Homework #1
Handed Out October 5, 2010
Due October 14, 2010

1) Read Chapters 1 and 6.
2) For the following cases compute Debye length, number of particles in a Debye sphere, the sound speed, the Alfven speed, β, and g.
    a) The solar wind – Assume the average energy is 10 eV and the density is $5x10^6$ m^{-3}. Also assume ions = H^+, B = 5 nT. If the plasma is moving at 400 km/s, what are the Mach numbers for the sound speed and the Alfven speed?
    b) The Earth's ionosphere at 100 km altitude – Assume an average energy of 1 eV, a density of 10^{12} m^{-3} and Ions = O_2^+, B = 0.1 G.
    c) The plasma sheet – Assume an average energy of 1 keV, a density of 10^6 m^{-3} and Ions = O^+, B = 10 nT.
    d) The corona of the Sun – Assume an average energy of 100 eV, a density of 10^{14} m^{-3} and Ions = H^+, B = 10 G.
3) A Maxwellian velocity distribution function is given by:

$$f(\mathbf{v}) = n\left(\frac{m}{2\pi kT}\right)^{3/2}\exp\left(-\frac{m\mathbf{v}\cdot\mathbf{v}}{2kT}\right)$$

Compute the average velocity and kinetic energy for particles described by this distribution function.

For 515 Students:

4) Write down the expression of a Maxwellian distribution function that is flowing with the velocity **u**. Sketch the distribution function indicating on the plot the following values (as a function of m, k, and T): the peak value, the temperature and v_{rms}, and the full width half maximum.

Hint: You might need $\int e^{x^2}\,dx = \sqrt{\pi}$