Internship Proposal

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Project Title:
Understanding how cell shape modulates axonal actin rings.

Level:

Master Student

Project Summary:

Neurons are one of the most striking examples of cell polarity. Their cytoskeleton is crucial to establish their distinctive shape and function. The full understanding of the neuronal cytoskeleton architecture and dynamics is essential to comprehend the neuronal cell biology and the mechanisms of axon degeneration and regeneration. The development of the super-resolution microscopy allowed the identification of a particular arrangement of actin, the membrane periodic skeleton (MPS), in which rings of actin, interconnected by spectrin tetramers, are periodically distributed along the axon. The MPS has been observed in every neuron type inspected so far, and is thought to provide physical support to the thin long axon, and to allow for the spatial arrangement of channels and signaling platforms in the axonal membrane. However, the detailed mechanism by which it is formed, the involved components, and its specific functions are still being investigated.

Work to be developed by the student:

Although the MPS is present in axons, there are scattered reports that some non-neuronal cells with thin extensions may also present a periodic subcortical cytoskeleton. Hence, it is possible that the mechanobiology of thin long axon-like structures may promote periodic actin ring formation. To evaluate this hypothesis, we will use human retinal pigment epithelium cells overexpressing II-spectrin, confined to micropatterned surfaces, such that axon-like extensions are formed. The possible assembly of periodic actin rings interspaced by II-spectrin will be resolved by super-resolution (STED). On the opposite side of the scale, it is still unknown if very large diameter axons such as the squid giant unmyelinated axons also organize a periodic subcortical axonal cytoskeleton. In this project, we will develop the methods necessary to analyse the actin cytoskeleton of giant axons. This will allow us to understand how cell shape determines the formation of actin ring structures.

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