# Offre d’emploi :

**Poste Post-doctorant (H / F) à LGL-TPE , Labex LIO**

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| Postdoctoral position - CDD |  | Job : | Qualifications : PhD |
|  |  | **catégorie : A+** |
| Period  24 month / 2 years | | Remuneration:  **Selon expérience, sur la base de la grille de rémunération en vigueur à l’Université de Lyon[[1]](#footnote-1)** | Starting date : September 1, 2022 |

The Université de Lyon is a world-class academic site of excellence. It is located ﻿ at the heart of the Auvergne-Rhône-Alpes region, in Lyon & Saint-Étienne.﻿

The Université de Lyon, which is structured around 12 member institutions and 25 associated institutions, has three major objectives:

* To be a major, attractive and responsible university
* To provide outstanding training and research opportunities
* To develop and promote the dynamics of the Lyon Saint-Etienne site

**Description of LabEx LIO**

In 2011, The Lyon Institute of Origins LabEx was selected following the first “Laboratory of Excellence” call for projects, part of the “Investissement d’Avenir” program for forward-looking research. It is one of 12 LabExes supported by the University of Lyon community of universities and establishments (COMUE). LIO brings together more than 200 elite researchers recruited throughout the word and forming 18 research teams from four laboratories in the Rhône-Alps region, all leaders in their fields, under the auspices of the University Claude Bernard Lyon 1 (UCBL), the Ecole Normale Supérieure de Lyon, and the CNRS. LIO’s goal is to explore questions about our origins, operating in a broad field of study that ranges from particle physics to geophysics, and includes cosmology, astrophysics, planetology and life.

## JOB DESCRIPTION

Supervisor: S.Durand (LGL-TPE), B. Gardonio (LGL-TPE), E. Bayard (LPENS), O. Ramos (ILM)

Job location: LGL-TPE, Campus La doua, bâtiment Géode, 2 rue Raphaël Dubois 69100 Villeurbanne

### Research project:

**Context**

Since the first earthquake recording in 1884, the development and improvement of seismic networks provide 50 years of instrumental recordings of Earth's seismicity to seismologists. This is a gold mine that is currently investigated to understand earthquake processes and their origin. Many information and models have already been extracted, such as the so-called Gutenberg-Richter law which states that the probability of an earthquake, P(M>M0), of a given energy, M, follows an exponential law such that log(P(M>M0))=-bM+a. The slope of this law, called "b-value", is investigated to produce seismic hazard maps which are used for building construction. As a result, a wrong estimation of this parameter can have catastrophic human and economic consequences. The way it is currently estimated relies on strong *a priori* choices and neglects time variations even though we know they exist1. In that context we have developed a Bayesian approach able to detect spatial and time variations of the "b-value" avoiding these strong *a priori* assumptions and which properly estimates the uncertainties on the inferred parameters.

In addition, physicists also study earthquake processes through experimental apparatus and physical approach, trying to link earthquake origin to physical parameters in a well constrained environment. The group of E. Bayart (LPENSL) focuses on ruptures propagation along a highly confined gouge layer2 thanks to a setup that they developed and which enables the detection of smaller ruptures preceding and succeeding a main event. In parallel, the group of O. Ramos (ILM) developed an experimental system able to reproduce in details and with millions of events, the main statistical relations describing seismicity3.

Due to the scale difference, the comparison of the rupture processes observed on natural faults and in laboratory experiments is not straight forward. Only a statistical approach can fill this gap. Therefore, the goal of this project is to link experiments and observations through a novel Bayesian approach to get a physical understanding of the b-value variations.

**Objectives & Working plan**

The aim of this project is thus to better understand the origin of earthquakes by applying a new statistical Bayesian methodology to both seismic data (LGL-TPE) and experimental data (LPENSL & ILM) and ultimately to link observations to physical parameters. First, the aim is to investigate spatial and time variations of the "b-value" applying a novel Bayesian approach, from global to regional scale, using 50 years of seismicity, which has never been done before. The Bayesian approach is already successful on synthetic cases.

Second, the aim is to link these variations to physical processes by analysing experimental data with the same methodology. The experimental setup of E. Bayart and O. Ramos enable to investigate different processes of the earthquake origin and to gather experimental data for different geometries and loading configurations. While the study of E. Bayart (LPENSL) focuses on the transition from static to sliding friction, the apparatus of O. Ramos (ILM) allows to investigate steady frictional motion.

Both E. Bayart (LPENSL) and O. Ramos (ILM) have already resources and man power to perform experimental work. Therefore, the post-doctorate scholar will focus on processing datasets, coming from both seismology and physic experiments.

References

[1] Gardonio, B., Campillo, M., Marsan, D., Lecointre, A., Bouchon, M., & Letort, J. (2019) Seismic activity preceding the 2011 Mw9.0 Tohoku earthquake, Japan, analyzed with multidimensional template matching (MDTM), Journal of Geophysical Research: Solid Earth, 124, 6815–6831. https://doi.org/10.1029/2018JB016751

[2] Elsa Bayart, Ilya Svetlizky & Jay Fineberg (2016) [Fracture mechanics determine the lengths of interface ruptures that mediate frictional motion](https://www.nature.com/articles/nphys3539), Nature Physics 12, 166–170

[3] S. Lherminier, R. Planet, V. Levy dit Vehel, G. Simon, K. J. Måløy, L. Vanel and O. Ramos (2019) [Continuously sheared granular matter reproduces in detail seismicity laws,](https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.122.218501)Phys. Rev. Lett. 122, 218501

**QUALIFICATIONS / SKILLS**

### Qualifications: The candidate must hold a PhD.

### Skill: The candidate should either have a strong background in physics or geophysics, and be comfortable in coding, preferably with python or matlab or fortran. The person is expected to interact with the whole research team and to regularly present the work in group meetings.

### Research requirements: The candidate must have already produced some research papers.

## SELECTION PROCESS

### Information about the job:

S.Durand (LGL-TPE)

[stephanie.durand@ens-lyon.fr](mailto:stephanie.durand@ens-lyon.fr)

Tél. : 04.72.43.12.65

B. Gardonio (LGL-TPE)

[blandine.gardonio@univ-lyon1.fr](mailto:blandine.gardonio@univ-lyon1.fr)

### Request candidature:

Applicants must email a CV, a statement of interest, a letter of recommendation and contact details for 2-3 references [labex.lio@gmail.com](mailto:labex.lio@gmail.com) before April the 1st, 2022.

1. *Exclusivement pour les contractuels* [↑](#footnote-ref-1)