

MUON TOMOGRAPHY FOR UNDERGROUND GEOLOGICAL SURVEYS

ONGOIG APPLICATION AT THE LOUSAL MINE (PORTUGAL)

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IN COLLABORATION WITH LOUMU TEAM

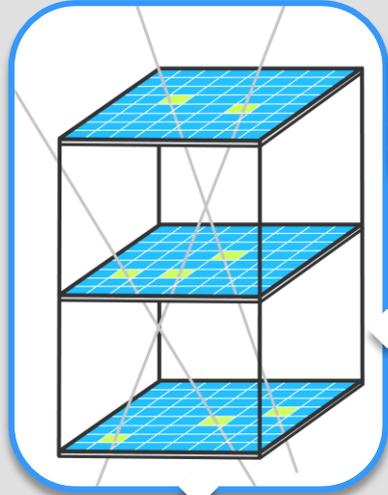
FCT Fundação
para a Ciência
e a Tecnologia



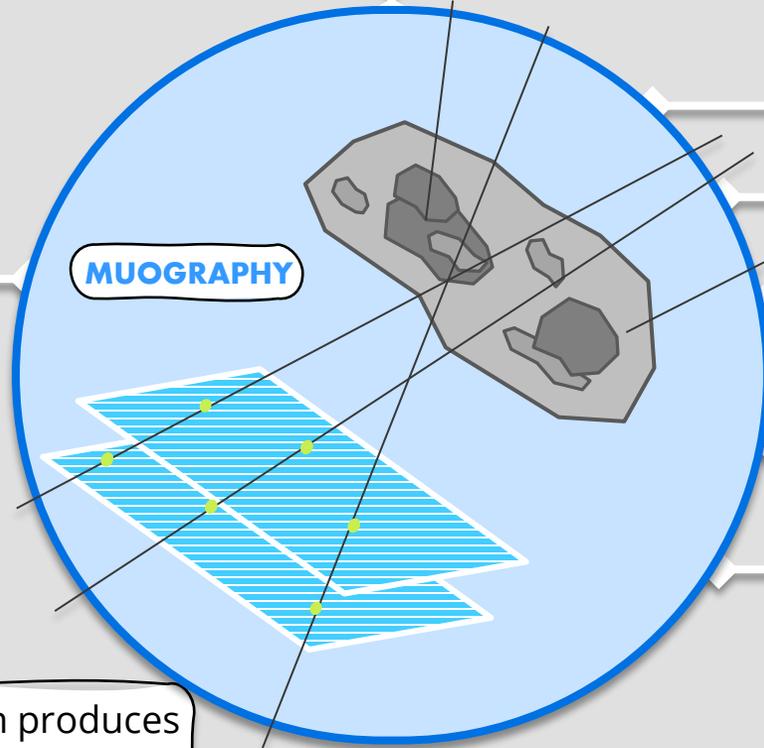
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MUOGRAPHY BASICS



Muon detectors assembled in a structure called a **MUON TELESCOPE**

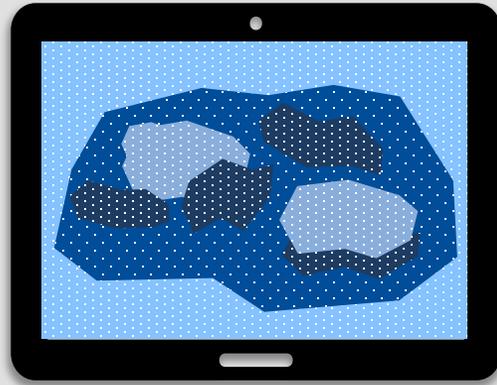


COSMIC RAYS

PARTICLE SHOWERS

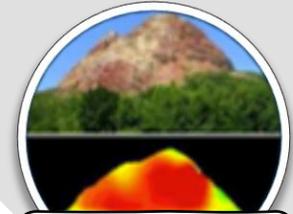
ATMOSPHERIC MUONS

MUOGRAPHY

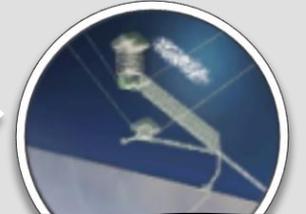


The observation produces images like "muon radiographs" called **MUOGRAPHS**

APPLICATIONS IN DIFFERENT FIELDS



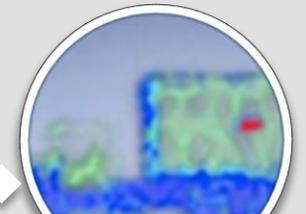
GEOSCIENCES



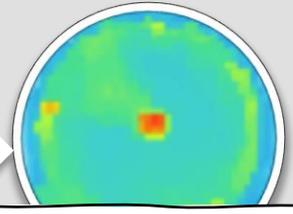
ARCHAEOLOGY



CIVIL ENGINEERING



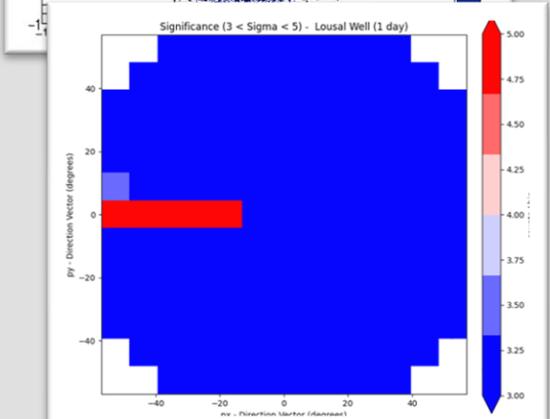
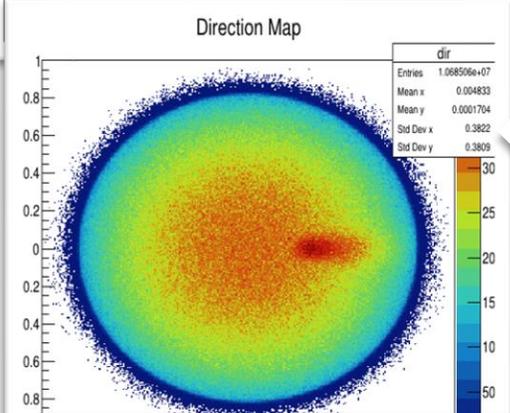
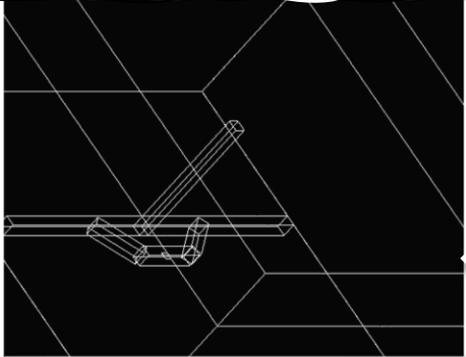
CARGO SURVEILLANCE



NUCLEAR REACTOR AND WASTE CONTROL

LOUMU PROJECT

SIMULATIONS AND TOOLS



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partículas e tecnologia



Instituto de Ciências da Terra
Institute of Earth Sciences



UNIVERSIDADE
DE ÉVORA

LoμMμ

SCIENCE WITH
COSMIC MUONS
AT THE LOUSAL MINE



Centro
Ciência Viva
doLousal
MinadeCiência



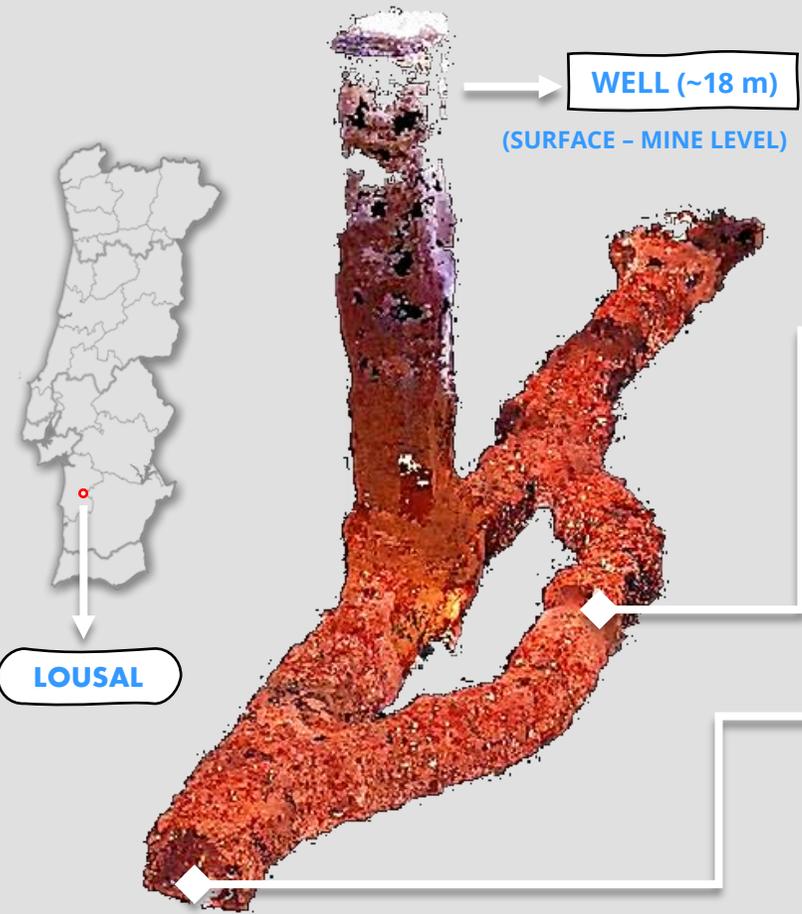
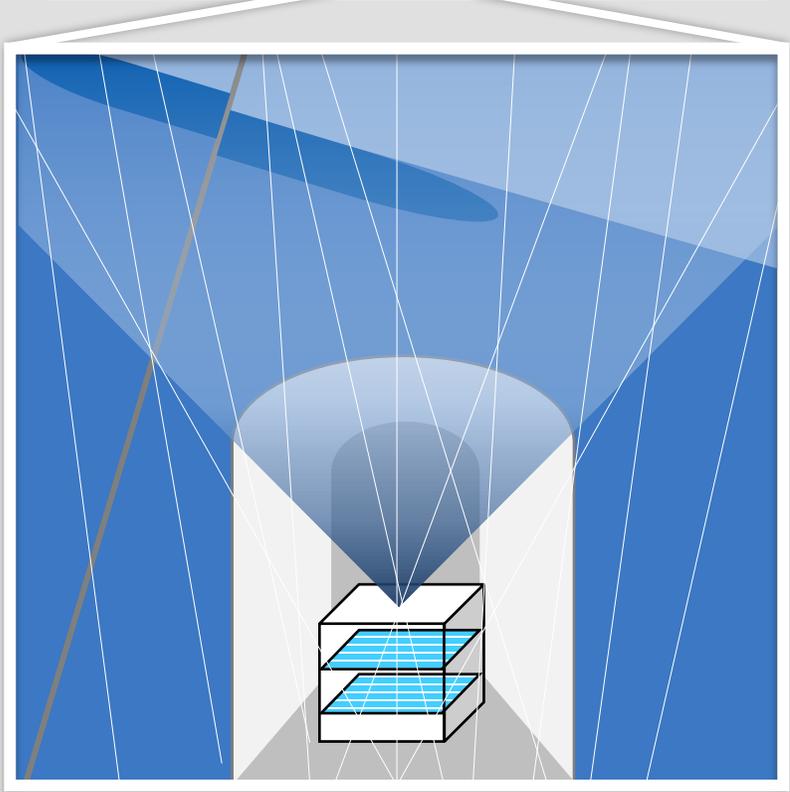
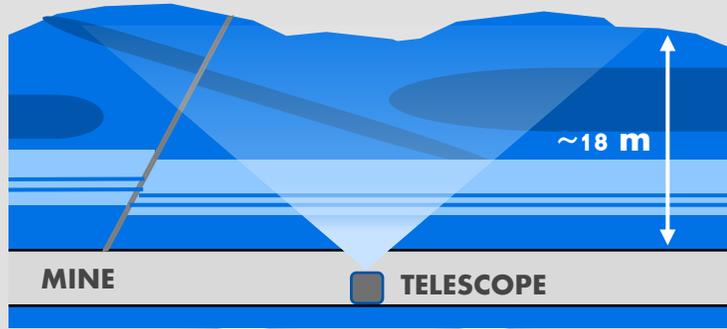
GEOPHYSICAL WORK



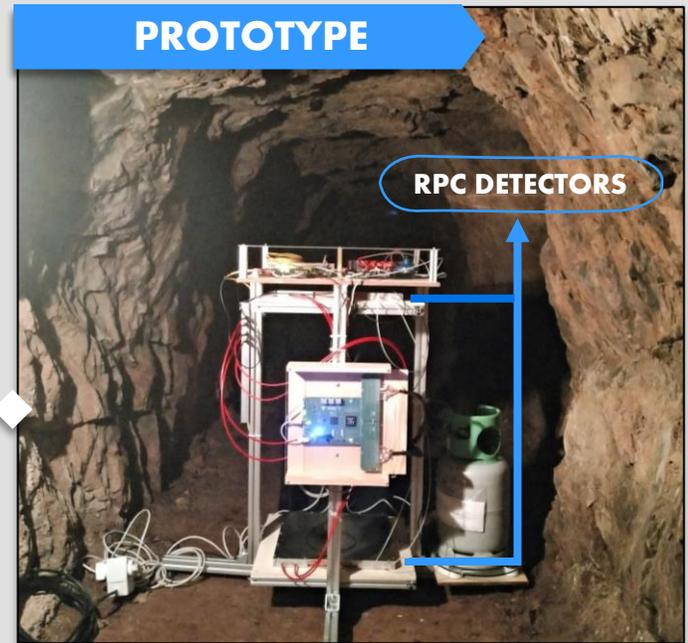
MUOGRAPHY AND TELESCOPES



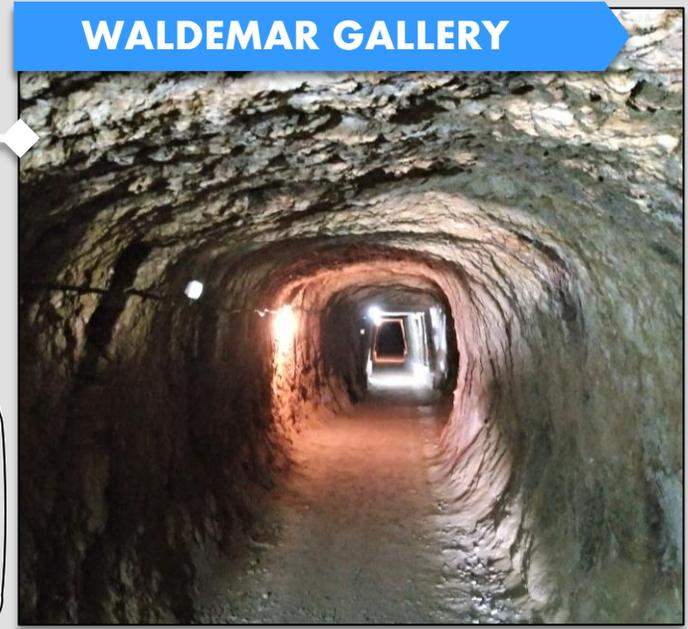
UNDERGROUND MUOGRAPHY - LOUSAL MINE



PROTOTYPE



WALDEMAR GALLERY



OBJECTIVE: to do a geological survey of the terrain between the telescope and the surface and improve the existing information with new data while testing the performance of the telescope

WORK PROGRESSION

STANDARD TECHNIQUES

PHOTOGRAMMETRY



+

GPR



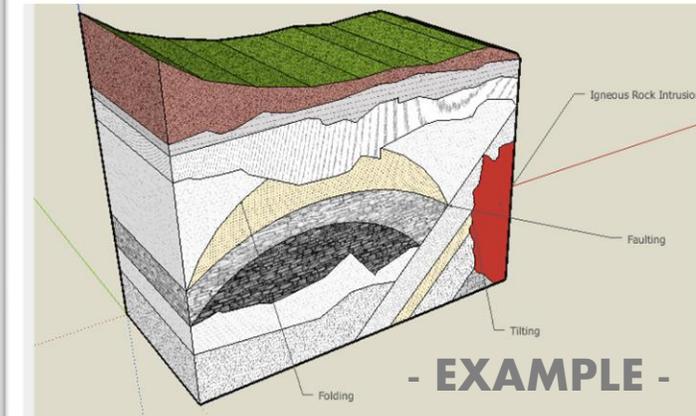
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SEISMIC REFRACTION



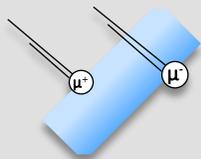
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REFERENCE GEOLOGICAL MODEL



FOCUS TECHNIQUE

MUOGRAPHY



$$\phi \propto \frac{1}{\rho}$$

SIMULATIONS

ANALYSIS TOOLS

TELESCOPE

$$g \propto \rho$$



JOINT INVERSION

MUOGRAPHY

+

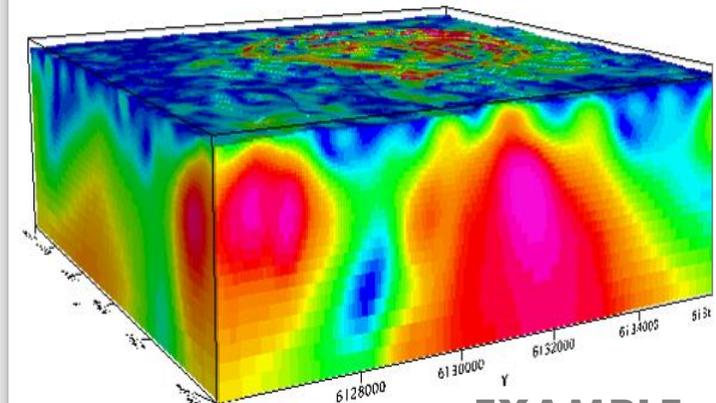
GRAVIMETRY

=

obtains the density through the attenuation of the muon flux

obtains the density through the strength of the gravitational field

RECONSTRUCTED 3D DENSITY MODEL



THANK YOU!



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IDPASC-FCT: PD/BD/150490/2019

LOUSAL MINE

