Mediterranean Thematic Workshops in Advanced Molecular Imaging

Contribution ID: **88** Type: **Poster**

# First images from the next-generation UHR human brain PET scanner

*Monday 5 September 2022 18:15 (2 hours)*

**Background:** Little progress was made during the last decades to improve the spatial resolution of brain PET scanners, even though the achieved state-of-the-art is far worse than the theoretical limit.
**Aim:** Develop an ultra-high-resolution (UHR) PET imager based on the field-proven LabPET-II technology platform for human brain imaging at the physical resolution limit.
**Method:** The UHR scanner relies on truly pixelated detectors featuring 1:1:1 coupling of scintillator, photodetector, and electronic readout to reach ˜1.2 mm resolution when imaging the human brain. The basic detector elements consist of 4×8 LYSO arrays of 1.12×1.12×12 mm³ read out by monolithic 4×8 APD arrays, assembled into 128-channel modules with a 2.5D architecture for thermal management and parallel signal processing by custom integrated circuits. The UHR scanner consists of 144 rings of 896 pixels (129,024 detectors) forming a 40-cm diameter by 23.5-cm long cylinder. The useful FOV is up to 30-cm diameter. Single events, along with physiological and motion data, are transferred via Ethernet links to the acquisition computer where a software coincidence engine merges and sorts out list-mode events in real-time for quantitative image reconstruction implementing motion correction.
**Results/Conclusions:** GATE simulations of the histology based BigBrain atlas demonstrate the ability to resolve FDG radiotracer distribution in cortical or basal brain structures, enabling potential differentiation of details in the entorhinal cortex and locus coeruleus, suspected to be involved in the onset of Alzheimer' s disease. Initial images were obtained using a partial prototype, demonstrating promising results towards microliter volumetric resolution for imaging the human brain.

## Topic Selection

Brain Imaging

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**Session Classification:** Posters and reception

**Track Classification:** Dedicated preclinical and brain imaging systems and algorithms