INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Laboratoire Interdisciplinaire de Physique (LIPhy)
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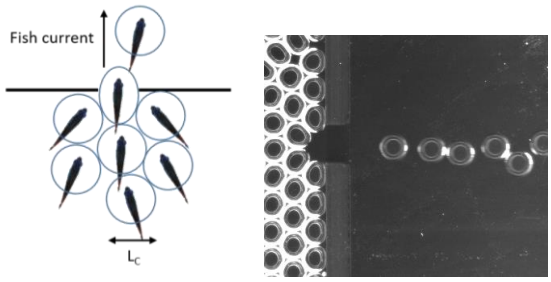
Internship location: LIPhy, Grenoble

Thesis possibility after internship: YES/~~NO~~
Funding: ~~YES~~/NO If YES, which type of funding:

Evacuation of a crowd, the fish-bubble analogy

Collective movements are a fascinating phenomenon that can be observed in living organisms at different scales, from bacteria to human crowds. We are interested in the case of schools of fish and more particularly in their evacuation through an opening of a size comparable to the size of the fish. We have recently shown that the escape of fish is analogous to that of bubbles[1]. Indeed, the fish outflow (fish/s) is well fitted by the Beverloo law used for bubbles in a similar situation by Bertho et al.[2]. We have modeled the fish as surrounded by a cognitive bubble that governs their outflow statistics (Figure, left).



(Left) Model of fish surrounded by a cognitive bubble while passing through a bottleneck. (Right) Preliminary results of bubbles evacuating through an opening.

We would like to further explore this analogy and its limits. To this end, we have recently built an experiment allowing the evacuation of bubbles through one or two slits. We can vary the size of the opening, the evacuation stress and the size of the bubbles. The aim of the internship will be to analyze the statistics of evacuation time intervals, in the same way as we did for fish, and see whether the model proposed for fish is valid for bubbles.
The physical questions are many and open: how intermittent is bubble evacuation? Can we observe blocking phenomena such as those seen with active particles or grains? What are the interactions between slits and their consequences on bubble evacuation rates?
Based on preliminary work, the trainee will have to finalize the experimental protocol by identifying the most controlled bubble injection conditions possible, and carry out the various experiments with the bubbles. He/she will then analyze the images obtained and take part in the modeling.

[1] Larrieu, R., Moreau, P., Graff, C., Peyla, P., & Dupont, A. (2023). Fish evacuate smoothly respecting a social bubble. Scientific Reports 13 (1), 10414
[2] Bertho, Y., Becco, C., & Vandewalle, N. (2006). Dense bubble flow in a silo: An unusual flow of a dispersed medium. Physical Review E, 73(5), 056309.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: ~~YES~~/NO Soft Matter and Biological Physics: YES/~~NO~~
Quantum Physics: ~~YES~~/NO Theoretical Physics: ~~YES~~/NO