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Exploring deep in-vivo application of laser-driven very-high, energy, wide spectrum electrons

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Laser-driven electron acceleration schemes can be easily and reliably used to accelerate electrons in the energy band between 20 MeV and 200 MeV, termed Very-High Energy electrons (VHEE) in medical physics. Such radiation quality is regarded as a candidate for novel radiation therapy schemes, owing to a favorable depth-dose deposition profile and the possibility of reaching very-high dose-rates required by FLASH therapy schemes.

We present the application of a laser-driven VHEE source to systematic irradiation of in-vitro, ex-vivo and in-vivo biological targets, aiming at explore the effects of the laser-driven temporal irradiation modality, calles fast-fractionation. Properties of the laser-driven electron beam (charge, spectrum, stability) will be discussed with an eye on dosimetry and beam caracterization best practices. Relaxation of spectral conditions enable reaching doses as high as 350mGy/shot over 1cm2 target diamter, and a uniform penetration up to 5cm.

The application to in vivo deep irradiation will be presented for the case of whole-thorax irradiation in mice. Passive beam expansion and shaping are used to conform the deposited dose to the target volume, while protecting at-risk organs. Perspectives of laser-driven sources as a tool for exploring the differential toxicity between conventional, FLASH and laser-driven irradiation modalities will be discussed.

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