

Internship Proposal Academic Year 2018-2019

1. Host team :

Research Unit (e.g. Department or Institute) : UNIC CNRS FRE 3693 (*to be integrated in the fall 2018 as a department in the new Neuro Paris-Saclay Institute*)

Research Unit Director : Daniel SHULZ

Research Team Director : Thierry BAL

Team name : Neurocybernétique thalamo-corticale

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2. Internship project title:

Network dynamics and single-cell VSD in “active” brain slices

3. Internship Description :

We have refined an in vitro technique that preserves spontaneous slow oscillations in neural circuits in mice brain slices (wild-type and transgenic). Our goals are to explore the dynamics of internally generated active states in neural circuits and in individual neurons dendrites, in particular using high-resolution voltage imaging (VSD). In recently designed cortical slices, the entorhinal cortex and the claustrum (a mysterious structure linking most cortical areas in the brain, and often compared to the thalamus) present spontaneous and robust synaptic activities in the form of slow oscillations. The project will explore synaptic interactions in these structures.

The entorhinal cortex is interesting to study using the active slice approach, because it is the generator of robust synaptic oscillations that we record intracellularly (patch-clamp) in pyramidal neurons and fast-spiking interneurons, in the form of robust Up and Down states (Tahvildari et al., 2012). The main goal is to study dendritic dynamics in individual neurons during circuit-generated active states, which has not yet been done.

The claustrum is a thin layer of interneurons and far-projecting pyramidal-like cell sandwiched between the insular cortex and the striatum. It is reciprocally connected with most cortical areas. Its role is unknown and intriguing, ranging from an attentional hub to the “seat of consciousness” (Crick & Koch, 2005). Preliminary results in our lab revealed robust spontaneous synaptic activities, and a sensitivity to neuromodulation. There is a series of possible explorations: the biophysical properties of the different cell-types, neuromodulation at

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the individual/network levels, dendritic properties using VSD, and synaptic interaction with neighboring cortex.

Cells and circuits dynamics will be explored using patch-clamp, dynamic-clamp, calcium and voltage-sensitive dye imaging, neuromodulation, and computational modeling (the latter through collaborations with A. Destexhe team in the UNIC and EITN departments).