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#9-56 Future Trends in Nuclear Medical Imaging

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Nuclear Medical Imaging is at the forefront of molecular imaging diagnostic, theragnostic and treatment follow-up techniques for a number of diseases (cancer, neurodegenerative impairment, cardiovascular disorders, etc···), particularly in the rapidly growing context of personalised medicine.

Although Positron Emission Tomography (PET) already provides the best molecular sensitivity and quantitative accuracy among all the other medical imaging modalities, there is a strong motivation for pushing even further the sensitivity, to allow reducing the radiation exposure to the patients and personnel, reducing the scan time, opening the way to follow-up on slow dynamic processes with long half-life isotopes (particularly important in the context of immunotherapy), as well as addressing new medical challenges, such as tracking a small number of cells.

Two routes are extensively explored to reach this ambitious objective. The first one is based on increasing the geometrical acceptance of the PET scanner by extending its axial field of view. This is the Total Body PET approach, initiated by the group at UC Davis and already producing impressive results.

The second route exploits the potential of time-of-flight (TOF) performance to improve the signal-to-noise ratio (SNR) of the reconstructed image and to increase the PET effective sensitivity. The accuracy of TOF is bound to the whole detector chain, namely scintillator, photosensor and readout electronics. One possible approach to overcome the timing resolution limits of standard scintillators commonly used in PET scanners, such as BGO, LSO, LYSO, LGSO, etc , is based on the metascintillator concept, a deep-tech approach, benefiting from recent important progresses in a number of disruptive technologies, to combine and optimize several functionalities in the same scintillator heterostructure. Capitalising of progress in nanotechnologies and in particular nanophotonics, high speed highly integrated electronics, artificial intelligence and more generally information technologies, metascintillators are a new class of multifunctional multi-intelligent scintillators combining the high stopping power and photo-fraction of well know scintillators, such as BGO, LSO, and the ultrafast scintillation of quantum confined excitons in nanocrystals. But the very fruitful cross-fertilisation between physics and medicine opens also the way to the development of cost-effective and portable imaging approaches, allowing a better deployment of nuclear imaging modalities in low- and medium-income countries (LMICs). As presented in this talk, this ambitious goal is supported by the IAEA (International Atomic Energy Agency) and is in line with an initiative being prepared by the WHO (World Health Organization) and the 3d out of 17 NATO sustainable goals for 2030: Good Heath and Well Being for everyone.

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