A “slingshot” laser-driven acceleration mechanism of plasma electrons

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Abstract

A laser-driven acceleration mechanism based on a violent impact of an ultra-short and ultra-in tense laser pulse against the electrons belonging to a superficial thin layer of a plasma seems to be possible [1,2]. 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”). The effect should arise also from impact onto gases or other states of matter, provided that the pulse is sufficiently intense to cause locally their complete ionization. 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, “The slingshot effect: a possible new laser-driven high energy acceleration mechanism for electrons”, arXiv:1309.1400.
[2] G. Fiore, “On plane-wave relativistic electrodynamics in plasmas and in vacuum”, arXiv:1312.4665, to appear in J. Phys. A.