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It is our pleasure to invite you to the following seminar:

Thursday September 19th, 2019, 11:00-12:00, BSP 407, Cubotron

**Cellular aggregates and microparticles: spontaneous migration,
collective phagocytosis, dancing**



Prof. Françoise Brochard-Wyart

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We introduce the broad field of entangled active matter. Unlike swarms of fish and flocks of birds, cells are bound by transient links and behave as activeviscoelastic pastes.

We investigate the collective migration of cell on adhesive gels, using 3D cellular aggregates as a model system. Aggregates spread by expanding outwards a cell monolayer, which may partially dewet, causing the aggregate to move. Varying the substrate rigidity induces different modes of aggregate motion: “Giant Keratocytes”, where the lamellipodium is a cell monolayer that expands at the front and retracts at the back; “Penguins”, characterized by bipedal locomotion; and “Running Spheroids”, for non-spreading aggregates. We characterize these diverse modes of collective migration by quantifying the flows and force field responsible of the bipedal stick-slip motion. We propose two possible mechanisms to explain the spontaneous migration of cellular aggregates: i) chemical modification of the substrate in analogy to reactive droplets. We show that it is possible to mimic a keratocyte with a droplet of oil containing a surfactant. The reactive droplet adopts a croissant shape also seen for keratocyte fragments and ii) symmetry-breaking arising from cell polarization in analogy to active droplets.

We then describe mixture of dead and living matter and how microparticles play with cells. The size of the particles is varied from nanometers to few microns. Nanoparticles (size 20nm) can be used as a glue “nanostickers” to enable the formation of self-assembled aggregates by promoting cell–cell interactions. Nanostickers by increasing the cohesion of tissues and tumors may have important applications for cellular therapy and cancer treatment. Micro-particles (size ≈ micron). We study the spreading of cell aggregates deposited on adhesive substrates decorated with microparticles. A cell monolayer expands around the aggregate. The cells at the periphery uptake the microparticles “gluttonous cells” by phagocytosis, clearing the substrate and forming an aureole of cells full of particles. As the size of the particles increases, macro-particles MPs (size ≈10 microns), they become too big to be eaten and they are put into motion” dancing” For hybrid cells-MPs aggregate, mixture of active-passive matter, we observe a phase separation, predicted by simulations for a mixture of particles with different level of activity.

[1]G.Beaune, C.Blanch-Mercader PNAS 2019 Spontaneous migration of cellular aggregates from giant keratocytes to running spheroids

Proc. Natl. Acad. Sci. U. S. A., 2018, Issue 51, pp12926-12931

[2] B.Brunel et al Nanostickers for cells: a model study using cell–nanoparticle hybrid aggregatesSoft Matter 12 (38), 7902-7907. 2015

[3] Grégory Beaune1et al *How gluttonous cell aggregates clear substrates coated with microparticles”Scientific Reports 7, Article number: 15729 (Nov 2017).