



## Science and technology in deep unerground laboratories

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Deep Underground Laboratories (DULs) are large research infrastructures with a minimum rock overburden equivalent to one km water equivalent. In DULs the flux of muons from cosmic rays is reduced by several order of magnitude with respect to the surface. This allows to perform research on very rare events, such as exotic radioactive decays, double beta decays, low energy neutrino and dark matter interactions. The phenomenon of neutrino oscillations has been discovered in DULs back in 1998. Solar neutrinos were first observed in a DUL in 1968. As of today thanks to research carried out in DULs over four decades we have studied in detail the energy production mechanisms in the sun's core. In 1987 neutrinos from a core collapse supernova in the Large Magellanic Cloud were observed confirming our basic understanding of this high energetic event. DULs, at present, are equipped with more sensitive and better performing experiments to improve significantly these early studies. The large SuperKamiokande detector in Japan can observe as many as ten thousand events for a core collapse supernova at the center of our galaxy. The Borexino experiment in Italy has observed CNO neutrinos which contribute to only 1% of the energy production in the sun but are very important for more massive stars. All these crucial measurements could have not been possible without operating experiments in a deep underground site.

In the last decade the research horizon in DULs has expanded to include gravitational waves, geophysics, astrobiology, and biology in underground environments.

DULs are equipped with facilities to measure low levels of radioactivity by means of different techniques. This offers a unique opportunity to study living organism in a low radioactivity environment, namely with a significant reduction of cosmic rays and neutrons with respect to surface. DULs are being used by a large community of scientists ranging from astrophysicists, particle physicists, geophysicists, and biologists. There are 14 DULs in operation worldwide which correspond to about one million cubic meters excavated.

In the talk a brief review of DUL's main features and research activities will be discussed.