Grade 12 physics V2

SPH4U

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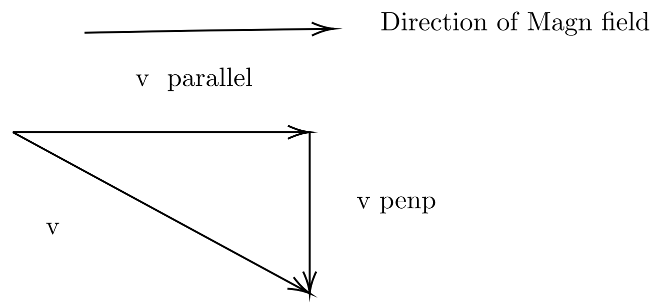
Chapter 1

Electricity and Magnetism

1.1 The motion of Charged Particles in Magnetic Fields

When a charged particle go through a magnetic field, we can seperate the motion in to two components.



What will the motion of the particle look like

- If the magnetic field is large and uniform, $\vec{v_{\parallel}}$ will remain constant
- Because the magnetic force is always perpendicular to $\vec{v_{\perp}}$, it will not affect the magnitude of $\vec{v_{\perp}}$, it will only cause the direction to change.
- If the magnetic field doesn't change, the F_M will be constant
- Thus, we get a corkscrew motion.

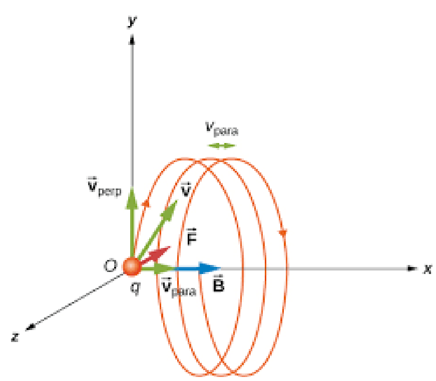


Figure 1.1: Motion of che charged particle

Aurora Borealis

The sun emits charged particles (ions), we call this the solar wind. When the solar wind reaches the Earth, the charged particles can become trapped in the Earth's mag field.

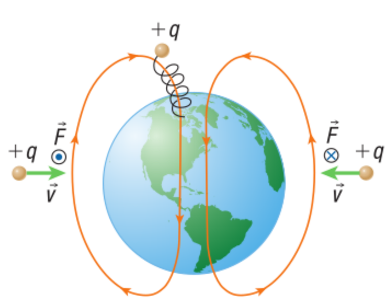


Figure 1.2: Aurora Borealis

The ions flow the mag field towards one of the poles. The ions start to descend as they get closer to the poles (to regions where the air is more dense). When one of the ions collide with an air particle (either oxygen or nitrogen) light is given off. If enough collisions occur, we are able to see the light.

Mass Spectrometers

Under the right conditions a particle that enters a magnetic field will undergo full uniform circular motion

Following two conditions must be met:

- The magnetic field must be relatively large and uniform.
- The particle must be travelling penpendicular.

Procedures

Mass spectrometer can be used to determine the mass of a particle with following steps:

- Something to inject particles into the spectrometer, at the correct plate of a particle.
- Something that causes the particles to become ionized
- A particle accelerator to "shoot" the particles into a magnetic field
- A large, uniform magnetic field
- A moveable ion detector (Used to determine where the ion emerges from the magnetic field)

Theorem 1.1.1
If we can determine the q of the particle; Magnetic Field Strength (B); Potential Difference Δv and radius of the particle's circular motion, the mass of the particle can be calculated using this formula:

$$m = \frac{|q|\, B^2 R^2}{2\,|\Delta v|}$$

Please do not include the sign when you are using the formula.