INTERNSHIP-PhD PROPOSAL

Laboratory name: Laboratoire de Physique de l'ENS de Lyon
CNRS identification code: UMR 5672
Internship supervisor: Denis BARTOLO
e-mail: **denis.bartolo@ens-lyon.fr**   Phone number: +33(0)47272 8492
Web page: **https://bartololab.com**
Internship location: ENS de Lyon
Thesis possibility after internship: YES (start 2026)   Funding: YES (ANR)
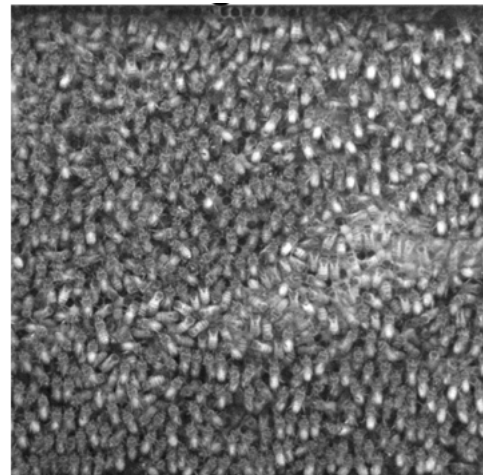
CROWDS AS ACTIVE MATTER

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 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.

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

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