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Laser-Ion Lens and Accelerator[1] TIANHONG WANG, Cornell University, VLADIMIR KHUDIK, The University of Texas at Austin, GENNADY SHVETS, Cornell University — Generation of highly collimated monoenergetic relativistic ion beams is one of the most challenging and promising areas in ultra-intense laser-matter interactions. We address this challenge by introducing the concept of laser-ion lensing and acceleration (LILA). Using a simple analogy with a gradient-index lens, we demonstrate that simultaneous focusing and acceleration of ions are accomplished by illuminating a shaped solid-density target by laser pulse at $10^{22} W/cm^2$ intensity and using the radiation pressure to deform/focus the target into a cubic micron spot. We show that the LILA process can be approximated using a simple deformable mirror model, and the analytical solution of the model will be provided and compared with 3D particle-in-cell simulations. Extensive scans of the laser and target parameters in 3D PIC simulations identify the stable propagation regime where the Rayleigh-Taylor (RT)-like instability is suppressed. Stable focusing is found at different laser powers (from few- to multi-petawatt), different laser formats (planar or gaussian), and different target compositions (from simple hydrogen target to two-ion-species target). Depending on those parameters, a wide range of ion kinetic energies from 200MeV to 750MeV can be obtained.

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Tianhong Wang
Cornell University

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