



Contribution ID: 17

Type: not specified

Simulating the focusing of laser-plasma accelerated particle beams

Wednesday, 30 October 2024 10:45 (25 minutes)

The interest in laser-plasma accelerated particle beams with potential application in the biomedical field is rapidly growing [1, 2]. The future use of such beams greatly depends on the development of specially designed focusing and beam transport systems that can control the delivery of the beam with a predefined set of parameters [3]. Some of the main issues that need to be addressed, particularly for the case of ultra-short accelerated hadrons, are the broad energy spectrum and the high angular divergence.

Here we present simulation-based studies which aim to understand the focusing effects of various beam steering elements such as coils, dipoles, quadrupoles and their combinations on laser-plasma accelerated particle beams. The proposed beamline configurations are being analyzed in terms of collection efficiency by varying the position, dimension and geometry of the magnetic elements, as well as the mean focusing distance and profile of the beam.

Acknowledgement: This work was supported by Project ELI-RO/DFG/2023_001 ARNPhot funded by Institute of Atomic Physics Romania

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[2] F. Kroll, et al., Tumor irradiation in mice with a laser-accelerated proton beam. Nature Physics 18, (2022), 316-322

[3] M. Wu, et al., Collection and focusing of laser accelerated proton beam by an electromagnetic quadrupole triplet lens, Nuclear Instruments and Methods in Physics Research, A 955, (2020), 163249

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Session Classification: Oral contributions V