

Prompt Gamma Imaging in Particle Therapy



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Contribution ID: 3

Type: **Oral**

Characterization of organic glass scintillators for a hybrid multi-particle imaging system for range verification in proton therapy

Friday, 7 July 2023 17:10 (30 minutes)

The high sensitivity of proton therapy to anatomical deviations implies improved treatment outcomes are achievable with real-time range monitoring. To this end, the NOVO project was initiated with the goal of developing a multi-particle imaging system for proton therapy. In this work, we characterize a novel organic glass scintillator (OGS) and investigate its potential for such a system, where range monitoring will be based on the simultaneous imaging of both secondary prompt gamma-rays and fast neutrons produced in patient tissues during treatment. The neutron vs. gamma-ray pulse-shape discrimination (PSD), light output, and energy resolution of a $10 \times 10 \times 200$ mm³ bar of OGS were evaluated using time-of-flight methods. Additional measurements with a $10 \times 10 \times 100$ mm³

OGS bar and radioactive emitters were made to investigate the coincident time, depth-of-interaction reconstruction, and energy resolution of the detector. The tested samples exhibited PSD figure-of-merits > 1 above 250 keV (corresponding to recoil protons > 550 keV). Additionally, above 400 keV an energy resolution $< 10\%$, coincident time resolution < 500 ps, and a position resolution < 10 mm was achieved. This work demonstrates that OGS is a promising candidate for particle therapy range verification using both neutrons and gamma-rays.

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Session Classification: Contributed talks IV