Investigation of beam-loading effect in laser wakefield acceleration

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The development of an efficient method of particle acceleration is one of the priority tasks of modern physics. Laser-plasma accelerators are among the most promising candidates for solving this problem of efficient acceleration, since they allow generating accelerating fields with an amplitude several orders of magnitude higher than it is possible in traditional RF accelerators. However in this type of accelerators at the values of the charge of accelerated beams required for many practical applications, the influence on the acceleration process of the own charge of the accelerated electron beam (beam loading effect) begins to play a significant role [1, 2]. Based on the linear theory and also on the self-consistent non-linear simulation performed using quasi-static WAKE code [3], the influence of the beam loading on the acceleration of this beam is investigated. Study was performed on how various parameters of this beam, such as its size and charge, affect the accelerating field due to the beam loading effect. The optimization method of initial electron beam parameters, based on the idea of the accelerating field flattening over the length of this beam, is proposed for efficient acceleration in Laser-WakeField accelerator, taking into account the beam loading effect.

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