# Call for a postdoc position

## Investigating the Propagation of Frictional Ruptures in Granular Media

**Supervisors:** Elsa Bayart and Gaël Combe
**Affiliation:** LIPhy and 3SR, University Grenoble-Alpes, Saint-Martin d'Hères campus
**Duration:** 12-months post-doc position (potentially extensible to 18-months)
**Start date:** as soon as possible
**Keywords:** friction; dynamic fracture; granular media; image analysis; strain measurements; experimental earthquakes mechanics; modelling

A **fully funded 1-year postdoc position** is available at the **Laboratoire Interdisciplinaire de Physique (LIPhy/Univ. Grenoble-Alpes)**, in collaboration with **Laboratoire Sols, Solides, Structures, Risques (3SR/Univ. Grenoble-Alpes)**. This position is funded by the **Labex Tec21**. Research will take place mainly at LIPhy and occasionally at 3SR, both located on the Saint-Martin d'Hères campus.

***Position's mission and main activities***

**Description:** The sliding of frictional solids occurs through the propagation of interfacial ruptures, which are at the origin of earthquakes when they propagate along seismic faults. These ruptures are simple shear cracks in the case of two intact solids in contact. However, the composition of seismic faults is complex, with the core often consisting of granular material, the gouge layer. The aim of this project is to study how the nature and dynamics of interfacial ruptures are impacted during propagation by the presence of a granular material. Our results will contribute to a better integration of fault composition into models, while identifying key physical parameters to characterize this composition.

**Mission:** The study is based on an existing experimental setup consisting of two sheared elastic solids sandwiching a granular material [1]. The aim is to study the fault's mechanical response to shear by measuring macroscopic forces, and to perform local measurements along the fault, namely high-frequency strain measurements (electronic measurements) and Lagrangian kinematic field measurements of the granular medium forming the gouge layer (using fast and/or high resolution imaging). These measurements will allow to characterize the dynamic strain fields that drive the rupture propagation and to compute the associated energy budget, providing an understanding of the factors that control rupture dynamics. To complement these experiments a numerical model inspired by DEM and perydynamic approaches will be developed to simulate the elastic behaviour of the solid plates and the shear response of the granular gouge [2]. Initial tests will validate the model's ability to generate propagative ruptures.

**Main activities:** The recruited person will be responsible for carrying out the experiments, analyzing the data, comparing them with existing models and/or proposing avenues for modeling and analysis, as well as adapting an existing numerical model to the geometry and mechanical properties under consideration.

- Conducting experiments for different parameter ranges with 2D kinematic field measurements (40%)
- Data analysis and comparisons with existing models, search for suitable models (40%)
- Adaptation of a numerical model and first tests (10%)
- Writing and communication of results (articles, conferences) (10%)

***Restriction or constraints related to the position***

LIPhy is a Restricted Zone (ZRR), a system designed to protect its scientific and technical potential by safeguarding the sensitive research and strategic innovations developed within it. After the selection of the candidate by the selection committee, the application must be approved by the administration according to the rules of the ZRR.

***Desired profile***

**Trade skills/ expertise:** The candidate must have a Ph.D. in physics, mechanics, or geophysics with solid experimental experience. Proficiency in a programming language such as Python or Matlab is required. Some experience or at least an affinity for numerical modeling is desirable. Some knowledge of electronics would be beneficial to the project, but is not required.

**Personal skills:** The candidate must have a good level of English (minimum B2). A good ability to interact with team members is desirable. A curiosity for scientific topics, especially geophysical ones, is appreciated.

**Desired professional experience**: ☒ beginner ☒ 2 to 5 years

**Previous formation, diplomas**: The candidate will have a Ph.D. in physics, mechanics, or geophysics and a proven track record in experimental research.

***Application process***

No deadline -- until position is filled. Applications should be submitted through the UGA portal: http://bit.ly/48hpFME

**Informal enquiries are welcome.**

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***References***

[1] Faure, Y. & Bayart, E. Experimental evidence of seismic ruptures initiated by aseismic slip. *Nature Communications* **15**, 8217, doi: 10.1038/s41467-024-52492-2 (2024).

[2] Song, X. & Silling, S. A. On the peridynamic effective force state and multiphase constitutive correspondence principle. *J. Mech. Phys. Solids* **145**, 104161, doi: 10.1016/j.jmps.2020.104161 (2020).