



Muon tomography with Resistive Plate Chambers for geological characterization

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ABSTRACT

Muon tomography is one of several fields of applied physics that have witnessed the successful use of particle detection based on Resistive Plate Chambers (RPC). In this work, we report on an innovative project concerning transmission muography for geological characterization. For this purpose, a muon telescope built of four RPC planes was mounted on an adjustable structure and the telescope's response to atmospheric muons was studied. Data acquisition campaigns took place at different locations for producing muographic images of the building of the Physics Department of the University of Coimbra, in Portugal. More recently, the detector was moved to an underground gallery of an old mine, where it is taking data that is being assessed in combination with the results from conventional geophysics techniques.

1. Introduction

1.1. Muon tomography

Muon tomography is a technique that explores the flux of muons that reach the Earth's surface to produce images of objects typically of large dimensions [1–3]. High-energy muons are produced in the atmosphere during the development of particle cascades initiated by interactions of cosmic rays. The fact that the muon flux at sea level is abundant, that muons travel through matter in almost linear trajectories and with small rate of energy loss, being able to reach hundreds of meters underground, makes atmospheric muons an excellent probe for imaging.

The two techniques used in muon tomography are transmission muography and scattering muography. In transmission muography, a detector is placed below an object that partially attenuates the muon

flux and characteristics of the object such as slant mass, size, shape are inferred from the directional dependence of the attenuation. In scattering muography, detectors are placed before and after an object with high atomic number, enabling a reconstruction of the properties of the object from the measurement of the muon scattering angles.

The field of muon tomography has witnessed a rapid development, with applications to several fields, such as archeology, vulcanology, civil engineering and industrial safety, each with specific requirements on the detection technique used, including telescopes based on Resistive Plate Chambers (RPC) [4].

1.2. LouMu project

The LouMu project is a collaborative effort, started in 2018, involving Portuguese physics, geology and science outreach institutions, with

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