

7. Particle dynamics

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

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

Comment your results in a) and b).

8. Magnetic gradient drift:

Compute the gradient \mathbf{B} drift velocity in the Earth's dipole field at $6 R_E$ radial distance for ions with energies of 1, 10 100, and 1000 keV. Assume that the particle energy is entirely in the perpendicular velocity.

Help:

The Earth's dipole field is given in spherical coordinates by

$$B_r = -2B_E R_E^3 \frac{\sin \lambda}{r^3} \quad (1)$$

$$B_\lambda = B_E R_E^3 \frac{\cos \lambda}{r^3} \quad (2)$$

with $B_E = 3.11 \cdot 10^{-5}$ T as illustrated below.

