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Monte Carlo determination of scintillator quenching effect in small radiation fields

Introduction: Fiber-coupled plastic organic scintillator detectors are exceptional for the measurement of the absorbed dose to water in small MV photon beams. This is mostly because of their high degree of water equivalence which results in an almost negligible perturbation of the radiation field. However, these detectors are less ideal when the signal generation and detection is considered. For signal generation it is well known that the light yield per absorbed dose for electrons with energies below approximately 100 keV produces less light than electrons with higher energies, which is the so-called ionization density quenching. Since there are spectral differences when changing from reference field size to small field sizes, the objective of this work is to investigate whether the quenching effect will affect in the same way for the reference field size than for small field sizes.
Materials and Methods: The Birks formalism was used for the determination of the light yield in the scintillators. This formalism was implemented in the Monte Carlo software EGSnrc specifically in its application egs_chamber. A new parameter to quantify the quenching effect was defined as the ratio of the scintillator light yield with quenching and without quenching for every specific field size. The radiation source was a 6MV phase space from the Varian TrueBeam.
Results: The results show that, within the uncertainties, the fluctuation of the quenching effect parameter is negligible regarding the field size.

Primary authors: Mr VALDES SANTURIO, Grichar (Technical University of Denmark); Prof. ANDERSEN , Claus E (Technical University of Denmark)

Presenter: Mr VALDES SANTURIO, Grichar (Technical University of Denmark)

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