

Group name: Lab of Development, Plasticity and Reprogramming of Sensory Circuits

IP name: Dr. Guillermina López-Bendito

Group web: <http://lopezbenditolab.com>

Title of the MRP/TFM:

Layer-specific 2-photon imaging of spontaneous cortical activity in neonates

Summary of the Project:

The development of sensory circuits in the brain is critically shaped by spontaneous neural activity occurring before sensory experience. These early activity patterns are thought to prepare the cortex for processing incoming sensory inputs, yet the mechanisms by which they guide circuit formation and sensory identity remain largely unknown. This project focuses on the visual (V1) and somatosensory (S1) cortices in the mouse brain, aiming to uncover how spontaneous activity contributes to the establishment and refinement of sensory-specific cortical territories. Our central question is: **How does early spontaneous neural activity influence the identity and plasticity of developing sensory circuits?** To address this, we will use layer-specific *in vivo* 2-photon calcium imaging to monitor spontaneous neuronal activity in V1 and S1 during the early postnatal period. We will perform 2-photon imaging with specific Cre mouse lines, followed by neuronal activity pattern analysis and histology, and immunohistochemistry. We expect to observe distinct spontaneous activity profiles that correspond to specific sensory modalities. These differences may reveal mechanisms by which the brain reallocates cortical territory and enhances remaining sensory systems, offering insights into developmental plasticity and potential strategies for sensory rehabilitation.

As a Master's student in this project, you will:

- Observe state-of-the-art neonatal mouse brain surgery, including craniotomy procedures
- Learn to operate a next-generation 2-photon microscope for *in vivo* imaging
- Participate in mouse brain tissue collection, histological processing, and immunohistochemistry
- Assist with imaging data analysis using Fiji/ImageJ
- Work under the close supervision of an experienced postdoctoral researcher in our lab

The student will receive dedicated guidance from a postdoctoral researcher throughout the training period, ensuring continuous support and skill development.

Methods and technology involved in the MRP/TFM Project:

- 2-Photon Calcium Imaging of live mouse brains (performed by the postdoctoral researcher; students will observe and assist with data analysis)
- Neonatal Craniotomy Surgery for *in vivo* imaging preparation
- Mouse Brain Histology and Immunohistochemistry for cellular and molecular analysis
- Tissue Sampling and Sectioning of perinatal mouse brains
- Fiji/ImageJ for imaging data processing and quantitative analysis
- Developmental Neuroscience Techniques to study spontaneous neural activity and sensory circuit plasticity

Member/s of the lab who will act as tutor/co-tutor of the project (if different from the group IP; PhD required to be tutor / co-tutor): Luwei Wang, Ph.D.

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