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High resolution preclinical and humanTotal body molecular imaging as companion tools for theranostics

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Molecular imaging systems (PET, SPECT) have been improved over the last 20 years using small changes in either reconstruction methods, collimator or detector. The availability of highy sampled Silicon multipliers and advanced positioning algorithms (Maximum Likelihood, Deep learning,..) lead to scintillation detectors with sub mm transverse resolution (at competitive cost with older PMT based detectors). This enables a redesign of PET and SPECT imaging systems. In PET the solid angle can be increased with factor 4-5 for the same amount of detector material as the new detectors have intrinsic depth-of-interaction and can operate very close to the subject. This has led to so-called preclinical Total body PET systems, one of these being developed, tested and commercialised at Molecubes and Innovative Molecular Imaging and Therapy dept (Ghent, Belgium). This is now further optimised for time-of-flight PET so it can used for a clinical Total body PET (PET2020) with very high sensitivity (20 x higher than state of the art Clinical PET-CT) and superior resolution (below 2 mm). This will enable accurate dosimetry, imaging at multiple halflives (eg. Zr-86 up to a month) and imaging of new PET isotopes with even small positron abundances (e.g. Y-90). For SPECT imaging the higher intrinsic resolution enables the use of smaller detectors and collimators with minimal magnification (or even magnification) and leads to more compact systems (fitting on a desktop for preclinical imaging). High energy collimators are now easier to construct (additive manufacturing) and enable imaging of energies up to (or even beyond) 511 keV.

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