

Dynamics of Confined Particles.

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In this talk we discuss the development of two novel grid free numerical methods and their application to the modeling of confined particles. The first method we will discuss is the Boundary Integral Treecode ideally suited for N body problems such as electrostatic and gravitational problems. Our method is based on an adaptive fast summation algorithm, and we have applied it to the simulation of Penning traps, among others. We are currently extending this method to a novel Asymptotic Preserving implicit Maxwell solver in 3D, whose long time limit recovers the Darwin limit of electromagnetics. The second numerical method we will discuss is a grid free Monte Carlo method, based on an adaptation of the hierarchical tree structure used in our 3D treecode field solver. The method has been applied to a range of gas dynamics problems, as well as to model the cooling processes in a BEC. We will present a host of results for both the Penning trap as well as the BEC.