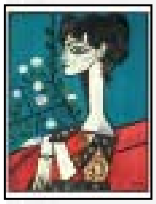
Maxwell's Omission #1



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Abstract:

Maxwell went to great length to derive point equations from the classical models that preceded him. He developed point equations for all models except two:

1) Kirchhoff's Law
2) Classical Motional Electric Law (F=QvxB)

This text will explore Kirchhoff's Law with respect to Maxwell's Equations.

A later text will explore The Classical Motional Electric Law with respect to Maxwell's equations.

Note: we use the term classical to distinguish the classical form of the Motional Electric Law from the New Magnetism form which was not available in Maxwell's Day.

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Scientist and engineers are familiar with the work of James Clerk Maxwell. He is the British scientist who mathematically unified electricity with magnetism (electromagnetism). The following four equations are the point forms of Maxwell's equations. These equations were developed from the work of earlier scientists whose names are given at right.

1) $\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$ Faraday's Law

2) $\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}$ Ampere's Circuital Law + Maxwell's Displacement current.

3) $\nabla \bullet \mathbf{D} = \rho$ Gauss's Law for electric fields.

4) $\nabla \bullet B = 0$ Gauss's Law for magnetic fields.

Equations 1 and 2 are required for Maxwell's derivation of electromagnetic waves. The derivation of electromagnetic waves is the crowning achievement of his work. Since his equations also include point forms of other classical models (equations 3 and 4), why is there no point form for Kirchhoff's Law? If we were to derive such a form of Kirchhoff's law it would be:

5) $\nabla \times \mathbf{E} = 0$ Kirchhoff's Law

The point form of Kirchhoff's Law (5) contradicts Faraday's Law (1) above. How can the curl of an electric field ($\nabla \times \mathbf{E}$) be equal to two different results?

Many non-electrical engineers who are familiar with classical electromagnetic theory usually respond that Kirchhoff's law is only valid for the case of static fields ($\partial \mathbf{B}/\partial t = 0$); however, any electrical engineer will attest that Kirchhoff's Law is used in both AC and DC circuit analysis (Mesh/loop analysis) so what's the deal?

Others say that the electric field developed by a changing magnetic field ($\partial \mathbf{B} / \partial t \neq 0$) is a non-conservative electric field. Many text books use the symbol $\mathbf{E}_m$ for the following expression of Faraday's Law:

6) $\oint E_m \bullet dL = -\frac{d\Phi}{dt}$ (for n=1) (see page scan of text book at end)

If we were to re-derive Maxwell's Version of Faradays Law from 1, then we would obtain

7) $\nabla \times \mathbf{E}_m = -\frac{\partial \mathbf{B}}{\partial t}$ (Notice the 'm' subscript which is omitted from texts)

But then what about the other equation required for classical electromagnetic wave propagation.

8) $\nabla \times \mathbf{H} = \frac{\partial \mathbf{D}}{\partial t}$ (for J =0)

Which can be rewritten as:

9) $(\nabla \times \mathbf{B})\frac{\mu}{\varepsilon} = \frac{\partial \mathbf{E}}{\partial t}$

The E field in 9 is a conservative E field because it is inferred from capacitive plates. Capacitors are modeled using Coulomb's Law.

How does one couple the non-conservative electric field in 7 with the conservative electric field in 9 to arrive at the famous plane wave equation?

New Electromagnetism (www.newelectromagnetism.com) provides a sensible solution to the conflict. It is correct that a changing magnetic field imparts energy to the charges in a closed conductive loop; however, it is through a kinetic transfer of energy (which does not have to be conserved) rather than through an electric field (which is conservative) (see the paper "New Induction"--ni.pdf). Because we can no longer say that a changing magnetic field creates an electric field (directly), electromagnetic physics is changed in the following ways:

1) Maxwell's electromagnetic wave equation is incorrect. Electromagnetic waves (light, radio, etc.) do not have an electric field component. Light is purely a magnetic phenomenon (see NIA1 at the above site).
2) There is no such thing as a "source-less" Electric field.

In this paper, we have taken a bold step in saying that Maxwell's electromagnetic wave model is invalid just because equation 1 is not quite correct. Since both equations 1 and 2 are required for Maxwell's model of electromagnetic waves, the demise of either invalidates Maxwell's wave model. Since it is going to be difficult for science to let go of Maxwell, we have produced another paper (maxdispcur.pdf) which invalidates equation 8.

We have collected over a dozen anomalies and paradoxes in classical electromagnetic theory see www.distinti.com/docs/apoce.pdf.

Let us now consider this example using the concept of *motional emf*. The force on a charge Q moving at a velocity $\mathbf{v}$ in a magnetic field $\mathbf{B}$ is

$$\boxed{\mathbf{F} = Q\mathbf{v} \times \mathbf{B}}$$

or

$$\frac{\mathbf{F}}{Q} = \mathbf{v} \times \mathbf{B} \tag{10}$$

The sliding conducting bar is composed of positive and negative charges, and each experiences this force. The force per unit charge, as given by (10), is called the *motional* electric field intensity $\mathbf{E}_m$,

$$\boxed{\mathbf{E}_m = \mathbf{v} \times \mathbf{B}} \tag{11}$$

If the moving conductor were lifted off the rails, this electric field intensity would force electrons to one end of the bar (the far end) until the *static field* due to these charges just balanced the field induced by the motion of the bar. The resultant tangential electric field intensity would then be zero along the length of the bar.

The motional emf produced by the moving conductor is then

$$\text{emf} = \oint \mathbf{E}_m \cdot d\mathbf{L} = \oint (\mathbf{v} \times \mathbf{B}) \cdot d\mathbf{L} \tag{12}$$

Engineering Electromagnetics 4th Ed -- Hayt

The above page scan is includes to demonstrate notation for non-conservative electric fields.

