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The Magnetoquasistatic Field and Gravity, $g = Gc^4\tau/\pi r^3$

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Abstract

Ampère-Maxwell circuital law is investigated and used to model the Earth as a series of stacked Faraday discs, which create the magnetoquasistatic field. A third new equation is constructed that relates gravity to the $\frac{1}{r^3}$ very near field of the Earth. Naturally occurring low frequency electromagnetic waves are coursing the surface of the Earth and penetrating humans and other nonmagnetic bodies. Similarities of the new equation and Einstein's general relativity equation are revealed with c^4, being prominent. A propagation delay is correlated to the resonant LC circuit of the inner Earth.

Keywords

Ampère-Maxwell Circuital Law, c^4, Gravity, Magnetoquasistatic, Wireless Energy Transfer

1. Introduction

Magnetic fields come in various forms. Permanent magnets have static fields which are usually circular or spherical. More typically there are radio frequency magnetic fields, which may change both in intensity and frequency. Radio frequency fields come in a large variety of shapes and sizes. The Earth's magnetic field is quasi-static, which means it can fluctuate slightly.

The magnetoquasistatic field of the Earth, is a piece of the electromagnetic field in which the slowly oscillating magnetic field dominates. A magnetoquasistatic field is typically generated by *low-frequency* induction from a magnetic dipole or a current loop. The magnetic near-field of the Earth behaves differently from the far-field electromagnetic radiation ($1/r$) or the near induction field

($1/r^2$). At extremely low frequencies the rate of change of the instantaneous field strength with each cycle is relatively slow. The electric and magnetic fields are decoupled, and the region extends no more than a wavelength.

Ampère's circuital law with the displacement current density considered, and Gauss magnetic flux continuity, is the primary laws to be discussed. The magnetic flux continuity law states that the net flux out of a closed surface area is zero. These laws determine the magnetic field intensity, H, given its source and the current density J. The magnetic flux is not everywhere irrotational, but it is solenoidal [1]. At such low frequencies the human body and many mineral rocks, which are weakly conducting non-magnetic bodies, are effectively transparent to magnetoquasistatic fields. As such, they will allow for the transmission and reception of signals through and to such obstacles. Naturally occurring low frequency electromagnetic waves are penetrating our bodies and every other living thing on Earth.

Since the magnetoquasistatic region is defined within one wavelength of the electromagnetic source, the Earth's magnetoquasistatic field is limited to a frequency range between about 1 kHz and 1 MHz [2]. In resonant coupling, the transmitter and receiver are tuned to resonate at the same frequency and have similar impedances. This allows power to flow from the transmitter to the receiver. Such coupling via the magnetoquasistatic field is called resonant inductive coupling and is the electromagnetic source for cosmic wireless energy transfer between the Sun and Earth.

In antenna theory, the radial electric field is made up of two components, which are 90 degrees out of time phase. The term involving $\frac{1}{r^3}$ represents the magnitude of the magnetoquasistatic field. The term involving $\frac{1}{r^2}$ represents the magnitude of the induction field and $\frac{1}{r}$ is known as the radiation field. The inductive portion of the electric field is 180 degrees out of phase with the inductive phase of the magnetic field [3]. This paper deals with the inductive portion of the electric field, or that which is commonly referred to as the magnetoquasistatic field.

By defining each of the three components of the electromagnetic field in terms of gravity it will be possible to model the Earth using dipole antenna theory, and then mathematically represent gravity as functions of the separate E and H fields. The purpose of this paper is to relate capacitor theory and the magnetoquasistatic field of the Earth using Sir Edward Bullard's and H. Gellman's first electrical model of the Earth, a simple electrical "engineering" dynamo [4]. Any power engineer with testing experience will quickly discern that Sir Edward Bullard was representing the Earth as an electro mechanical over current protective relay which operates on the principles of Faraday's disc. From a three-dimensional inductance/capacitance perspective using multiple Faraday discs, I then develop a representative equation for gravity in the magnetoquasistatic field.

2. Ampère-Maxwell Circuital Law

Ampère's circuital law equates the integrated magnetic field around a closed loop to the electric current passing through the loop. The original form of Maxwell's circuital law, which he derived from hydrodynamic analogies in his 1855 paper "*On Faraday's Lines of Force*" [5] relates magnetic fields to the electric currents that produce them. The original circuital law of 1855 was limited to static systems. For systems with electric fields that change over time, the original law was modified to include a term known as Maxwell's correction. The correction was conceived by James Clerk Maxwell in his 1861 paper *On Physical Lines of Force*, *Part III* [6] in connection with the displacement of electric particles in a dielectric medium. Maxwell added displacement current to the electric current term in Ampère's Circuital Law. In his 1865 paper, *A Dynamical Theory of the Electromagnetic Field* [7] Maxwell used this amended version of Ampère's Circuital Law to derive the electromagnetic wave equation. This became a historical landmark in physics by virtue of uniting electricity, magnetism and optics into one single unified theory.

Displacement current density is the quantity $\partial D/\partial t$ appearing in Maxwell's equations that is defined in terms of the rate of change of D or the electric displacement field. It has the same units as electric current density, and is a source of the magnetic field like actual current. The key difference is that it is not an electric current of moving charges, but a time-varying electric field. In a medium, as opposed to a vacuum, there is also thought to be a small contribution from the slight motion of charges bound in atoms, called dielectric polarization, which I shall neglect in this paper.

3. Ampère-Maxwell Equation for a Capacitor

The magnetic field is found in a standard capacitor using the integral form of Ampère's law with a random choice of contour where Maxwell's displacement current density term is added to the conduction current density:

$$\int_{\partial S} B \cdot \mathrm{d}l = \mu_0 \int_S \left(J + \epsilon_o \frac{\partial E}{\partial t} \right) \cdot \mathrm{d}S$$

This equation says that the integral of the magnetic field $\boldsymbol{B}$ around a loop ∂S is equal to the integrated current $\boldsymbol{J}$ through any surface spanning the loop, plus the displacement current term $\varepsilon_0 \frac{\partial \boldsymbol{E}}{\partial t}$ through the surface.

4. Ampère-Maxwell Equation and the Earth

The dynamo theory was proposed by the German-born American physicist Walter M. Elsasser and the British geophysicist Edward Bullard during the mid-1900s. Although various other mechanisms for generating the geomagnetic field have been proposed, only the dynamo concept is seriously considered today. Dr. Elsasser more simply described Bullard's "engineering" dynamo, as the Faraday disc to represent the electrical circuit of the Earth's current paths [8].

The electrical engineering dynamo representation of the Earth is the foundation for much of my work. To take the idea further, the inner Earth can be visualized as a stack of Faraday discs, which collectively we shall present as the source of the Earth's magnetoquasistatic field.

As depicted in **Figure 1**, the current crossing surface S_1 is entirely conduction current. Applying the Ampère-Maxwell equation to surface S_1 yields:

$$B = \frac{\mu_0 I}{2\pi r}$$

The current crossing surface S_2 is entirely displacement current. Applying Ampere-Maxwell law to surface S_2, which is bounded by exactly the same curve ∂S, but lies between the plates, produces:

$$B = \frac{\mu_0 I_D}{2\pi r}$$

Any surface S_1 that intersects the wire has current I passing through it, so Ampère's law gives the correct magnetic field. A second surface S_2 bounded by the same loop ∂S is shown in the figure inserted between the capacitor plates, therefore having no current passing through it. Without the displacement current term Ampere's law would give zero magnetic field for this surface. As such, without the displacement current term Ampere's law gives inconsistent results, the magnetic field would depend on the surface chosen for integration. Thus, the Ampere-Maxwell equation says that the displacement current term $\varepsilon_0 \partial E/\partial t$ is necessary as a second source term which gives the correct magnetic field when the surface of integration passes between the capacitor plates. Since the current is increasing the charge on the capacitor's plates, the electric field between the plates is increasing, and thus the rate of change of the electric field gives the correct value for the field B found above.

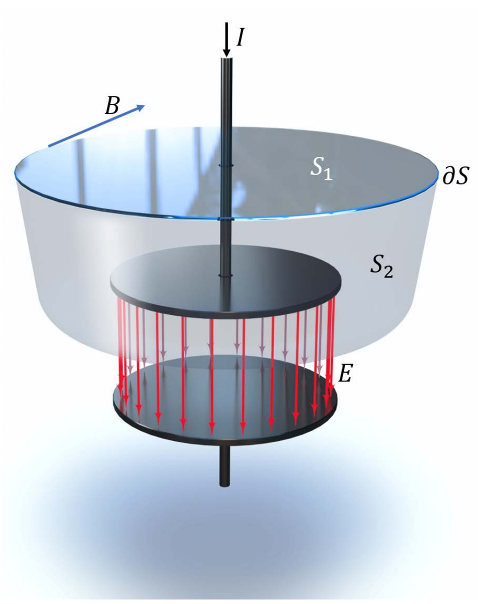

Figure 1. Faraday disc and displacement current.

5. New Equation for the Magnetoquasistatic Field

Using dipole antenna theory, the magnetoquasistatic function is defined as $\frac{1}{\omega r^3}$. Here, ω is the radial acceleration which is equivalent to

$$2\pi/\lambda = 2\pi f = 2\pi/\tau$$

where τ is the time period in seconds. In a rotating or orbiting object, there is a direct relation between distance from the axis, tangential speed, and the angular frequency of the rotation. This is my starting point for creating a new equation that represents gravity in the magnetoquasistatic field.

Acceleration, or g, has units of m/s^2. In order to have a final equation for gravity near Earth, a new equation must agree with these unit requirements. This is my constraint.

The inverse cube is a mandatory requirement in order to satisfy what we think we know about gravity in the magnetoquasistatic realm. Thus, the denominator on the right side of the equation must begin with meters quadrupled. In order to accommodate light, or c, in the numerator, we will need the quad function, or c^4, to obtain our standard acceleration numerator or meters (m). However, this leaves us with seconds quad in the denominator and to offset a time derivative constant, or τ, is added to the numerator. My new equation for gravity in the near field is thus,

$$g = G\frac{c^4\tau}{\pi r^3}$$

I note that πr^3 is related to the volume of a cylinder as originally described by Archimedes. The speed of light quadrupled, c^4, we easily recognize from Albert Einstein General Theory of Relativity [9].

Our time function or T is not so readily apparent and I offer clarification for my readers. The relationship between the frequency and the period T of a repeating event or oscillation is given by:

$$f = \frac{1}{T}$$

The resonant frequency is given by:

$$f_0 = \frac{\omega_0}{2\pi} = \frac{1}{2\pi\sqrt{LC}}$$

Substituting values, we see that

$$T^2 = 4\pi^2 LC$$

To align the time derivative with antenna propagation delay; tau simplifies to a time constant of,

$$\tau = T^2 = 4\pi^2 LC$$

The period of the Magnetoquasistatic field is proportional to the resonant frequency of the inner Earth which can be represented as a simple LC circuit. The iron core of the Earth I think of as L, or inductance, and the balance of the

Earth and atmosphere as C, or capacitance. Tau, thus represents the antenna propagation delay constant caused by the earth resonant circuit. I note that $4\pi^2 r$ represents the area of a sphere, suggesting the resonant LC circuit or frequency is related to the radius of the earth.

6. Conclusions

A new equation for the near-field of a planet has been constructed, which incorporates the speed of light, the inverse cube of the radius and a time period squared. It is theorized that the time period is the electrical time response, or propagation delay, of the Earth's LC circuit. Using a known value of capacitance of the Earth, suggests that L, or the inductance of the Earth is quite small.

The magnetoquasistatic near-field equation for gravity includes four [4] dimensional speed of light. The four-dimension speed of light I recognize from Albert Einstein's equation of general relativity:

$$G_{\alpha\beta} = \frac{8\pi}{c^4} G T_{\alpha\beta}$$

I can imagine light in the magnetoquasistatic field circumnavigating the globe in three dimensions and then working its way outward into the parabolic fourth dimension of space. Time is thought to be a "light travel delay" or "retardation" time scale adjusting factor based on the spherical capacitance and inductance of the Earth. LC circuits are known to have electrical propagation delays based on internal resistance, or R. I conclude that the Earth's internal resistance is the cause of retardation in the magnetoquasistatic field.

The magnetoquasistatic field is thought to be the dominant field where cosmic wireless energy transfer between the Sun and the Earth occurs. Perhaps someday energy can be directly harvested from the Earth's electromagnetic field by building a receiver tuned to the natural frequency of the magnetoquasistatic field traveling through and around our midst. We are literally awash in an energy field. More research into the bandwidth of 1 KHz and 1 MHz emanating from the Earth is warranted.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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