Calculation of ambient instantaneous dose rates (AIDR) depending on the mode of delivery in a single proton therapy treatment

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Introduction

Proton therapy is a firmly established therapeutic option for the treatment of many types of cancer, and a very active discipline from the point of view of technological development. Currently, there are several research areas with the aim of improving clinical results, reducing the size and cost of centers, and enabling access for more patients to this radiotherapy. Considering the physical characteristics of clinical proton beams, these improvements will definitely impact on radiation protection, sometimes in ambient instantaneous dose rates (AIDR), and consequently, the goal of this work was the calculation of these ambient dose rates, yielded in a single treatment, depending on the delivery modality, both, with actual techniques and others under development.

Method

The cornerstone of current active methods, Modulated Proton Therapy (IMPT), was compared with delivery modes under research, Proton Monoenergetic Arc Therapy (PMAT), Proton Flash Therapy (PFT), Proton Mini Beams (PMB), and finally, a blending active-passive method known as Pencil Scanning with Collimator (PSC). Calculations were developed using Monte Carlo codes (MCNP and PHITS) and experimental measurements, in IMPT and PMAT modes, whilst for PFT, PMB and PSC, only calculation with Monte Carlo were reached.

Results

Considering IMPT as baseline, results show that with PMAT, higher neutron fluences are yielded, but with lower energy, with great on activation, but lower on ambient dose equivalent. With PFT, however, current shielding should be reviewed with caution since the energies are the higher and the Ambient Instantaneous Doses Rates (AIDR) outside walls could overtake legal limits in some countries. With mixed methods, PMB and PSC, activation of collimators must be assessed.

Conclusions

Mitigating actions could be limiting orientation of beam and occupancies in some spaces, using special concretes in different areas, or change the design and location of treatment control room. Experimental measurements could help to achieve more precise assumptions, but neutron monitors must be able of measuring high-energy neutrons in pulsed fields. Active measurements should be supported with reliable data from passive monitors.

Natural detector irradiated with blue LEDs for measurements in Photodynamic Therapy (PDT) via Spectroscopy (UV-Vis), Design of Experiments (DOE) and Multiple Linear Regression (MLR)

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Introduction

Favored by chemical and biological means, the action of light incident to the focus generates relations with the photosensitizing agent, destroying cancer cells. The objective of this experiment is to investigate a satisfactory response for the use of Curcuma Longa L. (CLL) as a detector in Photodynamic Therapy (PDT) measurements.

Methods

The experiment consisted of a set of interconnected elements for the irradiations characterized in LEDs, for the irradiations in two concentrations of samples CLL-C1 and CLL-C2. Results of the spectra were evaluated in a Design of Experiment (DOE) associated with Multiple Linear Regression (MLR) for best response of the factors. The absorbance and wavelength readings were performed with 2^3 factorial in statistical analysis of the importance of the factors and their combinations.

Results

The results showed that detectors CLL-C1 and CLL-C2, propitious in their characteristics for the field of photodynamic therapy, equally the DOE and MLR evaluations; they are appropriate in the experiment for ascertaining the combinations of photosensitizer temperature and light.

Conclusions

In conclusion, the results of CLL samples indicate an acceptable linear response in function of dose, and therefore this material presents a potential use as a light radiation detector and for applications of quality control in photodynamic therapy.