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Geant4 simulation for detector development and PET imaging

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The main aim of this project will be to perform GEANT4 simulation as part of the medical imaging project which will be done using the Modern African Detector Laboratory (MANDELA) at University of Zululand. The university of Zululand Physics department is collaborating with the university of York Physics department and the university of the Western Cape in this research. Through this research the Watts et al., have identified a number of potential benefits by using QE in PET. Part of this project is to investigate some of these benefits. Positron Emission Tomography (PET) is a nuclear medicine imaging technique used for medical research and for imaging of cellular and anatomical processes, and medical diagnosis. This imaging technique is based on two gamma photons produce by the annihilation of positron-electron pair. These two gamma photons of at least 0.511 MeV are predicted to the entangled. Gean4 simulations is an important tool used to investigate the predicted entanglement. Recently, research predicts that the PET scanners based on quantum entanglement will be more economically and sensitive than the present technology. PET has been in existence since the 1970s due in large part to the pioneering work of Michael Phelps, PhD, Michel Ter-Pogossian, PhD, and others in the fields of medical physics and nuclear medicine. Through detailed experiments and simulations, the benefits of take advantage of the quantum entanglement of linear polarization between the two positron annihilation photons utilized in PET will be investigated. Implementing Geant4 simulation, which have included the predicted influence of quantum entanglement is confirmed by comparison with experimental data from a PET demonstrator apparatus. The development of quantum-entangled PET provides fresh approaches to major problems in next-generation imaging. We describe a straightforward technique to measure and eliminate in-patient dispersion and random backgrounds using only the quantum entanglement information in the PET events as an example of the potential advantages.

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MSc. Physics

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