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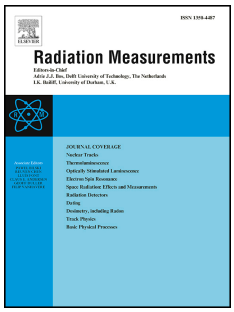

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Imaging of produced light in water during high energy electron beam irradiations from a medical linear accelerator

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Abstract

Measurements of dose distribution in water are important for high-energy electron beams from medical linear accelerators (LINAC). Although ionization chambers are commonly used for this purpose, measurements take a relatively long time, especially to obtain data for two- or three-dimensional dose distributions. To solve the problem, we tried imaging of produced light in water during irradiations of high energy electron-beams from LINAC. We placed a water phantom on a table of a LINAC system, and images of produced light in water were measured with a high-sensitivity cooled charge coupled device (CCD) camera during electron-beam irradiations of the water phantom. Measurements were made for different energies and doses of electron beams. We also measured the light spectra of the images by changing optical filters, to observe the difference of the images with respect to the wavelengths and to confirm the source of the optical light. In all irradiations of different energies and doses of electron-beams, we could obtain clear images of produced light in water. From the optical images, although the depth profiles were significantly smaller in shallow part of water, the ranges of the beams could be estimated within 1.7 mm difference with those calculated by the planning system. The lateral profiles and widths derived from the images of produced light were almost identical to those calculated by the planning system; the difference of the width was less than 2.3 mm. The light spectra of the images of produced light of water showed similar distribution to that of the Cerenkov-light although the distribution was slightly steeper. There was not a significant difference observed in the depth profiles between different wave lengths of light. The imaging of produced light in water during electron-beam irradiations has potential to be used for lateral profiles measurements, range and width estimations.

Key words: imaging; water; electron; Cerenkov-light; LINAC; spectrum