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Electromagnetic Radiation Energy and Planck' Constant

Mahmoud E. Yousif
Physics Department - The University of Nairobi
P.O.Box 30197 Nairobi-Kenya

ABSTRACT -- The components of Electromagnetic Radiation (EM-R) mechanism are analyzed; these includes the Flipping Time (t_F), and the Flipping Frequency (f_F); the condition initiating F-F and the formation of EM-R is suggested with a new formula for the speed of light c; the energy is classified into the input Kinetic Energy (E_k) and the output Radiation Energy (E_R), with a new formula derived for the output Radiation Energy (E_R), this formula is compared with the input Kinetic Energy (E_k); different structural formulas for Planck' Constant and its relations to Flopping Time (t_F) and Flopping Frequency (f_F) are derived and analyzed, and a relationship is establish between the two Flip-Flop Times $(t_{F1\ \&}\ t_{F2})$ and the combined energies of Circular Magnetic Field (CMF) and Electric Field (EF), as this relation produced EM-R, it also gives the products of Flipping Times (t_{F2}) and both CMF-EF, forming the Planck' Constant (h).

Keywords: Electromagnetic radiation Energy; Planck' Constant; Flip-Flop; Circular Magnetic Field; Electric Field.

I. Introduction

Planck presented new expression for entropy and radiation formula [1], which draw attention when Einstein published his photoelectric effect [2], Planck's paper resolved the blackbody radiation by visualizing energy as discrete quantity, composed of integer number of finite equal parts, in which the energy ε is proportional to the number of frequency ν [1], the paper managed to resolve the blackbody radiation because it captured the essence of energy transformation engulfed within the Planck' constant *h*, which to Planck remained a mystery, till Einstein explained the photoelectric effect [3], Planck also considered the difficulty in his constant *h* because it represents the product of energy and time [4] a relation which is difficult to conceived; while Einstein linked electrons "oscillators" with electromagnetic waves in 1905 [2], then in 1909 he introduced the wave-particle duality, stating that, energy and momentum split into a wave dominated in the Rayleigh-Jeans low-frequency region of the spectrum and a particle term dominated in the Wien's law high-frequency region [5], the duality in that lecture carried the current conception of photon, in which he associated electromagnetic fields of light with singular points, similar to electrostatic fields, and surrounded by fields of force that superposed to give the electromagnetic wave of Maxwell's classical theory [6], that presentation bridge the gap of knocking and removing photoelectron in his interpretation to the photoelectric effect [7], the mass-less photon became a controversial concept, thought to couple electric charges and electric or magnetic multi-poles by discrete irreducible process of photon emission and absorption connected by continuous processes of propagation [8], these lead some to think that Electromagnetic Radiation (EM-R) doesn't carries energy, while others gave it some percentage [9] because photon carries the rest [5], despite the fact that both electric and magnetic fields are energies [10], and all indications showed light as wave in nature rather than corpuscular when Hertz discovered electromagnetic waves in 1887 [11], that is why some urged stop using the word "photon," because radiation does not consist of particles [11], and Bohr regarded light-quanta, as "unable to throw light on the nature of radiation" [5].
The Planck' constant had been used perfectly during the past one century and regarded as a constant of nature [1], the constant *h*, a quantity with dimensions of an "action," an energy multiplied by a time, was taken to represent a momentum multiplied by a distance [11], but what if Planck constant turned to represents a quantity associated with the transformation of Electromagnetic Radiation? Although Planck accepted "quantum" explanation of atom, but he rejected extending it to EM-R, stating that "*instead of quantized electromagnetic fields, the problem of the quantum theory should be transfer to the area of interaction between matter and radiation energy*," [6], the disputes around quantized EM-R and the photon emerged from the breaks down of Electromagnetic Radiation (EM-R) into discrete jumps, or quanta, only detected under sufficient resolution [8], that was the point behind the formation of strong belief in the quantization of EM-R, solved by the Quantum Theory of Radiation (QTR), which lay out some guess rules and worked with it accordingly [11].

The recent paper titled "*The Electromagnetic Radiation Mechanism*" [12] suggested a mechanism for the production of Electromagnetic Radiation (EM-R); based on the Circular Magnetic Field (CMF) produced by energetic charged particles [13], facilitated by the Magnetic Interaction (***MI***) which explained the true nature of the magnetic force [14], after been confused with electric quantities [15], narrowing the scope of interpretation and analysis; the suggested new base strengthened with the Spinning Magnetic Field (*SMF*), Spinning Magnetic Force (SMF_C), and the nuclear force [16], all of which explained the interatomic forces and spectral line and the microscopic mechanisms [14].

This is the second part after EM-R mechanism [12], this paper utilized the above concepts to further investigate the EM-R transformation mechanisms of Flip-Flop (F-F), conditioned by the established constant relation between CMF radius (r_F) and the strong magnetic field or nucleus Spinning Magnetic Field (B_{1U} *or* B_{2e}), the F-F mechanism including the Flipping-Time ($t_{F)}$, Flipping-Frequency (f_F), Flipping-velocity (v_F) and Flipping-Distance (d_F); with a formula establishing the speed of light c which can explained its nature; as well as a new formulas for radiation energy (E_R), different from the kinetic energy (E_k), the structure of *energy-time* resulted in Planck' constant *h* is investigated and explained in different context, relating the Flipping-Time (t_F), Flipping-Frequency (f_F) and both kinetic energy (E_k) and Radiation energy (E_R), and attaining the Planck' constant (h) in various formations; the Planck' constant *h* is also investigated and derived within the variation of ***CMF*** during the Flip-Flop mechanism.

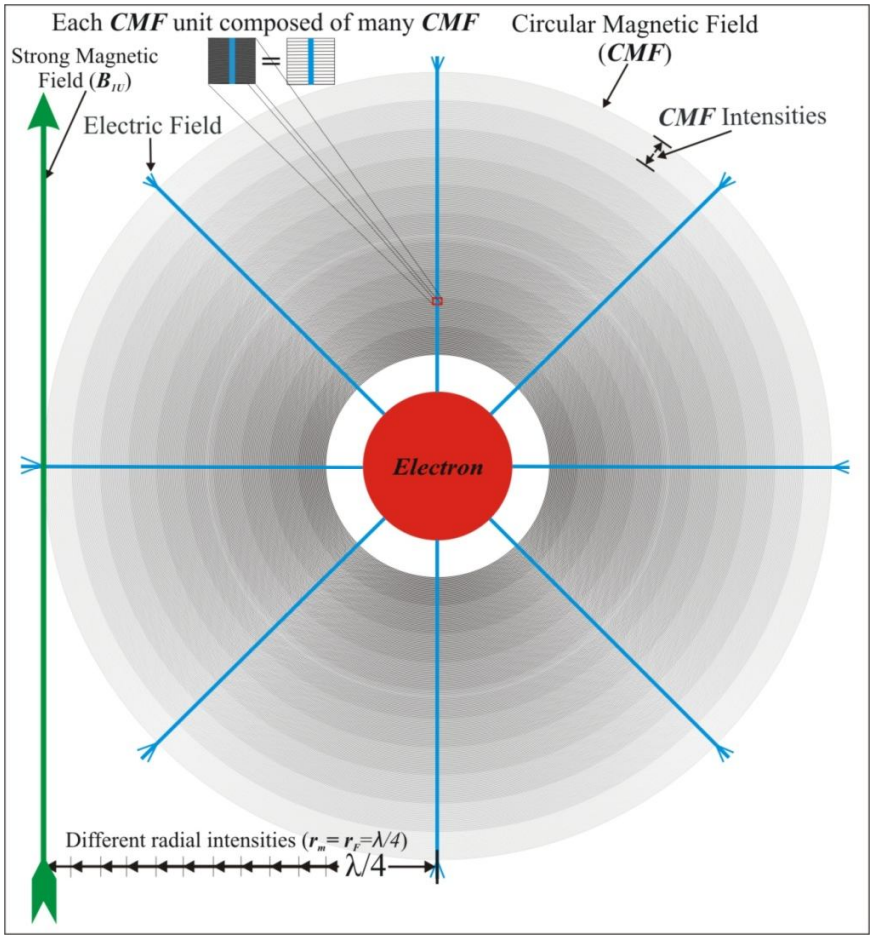

Fig. 1. The interaction between both the Circular Magnetic Field (***CMF***) and Electric Field (***EF***), produced by energetic electron and strong magnetic field (B_{IU}), can produce discrete Electromagnetic Radiation (EM-R), the characteristics of which is determined by the magnetic radius r_m of the ***CMF***, which is the Flipping Radius r_F, both related to the wavelength λ by ($r_m = r_F = \lambda/4$).

As the paper is an extension to the "Electromagnetic Radiation Mechanism" [12], aimed at investigating the contradiction between the suggested atomic model [14] and the electron diffraction phenomenon [17] interpreted as wave particle duality [18]; the method used in both studies is based on creating a model from the ambiguous characteristics of the Circular Magnetic Field (***CMF***), then comparing and testing the final results with available data, such as given in Tables 1&2 and Figs (1,2 and 4).

Understanding Electromagnetic Radiation Mechanism, radiation energy, Planck' constant and related phenomena is an important aspect and the main steps to understand the internal mechanism of nature, and to a better understanding to our position in the Universe based on accurate scientific knowledge, rather than imaginative speculations.

II. The Flip-Flop Time Synonymous to The Radiation Time

The Magnetic Force (F_m) and Lorentz Force (F_L) were proven to be equal [14], both given by

$$F_m = B_{1U} B_{e/p} r_m^2 c = B_{1U} q v \quad (1)$$

Where, $\boldsymbol{B_{1U}}$ is the magnetic force around which electron/proton gyrate, or nucleus Spinning Magnetic Field (SMF) [14] in Tesla, $\boldsymbol{B_{e/p}}$ is the Circular Magnetic Field (***CMF***) produced by charged particles (electron and proton) in Tesla, r_m is the magnetic radius in meter, c is speed of light in m.s^{-1}, and Magnetic Force F_m is in Newton.

The Flip-Flop (*F-F*) of combined Circular Magnetic Field (***CMF***) and Electric Field (***EF***) produced by energetic electron shown in Fig.1, initiated by precession motion, resulted in the *FF* movement showed in Fig.2-A, due to the Flipping Force $(\boldsymbol{F_F})$ [12], given by

$$F_F = B_{1U} B_{e/p} r_F^2 c = m a \quad (2)$$

Where, m is electron's or proton's mass in kg, r_F is the Flipping radius in meter, a is acceleration in $m.s^{-2}$ and the Flipping Force $(\boldsymbol{F_F})$ is in Newton.

Using the Lorentz Force (F_L) in Eq.(1), the Flipping-Force $(\boldsymbol{F_F})$ is expressed by

$$F_F = q B_{1U} v_F \quad (3)$$

Where, v_F the Flipping Velocity in m.s^{-1}, from Eq.(3), the v_F is given by

$$v_F = \frac{F_F}{q B_{1U}} \quad (4)$$

Arranging Eq.(4) the Flipping velocity v_F, is given by

$$v_F = \frac{q B_{1U} r_F}{m} \quad (5)$$

Replacing the velocity in Eq.(5) with distance over time (d/t), hence, the Flipping-Time (t_F) taken by ***CMW*** to Flip between distance d_F shown in Fig.2-A, is given by

$$t_F = \frac{m d_F}{q B_{1U} r_F} \quad (6)$$

Where, d_F is the Flipping-Distance along which ***CMF*** moves forth and back as shown in Fig.2-A, $\boldsymbol{B_{1U}}$ is strong magnetic field shown in Fig.1 and given in Table.1, or the Nucleus Spinning Magnetic Field (***N-SMF***) in atom as given in Table.2 [14], the strong magnetic field initiate the generation of EM-Wave by transforming electron's or proton's ***CMF-EF*** while gyrating around that strong magnetic field, (or when cyclotron radiation is produced), and r_F $(or\ r_m)$ is the flipping radius or the CMF radius, shown in Fig.2-B.

Table I Parameters of Electromagnetic Radiation (EM-R), Each Equation in This Paper can Be Verified Using These Parameters; From Upper Left are: Electron's Velocity (V), Kinetic and Radiation Energy (E_k & E_R), Flipping Frequency (f_F), Flipping Time (t_F), Wavelength (Λ), Flipping Radius ($r_F = \lambda/4$, Circular Magnetic Field ($\boldsymbol{B_{CMF}}$), Electric Field ($\boldsymbol{EF}$), and The Strong Magnetic Field ($\boldsymbol{B_{1U}}$).

V	E	f	t_F	λ	λ/4	B_{CMF}	EF λ/4	B_{1U}
3.814156836 4400215819 5654429480 61×10^{+5}	6.626075 5×10^{-20}	1.0×10^{+14}	1. ×10^{-14}	3. ×10^{-6}	7.5×10^{-7}	3.621307031 9459084345 6089618623 95×10^{-10}	2.560635412 7466666666 6666666666 67×10^{+3}	7.144775106 8120606978 2082048818 39×10^{+3}
3.814156836 4400215819 5654429480 61×10^{+6}	6.626075 5×10^{-18}	1.0 ×10^{+16}	1. ×10^{-16}	3. ×10^{-8}	7.5×10^{-9}	3.621307031 9459084345 6089618623 95×10^{-5}	2.560635412 7466666666 6666666666 67×10^{+7}	7.144775106 8120606978 2082048818 39×10^{+5}
1.206142295 6252779358 7978230112 35×10^{+8}	6.626075 5×10^{-15}	1.0 ×10^{+19}	1. ×10^{-19}	3. ×10^{-11}	7.5×10^{-12}	1.145157832 7733205830 0194418263 43×10^{+3}	2.560635412 7466666666 6666666666 67×10^{+13}	7.144775106 8120606978 2082048818 39×10^{+8}

From Eq.(6) the Flipping distance (d_F) shown in Fig.2-A, is given by

$$d_F = \frac{q\, B_{1U}\, r_F\, t_F}{m} \qquad (7)$$

Knowing the parameters in Eq.(7) thus, the Flip-Flop distance (d_F) at the end of which *EMW* disintegrates, as shown in Fig.2-A, is

$$d_F = \lambda\, \pi = 4\pi r_F \qquad (8)$$

But as mentioned and shown in Fig.2-A, the flipping radius $r_F = \lambda/4$, substituting $4\pi r_F$ from Eq(8) with d_F in Eq.(7), hence the following is derived

$$4\pi r_F = \frac{q\, B_{1U}\, r_F\, t_F}{m} \qquad (9)$$

Therefore the Flip-Flop time (t_F), during which a single EM-Wave disintegrates (or generates) is given by

$$t_{FA} = \frac{4\,\pi\, m}{qB_{1U}} \qquad (10)$$

Eq.(10) determined the time during which EM-Wave is generated for charged particles (electrons and protons), from which the Flipping Frequency (f_F) is given by

$$f_{FA} = \frac{qB_{1U}}{4\,\pi\, m} \qquad (11)$$

Where the Flipping Frequency (f_F) is in Hertz, the frequency in Eq.(11), can be obtained directly for electrons by

$$f_{FA} = 1.399624179978 \times 10^{10}\ B_{1U} \qquad (12)$$

Table.2. Variation of Spinning Magnetic Field (***SMF***) or ($\boldsymbol{B_{1U}}$) Magnitudes In Hydrogen Atom With Change In Level Radius (r_n), Resulted From Change in Level Velocity v_F, Caused by Level Excitation Potential (E_n), Resulted in Radiation of Spectral Line With Wavelength Λ [14], Given also The Supposed B_{1U} According to Eq.(14).

n	E_n (eV)	v_E $(m.s^{-1})$	r_n (m)	*SMF*-B_{1U} (T)	λ (Å)
1.61**6988106**	13.62	2,188,769.29	9.06x10^{-11}	137,356.12	00,911.00
		Supposed		235,283.48	00,911.00
2	10.21	1,894,729.27	8.40x10^{-11}	128,285.53	01,215.69
		Supposed		176,314.07	01,215.69
30	0.47	406,111.63	5.79x10^{-11}	039,901.40	026,462.29
		Supposed		008,099.95	026,462.29
120	0.11	200,586.98	5.65x10^{-11}	020,196.26	108,470.80
		Supposed		001,976.05	108,470.80

III. Electromagnetic Radiation (EM-R) Energy

The variation of both ***CMF-EF*** shown in Fig.1, during the Flip-Flop (*F-F*) movements, as resulted in Fig.2-A&B, is carried when specific conditioned occurred, that is when the CMF radius and the strong force has specific magnitude, given by

$$k_r = r_F \cdot B_{1U} = 5.3585813301090455233656153661379e-3 \quad (13)$$

Where, k_r is the due to the radius with value equal to 5.3585813301090455233656153661379e-3 Meter . Tesla, and since $r_F = \frac{\lambda}{4}$, substituting in Eq.{13}, the constant *k* is given by

$$k_\lambda = \lambda \cdot B_{1U} = 2.1434325320436182093462461464551e-2 \quad (14)$$

Where, k_r is the constant due to the wavelength with value equal to 2.1434325320436182093462461464551e-2 meter Tesla. Fulfillment of this condition lead to Flip-Flop and the change in both fields, and the following is obtained [12]

$$\frac{\partial BE}{\partial t} = CMF + EF \quad (15)$$

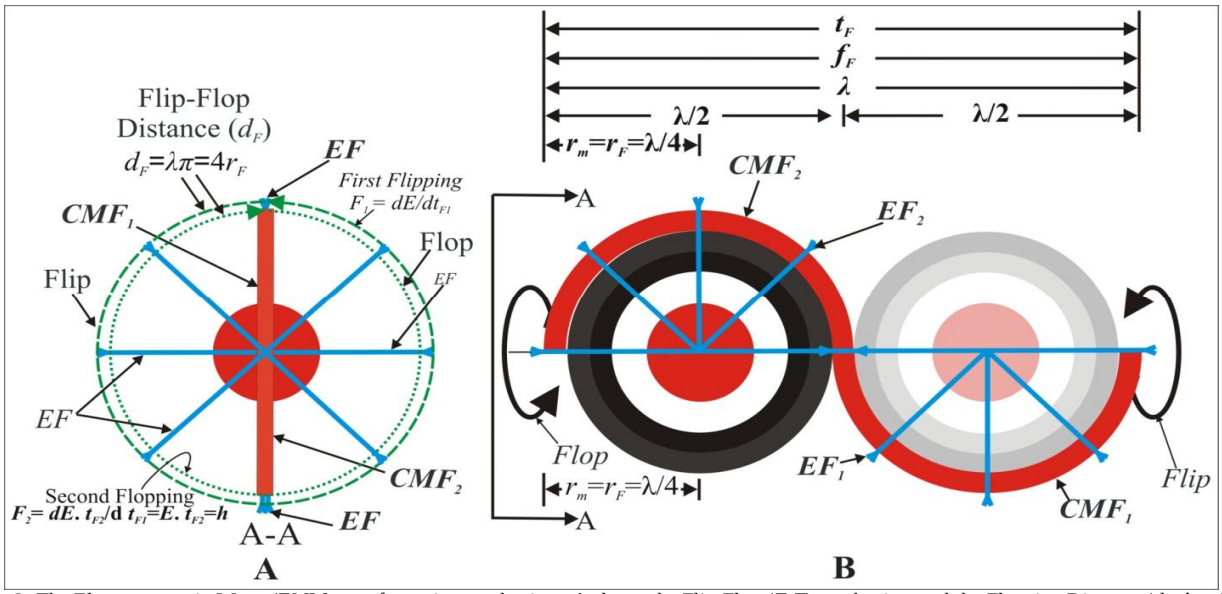

Figure 2. The Electromagnetic Wave (*EMW*) transformation mechanism; A shows the Flip-Flop (*F-F*) mechanism and the Flopping Distance ($d_F=\lambda\pi=4r_F\pi$), B shows the disintegration of both ***CMF-EF*** from the electron.

The EM Wave (EMW) resulted from Flip-Flop (*F-F*) movements lead to the split of the combined ***CMF-EF*** as a transverse wave consisting of ***MF*** perpendicular to ***EF*** and both are perpendicular to the direction of propagation as shown in Fig.3-A,B&C [12], this is given by

$$EMW = \frac{1}{2}(CMF + EF) + \frac{1}{2}(CMF + EF) \quad (16)$$

From Eq.(14), the electromagnetic Radiation (EM-R) was given by [12]

$$EMR = \frac{1}{2}(B_1 + E_1) + \frac{1}{2}(B_2 + E_2) \quad (17)$$

Where, EM-R is electromagnetic radiation, the above becomes

$$EMR = (B + E) \quad (18)$$

Transformation sequences of both ***CMF-EF*** are shown in Fig.3-A-B&C, to finally propagate away from the charged particle source, they can be described as an electromagnetic plane waves composed of electric field (***EF***) and magnetic field (***MF***) traveling along the x-axis (Fig.3-C) with speed of light c, which is derived from Eq.(11) in term of the CMF radius as

$$c = \frac{qB_{1U}\, r_F}{\pi\, m} = 5.59849671991252748143256370029 99e + 10\ B_{1U}\, r_F \quad (19)$$

Since $\lambda=4r$ hence, the speed of light given in Eq.(19) in term of radius, is given in term of wavelength by

$$c = \frac{qB_{1U}\, \lambda}{4\,\pi\, m} = 1.39962417997813187035814092507 5e + 10\, B_{1U}\, \lambda \quad (20)$$

The EM-W given by Eq. (18) is also has an associated energy density [10], given by

$$\frac{PE}{V} = \frac{1}{2}\left(\varepsilon_0 E^2 + \frac{B^2}{\mu_0}\right) \quad (21)$$

Where, ***E*** is the electric field, ***B*** is magnetic field, and both are varying in sinusoidal manner, PE is potential energy, V is unit volume, ϵ_0 is the permittivity of free space, and μ_0 is permeability of free space, the energy density is in Jm^{-3}; as shown in Fig.3-C, the contribution of both fields given by Eq.(21) is equivalent to Eq.(18) therefore, the analysis [10] is in line with Flip-Flop (*F-F*) mechanism generating *EMW* [12], and the energy density is

$$\frac{PE}{V} = \frac{1}{2}\,(\varepsilon_0 E^2 + \varepsilon_0 E^2) = \varepsilon_0 E^2 \quad (22)$$

It was suggested that, in EM-R, the instantaneous electric and magnetic energies are equal [19], and since ***EF*** is half contain of *EMW*, hence the energy and power in *EMW* is represented by the square of the magnetic field [10], but why the derived energy given by Eqs. (21 and 22) couldn't produce energy measured and derived by Planck? [1] And since the intensity of *EMW* is a measurable quantity; and detectors can measure the amount of energy per unit time and unit area that reach them [10], therefore measurement is the only true representation of *EMW*, which was carried by Planck.

IV. The Kinetic and Radiation Energies

The failure of EM Radiation (EM-R) to account for radiated energy, lead some to question the ability of *EMW* to carry energy, and how much that energy could be? [9], this after the duality and the introduction of photons which was perceived as having momentum [7], thought to carry that energy; even though both electric and magnetic fields are energies in themselves [10], and Eqs.(17&18) truly demonstrates the existence of that energy, but they failed to account for the whole black body radiation measured by Planck [1], hence the following is an attempt to look into this from different perspective.

Charge in motion produced Circular Magnetic Field (***CMF***) [13], the magnitude of which for electron ($\boldsymbol{B_e}$) and proton ($\boldsymbol{B_p}$) [20, 21, 22], is given by

$$B_{CMF} = \frac{q\, v}{r_m^2\, c} \quad (23)$$

Where, v is electron or proton velocity in $\mathrm{m.s^{-1}}$, c is the speed of light $\mathrm{m.s^{-1}}$, r_m the magnetic radius in meter, and $\boldsymbol{B_{CMF}}$ (or $\boldsymbol{B_e}$ and $\boldsymbol{B_p}$) is the magnitude of the ***CMF*** in Tesla; while the kinetic energy of the charged particle producing the ***CMF***, is given by

$$E_k = \frac{m\,v^2}{2} \tag{24}$$

Where, m is electron or proton mass in kg. The conclusion reached by Planck that, "energy element ε is proportional to the number of vibrations v," giving his famous equation [1], is

$$\varepsilon = h\,f \tag{25}$$

Where, h is Planck' constant in J.s, f is the frequency in Hertz, and ε is the Energy in Joules.
Although Planck's constant h was interpreted as proportionality between adjacent energies and frequencies showing radiation as discrete energy quanta or photon [7], contrary to that Planck himself considered quantum discontinuity as a kind of mathematical hypothesis, an artifact that doesn't reflects the real energy exchanges between matter and radiation [23], but Planck's quantization condition given by Eq.(25), was taken to implies that energies of these different modes of electromagnetic radiation lie in a discrete spectrum [7], but as Fig.3 shows, the EM-R released during the Flip-Flop (*F-F*) as given by Eq.(15), is just the energy contained within specific radius of ***CMF*** as shown in Fig.1 and given by Eq.(23), therefore the velocity due to energy given in Eq.(24), is the main factor behind the production of ***CMF*** ($\boldsymbol{B_{CMF}}$) as given by Eq.(23), and since square of the magnetic field $\boldsymbol{B_{CMF}}$ represents the radiated energy [10], therefore by replacing v in Eq.(23), with v in Eq.(24), a different energy formula is derived and named the radiation Energy ($\boldsymbol{E_R}$), and given by

$$E_R = \frac{B_{CMF}^2\, m\, r_m^4\, c^2}{2q^2} \tag{26}$$

Since the radius of *EMW* shown in Fig.2, is $r_m = r_F = \lambda/4$, replacing (r_F) in Eq.(26), the following is obtained

$$E_R = \frac{B_{CMF}^2\, m\, r_F^4\, c^2}{2q^2} \tag{27}$$

Substituting $\boldsymbol{E_R}$ with hf in Eq.(27), hence a second Flipping Frequency (f_{FB}) is given by

$$f_{FB} = \frac{B_{CMF}^2\, m\, r_F^4\, c^2}{2q^2 h} \tag{28}$$

The frequency given by Eq.(28) is the same as that given by Eq.(11), and since $t_F = 1/f$ therefore second Flipping Time (t_{FB}) equation is

$$t_{FB} = \frac{2q^2 h}{B_{CMF}^2\, m\, r_F^4\, c^2} \tag{29}$$

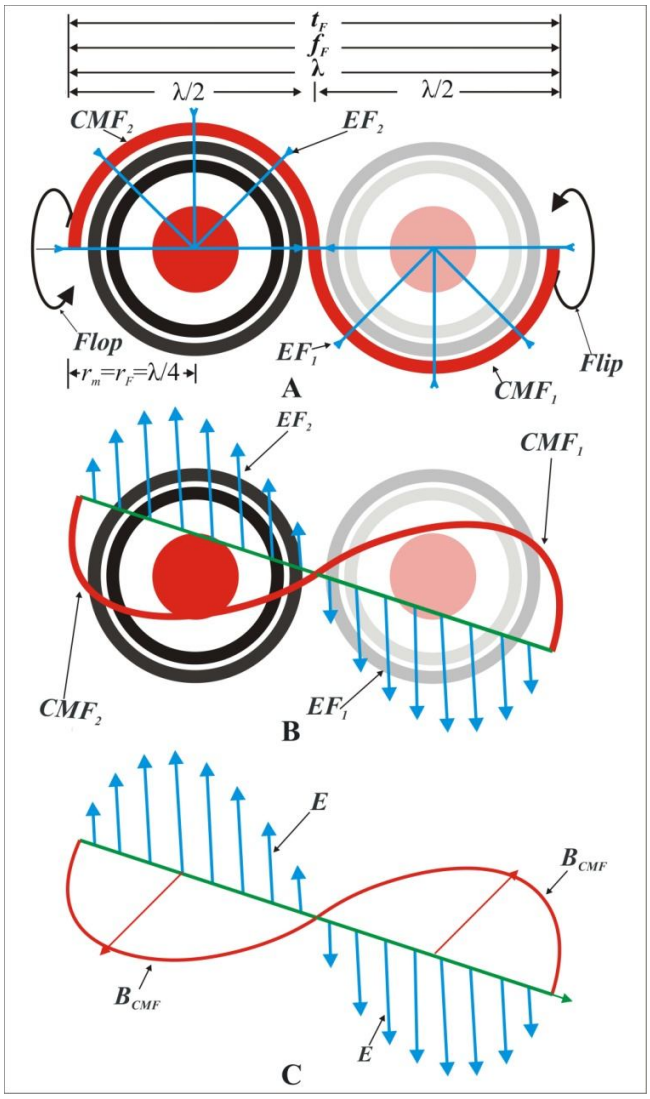

Figure 3. Sequential production of Electromagnetic Radiation (EM-R), in A the Flip-Flop of both Circular Magnetic Field (***CMF***) and Electric Field (***EF***), leads to disintegration of both ***CMF-EF*** as shown in B, while C shows the structured and direction of ***EM-R*** [12].

V. EM Radiation and Planck Constant-1

Since $r_\lambda = \lambda/4$, substituting in Eq.(27), the energy is given by

$$E_R = hf = \frac{B_{CMF}^2 \, m \, c^2 \lambda^4}{2\,(4)^4 \, q^2} \tag{30}$$

Dividing both parts of Eq.(30) on frequency *f*, the Planck' constant is given by

$$h = \frac{B_{CMF}^2 \, m \, c^2 \lambda^4}{2\,(4)^4 \, f \, q^2} \tag{31}$$

From Eq.(31), the Planck' constant contained elements of energy and time, therefore Eq.(31) can be written as

$$h = E_R \times t_{FA} = \frac{B_{CMF}^2 \, m \, c^2 r_F^4}{2 f_{FA} q^2} \tag{32}$$

Since $t = 1/f$, hence replace this in Eq.(31) the following is obtained

$$h = E_R \times t_{FA} = \frac{B_{CMF}^2\, m\, c^2 \lambda^4 t_{FA}}{2\,(4)^4\, q^2} \tag{33}$$

VI. EM Radiation and Planck Constant-2

Replacing t_{FA} in the left hand side of Eq.(33), with the Flop-Flop time t_{FA} given by Eq.(10), the following is obtained

$$h = E_k \times \frac{4\,\pi\, m}{q B_{1U}} = \frac{B_{CMF}^2\, m\, c^2 \lambda^4 t_{FA}}{2\,(4)^4\, q^2} \tag{34}$$

Replacing the symbol of energy $\boldsymbol{E_k}$ in Eq.(34) with the right hand of Eq.(24), the Planck constant is given by

$$h = \left\{\frac{mv^2}{2} \times \frac{4\pi\, m}{q B_{1U}}\right\} = \left\{\frac{B_{CMF}^2\, m\, c^2 \lambda^4 t_{FA}}{2\,(4)^4\, q^2}\right\} \tag{35}$$

Since $t_F = 1/f_F$, hence replacing this in the right hand side of Eq.(35), the Planck constant is also given by

$$h = \left\{\frac{mv^2}{2} \times \frac{4\pi\, m}{q B_{1U}}\right\} = \left\{\frac{B_{CMF}^2\, m\, c^2 \lambda^4}{2\,(4)^4 f_{FA}\, q^2}\right\} \tag{36}$$

But as showed in both parts of Eq.(35) the time appeared directly in both the left hand and the right hand sides of Eq.(35), this relation is expressed as

$$h = \{E_k \times t_{FA}\} = \{E_R \times t_{FA}\} \tag{37}$$

Eq.(37) shows the role of Flipping time (t_{FA}) in the formation of Planck' constant, and since Eq.(37) is equivalent to Eq.(35) and Eq.(36), therefore this structure is what Planck constant stand for, by multiplying Eq.(35) by frequency *f*, the energy of EM-Radiation is given by

$$E = hf = \left\{\frac{mv^2}{2} \times \frac{4\,\pi\, m}{q B_{1U}}\right\} f = \left\{\frac{B_{CMF}^2 m\, c^2 r_\lambda^4\, t_{FA}}{2q^2}\right\} f \tag{38}$$

Since as shown in Fig.2-B the Flipping frequency and Flipping time are emanating from the transformation of *EMW*; therefore, from Eq.(38), it is clear that, "*the multiplication of Planck' constant by frequency f is merely the removal of* Flipping time (t_{FA}) *or Flipping Frequency* $(1/f_F)$ *from the energy contained formula*." Hence, what is EM Radiation?

From Eq.(38), the EM Radiation could be defined as "*the momentary transformation of discrete structure of the Circular Magnetic Field (CMF) and Electric Field (EF) of an energetic charged particle during the Flip-Flop time, into EM-R moving with speed of light.*"

Eq.(38) showed the existence of two energies, the kinetic input energy before the Flip-Flop (*F-F*) and the radiation output energy after the Flip-Flop; rearranging the left hand side of Eq.(38), the following is obtained

$$E = hf_{FA} = \left\{\frac{2\,\pi\, m^2 v^2}{q\, B_{1U}}\right\} f = \left\{\frac{B_{CMF}^2\, m\, c^2 r_\lambda^4\, t_{FA}}{2q^2}\right\} f \tag{39}$$

From the right hand side of Eq.(35), the Planck' constant is given by

$$h = \frac{B_{CMF}^2\, m\, c^2 \lambda^4 t_{FA}}{2\,(4)^4\, q^2} \tag{40}$$

Planck' can also be given by

$$h = \frac{B_{CMF}^2\, m\, c^2 r_F^4\, t_{FA}}{2q^2} \tag{41}$$

Planck' can also be given by

$$h = \frac{2\,\pi\, B_{CMF}^2\, m^2\, c^2 r_F^4}{q^3 B_{1U}} \tag{42}$$

Or by

$$h = \frac{2\,\pi\, m^2 v^2}{q\, B_{1U}}\ J.s \tag{43}$$

From Eq.(43), the radiation energy is given by

$$E_R = h\, f_{FA} = \frac{2\,\pi\, m^2 v^2 f_{FA}}{q\, B_{1U}} \tag{44}$$

Dividing Eq.(43) by the t_F, the radiation energy is given by

$$E_R = \frac{h}{t_F} = \frac{2\,\pi\, m^2 v^2}{q\, B_{1U}\, t_F} \tag{45}$$

From Eq.(42), the energy is given by

$$E_R = h\, f_{FA} = \frac{2\,\pi\, B_{CMF}^2\, m^2\, c^2 r_F^4 f_{FA}}{q^3 B_{1U}} \tag{46}$$

Since the energy of EM radiation is determined by Flip-Flop time (t_{FA}) as given by Eq.(38), which is the inverse of the frequency, hence what determined the wavelength of *EMW*?

From Eq.(27) the wavelength is

$$\lambda = \sqrt[4]{\frac{2\,(4^4)\, q^2 E}{B_{CMF}^2 m\, c^2}} \tag{47}$$

Therefore modeling Eq.(47), a third Flipping time (t_{FC}) can be given by

$$t_{FC} = \sqrt[4]{\frac{(4^4)\, q^2\, v^2}{B_{CMF}^2\, c^6}} \tag{48}$$

Since $f_F = 1/t_F$, hence from Eq.(48) a third Flipping Frequency (f_{FC}) is given by

$$f_{FC} = \sqrt[4]{\frac{B_{CMF}^2\, c^6}{(4^4)\, q^2\, v^2}} \tag{49}$$

Replacing the formula representing t_{FA} in the left hand of Eq.(35), with the Flip-Flop time (t_{FB}) given by Eq.(29), the following is obtained

$$h = \frac{mv^2}{2} \times \frac{2q^2 h}{B_{CMF}^2\, m\, r_F^4\, c^2} \tag{50}$$

Replacing t_{FA} in Eq.(41), with the Flip-Flop time (t_{FC}) given by Eq.(48), the Planck' is obtained as

$$h = \frac{B_{CMF}^2 m\, c^2 r_\lambda^4}{2q^2} \times \sqrt[4]{\frac{(4^4)\, q^2\, v^2}{B_{CMF}^2\, c^6}} \quad (51)$$

Multiplying the energy given by Eq. (30), by the Flop-Flop time (t_{FA}) given by Eq.(10), the following is obtained

$$h = \frac{B_{CMF}^2 m\, c^2 \lambda^4}{2\,(4)^4\, q^2} \times \frac{4\,\pi\, m}{q B_{1U}} \quad (52)$$

The Planck' constant given by Eqs.(31; 32; 36) composed of energy divided by frequency, while Eqs.(33; 34; 35; 40; 41) composed of energy multiplied by Flopping time(t_{FA}), in Eqs. (42 and 43) the time given by Eq.(10) contained within both equations; in Eq.(50) the kinetic energy (E_k) is multiplied by Flipping time (t_{FB}), in Eq.(51) the radiation energy (E_R) is multiplied by Flopping time (t_{FC}) and in Eq.(52) the radiation energy (E_R) multiplied by the Flipping time (t_{FA}), while Eq.(44) energy is obtained by multiplying $h \times f_F$, while Eq.(45) energy is obtained by dividing $\frac{h}{t_F}$.

In all these relations, the time *t* stands for the Flopping time t_F, and both the Flipping time and the energy are related to the transformation process given by Eq.(15), therefore from this analysis the Planck' constant represent "*the product of Flip/Flop time and the Radiation Energy* (E_R) *of combined Circular Magnetic Field (CMF) and Electric Field (EF)*", hence this relation can be expressed as

$$E_R = \frac{h}{t_{F1/2}} \quad (53)$$

From Eq.(53), Planck' constant is given by

$$h = \varepsilon_R\, t_{F1/2} \quad (54)$$

As Planck's constant (*h*) was a mystery, till photoelectric effect was resolved [3], and Planck regarded energy "as made up of a completely determinate number of finite equal parts" [23], and Eq.(50), Eq.(51) and Eq.(52) gives the formula and value of Planck' constant [1] in three different forms, and as shown in Fig.1, the enlarged square contain smaller radial distances, each represents discrete amount of energy enclosed within related ***CMF-EF***, the intensity of which is specified by the flipping radius r_F which is quarter of the wavelength $(r_F = \lambda/4)$; and Planck realized the difficulty in explaining his constant lay in that it contain the product of energy and time [4] as given in all above equations and emphasized on Eq.(54), but realizing that the Flip-Flop movements composed of two opposite movements, as shown in Fig.2-A, these are t_{F1} *and* t_{F2}, and since magnetic and electric fields are energies [10], therefore the variation of both ***CMF-EF*** as shown in Fig.2-A, during the Flip-Flop movements, in sequences resulted in EM-R transformation, shown in Fig.3, and given by Eq.(15), thus the first Flip (F_1) movement disintegrating the first half of EMW_1 given by Eq.(16), is expressed by

$$\frac{1}{2} EMW_1 = \frac{d\varepsilon_1}{dt_{F1}} \quad (55)$$

Where, ε is the combined ***CMF-EF*** energy, and the second Flop (F_2) disintegrating the second half of EMW_2 is expressed by

$$\frac{1}{2} EMW_2 = \frac{d\varepsilon_2}{\frac{dt_{F1}}{dt_{F2}}} \quad (56)$$

But the second disintegration given by Eq.(56), is the transformation of EM-R, expressed as

$$EMW = \frac{d\varepsilon . t_{F2}}{dt_{F1}} \quad (57)$$

This relation, given by Eq.(57), can be expressed as

$$E_R = \frac{\varepsilon_R \,.\, t_{F2}}{t_{F1}} \quad (58)$$

The above relation, can be expressed as

$$\varepsilon_R = \frac{(B \cdot E) \cdot t_{F2}}{t_{F1}} = \frac{h}{t_{F1}} = CMF + EF \quad (59)$$

From Eq.(59) the following emerged

$$\varepsilon_R t_{F1} = (B \cdot E) \cdot t_{F2} = h = (CMF + EF) t_{F1} \quad (60)$$

Therefore, the Planck' constant *h*, is given by

$$h = \varepsilon_R \, . t_{F1} = (B \cdot E) \cdot t_{F2} = (CMF + EF) t_{F1} \quad (61)$$

Therefore, from these relations, the "*Planck' constant is the product of the second Flop time movement and both Circular Magnetic Field (**CMF**) and Electric Field (**EF**) energies.*"

With above as a bases, the multiplication of Radiation Energy E_R given by Eq.(30), by the first Flopping time t_{FA} given by Eq.(10), divided by the second Flopping time t_{FB} given by Eq.(29), gives the radiation energy; this relation is expressed as

$$E_R = \frac{h}{t_F} = \frac{E_R t_{FA}}{t_{FB}} = \frac{\pi \, B_{CMF}^4 \, m^3 \, c^4 \, \lambda^4 \, r_\lambda^4}{4^4 \, h \, q^5 \, B_{1U}} \quad (62)$$

The multiplication of Planck' constant *h* by Frequency as shown in Eq.(38) or Eq.(44) is merely a removal of the Flipping Time which is $(1/f_F)$ from the upper denomination, or removal of time t_{FA} from the formula as given in Eq.(38) or as given in Eq.(45), therefore the existence of time/frequency in the Planck' constant *h* only referred to the Flip-Flop time, or the period during which energetic ***CMF*** disintegrates, and since frequency is the number of occurrences of a repeating event per unit time [24], hence whenever condition given by Eq.(13) or Eq.(14) is satisfied, Flip-Flop occurred in which discrete ***CMF-EF*** energy is transformed into *EMW*; therefore the frequency means the repetition of energy transformation in unit time of Flip-Flop, and Planck' constant is the energy transformation in that unit time of Flip-Flop. Therefore the multiplication of frequency by Plank' constant is just the removal of time or frequency from the equation as demonstrated by Eq. (39), Eq.(44), Eq.(45) and Eq.(46).

VII. Conclusion

Electromagnetic Radiation (EM-R) is produced through the Flip-Flop (*F-F*) transformation process, when specific condition relating CMF radius r_F (or the wavelength) and the strong magnetic Field (B_{1U}) is satisfied; the process involved the Flip-Flop (*F-F*) of the combined Circular Magnetic Field (***CMF***) and the Electric Field (***EF***), the two movements of Flip-Flop (*F-F*) resulted in Flipping-Time (t_F) which is the period during which these movements are completed; this time is inversely to related Flipping-Frequency (f_F), and both are related to the wavelength (λ) and the Flipping Radius (r_F).

The EM-R is released with the speed of light c, which for the first time is expressed in term of the really mechanism which take place between strong field, flipping radius (or wavelength), charged, mass and pi, as given by Eqs. (19&20); not as given by Maxwell between permeability and permittivity of free space.

The amount of energy represented by the Circular Magnetic Field (***CMF***) and the Electric Field (***EF***) formed discrete energy, the amount of which is determined by the Flopping radius (r_F) which is quarter of the wavelength $(1/4\lambda)$, while the product of the second Flopping time and both ***CMF*** and ***EF*** energy produced the Planck' constant (*h*).

The Planck' Constant (*h*) can be defined as*: "the product of energy and time, which when it's specific Flopping Time* (t_F) *is removed; the resulted Radiation Energy* (E_R)*, is the amount that could have completed the flopping within that given Time* (t_F)*."*

We deduced equation for radiation energy (E_R) the amount of the EM-R is equal to that of the Kinetic Energy (E_k), and it clearly indicates the importance of the square root of the Circular Magnetic Field $(\boldsymbol{B_{CMF}})$ in the radiation energy, and that the equivalent of the EM-R Energy (E_R) with the input Kinetic Energy (E_k), showed the efficiency of EM-R transformation process, where all energy is radiated and there isn't any lose during the energy transformation.

The magnitude of the strong field $(\boldsymbol{B_{1U}})$ given in Tables.1, which could be derived using Eqs.(10&11), showed that the generation of higher frequencies exceeding 10^{16} Hz required higher magnitudes of magnetic fields, and this only produced in atom by the Nucleus-Spinning Magnetic Field (***N-SMF***) as given in Table 2, and the Sunspots [25], or stars [26].

The relationship between the wavelength (λ) and the Flopping radius (r_F) which is quarter of the wavelength $\lambda/4$ explained why it is important to have an antenna with quarter wavelength to obtain good transmission or reception.

The earlier discovered break down of EM-R into discrete jumps, or quanta [8] which can be detected as a click by detector and interpreted as a photon [27], and the Compton effect experiment thought to proved the existence of the photon [5] and the discrete detection of light in the Anti-bunching experiment [28], all these can easily be explained as the resulted energetic ***CMF-EF*** produced within the discrete Flipping Time (t_F) [29], therefore the repetition of CMF-EF transformation as it gives a series of f_F, it also gives the above discrete flickers, or what was interpreted as quanta of EM-R energy, without any photon, and since no any trace of photon was detected within the above EM-R transformation mechanism and related equations, hence as Albert Einstein had stated before "*Every physicist thinks that he knows what a photon is, I spent my life to find out what a photon is and I still don't know it*." If Einstein the founder of the quanta/photon failed to know it, hence what and where are the photons? This is what we would see in the next paper "***The Photoelectric Effects-Radiation Based***" [29].

Finally, the Electromagnetic Radiation Mechanism, Radiation Energy $(\boldsymbol{E_R})$ and the true knowledge of Planck' Constant (h) were the missing link in early twenty century when Einstein explained the Photoelectric Effects, where he was forced to introduced the wave particle duality to justify removal of photoelectrons by particle photon; that duality generated heated debates which continued till now even though in exhausted voices, because it is difficult to conceived the logic behind duality; therefore the true knowledge of both E_R and h will bring the proper explanation to the Photoelectric Effects, upon which current Physics was structured.

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