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Energy Gain of a Free Electron in a Pulsed Electromagnetic Plane Wave with Constant External Magnetic Fields JUSTIN ANGUS, SERGEI KRASHENINNIKOV, UCSD — We consider free electron interactions with a pulsed plane electromagnetic (EM) wave in the presence of static homogeneous magnetic fields. The main goal of this study is to find the energy gained by the electron after the wave has passed. We use the constants of motion, expressed in terms of the EM vector potential, which can be obtained from the relativistic equation of motion for a charged particle. For a constant magnetic field along the axis of the wave an exact solution is obtained for the energy gain for arbitrarily polarized EM plane wave with a Gaussian amplitude profile. It shows that significant energy gain is possible when the rest mass cyclotron frequency is resonant with the frequency of the wave, but that it decays exponentially when we deter from this resonance. For magnetic fields transverse to the axis of the wave it is shown that the governing equations can be reduced to a two-dimensional Hamiltonian system that when time-averaged in the in the limit where the cyclotron frequency is much less than that of the wave remain in Hamiltonian form. Solutions are sought in this limit for these time-averaged equations using both a Gaussian and step function profile for the wave. For both cases it is found that the maximum energy gain is independent of the size of the transverse magnetic fields and scales with the wave amplitude squared. This work was supported the US DoE under Grant DE-FG02-04ER54739.

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