From the Geosphere to the Cosmos: ASPERA Workshop

Abstract

ApP and associated sciences at LNGS

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The Gran sasso National Laboratory of INFN is a research infrastructure mainly devoted to astroparticle and neutrino physics. It offers the most advanced underground Laboratory in terms of dimensions, complexity and completeness of infrastructures.

The laboratory hosts also experiment aimed to study cosmogenic and primordial radionuclides, and experiments of geophysical interest as well.

Borexino is a solar neutrino detector located at LNGS. The main goal is the detection of the monochromatic neutrinos that are emitted in the decay of 7Be in the sun. However the intrinsic radioactivity achieved in the detector is much lower than expected which resulted in a broadening of the scientific program. The detector is very competitive for the observations of anti-neutrinos of geophysical origin. Geo-neutrinos are the ideal messengers of information about the earth interior composition. By measuring their flux and spectrum, it's possible to assess the radiogenic contribution to the total eat balance of the Earth. The measurement of the geo-neutrinos rate in Borexino will be reported and compared with the predictions of the most interesting geophysical models.

The LNGS hosts an ultra low background counting facility STELLA (Subterranean Low Level Assay): a service infrastructure devoted to highly sensitive radio purity measurements and material screening for the experiments installed at the LNGS. Its main core is the pool of 10 high purity Germanium (HPGe) detectors used for gamma spectroscopy. The installations and experimental set-ups will be described shortly. Gamma spectroscopy performed in a deep underground laboratory using ultra low background equipment gives the unique opportunity of having almost background free measurements. This is very helpful for example when measuring tiny objects with small amounts of radioactivity. Examples that have been measured recently are on one-hand small meteorite specimens, and on the other hand activated materials that were exposed to neutrons and charged particles under extreme conditions close to the plasma in the JET facility.

Within the framework of the scientific program ERMES (Environmental Radioactivity Monitoring for Earth Sciences) radon (222Rn) radiocarbon (14C) and tritium (3H) have been monitored in the groundwater inside the LNGS and different chemical, physical and fluid dynamical characteristics of groundwater have been detected. The uranium groundwater monitoring started on June 2008 with the aim of better defining the 222Rn groundwater transport processes through the cataclastic rocks as well as to check its contribution to the neutron background at the LNGS. Measurements evidence anomalies related to a preparation phase of the seismic swarm, which occurred near L'Aquila, Italy, from October 2008 to April 2009. Furthermore, high precision 14C measurements have been performed and ERMES extended the present maximum dating limit from 58,000 BP to 62,000 BP (5 mL, 3 days counting).

Finally LNGS hosts since several years an interferometric station with two geodetic extensometers. Both instruments are unequal-arm Michelson interferometers, using a 90 m long measurement arm and a <40 cm long reference arm, sharing the same stabilized HeNe laser source. The results of the analysis of the data produced by the interferometers before and after the occurrence of the April 2009 earthquake will be presented.

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