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) : CIRB
Research Unit Director : Marie-Hélène Verlhac
Research Team Director : Michaël Zugaro
Team name : Brain Rhythms and Neural Coding of Memory
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2. Internship project title

Network Mechanisms of Memory Formation and Consolidation

3. Internship Description

The two-stage theory of memory posits that new memories are initially encoded in a labile form in the hippocampus, then progressively stabilized as long term memory traces in the cortex via a hippocampo-cortical dialogue occurring during rest and sleep. This hypothesis was supported by the striking discovery that in rodents, during rest and sleep the hippocampus emits high frequency oscillations called 'ripples' during which it replays the same patterns of activity as during behavior — as if the animals were 'dreaming' about their previous experience.

Ten years ago, we provided the first direct and causal evidence that ripples play a critical role in memory consolidation (Girardeau et al. 2009, *Nature Neuroscience*). We then showed that ripple drive depends on synaptic plasticity during learning and on consolidation requirements during subsequent sleep (Girardeau et al. 2014, *Journal of Neuroscience*). We have also shown that encoding of episodic-like neuronal sequences during exploration requires fine timescale coordination between hippocampal cell assemblies (Cei et al. 2014, *Nature Neuroscience*), and that these neuronal sequences support subsequent replay during sleep (Drieu et al. 2018, *Science*). In addition, we have provided the first direct and causal evidence for the hypothesized hippocampo-cortical dialogue, involving enhanced coupling between ripples, cortical delta waves and spindles (Maingret et al. 2016, *Nature Neuroscience*).

Our goal is to better understand how hippocampal neuronal sequences during exploration and sleep relate to each other, how they evolve over days in the process of learning and memory, and how they are linked to signals from partner cortical and subcortical areas. To this end, we will monitor large numbers of neurons in freely moving rodents during learning of a novel memory task, and during sleep.

The candidate will be directly supervised by a PhD of the team, will be trained to perform all experimental procedures (animal handling and training, construction of electrode microdescenders, etc. except surgery) required in the field, and introduced to advanced analytical methods (spectral analysis, dimensionality reduction, detection of assemblies, etc.)