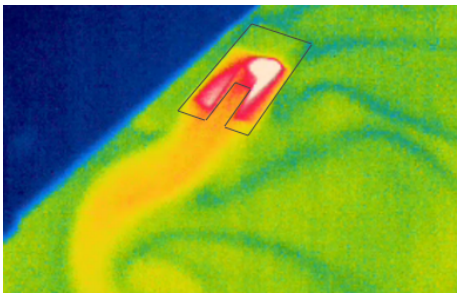
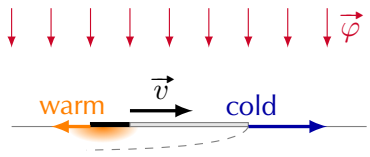
Light propelled thermocapillary vessel

M2 INTERNSHIP
CONTACTS :
cyril.picard@univ-grenoble-alpes.fr
elise.lorenceau@univ-grenoble-alpes.fr

LIEU DU STAGE :
Laboratoire Interdisciplinaire de Physique
140 Avenue de la Physique
38400 Saint Martin d'Hères





Infra-red picture of a sun boat and schematic of the propulsion mechanism.

The internship aims at understanding the motion of a new type of self-propelled interfacial micro-vessel. A lot of papers concern the self-propulsion of immersed particles, such as janus particles. The motion of small-bodies trapped at an interface has been much less considered. Among them, the best known system is the « soap-boat » whose motion is induced by a difference of surface tension generated by a flux of surfactant at the rear of the vessel[1].

We have recently developed a « sun-boat » based on a thermally induced difference of surface tension generated by a light source. The light is shined perpendicularly to the surface. The vessel presents a difference of radiation absorption between its bow and its stern that results in a difference of temperature and subsequently a difference of surface tension that propels the vessel. This type of propulsion is based on thermocapillarity and is reminiscent of the thermal Marangoni effect[2]. The wake behind such a vessel appears particularly intriguing as it is related to an unexpected recirculation around the vessel. Moreover its motion revealed to be drastically damped by any slight contamination of the interface. The internship will give the opportunity to clarify the physico-chemical mechanisms that control the vessel motion and the flow around it. The experimental approach will be based on infra-red and PIV measurement to be able to extract both the velocity and the temperature field from image analysis.

The student should be meticulous and rigorous. More generally the candidate should have a good interest for physico-chemistry, fluid dynamics and heat transfer.

1. E. LAUGA et A. M. J. DAVIS. Viscous Marangoni propulsion, *J. Fluid Mech.* **705**.May (2012), DOI : 10.1017/jfm.2011.484.

2. C. MAGGI et al. Micromotors with asymmetric shape that efficiently convert light into work by thermocapillary effects, *Nat. Commun.* **6** (2015), DOI : 10.1038/ncomms8855.