

Exercise 4, Plasma Physics, Hand in October 15, 2009

4

The magnetic field strength at a distance r of a current I carrying wire equals $B = \mu_0 I / (2\pi r)$. Assume that the wire is straight and infinite. The wire is surrounded by a current-free plasma.

a. Give the gyro-frequency of electrons at a distance of 1 m of the wire, which carries a current of $I = 100$ A.

In the following, consider the possible motion of the particles along the magnetic field, their gyration, and drift motion. Make sure, using words, graphics, and/or suitable coordinates, that you indicate directions unambiguously.

b. Qualitatively describe the orbit of an electron which only has a velocity component perpendicular to the magnetic field.

c. Describe the orbit of an electron with velocity predominantly parallel to the magnetic field direction. Can the mirror effect play a role?

d. Repeat questions (b) and (c) if, in addition, the wire is electrically charged to a potential ϕ . Assume that the electric force is small compared to the Lorentz force.