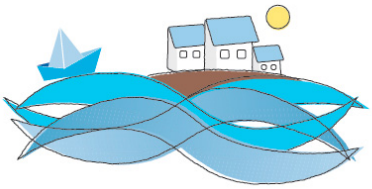

Mediterranean Thematic Workshops in Advanced Molecular Imaging

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A cost-effective, scalable approach to high-resolution, sub-100 ps TOF-PET

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There remains huge untapped potential for PET in the research, diagnosis and treatment of oncological, neurological, cardiovascular, infectious, and inflammatory diseases. However, to transform PET into a cost-effective tool for personalized medicine in a wide range of clinical applications, we must reduce the radiation dose (currently 5-25 mSv), scan time (currently > 10 minutes), and costs per patient (currently > 1000 €), all by an order of magnitude, as well as improve the compatibility with other modalities to enable multi-parametric data acquisition. Technologically, this translates into a need for more than 10-fold increased sensitivity, without sacrificing other crucial system parameters such as spatial and energy resolution.

In the US, the $15.5 million Explorer project aims at the world's first total-body PET/CT scanner with a 2 m long axial length, to demonstrate the clinical value of a ˜40-fold improved system sensitivity. While major scientific breakthrough are expected from this project, the system concept is intrinsically expensive as it is based on multiplication of existing detector technology.

A different way to improve effective sensitivity is to push time-of-flight (TOF) resolution to less than ˜100 picoseconds, ultimately to ˜10 ps. Results achieved by European researchers in recent years make it likely that high-resolution TOF-PET imaging with sub-100 ps time resolution can be demonstrated within the coming years [1-3]. In particular, the so-called monolithic scintillator concept shows how timing information can be extracted optimally from the spatio-temporal distribution of the optical signal produced upon the interaction of a gamma photon inside a transparent material [4,5].

Sub-150 ps timing in combination with near-1 mm spatial resolution has already been demonstrated in a simple, scalable, and cost-effective monolithic scintillator detector based on the widely available scintillator LYSO:Ce and digital silicon photomultipliers. Experimental evidence of the clinical imaging performance of this detector as well as further steps towards sub-100 ps clinical TOF-PET imaging will be discussed at the conference.

References

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Summary

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