Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Stochastic electron acceleration in laser-plasma interactions[1]

YANZENG ZHANG, SERGEI KRASHENINNIKOV, ALEXEY KNYAZEV, University of California, San Diego — Direct laser acceleration (DLA) is identified as one of the most important ways to accelerating electron, in the laser-plasma interactions, to high energies beyond the ponderomotive scaling. Many experimental, numerical, and theoretical works reveal that the presence of self-generated or externally applied quasi-static electric and magnetic (QEM) fields or a counter-propagating laser wave could facilitate electron acceleration. However, the analytic investigations of the mechanism of electron acceleration in the earlier studies of DLA are quite limited and complicated. In this work, we examine the electron acceleration in the laser waves and QEM fields by employing a new Hamiltonian approach by using proper canonical variables and system symmetry. The new Hamiltonian approach significantly simplifies the analysis of the electron dynamics and enables us to exhaustively explore the physics of electron acceleration, where we pay attention to the electron acceleration via the onset of stochastic motion. By deriving the Chirikov-like mappings, we obtain the stochastic conditions and thus the upper limits of the electron energy depending on system parameters.

[1]University of California Office of the President Lab Fee grant number LFR-17-449059.

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Date submitted: 03 Jun 2020 Electronic form version 1.4