We are interested in the propulsion mechanism of micrometer-sized swimmers within self-induced Marangoni flows in the low Reynolds number regime. The flows of interest are due to temperature or concentration inhomogeneities. The project is based on the observation that initially axisymmetric flows on a water-air interface are azimuthally unstable. In this presentation, this fact is illustrated by two experiments.

- Our first experiment (I) involves a micrometric carbon bead which is trapped at the water/air interface and heated up with a laser beam [1]. This hot spherical particle generates a temperature gradient that drives a thermocapillary flow. Most strikingly, the flow exhibits structures that range from slightly polar, to dipolar and even multipolar at sufficiently high laser powers.

- In our second experiment (II) we simply inject water through a narrow vertical tube located below the WA interface. The gap between the injector and the interface (∼1mm) is kept constant by means of a feedback loop. The fluid contains a small amount of sodium dodecyl sulfate (SDS, cmc/100), a well-known surfactant. Gradients in the surface concentration of SDS play a role analogous to that of temperature gradients in (I) as being the source of Marangoni flows. Similarly to what occurs in (I) we observe a symmetry-breaking of the primary axisymmetric flow in the form of complex dipolar and even multipolar patterns.

Dipolar flows (Fig.1 below), emerging as pairs of contra-rotating vortices, are thought to be the mechanism by which hot spherical particles move at large velocities (∼100 particle diameter/s) on the WA interface. Such flows stem from the destabilization of initially toroidal flows [2] that display similar shapes in both experiments (I) and (II). We currently focus our efforts on understanding how the instability sets in.


**Figure 1:** Example of a dipolar flow seen from above the WA interface in experiment (II). (a) : Streamlines (left). (b) : Structure unveiled by a droplet of fluorescent dye sent through the injector (right).