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Validation of the Monte Carlo Detector Effects model for the UCT POLARIS Compton camera

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The benefit of proton therapy will only truly be realized once an experimental in-vivo dose verification system has been developed. The use of a Compton Camera (CC) allows detection of the secondary radiation, specifically Prompt Gammas (PG), produced at the location of the dose deposition. The UCT Polaris detector is composed of two separate stages with two CdZnTe positron-sensitive crystals per stage, configurable in an orthogonal or face-to-face alignment. Previous work has shown that the CdZnTe crystals experience significant deadtime when exposed to a high dose-rate proton beam. The Monte Carlo Detector Effects (MCDE) model was developed to replicate these deadtime effects.

The goal of this work was to adapt the MCDE model to the UCT Polaris detection system, to allow for new detector configurations and to broaden the applicability of the model to high-activity gamma sources. The MCDE model results are compared to measured data from both a positron source in face-to-face configuration and a proton beam in orthogonal configuration. The observed differences between the measured and simulated results point to an overestimation in the underlying Geant4 model and to a change in one of the timing parameters used in the MCDE model. A two-parameter optimization code was run to improve the overall comparison between simulation and experiment, providing the most extensive validation of the MCDE model to date.

Apply to be considered for a student ; award (Yes / No)?

Yes

Level for award;(Hons, MSc, PhD, N/A)?

Hons

Primary authors: Mr SMUTS, Frank (Department of Physics, University of Cape Town); Dr PETERSON, Steve (Department of Physics, University of Cape Town); Mr HYSLOP, Nicholas (Department of Physics, University of Cape Town); Dr MAGGI, Paul (Lawrence Livermore National Laboratory, Livermore, CA, United States); Dr POLF, Jerimy (Department of Radiation Oncology, University of Maryland School of Medicine, Baltimore, MD, United States)

Presenter: Mr SMUTS, Frank (Department of Physics, University of Cape Town)

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