Fermilab

May 21, 2026

Fermilab 2026

NORBERT HOLTKAMP
Fermilab Director

U.S. DEPARTMENT of ENERGY
Fermi National Accelerator Laboratory is managed by FermiForward for the U.S. Department of Energy Office of Science

FERMI NATIONAL ACCELERATOR LABORATORY

Fermilab at a glance

- America's particle physics and accelerator laboratory
- Operates the largest US particle accelerator complex
- ~1,900 staff and ~$780M/year budget
- 6,800 acres of federal land
- Facilities used by 4,000 scientists from >50 countries

As we move into the next 50 years, we will continue to drive leadership in neutrino science and deliver and operate world-leading accelerator and detector facilities that enable transformative discovery.

FERMI NATIONAL ACCELERATOR LABORATORY

The future of Fermilab

LONG-TERM VISION

Answering the important science questions in fundamental physics by building new instruments & executing groundbreaking experiments

NEAR-TERM VISION

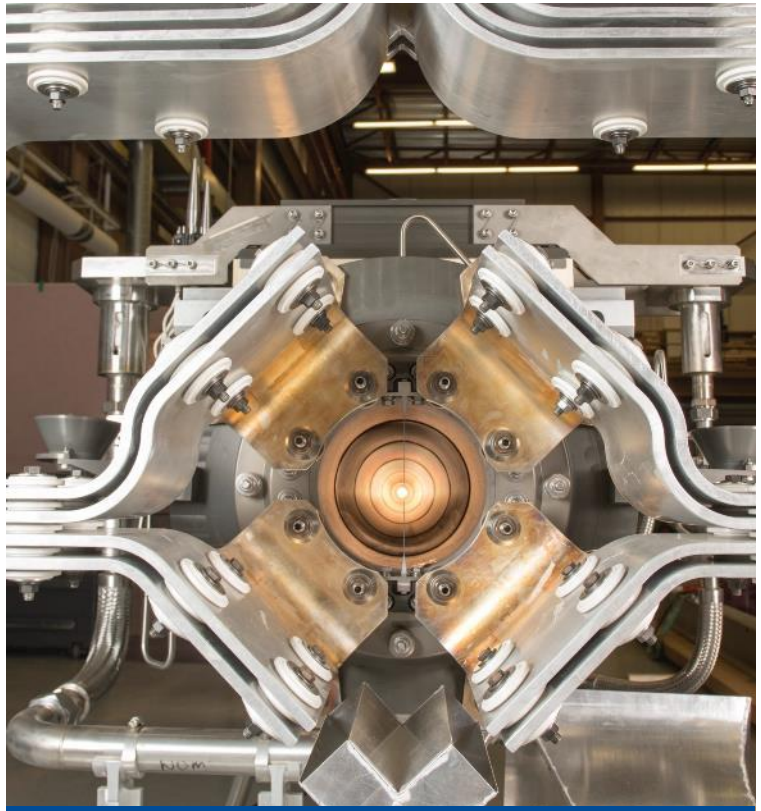
Current priorities are recognized science drivers and steppingstones towards compelling long-term vision

- Resolve the mysteries around the neutrino
- Use the Higgs boson as a new tool for discovery
- Drive technology and innovation for the benefit of science and society

From neutrinos to the Higgs boson to quantum science, Fermilab is shaping the next generation of scientific discovery and technology innovation

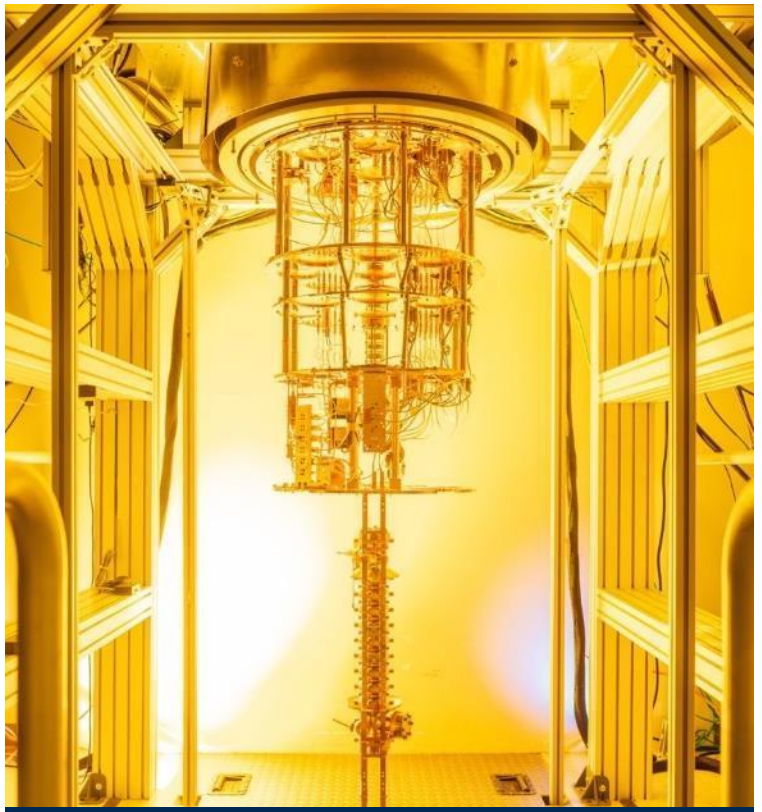
Our top priorities

We are **one lab.** We all work for **science.** We **focus.** We **collaborate.** We **execute.**



Beam to LBNF/DUNE-US by 2031

HL-LHC



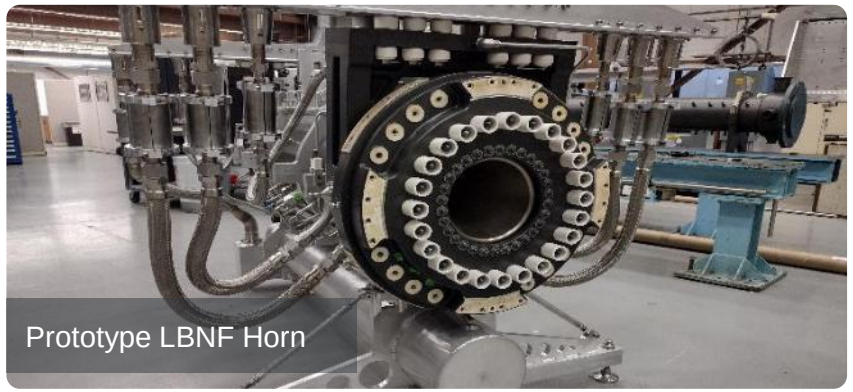
Driving Innovation

SCIENCE & TECHNOLOGY INITIATIVE

Enable a Next Phase of Neutrino Science with Beam to the DUNE Program in 2031

Launching Next Phase of Neutrino Science

Near-Term Vision: Address neutrino mysteries with the Deep Underground Neutrino Experiment (DUNE) and Long Baseline Neutrino Facility (LBNF)


Prototype LBNF Horn


DUNE Collaboration

1,500 scientists and engineers from more than 200 institutions in over 35 countries

- **Complete** the construction and commissioning of LBNF, the new PIP-II accelerator, and DUNE detectors
- **Provide** a more reliable and resilient Fermilab Accelerator Complex for the DUNE era
- **Operate** the ongoing programs which provide the scientific and technology foundation for DUNE Program

DUNE is the culmination of 25 years of global neutrino experiments

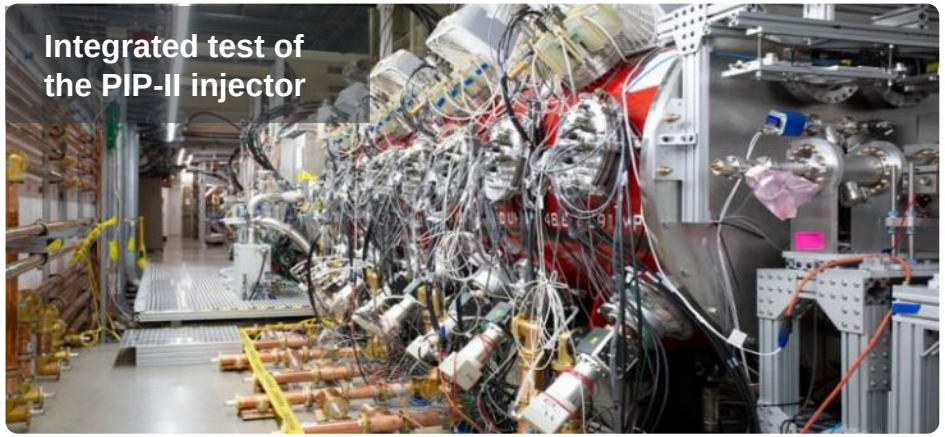
DUNE cryostat construction begins!

PIP-II: Proton Power for Research and Discovery

- State-of-the-art superconducting linear accelerator
- Unique in the US: extremely high duty factor, high power proton beam
- 2 MW of continuous proton power available for new beamlines in addition to LBNF/DUNE

Milestones

2026 // Accelerator installation
2027 // Cryoplant commissioning
2028 // Tie-in to existing complex
2029 // PIP-II commissioning



PIP-II provides a powerful and flexible beam for particle physics and beyond

Early data can help answer big questions

Guaranteed unambiguous (>5σ) mass ordering discovery

- Why are neutrinos so light?
- Where does neutrino mass come from?

World-leading measurements of ν_μ oscillation parameters

- Are there symmetries in neutrino oscillations?
- How are they broken?

Sensitivity to new physics in neutrino oscillations

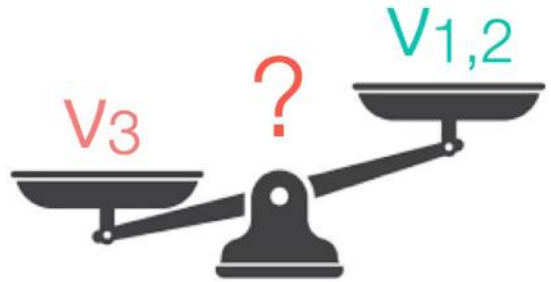
- Is the Standard Model complete?

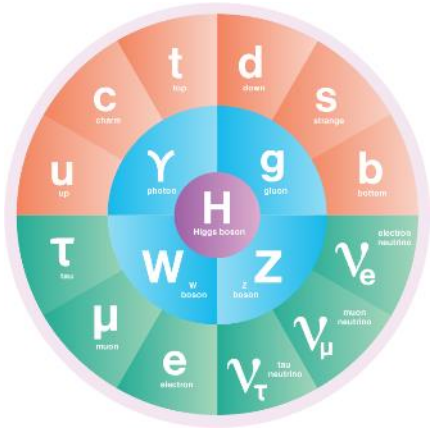
Study neutrinos from the sun and dying stars

- Complete our understanding of solar neutrino emission
- What does the birth of a black hole look like?

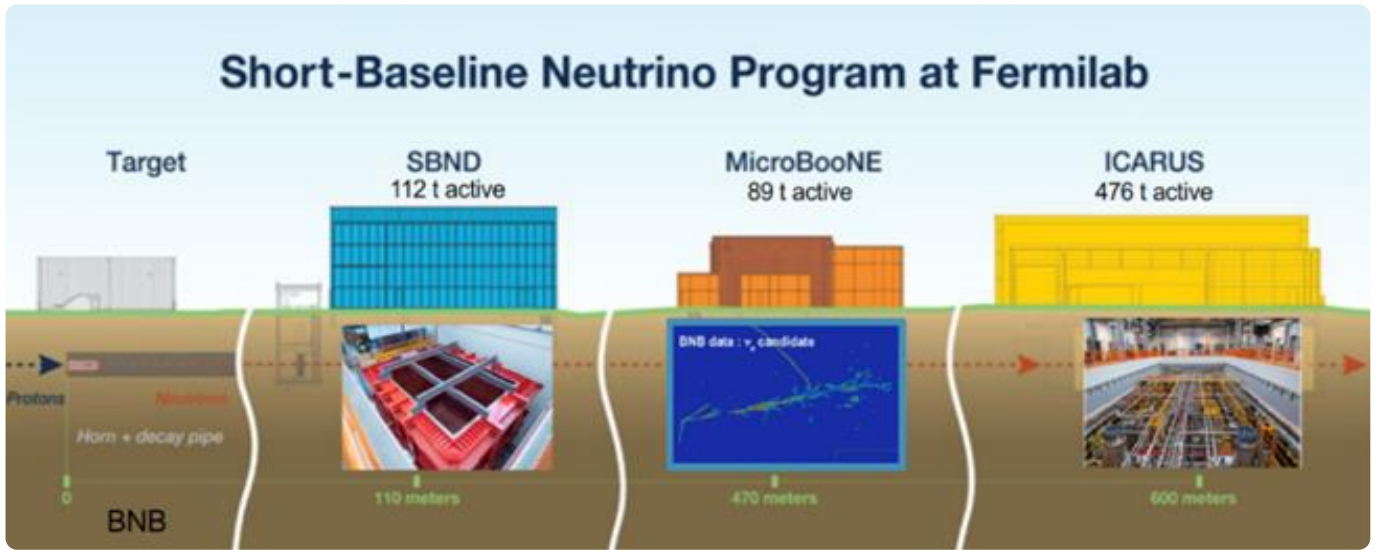
Sensitivity to dark matter in the beamline

- What is the nature of dark matter?





Delivering Science: Building Future Capability



Mu2e

Investigating Lepton Flavor Violation

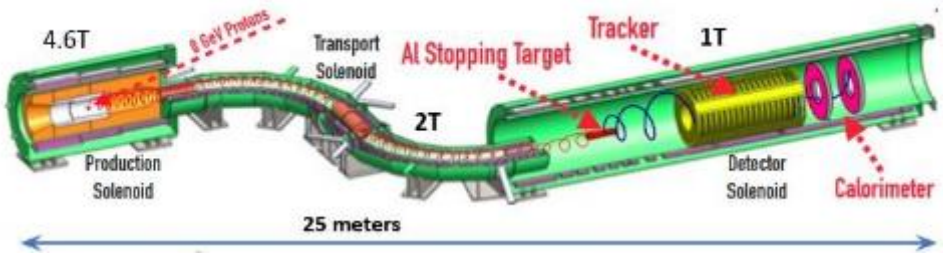
- Unprecedented muon intensity
- Muon conversion with 10,000× statistics

Short Baseline Neutrino Program

Measuring neutrino properties and gaining critical experience with liquid argon detectors

Laying a strong foundation – Transition to DUNE

Mu2e progress



Production solenoid [here]

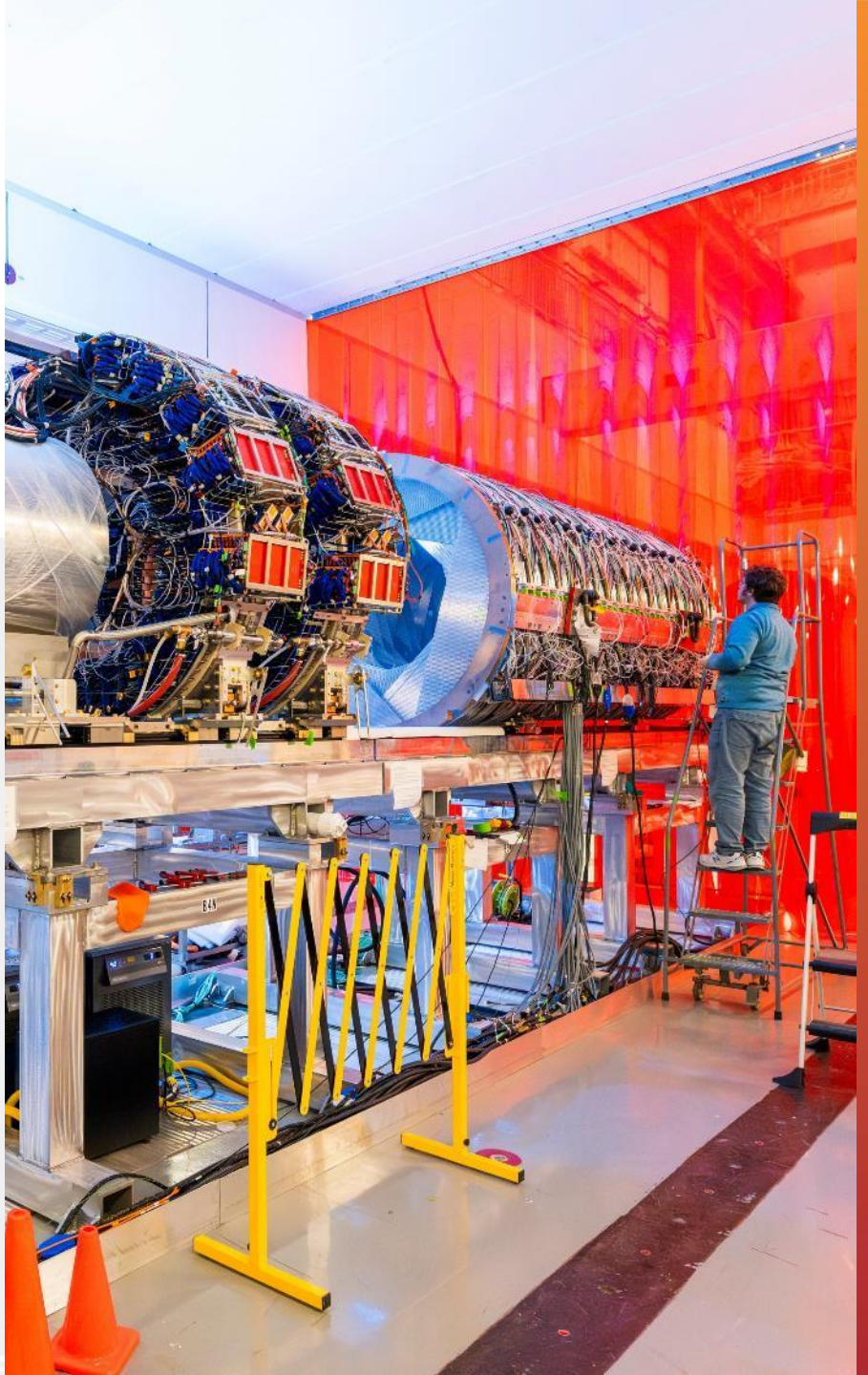
The production solenoid was delivered to Fermilab in Aug. 2025. This solenoid holds the target that creates the pions that decay into the muons for the experiment to study.

Transport solenoid [here]

The two magnets that make up the transport solenoid were moved into the Mu2e hall in Dec. 2023 and Feb. 2024. This solenoid's unique sinuous shape helps reduce the background noise for the experiment.

Detector solenoid – it's coming!

The detector solenoid is scheduled to be delivered this year. It will contain two of Mu2e's subdetectors — the calorimeter and the tracker.



SCIENCE & TECHNOLOGY INITIATIVE

Drive High Luminosity Large Hadron Collider (HL-LHC) Physics and Discovery

Leading U.S. Efforts at CERN's HL-LHC

Near-Term Vision: Capitalize on U.S. and international HL-LHC investments to advance Higgs particle science in the 2030s

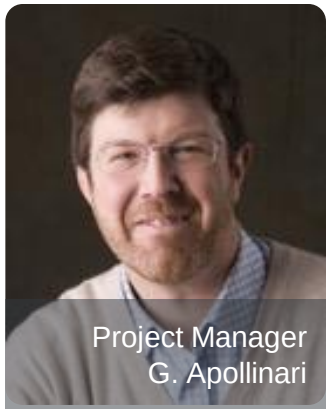

HL-LHC Magnet produced with advanced Nb_3Sn Technology


Calorimeter Endcap Cassette Demonstration

- **Complete** the U.S. contribution to both the HL-LHC Accelerator and CMS Detector Upgrade Projects
- **Provide** robust support of the CMS research program in the U.S. via our LHC Physics Center
- **Operate** the largest and most capable Tier 1 Data Center for CMS (40% global share)

Enabling immediate exploitation of the physics of the HL-LHC

HL-LHC Accelerator Upgrade Project

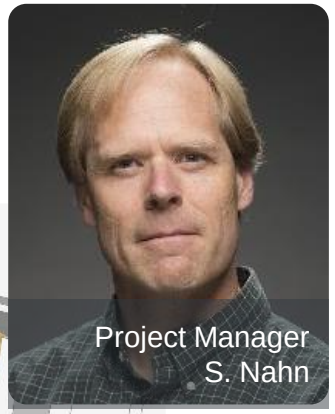

Project Manager
G. Apollinari

- DOE is contributing to the HL-LHC Accelerator Upgrade Project (AUP TPC - $266M)
  - 10 Cryo-assemblies
  - 10 SRF Crab Cavities
- In-kind deliveries to CERN are in progress (~50% delivered)
- Project on track to complete by late CY27 (~2 years ahead of scheduled CD4)

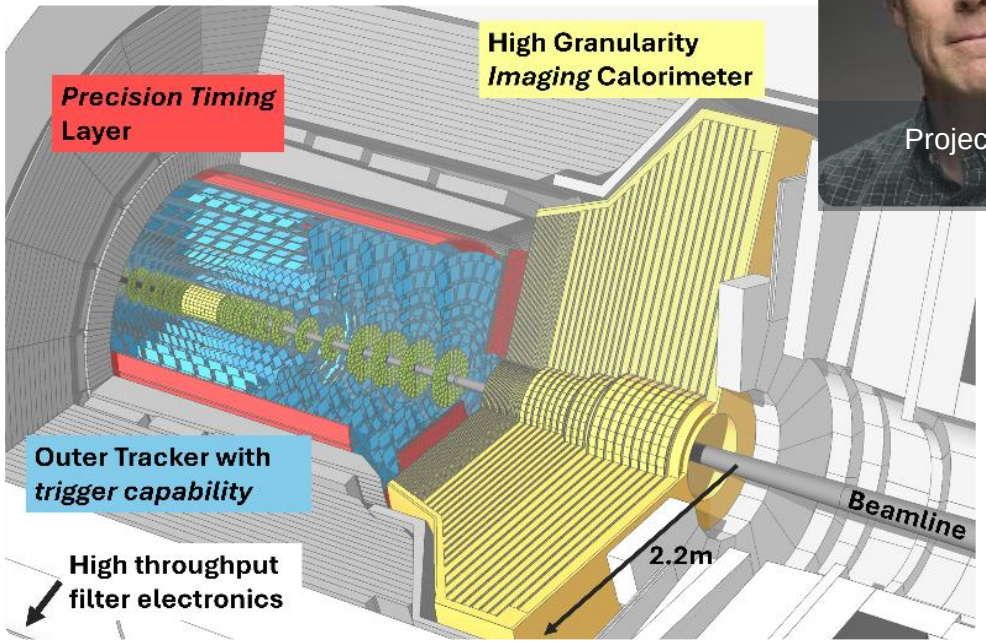
DOE Secretary Wright saw one of the record-setting magnets that will be the first of its kind to operate in a particle accelerator. The magnets will enable the upgraded LHC to provide 10x the current number of collisions.

Higher luminosity beam answers science questions in five versus fifty years

HL-LHC CMS Detector Upgrade Project



- Fermilab leads over 45 U.S. institutions building next-gen particle detectors for the HL-LHC
  - Cultivates next generation of U.S. scientists
  - Maintains U.S. leadership in international science
- CMS Detector Upgrade in production (TPC- $200M)
  - Assembly centers across U.S. established, ramping to full throughput
  - Early completion of U.S. project end of 2028 (CD-4 at end of 2030)
- Extreme environment drives innovation



Microelectronics and AI initiatives combine in adaptive, rad-hard, and ultra-fast ECON ASIC with embedded AI

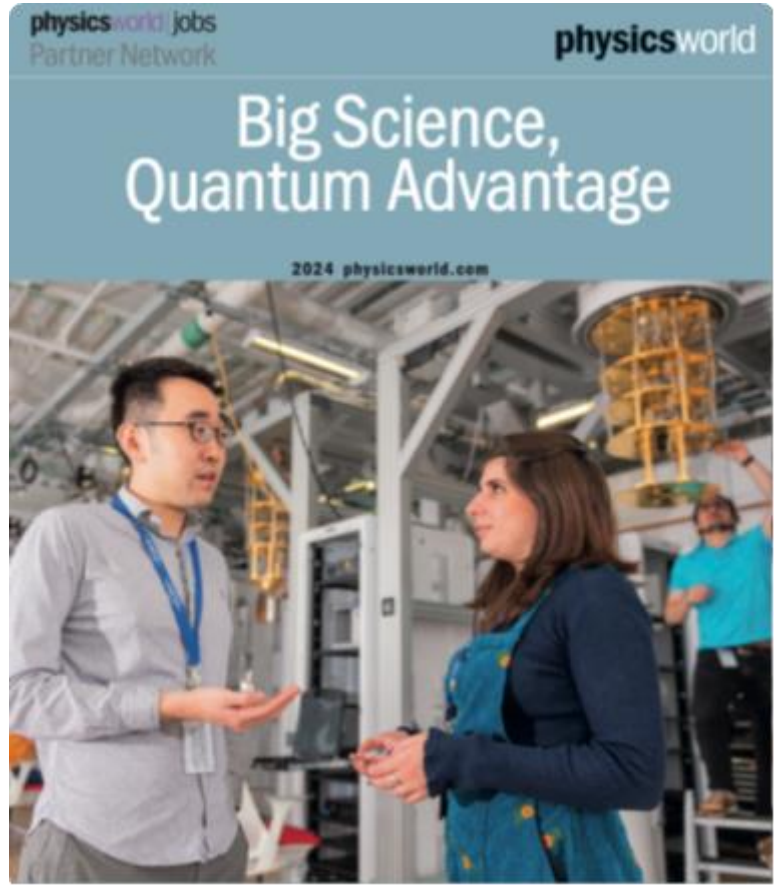
CMS upgrade is detector innovation at the bleeding edge of possibility

DRIVING INNOVATION

Apply World Leading Capabilities to Deliver Innovative Technologies and Enhance National Competitiveness

Technology is Shaping the Future of Discovery

- What new discoveries become possible with **quantum-enabled measurement**?
- How do we build **scalable quantum systems** that unlock new regimes of computation and sensing?
- How can **cryogenic materials science** unlock higher performance in quantum systems and next-generation microelectronics?
- How can **AI and advanced computing** accelerate scientific discovery across DOE missions?
- What breakthroughs in **accelerator science** are needed for next-generation facilities?
- How do we build **integrated, scalable systems** that combine physics, engineering, and computation?



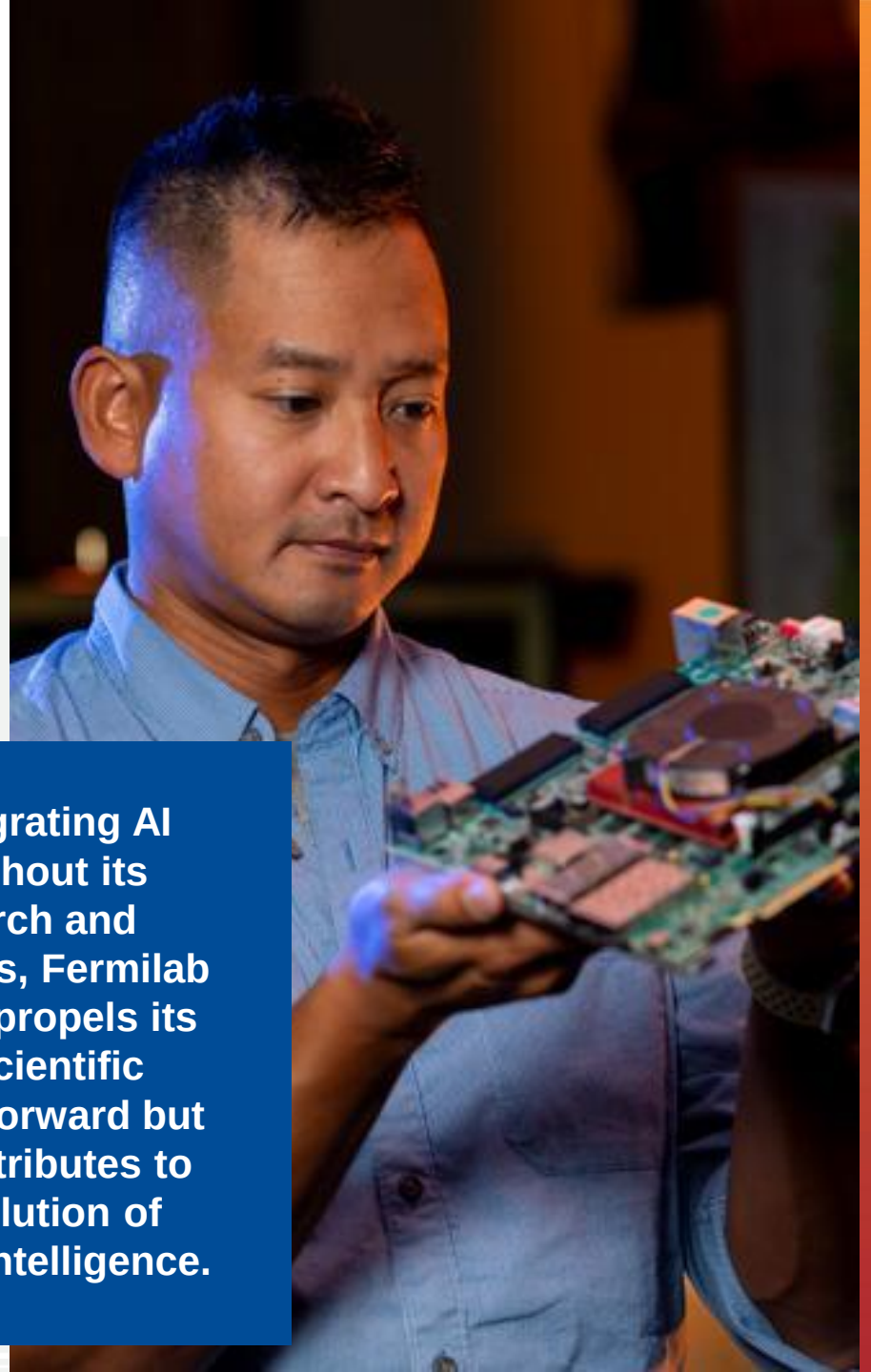
Innovating technologies goes hand-in-hand with advancing science

How AI enhances scientific goals of particle physics

Advancing discovery in high-energy physics research

Developing national AI capabilities that build on the challenges of particle physics and technologies

Fostering collaboration to address interdisciplinary AI challenges and share insights with scientific and technology partners



By integrating AI throughout its research and operations, Fermilab not only propels its own scientific mission forward but also contributes to the evolution of artificial intelligence.

FERMI NATIONAL ACCELERATOR LABORATORY

A symbiotic relationship

AI plays a key role across many of our **core research and mission areas**:

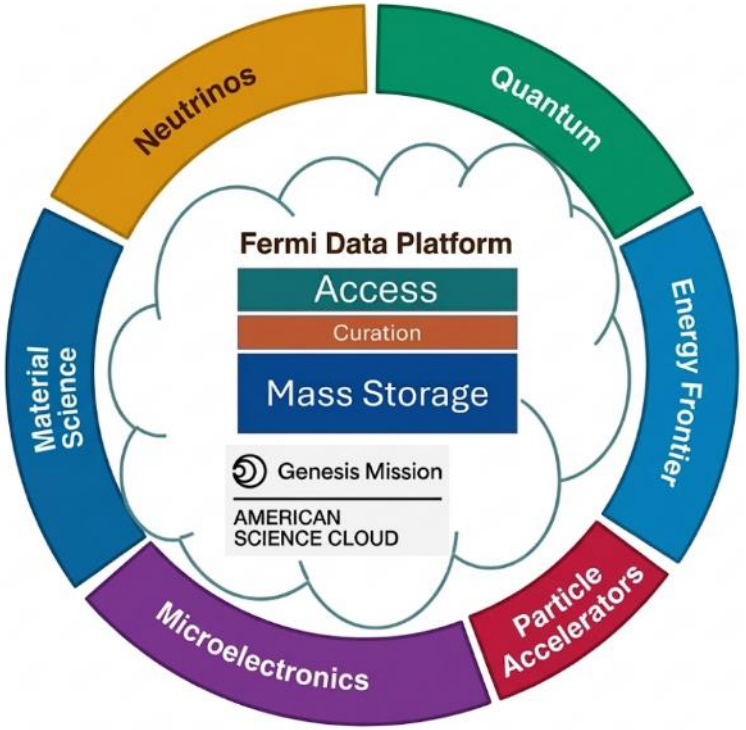
- Neutrino experiments
- Accelerator research
- Quantum information science
- Smart detectors and sensors
- Particle physics at colliders
- Astrophysics
- Business operations

Fermilab plays a central role in the **DOE's Genesis Mission**, a national initiative to **double U.S. scientific productivity through AI,** quantum technologies and advanced computing.

Fermilab's leadership in AI-enabled research, quantum science, microelectronics, and the design and operation of some of the world's most complex scientific instruments will be essential to the success of Genesis.

FNAL Vision for Supporting the Genesis Platform

Years of investments have built **world-class** workforce and infrastructure in **quantum** S&T, **cryogenics**, **AI-ready data serving**, major industry partnerships



Unique infrastructure and expertise to advance the Genesis Platform

Genesis AI for Science Early Wins

Genesis Mission

Accelerated Microelectronics Design in Extreme Environments

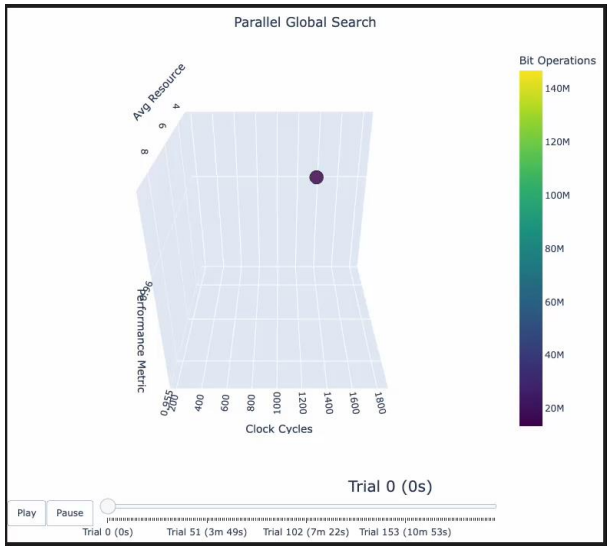
Speedup of circuit design from months to hours

AMD

SIEMENS

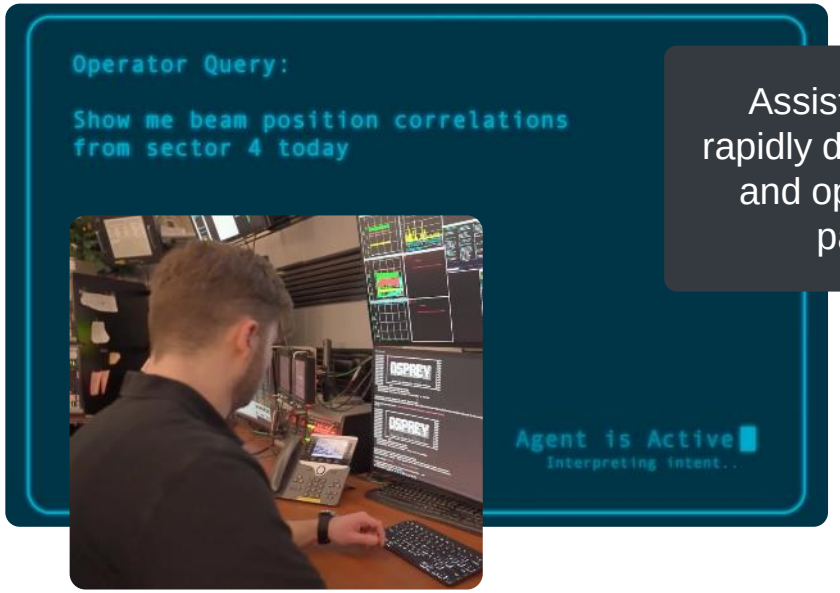
GlobalFoundries

Deploying novel AI surrogates on Genesis compute for 500x speed up in design exploration for qubit readout



Agentic AI Accelerator Operations

FNAL high-power proton facility part of multi-lab, cross-facility/program team pushing state-of-the-art for accelerator AI assistant capabilities



Assists operators in rapidly diagnosing issues and optimizing beam parameters

Genesis Model Teams working towards June showcase for America 250

FERMI NATIONAL ACCELERATOR LABORATORY

2026 DPF AT FERMILAB

July 20–24

FERMILAB, BATAVIA, IL

Physics contains multitudes.

Meeting of the **Division** of **Particles** & **Fields** of the American Physical Society

REGISTER TODAY:

dpf2026.fnal.gov

Fermilab

APS Division of Particles & Fields DPF

2026 Biannual Meeting Special Events

July 20

Particle Physics: Uncovering the Secrets of the Universe

- Public lecture by Mark Thomson, CERN Director-General

July 24

Future of High Energy Physics

- Panel discussion, in coordination with the Fermilab Users and Affiliates meeting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