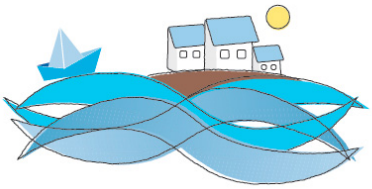

Mediterranean Thematic Workshops in Advanced Molecular Imaging

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Nuclear and CT imaging: what drives it ?

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Since the invention of the CAT scan by Hounsfield in the early 1970s, transmission and emission imaging modalities used in radiology and nuclear medicine have continually benefit from improvements in detection technology, signal treatment and applied mathematics. The development of 3D PET in the late 1980s, and of positron rotating partial-ring tomographs leaving potentially enough void between arrays of detectors to insert an X-ray tube and X-ray detectors, led to the invention of PET/CT in the early 1990s. Although the original concept of PET/CT could not be implemented as envisaged, the advent of the first PET/CT prototype in the late 1990s, which provided native fusion of anatomical and functional images, revolutionized rapidly both the practice and the market of nuclear medical imaging.

Riding the wave of PET/CT that was claimed to be the invention of the year 2000 by the Time Magazine, and thanks the development of solid-state photodetector devices insensitive to magnetic fields, industry majors have made recently a determined effort to bring PET/MR devices to the market. Although the pertinence of this new evolution of the imaging discipline remains to be assessed, it is nevertheless obvious that every technological breakthrough that would bring better insight and quantification of the metabolic function, or of several molecular pathways at a time, together with precise anatomical information, possibly at a reduced absorbed dose, constitutes a genetic trend for the development of future hybrid nuclear and CT imaging modalities.

In this regard, the invention of massively parallel hybrid pixel detectors for charged particle trajectography in high energy physics, once applied to the detection of X-rays for photon counting CT, paves the way to the development of spectral CT that will potentially provide the first ever intrinsically anatomo-functional medical imaging device, which could be used to image several functionalized contrast agents made of nanoparticles. In a similar line, improvements of scintillation spectrometry implementing photonic devices and novel compact and fast photodetectors such as SiPMs permits to improve dramatically signal-to-noise ratio of medical images by exploiting TOF information in the image reconstruction process. Hence, extrapolating this trend may possibly foreshadow the advent of reconstructionless positron tomography in some unknown but brilliant future of nuclear and CT imaging.

Primary author: C. MOREL, CNRS, FRANCE (Centre National de la Recherche Scientifique (FR))

Presenter: C. MOREL, CNRS, FRANCE (Centre National de la Recherche Scientifique (FR))

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