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Improving beam spectral and spatial quality by double-foil target in laser ion acceleration for ion-driven fast ignition[1]

CHENGKUN HUANG, Los Alamos National Laboratory

Mid-Z ion driven fast ignition inertial fusion [1] requires ion beams of 100s of MeV energy and $< 10\%$ energy spread. An overdense nm-scale foil target driven by a high intensity laser pulse can produce an ion beam that has attractive properties for this application. The Break Out Afterburner (BOA) [2] is one laser-ion acceleration mechanism proposed to generate such beams, however the late stages of the BOA tend to produce too large of an energy spread. The spectral and spatial qualities of the beam quickly evolve as the ion beam and co-moving electrons continue to interact with the laser. Here we show how use of a second target foil placed behind a nm-scale foil can substantially reduce the temperature of the co-moving electrons and improve the ion beam energy spread [3]. Particle-In-Cell simulations reveal the dynamics of the ion beam under control. Optimal conditions for improving the spectral and spatial spread of the ion beam is explored for current laser and target parameters, leading to generation of ion beams of energy 100s of MeV and 6% energy spread, a vital step for realizing ion-driven fast ignition.

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