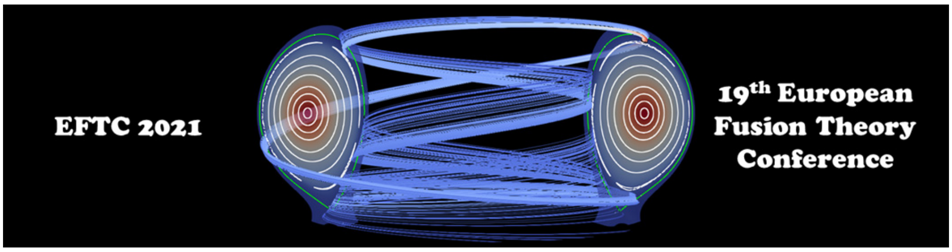

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Particle momentum and energy transport under interaction with Localized Wavepackets

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Wave-particle interactions are ubiquitous in space and laboratory plasma systems and have been the subject of intense research interest for many decades. From a theoretical point of view, the nonlinear motion of a charged particle with an electrostatic wave has been one of the basic paradigms of complex and chaotic Hamiltonian dynamics. However, although single particle dynamics have been extensively studied, the collective dynamics of an ensemble of particles with a distribution of initial momenta, has not been systematically investigated. Analytical results are well-known for two limiting cases: Landau damping for particle interactions with low amplitude wavepackets under the quasilinear theory and particle interactions with a monochromatic wave having finite amplitude. In this work we systematically investigate the collective particle dynamics, in terms of momentum and energy transport, under interaction with finite amplitude electrostatic Localized Wavepackets of various spatial widths. Both resonant and ponderomotive effects are shown along with their crucial dependence on the parameters of the wavepackets and the initial momentum distribution functions. The collective particle dynamics are described in terms of the time evolution of the momentum distribution function as well as its first moments. Our numerical findings are systematically compared to analytical results for the aforementioned limiting cases and extend to more general configurations. Moreover, we consider an analytical kinetic description of reduced kinetic models [5] and discuss its paramount importance for higher-dimensional systems such as those describing particle motion in toroidal plasmas where numerical particle tracing is computationally expensive.

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