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Metabolic and positronium imaging sensitivity of the total body J-PET tomographs

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On behalf of the J-PET Collaboration

A new and popular trend in the field of medical imaging, especially in the positron emission tomography, is the construction of scanners with a whole human body coverage. Such total body PET tomographs prove to be much more efficient and accurate with respect to the clinically available PET systems [1]. One of the groups, which is currently developing a total body scanner, is the Jagiellonian PET Collaboration (J-PET) [2]. In contrast to the standard crystal-based detectors, it utilizes axially arranged plastic scintillators.

During conventional PET imaging the information taken into reconstruction comes from the two, back-to-back annihilation photons. Standard metabolic imaging enables the diagnosis of the uptake of radiopharmaceuticals in cells [3]. Nevertheless, in almost 40% of cases positrons annihilations occur through the creation of a metastable positronium atom. Properties of such atoms like formation probability and mean lifetime turn out to have a dependence on the inner structure of tissues. It was proven that they can be used as an additional diagnostic indicator. The recently proposed positronium mean lifetime imaging method enables study of these characteristics [3-7].

In the framework of this work a simulation-based study of the sensitivity to the conventional and positronium imaging was conducted on the total body tomographs designed with the J-PET technology. For that a dedicated Toy Monte-Carlo model working in the event-by-event basis has been developed and validated. The research was conducted basing on the "NEMA Standards Publication NU 2-2018" [8]. Moreover, a comparison with the traditional short axial field of view PET system was performed.

References:
[1] S. R. Cherry et al., Total-Body PET: Maximizing Sensitivity to Create New Opportunities for Clinical Research and Patient Care, J. Nucl. Med., vol. 59, no. 1, pp. 3-12, Jan 2018
[2] P. Moskal et al., Simulating NEMA characteristics of the modular total-body J-PET scanner – an economic total-body PET from plastic scintillators, Phys Med Biol., vol. 66, no. 17, Sept 2021
[3] P. Moskal, E. Ł. Stepien, Prospects and Clinical Perspectives of Total-Body PET Imaging Using Plastic Scintillators, PET Clin., vol. 15, no. 4, pp. 439-452, Oct 2020
[4] P. Moskal, Positronium Imaging, 2019 IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC), 2019, pp. 1-3
[5] P. Moskal et al., Performance assessment of the 2 γpositronium imaging with the total-body PET scanners, EJNMMI Phys., 7:44, June 2020
[6] P. Moskal et al., Positronium in medicine and biology, Nat Rev Phys, vol. 1, pp. 527–529, Sept 2019
[7] P. Moskal et al., Feasibility study of the positronium imaging with the J-PET tomograph, Phys Med Biol., vol. 64, no. 5, Mar 2019
[8] NEMA Standards Publication NU 2-2018, National Electrical Manufacturers Association, 2018

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