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Research Article

Verifying the Effects of Symmetry Breaking of Electric Field in Space

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Abstract: The aim of this research is to see if the newly modified Maxwell equations had provided adequate solutions to the problem of symmetry breaking of electric fields. The symmetry breaking of electric fields had been proposed to be among the phenomenon responsible for electromagnetic wave generation. The effects of the symmetric breaking of the electric fields were investigated via a systematic approach by incorporating quantum mechanics into the ab-initio Maxwell equation. The following discoveries were documented. When electron acceleration increases, the symmetry breaking of the electric field is expected to be high. Upon further investigation, the possibility of high symmetry breaking of electric field exists when electron decelerates. Hence, there may be another phenomenon responsible for electromagnetic wave generation aside electron acceleration and the symmetry breaking of electric fields that has been proposed.

Keywords: Electromagnetism, mathematical model, quantum mechanical, symmetry breaking

INTRODUCTION

Recently, scientists have initiated the idea of integrating a small antenna into an electronic chip. This idea is possible if electromagnetic waves are generated not only from the acceleration of electrons, but from a phenomenon referred to as symmetry breaking of the electric field in space within the spatial configuration of the radiating system (Sinha and Amaratunga, 2015). Emetere (2015) had earlier proposed the possibility of antennas (plasma) to experience femto spin demagnetization of particulates. This study partly explains the possibility of dielectric medium to emit electromagnetic waves.

From the basics, Maxwell postulated four equations which explain the causes of electron acceleration in metallic antennas.

$$\nabla . E = \frac{\rho}{\varepsilon_0} \tag{1}$$

$$\nabla \times E = -\frac{\partial B}{\partial t} \tag{2}$$

$$\nabla \times B = \mu_0 J + \mu_0 \varepsilon_0 \frac{\partial E}{\partial t} \tag{3}$$

$$\nabla . B = 0 \tag{4}$$

Equation (1-4) represents the Coulomb's law, Faraday's law, Ampere's law and Gauss's law respectively. Here E is the electric field, ρ is the charge density, ε_0 is the permittivity of free space. B is the magnetic induction, μ_0 is the permeability of free space. J is the current density.

The incorporation of quantum mechanics into electromagnetism via a mathematical model has been illustrated in previous publications (Uno and Emetere, 2011; Emetere, 2014; Emetere, 2015). Seven postulations were induced from mathematical model of quantum mechanics and electromagnetism i.e., the modified Maxwell's equations:

$$E_{rt} + \left[\frac{\hbar^2}{2m}|\mathrm{B_r} - eA|^2 + |B_z + V_o e|^2 - \left(\left|B_z - E_o e\left(\frac{a^2}{r} - r\right)\right|^2 - |B_z|\right) + 2E_o V_o e^2 + \beta e_r\right]$$
$$E_r = \beta E_r e_r e^{-j\beta r}(sin\theta + cos\theta) \tag{5}$$

$$\frac{\partial}{\partial t}\left[(B_z + V_o e){E_r}^2\right] - \frac{\partial}{\partial t}\left[\left(B_z + E_o e\left(\frac{a^2}{x} - x\right)\right){E_r}^2\right] - \frac{1}{2}\frac{\partial B_z}{\partial t} = 0 \tag{6}$$

$$\frac{\hbar^2}{2m}{E_r}^2\frac{\partial}{\partial t}(\mathrm{B_r} - eA)$$

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$$= \beta B_r f_r e^{-j\beta r}(sin\theta + cos\theta) \quad (7)$$

$$\frac{\partial}{\partial t}E_z = \frac{\partial}{\partial t}E_z e_z e^{-j\beta r}(sin\theta + cos\theta) \quad (8)$$

$$2\left|B_z - E_o e\left(\frac{a^2}{r} - r\right)\right| E_r E_o e\left(\frac{a^2}{r^2} - 1\right) = \frac{j\beta}{8\pi}\left[\frac{E_r e_r}{r}(sin\theta + cos\theta) + \frac{2B_r f_r}{r}(sin\theta + cos\theta)\right] \beta e^{-j\beta r} \quad (9)$$

$$\frac{1}{8\pi}[\beta E_r(a,z)e_r + \beta B_r(a,z)f_r + E_z(a,z)e_z + B_z(a,z)f_z][cos\theta - sin\theta] = 0 \quad (10)$$

$$\frac{1}{8\pi}[-\frac{2}{z}e^{-j\beta r}sin\theta(B_z(a,z)f_z + E_z(a,z)e_z) - \frac{2}{z}e^{-j\beta r}cos\theta(B_z(a,z)f_z + E_z(a,z)e_z)] = 0 \quad (11)$$

where,

α and γ	=	The attenuation factors of the electrical fields
$E_\gamma(z)$ and $E_\alpha(z)$	=	The electric fields generated by the polar difference
β	=	The frequency of excited power
j	=	The antenna current
r	=	The radius or horizontal component of the antenna
z	=	The vertical component of the antenna
m	=	The magnitude of the particulates
ξ	=	The electrical permeability
μ_o	=	The magnetic permeability
e_r	=	The spin factor which determines the electron spin along the horizontal component
e_z	=	The antenna factor which determines the ratio of the electric field strength to the voltage
V	=	The total potential in space or near earth surface
V_o	=	A constant on the surface of the charged air
E_o	=	The electric field and a is the antenna potential
x	=	The Dybe length

The first four postulates have been verified upon its application to salient aspect of the antenna. For example, postulate 1 was used to resolve the magnetic field effects on the sheath of the plasma antenna (Emetere, 2015). Postulate 2 was used to resolve fading in multipath propagation in ultra wideband application (Emetere, 2014). Postulate 3 was used to improve the respond time in detecting natural lightning using any electromagnetic device (Emetere *et al*., 2014) Recently, postulate 4 is applied to the Helix antenna to examine satellite propagations in turbulent weather (Emetere *et al*., 2015).

Hence, the objective of this study is to resolve the problem of symmetry breaking of electric fields by using the modified Maxwell's equations. Numerical simulations were used to demonstrate salient expectations in practical cases. In section two, the material and methodology for the research were discussed. In section three, we examined the application of the modified Maxwell's equations to practical problems like symmetry breaking of electric fields. In the later part of section three, the implication of all the results obtained in section two were explained.

MATERIALS AND METHODS

The experiments were performed in a virtual system where all conditions were tailored to reflect real scenario-using the Matlab environment. We adopted the angular value of given by Hilborn (1995) for the angle between the perturbing electric field and the alignment axis i.e., 0 to $\pi/2$. The initial assessment of the electric field was carried when G is 0.02 Am/s and 2 Am/s.

RESULTS AND DISCUSSION

Postulate 7 is stated in Eq. (11). The theoretically explanation of postulates 7 is the ability of an electrical field being influenced by a changing magnetic field which depends on the angular shift. The quantum nature of the particulates is dependent on the size of the antenna only if the vertical component of the antenna is properly defined. Upon the implication of postulate 7, the symmetry breaking of the electric field in space within the spatial configuration of the radiating system can be determine upon the assumption that "the aerial's size is determined by the wavelength associated with the transmission frequency of the application". The mathematical interpretation is without the influence of magnetic fields or atomic collisions:

$$r_1 \neq r_2 \quad (12)$$

$$z_1 \neq z_2 \quad (13)$$

$$B_z = 0 \quad (14)$$

Hence, Eq. (11) can be transformed to:

$$\frac{E_{z1}}{E_{z2}} = \frac{z_1}{z_2}e^G Cot(\theta) \quad (15)$$

where, $G = j\beta r_1 - j\beta r_2$.

We propose that the joint effect of the polarized vectors E_{z1} and E_{z2} leads to a tilted circular polarization as shown on the vertical component (z_1/z_2) in Fig. 1. Hence, we consider various conditions to ascertain the effect of symmetry breaking in electric field.

From Fig. 2 and 3, the angle between the perturbing electric field and the alignment axis is active between $\pi/11$ and $\pi/5$. The symmetry breaking of the

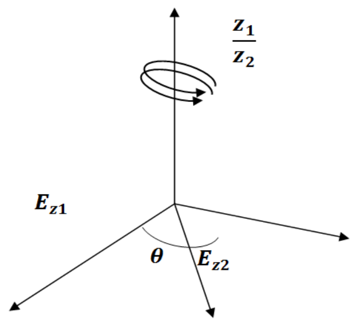

Fig. 1: Experimental geometries

electric field was more evident at G = 2Am/s. This simply means that when electron acceleration increases, the symmetry breaking of the electric field is expected to be high. This fact has not been confirmed by experiments, so it remains a hypothesis. Also, the simulations shows that when $E_{z1} > E_{z2}$, a sign of Alignment to Orientation Conversion (AOC) which is induced when the initial alignment is not parallel or perpendicular to the external electric field. This idea generates two major questions i.e., when is the symmetry breaking expected and does it occur for all material?

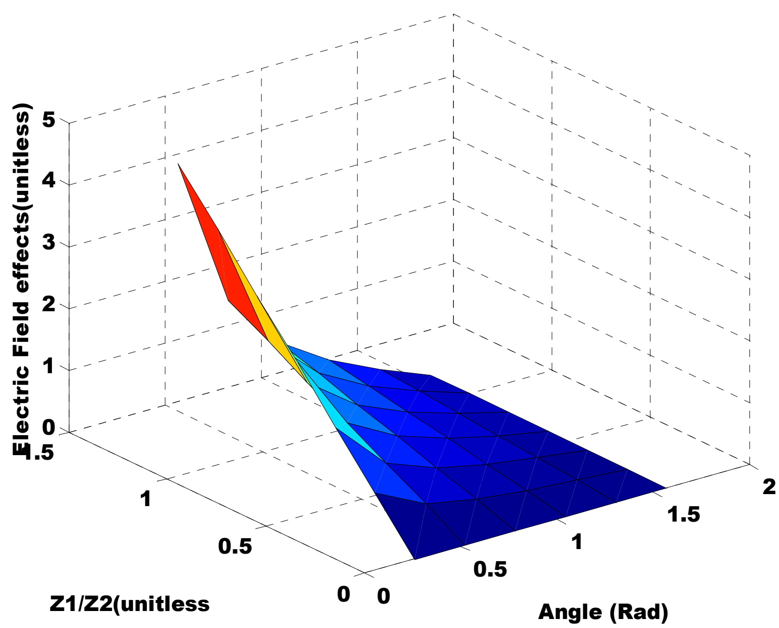

Fig. 2: Preliminary investigation of field when G = 0.02Am/s

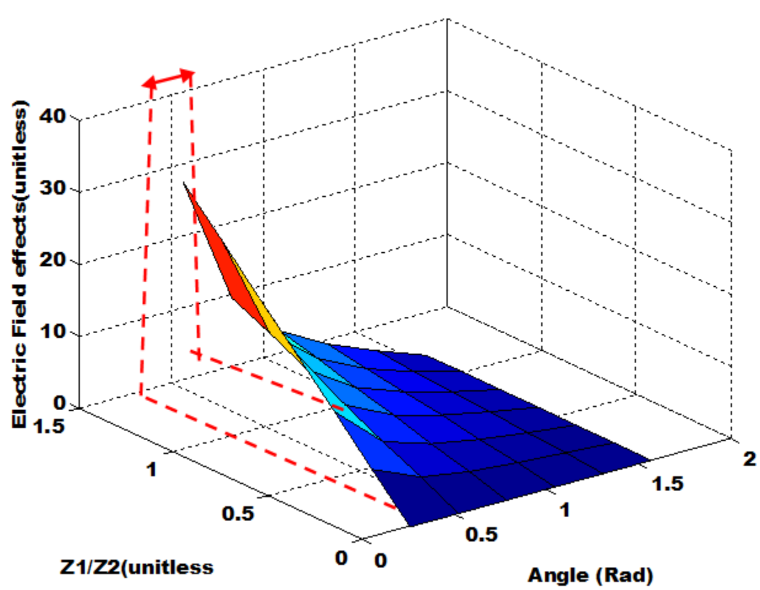

Fig. 3: Preliminary investigation of field when G = 2Am/s

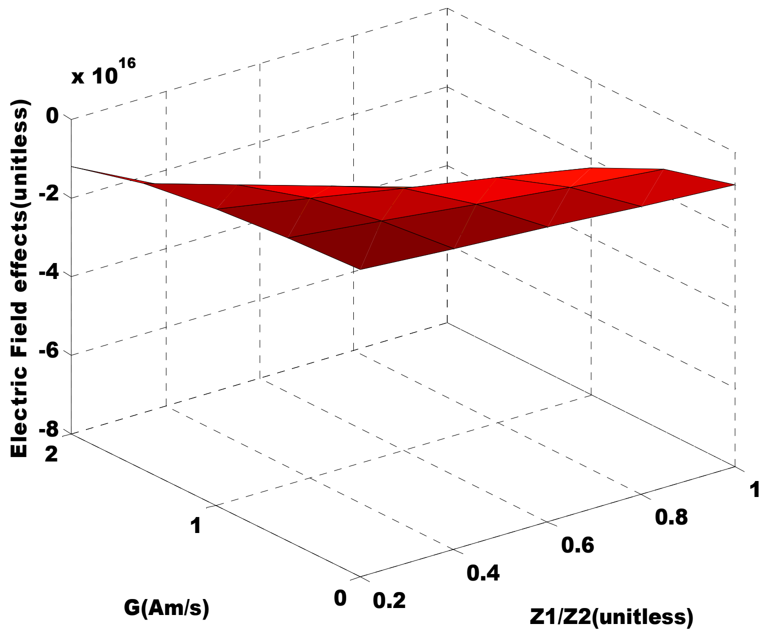

Fig. 4: Preliminary investigation of field when the initial alignment is parallel to the electric field

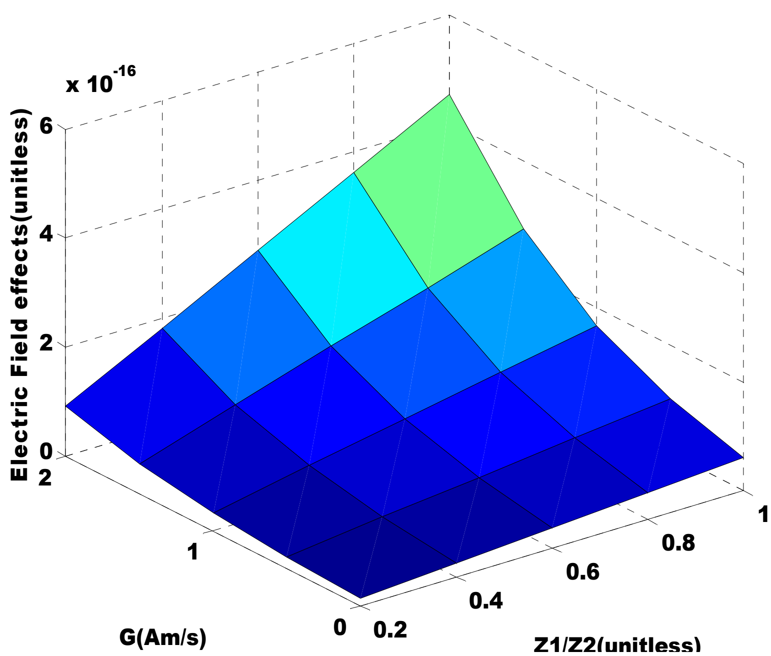

Fig. 5: Preliminary investigation of field when initial alignment is perpendicular to the electric field

The symmetry breaking was investigated when the initial alignment is parallel to the external electric field (Fig. 4). There are two events expected. First, the symmetry breaking vanishes as the vertical component ratio increases i.e., $z_1 > z_2$. Meanwhile, the electron acceleration increases despite the vanishing of the symmetry breaking of the electric field. The second event is the quasi-equilibrium state when the all three parameters are dependent on each other. The symmetry breaking was investigated when the initial alignment is perpendicular to the external electric field (Fig. 5). The symmetry breaking is insignificant though the increasing vertical component ratio initiates electron deceleration. This is due to the distortion of the atomic angular momentum distribution in the plane perpendicular to the electric field and the axis of initial alignment (Hilborn, 1995). However, when the angle between the initial alignment and the external electric field is $\pi/4$ as predicted by Auzinsh *et al*. (2006), the symmetry breaking becomes significant though there is

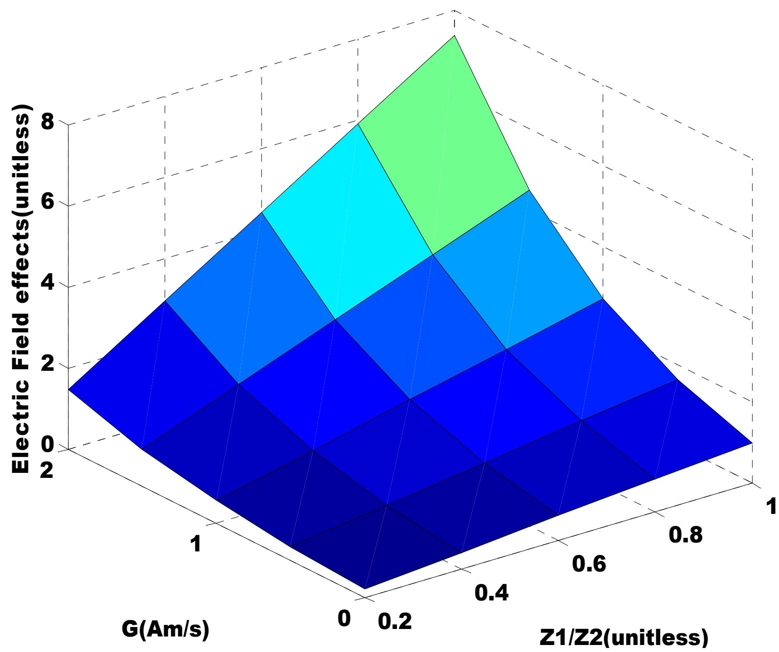

Fig. 6: Preliminary investigation of field when initial alignment is pi/4 to the electric field

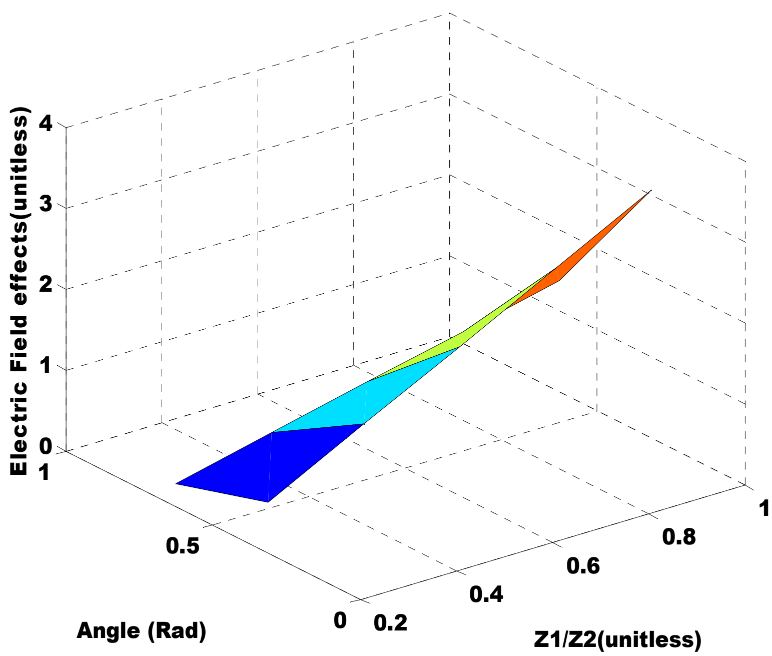

Fig. 7: Preliminary investigation of field when the initial alignment is parallel to the electric field

likely deceleration of electron (Fig. 6). This suggests that there may be another phenomenon responsible for electromagnetic wave generation aside electron acceleration and the symmetry breaking of electric fields as proposed by Sinha and Amaratunga (2015). We tried investigating what happens when acceleration of electron are insignificant (Fig. 7). The symmetry breaking of the electric field and the vertical component ratio increases as the angle between the initial alignment and the external electric field decreases.

CONCLUSION

The effects of the symmetric breaking of the electric fields were investigated via a systematic approach. The quantum mechanics of changing acceleration of electrons are complex especially relating theories with the generation of electromagnetic wave. However, the following discoveries were documented. When electron acceleration increases, the symmetry breaking of the electric field is expected to be high.

Upon further investigation, the possibility of high symmetry breaking of electric field exists when electron decelerates. Hence, there may be another phenomenon responsible for electromagnetic wave generation aside electron acceleration and the symmetry breaking of electric fields as proposed by Sinha and Amaratunga (2015).

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