Abstract Submitted
for the DPP11 Meeting of
The American Physical Society

Rayleigh-Taylor instability in RPA regime of the ion acceleration by the laser pulse V. KHUDIK, S.A. YI, T.H. RATLIFF, G. SHVETS, T.P. YU, A. PUKHOV — Dynamics of acceleration of the ion target irradiated by a circularly polarized laser pulse is studied analytically and via particle-in-cell (PIC) simulations. A self consistent analytical model of the target with finite thickness is developed. In this 1-D kinetic model, target parameters are stationary in the center of mass of the system, and electrons are bouncing in the potential well formed by the laser ponderomotive and electrostatic potentials. They are distributed in the direction of acceleration by the Boltzmann law and over velocities by the Maxwell-Juttner law. The laser pulse interacts directly only with electrons in a thin sheath layer, and these electrons transfer the laser pressure to the target ions. In the fluid approximation it is shown that despite the distribution of the density in space, the target is still susceptible to the Rayleigh-Taylor instability [1]. Using PIC simulations we found the growth rate of initially seeded perturbations as a function of their wavenumber for different target parameters and compare it with analytical results. Useful scaling laws between this rate and laser pulse pressure and target parameters are discussed. Also, specially-designed numerical experiments are performed to reveal difference between instabilities of the accelerated target and Rayleigh-Taylor instability.

[1] T.P. Yu, A. Pukhov, G. Shvets, M. Chen, T. H. Ratliff, S. A. Yi, and V. Khudik, Phys. Plasmas, 18, 043110 (2011).

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Date submitted: 25 Jul 2011 Electronic form version 1.4