LadHyX Seminar — March 16, 10:45

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Elasto-capillary-hydrodynamics of the gliding motion of myxobacteria

The motility mechanism of certain rod-shaped bacteria has long been a mystery, since no external appendages (pili, flagella or cilia) are involved in their motion which is known as "gliding". As a canonical example of such organisms, myxobacteria exhibit a gliding motility where the gliding speed depends on the substrate stiffness : an effect known as mechanosensitivity. While there exist some physical models for the mechanosensitivity of eukaryotic cells in tissues due to adhesion, the mechanism of myxobacterial gliding motility remains unclear mainly due to the existence of a thin slime layer secreted between the cell and the substrate.

In this talk, we will present how we shed light on some physical principles behind gliding, by developing a model that accounts for the elastic, viscous, and capillary interactions between the bacterial membrane, the slime layer, and the substrate. The nonlocality of the substrate deformations is properly accounted for through a suitable finite element formulation. Our findings reveal the existence of two mechanisms of thrust generation depending on the substrate stiffness. We will show that on very soft substrates, the thrust is localized at the leading edge of the bacteria where the growth of a capillary ridge creates a pressure gradient at the slime/air interface. However, on stiffer substrates where such capillary ridges are difficult to form, the thrust is distributed over the entire bacteria and given by the product of the membrane deformations and the lubricating slime pressure. Our model shows good agreement with experimental measures of the average velocity of *Myxococcus xanthus* cells on agar substrates at di erent concentrations.

The elasto-capillary-hydrodynamics interactions that will be described in this talk could potentially be at play in all myxobacteria swarms since they are valid over a wide range of substrate stiffness, from quasi-liquid to rigid surfaces.