The MU-RAY project: volcano radiography with cosmic ray muons.

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Cosmic ray muon radiography is a technique for imaging the variation of density within the top few hundred meters of a volcanic cone. It is based on the high penetration capability of the high energy muon component of cosmic radiation. The measurement of the flux variation of the incoming muons as they pass through the volcanic cone, allows the evaluation of the average density along the observation line with a precision of a few percent and with a spatial resolution which can be of the order of ten meters once optimal detection conditions are reached. Muon radiography can provide images of the top region of a volcano edifice with a resolution that is considerably better than that typically achieved with conventional methods. Such precise measurements are expected to provide us with information on anomalies in the rock density distribution, like those expected from dense lava conduits, low density magma supply paths or the compression with depth of the overlying soil.

The MU-RAY project has developed a muon telescope prototype for muon radiography. The telescope must be capable of working in a harsh environment with low power consumption, have a good angular and time resolution, with a modular design so that a relatively large active area can be transported and installed at the point of interest. The protype telescope consists of three X-Y planes of one square meter area made from plastic scintillator bars of triangular cross section. Light output from each bar is collected by a fast Wave Length Shifter fibre coupled to a silicon photomultiplier. The readout electronics is based on the SPIROC/EASIROC ASIC. The prototype is under test and will be soon installed at the Mt Vesuvio in Naples.
An overview of the muon radiography technique will be given followed by a description of the MU-RAY prototype with first results from the Vesuvio observations.