INTERNSHIP PROPOSAL

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CNRS identification code: UMR 8023
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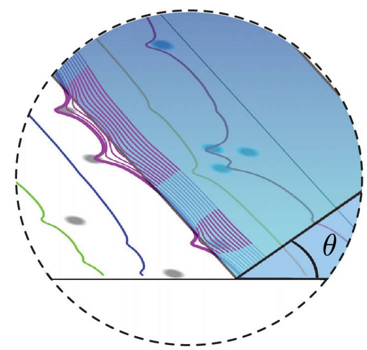
Internship location: LPENS (24 rue Lhomond, 75005, Paris)

Thesis possibility after internship: YES
Funding: POSSIBLY

Thermal avalanches and depinning transition of a contact line

Thermal avalanches are present in heterogeneous flows in disordered materials and in glassy systems. The dynamical heterogeneities in these materials, which reflect the interplay between endogenous mechanical noise and exogenous thermal noise, have primarily been studied theoretically in the context of creep flows of pinned elastic manifolds and in simulations of super-cooled liquids, with the notable exception of the logarithmic aging of crumpled sheets. The aim of the internship and the PhD thesis is to investigate the effect of finite temperature on the depinning transition of a contact line, utilizing a combination of controlled laboratory experiments, theoretical analysis, and numerical simulations.



This is what we *imagine* fluctuations of the contact line look like on nanoscopic scales.

Context — Thermally-activated motion is understood to be important in describing contact line dynamics, however, experimental proof has been indirect. Thermally-activated depinning of a contact line has never been directly observed. This is due to the small amplitude of thermal capillary waves which means that activated movements are on the nano-scale. In order to overcome this difficulty, we propose to study the problem by:

(1) A novel scaling of the experimental problem — We call a *thermalized* bath one where the spectral density of the waves resembles that of thermal capillary waves. In principle, one can use multiple vibrators or loudspeakers to produce an artificial "high temperature" thermalized bath. Then, fluctuations will be on the optical scale and the motion of the contact line over a single defect can be imaged under microscope in real-time and compared to that expected for thermally-activated pinning and depinning.

(2) Theory and numerical simulations — By balancing capillary and defect forces, numerical simulations allow us to calculate the force landscape and deformation of a contact line as it moves over defects. Then the objective is to calculate the dynamics of the contact line by solving the stochastic differential equations of motion on this landscape. Ultimately, the goal is to make a link between the properties of the defects (size, density…) and the measured dynamics (which have been described by a "hopping length").

Condensed Matter Physics: NO Soft Matter and Biological Physics: YES
Quantum Physics: NO Theoretical Physics: YES