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Investigating the impact of neutrons on Cadmium Zinc Telluride Compton Camera system

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During proton therapy (PT), excited-nuclei decay via emission of characteristic prompt gamma rays along the beam path within the target. These gamma rays are detectable via a Compton camera and can be used for in vivo proton beam range verification using a technique called prompt gamma imaging (PGI). The detection efficiency of a PGI device can be negatively affected by additional secondary radiation (primarily neutrons) produced alongside the prompt gamma rays.
The UCT Prompt gamma imaging system (Polaris) is a room temperature solid state Compton camera detector. The imaging device comprises of two independent detection platforms with each consisting of two Cadmium zinc telluride (CZT) crystals (20 x 20 x 10 mm^3) arranged side-by-side.
The goal of the project is to better understand the impact of neutrons on the Polaris detectors during PT and compare its response to traditional gamma ray detectors such as NaI and $LaBr_3$. CZT is sensitive to thermal neutrons due to the high interaction cross-section, but due to the nature of the detector system it is not possible to distinguish between gamma rays and other secondary radiation. Another limitation of the Polaris detector system is the inability to detect high energy gamma rays. The traditional detectors act as means of calibration for expected gamma ray spectra in the Polaris detectors and to highlight any neutron impact on the CZT crystals. Preliminary results are presented from measurements conducted at the UCT n-lab MeASURe facility (neutrons up to 14 MeV) and at iThemba LABS (66 MeV proton beam).

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

Yes

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

MSc

Primary author: Mr DE KLERK, Josiah (University of Cape Town Physics department)

Co-authors: PETERSON, Stephen (University of Cape Town); HUTTON, Tanya (University of Cape Town)

Presenter: Mr DE KLERK, Josiah (University of Cape Town Physics department)

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