7th European Advanced Accelerator Conference

EAAC2025

Contribution ID: **591** Type: **Poster (participant)**

In vivo whole-thorax irradiation in mice with laser-driven VHEE

Wednesday, 24 September 2025 19:00 (1h 30m)

Laser-Plasma Accelerators (LPAs) provide a compact source of ultra-short, high-dose-rate electron beams through acceleration gradients >100 GV/m. Capable of producing Very High Energy Electrons (VHEEs, >50 MeV), LPAs represent a promising alternative to conventional accelerators for preclinical radiotherapy, particularly due to their unique temporal structure and potential for FLASH-like delivery.

We report the successful whole-thorax irradiation of mice using a laser-driven VHEE beam (50-100 MeV) from the 150 TW LPA at the Laboratoire d'Optique Appliquée, aiming to assess fibrosis development, a key marker of late lung toxicity. A dedicated beamline was developed for this complex in vivo experiment, with passive beam expansion and shaping to conform the dose to the lung volume while sparing surrounding organs at risk. The protocol replicates that of the 2014 study by Favaudon et al., which first revealed the FLASH effect.

This benchmark experiment demonstrates the feasibility of performing complex, organ-specific irradiations with LPA-based VHEEs and provides a critical reference for situating laser-driven VHEE delivery between conventional and FLASH modalities.

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Session Classification: Poster Session

Track Classification: PS5: Applications