



Characterization of out-of-field of electron beams using Luminescence Dosimeters

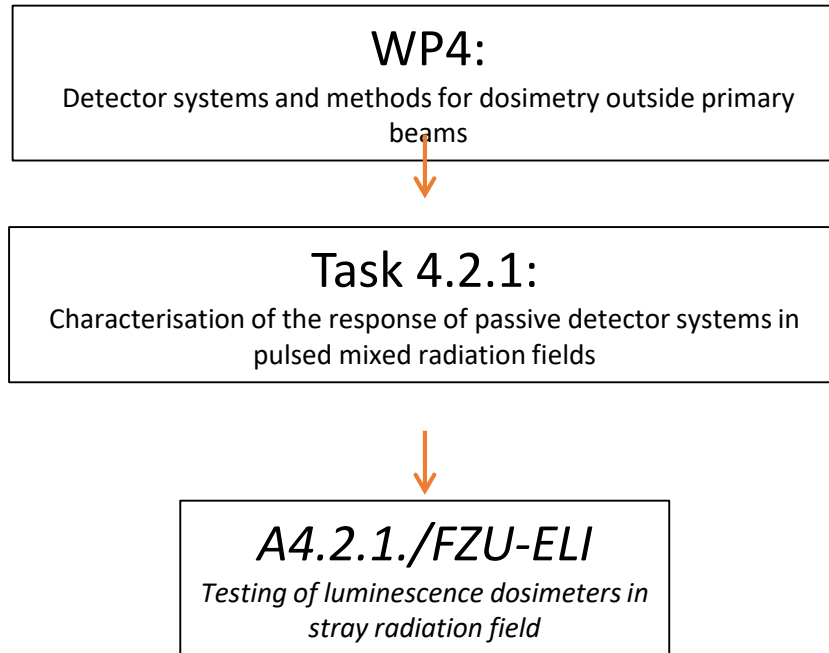


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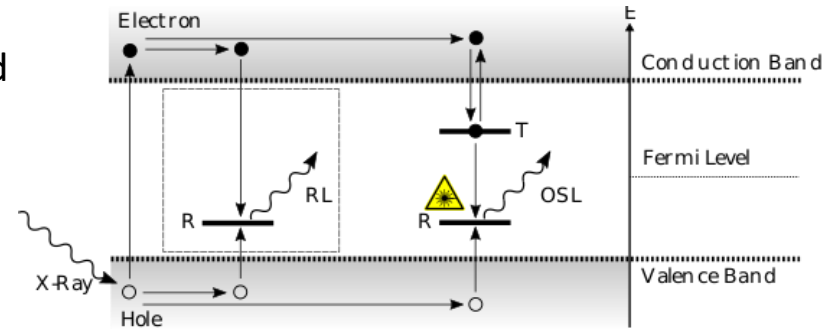
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- In this study, the Advapix Timepix3-Flex pixel detector was combined with passive solid-state dosimeters (thermoluminescence and optically stimulated luminescence dosimeters) to characterize the stray radiation at the reference UHPDR electron beam at the Metrological Electron Accelerator Facility (MELAF), Germany.
- Only the passive system results are here shown.

- **Optically Stimulated Luminescence (OSL):**
 - is the emission of light from a previously irradiated material when stimulated with photons of a specific energy.



- **Thermoluminescence (TL):**
 - is a phenomenon of light emission caused by heating a pre-irradiated insulator or semiconductor.:

- The intensity of the emitted light is proportional to the absorbed energy
- Low cost and easy availability
- Good dosimetric properties
- high sensitivity to ionizing radiation



- **BeO- OSLs**

- Dry pressed chips, 4.7 x 4.7 x 0.5 mm³
- Wide linear dose response (~1 μGy - Gy)
- Effective atomic number similar to human soft tissue ($Z_{\text{eff}}=7.2$)
- As BeO is sensitive to visible light: light-tight packaging



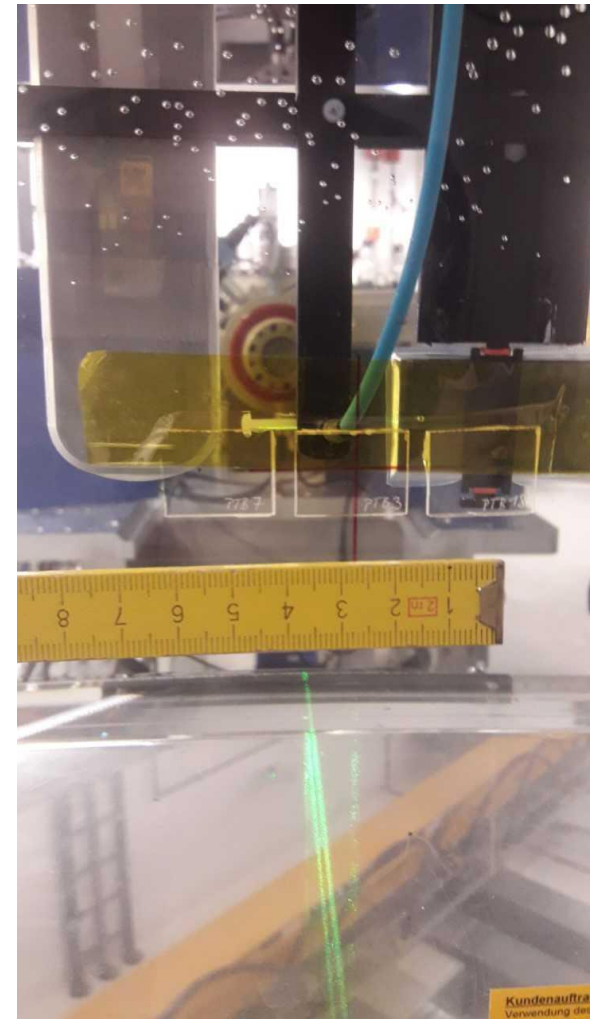
- **Lithium fluoride thermoluminescent phosphor** is an excellent material for broad dosimetric applications.

- resistivity against environmental conditions
- almost tissue-equivalence ($Z_{\text{eff}}\sim 8.2$)
- MCP-6 and MCP-7
 - LiF:Mg,Cu,P enriched in Li-6 or Li-7 respectively

A. Bourguin et al. *Characterization of the PTB ultra-high pulse dose rate reference electron beam*, Physics in Medicine & Biology, accepted 8 April 2022. <https://doi.org/10.1088/1361-6560/ac5de8>



- Ultra-high Pulse Dose rate reference field at PTB
- 20 MeV electron beam
- Pulse width: 2.39 μs
- Doses-per-pulse was varied
- Water phantom (30x30x30 cm³)
- Depth of 18.5 cm (in water) and later range of [3-7]cm.

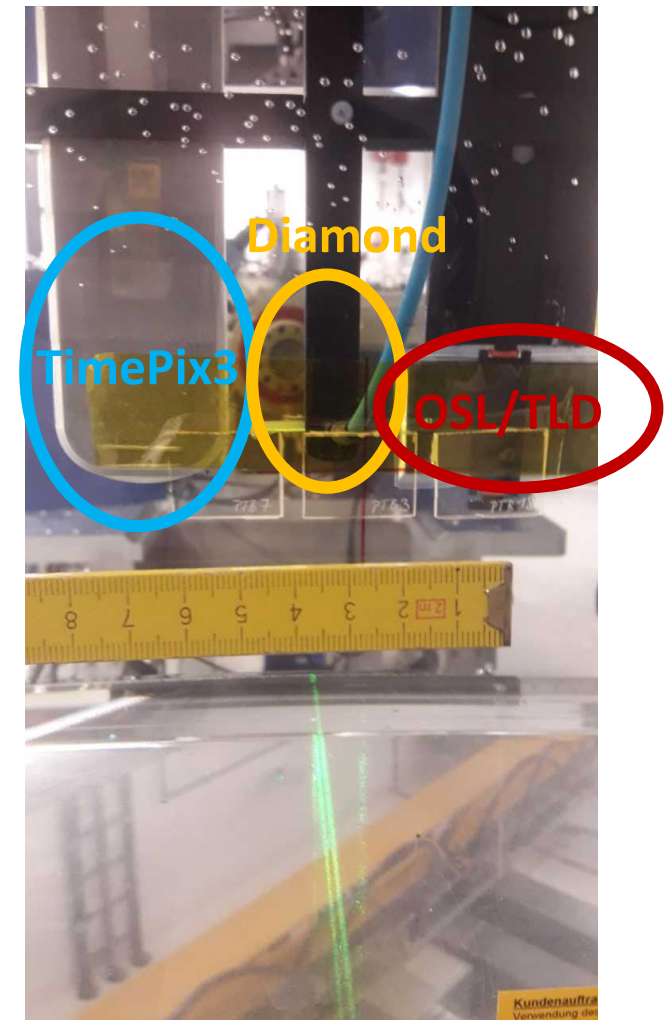


A. Bourguin et al. *Calorimeter for Real-Time Dosimetry of Pulsed Ultra-High Dose Rate Electron Beam*, Frontiers in Physics, October 2020.

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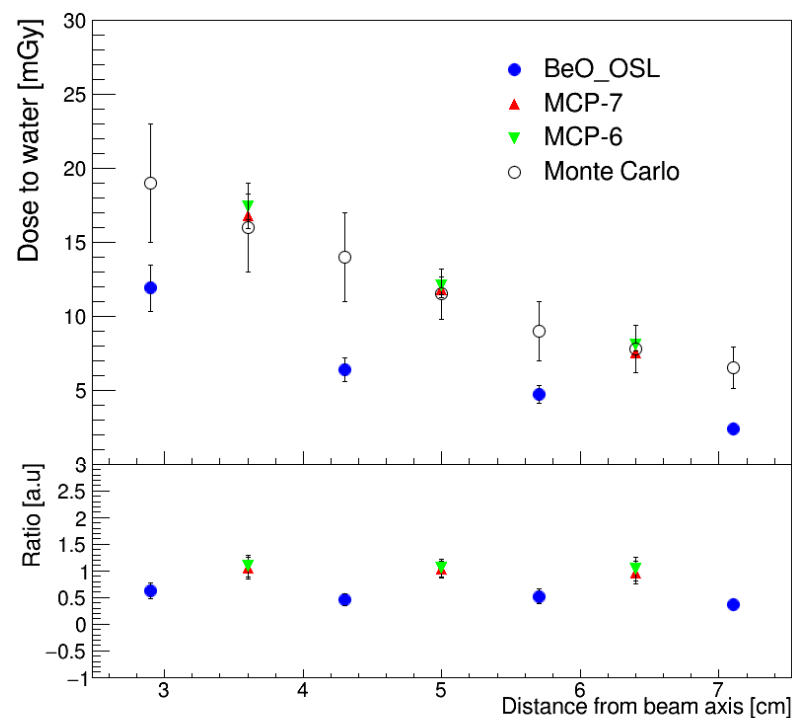
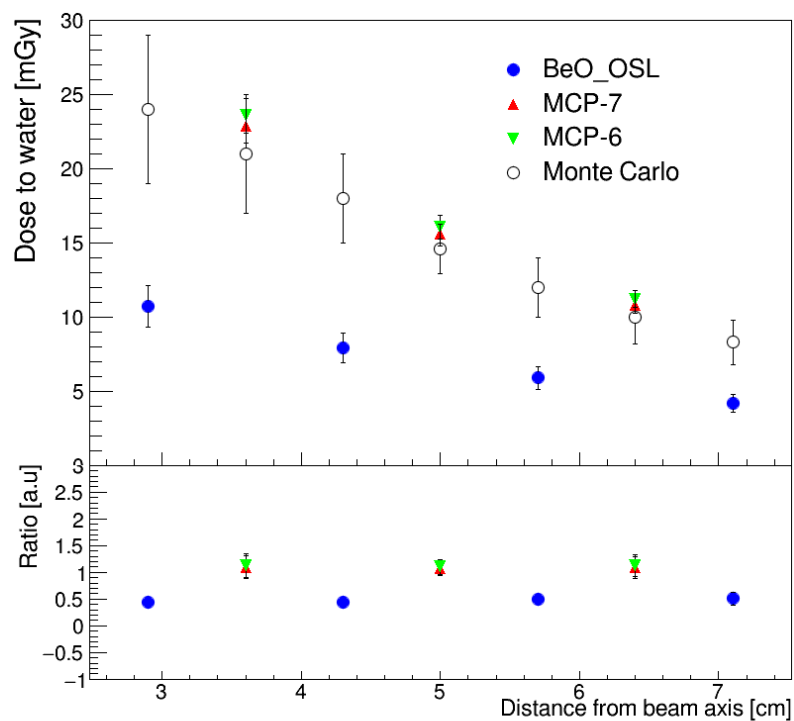


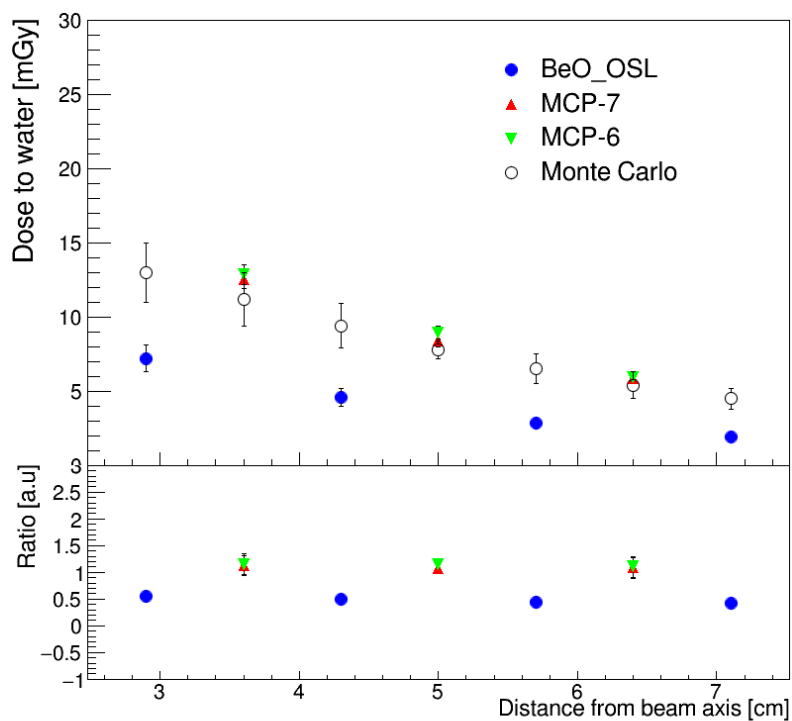
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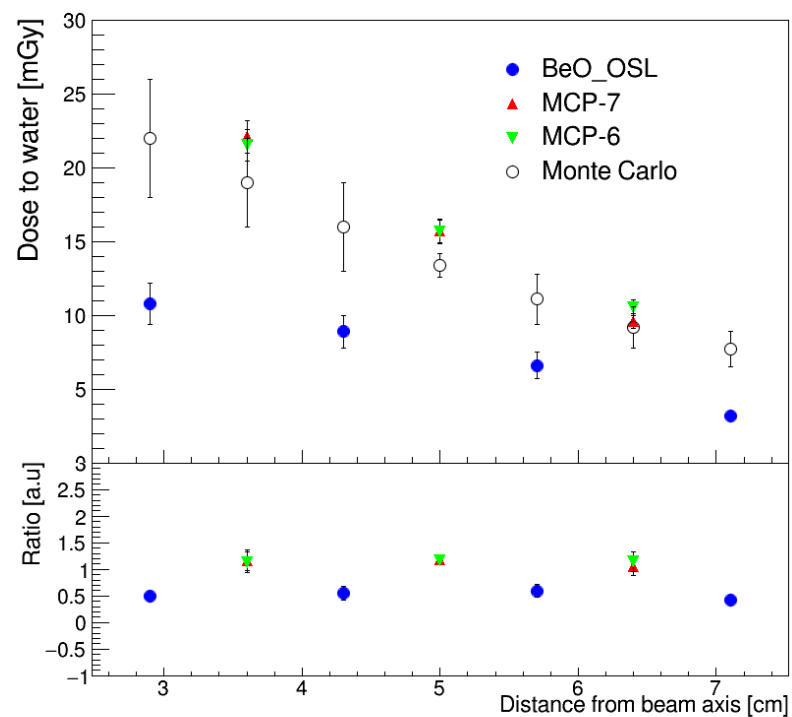
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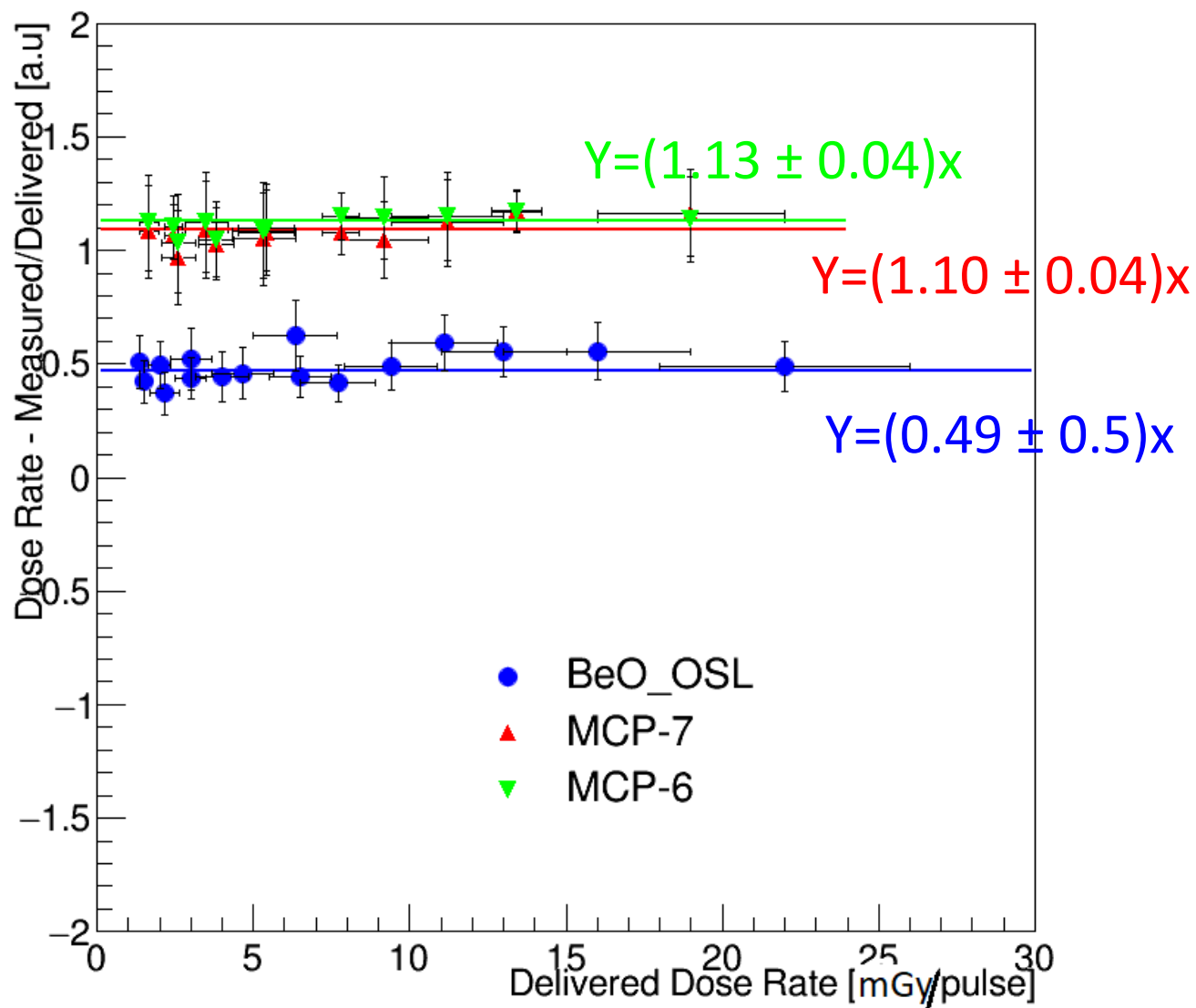




- 18.43 mGy per pulse (reference location)
- 1 pulses



- 33.92 mGy per pulse (reference location)
- 1 pulses



- The results demonstrate the BeO-OSL and TLDs response and ability to measure scattered radiation at ultra-high-dose-rate pulses of electron beams.
- Excellent agreement data-MC: lateral profile and dose/rate studies.
- Discrepancy BeO-OSL/MC (constant 0.5 factor) can be justified in terms of calibration discrepancy and/or wrong sensitivity correction
- A publication of the presented data and direct comparison with the measurements of the Timepix3 is being prepared.