TITLE: MUNCH – Multimodal Neuroimaging in Healthy Subjects and Neurological patients as a biomarker of healthy and abnormal brain functions.

ABSTRACT: Neuroimaging has profoundly advanced neuroscience research and clinical care rapidly in the past two decades. Multimodal neuroimaging advances the neuroscience research by overcoming the limits of individual imaging modalities and by identifying the associations of findings from different imaging sources. Since different approaches can reveal different physiological relation between the complex functionality aspects of the human brain in healthy and neurological conditions, the whole project can be divided in the following four subprojects:

Project 1 Estimating Dynamic Connectivity States in fMRI, PET-FDG, and EEG: their associations with metabolic connectivity and cognitive measures, and neurological impairment in stroke

Dynamic functional connectivity (dFC) analysis aims at understanding how interactions across the brain resting-state networks (RSNs) evolve over time. For a deeper understanding of this process, we aim to study dFC with both rs-fMRI and FDG PET signals assuming the resting-state brain to be in quasi-static states with spontaneous switching between them. We will apply both time- and frequency- based methods (sliding windows, hidden Markov model, ect..) to the resting state fMRI data and derive model parameters reflecting the states. In a parallel study we will relate EEG measures of connectivity (both band limited power and signal) to fMRI/PET-FDG measures. These connectivity studies will be also run in patients with focal injuries (stroke) at the sub-acute stage (~1-2 weeks) to relate changes in brain dynamics to neurological impairment and recovery. In particular, the study will investigate the relation between static functional, dynamic functional and metabolic properties in healthy and neurologically impaired subjects. Specifically, we hypothesized that brain networks having low spontaneous switching would be associated with lower metabolic state and performance to cognitive tests. Moreover, low spatial and temporal entropy will be related to worse neurological outcome.

This project is synergistic to the FLAG-ERA project (Brainsynch-hit) and submitted Human Brain Project (NetStim Stroke).

PARTICIPANTS (PI and co-PIs): PI: Maurizio Corbetta, co-PI: Alessandra Bertoldo.
Additional: Dante Mantini, Antonino Vallesi

EXPERIMENTAL DATA:

To be acquired	x
Already acquired (ready to be used)	x

If data need to be acquire, please provide a brief description of the Experimental setup, methods, instruments and scheduling (e.g. # of subjects, images/signals…):

Public data sets: Human Connectome Project, ADNI (only healthy subjects), Biobank, SchizConnect (only healthy subjects)

Additional FDG data sets are provided by Marco Aiello, Valentin Riedl, Paolo Zanotti-Fregonara.

In addition the following data set will be acquired, on the PET/MR or on 3T Ingenia Philips of the AOP, during the three years of the PhD: Total of 120 healthy subjects in which 20 patients will be scanned per decade (20-29, 30-39, 40-49, 50-59, 60:69, 70:79). The MR protocol will be composed by the following sequences: T1w iso-voxel 1x1x1 mm3, T2w iso-voxel 1x1x1 mm3, Flair, rs-fMRI (TR=2s, 30 min), DTI (3 shells, 14 B0). N=30 stroke patients + N=30 controls; N=30 tumor patients. HD-EEG will be also axquired.

Ethics committee:

Obtained	x
Conditioned submission*	Expected time response (in months): 2/3 months
Not required	

* request will be submitted only if a PhD student will be associated to the project