**Master 2 internship**

# Defining the proteome of lipids droplets

Supervisor: Dr. Luca Monticelli
Modeling Biological Macromolecules // CNRS & University of Lyon

Lipid droplets (LDs) are the organelles regulating the energy balance in cells. They are similar to oil-in-water emulsion droplets, surrounded by a lipid monolayer [1], and they are generated in the endoplasmic reticulum (ER). Despite their fundamental role in metabolism and disease, the mechanism of their formation remains poorly understood [2]. LD proteome controls LD assembly, dictates the direction of LD emergence (cytosol vs. ER lumen) and, most importantly, governs LD function. But how do lipid droplets acquire their proteome? Some ER proteins redistribute to nascent LDs, others remain on the ER, and some can be found both in the ER and in the LD. The determinants for protein partitioning are not understood. At the moment, experiments can only provide qualitative results on protein partitioning, and no structural information at the molecular level. Simulations can,

in principle, help interpreting experiments in terms of detailed mechanisms and structures. Our goal is to use simulations to investigate the molecular properties and interactions determining the LD proteome.

During the internship, the student will use advanced molecular simulation techniques to (a) *interpret experimental data* from our collaborators on protein distribution in model systems and living cells, and (b) *explore the molecular factors determining protein partitioning* between the ER and LDs. Simulations will be performed on multiple scales, from all-atom to coarse-grained level [3], and may be combined with new theoretical developments [4].
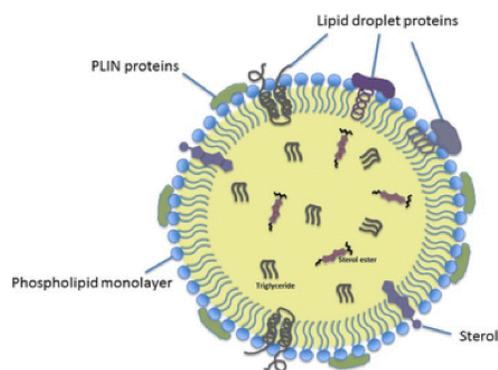


*Figure 1. Schematic representation of a lipid droplet.*

1.  Thiam AR, Farese RV, & Walther TC (2013) *Nat Rev Mol Cell Biol* 14(12):775-786.
2.  Thiam AR & Forêt L (2016) *BBA - Molecular and Cell Biology of Lipids* 1861(8):715-722.
3.  Monticelli L*, et al.* (2008) *J Chem Theory Comput* 4(5):819-834.
4.  Deslandes F, Thiam AR, & Foret L (2017) *Biophys J* 113(1):15-18.

**Requirements:** Candidates with a background in physics, chemistry, or bioinformatics are preferred. Basic knowledge of at least one programming language and Linux OS is a plus.

**Contact:** Interested candidates should contact Luca Monticelli (luca.monticelli@inserm.fr) and send their CV and a letter of motivation.