Well collimated high charge electron beams laser acceleration from subcritical plasma

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We present experimental and numerical studies of electron acceleration in the subcritical plasma pre-formed by the nanosecond prepulse. Experiments were conducted using 2 TW 50 fs laser pulse focused up to 10^{19} W/cm^2 intensity. The preplasma was formed by the 6-10 ns prepulse with controllable advance time with respect to the femtosecond one. Different geometries and targets were used– thick solid plates, thin 10 um films, dense gas jets. The optimal parameters were found in each case providing for production of low divergent (less than 50 mrad) electron bunches with energies upto 10 MeV and charges of 1-2 nC/J. The photoneutron diagnostics was employed to assess the number and energy spectrum of the relativistic electron beam. The photoneutron yield modelling was made using GEANT 4 package. The numerical simulation using the Mandor and Smiley PIC codes helped to reveal main features of the acceleration process: electron injection by the parametric instability or ionization injection followed by the DLA or combined DLA-LWFA process. The plasma formation was modelled by the hydrodynamic simulations. We also consider the injection and acceleration processes at higher energies (peak powers) of the femtosecond pulse.