15. Lorentz equation of motion

A particle with the mass m and the electric charge e is moving in homogeneous magnetic and electric fields: $\mathbf{B} = B\mathbf{e}_z$ and $\mathbf{E} = E\mathbf{e}_y$. Determine a solution of the equations of motion for the initial conditions $\mathbf{r}\,(t=0) = 0$ and $\mathbf{v}\,(t=0) = v_0\mathbf{e}_x$.

16. Particle dynamics

Consider an electron and an oxygen ion in the Earth's ionosphere at a magnetic pole and 300 km altitude.

a) Determine the electric field which is necessary to balance the gravitational force on the particles.

b) Assuming that the parallel velocity of the particles is 0, determine the perpendicular velocity for the two particles which is necessary to balance the gravitational force by the mirror force.

c) How large is the acceleration due to the mirror force for 1 keV particles?

17. Particle dynamics

Consider an isotropic Maxwellian plasma (electrons and protons) of density $n = 100\,\mathrm{cm}^{-3}$ and temperature $T = 10^7$K.

a) Determine the average curvature and gradient drift velocity for the Earth's dipole field in the magnetic equator as a function of radial distance.

b) Determine the resulting current densities at a radial distance of 5 R_E. Do you expect a considerable modification of the dipole field by the curvature and gradient drift currents? (Assume a locally one-dimensional layer of this current and compute the the magnetic perturbation.)

Please turn in the solutions to the homework on Friday, 3/07/08