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Simulation study of a hybrid laser-RF compact proton accelerator
JASON CHOU, SLAC / Stanford University, GLEN WHITE, VALERY DOLGASHEV, JEFFERY NEILSON, SAMI TANTAWI, SIEGFRIED GLENZER, FREDERICO FIUZA, SLAC — The generation of proton beams with 10s to 100s MeV with controllable spectral bandwidth in a compact system is important for applications that range from radiography of dense plasmas to tumor therapy. We use large-scale 2D and 3D particle-in-cell (PIC) simulations to explore the development of a hybrid accelerator that would combine the advantages of laser-driven (high-charge, low-emmitance, 10s MeV) proton beams with high-gradient RF acceleration (controllable spectral bandwidth) in a meter-scale compact system. We have used an adaptive mesh technique to model the full system self-consistently, from the laser-solid interaction, to transport, to the meter-scale acceleration in the RF structure. We have found that space-charge effects are minimized during transport due to the screening of accelerated electrons, but can be very important in the RF-acceleration stage. By tuning the distance of laser-plasma foil to the RF entrance and the injection phase we show the possibility to control space charge effects in order to obtain high-quality, high-charge protons beams in a compact hybrid accelerator.

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