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