

AA 545 – Kinetic Modeling: Vlasov-Poisson PIC

Due 11 Apr 2013

Part 1 – Preliminary Code

Write a code that evolves free streaming particles in phase space, (x, v_x) . Assume there are no forces and no collisions. Track the position and velocity of each particle. The code should work with an arbitrary number of particles. Implement periodic boundary conditions in the x direction. Visualize the particles motion by plotting the their positions in phase space as a function of time. Also plot particles' trajectory by not erasing their positions from previous time. Implement a diagnostic that computes the time history of the sum of the particles' kinetic energy.

1. Initialize a random particle distribution that is Maxwellian in v_x and is uniform in x using $N = 128, 512, 2048, \& 8192$. The FWHM in velocity should be 2. Use a domain that is $v_x = [-5, 5]$ and $x = [-2\pi, 2\pi]$.
2. Evolve the particle motion until $t = 8\pi$.
3. Produce plots of the particle positions for the $N = 512$ case at $t = 0, 2\pi, \& 8\pi$. Show the plot of the particle trajectory for the $N = 128$ case up to $t = 2\pi$.
4. Compare plots of the kinetic energy history for all four cases for different time step values.