Laboratoire Jean Perrin

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The Brain on the Move

Exploring Neuronal and Glial Dynamics During Natural Behavior

Understanding how brain activity gives rise to behavior is a central challenge in neuroscience. Our research combines advanced optical imaging, quantitative behavioral experiments, and computational approaches inspired by statistical physics to investigate how large populations of brain cells coordinate their activity across space and time. While most brain-wide imaging experiments require animals to remain immobilized or head-fixed, studying neural dynamics during natural behavior is essential to understand how the brain continuously interacts with its environment. Moreover, growing evidence suggests that glial cells, long considered primarily as supporting elements, actively participate in the regulation of neuronal activity and brain states. The small size and optical transparency of *Danionella* fish offer a unique opportunity to investigate the interplay between neuronal and glial dynamics in a freely behaving adult vertebrate.

This internship aims to further develop our large-scale behavioral tracking arena, in which a motorized camera continuously follows a freely swimming fish. The objective is to extend this platform to enable simultaneous brain-wide recordings of neuronal and glial activity during natural locomotion and exploration. The student will contribute to the integration of fluorescence imaging with the existing real-time tracking system, including the development of optical and mechanical solutions to maintain stable brain imaging despite the fish's movements. Particular challenges include motion compensation, synchronization of behavioral and fluorescence recordings, and optimization of imaging speed, spatial resolution, and signal quality. **The ultimate goal is to establish a platform capable of simultaneously monitoring brain-wide neuronal and glial activity while adult *Danionella* explore a large environment freely.**

This internship can serve as a starting point for a PhD project investigating the collective dynamics of neuronal and glial networks during natural behavior. The resulting large-scale datasets will open opportunities to explore how neuronal and glial activity interact across different spatial and temporal scales, how brain states evolve during spontaneous exploration, and how these dynamics relate to behavioral decisions. Combining experimental recordings with statistical physics, machine learning, and dynamical systems approaches will provide a framework for uncovering the principles governing brain-wide activity in freely behaving animals.