SPIN ESR 2.3: Next-Generation Physics-based earthquake forecasts

Host institution: British Geological Survey, UK

Supervisors:

Academic Supervisor: Ian Main (University of Edinburgh)
BGS supervisor: Margarita Segou (BGS)
co-supervisor: Brian Baptie (BGS)

Application deadline: 01.04.2021. Position remains open until filled.
Earliest possible starting date: 01.10.2021

General information

This PhD position is one of the 15 Early Stage Researcher (ESR) positions within the SPIN project (http://spin-itn.eu). SPIN is an Innovative Training Network (ITN) funded by the European Commission under the Horizon 2020 Marie Sklodowska-Curie Action (MSCA).

SPIN will focus on training 15 PhD candidates in emerging measurement technologies in seismology. We will research the design of monitoring systems for precursory changes in material properties, all while optimizing observation strategies. The unique interdisciplinary and inter-sectoral network will enable PhDs to gain international expertise at excellent research institutions, with a meaningful exposure of each PhD to other disciplines and sectors, thus going far beyond the education at a single PhD programme. For further information on the project, please consult our website at: http://spin-itn.eu.

Project description

Earthquakes show clustering in space and time, as illustrated by the aftershocks triggered by large events. Empirical descriptions of clustering explain many features observed in seismicity catalogues, and they can be used to construct forecasts that indicate how earthquake probabilities change over the short term. However, these statistical approaches do not offer significant improvement for the physical triggering mechanisms that govern earthquake occurrence. The complexity and heterogeneity imaged in the structure and stress field of the Earth makes any direct interpretation of laboratory experimental results challenging. Now, the theory of static stress transfer combined with the laboratory derived rate-and-state law that describes the seismicity response to a stress perturbation is able to describe the stress-mediated fault interactions within a testable framework.

Recent work shows that physics-based models match or even exceed the performance of empirical approaches when applied to aftershock sequences. The most important elements of improved performance in these approaches come from the consideration of heterogenous faulting networks and stress states. The challenge behind the development of empirical and physics-based forecasts lies largely in their interpretation since short-term earthquake probabilities for future large magnitude events remain low in an absolute sense (< 1% per day).

Here, we seek to push the limits of physics-based approaches in earthquake forecasting by including improved time-dependent representation of stress (transient deformation, pore pressure effects etc) to

Funded by the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 955515.

achieve an evolving physics-based model that will inform us about large-scale processes that occur in real Earth. In this project you will develop earthquake forecast models in large scale based on physics-based simulations aiming to improve our process-based understanding of earthquake triggering. Those large-scale processes may inform us about future experiments in the lab motivating further rock physics research. The framework will generate, evaluate, optimize and discriminate earthquake forecasts based on robust statistical modelling and validation.

Required skills and experience

We welcome applications from candidates who fulfill the following criteria:

- A completed research-oriented university degree, such as a Master's degree or BSc Hons, in a relevant field (e.g. Geophysics, Physics, ..) The PhD enrollment requirements will depend on the hosting institute, please refer to the individual project descriptions and institute webpages.
- An outstanding academic track record
- An good command of English, both verbal and written
- Dedication and enthusiasm for research, combined with scientific curiosity, reliability and the capacity to teamwork in an interdisciplinary environment.
- Knowledge of patterns of crustal deformation and experience in earthquake catalog analysis are considered a plus.

Please ensure that you fulfill the following **eligibility criteria** for ESR (Early Stage Researcher) positions in H2020 MSCA-ITNs, as ineligible candidates cannot be considered:
https://spin-itn.eu/recruitment/#eligibility-criteria

Application Procedure

The **application deadline** is April 1st, 2021. Application evaluations will start immediately, and will continue until all positions are filled. We wish to reflect the diversity of society and we welcome applications from all qualified candidates regardless of personal background. The selection will be exclusively based on qualification without regard to gender identity, sexual orientation religion, national origin or age.

Applications must include:

- A cover letter in which you describe your motivation and qualifications for the position.
- A CV including relevant competences, skills and publication list, if applicable
- Copies of degree certificate(s) and transcripts of records for previous studies (Bachelor and/or Master). Please indicate expected date of graduation if your Master's degree is not completed
- Contact information of two references
- Completion of the SPIN application form: http://uhh.de/min-spin-apply

The successful candidate must satisfy the entry requirements of the PhD programme at the University of Edinburgh to be registered as a PhD student, including an appropriate standard of English
Applications should be sent in **one single pdf file** with filename `SPIN_YourLastname_YourFirstname.pdf' to spin-applications.min@uni-hamburg.de

Data handling

By applying to a PhD position, you agree that all data concerning your application may be stored electronically and distributed among the supervisors involved in the selection procedure within the MSCA ITN SPIN. If you do not agree, your application can not be processed further, due to the project's centralised recruitment process. The data are used solely for the recruitment process and we do not share information about you with any third party.

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