Master's degree in Biology – Chemistry-Biology Department

Master 2 internship project
Year 2021-2022

Laboratory/Institute: Grenoble Institute of Neuroscience **Director:** Frédéric Saudou
Team: Neurocytoskeleton Dynamics and Structure
Head of the team: Isabelle Arnal & Annie Andrieux
Name and status of the scientist in charge of the project:
Adrien Antkowiak, MCF, UGA **HDR: yes ☐ no ☒**
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Program of the Master's degree in Biology:

☐ Immunology, Microbiology, Infectious Diseases ☐ Structural Biology of Pathogens
☐ Physiology, Epigenetics, Differentiation, Cancer X Neurosciences and Neurobiology

Title of the project: Reconstructing the neurocytoskeleton outside the neurons

Objectives (up to 3 lines):

The main objectives of this project are 1) to reconstitute in a cell free environment, the main actin networks found in neurons and 2) to determine if proteins involved in brain diseases (such as MAP6, tau) are able to remodel and impact the actin dynamics.

Abstract (up to 10 lines):

The cell cytoskeleton regulates many major biological functions such as cell differentiation, cell migration and immune response to name a few. Interestingly, actin filaments and microtubules are coordinated and this is key for many cellular functions in eukaryotic cells like neurons that are highly specialized cells extending long processes, axons and dendrites, responsible for nerve cell communication. In many brain diseases, the cytoskeleton in neurons is disturbed and proteins such as MAP6 and tau, that can be colocalized with the cytoskeleton (actin and/or microtubules), are mutated or have an altered expression profile. However, it is not clear to what extent MAP6 and tau are able to directly affect the organization and the dynamic properties of actin filaments and/or microtubules. Our objective is to determine the molecular impact of MAP6 and tau on the cytoskeleton remodeling in cell-free systems reconstituted from purified proteins. This Learning-By-Building bottom-up approach will allow us to decipher the precise molecular mechanisms induced by the proteins of interest on the cytoskeleton remodeling.

Methods (up to 3 lines):

Protein expression (bacteria, yeast) and purification (ion exchange, gel filtration, polymerization strategy), protein labelling, SDS-PAGE. Imaging (video-microscopy, TIRF). Analysis (ImageJ, R).

Up to 3 relevant publications of the team:

Prezel E *et al*. (2018) Tau can switch microtubule network organizations: from random networks to dynamic and stable bundles. Mol Biol Cell 29:154-165.

Peris L *et al*. (2018) A key function for microtubule-associated-protein 6 in activity-dependent stabilisation of actin filaments in dendritic spines. Nat Comm 9:3775.

Antkowiak *et al*. (2019) Sizes of actin networks sharing a common environment are determined by the relative rates of assembly PLoS Biol 17(6): e3000317.

Requested domains of expertise (up to 5 keywords):

Cytoskeleton dynamics, protein biochemistry, neurobiology, photonic microscopy.