M2/PhD project

Laboratoire Physique des Cellules et Cancer
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Team: Biology-inspired Physics at MesoScales (https://institut-curie.org/teams/buguin_silberzan)
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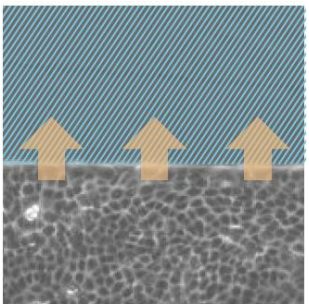
Kinetically locked-in cell migration on micro-patterned substrates



Emerging collective behaviors observed in biological tissues are largely controlled by the structure of the underlying extracellular matrix (ECM) and its interactions with the cells. Notably, cells can deposit oriented fibrous ECM which then acts as a guiding cue for neighboring cells. In cell populations, this trail of ECM acts as an effective "memory" between cells not only at the single cell level but also in cell populations. In confluent monolayers, it contributes to large correlation lengths in the supracellular organization of the cells and in their collective migration.

Aligned ECM on a surface can be mimicked by synthetic subcellular micro-patterns such as grooves. On the other hand, the spontaneous direction of collective migration can be controlled by the release of a well-defined barrier. In the absence of grooves, the direction of migration is perpendicular to the initial barrier. When the substrate is patterned with microlines making an angle with direction, the collective behavior of the monolayer is then either dominated by the initial barrier direction, by the grooves' direction, or may result from a compromise. In the same line, other geometries such as a regular array of obstacles defining an "easy axis" at an angle with the migration direction define an energy landscape in which collectively migrating cells may be kinetically locked-in, the corrugation of this energy landscape being tuned by the depth of the micropattern.

These experiments will be interpreted with our colleagues from the theory group of the laboratory, shedding light on the behavior of cell populations in complex environments.

Recent relevant references of the group (selection)

- Lacroix M et al.: *Emergence of bidirectional cell laning from collective contact guidance.* Nature Physics **20**, (2024) 1324
- Sarkar T. et al.: *Crisscross multilayering of cell sheets,* PNAS Nexus, **2**, (2023), pgad034
- Yashunsky V et al : *Chiral Edge Currents in Nematic Cell Monolayers* Physical Review X **12**, (2022), 041017.