Alternative efficient methods of dense plasma acceleration to high velocities

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Abstract

Numerical modelling of dense plasma acceleration processes was performed. In these investigations a scheme called "cavity pressure acceleration" (CPA) was applied, which allows driving propelling plasma objects in arbitrary direction in relation to the laser beam incident on a target and more efficient absorption of the laser pulse energy. Two different versions of these "non-classic" CPA schemes were taken into account: "backward acceleration" and "forward acceleration".

Those calculations complement the previously performed experiments on the PALS system, in which the results of acceleration of dense plasma objects (average speed obtained for 20 μm PS and 10 μm Al targets was ~ $6x10^7$ cm/s) were at the level of the top global results.

Numerical calculations were made for two different laser wavelengths: λ = 1.315 μm (iodine laser) and λ = 0,248 μm (KrF laser). For the "classic" i.e. ablative drive scheme, the advantage of using a short laser wavelength is obvious. Velocities obtained in this variant are two- three times higher than in the case of using a laser with several times longer wavelength. This also applies to other important parameters of the acceleration experiment, such as pressures generated and the amount of neutrons produced (when using appropriate targets).

Completed numerical calculations, as well as the previous experiments on the PALS system, show that the use of non-classical drive schemes enables comparable, very good results to be obtained also with lasers of longer wavelength.