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Proton acceleration from near critical density and underdense plasmas using ultra-intense laser pulses STEPAN BULANOV, VLADIMIR CHVYKOV, GALINA KALINCHENKO, TAKESHI MATSUOKA, PASCAL ROUSSEAU, VICTOR YANOVSKY, KARL KRUSHELNICK, DALE LITZENBERG, ANATOLY MAKSIMCHUK, University of Michigan — The propagation of ultra-intense laser pulses through plasma is connected with the generation of strong electric and magnetic fields and with electron and ion acceleration in the forward direction. Ion acceleration is more efficient in the region where the laser pulse exits the plasma. Since at the plasma-vacuum interface the magnetic field upon exiting the propagation channel redistributes plasma electrons thus forming a quasi-static charge separation electric field which accelerates and collimates ions. We present the results of 2D PIC simulation of the interaction of an intense laser pulse with underdense and near critical density plasmas. We show that the maximum ion energy can be controlled by matching the plasma density and its thickness to the laser pulse power and peak intensity. We show strong influence of the density gradients at the plasma-vacuum interface on ion acceleration. We performed simulations under the anticipated experimental conditions for the Hercules laser with pulse power of 300 TW, duration of 30 fs (FWHM), focused to a spot size of 0.8 μm FWHM onto a 60 μm, 2.25 n_{cr} dense plasma slab which predict the maximum proton energy of 500 MeV.

Stepan Bulanov
U of M

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