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Electron self-injection and acceleration into an evolving plasma "bubble" G. SHVETS, S.A. YI, V. KHUDIK, The University of Texas at Austin — We propose a new approach to injecting plasma electrons into a full blow-out (or bubble) region of laser wakefield accelerator in order to generate monochromatic high-energy electron beams. It is shown analytically and by two types of PIC simulations (VLPL and WAKE) that self-injection of the background plasma electrons into the quasi-static plasma bubble can be caused by slow temporal expansion of the bubble. The sufficient condition for the plasma electron trapping is that its Hamiltonian in the co-moving with the bubble frame must decrease by at least mc^2. We will demonstrate that the necessary condition for electron injection is more relaxed, and dependent on the plasma density and details of the bubble potential. We will also demonstrate that there is a minimum bubble expansion rate necessary for trapping and discuss its dependence on the details of the accelerating field near the tail of the bubble. We also demonstrate that a bubble whose expansion stops after injection generates a monoenergetic electron bunch, as electrons that are injected late in the expansion equilibrate in energy with those that are injected early. [1] S. Y. Kalmykov, S. A. Yi, V. Khudik, and G. Shvets, Phys. Rev. Lett. 103, 135004 (2009). [2] S. A. Yi, V. Khudik, S. Y. Kalmykov, and G. Shvets, Plasma Phys. Control. Fusion (in press, 2010). This work is supported by the US DOE grants DE-FG02-04ER41321 and DE-FG02-07ER54945.

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