Electron behavior in Electrostatics

1. input1.plasma

Description:

Analysis of plasma waves, measuring frequency and wavelength in thermal equilibrium

Ordering: 10s

Vary vthe, number of particles/cell.

Reference:

Krall and Trivelpiece, F. F. Chen

Significance:

Waves are a fundamental collective process in plasmas.

2. input1.traj1

Description

Analysis of trajectories of particles in thermal equilibirum.

Ordering 10s.

Varying number of particles/cell. Measure ratio of potential/kinetic energies. Vary the random numbers used in velocity initialization

Reference:

Significance:

Trajectories have a random element, which depends on the number of particles/cell.

Plasma exhibit discreteness effects as well as collective behavior.

3. input1.landau

Description:

Study of damping of single wave in plasma. Excite a single mode by an external driver, shut it off and observe the damping

Ordering 10s.

Vary phase velocity of external wave driver

Reference: Everybody

Significance: collisionless damping is a fundamental plasma process.

4. input1.doppler

Description:

Analysis of plasma waves in a drifting plasma.

Ordering:10s

Vary drift velocity, both positive and negative. Examine potential, kinetic energies.

Reference:

Krall and Trivelpiece

Significance:

Frequencies depend on the frame of the observer.

Notes: phase space plots.

5. input1.2stream

Description:

Wave instability of two plasma streaming through one another.

Ordering: 10s

Vary relative streaming velocities, Examine the growth rates and saturation, compare growth to linear theory.

Reference: Krall and Trivelpiece, F. F. Chen

Significance

Fundamental plasma instability

Notes: time reverse?

6. input1.bont

Description:

Wave instability of small beam in background plasma.

Ordering: 10s

Vary beam velocity, temperature, and number of particles. Compare growth with linear theory. Time Reversal

Reference: Krall and Trivelpiece, F. F. Chen

Significance:

Fundamental plasma instability often seen in laboratories and space. Illustration of ? Theorem; distribution with positive slope are unstable. Nonlinear saturation.

7. input1.testp

Illustrates subtraction technique. Observe excitation of plasma wave by single electron, by subtracting 2 simulations which differ by a single particle.

Ordering:

10s

Vary test charge velocity, vary number of particles/cell

Reference:

Kral land Trivelpiece

Significance:

Illustrates generation of wakes. Origin of fluctuation-diisipation.

8 input1.ebeam

Analysis of weak beam instability.

Ordering: 10s

Vary number of particles and observe growth rate.

Reference: Krall and Trivelpiece

Significance: particle discreteness can impact instabilities

9. input1.drag

Study of redistribution particles within a stable velocity distribution in thermal equilibrium. Track particles with same initial velocity as a function of time.

Ordering: 20s

Measure the mean velocity and velocity spread as a function of time.

Vary velocity group and number of particles

Reference: Ichimaru

Significance: Basic study of drag and diffusion effects n plasmas

10. input1.waterbag

Study relaxation of a non-maxellian, stable distribution and observe entropy change.

Ordering 20s

Vary particle number

Reference: Krall and Trivelpiece

Significance: Role of Thermal fluctuations in reaching equilibrium

11. input1.extwaterbag

Study of damping of single wave in non-maxwellian plasma. Excite a single mode by an external driver, shut it off and observe the damping

Similar to previous example of landau damping with maxwellian plasma.

Ordering 20s

Vary phase velocity of external wave driver

References:

Significance: shows relation between damping of plasma wave and gradients in the distribution function

12. input1.extwave

Study of non-linear wave phenomena such wave breaking and particle trapping. Excite a large amplitude single mode by an external driver

Ordering 20s

Vary wave amplitude

References:

Significance:

Non-linear waves and structures are an important aspect of plasma behavior.

Ion Behavior in Electrostatics

13. input1.ions

Study of Ion acoustic waves

Ordering 30s

Vary mass ratio and electron/ion temperature ratio

References: Krall and Trivelpiece, F. F. Chen

Significance:

Most fundamental ion wave in plasmas

14. input1.ion\_acoustic\_instability

Study of ion acoustic wave instability arising from relative electron ion drift

Ordering 30s

Vary electron drift velocity and mass ratio and particle number

References: Krall and Trivelpiece

Significance:

Instabilties due to relative streaming are ubiquitous in space and laboratory plasma.

15. input1.parametric

Study of parametric processes, non-linear coupling of strongly driven langmuir waves with ion acoustic waves

Ordering 30s

Vary amplitude of driven wave and mass ratio.

References: F. F. Chen

Significance: fundamental non-linear process in plasma.

15. input1.bont\_ions

Study of parametric processes arising from beam plasma instabilities with mobile ions

Ordering 30s

Vary beam density and beam velociity

Reference:

Significance: non-linear process without external driver

Electron behavior in Electromagnetics

16.input1.light

Study of light waves in unmagnetized plasma in thermal equilibrium

Ordering 100s

Vary particle number

Reference: F. F. Chen

Significance:

Most fundamental normal mode in unmagnetized electromagnetic plasmas

17. input1.weibel

Study of electromagnetic instability in unmagnetized plasma, Weibel instability driven by electron temperature anisotropy.

Ordering 100s

Vary the anisotropy.

Reference: Krall and Trivelpiece

Significance:

Widely seen in space and astrophysics

18. input1.LR

Analysis of electromagnetic waves in magnetized plasma with k parallel to B (Left and Right Circularly polarized and whistler modes). Compare dispersion relation with analytic theory.

Ordering 100s

Vary ratio of electron cyclotron frequency to plasma frequency

Reference: F. F. Chen, Krall and Trivelpiece

Significance:

Fundamental high frequency normal mode in magnetized electromagnetic plasmas

19. input1.X

Analysis of electromagnetic waves in magnetized plasma with k perpendicular to B. (Ordinary and Extraordinary, and electron Bernstein modes). Compare dispersion relation with analytic theory.

Ordering 100s

Vary ratio of electron cyclotron frequency to plasma frequency

Reference: F. F. Chen, Krall and Trivelpiece

Significance:

Fundamental high frequency normal mode in magnetized electromagnetic plasmas

Electron Behavior in Darwin (Radiationless electromagnetics)

20. input1.dweibel

Study of instability driven by plasma currents in unmagnetized plasma, Weibel instability driven by electron temperature anisotropy.

Ordering 200s

Vary the anisotropy.

Reference: Krall and Trivelpiece

Significance:

Widely seen in space and astrophysics

21. input1.whistler

Analysis of electromagnetic waves driven by plasma currents in magnetized plasma with k parallel to B (whistler modes). Compare dispersion relation with analytic theory.

Ordering 100s

Vary ratio of electron cyclotron frequency to plasma frequency

Reference: F. F. Chen, Krall and Trivelpiece

Significance:

Fundamental low frequency electron mode in magnetized plasmas with k parallel to B

22. input1.dawin

Analysis of waves driven by plasma currents in magnetized plasma with k perpendicular to B (electron bernstein modes). Compare dispersion relation with analytic theory.

Ordering 200s

Vary ratio of electron cyclotron frequency to plasma frequency

Reference: F. F. Chen, Krall and Trivelpiece

Significance:

Fundamental low frequency electron mode in magnetized plasmas with k perpendicular to B.

Ion Behavior in Darwin (Radiationless electromagnetics)

23. input1.ib

Analysis of low frequency ion waves in magnetized plasma with k perpendicular to B. (ion bernstein)

Ordering 210s

Vary mass ratio

Reference: Krall and Trivelpiece

Significance:

Fundamental low frequency ion mode in magnetized plasmas with k perpendicular to B.

24. input1.alfven

Analysis of low frequency ion waves driven by plasma currents in magnetized plasma with k parallel to B (alfven modes). Compare dispersion relation with analytic theory.

Ordering 210s

Vary mass ratio

Reference: F. F. Chen, Krall and Trivelpiece

Significance:

Fundamental low frequency ion mode in magnetized plasmas with k parallel to B