

M2 internship 2025

Monitoring and modeling bioelectric activity of cells

Laboratory: Physics of Cell and Cancer PCC - Institut Curie / CNRS UMR 168 / UPMC

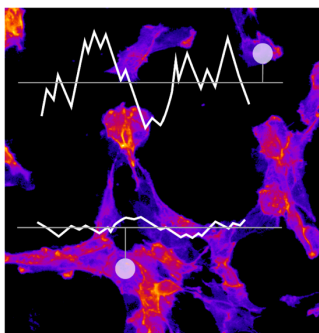
Teams: Light Observation and Control of Cellular Organization and Physical approaches of biological problems

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It has been recently recognized that **every cell exhibits an electrical activity**, from voltage drop across their membrane through patterning of surface charges. While the electrical activities of neurons and muscle cells (excitable cells) have been widely documented with regards to their functions, **the role of electric potentials in non-excitable cells remains to be explored**. Several studies suggest that such bioelectricity could be fundamental for processes both at the multicellular scale and at the unicellular one like development, migration, or cancer. In this internship, we propose to **explore the intrinsic fluctuations** of the bioelectric signal in cultured epithelial mammalian cells. We previously engineered cells to express a fluorescent biosensor reporting their electrical activity (based on Ruhl et al., *Advanced Science* 2024). On time scale of seconds to tens of minutes, significant fluctuations are observed and depend on the local context: single isolated cells present large fluctuations, while island of connected cells show dampened fluctuations. These fluctuations can be used to understand how cells are electrically coupled and how multicellular patterns of bioelectric activity emerge as well as better understand the biological and physical mechanisms dictating the electrical setpoint of cells.

The intern will combine **fluorescent live cell imaging and theoretical modeling** to measure and model these fluctuations. Ideally, we are seeking for a student with a background in physics/math that is willing to perform experiments in biology. **Required skills:** math, statistical physics, programming. **Beneficial skills:** notions of microscopy, image analysis, data processing.



***Bioelectric fluctuations in cells.** The image shows cells under the microscope, where the color denotes the electrical potential at the membrane. Over time, the potential fluctuates and depends on the context of the cell: whether isolated or in contact with neighbors.*