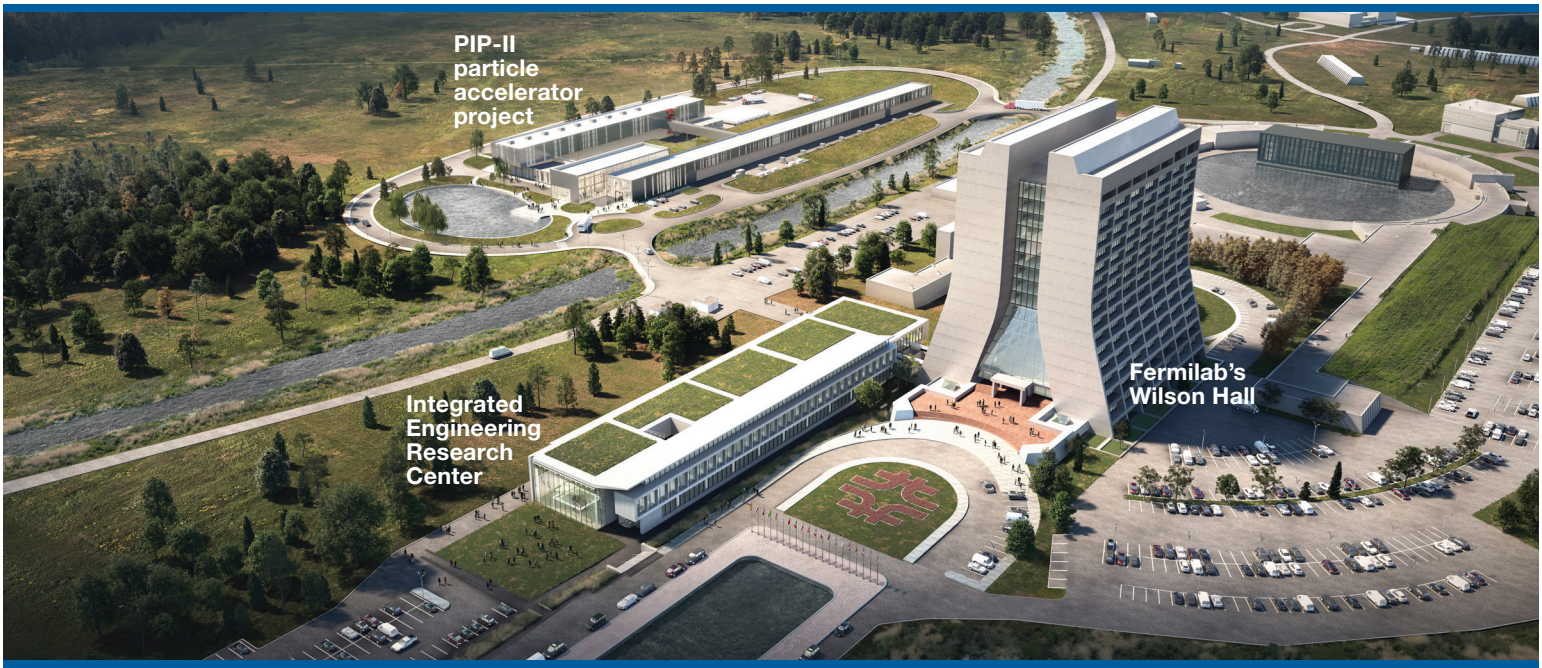
Fermi National Accelerator Laboratory

Fermilab is America's premier laboratory for particle physics and accelerator research, funded by the U.S. Department of Energy. Thousands of scientists around the world collaborate with Fermilab on research at the frontiers of discovery.



The PIP-II particle accelerator will be the new heart of the lab's chain of accelerators and power the neutrino beam for the Deep Underground Neutrino Experiment.

Particle physicists aim to discover what the universe is made of and how it works. They study the smallest building blocks of matter using some of the largest and most complex machines in the world.

Fermilab hosts a range of cutting-edge experiments and develops and builds technologies that support particle physics research at locations around the world, including deep underground laboratories in South Dakota and Canada, the Large Hadron Collider in Europe, and the South Pole Telescope.

Together with our international partners, we expand humankind's understanding of matter, energy, space and time, capturing imaginations and inspiring future generations.

The world comes to Fermilab

About 4,000 scientists from over 50 countries use Fermilab and its accelerators, detectors and computing facilities annually.

Almost 1,000 university students participate in our research and programs every year.

Fermilab reaches around 100,000 people per year through its education, public engagement and live online programs.

More than 2,470 graduate students have received their Ph.D. degrees based on research at Fermilab.

Fermilab contributes electronics and other critical components to upgrades to the CMS particle detector and the Large Hadron Collider at CERN.

Scientists from research institutions in 41 states and 55 countries collaborate with Fermilab.

New neutrino experiments and a new particle accelerator

More than 1,400 scientists from over 35 countries are building the international Deep Underground Neutrino Experiment, hosted by Fermilab. The new Long-Baseline Neutrino Facility will send a neutrino beam from Fermilab in Illinois through Earth to a giant neutrino detector at the Sanford Underground Research Facility in South Dakota.

To find out whether there are more than three types of neutrinos, Fermilab is building and operating the ICARUS, MicroBooNE and SBND particle detectors, which make up the laboratory's Short-Baseline Neutrino Program.

Construction is underway at PIP-II, a 700-foot-long superconducting linear particle accelerator, ensuring the long-term future of Fermilab's accelerator complex. It will power the world's most intense beam of high-energy neutrinos for the Deep Underground Neutrino Experiment.

Fermilab and the Large Hadron Collider

Fermilab played key roles in the Nobel Prize-winning discovery of the Higgs particle at CERN's Large Hadron Collider in Switzerland, from constructing equipment to analyzing data. It is the U.S. lead institution in the CMS experiment at the LHC.

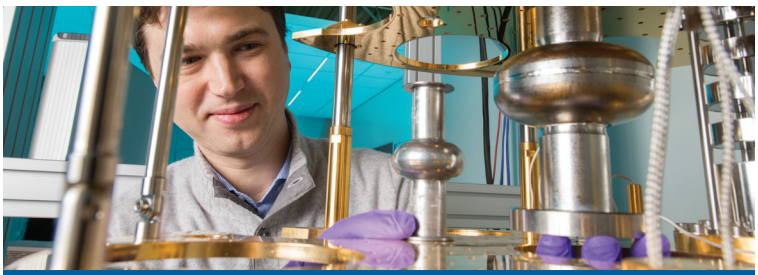
Scientists at Fermilab develop and contribute critical components for upgrades to the LHC and CMS. The Fermilab computing facility provides more computing power to CMS than any site outside of CERN.

Quantum science, artificial intelligence, machine learning

Fermilab applies its expertise to the field of quantum information science, focusing on quantum computing, quantum sensors and quantum communication. The lab is home to the Superconducting Quantum Materials and Systems Center, a national QIS center.

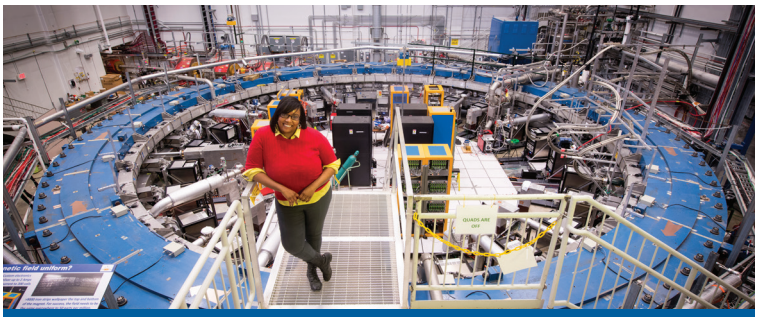
Researchers at Fermilab are leaders in artificial intelligence and machine learning for particle physics, using AI and ML to analyze big data sets and improve sensors operating in extreme environments.

Fermilab operates the second-largest particle accelerator complex in the world. The Main Injector produces the world's most powerful neutrino beam.



Fermilab advances technologies for quantum science, including quantum computers and sensors.

Scientists have built this prototype particle detector for the international Deep Underground Neutrino Experiment. The final detector modules, to be built in South Dakota, will be 20 times larger than this prototype.



Muon g-2 scientists have found strong evidence for new physics. Muons don't behave as predicted and might interact with hidden forces.

Dark matter and dark energy

Using the cosmos as a laboratory, Fermilab scientists explore dark matter and dark energy, which constitute 96% of the universe.

Scientists are analyzing the data of the Dark Energy Survey, which mapped one quarter of the southern sky and recorded 300 million galaxies, 100,000 galaxy clusters and 4,000 supernovae.

Fermilab scientists work on the next generation of experiments that will explore the dark universe, including the Super Cryogenic Dark Matter Search and the Large Synoptic Survey Telescope.

Muon experiments

Fermilab's precision experiments with muons, cousins of the electron, allow scientists to explore energy scales far beyond those accessible at the highest-energy colliders.

First results from the Muon g-2 experiment strengthen evidence of new physics. They show muons behaving in a way not predicted by theory.

The Mu2e experiment, currently under construction, aims to reveal new symmetries that may show how subatomic forces unify at high energies, as happened in the early universe.

Innovation

Fermilab is a world-leading center for superconducting magnets and radio-frequency cavities, crucial technologies for accelerators that also have potential in quantum computing and materials science.

Fermilab's computing innovations have led to multiple applications, driven by our need to process massive amounts of information, store it and transmit it effectively.

From medical treatments to quantum science, innovative technologies from particle physics help transform the way we live.