



UMR 7339 - CNRS, Aix Marseille University, Marseille, France

## Post-Doctoral Position available in CRMBM, Marseille, France

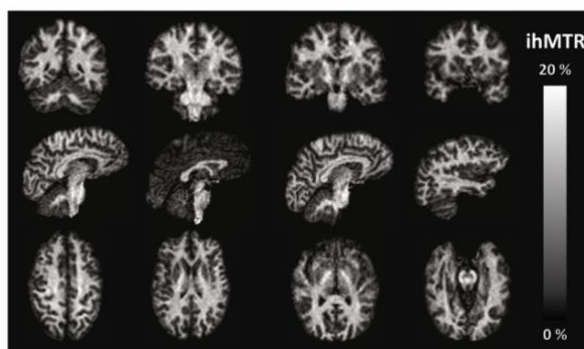
Starting as early as possible from January 2023 (open until filled)

### Quantitative imaging of lipid membranes with ihMT (qihMT): a new myelin MRI biomarker

#### Rationale

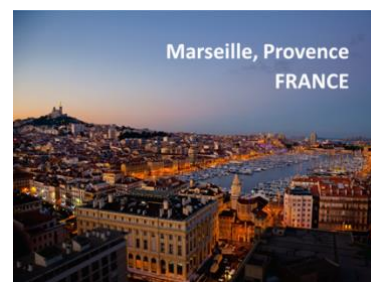
Large macromolecules exhibit a wide dipolar-broadened NMR spectrum, which can be selectively saturated and visualized by MRI following magnetization transfer (MT) to the free water pool. Recently an important characteristic of dipolar-broadened macromolecular lines has been observed using MRI through the discovery of **inhomogeneous magnetization transfer (ihMT)**. ihMT, is a refinement of MT that provides different contrast between tissues than MT by highlighting *dipolar order* effects within motion restricted molecules that are weighted by the corresponding longitudinal dipolar relaxation time  $T_{1D}$ . Because dipolar order relaxation is longer in myelinated tissues of the central nervous system than any other tissue observed, it is uniquely sensitive to myelin (Figure).

The absolute ihMT signal depends on various factors including the MRI experimental parameters but also the biophysical parameters that are characteristics of the dipolar order created in the myelin membrane (proton density, magnetization exchange rate between myelin protons and free water, lineshapes, relaxation times ( $T_1$  and  $T_{1D}$ )). In turn, these biophysical parameters are intrinsically related to the physical properties of the lipid membranes, including their composition and dynamics, which affect the local fluctuations of the dipolar magnetic fields. More generally, the assessment of the quantitative parameters characteristic of the dipolar order created in myelin lipid membranes using a quantitative ihMT (qihMT) approach will help deciphering their composition and motion processes, thereby allowing for a better and more comprehensive understanding of the relationship between the membrane properties and their biological function in pathologies.



#### Objectives

The proposed project aims at developing and validating a quantitative ihMT MRI framework: i) elaborate a comprehensive theoretical model considering all relevant biophysical parameters to describe the ihMTR signal in membranes; ii) implement and optimize ihMT MRI sequences and associated experimental scenarios to be tested in lipid membranes of incremental complexity (synthetic lipid membranes → myelin WM samples); iii) develop processing algorithms to infer the qihMT parameters from the experimental data thanks to the theoretical model; iv) validate the biophysical parameters derived from qihMT in membranes with techniques of reference for their characterization including liquid-state ( $^{31}\text{P}$ -,  $^1\text{H}$ -  $^{13}\text{C}$ -) and solid-state ( $^{31}\text{P}$ -,  $^1\text{H}$ -,  $^2\text{H}$ -) NMR. The successful candidate will have in charge the conduct of the numerical simulations and MR experiments including MRI sequence development and optimization, data acquisition, analysis, and statistics.



#### Qualifications

We are looking for a motivated candidate with a PhD in NMR, MR physics, biomedical engineering or related topic. Prior experience with numerical simulations, MRI/NMR technique developments would be advantageous. Good writing and communication skills in English are required. The successful candidate will work in the [PHENIOS team](#) of CRMBM composed of senior scientists, postdoctoral fellows and PhD students and in collaboration with a team of chemists in Bordeaux ([CBMN](#), [IECB](#)). The duration of the project (ANR funding) is 12 months (+ 2x12 months renewable) with a salary and benefits corresponding to usual Aix-Marseille University conditions.

#### Environnement

The [CRMBM](#) laboratory is in the center of Marseille, France, within La Timone university hospital.

#### How to apply?

Interested candidates should send their detailed CV and a cover letter by email to the attention of Guillaume Duhamel ([guillaume.duhamel@univ-amu.fr](mailto:guillaume.duhamel@univ-amu.fr)), and Olivier Girard ([olivier.girard@univ-amu.fr](mailto:olivier.girard@univ-amu.fr))