

## Motivation and Aims

This work aims to characterize the stray radiation produced by a 20 MeV pulsed electron beam in water phantom at the PTB facility in Germany.

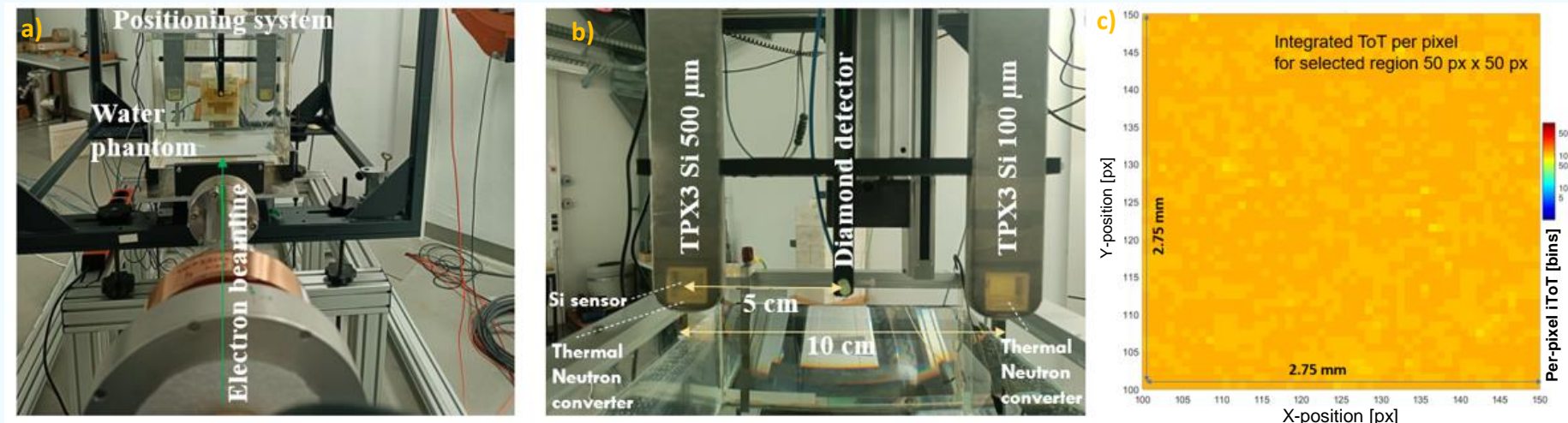
## Data acquisition: Timepix3 detector

- In these studies, the Timepix3 detectors were exposed to an environment with high dose-rate (DR), so they were operated in frame mode (Event + iTOT) the total/integrated per-pixel deposited energy and counts.
- Timepix3 semiconductor pixel detector characteristics:
  - ASIC chip with flexible PCB
  - Architecture: miniaturized Minipix TPX3 radiation camera
  - Sensors: Si of 100 and 500  $\mu\text{m}$  thickness
  - Time resolution per-pixel: 1.6 ns
  - Operation mode: Frame
  - Acquisition time: 0.1 s to register individual pulses (pulse length <math>< 3 \mu\text{s}</math>).

## Experimental setup at PTB

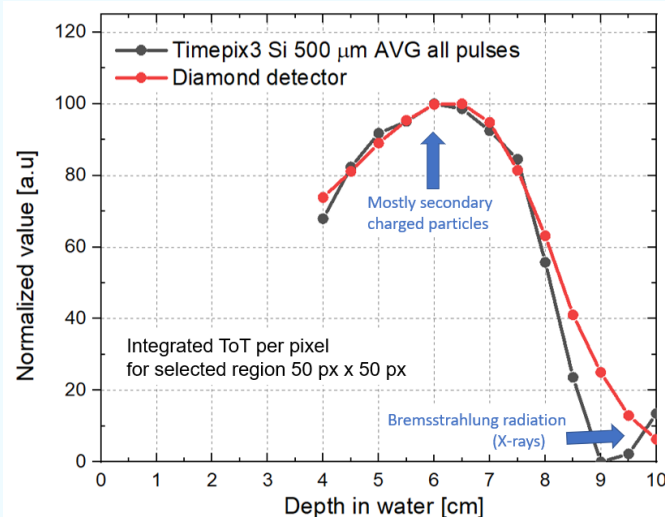
### Experimental Setup:

- Detectors: 2x Minipix Timepix3 Flex and 1x Diamond detector
- Accelerator: LINAC, PRF: 5 Hz, Pulse width: 1.3  $\mu\text{s}$  to 3  $\mu\text{s}$ , Dose per pulse at Zref: 1.8 Gy, Beam energy: 20 MeV
- Detector calibration: performed by Advacam.



**Figure 1.** Pictures of the PTB research LINAC beamline. a) The exit window flange and the water phantom with the customized Minipix Timepix3 Flex inserted into the water phantom. b) Detection system: 2x customized Minipix Timepix3 Flex placed symmetrically between a Diamond detector. c) Visualization by Timepix3 of the radiation field of scattered radiation inside the water phantom at 10 cm lateral position and depth of 4 cm by a primary 20 MeV electron beam at FLASH level intensity, 1.8 Gy/pulse, pulse length 2.39  $\mu\text{s}$ .

## Results: the depth beam profile



The depth profile was measured by the customized Minipix Timepix3 Flex detector with a Si sensor at 10 cm lateral distance from the beam.

**Figure 2.** Measured depth dose curve inside the water phantom by the Minipix Timepix3 Flex detector (black color) and estimated depth dose curve measured by the Diamond detector (red color). The Timepix3 detector was positioned at 10 cm lateral to the beam core and the Diamond detector was located in beam.

## Summary and conclusion

- An experimental method for stray radiation characterization in wide range of components (electrons, X-rays, and thermal neutrons) and dose rates up to UHDR levels was presented.
- A novel detection system based on customized Minipix Timepix3 Flex detectors in miniaturized waterproof setup was used to provide the depth and lateral beam profiles at various locations inside the water phantom.

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