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Dose enhancement and localisation by combining reduced mass targets and a pulsed solenoid for radiobiological effectiveness studies of laser accelerated protons

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Compact laser-driven proton therapy accelerators are a potential alternative to complex and expensive conventional accelerators, but still require substantial development in reliable beam generation, transport and dosimetric monitoring as well as validation in radiobiological studies.
We report on systematic investigations of ultrashort pulse laser-driven acceleration of protons from thin targets of narrow lateral dimension, so-called reduced mass targets (RMTs). A robust maximum energy enhancement (almost doubled) was found when compared to reference irradiations of plain foils of same thickness and material. Combining RMTs with a pulsed high-field solenoid for particle capturing, as developed at Helmholtz-Zentrum Dresden-Rossendorf, gives the potential to enhance the dose per pulse and localise it within a small irradiated volume. This might enable radiobiological effectiveness studies on volumetric tumours with laser-accelerated proton beams via in vivo animal irradiations –a nescessary step in the translational research chain towards laser-driven proton therapy of cancer.

Primary author: Mr KROLL, Florian (Helmholtz-Zentrum Dresden-Rossendorf)

Co-authors: Ms METZKES, Josefine (Helmholtz-Zentrum Dresden-Rossendorf); Mr ZEIL, Karl (Helmholtz-Zentrum Dresden-Rossendorf); Dr BUSSMANN, Michael (Helmholtz-Zentrum Dresden-Rossendorf); Prof. SAUERBREY, Roland (Helmholtz-Zentrum Dresden-Rossendorf); Dr ZHERLITSYN, Sergei (Helmholtz-Zentrum Dresden-Rossendorf); Dr KRAFT, Stephan D. (Helmholtz-Zentrum Dresden-Rossendorf); Prof. COWAN, Thomas E. (Helmholtz-Zentrum Dresden-Rossendorf); Dr HERRMANNSDÖRFER, Thomas (Helmholtz-Zentrum Dresden-Rossendorf); Dr KLUGE, Thomas (Helmholtz-Zentrum Dresden-Rossendorf); Prof. SCHRAMM, Ulrich (Helmholtz-Zentrum Dresden-Rossendorf)

Presenter: Mr KROLL, Florian (Helmholtz-Zentrum Dresden-Rossendorf)

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