DOI: 10.34854/ICPAF.51.2024.1.1.185

COMPACT LASER-PLASMA ELECTRON ACCELERATOR AND ITS APPLICATION TO THE GENERATION OF TERAHERTS RADIATION AND NUCLEAR PHOTONICS PROBLEMS *)

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The production of directed electron beams through the interaction of a femtosecond laser pulse of relativistic intensity with subcritical plasma is one of the most actively developing areas at the intersection of laser physics and plasma physics [1]. The most impressive results were obtained using unique laser systems with a peak power from 0.5 to several PW: the energy of a quasi-monoenergetic electron beam reaches 8 GeV with an acceleration length of only 20 cm [2]. At the same time, the low pulse repetition rate of such systems (no higher than 0.1 Hz) determines the low average beam current. In addition, many problems do not require such high electron energies, but the charge of the electron pulse and the average beam current are important [3]. It is precisely these electronic pulses that can be obtained using femtosecond laser complexes with a terawatt peak power level and capable of operating at kilohertz repetition rates.

This paper presents the results of computational and experimental studies of several schemes for accelerating electrons with a femtosecond laser pulse with a peak power of 1–2 TW, the possibility of scaling the developed approaches to high powers (tens of TW and PW), as well as the use of these beams for generating secondary radiation in a wide electromagnetic field range—from terahertz to gamma. In particular, we have obtained electron beams with an energy of up to 15 MeV, a charge of hundreds of picoculombs, and a divergence of about 0.1 rad [4, 5]. Original approaches will be presented that provide effective control of the energy spectrum of the beam at a high repetition rate, generation of quasi-unipolar pulses of terahertz radiation [6], gamma flares and photonuclear reactions [7].

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*) abstracts of this report in Russian