

INTERNSHIP-PhD PROPOSAL

Laboratory name: Laboratoire de Physique de l'ENS de Lyon

CNRS identification code: UMR 5672

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Internship location: ENS de Lyon

Thesis possibility after internship: YES

Funding: TBD

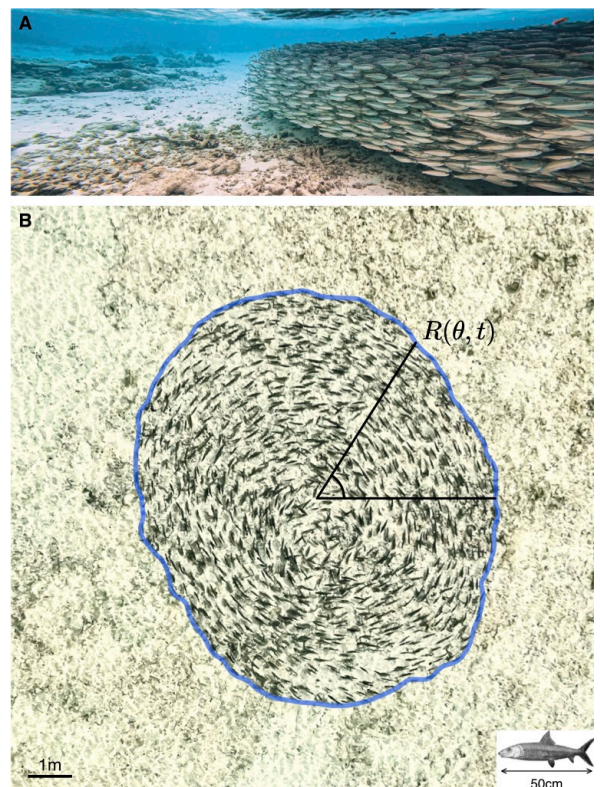
Fish Schools as Active-matter Droplets

When we watch a school of fish from above, we do not see thousands of individual trajectories or a complex network of interactions. We see a cohesive body whose boundary continuously ripples and deforms, either spontaneously or in response to predator attacks. These dynamics raise a simple question: could the fluctuating shapes of animal groups reveal the physical laws governing their collective motion?

This project aims to turn the shape fluctuations of wild fish schools into a quantitative probe of collective dynamics. Combining aerial drone observations with statistical data analysis, we will investigate how boundary deformations emerge, propagate and decay. Recordings of different species in the Caribbean, the Atlantic and Indian oceans will allow us to test whether these fluctuations follow common physical laws across contrasting environments and species.

To explain these observations, we will then combine simulations of interacting fish with hydrodynamic theory. In particular, we will investigate whether milling schools, in which fish circulate around a common centre, can be described as droplets of active fluids. We will then test whether the parameters governing collective motion can be inferred from boundary fluctuations alone, without tracking every fish.

Your Master's internship will focus on a specific part of this programme, with the possibility of continuing into a PhD. Depending on your interests and skills, your work can combine quantitative data analysis, numerical simulations and theoretical modelling, with opportunities to contribute to field observations.



A. Underwater image of a bait fish school milling in shallow water. Fish Length 10 cm. B. Aerial drone image of a milling school of 50 cm long fish. Their boundary blue constantly fluctuates even when no predator perturb the school. Credit: BartoloLab.