

The use of a TrueBeam system for the characterisation of optical fibre based dosimeters



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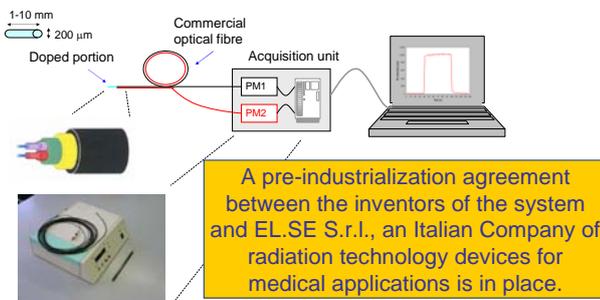
Introduction

Significant improvements occurred in radiation therapy technology during the recent years as effect of the availability on the market of new generations of linear accelerators. The modern machines are indeed able to deliver the planned dose to the tumour target in shorter time with respect to conventional systems thanks to the higher dose rates. Moreover, modern medical accelerators may deliver a highly focused and precisely modulated dose distribution through the use of small fields and beamlets of less than 10 mm in diameter.

Measurement of small photon beams is a well-known problem that requires very small detectors to guarantee a correct characterisation of the beam physical parameters.

Materials and Methods

Ce-doped silica radioluminescent (RL) optical fibre

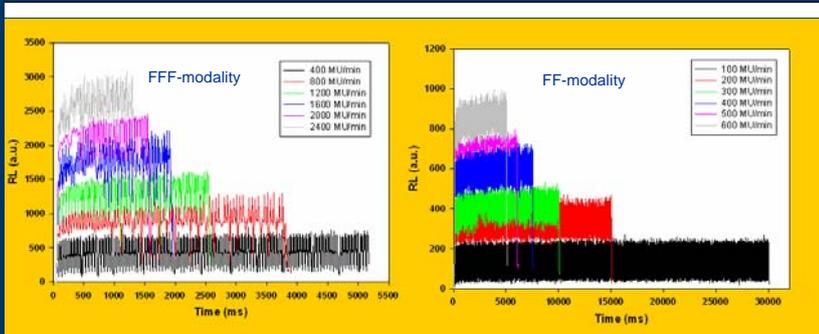


TrueBeam (Varian Medical System, USA)



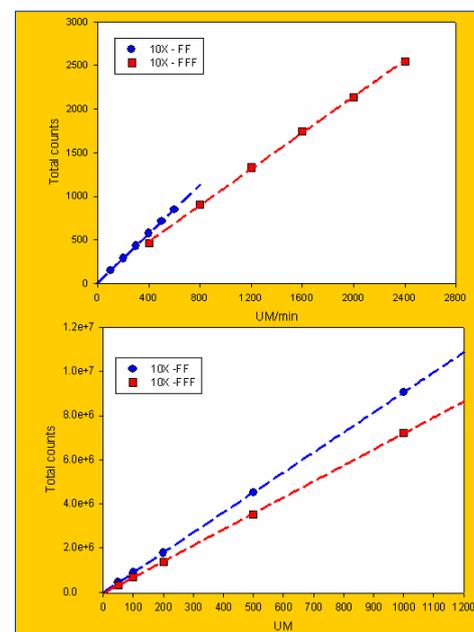
TrueBeam is a new accelerator designed for delivering both in flattened filter (FF) and flattening filter free (FFF) modality. Removal of the flattening filter implies the possibility of delivering treatments with higher dose rates, and with a much higher dose per pulse, with respect to conventional systems.

Results



RL signals vs. irradiation time, for the two modalities: FFF and FF. 10 MV X-rays, fixed dose of 50 Monitor Units (MU). The different pulse-modulation in the dose delivery with the two modalities can be distinguished.

Above panel: total counts vs. dose rate for a fixed dose of 50 MU
Below panel: total counts vs. dose for fixed dose rate of 2400 MU/min (FFF modality) and 300 MU/min (FF modality).
A satisfactory linear response was observed



Conclusions

Preliminary tests were performed to characterise a radioluminescent optical fibre based dosimeter using a TrueBeam medical accelerator. The good results obtained, as well as the already known luminescent and dosimetric properties of the system [1,2], make the device promising for measuring the small photon beams characterising the modern radiotherapy treatments.

References

- [1] Mones E, Veronese I, Moretti F, Fasoli M, Loi G, Negri E, Brambilla M, Chiodini N, Bramilla G, Vedda A. Feasibility study for the use of Ce³⁺-doped optical fibres in radiotherapy. Nucl. Instrum. Methods Phys. Res. A 2006; 562: 449-455.
- [2] Mones E, Veronese I, Vedda A, Loi G, Fasoli M, Moretti F, Chiodini N, Cannillo B, Brambilla M. Ce-doped optical fibre as radioluminescent dosimeter in radiotherapy. Radiat. Meas. 2008; 43:888-892.