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#09-38 Dose rate measurements in pulsed radiation fields by means of an organic scintillator

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Many dosimetric measurement systems are not suitable for the application in pulsed radiation fields regarding radiation protection scenarios. Even in a low mean dose rate in the range of 1 µSv/h. A main challenge is to process high detector loads within short time periods, while an appropriate dead time behavior and the suppression of pile up effects must be ensured.

A promising approach for an active dosimetric system fulfilling these requirements is the combination of a fast tissue equivalent scintillation detector coupled to a full digital signal processing unit. Such a system could allow real time dosimetry by measuring the deposited energy in the detector, while a discrimination between pulsed and non-pulsed events is realized by comparing the individual time stamps of the measured events. Additionally, pile up events can be identified by analyzing the pulse shape of the individual events. Therefore, a pulse shape parameter for each detected event is calculated by considering two individual integration gates (short gate and long gate) of the detected signal. If the long integration gate is in the range of the macropulse duration of the external beam, the deposited energy in the detector is proportional to the number of detected "pile-up events"and can be additionally considered in the dose rate analysis. Furthermore, due to the completely non-paralyzed dead time behavior of the detection system, it is possible to correct signal losses for the respective measurement.

A potential detector system based on a plastic scintillator and a digital data acquisition board was tested at the Bremstrahlungsfacility (γELBE, HZDR, Dresden, Germany) under various pulse frequencies (up to 10 kHz) and a macro pulse duration between 4 µs and 40 µs. The detection system was placed next to a polymethylmethacrylat phantom, which was irradiated with the bremsstrahlungsbeam. Additionally, dose rate measurements at the clinical TrueBeam therapeutic system (Varian) were performed, where the detector was placed outside the treatment room. For both measurements, it was possible to reconstruct the characteristic structure of the pulsed beam, which comprises the identification of the pulse length and repetition rate. Based on these measurements an appropriate analyzing algorithm for dose rate measurements was developed and will be presented.

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