



Science and Technology Strategy: 2026-2036

John Hill, Interim Laboratory Director

CAC April 9, 2026



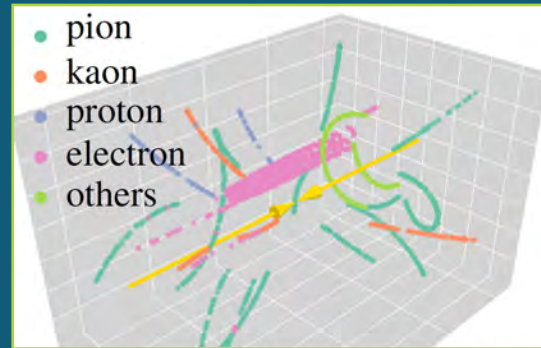
FY25 Highlights

Our outstanding science of today points to the BNL of tomorrow

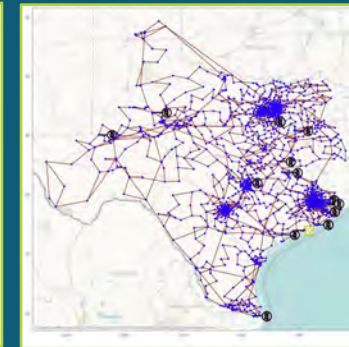
The **sPHENIX detector** at RHIC took more data in its last run than all detectors in all previous 25 runs combined.



Our AI is speeding scientific calculations x100-1000:



Particle physics



Electrical grid

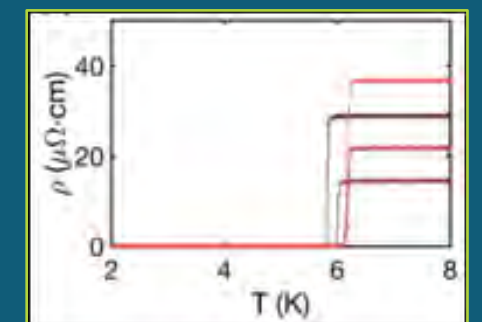
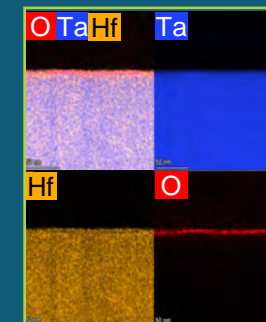


X-ray imaging

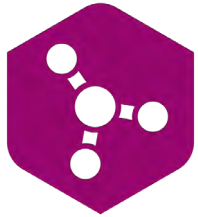
Our quantum center raised superconducting transition temperature in Ta-Hf alloys by 40% for potential low-loss qubits



C2QA
Co-design Center for
Quantum Advantage



2026 Lab Agenda: Charting Our Future



Understanding the Building Blocks of the Universe

- **Begin RHIC R&R project**
- Hold an EIC sub-project CD-2/3 Review
- Support successful completion of ATLAS Run 3. Deliver ATLAS upgrade project
- Provide required contributions to DUNE Far Detectors CD-2/3 Review
- Deliver EIC AI Plan to Lab Leadership



Leading in Discovery with Light-Enabled Science

- **Complex Bend R&D is on track for Testing in Storage Ring Operations**
- Host topical workshops on science opportunities provided by NSLS-IIU
- Demonstrate AI workflow for materials discovery



Developing Next-Generation Information Science and Capabilities

- Develop fabrication methods for silicon-based qubits
- **Exchange entangled photons in BNL-SBU Free Space Link**
- Demonstrate dexterous manipulation of a high voltage electrical board
- Establish pilot program for microelectronics industrial access
- Begin executing AI strategy and active in DOE-wide activities



Advancing Energy Security and Essential Resources Independence

- Commission cloud test chamber and submit first publication
- Establish core FWP for advanced Geothermal Materials
- **Commence HazCat 3 operations at RRPL**



Optimizing Operations to enable the Lab's Mission

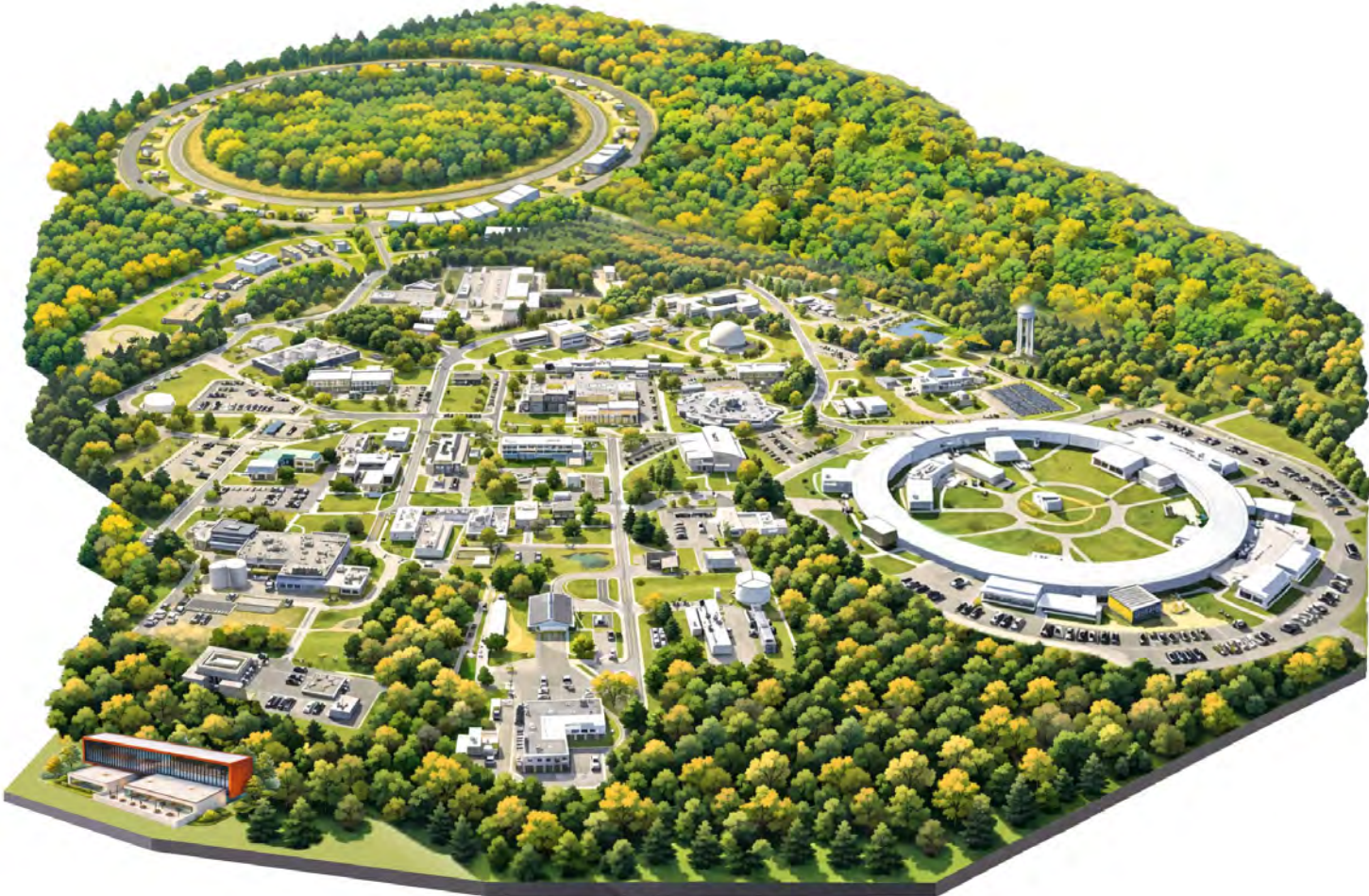
- Developing workforce strategic plan
- Deploy IT Governance model
- Reform financial structure
- Modernize Procurement
- Strengthen Accelerator Safety Implementation
- Strengthen Assurance
- Update Campus Plan
- Advance EIC portfolio
- Improve communications

Simultaneous excellence in science, operations, and community

BNL in 2036

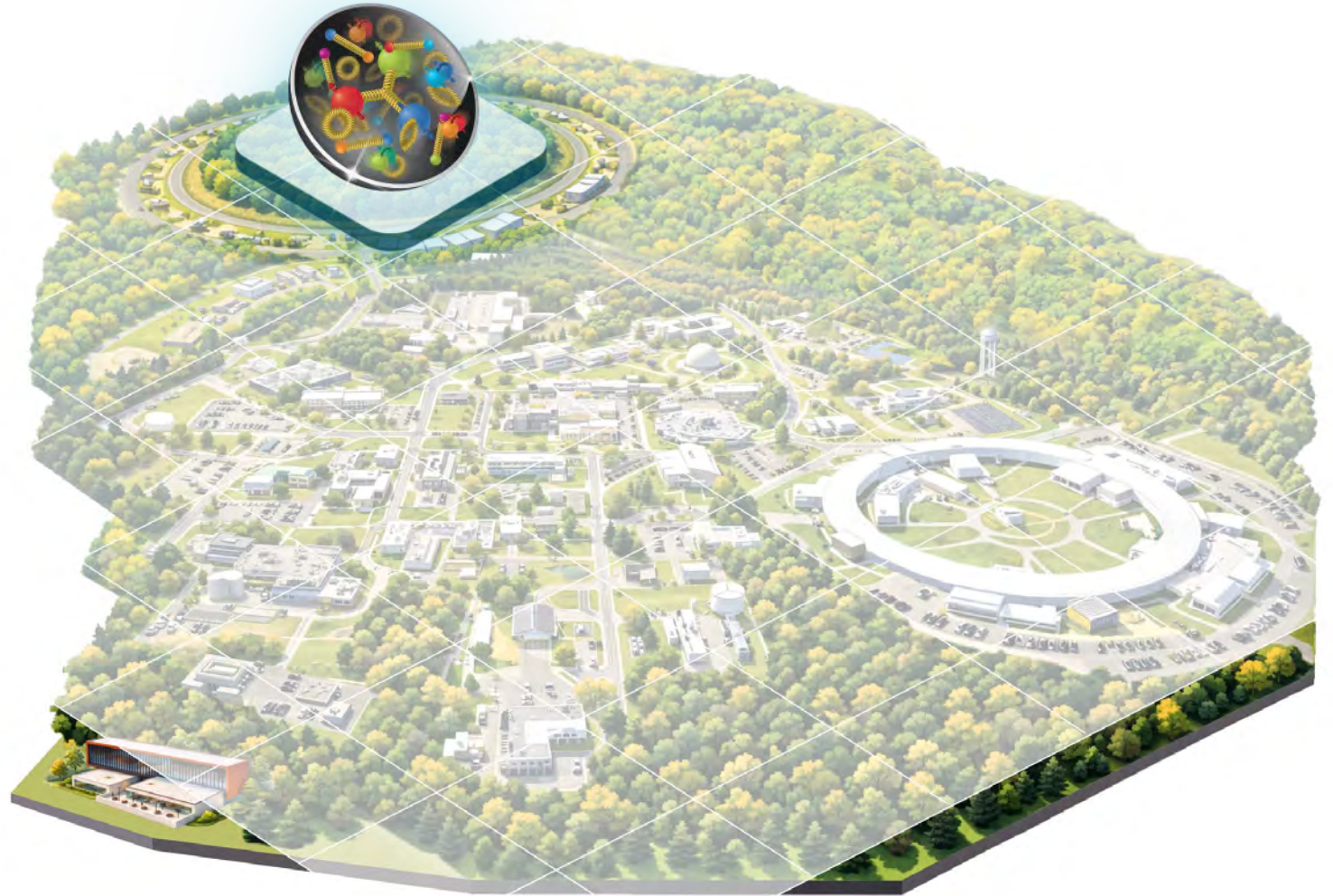
AI-accelerated discovery science to secure America's future

BNL in 2036



BNL in 2036

- Electron-Ion Collider



BNL in 2036

- Electron-Ion Collider
- **Genesis Mission**
 - Embodied AI
 - NSLS-II U
 - Microelectronics
 - AI at your fingertips



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- **Quantum Network**
 - Quantum computers
 - Satellite link



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- **Partnerships**
 - Academia
 - National labs, industry
 - State
 - International



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- **Infrastructure**
 - Main gate
 - Power
 - Integrated Operations Facility
 - Train station
 - User housing



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Key Components of 2036 Vision

- EIC makes it possible to watch the proton's quarks and gluons in motion
- Low-latency AI controls BNL's facilities and data, integrates facilities across DOE complex
- BNL leads the world in embodied AI for scientific facilities
- NSLS-II U delivers broad impact across science ecosystem
- BNL-derived distributed quantum computers accelerate DOE mission work
- Brookhaven- and Stony Brook-enabled secure U.S. quantum network spans the country
- Mission-ready infrastructure



Impacts of BNL's 2036 Vision

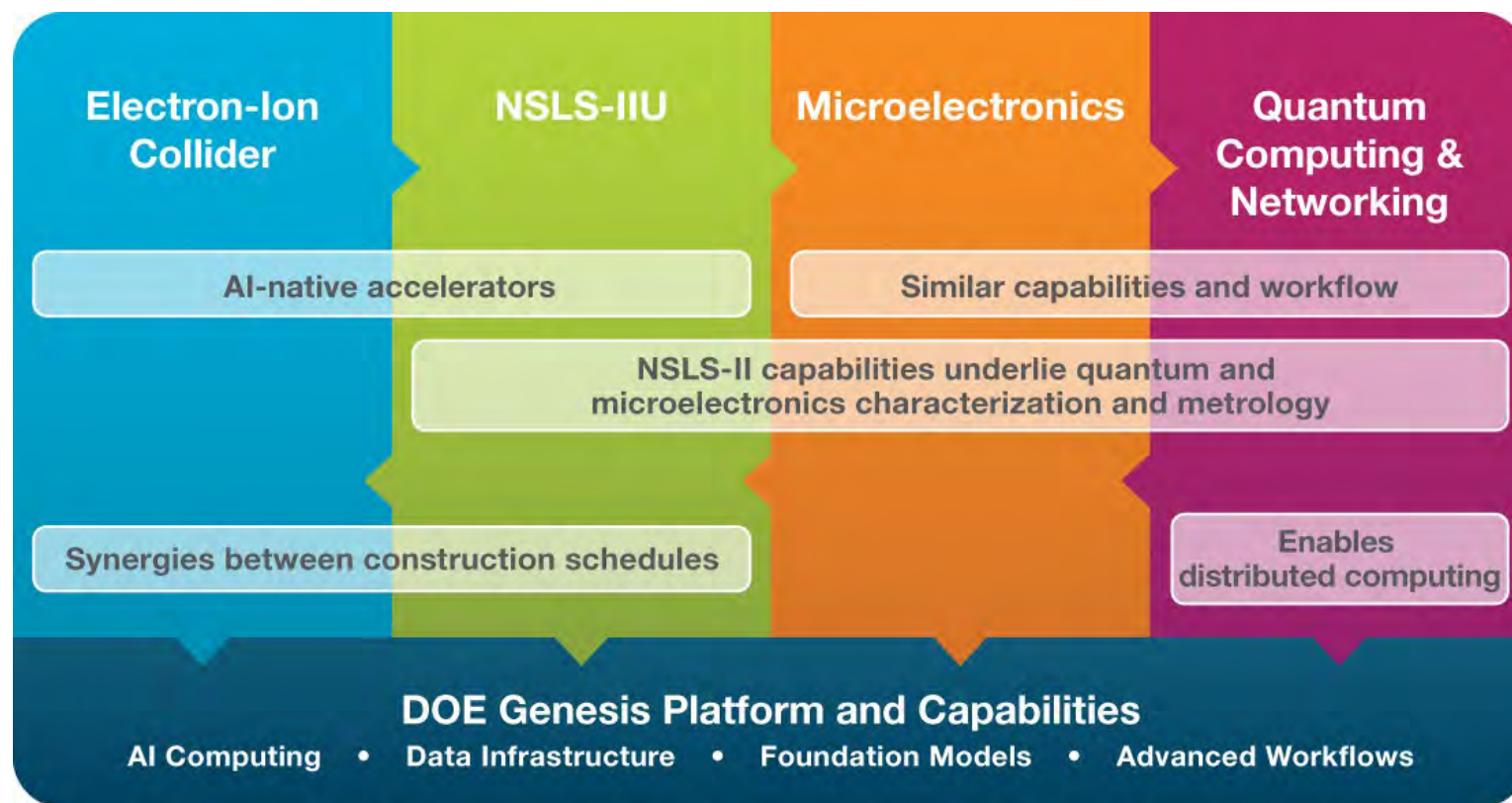
- U.S. leads the world in **nuclear and accelerator physics**. QCD dynamics in nucleons understood
- On-shored U.S. **microelectronics** manufacturing is world-leading and drives energy-efficient AI machines
- U.S. achieves **quantum supremacy**. Quantum computers commercially available for useful calculations
- U.S. achieves scientific and AI supremacy. BNL scientist uses **AI agent** to win physics prize
- AI accelerates scientific **productivity** of DOE **user facilities** by a factor of 10 or greater
- **Neuromorphics** enable 10x scaling or greater of AI computing with no increase in power requirements

These impacts — and the process of achieving them — support development of next-generation workforce



Big Ideas Form a Single Strategy

Vision: *Brookhaven will harness AI-accelerated discovery to be the Nation's leading national lab for scientific breakthroughs that secure America's future.*



Why now?

- Competition with other nations is intense.
- AI is a generational change. We must embrace it and drive it.

Why BNL?

- EIC, the Nation's only collider
- Unique mix of experimental facilities and expertise

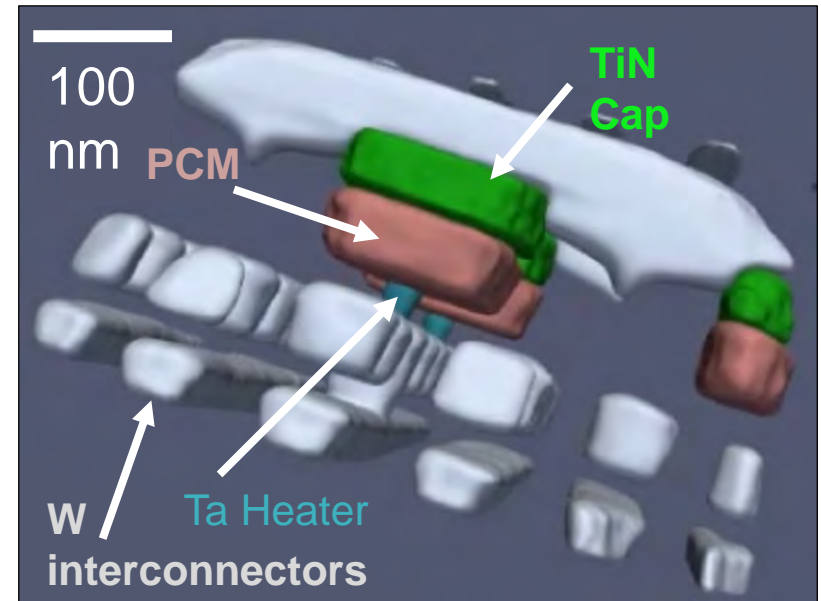
Road to 2036

In the next two years, we will target key activities to have immediate impact.

Immediate Critical Outcomes

To achieve our long-term vision and have immediate impact, we are targeting:

- Electron-Ion Collider
 - Initiate construction of EIC
- Artificial intelligence
 - Establish embodied AI Center
- Quantum information science
 - Demonstrate entangled devices
- Microelectronics
 - Establish industry portal to NSLS-II

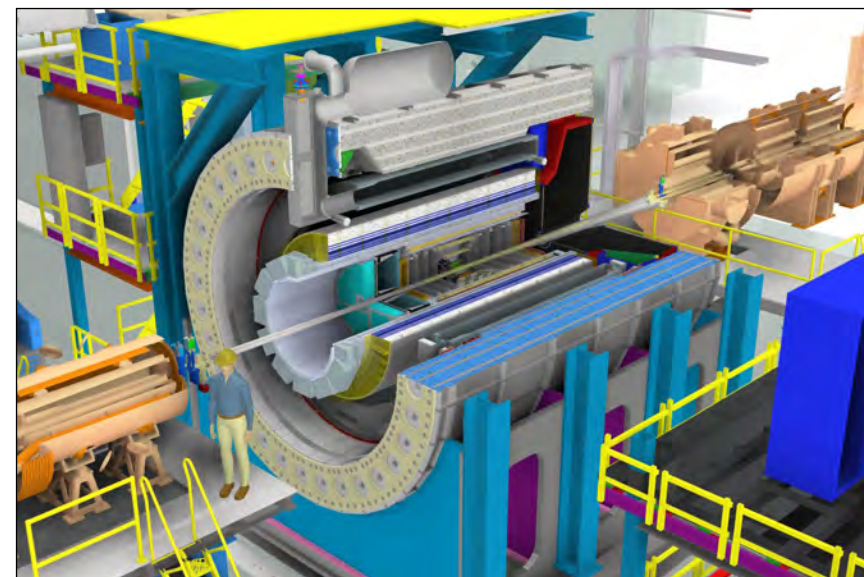


X-ray fluorescence (XRF) tomography on IBM's prototype PCM memory device (Courtesy of Christian Lavoie, IBM)

Electron-Ion Collider

Vision: *BNL will set the nuclear physics agenda for the next generation, designing, building, and operating the Electron-Ion Collider for the Nation with global impact.*

- Nobel Prize-worthy questions:
 - What is the origin of mass and spin in visible matter?
 - How do gluons generate the strongest force in nature?
- Project is underway:
 - ~\$3.1B TPC
 - CD-3B January 2026
 - \$402M costed to date
- “Portfolio” approach to ensure EIC is a success
- FY26 and FY27
 - Begin RHIC equipment removal and repurposing
 - Advance New York State scope
 - Initiate EIC construction



The ePIC detector at the Electron-Ion Collider

Artificial Intelligence



Vision: BNL will lead the use of embodied intelligence in science — integrating AI and humanoid robotics into our facilities so discovery unfolds in real time.

BNL will develop the science of AI and embrace AI for science.

Our mix of user facilities and experimental modalities is a microcosm of the DOE complex

BNL will address fundamental AI areas to advance our domain science:

- Multimodal foundational models
- Uncertainty quantification
- AI-enabled co-design
- Anomaly detection
- Scaling of AI (model size vs. agentic vs. distributed)

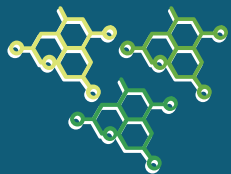


Humanoid robots will allow the introduction of embodied AI into facilities without having to retrofit them.

Quantum Information Science

Vision: BNL will lead the development of a distributed quantum computer with quantum advantage for DOE science.

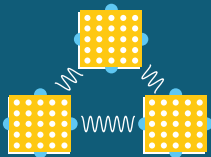
Quantum computing strategy builds on the successful Co-design Center for Quantum Advantage (C2QA)



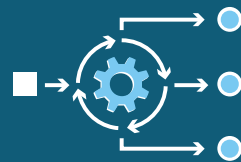
QIS materials



Quantum advantage for sensing



Scalable, fault-tolerant systems



Resource estimates and algorithms for quantum advantage

Materials science to:

- Improve coherence and fidelity
- Enable modular, extensible quantum computing

Quantum networking strategy builds on successful development of quantum network stack and testbed



- Heterogenous integration of quantum technologies
- AI-enabled scalability, classical-quantum advantage

Microelectronics Portal

Vision: BNL will establish itself as the portal for the U.S. microelectronics industry in next generation lithography and characterizing devices. It will lead development of new materials for information processing.



Potential SPP infrastructure investment at BNL~\$2B

A partnership between BNL, NY Creates, and SUNY for advanced semiconductor R&D

- Provide domestic, open-access facilities for early stage, collaborative research
- Start with X-ray metrology
- Reduce risk for companies developing next-generation EUV materials and components
- Develop a skilled workforce to grow the U.S. semiconductor sector

Timeline

- Phase I: Pilot program at NSLS-II & LBNL (FY26)
- Phase II: Expand pilot across DOE complex (FY27-28)

Brookhaven is Entering a Defining Decade

Our vision integrates world-leading user facilities, AI-enabled discovery, and impact across energy, environment, and national security.

Our strategy advances the Electron-Ion Collider and strengthens our discovery science enterprise. It expands applied and isotope programs.

Our organization aligns to execute major projects while accelerating science with AI and advanced computing as we also develop the next-generation workforce.

