Post-doctoral position in muography data analysis

The DIAPHANE project

The present post-doctoral position is opened for 1 year to physicists and/or geophysicists on the field of muography applied to geosciences with a particular focus on the domes of active volcanoes.

The DIAPHANE collaboration (Universités de Lyon, Rennes, Paris, UMR5822, 6118, 7154, CNRS IN2P3 – INSU) is the pioneering group in France using muography techniques to study the structure and the dynamics of active volcanoes since 2008.

It has deployed muon detectors over various kind of targets: active volcanoes (Soufrière of Guadeloupe, Etna, Mayon), underground laboratories, anthropic structures.

The main objectives of the present position is to analyze an unique dataset of muography data collected since 2015 on the dome of the Soufrière of Guadeloupe, to refine the present models and methods to invert data and build the masses distributions within the target and to participate to data taking campaign on sites.

Possible extension to these objectives is the setting-up of a new data taking campaign on an archaeological tumulus close to Thessaloniki in Greece.

Muography basics

The basics of muography are identical to those of medical radiography and has been recently popularized by the announcements of the ScanPyramids collaboration on the Gizeh's great pyramids. A particle beam is attenuated when it crosses matter. For the tomography of geological structures, the incident "beam" is composed of cosmic muons able to cross hundreds of meters of ordinary matter (Fig.1). A precise measurement of the spatial coordinates in a station of 3 or more detectors, together with a sub-nanosecond timestamp, allow reconstructing the muon trajectory and its propagation direction (Fig.2). By inverting the data one is able, within a given set of assumptions, to reconstruct in 3D the distribution of matter inside the structure (Fig. 3).

This imaging technique is very powerful since muons propagate along straight lines and has emerged as a unique complement to more traditional methods like gravimetry, electrical or seismic tomography.

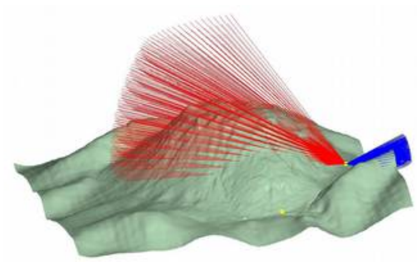

Fig. 1 – Principle of cosmic muon radiography: a detector (Fig. 2) placed at the bottom of the target measures the muon flux across it along several thousands of lines of sight

Fig. 2 – Muon telescope in operation on La Soufrière in July 2015. The telescope is remotely controllable.

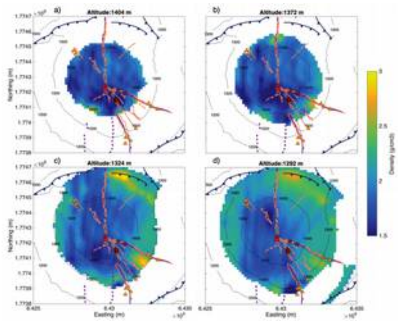

Fig. 3 – Horizontal slices across the 3D density model of La Soufrière derived from muon tomography [Error: Reference source not found].

Presently the Soufrière de Guadeloupe volcano is the most equipped in the world, with 6 different muon detectors around the dome, allowing a full online 3D reconstruction of the structure, and a complete set of geophysical detectors (T/P, seismic, acoustic) at the summit, allowing a detailed study of the system's thermodynamics in coincidence with the muon monitoring. The DIAPHANE project will last until mid-2019 (18 months left).
The final objective of the project is to setup a new imaging and monitoring tool to be systematically included within the survey system of active volcanoes and integrated in the hazard prevention scheme. This post-doctoral position, benefiting of the largest muon detectors equipment on field will be a key element to achieve this objective with a maximal visibility since this is a world's premiere.

Contact

Please send the following application materials as a single PDF to Dr. Jacques Marteau at marteau@ipnl.in2p3.fr :
1) curriculum vitae, 2) list of publications, and 3) summary of previous and current research as well as a short research project (no more than three pages in total). Applicants should have three reference letters sent to the same email address.
Rolling applications will be accepted, and applications will begin to be reviewed February 1st, 2018.