

# Hybrid multi-wave model for relativistic wave–plasma interaction

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## Abstract

A hybrid fluid-particle model is presented for relativistic beam-plasma interaction. The derivation uses a Lagrangian of the system of multiple waves and particles, and a slowly varying amplitude approximation to obtain a finite-dimensional system of ordinary differential equations for the wave amplitudes and the particle coordinates and momenta. The system is three-dimensional and relativistic. The model allows for studying of electron acceleration in a plasma channel. It is shown that the linear growth rate of the plasma wave can be enhanced when electromagnetic waves are present. Conditions for more efficient energy exchange between electrons and waves, and between plasma and electromagnetic waves are determined.