High-energy electron beams in the interaction of a high-intensity laser pulse with a near-critical density plasma

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This work shows the generation of high-energy electron beams during the interaction of a short laser pulse with an intensity of I = 10^{21} W/cm^2 with targets of near-critical electron density. Three-dimensional PIC ("particle-in-cell") slmulations [1] were performed for the laser pulse parameters corresponding to the PEARL laser system (Institute of Applied Physics of RAS). The energy of the laser pulse, localized in an FWHM spot with a diameter of D_{FWHM}= 4.12 μm, was equal to 7.5 J. The pulse duration was equal to 60 fs, which corresponds to the intensity $I_0 = 1.2 \times 10^{21}$ W/cm^2. The dimensionless amplitude of the laser pulse in the calculations was $a_0 = eE_y/(m_e c\omega_0)$=30. Calculations were carried out for two electron densities, $n_e = n_{\mathrm{cr}}$ and for $n_e = 2n_{\mathrm{cr}}$. The simulation showed high efficiency of direct laser acceleration of electrons from a near-critical density target for these electron concentrations. The electron energy spectrum reaches 150-200 MeV, and the charge of electrons with an energy higher than the ponderomotor energy ($\geq$ 11 MeV) is 100 nC for both target densities.
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