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A new cylindrical detector for borehole muon radiography.

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Muons of cosmic origin have a great capability to penetrate through matter. This property is exploited in muon radiography, a technique which allows to highlight
the presence of discontinuities in the subsoil of different possible origins, such as the presence of cavities, tunnels or rock masses. More generally, it provides two-dimensional maps of the mass distribution; if multiple measurements from different points are available, 3D distributions can be obtained. We have developed, in collaboration with TECNO-IN SpA and S.c.a r.l. STRESS, a detector optimized for borehole studies. The cylindrical shape is realized with arc-shaped plastic scintillator bars combined with rectangular section bars, arranged vertically. This geometry allows to maximize the effective surface of the detector and provides a large investigation volume. Currently the first constructed prototype is 1 m high and has a diameter of about 20 cm. It consists of 64 vertical bars for measuring the azimuth angle and 256 arcs for the z-coordinate measurement, considering a cylindrical coordinates system. The scintillation light is read out by 384 Silicon Photomultipliers, directly coupled to the bars. Particular attention has been paid to the transport of photons inside the scintillators, with the use of light guides realized by the bars itself.
The front-end and acquisition electronics, entirely housed inside the detector, are based on the EASIROC chip and are characterized by limited energy consumption (about 30 W for the entire detector).
The detector is enclosed in a waterproof case and is remotely controlled via ethernet. The presentation will describe the detector and the results obtained in a series of measurements carried out in the subsoil of the hill of Mt Echia in Naples, where its ability to reveal some known cavities and to identify possible hypothesized hidden cavities were tested.

Collaboration

Primary authors: Prof. AMBROSINO, Fabio (UNINA -INFN); SARACINO, Giulio (Istituto Nazionale di Fisica Nucleare); Mr ROSCILLI, Lorenzo (INFN); Dr CIMMINO, Luigi (UNINA INFN); Dr D'ERRICO, Mariaelena (Istituto Nazionale di Fisica Nucleare); Dr MASONE, Vincenzo (INFN)

Presenter: SARACINO, Giulio (Istituto Nazionale di Fisica Nucleare)

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