

## Advanced Software Packages For Beam Dynamics Simulation

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We are developing highly scalable and systematic software packages for beam dynamic simulations. Both traditional Particle-In-Cell (PIC) method and advanced direct Vlasov methods have been adopted. For the PIC method, particles are distributed evenly on different processors and space charge effect has been counted by solving Poisson equation on a finite mesh. Several Poisson solvers have been developed using Fourier, hp-Finite Element (hp-FEM) and Wavelet methods. These solvers can be used in Cartesian and Cylinder coordinate systems, hp-FEM based solvers can be used on both structured and unstructured meshes. Domain decomposition (DD) has been used to parallelize these solvers and all these solvers have been implemented into the PTRACK code. PTRACK is now widely used for large scale beam dynamics simulations in linear accelerators. For the direct Vlasov method, Semi-Lagrangian and discontinuous Galerkin methods scheme have been employed to solve Vlasov equation directly in 1P1V and 2P2V phase spaces. They all use the time splitting scheme proposed by Cheng and Norr. Simulation results will be presented and challenges will be discussed.