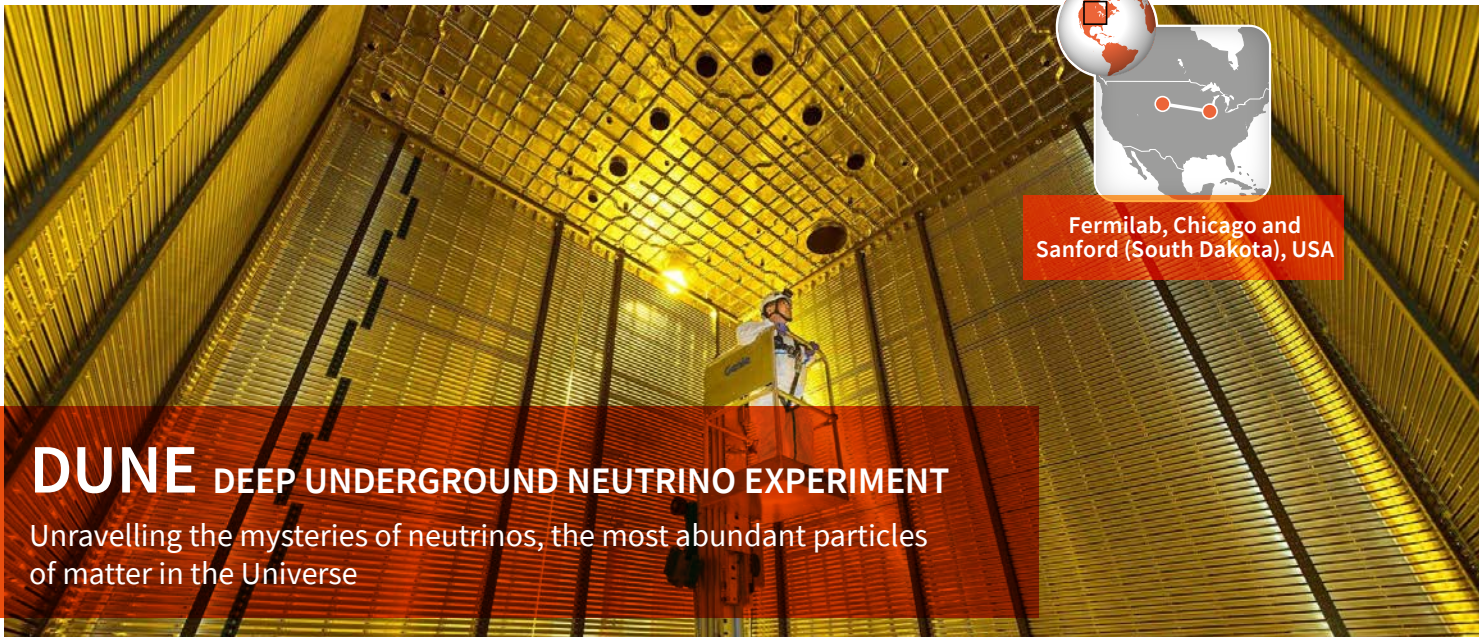


The origin, nature, masses and mixing of neutrinos



Fermilab, Chicago and Sanford (South Dakota), USA

DUNE DEEP UNDERGROUND NEUTRINO EXPERIMENT

Unravelling the mysteries of neutrinos, the most abundant particles of matter in the Universe

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- **Laboratories involved:** APC (Paris), CC-IN2P3 (Lyon), IJCLab (Orsay), IP2I (Lyon), LAPP (Annecy), LPSC (Grenoble)
- **Nature:** research infrastructure
- **Status:** international project under construction
- **Website:** <https://www.dunescience.org/>

SCIENTIFIC OBJECTIVES

The study of neutrinos is a major challenge: they could play a role in explaining the predominance of matter over antimatter in the Universe via CP violation. Thanks to the neutrino beam, DUNE should make it possible to determine the mass hierarchy of neutrinos and to search for CP violation in the lepton sector. The experiment will also study neutrinos from supernova explosions, and the stability of matter through the search for the lifetime of the proton. All these measurements will explore physics beyond the Standard Model and elucidate fundamental problems in cosmology and astrophysics.

RESOURCES DEPLOYED

- A beam of muon neutrinos and antineutrinos produced by the accelerator complex at Fermilab (Illinois), of unprecedented intensity thanks in particular to a new linear accelerator (PIP-II), and directed towards the distant DUNE detector, 1 300 km away.
- A set of nearby detectors at Fermilab, to precisely characterise the neutrino beam before it travels.
- A gigantic distant detector in South Dakota, 1 500 m underground, with 4 detection modules. Each module is a 62x14x14 m³ parallelepiped, containing 17 kt of liquid argon and instrumented in a Time Projection Chamber (TPC) to study in detail the interactions of neutrinos with argon.

1 300 international contributors

32 countries

201 laboratories world-wide

15 years of operation

15 years of study

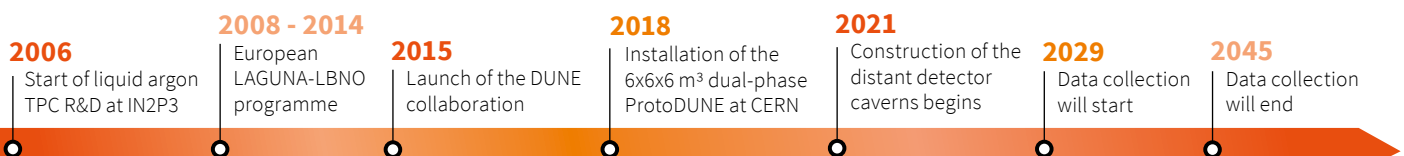
68 kilotonnes of ultra-pure liquid argon

IN2P3 CONTRIBUTIONS

- Design and construction of half of the second distant detection module, based on the so-called vertical drift technology. This is an evolution of the so-called double phase technology which has been the subject of R&D in France since 2006. The vertical drift technology has retained the main characteristics and advantages of the double phase technology.
- Development of algorithms for data analysis, event reconstruction and neutrino energy and kinematic measurements.
- Contribution to the computational efforts for data production and simulations at the IN2P3 CC.
- Contribution to the PIP II programme on the Spoke superconducting cavities of the linear proton accelerator.

OTHER FRENCH LABORATORIES INVOLVED

Irfu (CEA Saclay)



* Since 2015