Contribution ID: **222** Type: **Poster**

Detection and Simulation of Bragg Peaks in Proton Therapy Using Plastic Scintillators and Multiple Cameras

Tuesday, 28 May 2024 08:37 (1 minute)

Knowledge of the precise location of the Bragg Peak (BP) in proton therapy is crucial for optimizing its therapeutic effects and to minimize the damage to healthy tissues in cancer treatment [1]. In this work, we present test results and simulations of the light emitted by organic scintillators exposed to different proton energies and visualised by multiple cameras to reconstruct the BP. Furthermore, the TOPAS Monte Carlo simulation tool [2], based on Geant4, was used to accurately model the energy deposition of the proton beams and their light generation processes within the scintillators, as seen in Figure 1 (right),. Beam tests were performed at the Christie Proton Therapy Centre, Manchester, United Kingdom using a 70.0 x 3.9 x 9.9 cm3 polystyrene plastic scintillator with beam energies of 80 MeV, 120 MeV, 160 MeV, 200 MeV and 235 MeV. Image data were recorded using 16 MP Raspberry Pi cameras with a Sony IMX519 sensor [3] with 4.656 x 3.496 active pixels, each having 1.22 x1.22 µm2 size (Figure 1 left). The MATLAB machine learning (ML) tools [4] and ImageJ software [5] were used to post-process the data and to facilitate the detection of the BP and the energy deposition path. Further tests at the Christie's Proton Therapy Centre include the verification of the BP location from prompt-gammas generated during proton interaction in the organic scintillators by using a CAEN system composed of LYSO crystals and Hamamatsu silicon photomultipliers [6].

Collaboration

Role of Submitter

I am the presenter

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Session Classification: Applications to Industrial and Societal Challenges - Poster session

Track Classification: T5 - Applications to Industrial and Societal Challenges