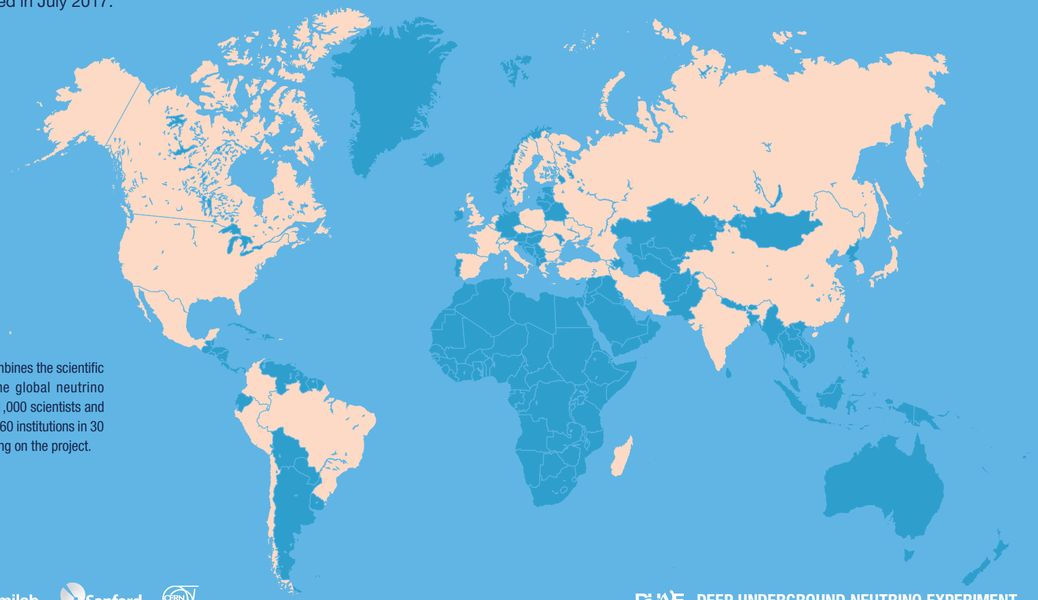
LBNF/DUNE
An international mega-science project hosted by the US

The **Long-Baseline Neutrino Facility (LBNF)** is the world's flagship science project to unlock the mysteries of neutrinos, the particles that could be the key to explaining why matter and the universe exist. Hosted in the United States, the international LBNF project takes advantage of existing US facilities. Construction takes place at the Department of Energy's Fermi National Accelerator Laboratory in Illinois—home of the world's most intense neutrino beam—and the Sanford Underground Research Facility in South Dakota, the deepest science laboratory in the United States.

LBNF will house the infrastructure and particle detectors for the international **Deep Underground Neutrino Experiment (DUNE).** The LBNF project will provide the huge caverns, buildings and infrastructure that DUNE will need in Illinois and South Dakota. Groundbreaking for the LBNF caverns at Sanford Lab occurred in July 2017.

About 1,000 scientists and engineers from more than 30 countries are developing the state-of-the-art technologies for this global mega-science project, including the massive DUNE particle detectors. The European Organization for Nuclear Research, CERN, is a leading partner and has committed to develop and deliver key components for the project, with additional contributions coming from institutions and funding agencies from around the world.

LBNF/DUNE will build on the strong partnership established between DOE and CERN and the strategic plans endorsed by the European and US particle physics communities. Bringing together scientists from around the world, it will drive neutrino science forward the way CERN's Large Hadron Collider drove the Nobel Prize-winning discovery of the Higgs boson.



The LBNF/DUNE project combines the scientific goals and expertise of the global neutrino physics community. About 1,000 scientists and engineers from more than 160 institutions in 30 countries are already working on the project.

U.S. Department of Energy · Fermilab · Sanford Underground Research Facility · CERN

DUNE DEEP UNDERGROUND NEUTRINO EXPERIMENT

LBNF/DUNE BY THE NUMBERS

3 TYPES OF NEUTRINOS
Discovered so far, including the discovery of the tau neutrino at Fermilab

2015 NOBEL PRIZE
Awarded for the discovery of neutrino oscillations, the science at the core of DUNE

10 TRILLION NEUTRINOS
Number of neutrinos from the sun that go through your body every second, even when it is dark

0.004 SECONDS
Time that neutrinos need to travel the 800 miles (1300 kilometers) from Fermilab in Illinois to the Sanford Underground Research Facility in South Dakota

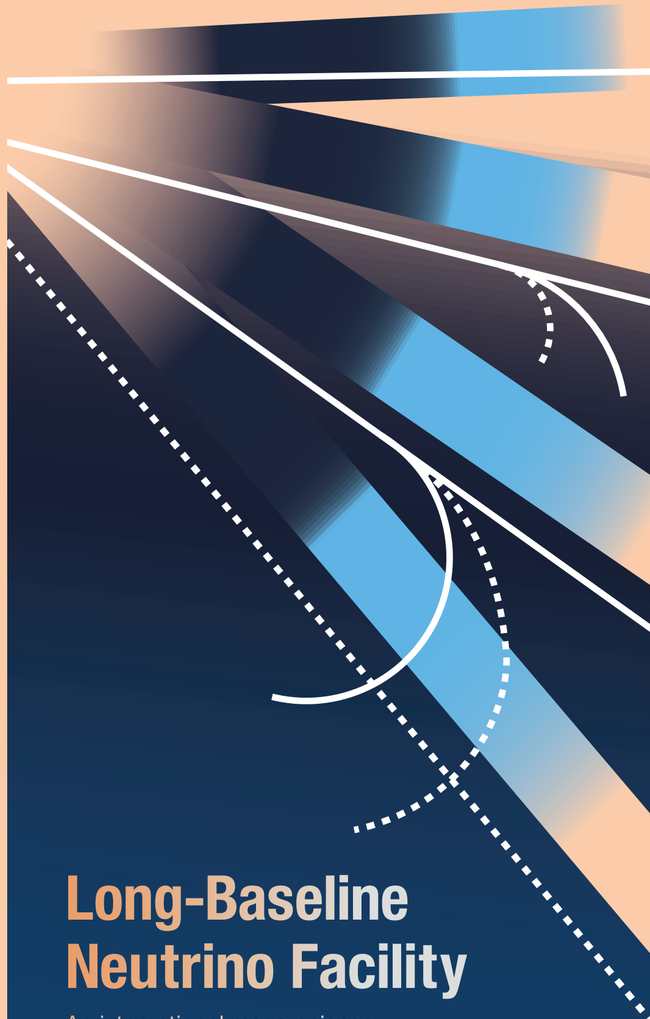
1.2 MILLION WATTS
Power of the Fermilab proton beam that will create neutrinos for DUNE

800,000 TONS
Amount of rock to be excavated to create the LBNF caverns for DUNE, about the weight of eight aircraft carriers

-300 DEGREES FAHRENHEIT
Temperature of the liquid argon in the DUNE particle detectors (-184 degrees Celsius)

70,000 TONS
Amount of liquid argon necessary to fill the DUNE detectors, 100 times more than previous detectors of this kind

Learn more about LBNF/DUNE at: **lbnf.fnal.gov** and **dunescience.org**



Long-Baseline Neutrino Facility

An international mega-science project for hosting the Deep Underground Neutrino Experiment in the United States

Deep Underground Neutrino Experiment at the Long-Baseline Neutrino Facility

An international mega-science project in the US

The Deep Underground Neutrino Experiment is the world's flagship neutrino project, driven by the ingenuity and expertise of scientists in more than 30 countries. More than 160 laboratories and universities are contributing to the development of particle accelerator and detector technologies for DUNE in the quest to understand how the universe works. The Long-Baseline Neutrino Facility will provide the huge caverns, buildings and infrastructure for hosting the project in the United States. Groundbreaking for the LBNF construction at Sanford Lab occurred in July 2017.

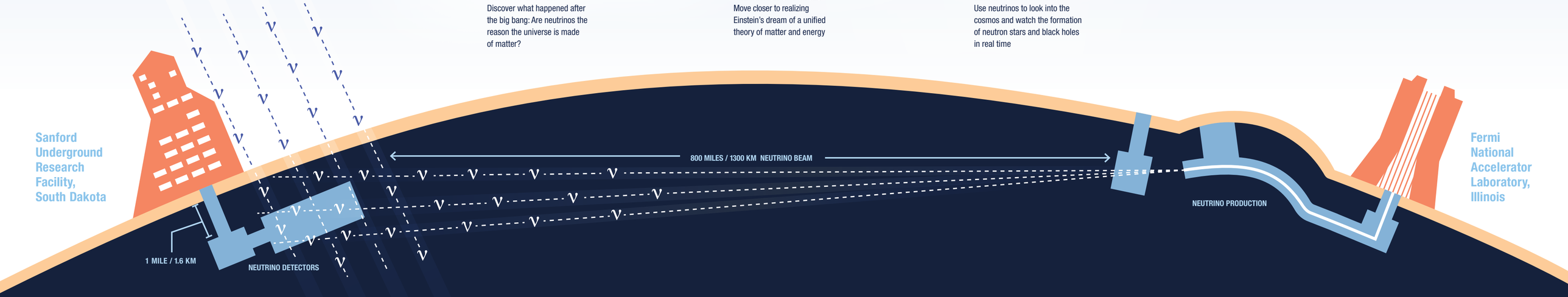
ORIGIN OF MATTER
Discover what happened after the big bang: Are neutrinos the reason the universe is made of matter?

UNIFICATION OF FORCES
Move closer to realizing Einstein's dream of a unified theory of matter and energy

BLACK HOLE FORMATION
Use neutrinos to look into the cosmos and watch the formation of neutron stars and black holes in real time

What is a neutrino?

Neutrinos are all around us. They are the most abundant matter particles in the universe. Each second, a trillion neutrinos pass through our bodies, yet very little is known about them. In nature, neutrinos are produced in great quantities in the sun and other stars. In the laboratory, scientists can make neutrinos and their antimatter counterparts—antineutrinos—with particle accelerators to learn more about the role they play in the universe.

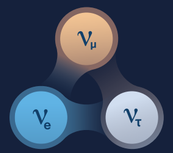


The world's best neutrino detector, located almost a mile underground

The mile-deep LBNF caverns at the Sanford Underground Research Facility will house the huge, 70,000-ton particle detectors of the international Deep Underground Neutrino Experiment. The deep location will shield the experiment from the cosmic rays that bombard earth's surface, while neutrinos easily travel through the rock to reach the supersensitive DUNE detectors.

HIGH-PRECISION PARTICLE TRACKS
The DUNE detectors will employ state-of-the-art liquid-argon technology to record particle tracks with unprecedented precision. The technology is key to searching for new subatomic phenomena and transforming our understanding of neutrinos and their role in the universe.

LONG-DISTANCE NEUTRINO BEAM
The distance between Fermilab and the Sanford Underground Research Facility is ideal for learning more about the origin of matter: it will give neutrinos and antineutrinos enough time to oscillate and reveal how matter and antimatter behave differently.



The world's most intense particle accelerator for neutrino research

DUNE needs neutrinos and antineutrinos. Lots of them. The powerful particle accelerator complex at the Department of Energy's Fermilab is the perfect tool. The Long-Baseline Neutrino Facility at Fermilab will produce the world's most intense neutrino and antineutrino beams and send them 800 miles (1300 kilometers) straight through the earth to the DUNE detectors—no tunnel necessary.

Design by Sandbox Studio, Chicago