Nuclear Physics

Overview

The Nuclear Physics (NP) program supports the Administration's highest priorities to maintain U.S. leadership in nuclear science and advance artificial intelligence (AI) and quantum information science (QIS). NP delivers high-value national laboratory and university research to support the future technical workforce for the nation; operates world-unique, accelerator-based user facilities; and expands world-class research infrastructure through construction of innovative scientific instruments. NP accelerates research output through AI and quantum computing, develops novel instrumentation based on QIS, and applies new microelectronics technologies in unique experimental environments. The Genesis Mission and realization of American Science Cloud (AmSC) will profoundly impact the analysis of large, complex data sets that have in the past taken decades to decode, accelerating the understanding of matter that benefits energy, commerce, nuclear medicine, and national security.

NP's mission is to explore the nature of matter: understanding how protons and neutrons are formed from elementary particles and how they interact to form elements, observed properties, and phenomena. Addressing this mission requires a broad range of experimental capabilities and theoretical approaches. Best-in-class accelerators at scientific user facilities are used to collide particles at nearly the speed of light, producing short-lived forms of nuclear matter for experimental investigation. Theoretical advances use leadership computing facilities to explore the interactions of quarks and gluons and model complex nuclear processes. Program outcomes benefit energy, commerce, nuclear medicine, and national security.

Highlights of the FY 2027 Request

The NP FY 2027 Request for $791.4 million, a decrease of $74.7 million below the FY 2026 Enacted, balances support for priorities in forefront nuclear physics research, including AI, QIS, facility operations, and construction.

Research

NP is the primary steward of the nation's nuclear physics research portfolio, providing approximately 95 percent of the U.S. investment in this field. The program maintains U.S. leadership by:

- Characterizing the quark-gluon plasma using AI-ready data from the Relativistic Heavy Ion Collider (RHIC) and the Large Hadron Collider (LHC); exploring the fundamental structure of nucleons at the sub-femtometer scale at the Continuous Electron Beam Accelerator Facility (CEBAF) to lay the foundation for Day 1 science at the future Electron-Ion Collider (EIC); and probing the limits of nuclear existence, heavy element isotope production, and nuclear astrophysics phenomena at the Facility for Rare Isotope Beams (FRIB) and the Argonne Tandem Linac Accelerator System (ATLAS).
- Discovering if the neutrino is its own anti-particle via the search for neutrino-less double beta decay (NLDBD).
- Advancing nuclear theory methods for quantum chromodynamics (QCD) and interpretation of experimental data.
- Curating reliable, accurate Nuclear Data for basic nuclear research and nuclear technologies, including fusion.
- Advancing AI tools and application of AmSC to significantly increase nuclear data analysis efficiency and precision, improve the quality of accelerator operations, and enhance the efficiency of experimental planning.
- Applying key nuclear science expertise for innovation in qubit research and quantum theory, for QIS technologies for future sensors, and for the pursuit of ultraprecise nuclear clocks.

Facility Operations

Funding supports activities for the safe, robust operations of the NP scientific user facilities, enabling world-class science:

- CEBAF operates 3,300 hours for the highest priority 12 GeV experiments.
- ATLAS operates 5,950 hours for compelling research in nuclear structure and astrophysics.
- FRIB operates 4,000 hours discovering and characterizing nuclei at the extremes of the nuclear chart.
- RHIC collider operations ended in FY 2026. Funding will support recovery and reuse activities and operation of the RHIC hadron injector complex for beam studies, isotope production, and to remain mission ready for the EIC.

Projects

The Request includes continued support for design and early construction for the EIC, the highest priority for facility construction in the Long Range Plan for Nuclear Physics to maintain U.S. leadership in nuclear physics and accelerator technology. No new funding is requested for two ongoing MIEs, the LEGEND-1000 ton scale NLDBD experiment and the High Rigidity Spectrometer at FRIB. These projects will make progress using prior year balances.

Nuclear Physics
Funding

(dollars in thousands)

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Nuclear Physics				
Medium Energy, Research	51,455	46,932	31,410	-15,522
Medium Energy, Operations	146,242	155,000	156,613	+1,613
Total, Medium Energy Physics	**197,697**	**201,932**	**188,023**	**-13,909**
Heavy Ion, Research	47,454	46,312	33,662	-12,650
Heavy Ion, Operations	187,000	182,805	140,000	-42,805
Heavy Ion, Projects	2,850	2,850	–	-2,850
Total, Heavy Ion Physics	**237,304**	**231,967**	**173,662**	**-58,305**
Low Energy, Research	76,967	61,592	45,755	-15,837
Low Energy, Operations	134,646	143,597	147,005	+3,408
Low Energy, Projects	5,259	17,000	–	-17,000
Total, Low Energy Physics	**216,872**	**222,189**	**192,760**	**-29,429**
Theory, Research	63,727	55,053	36,989	-18,064
Total, Nuclear Theory	**63,727**	**55,053**	**36,989**	**-18,064**
Subtotal, Nuclear Physics	**715,600**	**711,141**	**591,434**	**-119,707**
Construction				
20-SC-52 Electron Ion Collider (EIC), BNL	110,000	155,000	200,000	+45,000
Subtotal, Construction	**110,000**	**155,000**	**200,000**	**+45,000**
Total, Nuclear Physics	**825,600**	**866,141**	**791,434**	**-74,707**

Nuclear Physics
Explanation of Major Changes

	(dollars in thousands) **FY 2027 Request vs FY 2026 Enacted**
Medium Energy Physics The Request will support CEBAF accelerator complex operations for 3,300 hours. The Request will support the highest priority research, including participation in the SC initiatives for QIS, AI, and microelectronics.	**-13,909**
Heavy Ion Physics The Request will support RHIC hadron injector complex operation for beam studies and to remain mission ready for future EIC operations. Funding will support the highest priority research in heavy ion nuclear physics at universities and national laboratories, including support for QIS and AI. The Request also will support Established Program to Stimulate Competitive Research (EPSCoR), including early career awards in EPSCoR jurisdictions.	**-58,305**
Low Energy Physics The Request will support operations of two low energy user facilities: the ATLAS facility, which operates for 5,950 hours, and FRIB, which will provide beam time for 4,000 hours. The Request will sustain operations of the 88-Inch Cyclotron for a limited in-house nuclear science program focused on the search for element 120 and as an electronics irradiation capability. Funding will support the highest priority nuclear structure and nuclear astrophysics at universities and national laboratories.	**-29,429**
Nuclear Theory Funding will support the highest priority theory research efforts at national laboratories and universities, the U.S. Nuclear Data Program, specialized Lattice QCD computing hardware at Thomas Jefferson National Accelerator Facility (TJNAF), and participation in the Scientific Discovery through Advanced Computing (SciDAC) program. The Request will support initiatives in AI and QIS.	**-18,064**
Construction The Request will provide funding for the EIC to continue Project Engineering and Design activities and execute long-lead procurements and early construction.	**+45,000**
Total, Nuclear Physics	**-74,707**

Basic and Applied R&D Coordination
The NP mission supports the pursuit of unique opportunities for R&D integration and coordination with other DOE Program Offices, Federal agencies, and non-Federal entities, including coordination across DOE on AI; across SC and with other agencies on QIS; coordination of neutrino research and international partnerships in accelerator research and development with HEP; on forefront computing resources and technical expertise through the SciDAC projects and Lattice QCD research (ASCR and HEP); cross-section and decay data coordination through the U.S. Nuclear Data Program (National Nuclear Security Administration [NNSA], Nuclear Energy [NE], Advanced Research Projects Agency-Energy [ARPA-E], Defense Threat Reduction Agency [DTRA], Department of Homeland Security [DHS], Nuclear Regulatory Commission [NRC], National Science Foundation [NSF], National Institutes of Health [NIH], National Aeronautics and Space Administration [NASA], and DOE ASCR, BES, FES, IPR, and HEP); capabilities and techniques to test electronics for radiation sensitivity (NASA and DOD); accelerator research and enhancing U.S.-based supply chains for critical accelerator technologies (HEP); and research in developing neutron, gamma, and particle beam sources with applications in cargo screening (NNSA and DHS).

Program Accomplishments

Reconstructing Nuclear Collisions to Uncover Uranium's Shape
Nuclear physicists at Brookhaven National Laboratory demonstrated a new way to reveal the shapes of atomic nuclei, using the flow patterns of particles emerging from high-energy collisions of nuclei. Nuclear shapes determine which atoms can fission, decay in exotic processes, and dominate the mechanics of astrophysical processes. High energy nuclear collisions initiated with the Relativistic Heavy Ion Collider melt the protons and neutrons of nuclei to free their inner building blocks, quarks and gluons. The resulting quark-gluon plasma depends on the shape of the high-energy nuclear collisions. Using results from the STAR detector, researchers compared the flow and momentum of particles emerging from collisions with hydrodynamic expansion models to reveal uranium's oblong shape, consistent with other methods, but also new details, including differences in the relative lengths of uranium's three principal axes. The findings suggest that these nuclei are more complex than previously thought, and that the new method can provide deeper insight into other nuclei.

Final Majorana Demonstrator Results to Describe Neutrinoless Double-Beta Decay
The Majorana Demonstrator concluded data collection, performing the most sensitive neutrinoless double-beta decay search to date, benefiting from its operation in vacuum, excellent energy resolution, and low backgrounds. Neutrinoless double-beta decay, an ultra-rare nuclear process, can help explain why matter dominates the universe. Interpreting this result is subject to uncertainties from nuclear theory computations. Efforts led by Oak Ridge National Laboratory and Los Alamos National Laboratory put bounds on theory by measuring the closely related process of two-neutrino double-beta decay to excited states. The experiment set a half-life limit of $T_{1/2} > 8.3\times10^{25}$ y, corresponding to a range of limits on the effective neutrino mass of $m_{\beta\beta} <$ (113-269) meV. This work helps maintain U.S. scientific leadership in search for physics beyond the Standard Model.

Unleashing AI for More Powerful Particle Accelerators
Three of the nation's most powerful particle accelerators rely on superconducting radiofrequency (SRF) accelerator technology: the Continuous Electron Beam Accelerator Facility (CEBAF) at the Thomas Jefferson Accelerator Facility, the Spallation Neutron Source at Oak Ridge National Laboratory, and the Linac Coherent Light Source at the SLAC National Accelerator Laboratory. Studies used AI models of SRF accelerator operations, tested using real operations data from CEBAF in real- time and in recorded data mode. The AI models proved capable of identifying operational anomalies in real- time, predicting anomalies before operations are impacted, lowering levels of radiation, and load-balancing components.

Description

The Medium Energy Physics subprogram focuses on experimental tests of the theory of the strong interaction, known as Quantum Chromodynamics (QCD). The Request advances AI, QIS, and microelectronics tools that directly impact the speed and efficiency of QCD research.

Medium energy scientists aim to address specific questions including: How does QCD generate the spectrum and structure of conventional and exotic hadrons? How do the mass and spin of the nucleon emerge from the quarks and gluons inside and their dynamics? How are the pressure and shear forces distributed inside the nucleon? How does the quark–gluon structure of the nucleon change when bound in a nucleus? How are hadrons formed from quarks and gluons produced in high-energy collisions?

The research activity supports high priority research at universities and national laboratories and carries out high priority experiments primarily at CEBAF, Thomas Jefferson National Accelerator Facility (JLab). Scientists use various experimental approaches to determine the distribution of up, down, and strange quarks, their antiquarks, and gluons within protons and neutrons, as well as clarifying the role of gluons in confining the quarks and antiquarks within hadrons. Experiments that scatter electrons off protons, neutrons, and nuclei are used to elucidate the effects of the quark and gluon spins within nucleons, and the effect of the nuclear medium on the quarks and gluons. The subprogram also supports experimental searches for higher-mass "excited states" and exotic hadrons predicted by QCD, as well as studies of their various production mechanisms and decay properties.

CEBAF operations provide high quality beams of polarized electrons that allow scientists to extract information on the quark and gluon structure of protons and neutrons from measurements of how the electrons scatter when they collide with nuclei. CEBAF also uses highly-polarized electrons to make challenging precision measurements that may reveal processes that violate a fundamental symmetry of nature, called parity, in order to search for physics beyond what is currently described by the Standard Model of particle physics. These capabilities are unique in the world. Universities and national laboratories conduct complementary, focused experiments that require different capabilities.

A high scientific priority for this community is addressing an outstanding grand challenge question of modern physics: how the fundamental properties of the proton such as its mass and spin are dynamically generated by the extraordinarily strong color fields resulting from dense systems of gluons in nucleons and nuclei. In the future, the Electron-Ion Collider (EIC) will address this science. Scientists and accelerator physicists from the Medium Energy subprogram are strongly engaged and play significant leadership roles in the development of the scientific agenda and implementation of the EIC.

Transformative accelerator research and development (R&D) efforts advance approaches in superconducting radiofrequency (SRF) technology and accelerator science aimed at improving the operations of existing facilities and developing next-generation facilities for nuclear physics. Nuclear physicists participate in activities related to QIS and quantum computing (QC), in coordination with other SC research programs. NP-specific efforts include R&D on quantum sensors to enable precision measurements, development of quantum sensors based on atomic-nuclear interactions, and development of quantum computing algorithms applied to quantum mechanical systems and NP topical problems. Scientists leverage AI-ready data sets and AmSC to increase nuclear science research output and enhance accelerator facility operations. Scientists participate in the SC initiative on microelectronics R&D, emphasizing unique microelectronics that survive in cryogenic and high radiation environments.

The Request also continues support for honoraria for awards, including the Enrico Fermi Awards and the Ernest Orlando Lawrence Awards.

Nuclear Physics
Medium Energy Physics

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Medium Energy Physics	**$201,932**	**$188,023**	**-$13,909**
Research	$46,932	$31,410	-$15,522
Funding continues to support high priority experiments; develop, implement, and maintain scientific instrumentation; analyze data and publish experimental results; and train students in nuclear and accelerator science. Funding supports continued analysis of RHIC polarized proton beam data to investigate the origin of proton spin and supports the development of the EIC scientific program. Funding continues transformative accelerator science to improve operations of current and future NP facilities including applications of AI/ML. Research on microelectronics and quantum sensors to enable precision measurements will continue.		The Request will continue to support high priority experiments; develop, implement, and maintain scientific instrumentation; analyze data and publish experimental results; and train students in nuclear and accelerator science. The Request will continue accelerator science research and development to benefit accelerator performance, including applications of AI. Research on microelectronics and quantum sensors to enable precision measurements will continue.	The Request will focus investment on the highest priority research that utilizes CEBAF, RHIC data, and other facilities. Funding increases for AI approaches in the analysis of QCD data sets utilizing AmSC.

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Operations	$155,000	$156,613	+$1,613
Funding for operations of the CEBAF facility supports high priority experiments in 12 GeV science, providing 3,300 operational hours for research, beam development, and beam studies. Funding supports mission readiness of the CEBAF accelerator including all power and consumables, activities to reduce helium consumption and improve accelerator performance and reliability, high priority capital equipment, accelerator improvement, and key computing capabilities. Funding supports required staff for operations and participation in accelerator and SRF R&D. Lab GPP continues to advance the most urgent components of the campus strategy for infrastructure.		The Request for operations of the CEBAF facility will support high priority experiments in 12 GeV science, providing 3,300 operational hours for research, beam development, and beam studies. The Request will support mission readiness of the CEBAF including high priority capital equipment, accelerator improvement, and key computing capabilities. Lab GPP will support campus strategy infrastructure needs.	The Request will maintain operations hours while continuing support of the highest priority experiments and activities to improve CEBAF reliability and performance.

Nuclear Physics
Heavy Ion Physics

Description

The Heavy Ion Physics subprogram focuses on studies of nuclear matter at extremely high densities and temperatures, leveraging discovery opportunities in sensing, simulation, and computing with QIS and QC. This subprogram supports curation of data sets from colliders worldwide for AmSC and the development of AI models that bridge experiments with theory and shorten the time to science outcomes from complex experiments.

Heavy ion physicists strive to answer overarching questions in nuclear physics, including: How do the fundamental interactions between quarks and gluons lead to the perfect fluid behavior of the quark-gluon plasma (QGP)? What are the limits on the fluid behavior of matter? What are the properties of quantum chromodynamic (QCD) matter? What is the correct phase diagram of nuclear matter?

Scientists used the Relativistic Heavy Ion Collider (RHIC) to pioneer the study of condensed quark-gluon matter at the extreme temperatures, characteristic of the infant universe. With careful measurements, nuclear physicists have accumulated data using the Solenoid Tracker at RHIC (STAR) detector and the super Pioneering High Energy Nuclear Interaction eXperiment (sPHENIX) detector to gain insights into the processes early in the creation of the universe, and how protons, neutrons, and other parts of normal matter developed from that plasma. Analyses of these data are critical to understanding the physical characteristics of the QGP and discovering whether a critical point exists demonstrating a first order phase transition between normal nuclear matter and the QGP.

Collaboration at the Large Hadron Collider (LHC) at CERN provides U.S. researchers the opportunity to investigate states of matter under substantially different initial conditions than those provided by RHIC. Data collected by A Large Ion Collider Experiment (ALICE), the Compact Muon Solenoid (CMS), and ATLAS detectors confirm that the QGP discovered at RHIC is also seen at the higher energy, and comparisons of results from LHC to those from RHIC have led to important new insights.

Understanding how the fundamental properties of the proton such as its mass and spin are dynamically generated is a U.S. nuclear science community high scientific priority. The answer to this question is key to addressing an outstanding grand challenge problem of modern physics: how QCD—the theory of the strong force that explains all strongly interacting matter in terms of quarks interacting via the exchange of gluons—acts in detail to generate the “macroscopic” properties of protons and neutrons. The NSAC Long Range Plan identified the EIC as the highest priority for facility construction and recommended its expeditious completion. BNL and JLab are partners in design and construction of the EIC at BNL, incorporating AI broadly in its early stages to enable new analysis techniques and ensure efficient operation of the facility. Scientists and accelerator physicists from this sub-program play significant leadership roles in the development of the scientific agenda and implementation of the EIC.

Over the course of the construction and implementation of the EIC, RHIC operations funding will decrease as scientific staff, engineers and technicians move from RHIC operations to the EIC project. RHIC accelerator scientists have critical core competencies in collider operations that cannot easily be replaced; their support is embedded in the EIC total project cost. Throughout the EIC project, the temporary reprioritization of funds from the collider facility operations budget to the construction budget will effectively offset funds needed to implement the EIC, enabling a cost-effective path forward to the implementation of this world-leading facility.

The RHIC collider operations ended in FY 2026. The RHIC hadron injector complex operations will continue for beam studies to maintain readiness for EIC operations; maintain symbiotic, parallel, cost-effective operations of the Brookhaven Linac Isotope Producer Facility (BLIP) supported by the DOE Isotope Program to produce research and commercial isotopes critically needed by the Nation; and support the NASA Space Radiation Laboratory Program for the study of space radiation effects applicable to human space flight and mission electronics.

EPSCoR will focus on development of capacity and infrastructure for NP research in EPSCoR jurisdictions.

Nuclear Physics
Heavy Ion Physics

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Heavy Ion Physics	**$231,967**	**$173,662**	**-$58,305**
Research	$46,312	$33,662	-$12,650
Funding continues to support heavy ion research at universities and national laboratories for high priority experiments; to develop, implement, and maintain scientific instrumentation; to analyze data and publish experimental results; to contribute to the future EIC science program; and to train students in nuclear and accelerator science. Support continues for participation and instrumentation upgrades for international experiments (ALICE, CMS, and ATLAS LHC). Funding continues transformative accelerator science for current and future NP facilities, including applications of AI/ML. Research continues for QIS and EPSCoR grants and early career awards.		The Request will support heavy ion research at universities and national laboratories for high priority experiments; the development, implementation, and maintenance of scientific instrumentation; analysis of data and publication of experimental results; contributions to the future EIC science program; and the training of students in nuclear and accelerator science. Support will continue for participation and instrumentation upgrades for international experiments. The Request will continue accelerator science research and development, including applications of AI. Research will continue for QIS, EPSCoR grants, and early career awards.	Funding will focus on the highest priority heavy ion and QIS research and curating AI-ready collider data for AmSC to hasten research outcomes.
Operations	$182,805	$140,000	-$42,805
Funding supports RHIC operations at 1,500 hours to complete the science program with sPHENIX and support the RHIC injector complex including high priority facility and instrumentation capital equipment, high priority accelerator improvement projects, and computing capabilities for analysis.		The Request will support RHIC hadron injector complex operations for beam studies and the recovery and reuse of RHIC infrastructure for EIC. Funding will support high priority facility capital equipment to maintain mission readiness, as will continued investments in computing infrastructure.	RHIC operations will transition to focus on ensuring the RHIC hadron injector complex is ready to support future EIC operations. Funding will be reprioritized to support EIC.

(dollars in thousands)

FY 2026 Enacted	FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Projects $2,850	$ —	-$2,850
EIC OPC funds support the research and development that mitigates technical risk for design of accelerator and detector subsystems.	EIC OPC funds are no longer requested with the completion of research and development activities associated with the EIC accelerator and detector.	Research and development activities for the EIC project will be completed as planned.

Description

The Nuclear Theory subprogram includes activities in nuclear theory, computation, and nuclear data. The Request provides growing support for the application of AmSC to accelerate nuclear science by incorporating next generation AI models at the nexus of experiment, simulation, and theory that cross multiple energy scales. Nuclear theorists are active in QIS and QC, supporting developments topical to NP and other SC programs.

The nuclear theory activity simultaneously addresses fundamental questions on the physics of the very small (protons, neutrons, and fundamental particles) and the physics of the very large (nuclear reactions in the sun, neutron stars). Nuclear theory is inherently multidisciplinary as its fundamental questions are directly connected to other areas of science. Theoretical nuclear physics is invested in the development of new QIS tools to describe 99 percent of the visible matter in the universe and the underlying mechanism that holds together quarks and gluons within the nucleus of atoms. Major themes include extreme states of matter in the known universe displaying the largest temperatures and energy per volume; origins of the elements in the cosmos; and the role of the neutrino in the evolution of the early universe. This activity has a pioneering footprint in the interpretation of data obtained from experimental nuclear science, development of new high-performance supercomputers, novel AI architectures, and new numerical algorithms with applications to other areas of science and industry of direct benefit to U.S. national security and technology superiority. Collaborations within the university and national laboratory communities are also supported under this activity to address highest priority topics in nuclear theory that merit concentrated, team-based theoretical efforts.

This subprogram leverages lattice QCD computational tools that are critical for understanding and interpreting data from RHIC, LHC, and CEBAF. NP supports lattice QCD computing with investment in dedicated computational resources. The activity supports SciDAC, a collaborative program with ASCR that partners NP scientists and computer experts to address major scientific challenges that require capabilities of supercomputer facilities.

The nuclear data activity maintains the U.S. Nuclear Data Program (USNDP), targets high-priority nuclear data needs of relevance to the NP mission, and leads an interagency working group including the NNSA, NE, FES, DOE IP, and other federal agencies to coordinate targeted experimental efforts. The USNDP provides current, accurate, and authoritative data to basic and applied areas of nuclear science and engineering, maintaining public access to extensive nuclear physics databases of national and international importance and supporting approximately five million nuclear data retrievals annually. Research addresses gaps in nuclear data through targeted experiments and development/use of theoretical models. The National Nuclear Data Center (NNDC) at BNL manages the USNDP. The NNDC is designated as an SC Public Reusable Research (PuRe) Data Resource, a designation commensurate with high standards of data management, resource operation, and scientific impact.

Nuclear theorists conduct R&D on quantum sensors to enable precision measurements and develop quantum sensors based on atomic-nuclear interactions. They also perform R&D on nuclear physics techniques to enhance qubit coherence times and develop quantum computing algorithms applied to quantum mechanical systems and NP topical problems. In partnership with other SC programs, NP continues its role in jointly stewarding National QIS Research Centers that focus on building the fundamental tools and science base necessary for the U.S. leadership in QIS.

Nuclear Physics
Nuclear Theory

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Nuclear Theory	**$55,053**	**$36,989**	**-$18,064**
Research	$55,053	$36,989	-$18,064
Funding supports high priority theoretical research at universities and national laboratories. Theorists continue to focus on applying QCD to nucleon structure and hadron spectroscopy, the force between nucleons, and the structure of light nuclei. Advanced dynamic calculations to describe relativistic nuclear collisions and nuclear structure and reactions continue. Funding supports the fifth year of SciDAC grants, the fourth year of theory topical collaborations, and high priority QIS efforts. Target investments continue development of cutting-edge AI/ML techniques of relevance to nuclear science research.		The Request will support high priority theoretical research at universities and national laboratories for the interpretation of experimental results and exploration of new ideas and hypotheses that identify potential areas for future experimental investigation. The Request will support the first year of new SciDAC grants, the fifth year of theory topical collaborations, and high priority QIS efforts. Funding supports investments to pre-train and fine tune domain specific AI models relevant to nuclear science research.	Investments will focus on the highest priority research in nuclear theory, with expanded support for AI and leveraging AmSC to accelerate nuclear theory outcomes.
Funding continues USNDP efforts to collect, evaluate, and disseminate nuclear physics data for basic nuclear research and for applied nuclear technologies.		The Request will maintain USNDP efforts to collect, evaluate, and disseminate nuclear physics data to meet the needs for basic nuclear research and priority applications in government, academia, and industry.	USNDP will target areas most impactful to nuclear science and interagency partners.

Description

The Low Energy Physics subprogram includes activities in nuclear structure and nuclear astrophysics and fundamental symmetries. Scientists leverage AmSC and tailored AI models to boost nuclear science discovery timelines and enhance the performance of accelerator facility operations and associated scientific instruments. QIS R&D includes quantum sensors to enable precision measurements, development of quantum sensors based on atomic-nuclear interactions, and development of quantum computing algorithms applied to quantum mechanical systems and NP topical problems.

Questions associated with nuclear structure include: What is the nature of the nuclear force that binds protons and neutrons into stable nuclei and rare isotopes? What are the limits of nuclear existence? What is the nature of neutron stars? How does matter behave at the most extreme densities in the universe? Relevant nuclear astrophysics questions are: What are the origins of the elements in the cosmos? What are the nuclear reactions that drive stars and stellar explosions? NP research activities address these questions primarily using beams of stable and rare isotopes to develop a comprehensive description of nuclei and reveal new nuclear phenomena.

The ATLAS facility at the Argonne National Laboratory (ANL) is an SC scientific user facility and the world's premiere facility for stable beams, providing high-quality beams of all stable elements up to uranium and selected short-lived nuclei beams using the Neutron-generator Upgrade to the Californium Rare Ion Breeder Upgrade (nuCARIBU) ion source. Increasing ATLAS capabilities via a Multi-User Upgrade are underway to address user demand. FRIB at Michigan State University (MSU), an SC scientific user facility since FY 2020, provides beams of rare isotopes to test the limits of nuclear existence and advance understanding of the atomic nucleus and the evolution of the cosmos. FRIB's scientific reach will be enhanced with the implementation of the Gamma-Ray Tracking Array (GRETA) and the High Rigidity Spectrometer (HRS). This activity supports operations of the LBNL 88-Inch Cyclotron for an in-house program studying the properties of newly discovered elements as well as conducting searches for new super-heavy elements. NASA and industry exploit capabilities at the 88-Inch Cyclotron to develop radiation-resistant electronics for their missions. In addition, smaller university-based accelerator facilities are supported through this activity to address specific research areas.

Questions related to fundamental symmetries of nature addressed in low energy nuclear physics experiments include: What is the origin of the matter–antimatter imbalance in the universe? Are neutrinos their own antiparticles, and how do they acquire mass? Are there more forces than the four we know about? Are there undiscovered, light, weakly-interacting particles? Low energy experiments uniquely addresses aspects of these questions through precision studies using neutron and electron beams and decays of nuclei, including beta decay, double-beta decay, and the search for neutrino-less double beta decay (NLDBD). NP is the steward of neutrino mass measurements and the search for NLDBD. NP has funded neutrino experiments, playing critical roles in partnerships with NSF and in successful international experiments that include U.S. scientific leadership. This activity supports experiments probing electric dipole moments of atoms that would provide evidence for the violation of time reversal invariance and shed light on the matter/anti-matter imbalance in the universe.

The NSAC LRP recommended as the highest priority for new experiment construction that the U.S. lead an international consortium to undertake a NLDBD campaign. The observation of NLDBD would have profound consequences for understanding the physical universe. NP, including this activity, has invested in R&D on candidate technologies for next–generation ton-scale NLDBD experiments. In the near-term, within the NLDBD program, NP will focus on implementing the Large Enriched Germanium Experiment for Neutrinoless Double Beta Decay one ton (LEGEND-1000) project, in collaboration with international partners. LEGEND-1000 will deploy germanium-76 isotope incorporated into an array of solid-state detectors to reach a NLDBD lifetime limit of 10^{28} years within a planned ten-year measurement window, with rare event identification enhanced by AI. The High Rigidity Spectrometer research project and Ton Scale Neutrinoless Double Beta Decay major item of equipment will continue progress using prior year funds.

Nuclear Physics
Low Energy Physics

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Low Energy Physics	**$222,189**	**$192,760**	**-$29,429**
Research	$61,592	$45,755	-$15,837
Funding supports high priority university and laboratory nuclear structure and nuclear astrophysics efforts. Scientists are participating in the characterization of recently discovered elements and search for new ones. Scientists utilize AI/ML that can promote automated platforms to improve machine performance and reliability and advance detector design and data processing. High priority research in NLDBD and fundamental symmetries continues with a strategic mix of efforts.		The Request will continue support of high priority university and laboratory nuclear structure and nuclear astrophysics efforts including the search for new isotopes and elements. Scientists will prepare AI-ready datasets to promote automated platforms for improved machine performance and data processing. High priority research in fundamental symmetries will continue.	Investment will focus on the highest priority research, including experiments at ATLAS and FRIB, and precision studies with neutron and electron beams. Funding will expand AI efforts and utilize AmSC for discovery science.
Operations	$143,597	$147,005	+$3,408
ATLAS operates for 5,950 hours and FRIB operates for 4,000 hours. Funding supports operations, staff, maintenance, as well as the implementation of new detector and accelerator capabilities at both facilities. Funding sustains operations of the 88-Inch Cyclotron with focus on newly-discovered heavy elements.		ATLAS will operate for 5,950 hours and FRIB will operate for 4,000 hours. The Request will fund operations, staff, maintenance, as well as the implementation of upgraded capabilities at both facilities. The Request will sustain operations of the 88-Inch Cyclotron with a continued focus on newly-discovered heavy elements.	The Request will maintain operating hours while continuing support for the highest priority experiments at FRIB, ATLAS, and the 88-Inch Cyclotron.

Description

This subprogram supports line-item construction for NP, including engineering, design, and construction. Other project costs (OPCs) are funded in the relevant subprograms.

<u>20-SC-52, Electron Ion Collider EIC, BNL</u>

The FY 2027 Request of $200,000,000 will continue the construction effort for the EIC, which will be located at BNL. The estimated TPC range for the EIC project at CD-1, Approve Alternative Selection and Cost Range, is $1.7 billion to $2.8 billion. BNL has teamed with TJNAF to lead the development and implementation of the EIC. The EIC scope includes an electron injector, rapid cycling synchrotron, an electron storage ring, modifications to one of the two RHIC ion rings, one interaction region with a detector, support buildings, and other infrastructure. AI will contribute to all phases of the EIC, from design to future operations, where optimization of such a large-scale experiment is a complex problem characterized by multiple parameters. Application of the hardware and models developed under the Genesis Mission to EIC construction will provide insight on hidden correlations among the design parameters and will identify optimal tradeoff solutions in a multidimensional space of the objectives. The project has attracted international collaboration and contributions. The State of New York has approved $100 million for the construction of buildings to house equipment and technical infrastructure supporting the EIC accelerator and detector.

The EIC project will increasingly rely on RHIC scientists, engineers, and technicians as RHIC activities ramp down. This workforce has critical core competencies in collider operations essential to RHIC now and eventually to EIC operations. They cannot easily be replaced. The temporary reprioritization of funds from the collider facility operations budget to the construction budget will enable a cost-effective path forward to the implementation of this world-leading facility.

The EIC will maintain U.S. leadership in nuclear physics and accelerator technology. AI-ready data sets generated by EIC and processed on AmSC will accelerate the pace in addressing the outstanding question on how the fundamental properties of the proton, such as its mass and spin, are dynamically generated by the extraordinarily strong color fields resulting from dense systems of gluons in nucleons and nuclei, which has been a high priority for the U.S. nuclear science community for decades. The answer to this question is key to addressing a grand challenge problem of modern physics: how quantum chromodynamics—the theory of the strong force, which explains all strongly interacting matter in terms of quarks interacting via the exchange of gluons—acts to generate the "macroscopic" properties of protons and neutrons. The NSAC LRP recommends "…the expeditious completion of the EIC as the highest priority for facility construction."

A National Academies study, charged to independently assess the impact, uniqueness, and merit of the science that would be enabled by U.S. construction of an electron-ion collider, gave a strong endorsement to a U.S.-based EIC, and recognized its critical role in maintaining U.S. leadership in nuclear science and accelerator R&D. Scientists and accelerator physicists from both the Medium Energy and Heavy Ion subprograms are actively engaged in the development of the scientific agenda, design of the facility, and development of scientific instrumentation for the proposed EIC scope. Critical Decision-0 (CD-0), Approve Mission Need, was received on December 19, 2019, followed by CD-1, Approve Alternative Selection and Cost Range, on June 29, 2021, and CD-3A, Approve Long Lead Procurements, on March 28, 2024.

Activities and Explanation of Changes

(dollars in thousands)

FY 2026 Enacted		FY 2027 Request	Explanation of Changes FY 2027 Request vs FY 2026 Enacted
Construction	**$155,000**	**$200,000**	**$45,000**
20-SC-52 Electron Ion Collider (EIC), BNL	$155,000	$200,000	$45,000
Funding continues to advance engineering and design and initiate construction. RHIC operations includes a "reprioritization" of expert workforce from the RHIC facilities operations budget to support the EIC OPC and TEC request.		The Request will continue to advance engineering and design and initiate construction with the completion of RHIC collider operations. Expert workforce from RHIC collider operations will be reprioritized to support the EIC request.	Funding will continue to support engineering and design efforts and early construction activities following the end of operations of the RHIC collider.

Nuclear Physics
Capital Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Operating Expenses						
Capital Equipment	N/A	N/A	14,861	29,048	12,048	-17,000
Minor Construction Activities						
General Plant Projects	N/A	N/A	1,642	1,642	1,642	–
Accelerator Improvement Projects	N/A	N/A	2,675	5,211	35,211	+30,000
Total, Capital Operating Expenses	**N/A**	**N/A**	**19,178**	**35,901**	**48,901**	**+13,000**

Capital Equipment

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Capital Equipment						
Major Items of Equipment						
Low Energy Physics						
High Rigidity Spectrometer	137,241	45,080	3,259	15,000	–	-15,000
Ton-Scale Neutrinoless Double Beta Decay (NLDBD) MIE	412,660	10,800	2,000	2,000	–	-2,000
Total, MIEs	549,901	55,880	5,259	17,000	–	-17,000
Total, Non-MIE Capital Equipment	N/A	N/A	9,602	12,048	12,048	–
Total, Capital Equipment	**N/A**	**N/A**	**14,861**	**29,048**	**12,048**	**-17,000**

Notes:
- *The Capital Equipment table includes MIEs with a Total Estimated Cost (TEC) > $10M.*
- *The High Rigidity Spectrometer (HRS) is not an MIE, but a research project supported on a cooperative agreement with Michigan State University.*
- *The current estimated TEC for the NLDBD MIE is $410,660,000. With the focus of this MIE on the LEGEND-1000 project and a planned CD-1 review in FY 2026, revisions to the TEC are likely. In FY 2025 the $2,000,000 designated for TEC was redirected to OPC funding.*

Minor Construction Activities

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
General Plant Projects (GPP)						
Total GPPs $5M or less	N/A	N/A	1,642	1,642	1,642	–
Total, General Plant Projects (GPP)	**N/A**	**N/A**	**1,642**	**1,642**	**1,642**	**–**
Accelerator Improvement Projects (AIP)						
AIPs (greater than $5M and $34M or less)						
BNL-Cryo-Upgrade AIP	30,000	–	–	–	30,000	+30,000
Total AIPs (greater than $5M and $34M or less)	30,000	N/A	–	–	30,000	+30,000
Total AIPs $5M or less	N/A	N/A	2,675	5,211	5,211	–
Total, Accelerator Improvement Projects (AIP)	**N/A**	**N/A**	**2,675**	**5,211**	**35,211**	**+30,000**
Total, Minor Construction Activities	**N/A**	**N/A**	**4,317**	**6,853**	**36,853**	**+30,000**

Notes:

- *GPP activities $5M and less include design and construction for additions and/or improvements to land, buildings, replacements or addition to roads, and general area improvements. AIP activities $5M and less include minor construction at an existing accelerator facility.*

Nuclear Physics
Major Items of Equipment Description(s)

Low Energy Physics:

High Rigidity Spectrometer (HRS) Research Project
The HRS will enhance the scientific impact of the FRIB fast beam science program by providing luminosity gain factors up to one hundred for neutron-rich isotopes, with the largest gains for the most neutron-rich species. The HRS will allow experiments with beams of rare isotopes at the maximum production rates for fragmentation or in-flight fission. The NSAC LRP recognized that the HRS will push the study of unstable nuclei toward the driplines, increasing the scientific reach of FRIB. The HRS is funded through a cooperative agreement with MSU and is not a capital asset (MIE). HRS received CD-0 approval in November 2018, and CD-1 in September 2020, with a TPC range of $85,000,000 to $111,400,000. The performance baseline for the High Transmission Beam Line (HTBL) subproject of HRS was approved in March 2025 with a TPC of $49,700,000 and CD-4 in Q2 FY 2030. The FY 2027 Request does not include new funding for the HRS. Prior year funds will support the construction of the HTBL as well as the management team, coordination of collaboration activities, and preliminary engineering and design work for the Spectrometer Section (SPS) subproject of HRS towards future critical decision points.

Low Energy Physics:

Ton-Scale Neutrino-less Double Beta Decay (NLDBD) Program MIE
The Ton-Scale NLDBD Program, implemented by deploying experiments instrumenting a large volume of a specially selected isotope to detect neutrino-less nuclear beta decays where within a single nucleus, two neutrons decay into two protons and two electrons with no neutrinos emitted directly supports the NP mission to explore all forms of nuclear matter. NLDBD can only occur if neutrinos are their own anti-particles and the observation of “lepton number violation” in such neutrino-less beta decay events would have profound consequences for present understanding of the physical universe. The goal of the ton-scale program is to reach a lifetime limit of 10^{28} years with high confidence within a measurement window of five to ten years enabled by the implementation of AI techniques for data cleaning, analysis, and event classification. NLDBD received CD-0 approval in November 2018 with a TPC range of $215,000,000 to $250,000,000. Within the Ton-Scale NLDBD program, NP is prioritizing the LEGEND-1000 project, making use of germanium-76 isotope incorporated in an array of solid-state detectors. The FY 2027 Request does not include new funding for LEGEND-1000 and will make progress using prior year balances. Management activities and preparations for establishing the cost range and evaluation of alternatives are supported by prior year funds.

Nuclear Physics
Construction Projects Summary

(dollars in thousands)

	Total	Prior Years	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
20-SC-52, Electron Ion Collider (EIC), BNL						
Total Estimated Cost (TEC)	2,493,500	299,240	110,000	155,000	200,000	+45,000
Other Project Cost (OPC)	306,500	92,300	2,850	2,850	-	-2,850
Total Project Cost (TPC)	**2,800,000**	**391,540**	**112,850**	**157,850**	**200,000**	**+42,150**
Total, Construction						
Total Estimated Cost (TEC)	**2,493,500**	**299,240**	**110,000**	**155,000**	**200,000**	**+45,000**
Other Project Cost (OPC)	**306,500**	**92,300**	**2,850**	**2,850**	**-**	**-2,850**
Total Project Cost (TPC)	**2,800,000**	**391,540**	**112,850**	**157,850**	**200,000**	**+42,150**

Nuclear Physics
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 2025 Enacted	FY 2025 Current	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Scientific User Facilities - Type A					
Relativistic Heavy Ion Collider	**187,000**	**187,000**	**182,805**	**140,000**	**-42,805**
Number of Users	990	1,033	1,000	–	-1,000
Achieved Operating Hours	–	2,189	–	–	–
Planned Operating Hours	3,264	2,189	1,500	–	-1,500
Unscheduled Down Time Hours	–	716	–	–	–
Continuous Electron Beam Accelerator Facility	**146,242**	**145,742**	**155,000**	**156,613**	**+1,613**
Number of Users	1,650	1,736	1,730	1,650	-80
Achieved Operating Hours	–	3,236	–	–	–
Planned Operating Hours	3,294	3,236	3,400	3,300	-100
Unscheduled Down Time Hours	–	509	–	–	–
Facility for Rare Isotope Beams	**102,336**	**102,336**	**110,000**	**111,727**	**+1,727**
Number of Users	900	1,073	1,050	1,100	+50
Achieved Operating Hours	–	4,069	–	–	–
Planned Operating Hours	3,713	4,069	4,000	4,000	–
Unscheduled Down Time Hours	–	320	–	–	–
Argonne Tandem Linac Accelerator System	**25,110**	**25,110**	**26,110**	**27,416**	**+1,306**
Number of Users	430	453	450	450	–
Achieved Operating Hours	–	6,423	–	–	–
Planned Operating Hours	5,952	6,423	5,800	5,950	+150
Unscheduled Down Time Hours	–	384	–	–	–
Total, Facilities	**460,688**	**460,188**	**473,915**	**435,756**	**-38,159**
Number of Users	3,970	4,295	4,230	3,200	-1,030
Achieved Operating Hours	–	15,917	–	–	–
Planned Operating Hours	16,223	15,917	14,700	13,250	-1,450
Unscheduled Down Time Hours	–	1,929	–	–	–

Notes:

- *RHIC operations as an SC User Facility ended following the completion of collider operations in FY 2026. Operation of the RHIC hadron injector complex will continue for beam studies and to maintain readiness for future EIC operations.*

Nuclear Physics
Scientific Employment

	FY 2025 Enacted	FY 2026 Enacted	FY 2027 Request	FY 2027 Request vs FY 2026 Enacted
Number of Permanent Ph.Ds (FTEs)	790	756	715	-41
Number of Postdoctoral Associates (FTEs)	312	245	164	-81
Number of Graduate Students (FTEs)	440	331	241	-90
Number of Other Scientific Employment (FTEs)	1,044	1,007	946	-61
Total Scientific Employment (FTEs)	**2,586**	**2,339**	**2,066**	**-273**

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

20-SC-52 Electron Ion Collider (EIC), BNL
Brookhaven National Laboratory, BNL
Project is for Design and Construction

1. Summary, Significant Changes, and Schedule and Cost History

Summary
The EIC project will acquire facilities, infrastructure, systems, and equipment that will enable scientists to investigate the basic building blocks of nuclei and how quarks and gluons, the particles inside neutrons and protons, interact dynamically via the strong force to generate the fundamental properties of neutrons and protons, such as mass and spin. The EIC will be one of the first large-scale experiments to leverage AI for autonomous experimentation and near real-time control starting at design. The FY 2027 Request for the EIC is $200,000,000 of TEC funding. Critical Decision (CD)-1, Approve Alternative Selection and Cost Range, attained on June 29, 2021, included a TPC range of $1,700,000 to $2,800,000,000.

Significant Changes
The EIC project was initiated in FY 2020. The project most recent Critical Decision (CD) is CD-3A, Approve Long-Lead_Procurement, received on March 28, 2024. The estimated completion date (CD-4) of 1Q FY 2036 includes schedule contingency validated by peer review. The most recent Federal review completed in August 2025 confirmed the need for continued elaboration of the scope to define the subprojects strategy intended to leverage different levels of design maturity and improve the project's affordability. The first subproject could attain CD-2, Approve Performance Baseline, in Q2 FY 2026.

In FY 2026, the EIC team focused on preliminary design of the infrastructure, collider machine, and detector instrumentation while executing long-lead procurements. FY 2027 activities will include completing planning and design for conventional infrastructure and technical systems, executing long-lead procurements, pursuing agreements with potential in-kind contributors, and initiating execution of the first subproject. FY 2027 funding will support constructability studies and adjustments to validate technical assumptions and to reduce project risk.

The project has an assigned Federal Project Director (FPD) certified at Level 2.

Critical Milestone History

Fiscal Year	CD-0	Conceptual Design Complete	CD-1	CD-2	Final Design Complete	CD-3	CD-4
FY 2027	12/19/19	01/12/21	6/29/2021	2Q FY 2026	2Q FY 2027	2Q FY 2027	1Q FY 2036

CD-0 – Approve Mission Need for a construction project with a conceptual scope and cost range; **Conceptual Design Complete** – Actual date the conceptual design was completed (if applicable); **CD-1** – Approve Alternative Selection and Cost Range; **CD-2** – Approve Performance Baseline; **Final Design Complete** – Estimated/Actual date the project design will be/was complete(d); **CD-3** – Approve Start of Construction; **D&D Complete** – Completion of D&D work; **CD-4** – Approve Start of Operations or Project Closeout.

Fiscal Year	Performance Baseline Validation	CD-3A	CD-3B
FY 2027	TBD	3/28/2024	2Q FY 2026

CD-3A – Approve Long-Lead Procurements, for specialty materials procurement, including electrical infrastructure, magnets, refrigerators for the satellite cryogenics plant, and components for the injector, radio frequency power amplifier, and the detector.
CD-3B – Approve Long-Lead Procurements, for transportation, inspection, and refurbishment of excess magnets from Argonne National Laboratory and additional materials for the accelerator and detector.

Project Cost History

(dollars in thousands)

Fiscal Year	TEC, Design	TEC, Construction	TEC, Total	OPC, Except D&D	OPC, Total	TPC
FY 2026	262,000	2,231,500	2,493,500	306,500	306,500	2,800,000
FY 2027	252,000	2,241,500	2,493,500	306,500	306,500	2,800,000

Note:
- *This project has not received CD-2 approval; therefore, funding estimates are preliminary.*
- *In FY 2025, the CD-1 point estimate was used as the basis for this table. Beginning in FY 2026, the upper bound of the CD-1 TPC range was the basis for this table.*

2. Project Scope and Justification

Scope

The scope of this project is to design and build the EIC at BNL that will fulfill the scientific gap as identified in the Long Range Plan for Nuclear Science. BNL has partnered with TJNAF to implement the EIC project. The EIC will have performance parameters that include a high average beam polarization of greater than 70 percent for both electrons and light ions, and the capability to accommodate ion beams from deuterons to the heaviest stable nuclei. The EIC will also have variable center of mass energies from 20 to 100 GeV and upgradable to 140 GeV, high average collision luminosity from 10^{33} -10^{34} $cm^{-2}s^{-1}$, one detector and one interaction region at project completion, and the capacity to accommodate a second interaction region and a second detector.

The scope also includes a new electron injection system and storage ring while taking full advantage of the existing infrastructure by modifying the existing hadron facility of the RHIC infrastructure at BNL.

The electron system will include a highly polarized room temperature photo-electron gun and a 3 GeV electron linac injector. It will include a transfer line that brings the electrons into the storage ring at the energy of 5, 10, and 18 GeV that will be installed in a new tunnel adjacent to the existing 2.4-mile circular RHIC tunnel.

Modifications to the existing hadron system include the injection, transfer line and storage ring to increase beam energy to 275 GeV. It will include a strong-hadron-cooling system to reduce and maintain the hadron beam emittance to the level needed to operate with the anticipated luminosity of 10^{33} - 10^{34} $cm^{-2}s^{-1}$.

The interaction region will have superconducting final focusing magnets, crab cavities, and spin rotators to provide longitudinally polarized beams for collisions, where the outgoing particles will be collected by one detector.

An enhanced 2 K liquid helium cryogenic plant is provided for the superconducting radiofrequency cavities, with enhanced water-cooling capacity and cooling towers and chillers to stabilize the environment in the existing tunnel. Civil construction will also include electrical systems, service buildings, and access roads.

It is anticipated that non-DOE funding sources such as international collaborators and the State of New York, will contribute $250 million to the EIC project ($100 million from New York state, and $150 million from international collaborators). The timeframe for commitments by non-DOE contributors will vary throughout the life of the project and become more certain as planning for the project progresses. New York state committed to its contribution on February 7, 2024. All non-DOE funding sources will be incorporated into the project through the change control process once baselined**.**

Justification

The last four Long Range Plan reports have supported the EIC. The current Long Range Plan recommends the EIC as the highest priority for new facility construction. Consistent with that vision, in 2016 NP commissioned a National Academies of Sciences, Engineering, and Medicine study by an independent panel of experts to assess the uniqueness and scientific merit of such a facility. The report, released in July 2018, strongly supports the scientific case for building a U.S. based EIC, documenting that an EIC will advance the understanding of the origins of nucleon mass, the origin of the spin properties of nucleons, and the behavior of gluons.

The project is being conducted in accordance with the project management requirements in DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets.*

Key Performance Parameters (KPPs)

The KPPs are preliminary and may change prior to setting the performance baseline at CD-2. The threshold KPPs represent the minimum acceptable performance that the project must achieve for success. The objective KPPs represent the performance the project has planned to achieve. Achievement of the Threshold KPPs will be a prerequisite for approval of CD-4, Approve Project Completion.

Performance Measure	Threshold	Objective
Center-of-Mass	Center-of-mass energy measured in the range of 20 GeV- 100 GeV.	Center-of-mass energy measured in the range of 20 GeV- 140 GeV.
Accelerator	Accelerator installed and capable of delivering beams of protons and a heavy nucleus such as Au.	Ability to deliver a versatile choice of beams from protons and light ions to heavy ions such as Au.
Detector	Detector installed and subsystems tested with cosmic rays.	Inelastic scattering events in the e-p and e-A collisions measured in Detector.
Polarization	Hadron beam polarization of > 50 percent and electron beam polarization of > 40 percent measured at E_{cm} = 100 GeV.	Hadron beam polarization of > 60 percent and electron beam polarization of > 50 percent measured at E_{cm} = 100 GeV.

Performance Measure	Threshold	Objective
Luminosity	Luminosity for e-p collisions measured up to 1.5x10^{32} cm^{-2} s^{-1}.	Luminosity for e-p collisions measured up to 1.0x10^{33} cm^{-2} s^{-1}.

3. Financial Schedule

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Estimated Cost (TEC)				
Design (TEC)				
Prior Years	152,000	152,000	131,300	—
Prior Years - IRA Supp.	20,000	20,000	—	15,234
FY 2025	50,000	50,000	89,729	5,218
FY 2026	30,000	30,000	30,000	—
Total, Design (TEC)	**252,000**	**252,000**	**251,029**	**20,452**
Construction (TEC)				
Prior Years	19,000	19,000	—	—
Prior Years - IRA Supp.	108,240	108,240	—	2,972
FY 2025	60,000	60,000	—	24,579
FY 2026	125,000	125,000	—	58,240
FY 2027	200,000	200,000	200,000	21,997
Outyears	1,729,260	1,729,260	2,055,963	—
Total, Construction (TEC)	**2,241,500**	**2,241,500**	**2,255,963**	**107,788**
Total Estimated Cost (TEC)				
Prior Years	171,000	171,000	131,300	—
Prior Years - IRA Supp.	128,240	128,240	—	18,206
FY 2025	110,000	110,000	89,729	29,797
FY 2026	155,000	155,000	30,000	58,240
FY 2027	200,000	200,000	200,000	21,997
Outyears	1,729,260	1,729,260	2,055,963	—
Total, Total Estimated Cost (TEC)	**2,493,500**	**2,493,500**	**2,506,992**	**128,240**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Prior Years	82,300	82,300	78,234	–
Prior Years - IRA Supp.	10,000	10,000	–	9,865
FY 2025	2,850	2,850	3,274	95
FY 2026	2,850	2,850	3,000	40

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Other Project Cost (OPC)				
Outyears	208,500	208,500	208,500	–
Total, Other Project Cost (OPC)	**306,500**	**306,500**	**293,008**	**10,000**

(dollars in thousands)

	Budget Authority (Appropriations)	Obligations	Costs	IRA Supp. Costs
Total Project Cost (TPC)				
Prior Years	253,300	253,300	209,534	–
Prior Years - IRA Supp.	138,240	138,240	–	28,071
FY 2025	112,850	112,850	93,003	29,892
FY 2026	157,850	157,850	33,000	58,280
FY 2027	200,000	200,000	200,000	21,997
Outyears	1,937,760	1,937,760	2,264,463	–
Total, TPC	**2,800,000**	**2,800,000**	**2,800,000**	**138,240**

4. Details of Project Cost Estimate

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total Estimated Cost (TEC)			
Design	178,000	178,000	**N/A**
Design - Contingency	84,000	84,000	**N/A**
Total, Design (TEC)	**262,000**	**262,000**	**N/A**
Construction_No_Detail	1,624,500	1,624,500	**N/A**
Construction Contingency	607,000	607,000	**N/A**
Total, Construction (TEC)	**2,231,500**	**2,231,500**	**N/A**
Total, TEC	**2,493,500**	**2,493,500**	**N/A**
Contingency, TEC	*691,000*	*691,000*	***N/A***
Other Project Cost (OPC)			
R&D	86,500	86,500	**N/A**
Conceptual Design	11,000	11,000	**N/A**
Other OPC Costs	209,000	209,000	**N/A**
Total, Except D&D (OPC)	**306,500**	**306,500**	**N/A**
Total, OPC	**306,500**	**306,500**	**N/A**
Contingency, OPC	***N/A***	*N/A*	***N/A***
Total, TPC	**2,800,000**	**2,800,000**	**N/A**

(dollars in thousands)

	Current Total Estimate	Previous Total Estimate	Original Validated Baseline
Total, Contingency (TEC+OPC)	***691,000***	***691,000***	***N/A***

Note:
- *This project has not received CD-2 approval; therefore, funding estimates are preliminary.*
- *The upper bound of the CD-1 TPC range is the basis for this table.*

5. Schedule of Appropriations Requests

(dollars in thousands)

Fiscal Year	Type	Prior Years	FY 2025	FY 2026	FY 2027	Outyears	Total
FY 2026	TEC	299,240	110,000	110,000	—	1,974,260	2,493,500
	OPC	92,300	2,850	2,850	—	208,500	306,500
	TPC	391,540	112,850	112,850	—	2,182,760	2,800,000
FY 2027	TEC	299,240	110,000	155,000	200,000	1,729,260	2,493,500
	OPC	92,300	2,850	2,850	—	208,500	306,500
	TPC	391,540	112,850	157,850	200,000	1,937,760	2,800,000

Note:
- *In FY 2025, the CD-1 point estimate was used as the basis for this table. Beginning in FY 2026, the upper bound of the CD-1 TPC range was the basis for this table.*

6. Related Operations and Maintenance Funding Requirements

Over the course of the acquisition of the EIC, experienced RHIC scientists, engineers, and technicians will assume EIC project responsibilities. A gradual transition will balance the need for the scientific experts to continue to support RHIC while ramping up the EIC project. These individuals represent the scientific and technical workforce that are essential to the operations of a complex facility like RHIC and eventually, the EIC. They have critical core competencies in collider operations that cannot easily be replaced, and they represent the core facility operations force of RHIC and the EIC. The Request for RHIC Operations includes a reprioritization of the expert workforce from the RHIC facility operations budget to support the project under the EIC TEC request. The temporary reprioritization of funds from the facility operations budget to the construction budget will reduce the amount of new funds needed to implement the EIC, enabling a cost-effective path forward to the implementation of this world-leading facility. As the EIC nears CD-4 when the machine will be restarted, the scientists, engineers and technicians that are needed to operate the EIC will be transferred back to the facility operations budget.

Start of Operation or Beneficial Occupancy	1Q FY 2036
Expected Useful Life	50 years
Expected Future Start of D&D of this capital asset	1Q FY 2086

Related Funding Requirements
(dollars in thousands)

	Annual Costs		Life Cycle Costs	
	Previous Total Estimate	**Current Total Estimate**	**Previous Total Estimate**	**Current Total Estimate**
Operations, Maintenance and Repair	167,000	175,000	13,500,000	14,000,000

7. D&D Information

As part of the upgrade and renovation of the existing accelerator facilities, up to 366,000 square feet of new industrial space will be built as service buildings to house mechanical and electrical equipment. Construction will also include a new tunnel to house the electron injection and rapid cycling synchrotron. The new area will not replace existing facilities.

	Square Feet
New area being constructed by this project at BNL	366,000
Area of D&D in this project at BNL	0
Area at BNL to be transferred, sold, and/or D&D outside the project, including area previously "banked"	N/A
Area of D&D in this project at other sites	N/A
Area at other sites to be transferred, sold, and/or D&D outside the project, including area previously "banked"	N/A
Total area eliminated	0

8. Acquisition Approach

SC selected BNL as the site for the EIC on January 9, 2020. NP approved the Acquisition Strategy in conjunction with CD-1. DOE will utilize the expertise of the Management and Operating contractors at BNL and TJNAF to manage the project including the design, fabrication, monitoring cost and schedule, and delivering the technical performance specified in the KPPs. A certified Earned Value Management System based on those that already exist at both laboratories will evaluate project progress and ensure consistency with DOE Order 413.3B, Program and Project Management for the Acquisition of Capital Assets. SC will evaluate the M&O contractor's performance through the annual laboratory performance appraisal process. SC and the M&O will draw from lessons learned from other SC projects and other similar facilities in planning and executing the EIC project.