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Analytical theory for the laser driven TNSA ion acceleration
MATTEO PASSONI, Dipartimento di Chimica Materiali e Ingegneria Chimica "G. Natta", Politecnico di Milano, and Sezione di Milano INFN, Milan, Italy, MAURIZIO LONTANO, Istituto di Fisica del Plasma, C.N.R., Milan, Italy — Ions can be effectively accelerated during the interaction of an ultra-intense ultra-short laser pulse irradiating a thin solid target via the so-called Target Normal Sheath Acceleration (TNSA) mechanism. A theoretical model of the quasi-static electric field that is formed at the target surfaces, due to the appearance of a cloud of laser-produced hot electrons, has been developed. The 1-dim Poisson equation has been analytically solved assuming a Maxwell-Boltzmann distribution in the ultrarelativistic limit for those electrons which are bounded in the positive electrostatic potential produced by the excess of ions left in the target. The solution turns out to depend on the maximum energy of the electrons responsible for the acceleration. This model is used to describe the maximum energies and the energy spectra of the ions accelerated in the field, making possible satisfactory comparisons with the most recent experimental and numerical data and predictions of regimes achievable in the future.

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