Internship position

Level : Master 2

Title : **Nonlinear dynamics of membranes under shear**

Location : Institut Lumière Matière (ILM), LYON (http://ilm.univ-lyon1.fr/)
Team : Modélisation de la Matière Condensée et Interfaces
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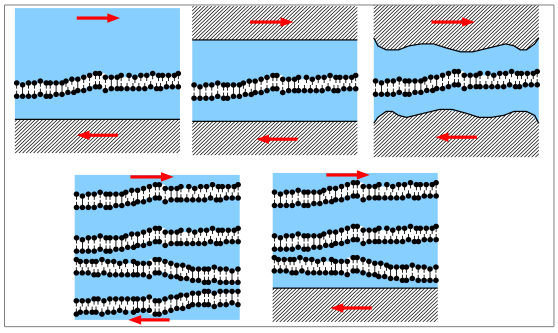
Keywords: Theory and modeling, nonlinear physics, non-equilibrium phenomena, pattern formation, bio-physics ; lipid membranes

Summary:
The aim of this project is to study the nonlinear dynamics of confined membranes under shear within a continuum model. This problem is motivated by the fact that self-assembled lipidic membranes are present in most biolubrication systems (such as the joins, eyes, or lungs). However, the role of membranes in biolubrication is still poorly understood. Here, we wish to study a simple model which will allow us to gain insight on the combined effect of confinement and shear : we place a membrane surrounded by a liquid between two walls, and force the system with shear by imposing constant and opposite velocities for the two walls (see Figure). In the small slope limit, the hydrodynamic flow of the surrounding fluid can be determined, and we end up with a nonlinear and nonlocal evolution equation for the membrane. This equation shares similarities with standard models for phase separation dynamics, but the specific elastic properties of the membrane (namely its bending rigidity) introduces novel ingredients. The nonlinear dynamics of the membrane should impact global friction of the system. Indeed, we suspect a transition to chaotic dynamics at large shear, which could lead to a strong reduction of the friction. The results of the project could shed new light on the behavior of membranes in biologically relevant lubricated contacts.

Depending on the interest and motivation of the candidate, the work will focus either on analytical investigation, or on the numerical study of the nonlinear differential equations governing the dynamics of the membrane.
Related experiments are performed at ILM-Lyon and in LAMCOS in INSA-Lyon.



Shéma représentant des membranes cisaillées dans des conditions de plus en plus complexes.

Possibility of PhD : yes

Références:
T. Le Goff, P. Politi, O. Pierre-Louis, Phys Rev E 92 022918 (2015)
T. Le Goff, P. Politi, and O. Pierre-Louis, Phys Rev E 90 032114 (2014)
] T. Le Goff, T.B. To, O. Pierre-Louis, submitted (2016)