

Problem sheet 2

Plasma Physics course
TU Dresden
Lecturer: Katerina Falk
Summer semester April – July 2021

Question 1:

Compute r_L when $v_{\parallel}$ is negligible for the following cases:

- a) A 10-keV electron in Earth's magnetic field $5 \times 10^{-5} \text{ T}$.
- b) A solar wind proton with streaming velocity 300 km/sec , $B = 5 \times 10^{-9} \text{ T}$.
- c) A 1-keV He^+ ion in the solar atmosphere near a sunspot, where $B = 5 \times 10^{-2} \text{ T}$.
- d) A 3.5-MeV He^+ ash particle in a 8-Tesla tokamak during DT fusion experiment.

Question 2:

Suppose the Earth's magnetic field is 3×10^{-5} at the equator and falls off as $1/r^2$, as for a perfect dipole. Let there be an isotropic population of 1-eV protons and 30-keV electrons, each with density $n = 10^7 \text{ m}^{-3}$ at $r = 5$ Earth radii in the equatorial plane.

- a) Compute the ion and electron ∇B drift velocities.
- b) Does an electron drift Eastward or Westward?
- c) How long does it take for an electron to encircle the Earth?
- d) Compute the ring current density in A/m^2 .

Note: The curvature drift is not negligible and will affect the numerical answer, but ignore it anyway.