Laboratoire Jean Perrin

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Seeing the Brain in Action

Deciphering How Thousands of Neurons Work Together

Understanding how large populations of neurons collectively process sensory information and generate behavior is a central challenge in neuroscience. Our research combines advanced optical imaging, large-scale neuronal recordings, and computational approaches inspired by statistical physics to investigate how brain-wide activity is organized across space and time. In particular, we aim to identify collective patterns of neural activity, understand their relationship to sensory processing and behavior, and uncover the principles governing the dynamics of large neuronal networks. The small size and optical transparency of *Danionella* fish offer a unique opportunity to address these questions in an adult vertebrate brain.

This internship aims to develop and optimize a single-objective selective plane illumination microscopy (SPIM) system for fast volumetric calcium imaging in adult *Danionella*. Unlike conventional light-sheet microscopy, the single-objective configuration enables both illumination and fluorescence detection through the same objective, providing optical access to the brain through the non-ossified region of the skull. This approach also facilitates integration with behavioral experiments. The student will contribute to the optical design, implementation, and characterization of the microscope, including measurements of spatial resolution, imaging speed, and fluorescence collection efficiency. **The ultimate goal is to establish a system capable of high-speed, brain-wide recordings of neural activity in adult *Danionella*.**

This internship can serve as a starting point for a PhD project combining experimental neuroscience with large-scale data analysis and theoretical modeling. Brain-wide recordings will open opportunities to investigate collective neural dynamics using tools from statistical physics, machine learning, and dynamical systems theory, with the aim of understanding how coordinated neuronal activity gives rise to brain function and behavior.