

Laboratory name: Laboratoire de Physique de l'ENS (LPENS)

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Internship location: LPENS, 24 rue Lhomond, 75005 Paris

Thesis possibility after internship: YES Funding: NO

Biophysical characterization of shear-induced buoyancy regulation mechanism in diatoms

Diatoms are a particular group of phytoplankton that contribute to an estimated 20% global primary production and carbon export. Despite their large-scale importance, their behavior and dynamics in the water column remain rather poorly understood. In particular their ability to control their position in the water column is still a mystery. Lacking swimming appendages like flagella, diatoms rely on passive advection by flows and active buoyancy regulation. At LPENS, our group is particularly interested in the regulation of their buoyancy induced by shear flows. Recently, in collaboration with Idan Tuval at IMEDEA (Mallorca) we could demonstrate for the first time that the species *Coscinodiscus granii* (Fig. 1A) actively modulates its intracellular density when sheared by external flows (Fig. 1B). For this master internship (M1 or M2) we aim at investigating the biophysicochemical mechanisms involved in such buoyancy regulation at the single cell level. We will combine biophysical approaches, video-microscopy/optics, image analysis, microfluidic techniques, microalgal culturing techniques and data analysis in order to decipher this complex process.

For M2 students, the internship can be followed with a PhD (funded through a doctoral scholarship to apply to). During the PhD the student will also have the opportunity to work on large scale biogeochemical simulations in order to investigate the effect of active buoyancy regulation on primary production and carbon export (in collaboration with Laurent Bopp at the Geoscience department), and/or to work on the coupling between such active response and turbulence through dedicated simulations (in collaboration with Idan Tuval and Jorge Arrieta at IMEDEA, Spain).

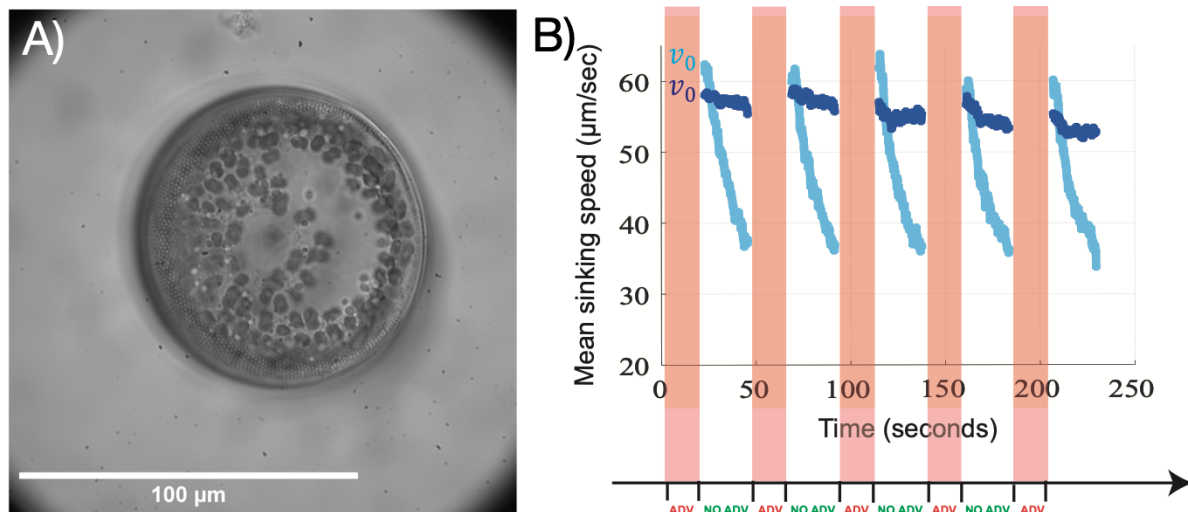


Fig.1. A) Microscopy picture of a single *Coscinodiscus granii* cell. The small particles inside the cells are the chloroplasts where photosynthesis takes place. B) We could show that these cells increase their density (and therefore sinking speed) when sheared by flows (orange periods), density that relaxes after the flows are stopped (light blue curves). Dead cells don't exhibit such response (dark blue curves), demonstrating that living cells do actively regulate their buoyancy. The mechanism by which they do so remains a mystery.

Condensed Matter Physics: NO

Quantum Physics: NO

Soft Matter and Biological Physics: YES

Theoretical Physics: NO