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Muography for Underground Geological Surveys: ongoing application at the Lousal Mine (Portugal)

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The LouMu Project is an ongoing collaboration between the Laboratory of Instrumentation and Experimental Particle Physics (LIP), the Institute of Earth Sciences (ICT) –University of Évora and the Lousal Ciência Viva Center which is evaluating the muography potential in the Lousal Mine, with the general aim to create the conditions to use muography as a novel method for geophysical surveys in Portugal.

The use of muons for geophysical surveys has been proved successful in numerous projects around the planet. Muon detection in underground environments is protected from the background radiation measured on the surface, but the number of muons arriving far depths is much lower. Geological and underground conditions should be considered when defining the required exposure time and developing suitable muon telescopes for the observation.

The Lousal Mine (Iberian Pyrite Belt) was exploited until 1988 and is presently an excellent European example of environmental rehabilitation and social improvement based on museum, scientific and educational activities. The observations are done from the Waldemar mine gallery, about 18 m below the surface. The telescopes, developed by LIP, use robust RPC detectors to observe the crossing muons in real time. The aim is to do a first geological survey of the region with muography, mapping already known structures and ore lenses and measuring their densities. The new data will then be used to improve the existing information, but the full process also serves to test the performance of the muon telescope and of the muography analysis tools.

A reference 3D model is being created by joining pre-existing geological and geophysical information and new measurements, done namely with seismic refraction and Ground Penetrating Radar (GPR). This model provides a reference against which to compare the muography results. Ideally, muography could be used to produce an equivalent 3D map of densities. This reference 3D model constructed with independent methods will be used to cross-check the muography results.

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