Directly Seeking Dark Matter

EDELWEISS

Observing dark matter particle collisions

Scientific leader: Jules Gascon (IP2I Lyon)*

Laboratories involved: IJCLAB (Orsay), IP2I (Lyon), LPSC's LSM Platform (Modane)

Nature: research infrastructure

Status: international cooperation involving Germany, France, the UK and Russia

Website: http://edelweiss.in2p3.fr/index.php?language=en

Scientific objectives

If the dark matter halo surrounding our Galaxy is made up of particles, these should cause very rare collisions within ordinary matter that knock either an atom or an electron out of place. EDELWEISS seeks to measure the heat produced by these collisions in Germanium detectors cooled to 20mK, and also to identify the charges produced by them. For the past 25 years, EDELWEISS has been developing more and more efficient generations of detectors to reveal ever lighter dark matter particles.

Resources deployed

The experiment is protected from parasitic ambient radiation (radioactivity, muons, etc.) by the 1 700 metres rock cover of the Modane Underground Laboratory, and by more than 40 tonnes of lead and polyethylene. A dilution cryostat cools to 20mK a set of detectors weighing up to 20 kilogrammes. The detectors are hyper-pure Germanium crystals covered with electrodes, on which a doped Germanium thermistor is glued. This is sensitive to abrupt temperature variations of less than 1 Kelvin.

10^6
suppression factor of cosmic rays

19
months: longest cooling time

18 to 22 microK
temperature of the detectors

10^9 cumulative background reduction factor: mountain + lead + polyethylene + active rejection

IN2P3 CONTRIBUTIONS

- The experiment was designed and carried out largely in France, with a major contribution from the IN2P3.
- Development and manufacture of bolometers
- Original design of the detector electrodes and their realization (Major technological breakthrough)
- Hosted at the Modane underground laboratory (LSM)

Other french laboratories involved

Irfu (CEA Saclay), Institut Néel (Grenoble), C2N (Palaiseau)

1998 Construction of Edelweiss I

2001 Record sensitivity for WIMPs above 35GeV

2005 Construction of Edelweiss II

2013 Record sensitivity for axion particles of 10 to 100keV

2014 Edelweiss-III, the most massive cryogenic Germanium assembly (20 kg)

2018 Record sensitivity for bosonic black particles <1keV

2019 First lightweight detector (33g), sensitivity record for WIMPs from 45 to 150MeV

2020 Record sensitivity for black photons from 6 to 9eV

* Since 2011