ÉCOLE DOCTORALE GALILÉE
Université Sorbonne Paris Nord

Contrat doctoral – ED Galilée

Titre du sujet : Interactions between functionalized nanoparticles and lipid membranes

- Unité de recherche : LVTS, UFR SMBH
- Discipline : 906 Santé Médecine et Biologie Humaine, B8SVS, Sciences de la vie et de la santé
- Direction de thèse : Raphaël Lévy, co-direction Giulia Fadda
- Contact : giulia.fadda@univ-paris13.fr, raphael.levy@univ-paris13.fr
- Domaine de recherche : biophysique
- Mots clés : membranes lipidiques, nanoparticules

Scientific context

Nanoscale dimensions confer interesting physical and chemical properties to particles. They are small enough to remain dispersed in various fluids, yet large enough to offer a significant surface to interact with, thus favouring adsorption, and ultimately uptake into cells[1-2]. The cell membrane, a complex structure composed prevalently of lipids and proteins, plays a pivotal role in this interaction. The entry of nanoparticles into cells offers opportunities to design drug delivery vehicles as well as contrast agents for biomedical research. Another rapidly developing field, in particular following the success of the mRNA vaccines, is the generation of lipid nanoparticles, encapsulating various active ingredients, including inorganic nanoparticles. The preparation and control of such nano-objects requires a detailed understanding of the interactions between nanoparticles and membranes. Model lipid membranes are interesting simplified models of biological membranes. Their simplicity enable to compare experimental results with theoretical predictions.

Objectifs

We aim to investigate the effect of materials, size, shape, functionalization on nanoparticle interactions with model membranes by combining a range of techniques including fluorescence, light and small angle x-ray scattering and impedance spectroscopy.[3] We will use suspended lipid membranes, surface-supported membranes and vesicles as model systems.

The project, at the interface between biophysics and chemistry, will offer an interdisciplinary training experience to a curious and motivated student who will work in the nano medicine team of the LVTS, which specialises in the synthesis and biomedical applications of organic and inorganic nanoparticles.

PhD director: Raphaël Lévy (LVTS: https://lvts.fr/) , **Cosupervisor**: Giulia Fadda (LVTS)

Funding: the supervisory team is looking for a candidate that they would support to compete for an "allocation doctorale de recherche" (PhD student stipend from French government) from the école doctorale Gallilée (https://ed-galilee.univ-paris13.fr/). There are no conditions of nationality but you must have obtained (or be on course to obtain this academic year) a master in a relevant discipline. If you are interested, you must contact Giulia Fadda or Raphaël Lévy (giulia.fadda@univ-paris13.fr, raphael.levy@univ-paris13.fr) as soon as possible and on the 23th May at the latest with a CV and a motivation letter.

1. Rascol, E., Devoisselle, J.M. & Chopineau, J. The Relevance of Membrane Models to Understand Nanoparticles-Cell Membrane Interactions. *Nanoscale* **8**, 4780–98, (2016).
2. Lévy, R. & Erden, Y. J. The long life of unicorns. *Precision Nanomedicine* **3**, 677–684 (2020).
3. Fadda, G. C., Lairez, D., Guennouni, Z. & Koutsioubas, A. Peptide Pores in Lipid Bilayers: Voltage Facilitation Pleads for a Revised Model. *PHYSICAL REVIEW LETTERS* **111**, (2013).