DIRECT ELECTRON ACCELERATION BY CHIRPED LASER PULSE IN THE REGIME OF DYNAMIC FOCUSING

D.A. Zayarniy and S.G. Bochkarev

Lebedev Physical Institute, Russian Academy of Sciences, Moscow, Russia, [bochkar@lebedev.ru](mailto:bochkar@lebedev.ru)

Now technology of chirped-pulse amplification makes it possible to achieve multi-TW and even PW-class laser system. Super power laser pulses are used for high energy electron and ion generation. Fluxes of accelerated particles are demanded for various applications including medicine, nuclear physics, etc. Nevertheless in the regime of high power laser fields a possibility of electron acceleration is restricted by some requirements. In free space an electron interacting with plane wave is not accelerated in average according to Lawson-Woodword theorem [1]. This is due to the fact that acceleration regions turn by deceleration ones. However this statement is not valid for special-limited fields, and also in the case of chirped pulse. Both conditions are realized for the regime of dynamic focusing of laser radiation. The idea of ponderomotive acceleration by dynamic laser focus was first proposed in paper [2]

In our paper we carried out the numerical simulation of chirped relativistically strong laser pulse with free electrons interaction in optic scheme diffraction grating – focusing lens or mirror. In such system, in focal plane the dynamic focusing may be observed. For EM field calculation the diffraction integral which allows description of spatial–temporal dynamics of spectral–limited chirped pulse was taken [3]. Matching optical scheme parameters makes it possible to reach a value of phase velocity a little less than speed of light what it is necessary for realization of the capture and acceleration scenario [4, 5].

The calculations of electron dynamics for electrons initially at rest and placed in the vicinity of polarization plane were fulfilled for schemes of unilateral and bilateral irradiation. For the last case in the intersection area of two counter propagating laser pulses standing wave is formed. The elliptic beam profiles with long radius of curvature along the polarization direction being much longer than radius in the perpendicular direction were used. The capture of electrons and their acceleration along focus moving direction were observed only for bilateral scheme and for their initial positions close to focal plane. The spectral–angular electron distributions were obtained depending on parameters of laser pulse.

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References

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