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Silicon strip detector for quality assurance in synchrotron microbeam radiation therapy

Pauline Fournier
University of Wollongong, pf891@uowmail.edu.au

Iwan Cornelius
University of Wollongong, iwan@uow.edu.au

Marco Petasecca
University of Wollongong, marcop@uow.edu.au

Elke Brauer-Krisch
European Synchrotron Radiation Facility, Grenoble, France, brauer@esrf.fr

Herwig Requardt
European Synchrotron Radiation Facility, Grenoble, France

See next page for additional authors

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Abstract

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Keywords

strip, radiation, microbeam, synchrotron, silicon, assurance, therapy, quality, detector

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Authors

Pauline Fournier, Iwan Cornelius, Marco Petasecca, Elke Brauer-Krisch, Herwig Requardt, Andrew Dipuglia, N Roberts, Christopher Hall, Andrew W. Stevenson, and Anatoly B. Rosenfeld

Silicon Strip Detector for quality assurance in synchrotron Microbeam Radiation Therapy

Introduction:
Microbeam Radiation Therapy (MRT) is a novel cancer treatment modality currently under development at a few synchrotron facilities around the world. The principle is to divide the incident synchrotron beam into an array of microbeams using a multislit collimator (MSC) in order to benefit from the dose volume effect which will spare the normal tissue while keeping a detrimental effect on the tumour tissue. The dose delivered within the microbeams is called the peak dose and the dose delivered in the middle of two microbeams, the valley dose. A high peak dose is desirable to deliver a dose to deep seated targets, but the valley dose needs to remain under the normal tissue tolerance level. Thus an optimised Peak to Valley Dose Ratio (PVDR) is needed. Considering the small size of the beams and massive dose rates (up to 15 kGy/s) used in MRT, accurate real-time dosimetry is a major challenge. The Centre for Medical Radiation Physics has thus developed the *X-Tream* quality assurance (QA) system based on a high resolution silicon Single Strip Detector (SSD) and wide dynamic range (10^5) readout system.

Materials and methods:
In-air fluence profiles have been measured with the SSD with the aim to develop a QA technique for MSC alignment. Also, PVDRs have been obtained in both water and solid water phantoms and finally, depth dose curves have been acquired under homogeneous beam configuration in order to be compared with a reference ionisation chamber (IC). Measurements have been carried out at both the European Synchrotron Radiation Facility and the Australian Synchrotron.

Results:
The in-air measurements' results showed a good correlation between the SSD and the monitor ionisation chamber used for MSC alignment purposes. Depth dose curves showed an over-response of the SSD at shallow depths.

Conclusion:
The SSD showed its ability to perform qualitative measurement of the microbeams intensity profile and to estimate the PVDRs. Nevertheless, considering the discrepancy observed in comparison with the IC, an investigation of the detector energy dependence is required.

Key words: microbeam dosimetry, silicon, synchrotron