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Controlled electron injection using nanoparticles in laser wakefield acceleration MYUNG HOON CHO, VISHWA BANDHU PATHAK, Center for Relativistic Laser Science, Institute for Basic Science, HYUNG TAEK KIM, Advanced Photonics Research Institute, GIST, KAZUHISA NAKAJIMA, CHANG HEE NAM, Center for Relativistic Laser Science, Institute for Basic Science, CENTER FOR RELATIVISTIC LASER SCIENCE TEAM — Laser wakefield acceleration is one of compact electron acceleration schemes due to its high accelerating gradient. Despite of the great progress of several GeV electron beams with high power lasers, the electron injection to the wakefield is still a critical issue for a very low density plasma 10^{17} electrons/cc. In this talk a novel method to control the injection using nanoparticles is proposed. We investigate the electron injection by analyzing the interaction of electrons with the two potentials - one created by a nanoparticle and the other by the wakefield. The nanoparticle creates a localized electric potential and this nanoparticle potential just slips the present wake potential. To confirm the Hamiltonian description of the interaction, a test particle calculation is performed by controlling the bubble and the nanoparticle potentials. A multi-dimensional particle-in-cell simulations are also presented as a proof-of-principle. Comparing theoretical estimates and PIC simulation, we suggest nanoparticle parameters of size and electron density depending on the background plasma density. Our scheme can be applicable for low plasma density to break though the limitation of self-injection toward extremely high energy electron energy.

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