

Introduction

This suite of codes in the directory mpbeps2 contains three separate main codes which share many functions. The electrostatic code mpbeps2 is the most simple, keeping only the Coulomb interaction between particles, with two position and two velocity components for the particles. The electromagnetic code mbbeps2 keeps the electric and magnetic fields described by the full set of Maxwell's equations, with two position and three velocity components for the particles. The Darwin code mdbeps2 keeps the electric and magnetic fields generated by particles (omitting light waves) described by the Darwin subset of Maxwell's equation where the transverse displacement current is omitted, with two position and three velocity components for the particles. The Darwin code can also be run as an electrostatic code by setting the speed of light to infinity. All codes can be run with relativistic equations of motion. The particle calculations are performed in parallel using OpenMP and MPI. If MPI is not available, the codes can be compiled with OpenMP only. Default input parameters to the code are described in the file input2mod.f90, and new values can be read in from a namelist file at run time. All codes currently use periodic boundary conditions.

Initializations

The plasma density can be initialized with 6 different density profiles, including uniform, linear, sinusoidal, and gaussian profiles among others. The initial velocity distributions are Maxwellian for non-relativistic particles or Maxwell-Juttner momentum distributions for relativistic particles. Both electrons and one species of ions are supported, and two populations of each species are possible (a background and a beam population).

External Forces

A fixed constant external magnetic field can be used with the Electromagnetic and Darwin codes. (The Darwin code can be run as an electrostatic code by setting the inverse speed of light c_i to zero in the namelist input.)

Diagnostics

For the electrostatic code, 5 field diagnostics are possible: energy, electron and ion densities, potential, and longitudinal electric field. The electromagnetic and Darwin

codes support the above diagnostics as well as 4 additional field diagnostics: ion current, vector potential, transverse electric fields, and magnetic field. In addition, the electromagnetic code supports a radiative vector potential diagnostic specifically to look for light waves.

Other Features

All the codes are time reversible., where a code can run forward for some time, then run back to the beginning. For the electrostatic and electromagnetic codes, round-off errors limit the accuracy of the time reversibility. The Darwin code uses an iterative scheme for solving the field equations, and this can also limit the time-reversibility.

Future Plans

External forces, particle diagnostics, restart and reset capabilities, high level libraries.