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

Internship Proposal
Academic Year 2018-2019

1. Host team:

Research Unit (e.g. Department or Institute): Inserm UMR1141 (from January 2019: NeuroDiderot Unit)
Research Unit Director: P. Gressens
Research Team Director: L. Hertz-Pannier / J. Dubois
Team name: Imaging neurodevelopmental phenotypes *inDev*

Team address:
CEA/SAC/DRF/NeuroSpin, 91191 Gif-sur-Yvette
Hôpital Robert Debré, 48 boulevard Serrurier, 75019 Paris

Supervisor of the Research Intern for this project: J. Dubois
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2. Internship project title:

Exploring the development of brain connectivity and maturation in preterm newborns with neuroimaging

3. Internship Description:

The last trimester of pregnancy is a critical period for the brain development, during which the main functional networks emerge and refine in relation to genetic, epi-genetic and environmental factors. The brain growth is intense, as well as the folding process which leads to complex patterns of cortical gyri and sulci. Besides, white matter fibers start to connect distant cortical and sub-cortical regions involved in common networks. Whereas imaging fetuses *in utero* remains a major challenge because of motion, studying premature newborns with magnetic resonance imaging (MRI) has offered the recent opportunity to characterize the temporal sequence of these processes and their relationships *in vivo*. Besides, electro-encephalography (EEG) recordings can provide non-invasive information on the early electrophysiological activity at patients' bedside. In particular, the most frequent EEG pattern recorded in preterm neonates (the so called delta-brushes DB) consists in rapid oscillations nested in a slow delta wave. Vanishing by term age, DBs can be observed as spontaneous activity, but also evoked by sensory stimulation or the own baby's movements, suggesting that DBs might be a developmental marker of early functional processing. Nevertheless, the possible links between the functional evolution of DBs during the preterm period and the structural brain changes in terms of connectivity and maturation have been little explored so far.

In this context, the master project aims to characterize the development of white matter connections (notably thalamo-cortical) and of cortical microstructure in preterm newborns studied longitudinally with MRI between 30 and 40 weeks of post-menstrual age. Focusing on the developing sensorimotor and auditory networks, these characteristics mapped at the

structural level will be compared to the functional DB activity recorded in other preterms of the same age following tactile and auditory stimulations. This study should provide original insights on the normal mechanisms of brain development, and might be generalized to provide early biomarkers of disturbances in case of early lesions or pathologies related to prematurity.

The student's work will be essentially to conduct MRI data analyzes. The internship will take place in NeuroSpin neuroimaging research center on the CEA campus in Saclay (15kms south of Paris).