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) : **Neuroscience Paris Seine, IBPS, Sorbonne Université, INSERM U1130 – CNRS UMR8246**
Research Unit Director : Hervé Chneiweiss
Research Team Director : Mangin/Legendre
Team name : Dsco
Address : 7 quai Saint-Bernard, 75005 Paris
Supervisor of the Research Intern for this project : **Dongdong LI**
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2. Internship project title:

Seeing and Understanding Glial Activities in Brain Neural Network

3. Internship Description :

Human brain comprises ~100 billion neurons, as well as a comparable number of glial cells[(1)]. Their dynamic communications control our cognition, emotion and behavior. While neurons are long viewed to be the information-processing cell, ever increasing evidence reveals unprecedented roles of glial cells in brain activity[(2)]. Notably, **astrocytes**, a major type of glial cell, actively regulate the function, therefore the health of neural circuits. The concept of '*tripartite*' synapse has emerged, which includes the neuronal pre- and post-synaptic elements and surrounding astrocyte processes, all interacting in a reciprocal manner[(3)].

Astrocyte activity is encoded by dynamic **calcium** signals, which tightly regulate the microenvironment at neuronal synapses, and has also been implicated in animal behaviors such as body energy balance, sleep, memory consolidation and addiction[(4)]. Aberrant astrocyte calcium activity stands as a prominent feature of neurological disorders such as Alzheimer's disease. Nowadays, deciphering the cellular and molecular mechanisms that regulate astrocyte calcium activity is an essential challenge for neuro-medical research. It will help to understand, so to normalize glial abnormality in brain diseases.

By a multidisciplinary approach combining mouse genetic/chemical model, optical microscopy and pharmacology, this short-term project aims to enable the **Master-2 student to**

1) **obtain the state-of-art knowledge on the significance of astrocytes in brain function;**
2) **image directly astrocyte calcium activity in neural networks in living brain tissues;**
3) **probe cellular pathways that regulate astrocyte calcium kinetics in situ.**

The supervisor possesses experiences in optical imaging of neuronal and glial activities, optogenetics, and the cellular mechanism of astrocyte activities (http://cvscience.aviesan.fr/cv/1811/dongdong-li), and will work closely with the student on both theoretical and experimental aspects. There is no technical hindrance

This project is readily to be started without difficulty, while all technical requirements are already established in the host lab. Not only will the up-to-date training on brain neuron-glia interaction be delivered, novel observations on glial activity regulation are also expected. This project is coherent on itself, but can also pave the basis for a potential long-term study (like a PhD study).

References:

1. Herculano-Houzel, S. (2014) The glia/neuron ratio: how it varies uniformly across brain structures and species and what that means for brain physiology and evolution. *Glia* **62**, 1377-1391
2. Barres, B. A. (2008) The mystery and magic of glia: a perspective on their roles in health and disease. *Neuron* **60**, 430-440
3. Dallerac, G., Zapata, J., and Rouach, N. (2018) Versatile control of synaptic circuits by astrocytes: where, when and how? *Nat Rev Neurosci* **19**, 729-743
4. Santello, M., Toni, N., and Volterra, A. (2019) Astrocyte function from information processing to cognition and cognitive impairment. *Nat Neurosci* **22**, 154-166