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Numerical challenges in laser driven electron-positron plasma

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The next generation of laser facilities will make possible to study electron-positron laser plasma arising due to electromagnetic cascades.
The cascade consists of quantum electrodynamic effects of hard photon emission and electron-positron pair creation.
A central problem in description of plasma with quantum electrodynamic effects is the need for a proper model for radiation, which would simultaneously account for both classical radiation responsible for collective emission and quantum recoil due to non-coherent hard photons.
The mathematical description of the cascades boils down to a system of transport equations for particles distribution function and the Maxwell equations for electromagnetic fields.
Numerical simulation of these equation in ultra-high intensity regime involves difficulties arising from broad spectrum of time and space scales simultaneously present in the problem.
The major part of applied computations concerning the kinetic equation is based on the probabilistic Monte Carlo methods. However, the stochastic method heavily relies on the use of random sampling of transport integrals and may lead to noisy and possibly unstable solution of the transport equation.
Alternative highly accurate deterministic methods for the kinetic equations are computationally demanding.
In this context the adaptive grid refinement is advantageous because of electromagnetic cascades are localized at laser focus.
In this talk, I will review recent advances in the computational algorithms for QED plasma and discuss open problems.

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