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Evaluating beam neutralization and transport dynamics in laser-driven ion accelerators

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We are developing a laser-driven ion accelerator aimed at downsizing heavy ion therapy devices. The ion beam produced by this accelerator exhibits low emittance(transverse emittance is approximately 10-3 π mm-mrad and longitudinal emittance is approximately 10-5 eV・s), with a very short pulse width (about picoseconds). As a result, the peak current reaches the kA level. However, explosive beam divergence is mitigated by co-moving electrons that neutralize the beam's space charge in the high-density region immediately following acceleration. This study involved acceleration calculations and transport calculations of proton beams over 40 cm (up to just before the quadrupole magnet) using the Par-ticle-in-Cell (PIC) simulation code to assess the ion beam's space charge neutralization characteristics. This presentation will show the results of our simulations using the PIC code, which analyzed the degree of neutralization by co-moving electrons. The results suggest the potential for optimizing target thickness when utilizing of specific energy ions produced by laser-driven ion acceleration. The results suggest confirmation of the space charge neutralization phenomenon in the laser-accelerated ion beam.

Footnotes

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