TITLE of the internship: Effect of endocrine-disruptors on the biophysical properties of the myelin sheath.

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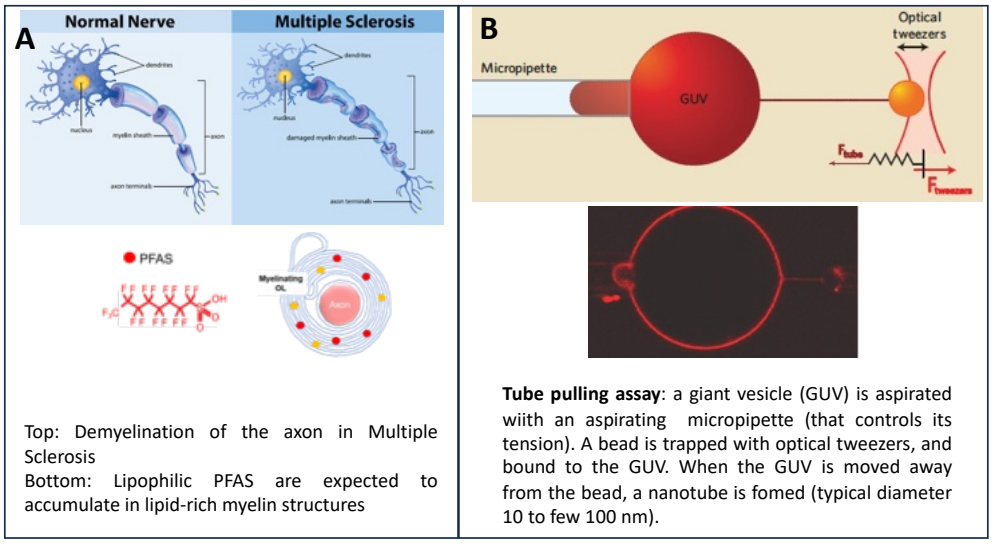
This internship can be followed by a PhD : NO (a priori)

Keywords	Skills
Giant liposomes, membrane mechanics, optical tweezers, endocrine disrupting chemicals, Multiple Sclerosis	Interest for interdisciplinary work and experiments, possibly some experience with manipulation of biological samples or with soft matter

Topic of the Internship :

Environmental factors such as **endocrine disrupting chemicals** (EDC) are suspected to explain the rapidly increasing number of cases of **Multiple Sclerosis (MS)** (*"Sclérose en plaques"* in French**)**, a disease related to the progressive disruption of the **protective myelin sheath** that covers nerve fibers (Fig. 1A, Top). Our collaborators Sylvie Remaud (neuroendocrinologist, Musée National d'Histoire Naturelle) and Bernard Zalc (Neuroscientist, Institut du Cerveau et de la Moelle épinière) have obtained preliminary data showing that flame retardants or fluorosurfactants (PFAS) affect the myelin formation process and remyelination *in vivo*. These lipophilic components could indeed accumulate in the lipid-rich structures like the myelin sheath (Fig. 1A, Bottom) and modify its membrane composition, as well as its mechanical properties, thus compromising its capability to coat long projecting axons.

The internship project aims at studying the **mechanical properties of membranes affected or not by PFAS** using biophysical approaches. We will form Giant Vesicles with lipids extracted of the myelin of animals exposed or not to PFAS, using standard methods well mastered in the group [1]. The elastic modulus, the interlayer friction and the lysis tension (tension at which membrane ruptures) of these liposomes will be measured using **tube pulling experiments** and **micropipette aspiration**, respectively (Fig. 1B), techniques that the team have contributed to develop [2]. In parallel, our collaborators will use lipidomics to analyze the lipids composition of the myelin of these animals exposed or not to PFAS.



Top: Demyelination of the axon in Multiple Sclerosis
Bottom: Lipophilic PFAS are expected to accumulate in lipid-rich myelin structures

Tube pulling assay: a giant vesicle (GUV) is aspirated wiith an aspirating micropipette (that controls its tension). A bead is trapped with optical tweezers, and bound to the GUV. When the GUV is moved away from the bead, a nanotube is fomed (typical diameter 10 to few 100 nm).

References

[1] M. Garten, D. Lévy, and P. Bassereau, in *The Giant Vesicle Book* (2019) *Creating membrane nanotubes from GUVs* pp37-51
[2] C. Prévost, M. Simunovic, and P. Bassereau, in The Giant Vesicle Book (2019) *Protein reconstitution in Giant Vesicles* pp363-377