Optimization of hard radiation sources based on direct laser acceleration electron bunches

Umarov I R[1,2], Veysman M E[1], Popov V S[1], Rosmej O N[3] and Andreev N E[1,2,@]

[1] Joint Institute for High Temperatures of the Russian Academy of Sciences, Izhorskaya 13 Bldg 2, Moscow 125412, Russia

[2] Moscow Institute of Physics and Technology, Institutskiy Pereulok 9, Dolgoprudny, Moscow Region 141701, Russia

[3] Goethe University Frankfurt, Max-von-Laue-Strasse 1, Frankfurt am Main 60323, Germany

[@] andreev@ras.ru

Laser sources of relativistic electrons are an effective tool of generating MeV gamma rays, electron-positron pairs, betatron and terahertz radiation, and neutrons. Direct laser acceleration (DLA) is one of the most efficient ways to convert laser energy into the energy of accelerated electrons. After that, the energy of this DLA bunch can be converted into gamma, positron, and neutron radiation using a metal converter. Those intense beams of photons and neutrons in the MeV energy range can be used in many fields of research, such as diagnostics of matter in extreme states, nuclear physics and materials science, as well as in medical and biophysical applications. The concept of creating efficient gamma-ray sources based on relativistic electrons obtained by means of DLA in the interaction of a laser pulse with an extended plasma of critical density is presented. The dependence of the photon flux on the energy of accelerated electrons and the target thickness has been studied. Different converter materials were considered to maximize the secondary particle yield. Optimization was performed based on the results of end-to-end numerical particles-in-cell Monte Carlo simulations.