Miniscidom: a scintillator-based tomograph for reconstruction of mm-scale dose distributions

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Laser plasma based sources can achieve a high peak dose rate and short acceleration length (∼µm) compared to conventional sources.
These two unique features result in potentially more compact and flexible irradiation setups, e.g. suitable for radiobiological studies on ultra-high dose rate effects. These experiments require a precise and dedicated beam dosimetry and beam monitoring adapted to the conditions at laser-driven sources, such as single-shot resolving online devices to characterize volumetric dose distributions.

Established methods, such as radiochromic films, can serve as dosimeters but have the shortcoming of requiring offline evaluation, i.e. preventing immediate feedback to the experiment. Moreover, their lower detection threshold might require multi-shot accumulation. Both features are not optimal for laser driven sources featuring shot-to-shot fluctuations.

Here we present the MINISCIDOM device which allows for single-shot tomographic reconstruction of 3D dose distributions deposited by a laser-driven proton pulse.

The dose is measured using the light emission of a plastic scintillator recorded by a CCD camera and a bi-telecentric objective.
The lower detection limit lies at 500 mGy and using filters we can explore a wide range of single shot doses, currently tested up to the 20 Gy level.
With a high spatial resolution of 400 µm for the reconstructed dose distributions, control of dose homogeneity is possible. The common problem of quenching in the scintillator with higher LET of the incoming protons is corrected via a single-shot Monte-Carlo-based method.

I will present first detector applications in the context of radiobiological studies performed at Helmholtz-Zentrum Dresden-Rossendorf using the Draco Petawatt laser system.