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Near-surface electron acceleration by grazingly incident laser pulses

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With the help of 3D numerical simulations, we demonstrate the possibility to accelerate a high number of electrons (tens of nC) to tens or even hundreds of MeVs using relativistic laser pulses ($\sim 10^{22}$ W/cm^2) grazingly incident on solid targets. It is shown that in this regime, the electrons are accelerated mostly efficiently at some distance from the target, and the key factor in that is the field structure in which the longitudinal electric field becomes dominant at a certain distance. Also the presence of the dense plasma surface allows for efficient electron injection into the field structure. We also study the effect of the plasma surface shape on the electron acceleration efficiency. It turns out that the presence of the target density gradient can significantly increase the radiation power due to more efficient electron injection into the accelerating field. The optimal preplasma properties for efficient electron acceleration are determined as well. A model of electron acceleration in this regime is also developed, that allows one to estimate some of the characteristics, and the key results agree with the simulations.

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