Contribution ID: **162** Type: **not specified**

Quality-preserving laser-plasma ion beam booster via hollow-channel magnetic vortex acceleration

Thursday, 25 July 2024 13:30 (20 minutes)

Laser-driven ion acceleration offers ultra-short (10s of fs for 10s of MeV), high-charge (100s of pC), and ultra-low slice emittance particle bunches. Mastering these sources can have a high impact on fundamental and applied research applications in physics, industry, and society, ranging from next-generation hadron colliders or neutrino factories, drivers for inertial fusion energy, radiotherapy, nuclear physics, warm-dense matter research, secondary radiation generation for material research and security applications, and possibly even radiation hardness of spacecraft. Despite clear progress in the last decades, particularly in the maximum ion energy using 1-10 Joule class laser systems, the desired energies for some applications still cannot be reached. Relieving the requirements imposed by a single laser-ion source, we present a staging concept that boosts a proton beam into the desired energy regime of 100s of MeV/u within a few compact, beam-quality-preserving plasma stages. Our approach is based on magnetic vortex acceleration, using near-critical density targets with a pre-formed hollow channel to boost the energy of a temporally matched ultra-intense proton bunch. With fully self-consistent 3D particle-in-cell simulations using the exascale code WarpX, we demonstrate robustness in bunch acceptance (temporal and spatial), transport, energy boost, energy spread, and emittance preservation, using current and near-term available laser-system parameters.

Working group

WG2 : Laser-driven plasma acceleration of ions

Primary author: GARTEN, Marco (LBNL)

Co-authors: BULANOV, Stepan (LBNL); HAKIMI, Sahel (Lawrence Berkeley National Laboratory); OBST-HUEBL, Lieselotte (Lawrence Berkeley National Laboratory); MITCHELL, Chad (Lawrence Berkeley National Laboratory); SCHROEDER, Carl (Lawrence Berkeley National Laboratory); ESAREY, Eric (LBNL); GEDDES, Cameron (LBNL); VAY, Jean-Luc (Lawrence Berkeley National Laboratory); HUEBL, Axel (Lawrence Berkeley National Laboratory, USA)

Presenter: GARTEN, Marco (LBNL)

Session Classification: WG2