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EXPLANATION OF THE MOTIONLESS ELECTROMAGNETIC GENERATOR BY SACHS'S THEORY OF ELECTRODYNAMICS

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It is shown that the principles of general relativity as developed by Sachs [1] can be used to explain the principles of the motionless electromagnetic generator (MEG), which takes electromagnetic energy from Riemannian curved space-time and in consequence outputs about twenty times more energy than inputted [2]. Therefore, it is shown in the most general manner that electromagnetic energy can be extracted from vacuum and used to power working devices such as the MEG, devices which are reproducible and repeatable [2].

Key words: electromagnetic energy from curved spacetime; motionless electromagnetic generator.

1. INTRODUCTION

By considering irreducible representation of the Einstein group, Sachs [1] has shown that the electromagnetic field tensor exists and propagates through the vacuum if and only if the spacetime being considered is curved, with a non-zero curvature tensor $R_{\mu\nu}$. The electromagnetic field tensor $F_{\mu\nu}$ and the four-current j^{ν} can be expressed in terms of the curvature tensor. In this paper, an expression for the energy density available from the vacuum is derived in terms of the field tensor and four-current, and this expression for the energy is used to explain the reproducible and repeatable device known as the motionless electromagnetic generator (MEG) recently developed by Bearden et al., and replicated empirically [2]. Using a particular choice of metric, the theory of electromagnetics developed by Sachs [1] reduces to O(3) electrodynamics [3-5], which is therefore a theory developed in curved spacetime.

2. ENERGY DENSITY IN CURVED SPACETIME

The most general forms of the electromagnetic field tensor $F_{\mu\nu}$ and four-current j_{μ} have been given by Sachs [1] in a generally covariant form:

$$F_{\rho\gamma} = Q\left[\frac{1}{4}(\kappa_{\rho\lambda}q^{\lambda}q_{\gamma}^{*}+q_{\gamma}q^{\lambda*}\kappa_{\rho\lambda}+q^{\lambda}\kappa_{\rho\lambda}^{+}q_{\gamma}^{*}+q_{\gamma}\kappa_{\rho\lambda}^{+}q^{\lambda*})+\frac{1}{8}\left(q_{\rho}q_{\gamma}^{*}-q_{\gamma}q_{\rho}^{*}\right)R\right] \tag{1}$$

and

$$j_{\gamma} = \frac{Qk'}{4\pi}\left(T_{\rho}^{\rho}q_{\gamma}^{*}-q_{\gamma}T_{\rho}^{\rho*}\right), \tag{2}$$

where Q is a constant of proportionality with the dimensions of charge, q^λ is a quaternion-valued metric and $\kappa_{\rho\lambda}$ is a curvature tensor. In these equations, R is a scalar curvature and k' is a constant of proportionality. The quantity T_ρ is quaternion-valued source term in the field equation

$$\frac{1}{4}\left(\kappa_{\rho\lambda}q^\lambda + q^\lambda\kappa^+_{\rho\lambda}\right) + \frac{1}{8}Rq_\rho = kT_\rho, \tag{3}$$

which generalizes the Einstein field equation [1].

From Eqs. (1) and (2), we can construct the generally covariant and quaternion-valued Lorentz force:

$$f^\mu = F^{\mu\nu}j_\nu = -\partial_\nu T^{\mu\nu}, \tag{4}$$

where $T^{\mu\nu}$ is a generally covariant canonical energy-momentum tensor. Such a force exists in the vacuum, considered as Riemannian curved spacetime. This result is contrary to the Maxwell-Heaviside theory, which is developed in flat spacetime and which is an asymptotic limit of the Sachs theory [1]. It is always possible to write a Lorentz force as in Eq. (4) because $F^{\mu\nu}$ and j_ν can always be defined in curved spacetime. The Lorentz force f^μ is the product of two quaternion-valued and generally covariant quantities and, in consequence, is itself quaternion-valued and generally covariant.

We consider the inhomogeneous field equation given by Sachs [1]:

$$\partial_\nu F^{\mu\nu} = \mu_0 j^\mu, \tag{5a}$$

where μ_0 is the vacuum permeability in S.I. units and express the electromagnetic field tensor $F^{\mu\nu}$ in terms of a generally covariant four-potential A^μ which can be defined from Eq. (1) as

$$F_{\mu\nu} = \partial_\mu A^*_\nu - \partial_\nu A^*_\mu + \frac{1}{8}QR(q_\mu q^*_\nu - q_\nu q^*_\mu), \tag{5b}$$

that is, as

$$A^*_\gamma = \frac{Q}{4}q^*_\gamma \int_0 \left(\kappa_{\rho\lambda}q^\lambda + q^\lambda\kappa^+_{\rho\lambda}\right) dx^\rho \equiv \left(A^0_\gamma, A^1_\gamma, A^2_\gamma, A^3_\gamma\right)^*, \tag{6}$$

where the asterisk in this equation denotes quaternion conjugation [1].

The generally covariant energy density is then given by

$$\frac{En}{V} = A^\mu j^*_\mu, \tag{7}$$

where j_μ and A^μ are given by Eqs. (2) and (6), respectively, in terms of the generally covariant and quaternion-valued curvature tensor $\kappa_{\rho\lambda}$.

If the latter is zero, as in flat spacetime, the energy density (7) vanishes. Therefore, in Maxwell-Heaviside theory, energy density from the vacuum is not available and there is no generally covariant vacuum four-current or vacuum Lorentz force f^a_μ in flat spacetime. The conserved energy density (7) is a product of two quaternion-valued entities, and is itself quaternion-valued. It can be developed using the identity [1]

$$q^\mu q^*_\mu = 4\sigma_0, \tag{8}$$

where

$$\sigma_0 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}. \tag{9}$$

On using the definitions

$$A^\mu := A_0 q^\mu, \quad j^*_\mu := j^*_0 q^*_\mu, \tag{10}$$

a simple expression

$$\frac{En}{V} = A^\mu j^*_\mu = 4A_0 j^*_0 \sigma_0 \tag{11}$$

is obtained for the energy density (7) in terms of the quaternion-valued Pauli matrix σ_0. The magnitude of the generally covariant energy density is therefore

$$\frac{En}{V} = 4A_0 j^*_0. \tag{12}$$

We now define the quaternion-valued metric in the complex basis ((1),(2),(3)) for the three-dimensional space. This definition follows from a consideration of the flat spacetime limit

$$q^\mu q^{\nu *} - q^\nu q^{\mu *} \to \sigma^\mu \sigma^\nu - \sigma^\nu \sigma^\mu \tag{13}$$

on using the properties

$$\sigma^0\sigma^1 - \sigma^1\sigma^0 = 0, \quad \sigma^0\sigma^2 - \sigma^2\sigma^0 = 0, \quad \sigma^0\sigma^3 - \sigma^3\sigma^0 = 0, \tag{14}$$

$$\sigma^1\sigma^2 - \sigma^2\sigma^1 = 2i\sigma^3, \quad \sigma^2\sigma^3 - \sigma^3\sigma^2 = 2i\sigma^1, \quad \sigma^3\sigma^1 - \sigma^1\sigma^3 = 2i\sigma^2.$$

In the Sachs theory, the metric field $q^\mu(x)$ is defined by the line element [1]

$$ds = q^\mu(x) dx_\mu, \tag{15}$$

which in special relativity (flat spacetime) becomes

$$ds = \sigma^\mu dx_\mu. \tag{16}$$

The metric field $q^\mu(x)$ is a four-vector, whose four components are each quaternion-valued (i.e., can be represented by a 2×2 matrix). There cannot be more than sixteen components in $q^\mu(x)$ and the product of two quaternion-valued components is quaternion-valued. Therefore, a product such as $q^\mu(x)$ is a non-commutative but not antisymmetric in μ and ν. It follows that there are generally covariant components such as

$$\begin{aligned} q_x &\equiv q^1 = (q^{10}, q^{11}, q^{12}, q^{13}) , \\ q_y &\equiv q^2 = (q^{20}, q^{21}, q^{22}, q^{23}) , \\ q_z &\equiv q^3 = (q^{30}, q^{31}, q^{32}, q^{33}) , \\ q^0 &\equiv q^0 = (q^{00}, q^{01}, q^{02}, q^{03}) . \end{aligned} \tag{17}$$

A component such as

$$q_x = \left(q_x^0, q_x^1, q_x^2, q_x^3\right) \tag{18}$$

has no more than four single-valued components and in the flat spacetime limit must reduce to

$$\sigma_x = (0, \sigma_x, 0, 0). \tag{19}$$

It follows that, in the flat spacetime limit,

$$q_x^0 \to 0, \quad q_x^1 \to \sigma_x, \quad q_x^2 \to 0, \quad q_x^3 \to 0. \tag{20}$$

The components q_x^1 and q_y^{2*} must be single-valued and must be 2×2 matrices, i.e.,

$$q_x^1 = \begin{bmatrix} 0 & q_x^1 \\ q_x^1 & 0 \end{bmatrix}, \quad q_y^{2*} = i \begin{bmatrix} 0 & -q_y^2 \\ q_y^2 & 0 \end{bmatrix}. \tag{21}$$

The metric field $q^\mu(x^\mu)$ must be a function of x^μ, whose space part is represented by the complex basis ((1),(2),(3)); it therefore is possible to define scalar elements

$$q_x^{(1)} = \frac{A_x^{(1)}}{A^{(0)}}, \quad q_y^{(2)*} = \frac{A_y^{(2)}}{A^{(0)}} \tag{22}$$

and vector relations such as

$$\mathbf{q}^{(1)} \times \mathbf{q}^{(2)} = i\mathbf{q}^{(3)*}, \tag{23}$$

with

$$\mathbf{q} = q^{(1)}\mathbf{i} + q^{(2)}\mathbf{j} + q^{(3)}\mathbf{k}. \tag{24}$$

If we consider the propagation of the electromagnetic field with phase ϕ, the metrics can be written as

$$\mathbf{q}^{(1)} = \frac{1}{\sqrt{2}}(i\mathbf{i}+\mathbf{j})e^{i\phi}, \quad \mathbf{q}^{(2)} = \frac{1}{\sqrt{2}}(-i\mathbf{i}+\mathbf{j})e^{i\phi} \tag{25}$$

in the Cartesian basis (**i**, **j**, **k**).

3. EXPLANATION OF THE MEG USING SACHS'S ELECTRODYNAMICS

The explanation of the motionless electromagnetic generator (MEG) in Sachs's theory is that the $\mathbf{B}^{(3)}$ vacuum magnetic field component defined by

$$B^{(3)} = \frac{1}{8}QR \tag{26}$$

is converted directly into the energy density

$$\frac{En}{V} = \frac{1}{\mu_0}\mathbf{B}\cdot\mathbf{B} \tag{27}$$

and electromotive force, where **B** is the static magnetic field of the core of the MEG device [2]. If there is no spacetime curvature, the $\mathbf{B}^{(3)}$ field is zero because the scalar curvature R is zero (Maxwell-Heaviside electrodynamics) and there can be no vacuum energy (12) available for use by the MEG device, no vacuum current j^{μ}, and no field tensor $F_{\mu\nu}$ or vacuum Lorentz force f^{μ} in special relativity. The MEG device therefore shows that in general a theory of electrodynamics in curved spacetime is needed to explain the ability of devices to extract energy from the vacuum in usable form [1]. In other words, the Maxwell-Heaviside theory has no explanation for devices such as the MEG.

The fundamental reason for this is that in flat spacetime, the electromagnetic field does not propagate because the curvature tensor is zero. The $\mathbf{B}^{(3)}$ component in the Sachs theory is given by Eq. (26) and vanishes if the scalar curvature vanished in flat spacetime. The only way of expressing non-zero energy density for the propagating electromagnetic field is through the $\mathbf{B}^{(3)}$ component, because products of transverse components average to zero over many cycles of the field. In the motionless electromagnetic generator, the vacuum energy (12) from curved spacetime is converted directly into electromotive force, producing a reproducible and repeatable coefficient of performance (COP) much greater than unity.

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