Master 2 Internship

Title: Granular Brownian motion in confinement

Supervisors: Yacine Amarouchene (University of Bordeaux), Pascal Damman (University of Mons), and Thomas Salez (University of Bordeaux)

Contact: thomas.salez@u-bordeaux.fr

Project: *Motility of microscopic biological entities with the aim of reaching specific targets is a central question of biology, as evidenced by: cancer metastasis, durotaxis of stem cells, self-assembly in tissues and organs, antibody recognition, or DNA replication, among numerous other examples. In an idealization attempt, this problem could in principle be reduced to physics through a combination of a few essential ingredients: viscous flow, elastic boundaries, confined environment, thermal fluctuations, and activity. Considering all these aspects together is clearly beyond the scope of our current knowledge – when even the simple definitions of temperature and pressure for a gas of active particles remain a real challenge for researchers. Nevertheless, already in the passive case, some fundamental aspects central to biological motility should be addressed. The study of Brownian motion in confined and soft-lubricated environments thus appears as one of the canonical problems of biophysics. Despite the obvious character of this statement, studies are scarce on the topic, which is probably attributed to the difficulty of probing the associated effects experimentally.*

The present project naturally aims at filling this gap by using an original approach, invoking the similarities between macroscopic vibrated granular matter and Brownian motion of mesoscopic colloidal entities. Experiments on 2D vibrated hard disks, in a relatively dense "solvent" of smaller disks, will be developed and conducted at University of Mons (Belgium), in order to effectively recover and characterize the bulk Brownian phenomenology. Then, from that calibration step, departures in confinement and interfacial situations will be studied through several relevant boundary conditions (rigid/soft/corrugated/active walls, lubrication/rarefied/polymer solvent regimes, etc.). The results will be analyzed theoretically at University of Bordeaux (France).

The student will share her/his time between the Mons and Bordeaux laboratories, depending on her/his taste and the project requirements. The potential thesis afterwards will be officially set as a European joint supervision. The student will benefit from the two environments as well as from two existing consortiums developed by the supervisors: i) one on granular assemblies as mimetic materials for real amorphous matter; and ii) one on colloidal Brownian motion near a soft wall. The student, interested by some of these aspects of our activities should not hesitate to visit our website and contact us for more details.