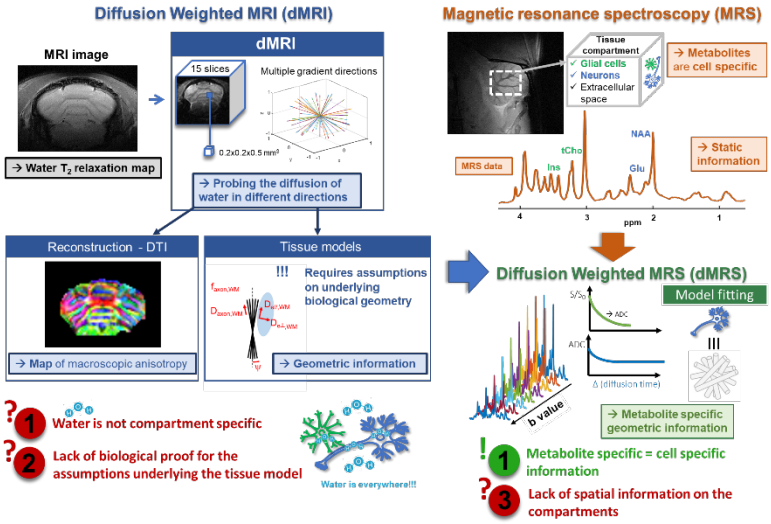
Location: EPFL AVP-CP CIBM-AIT, Bâtiment CH F.
Start date: to be agreed
Duration: 4 years each position

PhD and PostDoc positions

Shedding light on the invisible: mapping brain microstructure using diffusion magnetic resonance spectroscopic imaging

Dr Cristina Cudalbu from the CIBM MRI EPFL Animal Imaging and Technology Section is looking for **two highly motivated PhD and PostDoc candidates** (with complementary background i.e. physics/bioengineering and neuroscience) working together in the area of **diffusion weighted MR spectroscopy/spectroscopic imaging (dMRS/dMRSI)** at ultra-high magnetic fields and **cross-validation of metabolite diffusion metrics** using both 3D brain cell organoids and in vivo rodent models.

This project is part of an interdisciplinary collaborative SNSF proposal and will take advantage of the: 1) unique bioimaging facilities of the CIBM MRI EPFL, in particular the **ultra-high field 9.4T and 14.1T *in vivo* MR systems, two cryo-probes and the first PET/MR insert for preclinical studies in Switzerland,** and 2) unique **consortium of 4 PIs enrolling 3 PhDs and 5 PostDocs for this project**.



Background

Non-invasive methods to advance our understanding of brain metabolism and microstructure concomitantly are instrumental in characterizing brain physiological and pathological processes. Diffusion MRI (dMRI) of water provides information about tissue microstructure non-invasively, but its specificity is limited due to ubiquitous presence of water. Brain metabolites measured by MR spectroscopy (MRS) are predominantly intracellular and some have a reportedly preferential localization in specific brain cell types. Diffusion MRS (dMRS) can thus provide quantification of cell-type specific microstructure, but can be further enhanced by adding spatial information across the brain; i.e. developing diffusion MR spectroscopic imaging (dMRSI).

Project description

Our goal is to push further a new concept for quantification and validation of brain microstructure through diffusion of brain metabolites and water at cellular and sub-cellular scale, by implementing dMRSI acquisitions and metabolite diffusion modeling techniques validated with 2-photon microscopy (2PEF) and mass spectrometry (MS). Our target application is the critical period of brain development and associated potential injury, that we will assess using both 3D brain cell organoids (validation of metabolite diffusion metrics) and in vivo rodent models.

The **PhD candidate** will push dMRS methodology to a next level with regards to 1) spatial resolution by developing dMRSI at ultra-high fields; 2) MR acceleration ((sparse k-space sampling, spatial-spectral encoding); 3) all combined with denoising techniques and exquisite sensitivity of cryoprobes, thus going beyond the state-of-the-art in preclinical studies.

The **PostDoc candidate** will: 1) develop a MR compatible bioreactor for alive measurements of 3D brain cell organoids using dMRSI and dMRI (in collaboration with the group of Prof O Braissant, one of the PIs and the PhD candidate). This bioreactor will be also adapted for 2PEF microscopy, cell clamping and measure of cell-

specific intracellular metabolites; 2) to measure for the first-time living 3D brain cell organoids at different stages of development as well as under ischemia and creatine deficiency, using the same dMRSI approaches developed by the PhD candidate.

The PhD and PostDoc will work closely together, and will strongly and synergistically interact with the other PhD and PostDocs enrolled on the same project who will: 1) develop joint spectral-diffusion fitting, joint water-metabolite fitting and machine learning on realistic numerical substrates; 2) go beyond traditional microstructural validation using 2PEF microscopy (validation of exact morphology of living neural cells) and MS (validation of brain metabolite compartmentation in specific neural cells) using for the first time 3D brain cell organoids; 3) evaluate in vivo the level of biological sensitivity and specificity of underlying microstructural changes through metabolite diffusion models in two pathological conditions.

Supervisor:

Dr Cristina Cudalbu, CIBM MRI EPFL, Cristina Cudalbu, PhD – MRS4BRAIN - EPFL

Consortium/Collaborators:

- Assistant Prof Ileana Jelescu Ileana Jelescu – Microstructure Mapping Lab (unil.ch)
- Prof Olivier Braissant, Olivier Braissant, professeur au Service de chimie clinique du CHUV et à la Faculté de biologie et... | Phototheque UNIGE
- Prof Stéphane Sizonenko https://neurocenter-unige.ch/research-groups/stephane-sizonenko/
- The PhD student and PostDoc will also be a part of the Mrs4Brain Group - EPFL and will build on our current work in dMRS and accelerated MRSI techniques at ultra-high field.

Skills:

Master's degree (for PhD position) and PhD degree (for PostDoc position) in (biomedical) physics, bioengineering, neuroscience or a similar degree. Ambitious scientists with initiative, curiosity, natural taste for problem solving. Experience in programming (i.e. Matlab, Python) is a plus. Proficient in English, both verbal and in writing.

We offer:

A dynamic, interdisciplinary, and international team of very motivated people: Mrs4Brain Group - EPFL.; A stimulating working environment based at CIBM in Lausanne, Switzerland; Access to cutting-edge technology and state-of-the-art resources; Salary in compliance with Swiss National Science Foundation guidelines.

How to apply:

Applications will be considered until the position is filled, so interested candidates are encouraged to apply early. Please send your CV and motivation letter to cristina.cudalbu@epfl.ch

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About CIBM

The CIBM Center for Biomedical Imaging was founded in 2004 and is the result of a major research and teaching initiative of the partners in the Science-Vie-Société (SVS) project between the Ecole Polytechnique Fédérale de Lausanne (EPFL), the Université de Lausanne (UNIL), Université de Genève (UNIGE), the Hôpitaux Universitaires de Genève (HUG) and the Centre Hospitalier Universitaire Vaudois (CHUV), with the generous support from the Fondation Leenaards and Fondation Louis-Jeantet. CIBM brings together highly qualified, diverse, complementary and multidisciplinary groups of people with common interest in biomedical imaging.

We welcome you in joining the CIBM Community

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