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Constant-gradient resonant laser acceleration of electrons in the plasma bubble regime GENNADY SHVETS, XI ZHANG, VLADIMIR KHUDIK, Department of Physics and Institute for Fusion Studies, The University of Texas at Austin — We present a new mechanism of steady electron acceleration resulting from the interplay of direct laser acceleration (DLA) and the deceleration by the longitudinal wakefield which takes place in the plasma bubble regime. The unusual aspect of such arrangement that sets it apart from the earlier considered case of synergistic laser wakefield/DLA [1] is that the plasma wake removes the energy from the electrons while at the same time increasing the amplitude of their betatron oscillations. Using PIC simulations, we demonstrate that such regime can be realized through external injection of electrons into the decelerating phase of the plasma bubble. It is also found that electrons can be accelerated via resonant interaction of the laser with high harmonics of the betatron motion. We show that the two key parameters determining the maximum energy gain are the ratio of the laser field to the longitudinal field, and the difference of the phase velocity of the laser wave from the speed of light. A similarity with the pendulum motion is revealed and used to explain how the acceleration is terminated. This work was supported by DOE grants DESC0007889 and DE-SC0010622, and by an AFOSR grant FA9550-14-1-0045.

[1] X. Zhang et al., Phys. Rev. Lett.,114,184801 (2015).

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