Master 2: INTERNSHIP PROPOSAL

Laboratory name: Laboratoire de Physique Statistique
CNRS identification code: UMR 8550
Internship director'surname: Frédéric Léchenault
e-mail: frederic.lechenault@lps.ens.fr Phone number: 0144323447
Web page: http://www.lps.ens.fr/~foldingslidingstretchinglab/
Internship location: ENS

Thesis possibility after internship: YES
Funding: NO

Hysteretic vs critical response of a granular bed close to failure

Granular systems have been the heart of a vivid research activity for the past two decades, one of the main quests being a statistical understanding of their collective properties. A particularly significant question is that of the transition to flow, or the failure under stress. The precise nature of this solid-to-liquid phase transition has remained elusive.

The principal experimental difficulty is in preparing a large system in a state close to isostaticity. We have recently devised an experimental set-up that allows one to prepare a model granular bed in reproducible and well-controlled states through the use of horizontal vibrations and cyclic gravitational loading. This preparation can then be brought arbitrarily close to failure by inclining the bed. A weighted plate, whose position is measured with high precision, covers the grains and provides a measurement of the elastic shear response of the system when inclined. We anticipate that a careful investigation of this response, in particular the way it vanishes close to failure, will yield insights into the nature of the transition.

Additional measurements and modification of the apparatus are also envisioned. For example, through the use of lock-in amplification the vibration system can be used to probe the frequency response of the layer, which would provide a much more complete picture of the failure mechanisms. Also, characterizing the speed of sound in the medium would be interesting since it is typically used to probe the elastic properties of soils and in geomechanical applications in general. A natural extension of the project is the investigation of the role of cohesion. The cohesive nature of the interactions in this case yields a poorly understood phenomenology, in particular the formation of aggregates, the understanding of which is of interest in many fields, including planetary formation.

The project involves extensive experimental exploration of the system as well as numerical modeling and fine theoretical description of the observations.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES Macroscopic Physics and complexity: YES
Quantum Physics: YES/NO Theoretical Physics: YES/NO