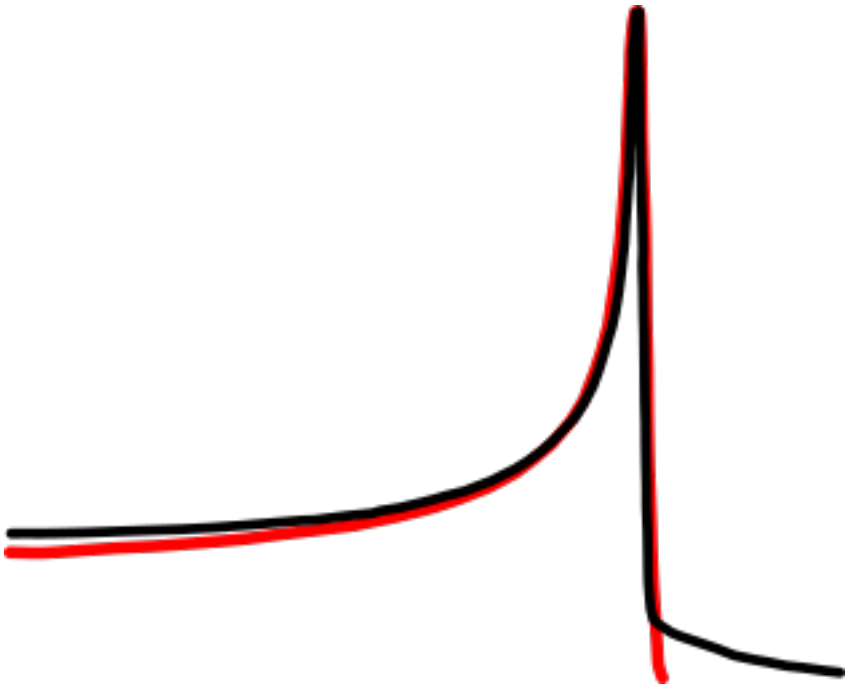
Heidelberg Workshop on Particle Detectors for Ion Beam Therapy Applications

Thursday, 14 July 2022 - Thursday, 14 July 2022

PI



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Scintillation Fibre Transverse Profile Monitor for Low-Intensity Ion Beams

Author: Richard Hermann[1]

[1] *HIT*

Corresponding Author: richard.hermann@med.uni-heidelberg.de

Low intensity ion beams (below 10 million ions/sec.) can be provided at HIT for various experiments via manual degrading, but for now without a feedback system. The development of a transverse ion beam profile monitor for low intensity regions is therefore of interest. The principle of operation is based on scintillating fibres, which transform deposited energy of a throughpassing ion in photons, which are then converted and amplified via silicon photomultipliers (SiPMs) to electric pulses. These pulses are recorded and processed by a new sophisticated readout electronics, the front-end readout system (FERS) A5200 by CAEN. A prototype set-up consisting of all above mentioned parts was tested in beam and has proven to record the transverse beam profile successfully from the intensities of 1E7 ions/s till as low as 100 ions/s.

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Lateral pencil-beam position monitoring in scanned carbon-ion beam therapy

Author: Renato Felix Bautista[None]

A better sparing of healthy tissue and critical organs surrounding a tumor volume is reached in ion beam radiotherapy, in comparison with the conventional X-ray radiotherapy. In radiotherapy with carbon ions, that requires the use of synchrotrons, however, the ion beam delivery is more prone to uncertainties due to the fine-tuning of the beam delivery system, compared to radiotherapy with cyclotron-based protons. These uncertainties can affect the lateral position of the beam during the treatment delivery. This work presents a methodology to monitor the lateral beam positions with high precision by exploiting the tracking of secondary ions produced inside the patient during the treatment delivery. For the secondary ion tracking, a mini-tracker based on Timepix3 detectors was used. The performance of the method was tested in realistic clinic-like treatment situation using an anthropomorphic head phantom irradiated with typical doses at the Heidelberg Ion-Beam Therapy center in Germany. By tracking the secondary ions, the total number of lateral pencil beam positions were successfully measured. Using these data, the beam scanning movement during the delivery was

visualized in detail. By comparing to the reference, the majority of the precision and accuracy values were in line with the clinically accepted uncertainties of ±1 mm.

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A Scintillating Fibre Beam Profile Monitor

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HIT 1 -

Corresponding Author: tomhansmann@web.de

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Tim Gehrke 2 - DKFZ

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HIT 2

Corresponding Author: tomhansmann@web.de