Lipid membranes exhibit non-trivial properties especially at length scales larger than molecular sizes. A purely molecular description of membranes is insufficient to arrive at a quantitative
understanding of their function and require meso-scale concepts coming from soft matter and statistical physics. In addition, cell membranes involve a wide number of membrane-interacting proteins that can alter the overall physical description of the membrane itself. Our goal is to contribute to a more comprehensive understanding of biological membranes and their role in living systems.

Model bio-membranes and cell membranes

To understand the role of lipid membranes and associated proteins involved in essential cellular functions such as intracellular trafficking, endo/exocytosis, cell infection, transmembrane transport of ions and protein diffusion, our group has developed multidisciplinary approaches that are largely based on synthetic biology, biomimetic systems and quantitative physical measurements. The team has successfully developed several physical approaches for the micromanipulation of giant unilamellar vesicles (GUVs) and cells, combining micropipette aspiration and optical tweezers with confocal microscopy. These technological approaches are particularly powerful for the study of membrane nanotube extension, both from GUVs and cells, and allow one to control the membrane tension and measure associated forces. Our research is motivated by close collaborations with biologists and theoreticians, both within and outside Institut Curie, and have involved such projects as the activity of transmembrane proteins (e.g., ion pumps, adhesion proteins, voltage-gated ion channels), membrane fission by ESCRT complexes, membrane deformation by toxins and viral proteins, the role of membrane curvature in the mobility and sorting of lipids and proteins (including BAR-domain proteins and dynamin), and how cell membrane mechanics contribute to cellular force generation that underlies the formation and dynamics of filopodia.

Key publications

Year of publication 2020

Aurélie Bertin, Nicola de Franceschi, Eugenio de la Mora, Sourav Maiti, Maryam Alqabandi, Nolwen Miguet, Aurélie di Cicco, Wouter H. Roos, Stéphanie Mangenot, Winfried Weissenhorn,
Human ESCRT-III polymers assemble on positively curved membranes and induce helical membrane tube formation

*Nature Communications* : 11 : 2663 : DOI : 10.1038/s41467-020-16368-5

Year of publication 2019

Myosin 1b is an actin depolymerase.

*Nature Communications* : 10 : 5200 : DOI : 10.1038/s41467-019-13160-y

Membrane curvature induces cardiolipin sorting.

*Communications Biology* : 2 : 225 : DOI : 10.1038/s42003-019-0471-x

Year of publication 2018

Membrane reshaping by micrometric curvature sensitive septin filaments

*Nature communications* : DOI : 10.1038/s41467-019-08344-5

Ezrin enrichment on curved membranes requires a specific conformation or interaction with a curvature-sensitive partner.

*elife* : 7 : e37262 : DOI : 10.7554/eLife.37262

The ESCRT protein CHMP2B acts as a diffusion barrier on reconstituted membrane necks.