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Computational study of transport and energy deposition of intense laser-accelerated proton beams in solid density matter J. KIM, C. MCGUFFEY, B. QIAO, F.N. BEG, UC San Diego, M.S. WEI, General Atomics, P.E. GRABOWSKI, UC Irvine — With intense proton beams accelerated by high power short pulse lasers, solid targets are isochorically heated to become partially-ionized warm or hot dense matter. In this regime, the thermodynamic state of the matter significantly changes, varying the proton stopping power where both bound and free electrons contribute. Additionally, collective beam-matter interaction becomes important to the beam transport. We present self-consistent hybrid particle-in-cell (PIC) simulation results of proton beam transport and energy deposition in solid-density matter, where the individual proton stopping and the collective effects are taken into account simultaneously with updates of stopping power in the varying target conditions and kinetic motions of the beam in the driven fields. Broadening of propagation range and self-focusing of the beam led to unexpected target heating by the intense proton beams, with dependence on the beam profiles and target conditions. The behavior is specifically studied for the case of an experimentally measured proton beam from the 1.25 kJ, 10 ps OMEGA EP laser transporting through metal foils. This work was supported by the U.S. DOE under Contracts No. DE-NA0002034 and No. DE-AC52-07NA27344 and by the U.S. AFOSR under Contract FA9550-14-1-0346.

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