Proposal of Master Research Project / Trabajo fin de Master for the academic year 2022-23

Group name: **Development, plasticity and regeneration of thalamocortical circuits**
IP name: **Guillermina López-Bendito**
Group web: **http://lopezbenditolab.com/**

Title of the MRP/TFM:

Role of spontaneous activity in the development of area-specific circuits in the cortex.

Summary of the Project:

The cerebral cortex is responsible for many of the higher-level cognitive functions in mammals, including perception, decision making, motor planning and in human mammals, language. These functions are allocated to different patches of the cortical sheet posing the question of how the distribution of functionality into areas develops from an initially uniform neuroepithelium. During brain development, patterns of activity emerge spontaneously and play a pivotal role in the organization of the circuits. However, the role of these patterns of activity in endowing cortical areas with specific functionality remains unclear. Some preliminary results in our lab reveal that distinct sensory territories, visual and somatosensory, show distinct patterns of activity from early stages in development and that these patterns are somehow influenced by the patterns of spontaneous activity in peripheral receptors (eyes, whiskers).

In this project, we propose to use wide field functional calcium imaging of the dorsal cortex in embryonic and early postnatal mice to continue exploring the ontogeny of the patterns of activity presented by the distinct sensory territories. For the data analysis, we will use image processing techniques and machine learning routines for detecting and classify the patterns of activity acquired.

The aims of this project for the students are:

Become familiar with the technique for acquiring functional calcium imaging in vivo,

Learning a pipeline for analysing functional calcium imaging data, including pre-processing of images (denoising, registration, segmentation), feature extraction, finding of patterns, visualization of data and quantification, and contribute to the improvement of the method.

Due to the nature of the project, it is recommended a strong motivation for analysis tasks and some basic coding experience, though the last one is expected to be acquired during the course.

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Methods and technology involved in the MRP/TFM Project:

In vivo acquisition of mesoscale calcium images using transgenic mice in which neurons of the isocortex express a calcium indicator from the family GCaMP6.

Processing of neural images and data analysis (MATLAB, Python)

Member/s of the lab who will act as tutor/co-tutor of the project (if different from the group IP): Dr. Dorien Vandael, Dr. Daniel Torres Romero

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