# Post-doctoral positions
## Measuring and modeling brain metabolite diffusion

## Context

Two **4.5-year post-doctoral positions** funded by a grant from the European Research Council (LactaDiff project, PI: Julien Valette) are available now. One position is about **diffusion-weighted MR spectroscopy methods**, the other about **diffusion modeling** (see details below).

The work will be primarily performed in MIRCen, the preclinical research center from the French Atomic Energy Commission CEA site of Fontenay-aux-Roses (5 km south from Paris). MIRCen is equipped with a state-of-the-art 11.7 T MRI scanner for rodents, and provides on-site expertise and access to confocal microscopes, gene transfer facilities... Experiments on humans will be performed NeuroSpin, the high field MRI research center in the CEA site of Saclay (10 km south from Paris). NeuroSpin is equipped with a 7 T clinical MRI, and soon operating the first 11.7 T clinical scanner.

## Position 1: Diffusion-weighted MR spectroscopy methods

The post-doc will develop **diffusion-weighted MR spectroscopy methods** to measure brain metabolite diffusion *in vivo*. In particular, the post-doc will optimize **polychromatic radiofrequency pulses** and their incorporation inside dedicated **diffusion-weighted MRS sequences**, to characterize the **diffusion of brain lactate** with unprecedented precision. Methods will first be developed in the healthy rodent brain at 11.7 T and evaluated in rodent models where the cellular compartmentation of brain lactate is expected to vary (work performed in MIRCen). Then, methods will be transposed on an 11.7 T clinical scanner to investigate potential variations of brain lactate compartmentation in various conditions in humans (work performed in NeuroSpin). Throughout the project, the post-doc will work in close collaboration with other members of the research team. The post-doc will be primarily based in MIRCen but is expected to spend a significant fraction of his/her time in NeuroSpin, and to develop strong ties with researchers in both labs.

Candidates should already have a solid background in MR physics, *in vivo* MRI/MRS, and expertise in pulse programming (Bruker or Siemens, and willing to learn). Knowledge of diffusion-weighted MR and radiofrequency pulses design (e.g. Shinnar - Le Roux algorithm) would be a strong asset.

## Position 2: Compartment-specific modeling of brain diffusion

The post-doc will develop **diffusion modeling and analysis**. More specifically, he/she will be developing models to predict diffusion-weighted MR signal inside different cell populations (**neurons and astrocytes**) and in the **extracellular space**. Conversely, diffusion-weighted MR spectroscopy data will be analyzed to determine the relative fraction of brain metabolites,

and in particular lactate, in these different compartments. Modeling will be mostly based on **numerical simulations** of diffusion-weighted MR signal inside **compartment geometries 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. These new methods will be evaluated on data acquired in rodents and humans at 11.7 T.

Candidates should be expert in at least one of the following domains, and willing to deeply engage in the others:
- MR physics and sequences, diffusion-weighted MR.
- Diffusion physics and mathematics.
- Computer programming and computational methods, including Matlab and C languages, 3D modeling and rendering, Monte Carlo simulations, parallel computing, GPU programming, machine learning.


## For both positions

Besides specific requirements as described above, candidates should hold a Ph.D. in chemistry/biophysics/physics or equivalent. Salary will be commensurate with experience (past post-docs, etc…). They should be highly motivated, creative, and willing to collaborate with people having different backgrounds, in particular biologists and medical doctors. Candidates should be fluent in English or in French.


## Contact info

CVs and application letters (specifically mentioning which of the two positions the candidates are applying for), as well as requests for additional information, should be sent to Julien Valette by email at the following address: [julien.valette@cea.fr](mailto:julien.valette@cea.fr)