On the amplitude of a nonlinear wake wave generated by a short intense laser pulse in plasma

Gainichina Y R[2,1,@] **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

[@] gainichina.iur@phystech.edu

An equation for the potential of wake wave generated by a femtosecond laser pulse is reviewed in one-dimensional limit.

The group velocity of the pulse can be assumed equal to the speed of light $v_g \approx c$ in rarefied plasma approximation ($n_e \ll n_{\text{crit}}$, where n_e—the electron density, $n_{\text{crit}} = m\omega^2/4\pi e^2$—the critical plasma density). In this case, for the weakly relativistic laser pulse intensities, the equation has an analytical solution [1], [2] in the linear approximation. For the ultrarelativistic amplitude of the laser pulse, the nonlinearity of the equation is essential, and the numerical solution is obtained. Both solutions are analyzed and compared. The dependence of the wake wave amplitude on duration and intensity of the laser pulse is found.

The solution of the equation for the potential in the case of $v_g \neq c$ is also reviewed. The values of the plasma density, at which the rarefied plasma approximation can be used are estimated.

[1] Esarey E, Schroeder C and Leemans W 2009 *Reviews of Modern Physics* **81**(3) 1229–1280
[2] Gorbunov L M and VI K 1992 *Trudy of the P. N. Lebedev Physics Institute* **213** 3–54