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Enhanced ion acceleration in the transition regime from opaque to transparent plasmas[1] ROHINI MISHRA, FREDERICO FIUZA, SIEGFRIED GLENZER, Stanford Linear Accelerator Center — Using Particle-in-Cell (PIC) simulations, we investigate ion acceleration in high-intensity laser-plasma interactions in for targets that become laser transparent to the laser during the interaction process. A theoretical model is developed to derive an optimal target electron areal density 'n.L' as a function of laser normalized intensity and the pulse duration in the laser transparent regime. A large schematic parametric scan for a wide range of target electron density (n) and thickness (L) is performed and shown to be consistent with analytical prediction. Our simulations show that iIon acceleration in optimal conditions relies on the re-heating of the expanding sheath electrons by the laser and enhancing enhancement of the Target Normal Sheath Acceleration (TNSA) electric field after the plasma becomes transparent to the laser light. This enhanced TNSA field decays slower compared to conventional TNSA resulting in significantly higher proton energies. Our results open the way to the exploration of optimized ion acceleration in the transparency regime, not only with nm-scale foils but also with recently developed micron-scale hydrogen jets.

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