

COLLABORATIVE IBEC INTERNATIONAL PhD PROGRAMME

Position

1. Project Title:
Multivalent Modulation of Neurovascular Transcytosis for Neurodegeneration Therapy
2. Research project/ Research Group description

The blood-brain barrier (BBB) is a highly selective permeability barrier that safeguards the central nervous system (CNS) from potentially harmful substances while regulating the transport of essential molecules. Its dysfunction is increasingly recognized as a pivotal factor in the pathogenesis of several neurological disorders, including Alzheimer's disease (AD), Parkinson's disease (PD), vascular dementia (VD), Amyloid Lateral Sclerosis (ALS), contributing to the accumulation of amyloid- β ($A\beta$) plaques. We propose developing a novel therapeutic strategy targeting the low-density lipoprotein receptor-related proteins 1 (LRP1) and 8 (LRP8) on the BBB. Our design leverages the multivalent nature to modulate receptor-mediated transport, biasing LRP trafficking toward transcytosis and thereby upregulating its expression to promote efficient toxic byproducts associated with degenerative processes, including amyloid- β ($A\beta$), hyperphosphorylated tau (pT), α -synuclein (αS), TDP-43 and other. The idea is to restore vascular transport and function to prevent and reverse neurodegeneration. We have already identified several markers associated with vasculature dysfunction, and here, we will further our study using animal models of relevant diseases. We plan to combine a multiscale study from receptor to cell to tissue to organism, assessing critical parameters such as drug valency, size, uptake rates, and selectivity.

3. Job position description (max. 2.000 characters)

The PhD candidate will work on developing multivalent nanomedicines and studying their interaction with blood-brain barriers constructed from healthy and disease animal models to shed the light of the cargo transcytosis and endothelial cells modulation. We will combine these with advanced physical modeling and in vivo evaluation generating dynamic data set for predictive algorithm and assessing therapeutic impact.

The student will join a long-standing and successful collaboration between the West China Hospital and the IBEC, including 5 individuals working across the two centres. The student will have access to state-of-the-art imaging, omic, and computational facilities. We expect candidates with either life or physical science backgrounds willing to train in cell biology, machine-learning analysis methods, advanced imaging, and neurobiology.

Group Leader at IBEC

1. Title: ICREA Professor
2. Full name: Giuseppe Battaglia
3. Email: gbattaglia@ibeccarcelona.eu
4. Research Group: Molecular Bionics

Collaborator in the other institution

1. Title: Full Professor
2. Full name: Xiaohe Tian
3. Email: xiaohe.t@wchscu.cn
4. Institute: West China Hospital Sichuan University
5. Research group: NeuroNano lab