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Master 2 internship: Dynamics of an active particle in a potential well

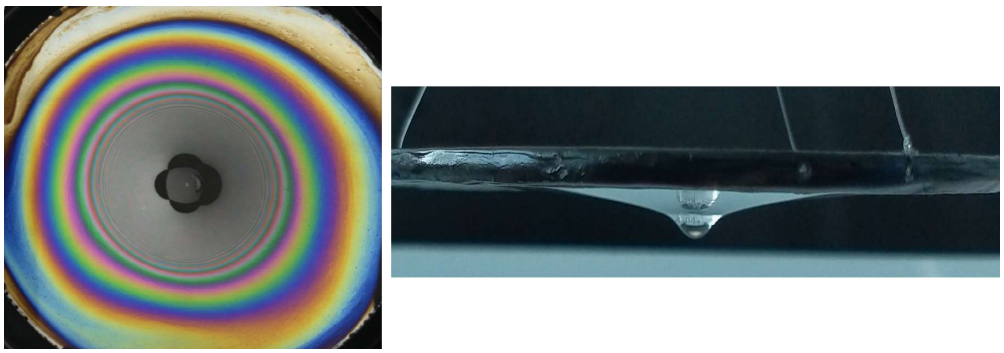

Figure 1: Particle deforming a soap film. Left: top view. Right: side view.

Abstract:

Active matter covers materials that consist of self-propelled entities such as microorganisms, active particles and artificial micro-swimmers, which exhibit collective behavior. These systems are driven out of equilibrium by the energy directly supplied at the level of individual constituent active particles that are self-propelled. Examples of active matter are biological systems such as schools of fish or bacteria, as well as artificial systems such as suspensions of self-propelled colloids, or other synthetic micro-swimmers. In order to grasp the behaviors of these systems, it is necessary to understand the fundamental rules that govern idealized versions of these systems. Over the years, interest in the control of active motion has increased using external fields, in particular, gravitational, magnetic, and flow fields.

In this master project, we will investigate experimentally and theoretically how a single artificial active particle behaves when confined in a potential harmonic well. In this experiment, the active particle consists in a self-propelled millimetric Marangoni boat fueled with camphor or alcohol. It is placed on the interface of a soap film hanging on a horizontal frame. In this configuration, the film acts as a harmonic potential well attracting interfacial bodies towards its center. The student will investigate some original aspects of the dynamics of a self-propelled milli-swimmer on a soap film, and characterize the system's mechanical/physical properties for different shapes and number of swimmers, as well as soap film interface composition.

This internship may lead to a PhD thesis focusing on the characterization of the dynamics and interaction of active or non-active objects on soap films.