

# INTERNSHIP-PhD PROPOSAL

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

Internship supervisor: Denis BARTOLO

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Internship location: ENS de Lyon

Thesis possibility after internship: YES

Funding: YES (ANR)

## CROWDS AS ACTIVE MATTER

One of our primary goals is to uncover the collective dynamics of interacting humans and animals using principles of physics. In essence, we aim to describe large groups of animals and human crowds as active continua.

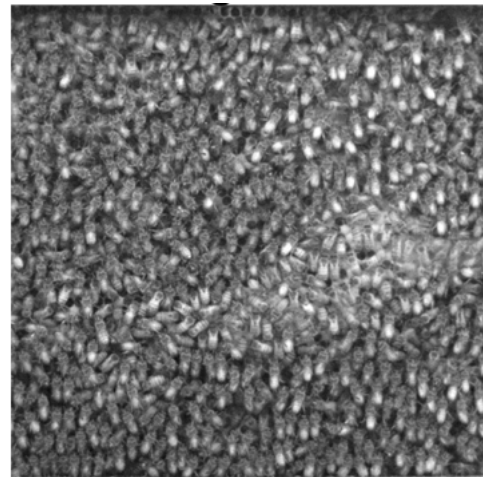
While computer algorithms can generate stunning visual impressions of bird flocks, fish schools, and human crowds, understanding and predicting their collective dynamics involves more than visual resemblance. To date, predicting how large groups respond to physical, social, or biological stimuli remains a significant scientific challenge.

We address this challenge by acquiring and analyzing unprecedented datasets on fish schools and bee colonies. Our primary objective is to explain their spontaneous fluctuations and their responses to predators. For an introduction to the type of questions we could address during your project, and the type of concepts and tools we would use, you can view our initial study of human crowds as active fluids [here](#).

PhD candidates are deeply involved at every stage of our investigations, from gathering data and imaging large-scale natural systems, to performing statistical analyses and developing predictive mathematical models. Master's interns typically focus on analyzing data and contribute to the development of quantitative theories.

We'd be delighted to discuss potential projects with you, either via Zoom or in Lyon.

Condensed Matter Physics: YES	Macroscopic Physics and complexity: YES
Quantum Physics: YES	Theoretical Physics: YES



Top: A physicist induces a perturbation to the organization of fish school. (D. Bartolo). Bottom: Bee colony in an instrumented beehive. (ANR BeeHavior project).