AN EXPERIMENTAL TEST OF THE EXISTENCE OF WHITTAKER'S g AND f FLUXES IN THE VACUUM

ABSTRACT

Whittaker has shown that the electromagnetic entity in vacuo consists fundamentally of two longitudinally directed magnetic fluxes, g and f, which are physical and produce measurable effects in theory. In this paper, an experiment is proposed in which the physical nature of g and f can be tested when there are no fields and vector potentials present. The only entity present under the experimental design conditions is a physical scalar potential, which quantizes to a physical time-like photon.

INTRODUCTION

Superpotential theory was initiated by Whittaker {1,2}, who showed that the electromagnetic entity under all conditions can be described by two longitudinally directed magnetic fluxes, g and f, from which electric and magnetic fields are obtained by double differentiation. In this paper, an experimental design is proposed to test whether g and f are physical and gauge invariant, or unphysical. A successful demonstration of the physical nature of g and f will indicate that, in the vacuum, there are longitudinal waves present, as well as the transverse waves of the received view {3-5}. The magnetic fluxes g and f cannot exist physically without a magnetic flux density being present in a beam of finite radius. Such a longitudinally directed magnetic flux density has been proposed {6-10} and referred to as the $\boldsymbol{B}^{(3)}$ component of radiation, a component of O(3) gauge theory applied to electrodynamics.

EXPERIMENTAL DESIGN

The experimental design is very simple. Two dipole antennae are set up in close proximity so that the vector potentials $\boldsymbol{A}_1$ and $\boldsymbol{A}_2$ from each antenna cancel:

$$\boldsymbol{A}_1 = -i\frac{\kappa e^{i\kappa r}}{4\pi c\varepsilon_0 r}\boldsymbol{p}_1 \tag{1}$$

$$\boldsymbol{A}_2 = i\frac{\kappa e^{i\kappa r}}{4\pi c\varepsilon_0 r}\boldsymbol{p}_2 \tag{2}$$

Here $\boldsymbol{p}_1$ and $\boldsymbol{p}_2$ are the dipole moments of each antenna, κ is the wave-vector magnitude, r is the radius vector magnitude, ϵ_0 is the vacuum permittivity and c the speed of light in vacuo. The expressions are therefore in S.I. units.

The principle of the experiment is therefore very simple. We have:

$$\boldsymbol{A} = \boldsymbol{A}_1 + \boldsymbol{A}_2 = 0; \qquad \boldsymbol{E} = 0; \qquad \boldsymbol{B} = 0; \tag{3}$$

so there are no vector potentials or fields present in the vacuum. Also, Whittaker's f and g vector functions are equal in magnitude but opposite in direction:

$$\boldsymbol{g}_1 = -\boldsymbol{g}_2; \qquad \boldsymbol{f}_1 = -\boldsymbol{f}_2. \tag{4}$$

However, the scalar magnitude of $\boldsymbol{g}$, denoted G, from both antennae is the same, and the sum of G from both antennae is {11-14}:

$$2G = \frac{2}{\sqrt{2}} A^{(0)} \left(X - iY \right) e^{i(\omega t - \kappa Z)}. \tag{5}$$

The scalar potential from $2G$ is therefore {11-14}:

$$\phi_L = 2\dot{G} \tag{6}$$

and obeys the massless Klein-Gordon equation:

$$\Box\phi_L = 0. \tag{7}$$

It can be shown {11-14} that canonical quantization of (7) leads directly to an ensemble of massless bosons which are physical time-like photons, each of energy $\hbar\omega$. The complete classical energy in the electromagnetic entity emanating from the double dipole antenna is:

$$H = \frac{2}{\mu_0} \int \boldsymbol{B}^{(3)} \cdot \boldsymbol{B}^{(3)} dV \tag{8}$$

where $\boldsymbol{B}^{(3)}$ is the Evans-Vigier field {6-10}.

DISCUSSION

When all vector potentials and fields are eliminated, the energy (H) should be detectable by a bolometer, even though there are no vector potentials or fields present. This would demonstrate the physical nature of $\boldsymbol{f}$ and $\boldsymbol{g}$ in the vacuum. Recent theoretical work suggests that the fluxes $\boldsymbol{g}$ and $\boldsymbol{f}$ are physical. The experiment would also demonstrate in another way the physical nature of $\boldsymbol{B}^{(3)}$, which has already been shown to be physical in several other ways {6-10}. Since G is a propagating wave, it travels through the vacuum, and when it meets matter, the d'Alembert condition (7) may no longer hold, so fields may reappear upon interaction with matter, specifically a single electron. This would be an interaction between a physical time-like photon and an electron, producing, perhaps, a photoelectric effect and measurable electric fields. If the logic of Whittaker's papers is followed, there can exist physical time-like photons in the vacuum without fields or vector potentials. Apart from the need to invoke the longitudinal flux density $\boldsymbol{B}^{(3)}$, this is a result of the Maxwell-Heaviside equations which therefore produce longitudinal scalar waves in the vacuum.

SCALAR INTERFEROMETRY

When two scalar beams of the type:

$$G_1 = \frac{A^{(0)}}{\sqrt{2}} \left(X - iY \right) e^{i(\omega t - \kappa Z_1)} \tag{9a}$$

$$G_2 = \frac{A^{(0)}}{\sqrt{2}} \left(X - iY \right) e^{i(\omega t - \kappa Z_2)} \tag{9b}$$

interfere, their combined energy density in the zone of interference is easily shown to be:

$$\frac{En}{V} = \frac{cI}{R^2 \omega^2} \left[1 + \cos\left(\kappa \left(Z_1 - Z_2 \right) \right) \right] \tag{10}$$

where I is the combined power density in watts per square meter, ω is the angular frequency and Z_1 - Z_2 is the difference in propagation distance of each beam.

If we now define:

$$G_3 \equiv \frac{1}{G^{(0)}}\left(G_1 + G_2\right)\left(G_1^* + G_2^*\right) \tag{11}$$

$$\Box G_3 = B \neq 0 \tag{12}$$

and a fluctuating magnetic flux density magnitude appears in the zone of interference. Therefore so does a fluctuating electric field strength magnitude $E = cB$. Outside the sone of interference, the fluctuating B and E disappear again.

The heat due to the scalar beams and the fluctuating E and B should be detectible. Note that eqn. (12) is a gauge invariant construct and so the B and E produced in the interference zone are real and physical. The energy density En/V is also gauge invariant and fluctuates in the interference zone:

$$\frac{En}{V} = \frac{B^{(0)2}}{\mu_0} = \frac{GG^*}{R^4 \mu_0} \tag{13}$$

because $B^{(0)}$ is a magnetic flux density and G is a magnetic flux, with R^2 as the beam area. The lateral extent of the beam is constrained by the inverse lateral distance raised to the fourth power. Of course, if R is constant, it is not infinitely expanding. So X and Y are constrained by $X^2 + Y^2 = R^2$.

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