

# The Electromagnetic Radiation Mechanism

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## ABSTRACT

This paper suggested a mechanism for Electromagnetic Radiation (EM-R); the mechanism is based on the Flip-Flop (F-F) of combined Circular Magnetic Field (CMF) and Electric Field (EF) produced by energetic charged particles, the action released the EM-R; while as the F-F generates EM-R, it is also achieved within specific Flipping Time ( $t_f$ ), the inverse of which is the Flipping Frequency ( $f_f$ ), the model is compared with Maxwell's two transformations to elaborate differences and characteristics, hence when EM-R is better understood, that will reflect on the physical world and related human ideas and philosophies.

**Keywords:** Electromagnetic radiation Mechanism, Light mechanism, Flip-Flop, Circular Magnetic Field

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## INTRODUCTION

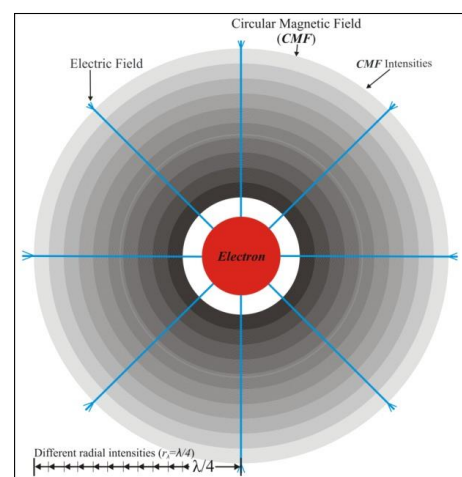
The quest by some for mechanism behind light had generated debates for meaningful explanations to the physical mechanisms behind light waves and frequencies and how an excited atom generates photons, or vibrating electrons emit electromagnetic fields, or if there is a theory describing how a light wave comes to take that transverse form, for atoms or electrons, and the relationship between atoms' movement and the Electromagnetic Wave (EM-W) and what's the "in-between" mechanics that causes an atom's motion to be turned into an EM-W, these and others showed eagerness by many to know the really mechanism produced EM-W, which is one of the most contentious and controversial issue in Physics history (Trinklein, 1990), the history of physics and many scientific studies were greatly influenced by the nature of Electromagnetic Radiation (EM-R), its structure and characteristics had divided scientists for three centuries, till Einstein decisively resolved the photoelectric effect and coined the dualism compromise (Giancoli, 2009); although the mechanism mentioned by Einstein relating the production of visible light by the cathode rays, in which he assumed the kinetic energy of electron goes into the production of many

light energy quanta (Einstein & into English, 1965), but it doesn't amount to how light is produced. The discovery of the magnetic effects caused by electric current in 1819 by Hans Christian Oersted (Nightingale, 1958), lead André Ampère to determine the Circular Magnetic Field (CMF) around a conductor carrying electric current, he presented an equivalent magnetic formula using electric parameters for force between two conductors carrying electric current (Trinklein, 1990), with discovery of electrons at the end of nineteenth century (Sachs, 1988), it was discovered that the circular magnetic field (CMF) around moving electric charge is the CMF around conductor carrying electric current (Wolski, 2011), and CMF is found to be produced around moving charged particles (Butler & Messel, 1963). The blackbody radiation was envisioned as a different mechanism of EM-R not a representation of the field of force of charged particles in motion (Sachs, 1988), that was at the end of nineteenth and early twentieth century, a period in which many discoveries were made (Conn & Turner, 1965), scientists debated vigorously about the nature of light, whether it is particle as advocated by Isaac Newton or waves as proposed by Christian Huygens (Trinklein, 1990), and that seems finally ended when Einstein

presented the theory of light quanta in 1905, in which he combined electromagnetic wave and particle photon to explain photoelectrons ejection (De Broglie, 1929), Einstein based his arguments for his light quanta hypothesis upon Boltzmann's statistical interpretation of the entropy, not the photoelectric effect (Stuewer, 2007), and he first used the word quanta (Einstein & into English, 1965), then in 1909 he introduced the wave-particle duality, based on the splits in energy and momentum into a wave dominant in low-frequency and particle term in high-frequency region (Stuewer, 2007), the explanation was intended to fill the gap in his interpretation of the photoelectric effect which necessitates the collision of photons with electrons to be released (Sachs, 1988), the theory was then extended in 1914 to allow part of energy to be emitted in the form of an ejected corpuscle (Millikan, 1916), thus he combined electromagnetic wave and particle quanta (photon) to explain photoelectrons ejection, by doing this he coined the light duality, bringing back Newton's corpuscular theory into arena (De Broglie, 1929), Einstein theory benefited from Max Planck 1900 radiation Law, which presented energy of EM-R as a discrete quantity, composed of integer number of finite equal parts (Planck, 1901), although Planck believed in the existence of unified picture for universal laws of science (Kragh, 2000), and considered his assumption merely a mathematical trick to obtain the right description of the black body radiation spectral intensity profile (Deshmukh & Venkataraman, 2006), but his suggestion lead into two lines: The electromagnetic waves/particles by Einstein-de Broglie-Schrödinger and the quantization of the structure of atoms by Bohr-Heisenberg-Born (Yang, 2004), where the quanta idea was extended by Niles Bohr in 1913 to include atomic model, overcoming electron's acceleration and energy depletion in the classical model (Sachs, 1988). De Broglie extended Einstein's light wave/particle duality, by considering it as a general theory that can be implemented into the entire physical world (Young & Freedman, 2008), these developments showed difficulties surrounding black-body radiation, specific heats, and the photoelectric effect, which brought quantum mechanics (Kuhn, 1970), thus as Einstein wave duality interwoven with heavier mass duality with serious consequences, intense historical debates were conducted early twentieth century regarding different aspects of quantum and the duality (Sachs, 1988), but quantum survived, and Einstein's interpretation of the photoelectric effect became the building blocks of the quantum theory (Deshmukh & Venkataraman, 2006), and formed the basis of current fundamental physics.

As quanta was substituted by photon, that turned to be a symbol of division once again; only accepted by some due to the lack of alternative mechanism; and light wave particle duality represents the bases upon which all contentious issues in physics emerged; the debates around which still going on; the unknown characteristics of the Circular Magnetic Field (CMF) (Wolski, 2011; Mahmoud E Yousif, 2003a) is investigated in relation to EM-R; a relation left behind when the blackbody radiation was mixed with EM-R (Sachs, 1988) which lead to confusion and divergences; our investigation resulted in a mechanism explaining EM-R and many related characteristics, which could help bringing answers to many questions, such as the wave-particle dualism which resulted

from photoelectric effect physical explanation (Sachs, 1988). The conclusion that the confusion resulted from explanation of forces produced from electric charges by combining both electric (E) and magnetic (B) quantities that cannot be measured directly (Novotny, 2014), consequently equations derived from these formulas diverted attention from true natures and mechanisms of these phenomena, hence that was among reasons why the Magnetic Interaction (MI) was suggested, which correctly explained the true nature of the magnetic force (Mahmoud E Yousif, 2003a), it helped in the understanding of magnetism and mechanism behind different magnetic forces, it also helped interpreting many natural phenomena, such as the Spinning Magnetic Field (SMF), Spinning Magnetic Force (SMF<sub>C</sub>), and the nuclear force (Mahmoud E Yousif, 2003b), the External Magnetic Field (ExMF) and the Nuclear Fusion (M. E Yousif, 2004), it explained the interatomic forces and spectral line mechanism (Mahmoud E Yousif, 2003a), and the Sunspots Mechanism (M. E Yousif, 2013), among others.



**Fig.1** An energetic electron, producing Circular Magnetic Field (CMF) around itself (Butler & Messel, 1963), and Electric Field (EF) (Wolski, 2011), the CMF is proportional to the velocity, and inversely proportional to the radius, both CMF&EF creates electromagnetic radiation.

These formations helped in the establishment of a mechanism for the EM-R, a mechanism approached in three parts, this EM-R Mechanism (EM-RM), Electromagnetic Radiation Energy and Planck' Constant (Mahmoud E Yousif, 2014a), and the Photoelectric Effects-Based on Radiation Ejection (Mahmoud E. Yousif, 2014b). This first part explained the mechanism behind the transformation of combined Electric-Magnetic Fields into EM-R, within different observed groups, the paper disclosed factors leading to this transformation, such as the Flipping Force ( $F_F$ ), the Flip-Flop (F-F) action, which related to the Flipping Time ( $t_F$ ) and Flipping Frequency ( $f_F$ ). The contradiction between the suggested atomic model (Mahmoud E Yousif, 2003a) and the electron diffraction phenomenon (Bach, Pope, Liou, & Batelaan, 2013) interpreted as wave particle duality (De Broglie, 1929) initiated this investigation; the non existence of data about EM-R mechanism, lead to the use of a method

based on creating a model from the ambiguous characteristics of the Circular Magnetic Field (CMF), then comparing and testing the final results with Maxwell's and current recognized EM-R data, such as given in Table 1 and Figs (2 & 7).

This paper is an attempt to decipher the EM-R mechanism and related characteristics, with an aim of discovering facts behind this transformation, the knowledge of which will necessitate the revision of current theories and consolidate the suggested fundamental physics, which is an extension to the aborted classical physics, the expansion of which was hampered by the particle wave duality; as this concern many (Sachs, 1988) and continued to represent divisive factor within the theoretical physics, this and the other parts will bring attention to those who thinks QED is unnecessary (Shih, 2005) and agitate for reviewing the current bases with these alternatives, and since many developments in scientific sectors were coined by the current bases, which limited the full utilization of immense potentials in nature, it is the aim of this paper to unlock these potentials, and above all to help in restoring logic and truth to EM-R and related fields.

### THE CIRCULAR MAGNETIC FIELD (CMF) AND CHARGED PARTICLES DYNAMICS

The Coulomb's law for magnitude of electric field around point charge (Wolski, 2011) is given by

$$E = \frac{q}{4\pi \epsilon_0 r^2} \quad (1)$$

Where, q is the electric charge in Columb, r is the radial distance at which the field is measured in meter,  $\epsilon_0$  is permittivity of free space  $8.854 \times 10^{-12}$  Farads/meter, and E is the electric field in N/C  $V.m^{-2}$ . If such source of charge is at rest or moving with constant speed, it make starting and stopping E and looping B and since magnetic field is produced due to motion of electric charges, either as macroscopic or microscopic currents (Newman, 2008), therefore, the Circular Magnetic Field (CMF) around conductor carrying electric current is given by

$$B = \frac{\mu_0 I}{2\pi r} \quad (2)$$

Where,  $\mu_0/2\pi$  is the constant of proportionality, I is electric current in Ampere,  $\mu$  is the permeability of free space equal to  $4\pi \times 10^{-7}$  T.m/A, and the magnetic field B in Tesla. While the Circular Magnetic Field (CMF) produced by charge in motion, was derived using Maxwell's and Einstein's theories (Butler & Messel, 1963), the CMF for both electrons and protons are  $B_e$  and  $B_p$  respectively (Alonso, Finn, & Stetson, 1969; Ballif, 1969; Fuch, 1967), the field is given by

$$B_{CMF} = \frac{q v}{r_m^2 c} \quad (3)$$

Where,  $B_{CMF}$  is the magnitude of the Circular Magnetic Field in Tesla, v is charged particle (electron or proton) velocity in  $m.s^{-1}$ , c is the speed of light in  $m.s^{-1}$ ,  $r_m$  is the magnetic radius in meter. The CMF resulted from moving charge is very strong, the magnetic fields created by nucli in High-energy Ion

Colliders (HICs) while moving close to the speed of light are much stronger than any fields, including the critical magnetic field for electrons  $B_c = m_e/e = 4 \times 10^9$  Tesla, and the  $\sim 10^{11}$  Tesla of neutron stars, this field reached  $\sim 10^{13}$  Tesla, at the Relativistic Heavy Ion Collider (RHIC) in Brookhaven National Laboratory (BNL) and  $\sim 10^{14}$  Tesla at Large Hadrons Collider (LHC) in CERN-HIC (Itakura, 2010). The suggested Magnetic Interaction (MI), was based on a magnetic formula which is equivalent to Lorentz force (Mahmoud E Yousif, 2003a), it widened the scope of interaction, both are given by

$$F_m = B_1 B_{e/p} r_m^2 c = F_L = B_1 q v \quad (4)$$

Where,  $B_1$  is the strong magnetic field around which electron/proton gyrate or nucleus Spinning Magnetic Field (SMF) in Tesla (Mahmoud E Yousif, 2003a),  $B_{e/p}$  is the CMF is as given by Eq.(3), and both  $F_m$  and  $F_L$  are Magnetic Force and Lorentz Force respectively in Newtons.

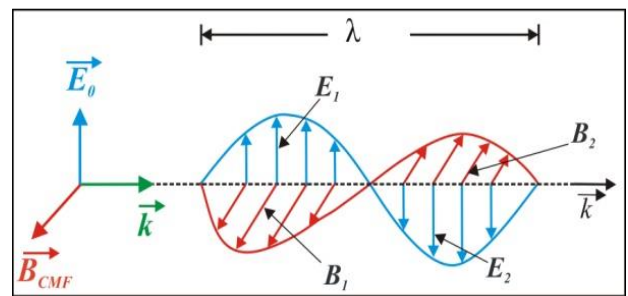


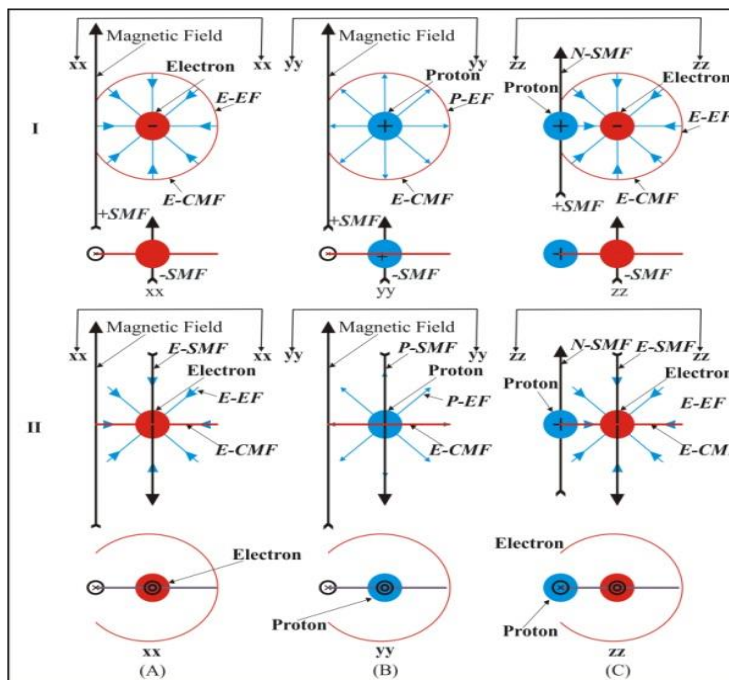
Fig2 The known shape of Electromagnetic Radiation (EM-R) (Giancoli, 2009), the envelop consist of Electric Wave (EW) and Magnetic Wave (MW).

### THE ELECTROMAGNETIC WAVE (EMW)

An energetic electron as shown in Fig.1, is surrounded by Circular Magnetic Field (CMF), given by Eq. (3), the CMF is formed with variable magnitudes from surface, and varied with velocity, the kinetic energy of the electron is given by

$$E_k = \frac{m v^2}{2} \quad (5)$$

Where,  $m_e$  is electron mass in kg. Although different shapes of oscilloscopes signals existed on internet, but non showed the Electromagnetic Wave (EM-W) shown in Fig.2 (Tektonix, 2000; Test, 2011), which is the known shape of EM-W (Tektonix, 2000); derived from Maxwell equations, where electric and magnetic fields are perpendicular to each other, and both consist of sine waves and in phase, and both comes to a zero point on the propagation line at the same place and time, some thinks magnetic field energy is at maximum when the electric field energy is at minimum and vice versa, they are perpendicular but they are out of phase by 90 degrees, but does Fig.2 showed the true shape of Electromagnetic Wave (EM-W)?



**Fig.3** Energetic electron's and proton's Circular Magnetic Field (CMF) interacted and gyrates around intense magnetic field in I-A&B; while in I-C electron's CMF in hydrogen atom interacted with Proton-Spinning Magnetic Field (P-SMF), with resulted gyration. II-A&B shows electron/proton flip due to strong magnetic field, and II-C shows energized electron in hydrogen atom flip due to P-SMF.

The energetic electron shown in Fig.1 has electric and magnetic fields given by Eqs. (1&3); electron/proton can gyrate around strong magnetic lines of force as shown in Fig.3-A&B-I, while Fig.3-C-I, shows electron gyrate in hydrogen atom; the three particles in Fig.3-I, gyrates due to interaction of both their CMF with a strong magnetic field or Nucleus Spinning Magnetic Field (N-SMF) as given by Eq.(4) (Mahmoud E Yousif, 2003a), such particles were thought to radiate EM radiation when accelerated, where Maxwell's equation relating changing magnetic flux with an induced electric field (Faraday's law) as

$$E = - \frac{\Delta\Phi_B}{\Delta t} \tag{6}$$

While changing electric flux with an induced magnetic field, is given by

$$B = - \frac{\Delta\Phi_E}{\Delta t} \tag{7}$$

But what mechanism leads to EM radiation?

**THE CIRCULAR MAGNETIC WAVE (CMW)**

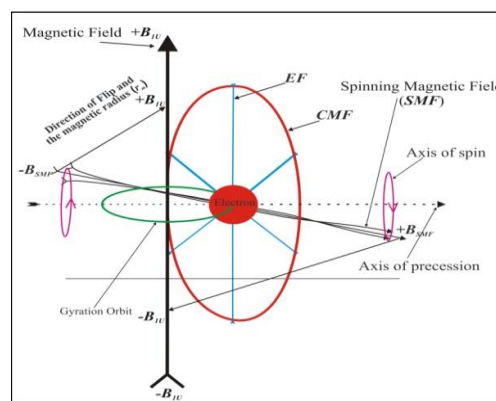
The energetic electron shown in Fig.1, composed of Electric Field (EF) and Circular Magnetic Field (CMF), the magnitude of which are given by Eqs.(1&3) respectively, the CMF exists only when electrons/protons are in motion, but within that motion, if electron or proton Flip and Flop within finite time  $\Delta t$ , while gyrating around an intense magnetic field, or when excited and moved in an atom to higher radial orbit, or due to alternating power in Transmitting antenna, or sudden F-F while in motion; and since Electromagnetic Wave is time-varying magnetic fields (Newman, 2008), and the F-F represents variation of both CMF-EF within short time; therefore the F-F of both CMF and EF as shown in Fig.3- II-

A,B&C, disintegrates both fields from the electron/proton in sequence shown in Fig.5-A, this state is given by

$$\frac{\partial BE}{\partial t} = CMF + EF \tag{8}$$

The disintegration of both CMF and EF from electron/proton as given by Eq. (8) above and the appearance of different formation, shown in Fig.5-I-B,II-B&III-B, is based on ninety degrees angle ( $90^0$ ) difference between both CMF and EF, and the formation of EM-W from above, given by

$$EMW = \frac{1}{2}(CMF + EF) + \frac{1}{2}(CMF + EF) \tag{9}$$

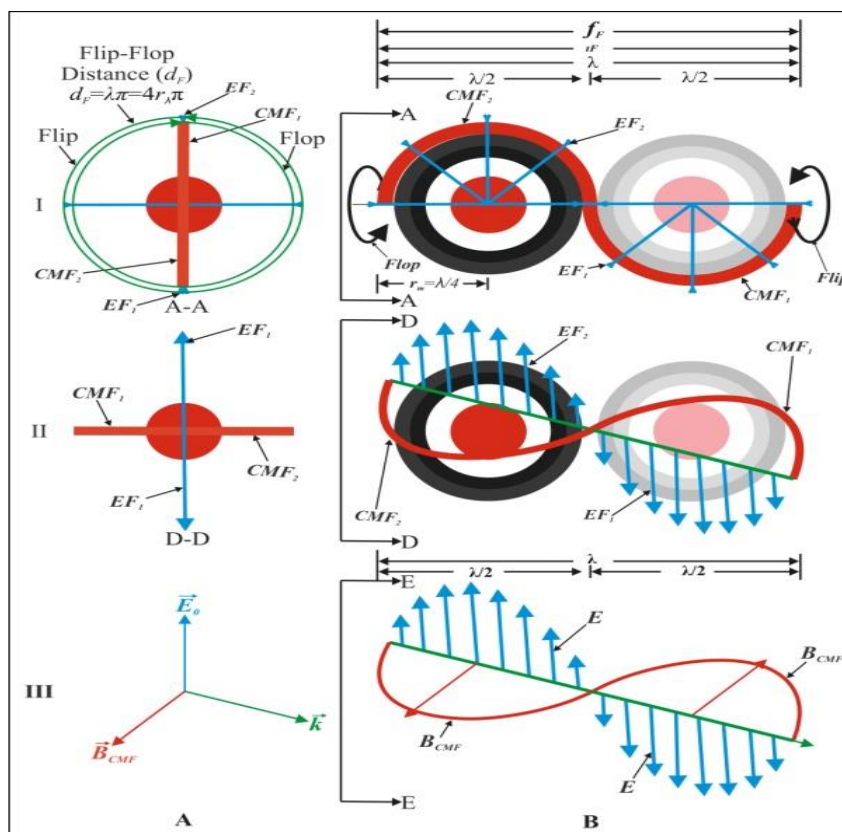


**Fig.4.** Spinning electron is also precession while gyrating at small radius around magnetic line of force (Soderberg, 2014). Due to precession, the Spinning Magnetic Field (SMF) interacts with the magnetic field leading to the Flip-Flop (F-F) of electron/proton as shown in Fig.3-II, resulted in the released of both the Circular Magnetic Field (CMF) and Electric Field (EF) as an Electromagnetic Radiation (EM-R).

**FLIPPING FORCE AND FLIP-FLOP (F-F) TIME**

The F-F phenomenon is traced to alignment of nucleon' or electron' magnetic moment parallelly or antiparallelly with strong magnetic field ( $B_{1U}$ ) in magnetic resonance (Elwell & Pointon, 1978), resulted from generation of magnetic field, or magnetic moment by atomic nuclei while spinning (Soderberg, 2014), during Electron Spin Resonance (E.S.R.) spectroscopy, electron moment is flipped antiparallel to the strong field, when resonance is obtained (Elwell & Pointon 1978), these are the  $+1/2$  spin when aligned with  $B_{1U}$ , or  $-1/2$  spin state, when aligned opposed to  $B_{1U}$  (Soderberg, 2014), the common factor in both alignment is the suggested production of intrinsic Spinning Magnetic Field (SMF), as produced by spinning atomic nuclei (Soderberg, 2014); and since the precessional motion by electron and proton within neutron was suggested to disintegrates neutron into proton and electron (Mahmoud E Yousif, 2003b), it also forced proton's parallel magnetic moment to flip into antiparallel position

during resonance (Soderberg, 2014), therefore as electrons and protons spins around its axis while gyrating around strong magnetic field, as showed in Fig.3-I-A&B, it is suggested that they also rotates in precessional motion as showed in Fig.4, whereas for interatomic electrons shown in Fig.3-I-C, such precessional is denied while in natural orbit by the balance of both electrostatic and magnetic forces with centripetal force, but when such electron is excited and moved to higher radial orbit, it experience precessional (Mahmoud E Yousif, 2003a). The common factor between electron/proton radiation while gyrating around strong magnetic field; or close to strong magnetic field; or spectral line produced by electron in atom; or radiating EM-W from electron in transmitting antenna; or radiation from jiggling electric charge on heated metal (Shih, 2005), or the strong magnetic and electric fields from fluctuation of proton positions in the colliding nuclei (Bzdak & Skokov, 2012), the common factor is based on Planck realization that, energy



**Fig.5** A-I-II&III shows the sequential transformation of both Circular Magnetic Field (CMF), and Electric Field (EF) into Electromagnetic Radiation (EM-R) by Flip-Flop (F-F), while B-I shows the F-F mechanism.

should be realization that, energy should be imagined as a discrete one, composed of integer number of finite equal parts (Planck, 1901) therefore, with some preservation on integer, the suggested mechanism in which these waves are generated as a consequence of F-F mechanism resulted in Eq. (9); and shown in Fig.5-B, is caused by sudden magnetic force of attraction between the positive field (+B) of electron/proton Spinning Magnetic Field (SMF) and the negative strong magnetic field ( $-B_{1U}$ ), around which electron/proton gyrates,

Flipping details is shown in Fig.4. The Flip in atom is caused by force of magnetic attraction between the positive field ( $+B_{SMF}$ ) of Electron Spinning Magnetic Field (SMF) and the nucleus ( $-B_{SMF}$ ) Nucleus-Spinning Magnetic Field (N-SMF), as shown in Fig.3-II-C, when the atom is excited and energized (Mahmoud E Yousif, 2003a). In Transmitters, electrons Flips at the beginning of each sinusoidal power sent from the transmitter, when electrons reached one end of the transmitting antenna they flip at the start of their movement towards the

opposite direction, a time power polarity changed, at that moment electrons changes direction by Flipping, and disintegration and releasing of CMF-EF. Therefore, except in transmitting antenna and jiggling, the F-F of electron/proton given by Eq. (9) is due to the Flipping Magnetic Force ( $F_F$ ) resulted from interaction between Electron-Spinning Magnetic Field (E-SMF) with the magnetic field around which both particles gyrates as shown in Fig.3.-I-A&B and Fig.4, therefore using the Magnetic Force ( $F_m$ ) formula giving by Eq. (4), the Flipping Force is given by

$$F_F = B_{1U} B_{SMF} r_m^2 c = m a \quad (10)$$

Where,  $B_{1U}$  the strong magnetic field in Tesla,  $B_{SMF}$  electron's or proton's Spinning Magnetic Field,  $r_m$  is the magnetic radius,  $c$  is speed of light,  $m$  is electron's or proton's radius,  $a$  is acceleration in  $m.s^{-2}$  and the flip force  $F_F$  is in Newton. In atom, the Flipping-Force is given by

$$F_{FA} = B_{N-SMF} B_{E-SMF} r_m^2 c = m a \quad (11)$$

Where,  $B_{E-SMF}$  is Electron's SMF,  $B_{N-SMF}$  is Nucleus-Spinning Magnetic Field (N-SMF) or Proton-SMF for hydrogen atom and  $F_{FA}$  is the Flipping Magnetic Force for atom in Newton. Eq. (10) is developed to read as

$$F_F = B_{1U} B_{SMF} r_m^2 c = m \frac{v_F}{t_F} \quad (12)$$

Where,  $v_F$  is the Flipping velocity by which electron/proton Flip in  $m.s^{-1}$ , and  $t_F$  is the Flipping time during which the Flipping occurred in second, hence from Eq.(12), the flipping time  $t_F$  is given by

$$t_F = \frac{m v_F}{F_F} s \quad (13)$$

Since the Magnetic Force ( $F_m$ ) and Lorentz Force ( $F_L$ ) given by Eq. (4) are equal (Mahmoud E Yousif, 2003a), therefore, using the Lorentz Force, the Flipping velocity is given by

$$v = \frac{F_F}{q B_{1U}} \quad (14)$$

From Eq. (14) the time during which a single EM-W disintegrates (or generated) is derived (Mahmoud E Yousif, 2014a), and given by

$$t_F = \frac{4 \pi m}{q B_{1U}} \quad (15)$$

Since Eq. (15) determined the time during which EM-W is generated from charged particles (electrons and protons), and since  $\frac{1}{t_F} = f_F$ , therefore the frequency of EM radiation is given by

$$f_F = \frac{q B_{1U}}{4 \pi m_e} = (1.3996242 \times 10^{10} B_{1U}) \quad (16)$$

Examples of  $t_F$  and  $f_F$  are shown in Table.1. As electromagnetic waves are similar, in having transverse electric and magnetic fields (Newman, 2008), therefore the mechanism generating EM-Wave through the F-F mechanism could be classified in five main categories, these are:

- a-EM-W generated by energetic electron/proton gyrating around strong magnetic field.
- b-EM-W generated by energetic electron/proton moving close to strong magnetic field.
- c-EM-W generated by electron as spectral line in an atom.
- d-EM-W generated by transmitting antenna.
- e-EM-W generated by jiggling electric charge at hot surface.

Table.1 Example of the parameters resulted from Eq. (15) and Eq. (16)

$E_k$	$v_e$	$f_F$	$t_F$	$\lambda$	$r_m = r_{\lambda=(\lambda/4)}$	CMF( $B_{CMF}$ )	$B_{1U}$
$6.63 \times 10^{-29}$	$1.14 \times 10^{+1}$	$1.0 \times 10^{+5}$	$1. \times 10^{-5}$	$3. \times 10^{+3}$	$7.5 \times 10^{+2}$	$1.15 \times 10^{-32}$	$7.14 \times 10^{-6}$
$6.63 \times 10^{-18}$	$3.81 \times 10^{+6}$	$1.0 \times 10^{+16}$	$1. \times 10^{-16}$	$3. \times 10^{-8}$	$7.5 \times 10^{-9}$	$3.62 \times 10^{-5}$	$7.14 \times 10^{+5}$

### THE MAXWELL'S TRANSFORMATIONS

With reference to Maxwell's Eqs. (6&7), and since both equations predicted the transformation of both electric and magnetic fields, hence this is to be checked in the following analysis based on the EM-W shown Fig.2, which could be expressed as

$$EMW = (CMF_1 + EF_1) + (CMF_2 + EF_2) \quad (17)$$

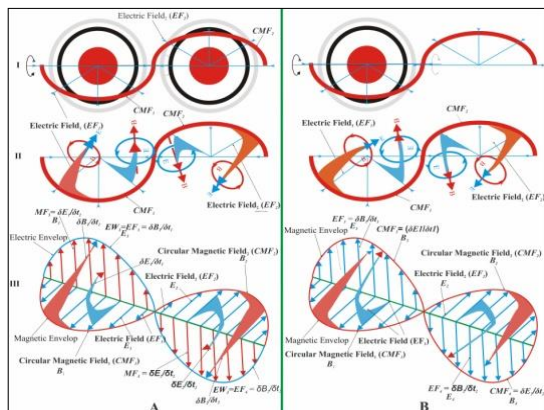


Fig.6 Two possibilities resulted from Maxwell transformations using Eqs. (6&7). (A) Shows two envelopes, one composed of Magnetic Wave (MW) the other from Electric Wave (EW), while (B) showed both envelopes composed from Magnetic Wave (MW).

Fig. 6-A&B shows the two probabilities that can emerged from interpretation of both Eq. (6) and Eq. (7), the origin of the field which emerged from Fig. 6-A-II, contain CMF and EF designated as CMF<sub>1</sub>, EF<sub>1</sub>, CMF<sub>2</sub> and EF<sub>2</sub> respectively, as given by Eq. (17); hence each of these four parts transformed by Eqs. (6&7), where the first envelop composed of CMF as shown in Fig.6-A-II, while the second envelop composed of EF, and both resulted in Fig. 6-A-III and given by

$$EMW = \left\{ \frac{1}{2} \left( (B_1 + \frac{\delta B_1}{\delta t_1}) + (E_1 + \frac{\delta E_1}{\delta t_1}) \right) + \frac{1}{2} \left( (B_2 + \frac{\delta B_2}{\delta t_2}) + (E_2 + \frac{\delta E_2}{\delta t_2}) \right) \right\} \quad (18)$$

In Eq. (18) above, and as shown in Fig. 6-A-II-III, and related to Eqs. (6 & 7), the change in the first  $CMF_1 = \frac{\delta B_1}{\delta t_1}$  it produced envelop  $EW_3$ , the change in the first  $EF_1 = \frac{\delta E_1}{\delta t_1}$  produced the third  $MF_3$  of the red color, the second change in  $CMF_2 = \frac{\delta B_2}{\delta t_2}$  produced the forth envelop  $EW_4$ , and the second

change in  $EF_2 = \frac{\delta E_2}{\delta t_2}$  produced the fourth  $MF_4$  of the red color, therefore a single frequency of EM-W given by Eq. (18) transformed into

$$EMW = \left\{ \frac{1}{2}((B_1 + B_3) + (E_1 + E_3)) + \frac{1}{2}((B_2 + B_4) + (E_2 + E_4)) \right\} \quad (19)$$

The second option using Eq.(6) and Eq.(7), is based on the formation of CMF as wave envelopes, this as shown in Fig.6-B-II&III, it contained CMF and EF designated as  $CMF_1, EF_1, CMF_2$  and  $EF_2$  respectively; but EF transformed into MF and CMF into EF as shown in Fig.6-B-III, is given by

$$EMW = \left\{ \frac{1}{2} \left( (B_1 + \frac{\delta E_1}{\delta t_1}) + (E_1 + \frac{\delta B_1}{\delta t_1}) \right) + \frac{1}{2} \left( (B_2 + \frac{\delta E_2}{\delta t_2}) + (E_2 + \frac{\delta B_2}{\delta t_2}) \right) \right\} \quad (20)$$

In Eq. (20) above, and as shown in Fig.6-B-II&III, the change in the first  $CMF_1 = \frac{\delta B_1}{\delta t_1}$  produced  $EF_3$ , the change in the first  $EF_1 = \frac{\delta E_1}{\delta t_1}$  produced envelope  $CMW_3$  of the red color, the second change in  $CMF_2 = \frac{\delta B_2}{\delta t_2}$  produced forth  $EW_4$ , and the second change in  $EF_2 = \frac{\delta E_2}{\delta t_2}$  produced envelope  $CMF_4$  of the red color, therefore a single frequency of EM-W given by Eq. (20) becomes

$$EMW = \left\{ \frac{1}{2}((B_1 + E_1) + (B_3 + E_3)) + \frac{1}{2}((B_2 + E_2) + (B_4 + E_4)) \right\} \quad (21)$$

From these results, great discrepancies appear between the three models given by Eq. (9), Eq. (19) and Eq. (21), each depicted by Fig.5-C, Fig.6-A-III and Fig.6-B-III respectively; hence these models are examined based on two EM-W practical experiments.

### ELECTROMAGNETIC RADIATION (EM-R) STRUCTURE

Since both Eq. (19) and Eq. (21) depicted by Fig.6-A & Fig.6-B are derived from Maxwell's Eqs.(6&7), and both showed electromagnetic wave envelopes, composed either magnetic-electric wave or magnetic-magnetic wave, but both were not the result obtained in both the circularly polarized light (Ohanian, 1994) and the series of time-lapse photographs of the electric field, produced by the radiating electron over a small planar patch, perpendicular to the direction of propagation of the radiation, where EF always either pointing up or down (Newman, 2008), in both experiments the electric fields proved to raise and falls along the propagation path, in line with the shapes of electric and magnetic fields shown in Fig.7 (Duke, 2013), therefore after F-F action producing EM-W, shown in Fig.3-II-A-B&C, and given by Eq. (8), it lead to the disintegration of the combined CMF-EF as a transverse wave consisting of CMF perpendicular to EF and both are perpendicular to the direction of propagation as shown in Fig.5-A-III, therefore the perpendicular displacement of line vectors along the propagation axis out to the sine wave represents the magnitude and direction of the electric field (Ohanian, 1994), while the circularly polarized

electromagnetic plane wave (Ohanian, 1994) is merely a variation between the peaks of opposite magnitudes, thus the sine wave traced by the electric field represents the last CMF along which the EF was disintegrated during the F-F action as shown in Fig.5-B-I-II & III, therefore the EM-W given by Eq. (9) becomes,

$$EM - R = \frac{1}{2}(B_1 + E_1) + \frac{1}{2}(B_2 + E_2) \quad (22)$$

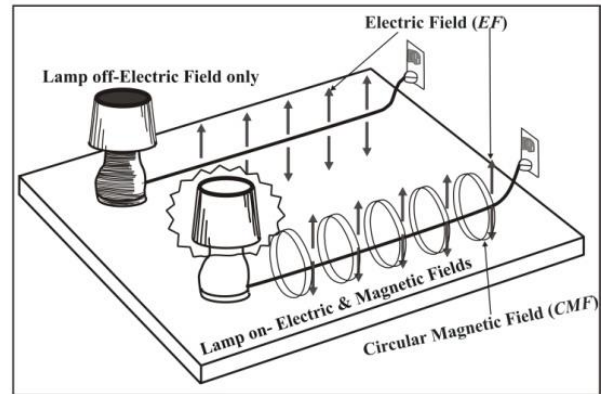


Fig.7 Vertical Electric Field (EF) and Circular Magnetic Field (CMF) produced by electric current (Duke, 2013), the combined fields are similar to suggested Electromagnetic radiation model in Fig.5-B-III.

Where, EM-R is the electromagnetic radiation, hence from Eq. (22), the EM-R is given by

$$EM - R = (B + E) \quad (23)$$

As both B and E fields shown in Fig.5-B-III, propagate away from the source, they can be described as an electromagnetic plane waves composed of oscillating electric and magnetic fields traveling along the x-axis, both E and B fields oscillate together perpendicular to each other, and both lie in a transverse plane, perpendicular to the x-direction along which the wave travels with speed of light c, thus each magnitude of the fields represents a traveling waves.

### RESULT AND CONCLUSION

The results from this paper showed the existence of a mechanism for the generation of Electromagnetic Radiation (EM-R), this mechanism is based on the characteristic of producing Circular Magnetic Field (CMF) and Electric Field (EF) which are the fundamental bases for this generation. The Flip-Flop (FF) of combined CMF-EF at specific Flipping Time ( $t_f$ ), leads to the transformation of Electromagnetic Radiation (EM-R); there are several groups within which EM-R is generated, but all of which are transformed by the F-F mechanism. From the generation mechanism, the Flipping Frequency ( $f_f$ ) in EM-R is a byproduct of the  $t_f$ , which is basic for this transformation; and a specific shape for EM-R, had been established reflecting the sequential disintegrated shape of the CMF-EF. The suggested EM-R mechanism, made it possible to better be understand the light within its own natural characteristics, and as a phenomenon generated within specific rules and mechanism.

The black body radiation, and related thermodynamics studies greatly influenced and derailed the quest towards the true mechanism generating EM-R. This proposed mechanism raised many questions about the phenomena, such as the EM-R Energy, Planck' Constant, Photoelectric Effect and others, the first three are to be answered, while others could generate

more debates about the phenomena, which in the final analysis can better be addressed and understood. But from this mechanism, the following is true: "quanta are the magnetic and electric energies embedded within the Circular Magnetic Field (CMF) during the F-F action."

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