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The TRIMAGE project: A Trimodality brain scanner for early diagnosis of schizophrenia

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TRIMAGE is an interdisciplinary FP7-funded European collaboration aimed at developing a cost-effective dedicated brain PET/MR/EEG brain scanner for early diagnosis of schizophrenia. The brain activity measured with fMRI, combined with the highly sensitive molecular information provided by PET, and the highly sensitive temporal information from EEG converge into a new imaging tool for diagnosing, monitoring and follow-up of mental disorders.

As for the clinical aspects we are interested in the multimodal assessment of response inhibition. The Loudness Dependence of Auditory Evoked Potential (LDAEP) is a suitable biomarker of inhibitory action in signal processing. Patients with schizophrenia may exhibit alterations in the responsiveness to sensory stimuli (i.e., stronger LDAEP values). We aim to further elucidate the relationship between multimodal neuroimaging methods and dimensions of symptoms, observable behavior, personality traits and general psychopathological dysfunction.

A sample of 20 healthy controls and 20 patients with manifest schizophrenia will be initially examined with the LDAEP paradigm in a trimodal approach with the available 3T MR-PET scanners in Munich and Jülich. In Munich, FDOPA will be used and static and dynamic analyses will be compared with fMRI data; in Jülich, PET measurements with the radiotracer [11C]-flumazenil will assess the binding potentials of GABA-A receptors. MRS will provide data about GABA concentrations. At the end of this first clinical evaluation a set of suitable biomarkers will be proposed.

The MR magnet will be cryogen-free with main B0 field of 1.5 T. Magnet warm bore is 720 mm with a field uniformity of ± 1 ppm and a field stability < 0.1 ppm/hour. The 5 gauss line fringe field will be < 2.8 m axially. The gradient coil has a maximum strength of 42 mT/m (X,Y) and 41.2 mT/m (Z) with a slew rate of 123 T/m/s (X,Y) and 127 T/m/s (Z). The typical MR sequences to be used will be: UTE (for attenuation correction), MPRAGE and FLAIR (for anatomical information) EPIK (for High resolution functional information)

The PET component is designed to provide performance beyond the state of the art for clinical PET systems with an expected spatial resolution of about 2 mm FWHM. The PET field-of-view will be 162 mm axially and 240 mm diameter with an open bore of 308 mm diameter. The PET detector comprises 216 tiles featuring two layers of LYSO crystal matrices (3.4 mm pitch) with half pitch staggering. SiPM matrices will be used as photodetectors, and a DAQ based on the TRIROC ASIC and FPGAs will take data in list mode.

A state-of-the-art MR-compatible EEG cap with 32 channels will be simultaneously used with the PET/MR scan.

The results of the first clinical results, of the simulations and of the experimental tests will be presented

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