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Overcomingthe Dephasing Limit in the Bubble Regime by Synergybetween Direct Laser Acceleration and Laser Wakefield Acceleration[1]

XI ZHANG, VLADIMIR KHUDIK, GENNADY SHVETS, Department of Physics and Institute for Fusion Studies, The University of Texas at Austin — Direct Laser Acceleration (DLA) in the bubble regime is an acceleration mechanism [1] that combines the traditional plasma wakefield acceleration inside the plasma bubble with energy gain directly from the laser pulse. Recent experiments [2] demonstrated one of the signatures of the DLA: highly efficient gamma-rays from resonantly excited betatron oscillations of accelerated electrons inside the plasma bubble. Here we propose another potential benefit of DLA: the reduction of dephasing between the accelerated electrons and accelerating field of the bubble. A simple semi-analytic model is developed to investigate the synergy between DLA and LWA acceleration mechanisms. We propose to enhance the DLA by adding a second time-delayed weak laser pulse capable of interacting with bubble electrons right after self-injection [3]. This scenario is validated by direct PIC modeling using the 2D VLPL code. The prospects for achieving high-energy electrons at the Texas Petawatt laser are discussed.

[1] A. Pukhov et al., Phys. Plasmas. 6, 2847 (1999).
[2] S. Cipiccia et al., Nature Phys. 7, 867-871 (2011).
[3] S. Kalmykov, S. A. Yi, V. Khudik, and G. Shvets, Phys. Rev. Lett. **,**135004 (2009).

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