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Plastic scintillators as in-vivo dosimeters for photons and electrons in external beam radiation therapy: Angular dependence of response (G)

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Plastic scintillation detectors (PSD) are excellent candidates for in-vivo dosimetry due to their small size, sensitivity and potential for real time readout. One challenge associated with PSD dosimetry is the contamination of the scintillation signal with Cerenkov radiation and fluorescence. An implicit assumption made with PSDs is that the spectral components of the scintillator and fiber response are invariant between calibration and measurement conditions. In this study this assumption was tested by measuring the spectral content of the emissions of the scintillator and the optical fiber as a function of the angle of incidence of a radiation beam on a PSD. We studied two different Kuraray plastic scintillators coupled to Mitsubishi Eska optical fiber. The spectral content of the PSD emissions was measured with a spectrophotometer. The PSDs were placed both at the surface and at depth in a solid water phantom in different orientations in the beam. The gantry angle was varied between 0^0 and 45^0. The normalized emission spectra of the scintillators and the fibre were compared for different orientations and gantry angles. Photons of energy 6 MV and electrons of energies 6 MeV and16 MeV were investigated. On the surface, the relative contributions of Cerenkov and fluorescence vary as a function of gantry angle when the PSD is oriented in the plane of gantry rotation. For 6 MV, 6MeV and 16MeV, we found a variation of 2.5, 4.5 and 5.5 % in the peak emission of optical fiber and 2.5, 7.3, and 9.3 % in the emission of the scintillator respectively. The variability in decreased with depth. The effect of this variability on dose prediction (with assumption of spectral composition invariability) was studied.

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