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First Positronium and Quantum Entanglement Imaging of humans with J-PET

Jagiellonian-PET (J-PET) is a novel, cost-effective positron emission tomography technology based on plastic scintillators [1,2]. The J-PET system constructed at the Jagiellonian University is the first multi-photon PET scanner [3] capable of measuring momentum vectors and the orientation of polarization planes of photons originating from positronium decays [4]. Positronium imaging is a newly invented method for imaging the properties of positronium in living organisms [5,6,7,8]. Quantum Entanglement Imaging is a method enabling the imaging the degree of the entanglement of annihilation photons [9].

We will present the first-ever images of the properties of positronium in humans [8], the first multi-photon images from the decays of positronium atoms into three photons [3], and the first observation of non-maximal entanglement of photons from positronium annihilation in matter [9]. We will discuss the status of the development of (i) positronium imaging and (ii) degree of quantum entanglement imaging as possible diagnostic biomarkers of tissue pathology [10] and biomarkers of hypoxia [11].

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Author: MOSKAL, Pawel

Presenter: MOSKAL, Pawel