Electromagnetism

Introduction

Magnetism and the electromagnetic effects which have made it possible for us to generate electricity and build electric motors are accidents of nature. Electric and magnetic flux are the building blocks of nature and the laws governing their interaction are those required to make it possible to build atoms and photons.

In our unified theory, everything in the universe is made of energy in its two stable forms of electric and magnetic flux. The two are unified in the sense that they are complementary, with every natural process involving the exchange of energy between its two forms. Electric flux exists to form elementary charged particles. Magnetic flux exists to provide elementary charged particles with the property of inertia and allow them to form composite particles.

Elementary charged particles are nothing but electric flux in a particular geometrical form in which the flux terminates in an inner spherical surface of electric charge. The charge is not a separate entity, but part of the flux! The electric flux of each elementary charged particle exits independently of the others and they all coexist in space. The force between two elementary charged particles results from the fact that the inner surface of charge of each sits within the flux of the other. They have potential energy by virtue of their positions within each other's electric field. The total electric energy of an elementary charged particle is $E = m c^2$ of which $\frac{3}{4} m c^2$ is contained in its electric flux and $\frac{1}{4} m c^2$ is the potential energy resulting from its separation from its antiparticle (or other particles of opposite charge). The latter is based on annihilation and creation taking place when their centres are a distance apart equal to three radii. These are empirical results deduced from the observed inertial mass of the electron and the frequency of gamma ray photons produced by electron positron annihilation.

The electric flux of an elementary charged particle has an energy density $\frac{1}{2} \vec{D} \cdot \vec{E}$ where $\vec{D} = \varepsilon_0 \vec{E}$. The constant ε_0, called the permittivity of space, should be thought of as a property of electric flux related to its ability to contain energy as defined in the relationships:

$$\frac{1}{2} \vec{D} \cdot \vec{E} = \frac{1}{2 \varepsilon_0} D^2 = \frac{\varepsilon_0}{2} E^2$$

The electric flux of all elementary charged particles coexisting in space forms a background against which the motion $\vec{v}_i$ of the flux $\vec{D}_i$ of an individual elementary charged particle generates magnetic intensity:

$$\vec{H}_i = \vec{v}_i \wedge \vec{D}_i$$

The moving elementary charged particle possesses kinetic energy in the form of a magnetic field of flux density $\vec{B}_i = \mu_0 \vec{H}_i$ This magnetic field has an energy density $\frac{1}{2} \vec{B} \cdot \vec{H}$. The constant μ_0, called the permeability of space, should be thought of as a property of magnetic flux related to its ability to contain energy as defined in the relationships:

$$\frac{1}{2} \vec{B} \cdot \vec{H} = \frac{1}{2 \mu_0} B^2 = \frac{\mu_0}{2} H^2$$

Work has to be done by electric potential acting on an elementary charged particle to increase its kinetic energy. This action takes time. Thus magnetic flux gives the elementary charged particle the property of inertial mass. Without it, the elementary charged particles would rush together with infinite acceleration and the universe would end.

Both electric flux and magnetic flux are quantised making the formation of atoms possible.

Quantisation of magnetic flux allows stable composite particles to form such that an orbiting charge creates a current loop. Rutherford's model of the hydrogen atom is the prime example with the orbiting electron creating a current loop. The magnetic field generated by the motion of an elementary charged particle in linear motion consists of circular quantum strands of flux perpendicular to its path. The rapid change of direction involved in orbiting the nucleus strips flux from the electron. If its path were a hyperbole, the energy contained in this flux would be lost as radiation, but the orbit forms a current loop which can contain the flux. The quantised nature of magnetic flux means that the orbit must be threaded by an integer number of quanta of flux. The allowed orbits of the electron relate to the number of quanta of flux. The orbital kinetic energy of the electron is shared equally between the flux threading its orbit and that within one radius of its surface which moves with the electron. Analysis of the geometry of the flux threading the orbit shows that its energy content is concentrated in a tunnel surrounding the orbit.

In our view, any particle which possesses a magnetic moment must be a composite particle consisting of two or more elementary charged particles. Quantum mechanics asserts that the ground state orbit of an electron has no angular momentum and that the observed magnetic moment must be a property of the electron. We consider this to be a nonsense. Not only is there no way in which a particle the size of an electron could generate a magnetic moment of such magnitude, but the fact that the force of attraction between magnetic dipoles obeys an inverse fourth power law would result in electrons being stuck together in chains.

An electron and a positron cannot form a stable particle because their masses are equal and their charge opposite preventing their orbital motion forming a current loop. Three quarks on the other hand can form a stable particle with the two similar charged quarks orbiting the third (at opposite points on the same orbit).

Magnetic flux also has the property that its motion through the background of the electric fields of all charges generates an electric intensity:

$$\vec{E} = \vec{v} \wedge \vec{B}$$

An electric intensity by itself has no physical form. It can only exist within electric flux(!) and electric flux is quantised.

The combination of these factors allows energy to exist as a bundle of electric and magnetic flux travelling through the background at such a speed that the motion of each generates the intensity of the other. The conditions for this are:

- That the electric and magnetic flux are everywhere orthogonal with each other and the direction of motion.
- That both move through the background with a velocity $c = \frac{1}{\sqrt{\varepsilon \mu}}$.

This solution can be simply derived from the four equations:

$$\vec{D} = \varepsilon_0 \vec{E} \quad ; \quad \vec{B} = \mu_0 \vec{H} \quad ; \quad \vec{E} = \vec{v} \wedge \vec{B} \quad ; \quad \vec{H} = \vec{v} \wedge \vec{D}$$

Maxwell derived a similar result through the restatement of earlier laws in his four equations and his derivation of the wave equations of light. The two are mathematically equivalent, but represent different ways of looking at a wave. Maxwell remains stationary observing the waves pass whereas we travel with the wave observing its form.

Maxwell's laws are fundamental to physics and electrical engineering.

We express the equivalent of as:-

- The movement of electric flux $\vec{D}$ generates magnetic intensity: $\vec{H} = \vec{v} \wedge \vec{D}$
- The movement of magnetic flux $\vec{B}$ generates electric intensity: $\vec{E} = \vec{v} \wedge \vec{B}$
- Electric flux terminates in electric charge: $Div\, \vec{D} = \rho$
- Magnetic flux forms loops: $Div\, \vec{B} = 0$

But differ conceptually in that:-

- Magnetic flux is quantised.
- The electric flux $\vec{D}_i$ of elementary charged particles coexist in space.
- Together, the coexisting $\vec{D}_i$ form a background.
- The motion of each $\vec{D}_i$ through the background generates a magnetic intensity: $\vec{H}_i = \vec{v}_i \wedge \vec{D}_i$
- Magnetic intensity $\vec{H} = \sum_i \vec{v}_i \wedge \vec{D}_i$ is a mathematical artefact, not a physical entity.
- Changes in the energy density of a magnetic field are accomplished by the movement of energy within (and parallel to) the individual $\vec{D}_i$ between the magnetic flux and the surface of the charge where it becomes a force doing work by or against electric potential.

The quantisation of electric and magnetic flux results in two solutions of Maxwell's equations which describe radio waves and photons respectively. Radio waves have many quanta of flux in each half phase. Photons have just one quanta of electric and one quanta of magnetic flux in each phase. We suggest that the quanta of electric flux is 1/6 of the flux of an electron resulting in photons 8 phases long (which is not inconsistent with the fact that distant storms at sea create wave trains of 7 significant peaks) . While Maxwell believed electromagnetic radiation to involve changes in flux density of stationary flux, we assert that the flux moves at the speed of light.

Observation of interference phenomena suggests that Maxwell's original understanding of electromagnetic radiation as a transverse wave is valid as a perturbation of existing stable electric and magnetic fields. We believe single photon diffraction (if it exists) to result from an interaction between the two solutions.

Classical Electromagnetism is in error when it assumes that electric flux is singular. The result of this error led to the necessity to invent an artefact called magnetic vector potential. While we assert that the electric flux of the individual electron exists in its own right, classical theory attributes this property to its electric potential ϕ_i. The magnetic vector potential is $\vec{A} = \sum_i \phi_i \vec{v}_i$ can then be asserted to generate the magnetic field. This works because of the properties of vector field theory and calculus.

However, nature cannot do abstract mathematics. We prefer to understand how nature works and tailor the mathematics to fit.

We have stated that Electromagnetism is an accident of nature. The laws of Electricity and Magnetism as they were first formulated relate to manufactured objects and machines. Faraday discovered that the relative motion between an electric circuit and a magnetic field generated an electric current. He formulated a law in terms of magnetic flux cutting the circuit, but this is not how nature works. Nature works much more simply, but with much more complexity! The relationship between the magnetic flux and an individual moving electron is simple. While nature is doing simple naturally additive processes controlled by the geometry of the magnetic field and conductors of the circuit, to imitate her we must do some diabolical mathematics to sum the individual actions of moving electrons into the action of a current.

The electron's motion generates a magnetic intensity:

$$\vec{H}_i = \vec{v}_i \wedge \vec{D}_i$$

Each $\vec{H}_i$ contributes to the magnetic field and its energy density:

$$\vec{B} = \mu_0 \sum_i \vec{v}_i \wedge \vec{D}_i$$

$$\text{Energy density} = \frac{1}{2} \vec{B} \cdot \sum_i \vec{v}_i \wedge \vec{D}_i$$

Such that each electron makes a contribution $\frac{1}{2} \vec{B} \cdot \vec{v}_i \wedge \vec{D}_i$ to the energy density of each element of volume of the magnetic field. This contribution may be positive or negative. While its velocity $\vec{v}_i$ remains constant, its contribution would appear to remain constant, but that is too complicated for nature. Nature can only move energy to and from the electron parallel to its electric flux and each conical volume element of the flux ends at a particular place on the surface of the electron. While there might be no net change in the electron's contribution to the whole field, energy may well be flowing into some parts of its surface and out of others. We have to take into account the energy flow into (or out of) each element of the surface, calculate the force and sum the forces over the surface of the electron. This is the only way in which we can explain how centrifugal force is generated in an electromagnetic theory of mass.

And that is just one electron. We have to take into account all the conduction band electrons in the wire of the circuit.

Never the less, with a few very powerful mathematical techniques such as the use of tubes of flux to divide up space for integration, we can derive the Classical Laws.