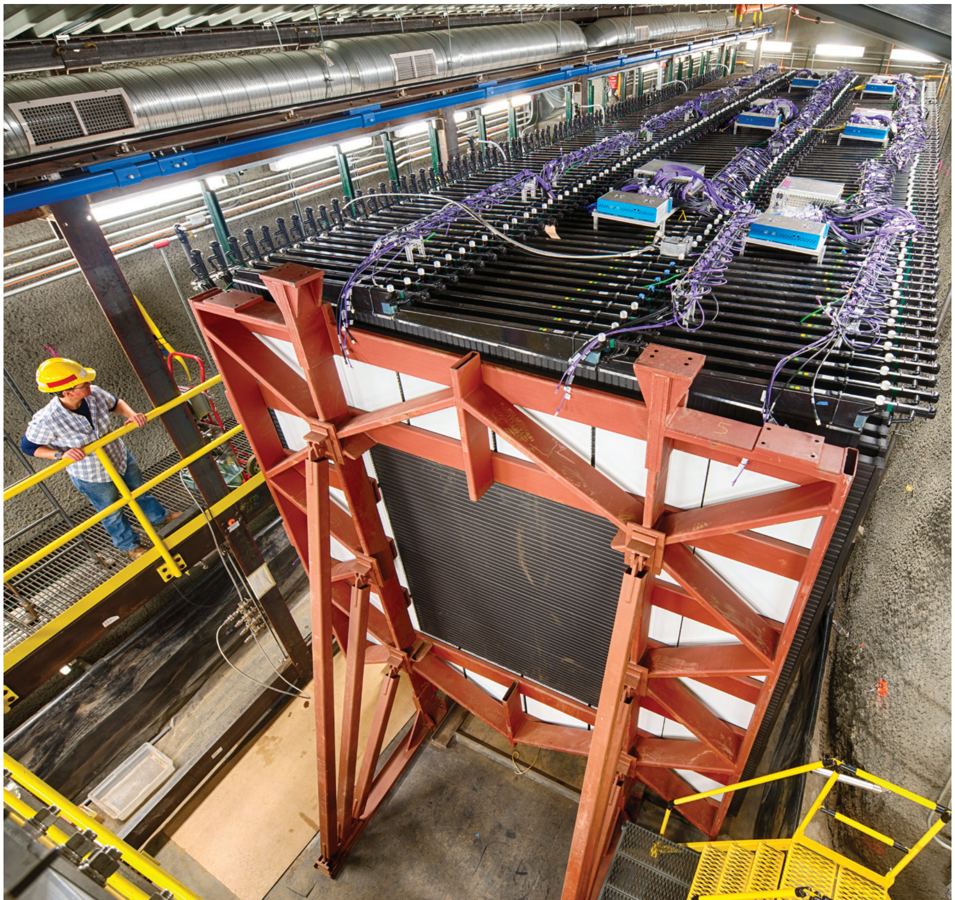
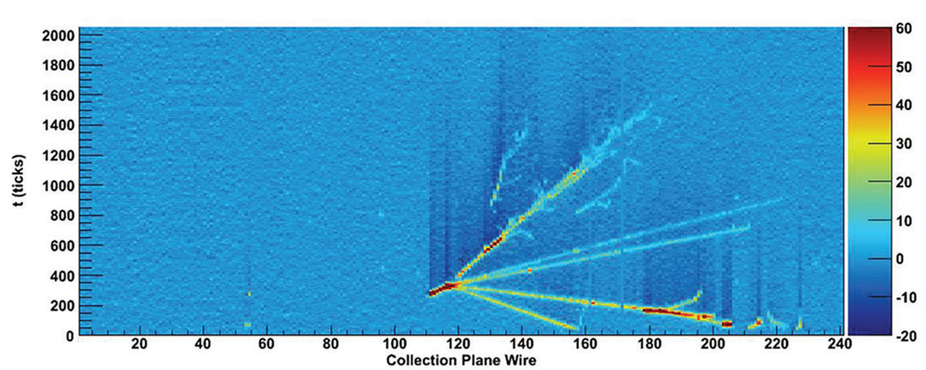
Neutrino experiments at Fermilab

Scientists from around the world use Fermilab's particle accelerator complex to research some of least understood particles in the universe: neutrinos. A suite of experiments aims to discover the role that these mysterious particles played in the evolution of the universe.



Neutrinos are extraordinarily light: Each weighs less than a millionth of the mass of an electron. While we don't know the absolute mass of the neutrino, we do know that its three known types have different masses. With the NOvA experiment, scientists aim to discover the mass ordering of the three types.

Particle tracks created by a neutrino interaction in liquid argon.



Mysterious neutrinos

Neutrinos are among the most abundant particles in the universe. Each second, a trillion neutrinos from the sun and other celestial objects pass through your body. Although neutrinos are all around us, they are very difficult to study. Neutrinos go through all matter and rarely leave a trace.

Why are neutrinos important?

Neutrinos may provide the key to answering some of the most fundamental questions about the nature of our universe. The discovery that the three known types of neutrinos oscillate and transform into each other has revolutionized scientists' understanding and raised new questions about matter, energy, space and time. Neutrinos might be the reason we exist, why the universe is filled with matter rather than light and radiation.

Intense beams for groundbreaking experiments

Fermilab strives to be the best laboratory for neutrino research in the world. Its particle accelerator complex produces the most intense beams of high-energy neutrinos. The laboratory operates several neutrino detectors that weigh from a few hundred pounds to more than 14,000 tons, employ different detection technologies and probe neutrino beams at short and long distances, from a few hundred meters to 800 kilometers. These detectors enable scientists to study neutrino oscillations, search for new neutrino interactions and look for new types of neutrinos.

Plans for the future

An international collaboration of scientists plans to use the Fermilab accelerator complex for the Deep Underground Neutrino Experiment, powered by the Long-Baseline Neutrino Facility. It would send neutrinos 1,300 kilometers through Earth's crust from Fermilab in Batavia, Illinois, to the Sanford Underground Research Facility in Lead, South Dakota. That distance is ideal for discovering subtle differences in neutrino and antineutrino oscillations, perhaps the key to the dominance of matter in our universe. For more information, visit neutrino.fnal.gov.