Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

Universal Scalings for Direct Laser Acceleration of Relativistic Electrons in Ion Channels VLADIMIR KHUDIK, ALEXEY AREFIEV, XI ZHANG, GENNADY SHVETS, Department of Physics and Institute for Fusion Studies, The University of Texas at Austin — Direct Laser Acceleration (DLA) of electrons in ion channels is investigated in the general case when the laser phase velocity is greater or equal to the speed of light, and the electrons execute a fully three-dimensional trajectory inside the focusing channel. In the paraxial limit of electron motion (mostly forward), we develop an analytic theory that provides an accurate estimate of the maximum possible energy gain of the electrons as a function of their initial conditions and laser parameters. Some of the counter-intuitive predictions validated via particle simulations include the emergence of the phase space barriers that prevent electrons from getting accelerated, and the threshold-like dependence of the energy on the initial conditions. The predictive power of the theory is demonstrated by identifying the laser-plasma parameters for the electron acceleration through the resonant interaction between the third harmonic of betatron oscillations and the laser wave. Possible experimental signatures of the high-order resonances will be discussed. This work was supported by DOE grants DESC0007889 and DE-SC0010622, and by an AFOSR grant FA9550-14-1-0045.

Vladimir Khudik
Department of Physics and Institute for Fusion Studies,
The University of Texas at Austin

Date submitted: 24 Jul 2015 Electronic form version 1.4