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**Effect of carrier envelope phase on betatron oscillations and direct laser acceleration of electrons in ion channels and plasma bubbles** JIHOON KIM, TIANHONG WANG, School of Applied and Engineering Physics, Cornell University, VLADIMIR KHUDIK, Department of Physics and Institute for Fusion Studies, The University of Texas at Austin, GENNADY SHVETS, School of Applied and Engineering Physics, Cornell University — When the laser pulse length is of the order several wavelengths [1] or has a very sharp front due to etching [2], the ponderomotive approximation breaks down. Such laser waves propagating inside a plasma cause controllable asymmetric plasma electron expulsion from laser according to the carrier envelope phase (CEP) and form a periodically oscillating plasma bubble. This can result in periodic transverse kicking of the electrons in the plasma bubble, which may significantly affect their dynamics, energy gain, and the excitation of betatron oscillations. We find that under certain conditions, the transverse CEP force can constructively interfere with direct laser acceleration (DLA) and enhance the betatron oscillations. Using first-principles 3D Particle-In-Cell (PIC) simulations and analytic calculations, we estimate the effect of CEP-induced oscillations on the energy gain of electrons via DLA in ion channels and plasma bubbles. [1] E.N.Nerush and I.Yu.Kostyukov Phys.Rev.Lett. 103,035001(2009) [2] Ma, Yong, et al. Scientific Reports. 5,30491(2016)

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