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High energy proton acceleration at DRACO-PW and radiobiological applications

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Recent developments at the high-power laser facility DRACO-PW enabled the production of polychromatic proton beams with unprecedented stability. This allowed the first in vivo radiobiological study to be conducted using a laser-driven proton source. Yet, the ability to achieve energies beyond the 100 MeV frontier is matter of ongoing research, mainly addressed by exploring advanced acceleration schemes like the relativistically induced transparency (RIT) regime.

In this talk, we report on experimental proton acceleration studies at the onset of relativistic transparency using pre-expanded plastic foils. Combined hydrodynamic and 3D particle-in-cell (PIC) simulations helped to identify the most promising target parameter range matched to the prevailing laser contrast conditions carefully mapped out in great detail beforehand. A complex suite of particle and optical diagnostics allowed characterization of spatial and spectral proton beam parameters and the stability of the regime of best acceleration performance, yielding cut-off energies larger than 100 MeV in the best shots.

The reported progress for proton acceleration directly feeds into our program on ultra-high dose rate radiobiology. We operate a fully-equipped beamline including beam monitoring and dosimetry adapted to ultra-high dose rate proton pulses at DRACO-PW.

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