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Stochastic acceleration of electrons in colliding laser beams. YANZENG ZHANG, SERGEI KRASHENINNIKOV, University of California, San Diego — The electron dynamics in counter-propagating laser beams has attracted a great deal of interest and the stochastic acceleration was thought the reason for high energized electron tails observed in laser-plasma interaction. However, due to the multidimensional spatiotemporal characteristics of the laser waves and strong non-linearity of relativistic electron in these waves, the analytic investigation of stochastic electron acceleration in the colliding laser waves is rather limited or complicated. The numerical simulations could also provide criterion for stochasticity but the lack of theoretic analysis limits its universal applicability. In this work, we investigate the mechanism of stochastic electron acceleration in colliding laser waves by employing proper canonical variables and effective time, such that the new Hamiltonian becomes time independent when the perturbative (weaker) laser wave is absent. The analysis clearly reveals the physical picture of stochastic electron dynamics. It shows that when the amplitude of the perturbative laser field exceeds some critical value, stochastic electron acceleration occurs within some electron energy range. It demonstrates that the essential role of the perturbation is to change the dephasing rate (new Hamiltonian) between the electron and dominant laser such that the maximum electron kinetic energy, which could be gained under stochastic acceleration, can significantly exceed the ponderomotive scaling for the dominant laser. The numerical simulations integrating the Hamiltonian equations are in a very good agreement with the findings from our analytic theory.

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