Master de Sciences et Technologies
Mention Biologie Intégrative et Physiologie
Parcours : Neurosciences
Responsable : Professeur Régis Lambert

Internship Proposal
Academic Year 2019-2020

1. Host team :

Research Unit (e.g. Department or Institute) : SPPIN UMR 8003
Research Unit Director : Martin Oheim
Research Team Directors : Brandon Stell / Marin Manuel

Team names: Cerebellar Neurophysiology
Motor Neurons & NeuroMuscular Junctions

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2. Internship project title:

In vivo two-photon imaging of sensorimotor integration in the cerebellar cortex during locomotion.

3. Internship Description :

All systems that move and interact with their surroundings have to discriminate external stimuli from stimuli arising from their own movements. A static system can simply observe its environment with its sensory receptors, but once the system begins to move, it stimulates its sensory receptors through its own actions and has to be able to discriminate those stimuli from the stimuli arising from external sources. Moving organisms throughout the animal kingdom have found a common solution to this problem by using the information from the movement command (known as the corollary discharge or efferent copy) to cancel the sensory stimulation (reafferent) that would normally arise from that movement (Crapse and Sommer, 2008). Evidence from cerebellum-like structures of weakly electric fish shows that lower vertebrates quickly cancel complex self-generated stimuli by combining the reafferent sensory signal with the corollary discharge. Both signals converge onto principal cells in the cerebellar-like structures and the cancellation happens because the corollary discharge produces an inhibitory signal ("negative image") in the principal cells that cancels the excitatory signal from the reafferent input (Bell, 1981; Bodznick et al., 1999). The negative image formation is achieved through rapid plastic changes of the inputs to the principal cell synapses (Sawtell, 2017). It is often proposed that the cerebellum of mammals uses a similar mechanism to discriminate external from self-generated stimuli but this has yet to be proven at the cellular and synaptic level. We will use a unique combination of techniques (fictive locomotion in mice and monitoring of activity in populations of identified cells in the cerebellar cortex with 2-photon calcium imaging) to determine the mechanisms by which the cerebellar cortex processes sensory and motor information. This unique approach allows us to break the cycle of the motor command to sensory stimulation into individual components and observe the individual impact of each component on the cerebellum. After acquiring an understanding of the mechanisms by which each component affects the cerebellum we will observe how the mechanisms interact with each other in a head-fixed awake animal. Together this will allow us to test the hypothesis that the cerebellar cortex of mammals adapts to cancel the effect of any sensory stimulus that consistently accompanies a motor command and provide an understanding of those mechanisms.