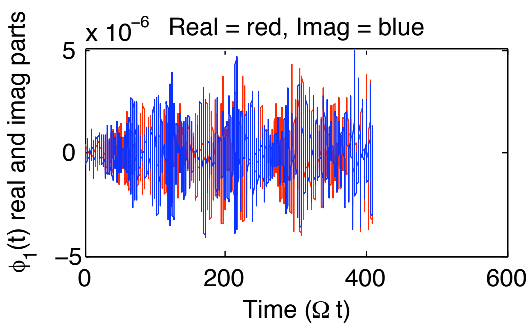
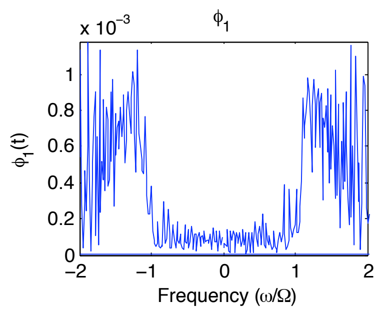
Homework 4

APAM 4990 (2010)

As shown in the document on the web (http://w3.pppl.gov/˜wwlee/1D_code.pdf) and below, the test results from the code, GK1D_CU.m, give the correct frequencies and the fluctuation amplitude for the plasma waves as predicted by theory. However, there is no evidence for Landau damping. These results were obtained by using option (1) for both predictor and corrector steps in the code.



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delta-f plasma waves

tau=1;
vte=1;
vti=sqrt(1/1837);
theta=1.;
kappan=0.0;
N=1,000;
nsteps=4096;
dt=0.1;
filter=1;

Theory: \phi =  10{-4} /sqrt{1000}
= 3x10^{-6}

Theory: freq= sqrt(1 + 3*0.75^2) =
1.64
```

Scheme A: One possible way to see the damping is to activate the full-F scheme by turning on both option (1) and option (2) simultaneously in the code in the beginning of the time loop for, say, 100 or more time steps, before turning it back to the δf scheme, i.e., option (1). The purpose is to perturb the system with a high level of noise first, before turning on the low noise δf scheme.

Scheme B: The code was written for going from δf to Full-F by turning on options (1) + (2) + (3) in the code at the same time. Therefore, for going from Full-F to δf, one has to further modify the code to reverse that order.

The assignment is to use Scheme A. Scheme B may be too advanced for the present purpose.

Although you don't need them for this home work problem, detail descriptions for these schemes can be found in our recent Computational Physics Communications paper, "A Generalized Weight-Based Particle-In-Cell Simulation Scheme, (to appear)" which can be downloaded from http://www.pppl.gov/pub_report/2010/PPPL-4488.pdf, as pointed out on my website.