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Estimation of the sensitivity for quantum entanglement imaging with total-body J-PET

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In positron emission tomography, the density distribution
of electron-positron annihilations in the patient's body
is reconstructed based on the measurement of the time and position
of the annihilation photon's interactions in the detection system.
In this study, we demonstrate that J-PET scanner based on plastic scintillators
enables the effective application of polarization of annihilation photons as an additional parameter having the potential to improve the specificity of PET diagnosis.
The polarization of annihilation photons can be determined by measuring the primary and Compton scattered photons. In the J-PET scanner, annihilation photons scatter only via the Compton effect, making J-PET especially suited for measuring their polarization. Using a 192-strip prototype scanner, we have performed measurements of the distribution of the relative angle between the polarizations of annihilation photons, demonstrating that the J-PET tomograph enables the application of photon polarisation for diagnosis. Moreover, using the GATE software we have estimated the sensitivity profile for imaging the relative angle between annihilation photons' polarisation with the total-body J-PET scanner, which is under construction at the Jagiellonian University. In this presentation, the experimental results achieved with the J-PET prototype and the results of simulations for the total-body J-PET will be presented and discussed.

Field

Systems and applications

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