

IBEC-VHIR INTERNATIONAL PhD PROGRAMME

Position

1. Project Title/ Job Position title:

Unraveling the Potential of MRI Biomarkers in Multiple Sclerosis: Advancing Diagnosis, Monitoring, and Understanding Disease Mechanisms

2. Research project / Research Group description (max. 2.000 characters)

Multiple sclerosis (MS) is the leading cause of non-traumatic neurological disability in young adults. It is a chronic disease of the central nervous system, with an etiology that remains unknown. Although MS currently has no cure, available treatments can slow the progression of disability. **Magnetic resonance imaging (MRI)** is the gold standard for diagnosing MS, tracking disease progression, and evaluating responses to treatment.

There is a pressing need in MS research for novel MRI-based biomarkers that capture the diverse pathophysiological mechanisms underlying the disease. These include inflammation, demyelination, remyelination, axonal and dendritic loss, iron deposition, neurodegeneration, and gliosis. These processes are intrinsic to MS and are faithfully reflected in its animal model, experimental autoimmune encephalomyelitis (EAE).

Advances in recent decades in the field of MRI analysis have significantly transformed the landscape of neuroradiology. The ability to generate multiple quantitative measures from each MRI scan, combined with advanced methodological approaches incorporating artificial intelligence, has expanded diagnostic precision, enabled personalized treatment strategies, and opened new avenues for understanding complex neurological conditions.

In this context, **the aim of the proposed project is to elucidate the pathophysiological underpinnings of MRI-derived biomarkers currently used in MS.** Specifically, this investigation will be conducted using the **EAE animal model**. Animals will be scanned at different time points during disease progression using a complete MRI acquisition protocol that includes **T1-, T2-weighted, diffusion-weighted sequences** and state-of-the-art metabolic imaging techniques such as **hyperpolarisation-enhanced MRI**. Development of new MRI sequences will also be explored, as well as the potential effects of a treatment on these measures.

This project is a collaboration between the “Molecular Imaging for Precision Medicine” group at IBEC (ibecbarcelona.eu/molecular-imaging-for-precision-medicine) and the “Neuroradiology Group” at VHIR (<https://vhir.vallhebron.com/en/research/neuroradiology>).

3. Job position description

This PhD project involves experimental research aimed at investigating the pathophysiological mechanisms underlying MS using advanced preclinical models and cutting-edge MRI techniques. The job position accommodates two distinct profiles:

- (1) a biologist/biochemist with an interest in image analysis and linking the derived measures with their physiopathological substrate; or
- (2) an engineer/mathematician/physicist more focused on developing new sequences and analytical approaches that allow to measure new components of the disease.

Collaboration with multidisciplinary teams at IBEC and VHIR will be a core component of the position, fostering a synergy of expertise in molecular imaging, neurobiology, and therapeutic development. The PhD student will be expected to present their research findings in team meetings, scientific publications, and conferences, making meaningful contributions to the broader academic and medical research community.

Applicants should hold a Master's degree in Biochemistry, Molecular Biology, Biomedical Engineering, or a related field. A strong background in neuroscience, molecular imaging, or preclinical research is essential, with a preference for candidates experienced in animal models of neurological diseases. Hands-on expertise in MRI acquisition or related imaging technologies is highly desirable, along with proficiency in data analysis tools such as MATLAB, Python, or R for processing complex imaging datasets. Candidates must demonstrate strong analytical skills, effective communication, and the ability to work collaboratively in an interdisciplinary research setting.

IBEC and VHIR will provide training in cutting-edge technologies such as hyperpolarization-enhanced MRI and advanced preclinical models. The candidate will have access to international collaboration opportunities, professional development programs, and a competitive PhD stipend in line with institutional and national standards.

Group Leader at IBEC

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Group Leader at VHIR

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