THOMSON REUTERS ENDNOTE
[Abdallah ,3(12): December 2016] ISSN 2348 – 8034
DOI-10.5281/zenodo.221012 Impact Factor- 4.022

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

DERIVATION OF PLANK ENERGY EQUATION FROM MAXWELL'S EQUATIONS

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ABSTRACT
In this work the expression for the electromagnetic energy is derived from Maxwell's equations; and found a useful energy relation. This expression for displacement current density is together with relation between amplitude and particles density is used to find electromagnetic energy. This energy is found to be typical to plank quantum energy formula. Another derivation is made to find classical oscillator energy from photon plank energy relation.

Keywords: *Plank energy, Maxwell's equations, and displacement current.*

I. INTRODUCTION
Classical physics divide Physical lows into two main parts .Newton's lows which describe matter particles, and Maxwell's equations which take care of electromagnetic energy waves. This classification survives till. Max plank found that the explanation of the black body radiation is impossible unless light behaves as discrete energy quantum, known as photons [1, 2].This means that light has dual wave and particle nature .The particle behaviour of light waves motivates De Broglie to suggest that particles like electrons can behave sometimes like waves. This suggestion was confirmed experimentally, by Davison and Crimer which observe electron diffraction by a solid crystal [3, 4].The dual nature of atomic world encourages Schrödinger and independently Heisenberg to construct quantum theory that can describe microscopic world. The attempt to arrive at a relativistic wave equation is based on relativistic energy-momentum relation. The equation results are called Klein-Garden equation [5]. Another equation based on energy-momentum linear equation is called Dirac. Quantum equations succeeded in describing wide variety of physical phenomena concerning the atomic world [6]. However, there are many physical phenomena that cannot be explained by using quantum laws directly. For instance some high temperature super conducting phenomena, like isotope effect, pressure. This work is devoted to bridge the gap between Maxwell's electromagnetic wave description of light and quantum plank particle description. This is done in section (2) and (3). Section (4) and (5) are devoted for discussion and conclusion equation in the equation by considering first- order spatial derivatives , rather than increasing the order of the time derivatives [7].

II. PHOTON ENERGY & DISPLACEMENT ERROR
The displacement current J is given by

$$J = \frac{\partial D}{\partial t} = \varepsilon \frac{\partial E}{\partial t} \quad (1)$$

Where:

$$D = \varepsilon E = \quad Electric\ flux\ density$$

Thus:

$$J = \varepsilon \frac{\partial E}{\partial t} \quad (2)$$

$where\ \ \varepsilon\ \ is\ the\ electric\ permitivity$

$E\ \ is\ the\ electric\ field\ intensity$ [8, 9]

The electric travelling wave is given by:

ISSN 2348 – 8034
Impact Factor- 4.022

$$E = E_0 e^{i(kx-\omega t)} (3)$$

$E_0 \equiv maximam\ electric\ fint$

$$k \equiv wave\ number$$

$\omega \equiv angular\ frequancy$

$$k = \frac{2\pi}{\Lambda}, \quad \omega = 2\pi f \ (4)$$

From equations (2) the current density and (4) is given by:

$$J = \frac{\partial(\varepsilon E)}{\partial t} \quad (5)$$

$$J = \varepsilon \frac{\partial E}{\partial t} = \varepsilon \frac{\partial (E_{0\ e}{}^{i(\Re x\ -wt)})}{\partial t} \ (6)$$

Thus the displacement current is

$$J = \mathcal{E}\,(-\mathrm{i}\omega E) = -\mathrm{i}\omega \mathcal{E} E \ \ (7)$$

On the other hand the electric potential V can be written as:

$$v = E \,.\, L (8)$$

And $I = JA (9)$

Where L is the conductor length is given by the electric power (P_r):

$$P_r = VI \quad (10)$$

Substituting equation (8) and equation (10) yields:

$$P_r = (\mathrm{EL})(\mathrm{JA})\ (11)$$

$$P_r = (EL)\ (J\, w\, \varepsilon E\, A)\ (12)$$

$P_r = -\mathrm{J}\,\omega\,\varepsilon\, E^2\,(\mathrm{A\,L}) = -J\,\omega\,\varepsilon E^2\,(\mathcal{V})$ (13)

Thus the power emerged per unit volume is given by:

$$\frac{P_r}{V} = -i\,\omega\,\mathcal{E}E^2 = \omega\,\mathcal{E}E^2 \ \ (14)$$

This expression is found by considering (e .m) wave can be considered also as photon. But the density is malted to E according to

$n = c_0 E^2$ (15)

the relation combining (14) and (15) yields

$= n\,h\,f = c_0 \mathrm{h\,f}\ E^2 = \omega\,\varepsilon E^2 = 2\pi\,\varepsilon f E^2 (16)$

Thus the blank constant is given by:

$$c_0 h = 2\pi\,\varepsilon$$

- $h = \frac{2\pi\,\varepsilon}{c_0} \quad (17)$

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III. PHOTON ENERGY & HARMONIC OSCILLATOR

According to wave mechanic the number of particles n are proportional to the square of Amplitude A, According to the relation:

$$n = c_0 A^2 \quad (18)$$

The photon energy is given by:

$$E = \hbar\omega \quad (19)$$

Thus the total photon energy is having different frequencies is given by:

$$E = (\hbar \int \omega d\omega) n = (\frac{1}{2}\hbar\omega^2) n \quad (20)$$

But according to Newtonian mechanics for harmonic motion

$$E = m\omega^2 A^2 \quad (21)$$

hence from equations (1) & (4)

$$m\omega^2 A^2 = \left[(\frac{1}{2})(hc_0)\right]\omega^2 A^2 \quad (22)$$

This means that the photon masses

$$m_p = m = \frac{1}{2} hc_0 \quad (23)$$

IV. DISCUSSION

It is very interesting to note that by using the concept of displacement current found from Maxwell's equation's the current density is frequency dependent see equation (7). Using the ordinary expression of electric power equations (4) and (5) shows that the power is frequency dependant. Using these relations with the power relation found from photon concept. It is clear that the energy of a single photon can be found from Maxwell's equations which describe the wave behaviour of electromagnetic waves. The Plank constant can be obtained by adjusting the free parameter co.

Section (3) shows also that the wave and particle natures of photons are co related. It shows that using plank photon energy one can find the classical expression for harmonic oscillator as show by equations (3&5).

V. CONCLUSION

The wave and particle nature of electromagnetic waves can be shows to be co related by using simple arguments based on the notion of displacement current and classical harmonic oscillator energy.

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