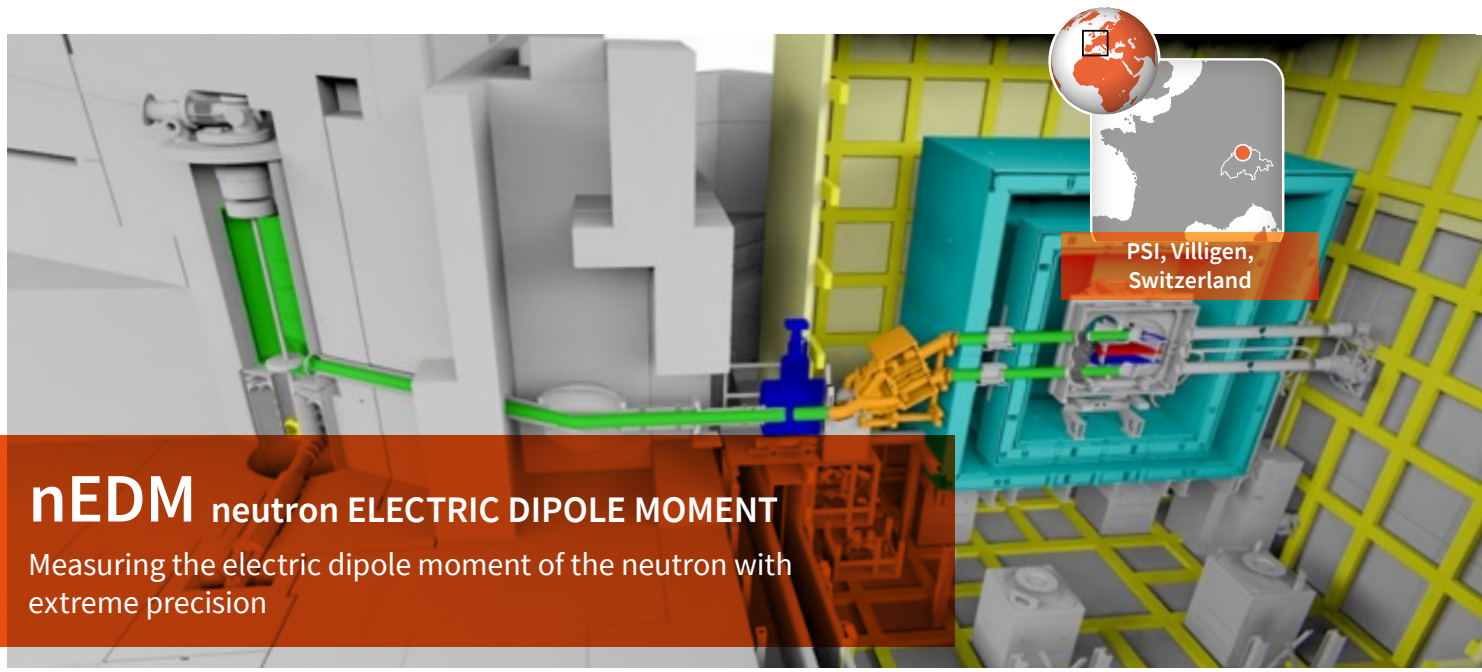
National Institute of Nuclear and Particle Physics

The origins of matter, in search of a new physics



nEDM neutron ELECTRIC DIPOLE MOMENT

Measuring the electric dipole moment of the neutron with extreme precision

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- **Scientific leader:** Thomas Lefort (LPC Caen) *
- **Laboratories involved:** LPCC (Caen), LPSC (Grenoble)
- **Nature:** research infrastructure
- **Status:** international project mainly funded by Switzerland, France, Germany, Belgium and Poland
- **Website:** https://www.psi.ch/en/nedm

15 laboratories involved

25 years since the start of the project

50 tonnes: weight of the device

10^{-14} e.fm: sensitivity target

17 billion neutrons detected

SCIENTIFIC OBJECTIVES

The aim of the nEDM project at PSI is to reveal a possible electrical dipolarity within the neutron. Its presence would signal the discovery of physics beyond the Standard Model, which is now necessary to explain the origin of the matter-antimatter asymmetry generated at the first moments of the Big Bang. The sensitivity of the second phase of the project, the n2EDM experiment, will be improved by an order of magnitude compared to the most precise measurement carried out to date. This will give unprecedented indications of the presence of new physics.

RESOURCES DEPLOYED

The neutron EDM measurement is carried out at the PSI's ultra-cold neutron source. Ultra-cold neutrons are polarised and then exposed to a strong electric and magnetic field in a chamber where they are confined for about three minutes. The EDM of the neutron is then determined from the extremely precise measurement of the precession frequency of their spin. The magnetic field must be perfectly controlled: the chamber is installed in a unique magnetic shield and uses a combination of atomic magnetometers. The precision objective requires four years of data collection.

IN2P3 CONTRIBUTIONS

- Construction of the non-magnetic vacuum chamber.
- Generation of internal magnetic fields.
- Hg magnetometry.
- Magnetic field mapping.
- Neutron detection and polarisation analyser, neutron beam switcher.
- Data analysis and characterisation of systematic effects.

1998 Start of the project at PSI

2003 Involvement of IN2P3

2010 Production of the first ultra-cold neutrons

2014 Start of phase 1 data collection (nEDM)

2020 Publication: World's best limit on neutron EDM

2023 Commissioning phase 2 (n2EDM) expected

* Since 2016

April 2022