Adaptive Numerical Vlasov Simulation of Intense Beams

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Numerical simulation of intense beams studied for heavy ion fusion are often based on the Vlasov-Poisson equations and involve strongly nonlinear phenomena. In such regimes a direct simulation of the Vlasov equation can be more efficient than a PIC method especially when a precise description of the tail of the distribution function is needed.

One of the drawbacks of Vlasov solvers in the context of beam simulation is that they are in general based on a uniform mesh of phase space that needs to cover the whole phase-space that will be reached by the particles during the entire simulation. In configurations like periodic focusing or alternating gradient focusing the beam envelope can move considerably so that one needs to grid enormous regions of phase space that are inoccupied at any given moment. In order to overcome this kind of inefficiencies inherent to Vlasov solvers we investigate different kind of methods based on a grid of phase space which moves during time. The first kind of method is based on the use of a uniform logical grid that is mapped to the envelope of the beam at each time step. The second kind of method uses a fully adaptive grid which is automatically determined at each time step according to the local variations of the distribution function.

In this talk, we shall describe both these approaches and their application to beam simulation.