

# Density Imaging of Volcanoes using Atmospheric Muons

**Master 2 Research Internship** at Laboratory of Physics of Clermont (LPC)

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Muography is a novel imaging technique based on the attenuation of the atmospheric muon flux. It is particularly well suited to the study of large structures as volcanoes, pyramids, etc. The (2D) integrated density maps are inferred from the measurement of the flux of ballistic muons transmitted through the targets.

The muon telescopes of the current generation are plain trackers. They do not measure the energy of the impinging particles and do not allow for a robust particle identification. The low energy particles that make up the background affecting the muographic measurement are generally rejected by using a lead scatterer and/or absorber.

A novel generation of muon telescopes is under development at LPC, combining highly segmented trackers made of single gap Glass Resistive Plate Chambers (GRPCs) with mm position resolution and Time of Flight detectors made of multi-gap GRPCs with better than 50 ps time resolution. The trainee will be in charge of optimising the detector configuration for foreseen measurements on active Italian volcanoes (Vulcano and/or Stromboli in Eolian Islands) for reaching the best sensitivity to the density measurement in the pre-defined Regions of Interest of the targets. Indeed, the expected number of signal muons to be detected and therefore the achievable density resolution is driven by the detection surface of the detector; on the other hand, the rejection of the low energy background improves with the tracker segmentation. The detector optimisation needs to be performed at constant cost and power consumption for the detectors and relies on pre-existing estimates for the signal and background fluxes for each target.

The trainee will work in the muography team at LPC, team with an internationally recognised expertise in this research field. He/she will participate to the characterisation of the GRPC detectors with a cosmic test-bench at LPC. The LPC team collaborates with particle physicists, geophysicists and volcanologists from France, Italy and Portugal. The trainee will therefore have the opportunity to work in an interdisciplinary and international work environment. The internship offers a rare opportunity to closely work with a running detector and to get involved at the same time with high level analysis tools.

The internship can be continued with a PhD.