



European Research Council
Established by the European Commission

Post-doctoral position

Compartment-specific diffusion modeling in the brain

Job description: The present offer is for a >3-year post-doctoral position funded by a grant from the European Research Council (LactaDiff project, PI: Julien Valette) and available now. The post-doc will work on **microstructural modeling of diffusion**, to predict diffusion-weighted MR signal inside different cell populations (neurons and astrocytes) and in the extracellular space. Modeling will be mostly based on **numerical simulations** of diffusion inside **microstructure as directly extracted from *ex vivo* optical or electron microscopy**, or inside **parameterized geometries** that remain to be implemented to some extent, in particular for the extracellular space. Analytical models will also be considered, if relevant. One important application will consist in analyzing diffusion-weighted MR spectroscopy data acquired in rodents and Humans at 11.7 T, to determine the relative fraction of lactate in the different compartments. This will allow answering major neuroscience questions related to brain energy metabolism and lactate shuttling.

Location and environment: Our team has world-leading expertise in diffusion-weighted MR spectroscopy (e.g. [1-3]), and has introduced original diffusion modeling strategies (e.g. [4-6]). The work will be performed in MIRCen, a preclinical research center part of the French Atomic Energy Commission (CEA), located in Fontenay-aux-Roses (5 km south from Paris). MIRCen is equipped with state-of-the-art 11.7 T MRI scanner for rodents, and provides on-site expertise and access to confocal microscopes, gene transfer... Collaboration will be tight with CEA/NeuroSpin, which is just a few km away and will soon operate an 11.7 T clinical MR.

Candidate profile: The candidate should hold a PhD in biophysics/physics/computer sciences or related fields. Salary will be commensurate with experience (past post-docs, etc...). He/she should be highly motivated, creative, and willing to collaborate with people having different backgrounds, such as neurobiologists. The candidate should be fluent in English or in French. The candidate should be an expert in at least one of the following domains, and willing to deeply engage in others:

- MR physics and sequences, diffusion-weighted MR.
- Diffusion physics and mathematics.
- Programming and computational methods, including Matlab/C++, Monte Carlo simulations, parallel computing, GPU programming, machine learning.

Contact info: CVs and application letters, as well as requests for additional information, should be sent to Julien Valette by email at the following address: julien.valette@cea.fr

Team's publications (excerpt):

- [1] Valette et al., Brain metabolite diffusion from ultra-short to ultra-long time scales: what do we learn, where should we go? *Front Neurosci* 2018;12:2.
- [2] Ligneul et al., Diffusion-weighted magnetic resonance spectroscopy enables cell-specific monitoring of astrocyte reactivity in vivo. *Neuroimage* 2019;191:457-469.
- [3] Vincent et al., Characterizing extracellular diffusion properties using diffusion-weighted MRS of sucrose injected in mouse brain. *NMR Biomed* 2021;e4478.
- [4] Palombo et al., New paradigm to assess brain cell morphology by diffusion-weighted MR spectroscopy in vivo. *PNAS* 2016;113(24):6671-6.
- [5] Palombo et al., Can we detect the effect of spines and leaflets on the diffusion of brain intracellular metabolites? *Neuroimage* 2017;182:283-293.
- [6] Nguyen et al., Efficient GPU-based Monte-Carlo simulation of diffusion in real astrocytes reconstructed from confocal microscopy. *J Magn Reson* 2018;296:188-199.