## POLAR ACTIVE NEMATICS: THE PHYSICS UNDERLYING BACTERIAL ORGANIZATION ON SURFACES

Active matter is an emergent field in Physics that deals with intrinsically out-of-equilibrium systems, which are made up of active particles capable of harvesting and consuming energy from the surrounding environment. In this context, active nematics represent a broad class of active systems. They exhibit long-range orientational but no positional order.

Bacteria constitute a particular class of active nematics as the number and the size of particles vary in time. In addition, they display polar adhesion. As a consequence, the correlation length of the orientation field decrease with the polarity and number of adhesions. This lead to a completely new situation in which the nematic particles are pinned to the substrate and steric interactions propagate over long length scales.

The project aims at elucidating the crosstalk between adhesion and topological defects. We want to understand how the topological defects are correlated to the pattern of adhesion either between bacteria (cell-cell adhesion) or with the substrate (cell-susbstrate adhesion). The project will also investigate how the strength of adhesion and the growth rate of bacteria influence the number and lifetime of the topological defects within growing colonies. Besides, since bacterial adhesion is polar, we would like to understand the cellular mechanisms that allow to break the symmetry of adhesins distribution on the bacterial envelope. Our long term goal is the design a multi-scale modeling for microcolony formation.

During its internship, the student will receive training in instrumentation, data analysis, numerical simulations and modelling. The internship can lead to a thesis. Interested candidate should contact Nicolas Desprat (desprat@ens.fr). The ABCD lab is part of the Laboratory of Physics of ENS Paris (LPENS). The LPENS is a multidisciplinary environment where experimental biophysics converses with theoretical physics. The project will be done in collaboration with microbiologists at Institut Pasteur.