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Optimized laser-driven electron acceleration inside a hollow core target[1] KATHERINE CHIN, University of California, San Diego, ZHENG GONG, University of Texas at Austin, TAO WANG, ALEXEY AREFIEV, University of California, San Diego — When a hollow core plasma target is irradiated by a short laser pulse with intensity $I_0 \sim 10^{20}\,\mathrm{W/cm^2}$, electrons are extracted from the channel walls and injected into the initially empty area by the transverse laser electric field. The accumulated net negative charge background provides an optimized structure for quasi-static electric and magnetic fields which allows the longitudinal laser electric field to facilitate collimated electron acceleration. When electrons move with the laser pulse inside the channel, the electron density exerts a non-negligible feedback on the dispersion relation of the laser pulse which raises its phase velocity v_{ph}. Leveraging on theoretical analyses and 2D particle-in-cell (PIC) simulations, we demonstrate that v_{ph} is the key factor which dominates the electron acceleration process and determines both saturation time and maximum attainable energy. The correctional term introduced by the electron density fits our PIC simulation results more closely in comparison to the traditional waveguide dispersion relation. The dependence of the superluminal phase velocity on the laser amplitude a_0 and channel inner radius R is also confirmed.

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