

INTERNSHIP PROPOSAL

Laboratory name: Physics of Cells and Cancer

CNRS identification code: UMR168

Internship director's surname: Antony Lee & Koyomi Nakazawa

e-mail: antony.lee@curie.fr

Phone number: 01 56 24 67 90

Web page: <https://institut-curie.org/team/martin>

Internship location: 11 rue Pierre et Marie Curie 75005 Paris

Thesis possibility after internship: YES

Funding: NO

Actomyosin-driven active liquid droplets

Liquid-liquid phase separation (LLPS) is a key process through which cells can spatially compartmentalize macromolecules. Some proteins associated with the nucleation of cytoskeletal filaments, such as actin, can form phase-separated droplets in vitro, and actin growth leads to deformation of these droplets. Recently, we have developed a platform through which an actin nucleation promoter can be targeted to artificial phase-separated RNA-polypeptide droplets; growing actin filaments self-assemble into criss-crossing rings within the droplets (Figure 1(A)), and bundles outside of it (Figure 1(B)).

On the other hand, the host team has also developed a minimal molecular system where polymerizing actin filaments and various myosin motors (myosin II, V, and X) self-assemble into filament bundles that undergo a wave-like beating similar to the beating of sperm flagella (Figure 1(C); Pochitaloff et al., *Nat. Phys.*, 18:1240 (2022)). So far, these beating bundles can be anchored to the surface of a glass coverslip or of a polystyrene microbead.

In this internship, we propose to explore how myosin motor activity may lead to the remodeling of liquid droplets from which actin filaments are growing. A possible goal is to observe the beating of droplet-anchored bundles, which could be compared qualitatively and quantitatively to microbead-anchored bundles. Another possibility is the observation of actin ring remodeling and contraction in a manner reminiscent of the closure of the cytokinetic ring during cell division.

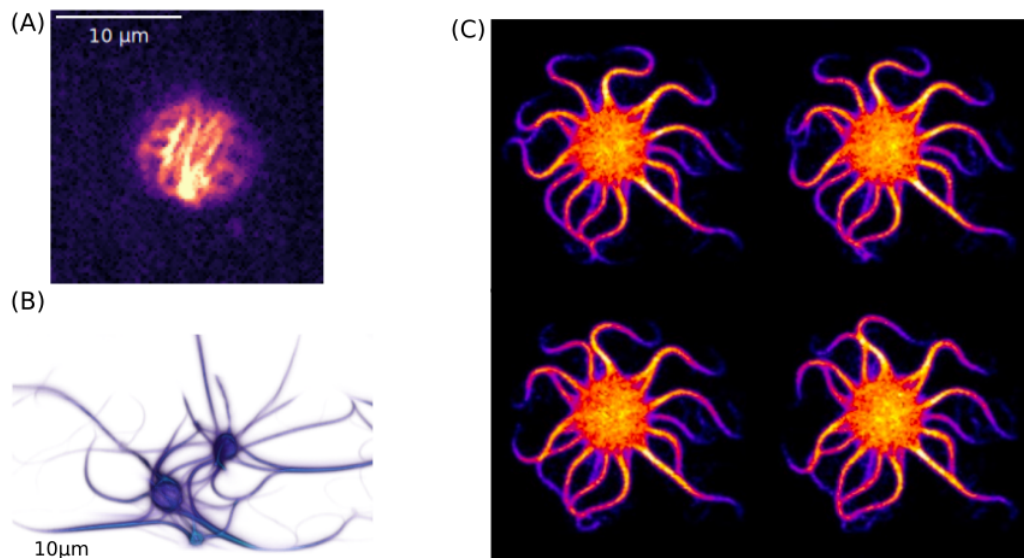


Figure 1: (A) Criss-crossing actin rings confined in a phase-separated RNA-polypeptide droplets. (B) Actin-filament bundles grown from droplets. (C) Autonomous 2D undulations of actin-filament bundles driven by myosin II motors [2].

Specialty: Soft Matter and Biological Physics

Keywords: Self-organization, molecular motors, cytoskeleton, liquid-liquid phase separation, reconstituted systems, bottom-up approaches.

Skills: Protein biochemistry, fluorescence microscopy.