Proposal of Master Research Project (MRP) for the Academic Year 2026-27

Group name: Development, Wiring and Function of Cerebellar Circuits
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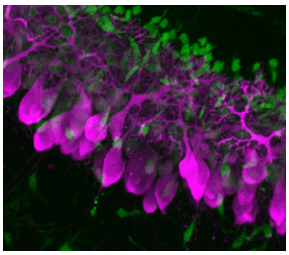
Title of the MRP:
Cerebellar control of Cortical Maturation

Summary of the Project

Cerebellar injury and malformation are among the most common neurological findings in preterm infants and represent a significant risk factor for autism spectrum disorder (ASD). Despite this clinical relevance, the mechanisms linking early cerebellar dysfunction to ASD-relevant brain changes remain poorly understood.

Recent work from our group shows that excitatory output from the cerebellar nuclei during the first postnatal week reaches the cerebral cortex and influences the transcriptional maturation of specific cortical areas. Disrupting this cerebellar output dysregulates a convergent set of ASD-associated genes in frontal and motor cortices, and produces lasting social and behavioral alterations in adult mice. This project will extend these findings by characterizing the cellular and molecular consequences of disrupted cerebellar signaling on cortical circuit organization, using histological and molecular approaches.



The student will work with established mouse models in which cerebellar output has been selectively perturbed during early postnatal development. Using these models, the student will characterize cortical changes at the structural and molecular levels and contribute to the validation of candidate pathways identified by transcriptomic profiling.

Specific Objectives

1. To characterize cortical cytoarchitecture and laminar organization in cerebellar perturbation models using immunohistochemistry and confocal imaging.
2. To analyze the distribution and density of defined cortical neuronal populations (excitatory, inhibitory) in affected versus control animals.
3. To validate the cortical expression of candidate ASD-associated genes identified by RNA sequencing using in situ hybridization and immunohistochemistry.
4. To contribute to tissue processing and sample preparation for transcriptomic or functional analysis pipelines running in the lab.

Methods and technology involved in the MRP:

- Mouse genetics and transgenic model handling
- Immunohistochemistry and confocal microscopy
- In situ hybridization (RNAscope or equivalent)
- Tissue clearing (iDISCO+) and 3D reconstruction by light-sheet microscopy
- Viral tracing techniques
- Molecular biology approaches

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