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Computational study of transport and stopping of a laser-accelerated proton beam in solid targets J. KIM, B. QIAO, C. MCGUFFEY, F.N. BEG, UCSD, M. WEI, R.B. STEPHENS, General Atomics, M.E. FOORD, P.K. PATEL, H. MCLEAN, LLNL — Laser-accelerated proton beams produced from a spherically curved surface can be focused to high peak particle density ($> 10^{19}$ particles/cm^3), which can heat a thin solid foil rapidly into a state of warm dense matter (WDM), having solid densities and temperatures of $\sim$1-100 eV. Ion beam transport and stopping in such extreme, dynamic regimes is largely unexplored and is important for fusion science and high-energy density physics. We present numerical modeling results of proton beam transport and heating in WDM using a new ion stopping power calculation module that we have recently implemented in the hybrid PIC code LSP. In this module, the contributions from both the bound and free electrons are accounted for the total ion stopping power, and the matter's response to the high-flux beam (heating, ionization, strong return currents) is self-consistently described by applying the equation of state (EOS) at each grid point and time step. The complex dynamics of proton beam interaction with WDM have been systematically studied, showing significant dependencies on the beam intensity, target material, and initial target plasma temperature. This work was supported by the DOE/NNSA Grant DE-NA0002034 (NLUF).

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