

# Mechanism of electron bunching by a relativistically intense laser pulse when crossing a nonuniform-plasma boundary

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The one-dimensional numerical simulation of electron bunch production in the passage of an ultrarelativistically intense laser pulse through a plasma boundary with a transition layer permits elucidating the main qualitative characteristics of this physical phenomenon [1]. As shown in the work [2], owing to the phase velocity variation of the wake wave produced by the laser pulse near the onset of plasma density plateau, there is a mechanism which favours a more intense bunch generation for the plasma with a diffuse boundary than for the plasma with a sharp boundary. As a consequence, the electrons that are accumulated in the bunch group more densely along the bunch length to form bunches with a denser head part. By separating out these electrons from the total set of bunch electrons, for the diffuse-boundary plasma it is possible to obtain bunches with characteristics which are superior to those obtained from the sharp-boundary plasma. By varying the plasma density and transition layer length as well as by selecting the cutoff energy, it is possible to control the bunch parameters and select the optimal values for the bunch injected into a laser-plasma accelerator.

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[1] Kuznetsov S V 2019 *Technical Physics Letters* **45** 683–686

[2] Kuznetsov S V 2020 *Quantum Electronics* **50** 929–933