Plasma Astrophysics (ASTR6880)
Exercise 1

Return the solutions until lecture on Wednesday, October 9, 2013

1. Calculate the electron plasma frequency ω_p, Debye length λ_D, plasma parameter Λ, and mean free path λ_{mfp} for following plasmas (notes the units)

   (a) Fusion experiment: $T_e \approx 10$ keV, $n_e \approx 10^{19}$ m^{-3}, $B \approx 1$ T

   (b) High-latitude ionosphere at 150 km altitude: $T_e \approx 0.1$ eV, $n_e \approx 10^5$ cm^{-3}, $B \approx 50000$ nT

   (c) Solar wind at 1 AU: $T_e \approx 10$ eV, $n_e \approx 10$ cm^{-3}, $B \approx 5$ nT

   (d) Core of Sun: $T_e \approx 1$ keV, $n_e \approx 10^{26}$ cm^{-3}, no B-field

   (e) Neutron star environment: $T_e \approx 100$ keV, $n_e \approx 10^{12}$ cm^{-3}, $B \approx 10^8$ T

2. Calculate the gyro frequency ω_c and Larmor radius r_L for the following particles (notes the units)

   (a) A 10 keV electron moving with pitch angle of 45° with respect to Earth's magnetic field of 30000 nT

   (b) Solar wind proton moving at 400 km/s perpendicular to the interplanetary magnetic field 5 nT

   (c) A 1 keV He^+ ion in solar atmosphere near a sun spot where $B = 5 \times 10^{-2}$ T ($v_\parallel = 0$)

Please write the solutions in English.