

2019 Helmholtz – OCPC – Program for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project: Synaptic plasticity in sleep wake regulation and depression.

Helmholtz Centre and institute:

Forschungszentrum Juelich GmbH, Institute of Neuroscience and Medicine - Molecular organization of the brain (INM-2)

Project leader: PD Dr. med. David Elmenhorst

Web-address:

http://www.fz-juelich.de/inm/inm-2/EN/Research/Neuroimaging/Molecular_Plasticity/_node.html

Description of the project:

Patients with major depression benefit from therapeutic sleep deprivation. The causality of this clinically effective therapeutic measure is unknown and the underlying molecular mechanisms remain elusive. We hypothesize that prolonged wakefulness is associated with an increase in synaptic strength, and that the synaptic dysregulation is affecting long term potentiation in patients with major depression. The aim of the project is to examine the synaptic basis of the antidepressant effect of therapeutic sleep deprivation by Positron Emission Tomography (PET) imaging of the synaptic vesicle protein 2A (SV2A) as a measure of synaptic density and functional connectivity based on magnetic resonance imaging (MRI) in patients and healthy subjects. This novel brain imaging technique of the SV2A allows to monitor the amount of synapses in the living brain of humans in relation to functional network changes.

We propose that synaptic density determined with PET has the power to become a biomarker for the success of therapeutic sleep deprivation and thus providing means for future stratifications of different therapies in major depression. Identifying and understanding the mechanisms that mediate the effects of sleep restriction is necessary to develop effective interventions. This project will test a model that can be used to improve schedule design.

The quantification of synaptic density will be accompanied in a combined PET-MRI scanner by state of the art quantifications of brain network properties. Based on resting state fMRI measures dynamic changes in the functional connectivity, diffusibility of fiber tracks or regional homogeneity will be determined.

Our proposed team of equal partners brings together the necessary extensive expertise and state-of-the-art methods and facilities for in vivo brain imaging, sleep physiology, EEG analyses, pharmacology, and cognitive testing. All collaboration partners have successfully conducted similar projects in the past, partly in collaboration as demonstrated by joint publication (see below).

Dr. David Elmenhorst has long-standing expertise in the field of neuroimaging, including conducting studies with healthy subjects and patients, especially in the context of sleep/wake regulation. He has the necessary official qualification required by the German authorities (BfS, BfArM) to perform PET and MRI investigations in humans. He will thus be responsible for: overseeing the ethical and legal aspects of imaging human subjects, participating in the selection of subjects, and overseeing the imaging experiments, which will include the supervision of technical personnel and data analysis.

Description of existing or sought Chinese collaboration partner institute:

Dr. Ruiwang Huang is a full professor in School of Psychology and the director of the Brain Imaging Center, South China Normal University (SCNU). The School of psychology has ERP labs, an fMRI centre, an optical Imaging lab, and a sleep research centre. The psychology discipline has been ranked amongst the top three in 2009 and 2012 according to the official national assessments. Dr. Ruiwang Huang received a PhD in Physics from the University of Nottingham in UK in 2001. During 2001-2009, he performed MRI sequence development in the Institute of Neuroscience and Medicine (INM), Forschungszentrum Juelich in Germany. In 2009, he joined the State Key Laboratory of Neuroscience and Learning, took a job of a MRI physicist and vice director of Imaging Center for Brain Research in Beijing Normal University. Since 2010, he moved to Guangzhou as a full professor. Currently, Dr. Huang's research interests focus on the influence of learning on the brain structure and function, the neural mechanism of different conscious states, and the brain function-structure relationship. He has close collaborations with many local hospitals in Guangdong Province. During 2016-2017, one of his excellent master students, Shumei Li, was a recent visitor in the INM-2 and has been collaborating for two publications in Journal of Neuroscience ("Phosphocreatine Levels in the Left Thalamus Decline during Wakefulness and Increase after a Nap") and Radiology ("Reduced Integrity of Right Lateralized White Matter in Patients with Primary Insomnia: A Diffusion-Tensor Imaging Study"). Recently, another student, Changhong Li, is continuing his PhD studies in INM2 (Specific and shared brain architectures with faster transitions determined by dynamic functional connectivity after acute sleep deprivation. Li et al. in preparation).

We also welcome collaboration with any Chinese institution that deals with the same subjects and shares our scientific interests.

Required qualification of the post-doc:

- PhD in neuroscience, psychology or medicine
- Experience with Neuroimaging
- Additional skills in programming
- Planned project duration: 2 years

PART B

Documents to be provided by the post-doc, necessary for an application to OCPC via a postdoc-station in China, which is affiliated to a research institution like a university:

- Detailed description of the interest in joining the project (motivation letter)
- Curriculum vitae, copies of degrees
- List of publications
- 2 letters of recommendation
- Proof of command of English language

PART C

Additional requirements to be fulfilled by the post-doc:

- Max. age of 35 years
- PhD degree not older than 5 years
- Very good command of the English language
- Strong ability to work independently and in a team