Resolving Frame Shift Paradox in Magnetism

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Abstract

Magnetic field strength and magnetic force depend on velocity which leads to an inconsistency as magnetic field strength and magnetic force are absolute quantities (that means frame-independent quantities) whereas velocity is a relative quantity (that means frame-dependent quantity). In this paper modified laws of magnetic field and magnetic force have been presented in order to resolve frame shift paradox.
Keyword : Frame shift paradox.

1 ETHER : A MEDIUM FOR MAGNETIC FIELD

Let's assume that there exists a medium termed as 'ether' which is responsible for magnetic field.

2 LAW OF MAGNETIC FIELD

Magnetic field **B** in a medium of magnetic permeability μ due to a moving charge q, at a distance r from the charge will be

$$\mathbf{B} = \frac{\mu\, q\, \mathbf{v} \times \mathbf{r}}{4\pi\, r^3}$$

where **v** is the relative velocity of the charge with respect to the ether.

3 LAW OF MAGNETIC FORCE

Magnetic force **F** experienced by a moving charge q in a magnetic field **B** will be

$$\mathbf{F} = q\,(\mathbf{v} \times \mathbf{B})$$

where **v** is the relative velocity of the charge with respect to the source of the magnetic field.

4 BIOT-SAVART LAW

It can be obtained from the law of magnetic field that the infinitesimal magnetic field **dB** due to an infinitesimal and electrically neutral current element **Idl**, at a distance r from it will be

$$\mathbf{dB} = \frac{\mu\, I\, \mathbf{dl} \times \mathbf{r}}{4\pi\, r^3}$$

where

$$I = nev_d A$$

where v_d is the magnitude of the average drift velocity for the free electrons with respect to the current element.

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5 FORCE ON A MOVING CHARGE DUE TO A STRAIGHT WIRE

Consider a charge q moving with a velocity **v** with respect to and outside of a straight current carrying wire which is electrically neutral throughout its entire length. By Biot-Savart law, the magnetic field for a straight current carrying wire which is electrically neutral throughout its entire length, in cylindrical coordinates, will be

$$\mathbf{B} = \frac{\mu I (\sin \alpha_1 + \sin \alpha_2)}{4\pi r} \hat{\boldsymbol{\theta}}$$

Now it can be obtained, from the laws of magnetic field and magnetic force, that the force experienced by the charge q will be

$$\mathbf{F} = q(\mathbf{v} - \mathbf{v_d}) \times \mathbf{B}$$

where $\mathbf{v_d}$ is the average drift velocity for the free electrons with respect to the wire.

References

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