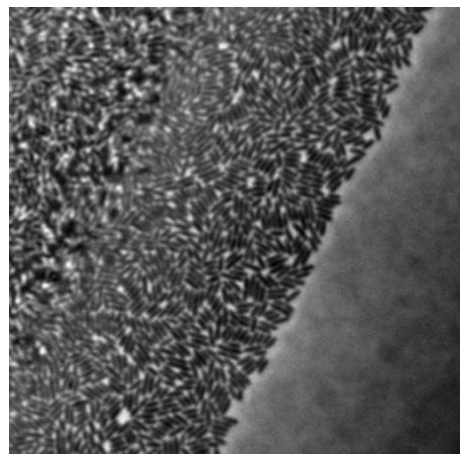
Bacterial Active Matter in Expanding Colonies

Scientific Context

The growth of bacterial colonies is the result of single-cell scale processes (such as cell division or cell motility) but also larger scale physical processes (nutrient diffusion, surface wetting). Moreover, cell-cell and cell-substrate interactions can translate into long-range correlations. This project aims at deciphering the contribution of these physical processes to the morphogenesis of swarming colonies of *Pseudomonas aeruginosa*.

Scientific Questions

Swarming is the ability to collectively spread across solid surfaces. *P. aeruginosa* (2 microns long) harbours one flagellum and swims in a run-reverse-run mode. *P. aeruginosa* swarming colonies (10 cm diameter) exhibit behaviours typical of active matter across scales: nematic active turbulence in the center of the colony, jamming transition near the edge (fee figure), self-organisation in discrete layers, etc. The goal of this project is to understand to which extent the cellular properties (swimming patterns, number of flagella, cell body size) control swarming dynamics.



Tools

To address these questions, we combine innovative microscopy techniques at all scales (from single cell to the whole colony), image analysis at all scales, and microbiology techniques. We work in close collaboration with theoretical physicists, Pierre Illien (PHENIX) and Raphaël Voituriez (LJP).

Where

The project is funded by the ANR (X-BACAMAT, 2022-2025). The Jean Perrin Laboratory covers a wide variety of questions related to the physics of biological systems. The microbiology group uses several model systems to study biofilm formation, evolution, mechanobiology, and bacterial active matter.

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