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Laser Acceleration of Monoenergetic Protons in Moving Double Layer from Thin Foil V.K. TRIPATHI, C.S. LIU, X. SHAO, East West Space Science Center, University of Maryland — We present analytic theory of laser acceleration of monoenergetic protons by irradiation on a thin foil, reported by Yan et al., 2008 in simulations. The ponderomotive force pushes the electrons forward, leaving ions behind until the space charge field balances the ponderomotive force at distance $\Delta_s \approx a_0(n_c/n_0)\lambda_L/\pi$, where a_0 and λ_L are the normalized laser amplitude and wavelength, n_c is the critical density and $n_0$is the plasma density. For the target thickness $D = \Delta_s$, the electron sheath piled up at the rear surface, is detached from the bulk ions and moves into vacuum, carrying with it the protons contained in the sheath width $\sim c/\omega_p$, where ω_p is the plasma frequency. These protons are trapped by the self field of the dense electron sheath and are collectively accelerated as a double layer by the laser ponderomotive force, giving proton energy ≈ 200 MeV at $a_0 = 5$, $n_c/n_0 = 10$ and pulse length 90 fs.

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