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A "slinge shot" laser-driven acceleration mechanism of plasma electrons

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We have recently proposed [1-2] a new laser-driven acceleration mechanism based on the violent impact of an ultra-short and ultra-intense laser pulse against the electrons belonging to a superficial thin layer of a low-density plasma (or gas, provided the pulse is sufficiently intense to locally cause its complete ionization). The interplay among the strong ponderomotive effect, the excited restoring electric field (originated by charge separation) and the finite size of the laser spot causes the expulsion of electrons from the plasma surface with high energy in the direction opposite to that of the pulse propagation ("slingshot effect"). We now reduce [4] the relevant equations to two first order ODE (or a collection of) and thus give a reliable quantitative description of the effect for a broad range of intensities and initial densities, both smooth and step-shaped. Its experimental verification seems to be feasible and, if confirmed, would provide a new laser-driven acceleration mechanism for electrons.
[1] G. Fiore, R. Fedele, U. De Angelis, Phys. Plasmas 21 (2014), 113105.
[2] G. Fiore, J. Phys. A47 (2014), 225501; Acta Appl. Math. 132 (2014), 261-271.
[4] G. Fiore, S. De Nicola, in preparation.

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