliers to both produce components and innovate 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 2024 Request

The FY 2024 Request for $34.3 million will focus resources on fundamental research, operation and maintenance of a scientific user facility, and production of accelerator technologies in domestic industry. The FY 2024 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 will provide focused investment on enhancing research on clean energy, climate, and related topics at Historically Black Colleges and Universities (HBCUs) and Minority Serving Institutions (MSIs), including attention to underserved and environmental justice regions;
- ARDAP's participation in the Reaching a New Energy Sciences Workforce (RENEW) initiative will expand targeted efforts, including a RENEW graduate fellowship, to broaden participation and advance belonging, accessibility, justice, equity, diversity, and inclusion in SC-sponsored research.

The FY 2024 Request also will support operations of the Brookhaven National Laboratory (BNL) Accelerator Test Facility (ATF) for 2,100 hours and will provide funding to address significant remedial maintenance and deferred maintenance items, resulting in increased facility reliability and availability.

Accelerator R&D and Production Funding

(dollars in thousands)

	FY 2022 Enacted	FY 2023 Enacted	FY 2024 Request	FY 2024 Request vs FY 2023 Enacted
Accelerator R&D and Production				
Accelerator Stewardship, Research	11,117	15,554	19,754	+4,200
Accelerator Stewardship, Facility Operations and Experimental Support	5,137	6,000	8,434	+2,434
Total, Accelerator Stewardship	**16,254**	**21,554**	**28,188**	**+6,634**
Accelerator Production, Research	1,746	5,882	6,082	+200
Total, Accelerator Production	**1,746**	**5,882**	**6,082**	**+200**
Total, Accelerator R&D and Production	**18,000**	**27,436**	**34,270**	**+6,834**

SBIR/STTR funding:

- FY 2022 Enacted: SBIR $576,000 and STTR $81,000
- FY 2023 Enacted: SBIR $686,000 and STTR $96,000
- FY 2024 Request: SBIR $686,000 and STTR $97,000

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[a]. 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.

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, DHS, 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[b] 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 subprogram. 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.

Program Accomplishments
In FY 2022, the Accelerator Stewardship and Accelerator Development subprograms funded 45 institutions, including 19 private companies, and 9 DOE national laboratories. The funded R&D efforts resulted in 3 patents, more than 40 publications, and more than 85 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 a total of 1,972 user hours in FY 2022, 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 25 active experiments, which produced 13 publications. Since 2014, BNL-ATF has provided more than 21,428 user beamtime hours.

[a] https://www.osti.gov/servlets/purl/1863553

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

Activities and Explanation of Changes

(dollars in thousands)

FY 2023 Enacted	FY 2024 Request	Explanation of Changes FY 2024 Request vs FY 2023 Enacted
Accelerator R&D and Production $27,436	**$34,270**	**+$6,834**
Accelerator Stewardship $21,554	$28,188	+$6,634
Research $15,554	*$19,754*	*+$4,200*
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 continue 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 Accelerator Stewardship program will fund a modest increase in FAIR initiative activities and increase support for critical R&D on ultrafast laser technology. The RENEW initiative will increase support of workforce development in accelerator science and engineering that focuses resources on HBCUs, MSIs, and Emerging Research Institutions to diversify the workforce.
Facility Operations and Experimental Support $6,000	*$8,434*	*+$2,434*
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 significant progress addressing deferred maintenance issues that adversely impact facility availability.	Funding will support increased operating costs, and critical deferred maintenance to enable significant improvements in facility reliability and availability.

(dollars in thousands)

FY 2023 Enacted	FY 2024 Request	Explanation of Changes FY 2024 Request vs FY 2023 Enacted
Accelerator Production $5,882	$6,082	+$200
Research *$5,882*	*$6,082*	*+$200*
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 increase the number of partnerships and collaborative R&D efforts to work with and strengthen domestic suppliers for critical accelerator technologies for SC scientific facilities. Increased investments will allow more of the identified supply chain risks to be addressed. Critical areas include advanced superconducting wire and cable, superconducting RF cavities and associated components, and high efficiency RF power sources for accelerators.	The number and breadth of supply chain risk reduction activities will continue to ramp up, addressing more of the high-risk accelerator technologies needed for SC facilities.

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 2022 Enacted	FY 2022 Current	FY 2023 Enacted	FY 2024 Request	FY 2024 Request vs FY 2023 Enacted
Scientific User Facilities - Type A					
Accelerator Test Facility	**5,797**	**7,239**	**6,410**	**8,844**	**+2,434**
Number of Users	80	87	87	112	+25
Achieved Operating Hours	–	1,972	–	–	–
Planned Operating Hours	1,800	1,800	1,900	2,100	+200
Unscheduled Down Time Hours	–	398	–	–	–
Total, Facilities	**5,797**	**7,239**	**6,410**	**8,844**	**+2,434**
Number of Users	80	87	87	112	+25
Achieved Operating Hours	–	1,972	–	–	–
Planned Operating Hours	1,800	1,800	1,900	2,100	+200
Unscheduled Down Time Hours	–	398	–	–	–

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.*

Accelerator R&D and Production
Scientific Employment

	FY 2022 Enacted	FY 2023 Enacted	FY 2024 Request	FY 2024 Request vs FY 2023 Enacted
Number of Permanent Ph.Ds (FTEs)	9	14	17	+3
Number of Postdoctoral Associates (FTEs)	3	4	6	+2
Number of Graduate Students (FTEs)	15	23	28	+5
Number of Other Scientific Employment (FTEs)	15	23	28	+5
Total Scientific Employment (FTEs)	**42**	**64**	**79**	**+15**

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