The Photoelectric Effects: Radiation Based With Atomic Model

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ABSTRACT

A Radiation Magnetic Force ($F_{mR}$) frequency controlled formula is derived, signifying the embaddement of magnetic force in Electromagnetic Radiation (EM-R) similar in nature to Radiation Magnetic Energy ($h\nu$) or Planck’ formula ($hf$); both formulas derived and identified the Excited Force ($F_{Ex}$) and Energy ($E_{Ex}$), the Interatomic Resistance Force ($F_I$) and Energy ($E_I$), or the work function), the Photoelectric Effect Force ($F_p$) and Energy ($E_p$); this identifications is the realization of forces and energies bestowed in EM-wave expressed by $h\nu$; the derived Orbital Magnetic Force ($F_{Omr}$) and established the interatomic forces and energies for different atoms; both formulas produced various interatomic parameters, an example of potassium atom is given, also the related spectral line for each of the 19th electrons, regulated by formulas deriving each stage; the paper helped in reestablishing the wave nature of EM-R, which could forged the way for a better understanding to the microscopic-world.

Keywords: Photoelectric Effect, Radiation Magnetic Energy, Radiation Magnetic Force, Atomic Model, Spectral Line

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INTRODUCTION

One can easily claimed that, the three greatly debated human ideas through history, were the heliocentric principle by Copernicus/Galileo, Evolution of Darwin and 1905 photoelectric Effect by Einstein. Back in 1887 when Hertz discovered the Electromagnetic Radiation (EM-R) scientists thought the nature of EM-Wave finally settled , but when Max Planck published his ideas about the discrete nature of electromagnetic radiation energy in 1900 (Planck, 1901), Einstein saw in it the tool to tackle the photoelectric effect in 1905 (Einstein & into English, 1965). In his paper Einstein based his arguments for his light quanta hypothesis upon Boltzmann’s statistical interpretation of the entropy, not the photoelectric effect (Roger H Stuewer, 2006), his core argument drew on the thermodynamic behavior of high frequency heat radiation, coined as quanta (Norton, 2013), using the word quanta (Einstein & into English, 1965), he didn’t mentioned photon related wards at that time (Sachs), later in 1909 he introduced the wave-particle duality, showing that, the mean-square energy and momentum fluctuations split naturally into, a wave term dominated in the Rayleigh-Jeans (low-frequency) region and a particle term dominated in the Wien’s law (high-frequency) region of the spectrum (Roger H Stuewer, 2006), this is 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 permit part of the energy to be emitted in the form of an ejected corpuscle (Millikan, 1916) and photon as it referred
to the quantum of electromagnetic radiation was coined two decades later by Gilbert Newton Lewis (Shih, 2005) although the quanta ideas were based on Planck paper (Planck, 1901), but Planck believed in the existence of unified picture for universal laws of science reflecting the inner mechanisms of nature, an objective reality where human thoughts and passions had no place (Kragh, 2000), he thought his new assumption merely as a mathematical trick to obtain the right description of the black body radiation spectral intensity profile (Deshmukh & Venkataraman, 2006), he publicly resisted Einstein’s hypothesis, stating that “Instead of quantized electromagnetic fields, one should attempt to transfer the whole problem of the quantum theory to the area of interaction between matter and radiation energy” (Shih, 2005), he also described the whole duality as “unnecessary” (Roger H Stuewer, 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), here one can ask is this misinterpretation of data, or the other phase of nature? Both lines developed intensively during the past hundred and ten years, to the extent most people currently forgot how vigorously Einstein photon idea was rejected and opposed, by prominent contemporary scientists like Millikan, Lorentz and Planck (Millikan, 1916), but the contested voices of Bohr, Kramers and Slater, that rejected light quanta and worked on counter theoretical programs lowered by Compton decisive experiment in 1923 (Campos, 2004), when he affirmed that “scattering is a quantum phenomenon; and a radiation quantum carries with it momentum as well as energy” (Arthur H Compton, 1923), Compton carried his experiment not motivated or influenced by Einstein’s 1905 light-quantum or photon hypothesis (R. H. Stuewer, 2014), but the fact that the quantum theory of scattering is applies only to light elements (Arthur Holly Compton, 1922), and Compton equations failed to resolve the heavy atoms issue, in which the recoil energy is smaller than the binding energy of the scattering electron (Mehra & Rechenberg, 2001), even prominent scientist like Raman derived a classical solution for Compton effect (Raman, 1928), among reasons why it was revisited. However what burden forced Einstein to questioned light quanta near the end of his life (Shih, 2005), dose that means he was not satisfied with his own answer, inferring doubt about photon as particle and existence? that is why Millikan praised Einstein’s equation, and emphasized that it lack visible theoretical support (Millikan, 1916, 1916), while some thinks Einstein discovered greatest and importance relationships but the reasons for them are as yet not at all understood (R. H. Stuewer, 2014), thought to exists and to be discovered someday (Roger H Stuewer, 2006), although Millikan revoked his early position about photon in his 1950 Autobiography (R. H. Stuewer, 2014), however, whatever relevant the acceptance level of Einstein’s formula was, but it leaves the experimental interpretation opened when new ideas emerged.

This paper is the third in a series started with “The Electromagnetic Radiation Mechanism” (Yousif, 2014b) which investigated the transformation mechanism of both the Circular Magnetic Field (CMF) and Electric Field (EF) into discrete Electromagnetic Radiation (EM-R) and different aspects related to that transformation/generation and compared it with Maxwell’s equations, followed by “Electromagnetic Radiation Energy and Planck’ Constant,” which investigated the condition and radiation energy behind EM-R and the nature, characteristics and mechanism behind Planck’ Constant (h) and speed of light formula (Yousif, 2014a), both papers are based on principles derived from the unknown characteristics of Circular Magnetic Field (CMF) produced by energetic charged particles, facilitated by the Magnetic Interaction (MI) which explained the nature of the magnetic force (Yousif, 2003a), after been confused with electric quantities (Novotny, 2014), and the characteristics of the Spinning Magnetic Field (SMF), Spinning Magnetic Force (SMF\(_c\)), and the nuclear force (Yousif, 2003b), as well as the interatomic forces and spectral line of hydrogen atom (Yousif, 2003a), all of which are utilized to further investigate the Photoelectric Effects mechanism, relating it and both the interatomic Magnetic Force (\(F_{m}\)) and Electrostatic Force (\(F_e\)), with a formulated Radiation Magnetic Force (\(F_{r}\)), in a structure helped to establish the mathematical origin of Planck’ energy formula (hf), as both formulas showed how Magnetic Force (\(F_{m}\)) and Radiation Energy (\(E_R\)) are conveyed or embedded with impinging EM-R to change interatomic forces and energies, they both explained the interatomic magnetic force and energy acquired by photoelectrons, hence a logical interpretation of the photoelectric effects, and the Compton effect (Yousif, Unpublished) and since both effects are obtained using light, X-rays and \(\gamma\)-rays, all of which within EM-R spectrum, a relationship is suggested relating the Excited Force (\(F_{Es}\)) and Energy (\(E_{Es}\)), the Intaratomic Resistance Force (\(F_{Ir}\)) and Energy (\(E_{Ir}\), (or the work function), the Photoelectric Effect Force (\(F_P\)) and Energy (\(E_P\)), as phenomenon of one origin, but differ in range of frequency, force, energy and secondary characteristics. The formulated Radiation Magnetic Force (\(F_{r}\)), helped in extending and expanding the hydrogen atomic model (Yousif, 2003a) to all atoms, an example is given for the 19 electrons parameters in Potassium atom, with another providing spectral line of each of the 19 electrons in the Potassium atom. The familiarity of the current generation with present scientific knowledge, remind one with the sad remark by Max Planck that “a new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it.” (Kuhn, 1970), and as Sachs put it “It is a lesson of history that we should never accept a scientific truth as a final truth.” (Sachs, 1988), if so how can we know a false theory when confirmed by spurious experimental data (R. H. Stuewer, 2014). The paper aimed to investigate the contradiction between our atomic model (Yousif, 2003a) and the electron diffraction phenomenon (Bach, Pope, Liu, & Batelaan, 2013) Liu & Batelaan, 2013 interpreted as wave particle duality (Broglie, 1929); 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 derived data, given in accompanied Tables and
THE MAGNETIC FORCE AND RADIATION ENERGY

The Magnetic Force ($F_m$) and Lorentz Force ($F_L$) are proved to be equal (Yousif, 2003a), and given by

$$F_m = B_{1u}B_{2e} \frac{q}{r_m} c = F_L = B_{1u}q \nu_e$$  \hspace{1cm} (1)

Where, $B_{1u}$ is the strong magnetic field around which electron gyrate, or nucleus Spinning Magnetic Field (SMF) (Yousif, 2003a) in Tesla, $B_{2e}$ is the Circular Magnetic Field (CMF or $B_{CMF}$) produced by electron in Tesla, $r_m$ is the magnetic radius in meter, $c$ is the velocity of light in $m.s^{-1}$, and the Magnetic Force ($F_m$) and Lorentz Force ($F_L$) are in Newton. While electron in motion produced the Circular Magnetic Field (CMF or $B_{CMF}$) (Stuart Thomas Butler, 1963), used in Eq (1), the magnitude of which represents the difference between the two equations (Yousif, 2003a), is given by (Alonso, Finn, & Bertalocchini, 1967; Ballif, 1969; Fuch, 1967)

$$B_{CMF} = B_{2e} = \frac{q \nu_e}{r_m} c$$  \hspace{1cm} (2)

Where, $\nu_e$ is electron velocity in $m.s^{-1}$, and $B_{CMF}$ (or $B_{2e}$) is the magnitude of the CMF in Tesla. The kinetic energy of such electron producing CMF, is given by

$$E_K = \frac{m_e \nu_e^2}{2}$$  \hspace{1cm} (3)

Where, $m_e$ is electron mass in kg.

![Fig 1a](#) An energetic electron surrounded by radial intensities of both the Circular Magnetic Field (CMF) and Electric Field (EF).

![Fig 1b](#) The first stage of the Flip-Flop (F-F) mechanism producing Electromagnetic Radiation (EM-R), the figure also shows the relation between Wavelength ($\lambda$), Flipping Time ($t_F$), Flipping Frequency ($f_f$) and Magnetic Radius ($r_m$) or Flipping Radius ($r_F$).

The Circular Magnetic Field (CMF) and the Electric Field (EF) shown in Fig 1-a, suggested to represents the base upon which Electromagnetic Radiation (EM-R) is produced, through the transformation process, shown progressively in Fig.1-a,b,c & d, transformed/produced through the Flip-Flop (F-F) mechanism to emerged as EM-R shown in Fig.1-d (Yousif, 2014a, 2014b), the Electromagnetic Radiation Energy ($E_R$) is equal to the Kinetic Energy ($E_K$), and both are equal to the Planck’s formula, as the followings are multiplied by energy, time and frequency (Yousif, 2014a)

$$E_R = hf = \left(\frac{m_e \nu_e^2}{2}\right) \times \left(\frac{4 \pi m_e q B_{1u}}{f_f}\right) = \left(\frac{B_{CMF}^2 m_e c^2 r_F^4}{2f q^2}\right) f$$  \hspace{1cm} (4)

Where, the $r_F$ is the Flipping Radius or the Magnetic Radius ($r_m$), $E_R$ is the Electromagnetic Radiation Energy, and since the Flipping time $T_F = \frac{4 \pi m_e}{q B_{1u}}$ given with the kinetic energy on the left hand of Eq(4) is inverse of the frequency ($1/f$) the following is true

$$E_R = \left(\frac{m_e \nu_e^2}{2}\right) = \left(\frac{B_{CMF}^2 m_e c^2 r_F^4}{2f q^2}\right)$$  \hspace{1cm} (5)

As shown in Fig.1-a, the magnetic radius ($r_m$) is the Flipping Radius ($r_F$) and equal to $\lambda/4$ (Yousif, 2014b), substituting this in the right hand side of Eq (5), the following is obtained

$$E_R = \left(\frac{m_e \nu_e^2}{2}\right) = \left(\frac{\beta^2_{CMF} m_e c^2 \lambda^4}{2(4^4) q^2}\right)$$  \hspace{1cm} (6)

Since $\lambda = c/f$ substituting in Eq (6), the following is obtained

$$E_R = hf = \left(\frac{\beta^2_{CMF} m_e c^6}{2(4^4) q^2 f^2}\right)$$  \hspace{1cm} (7)

Eq(4) contained element of time, and Eq(5) contained element of distance, while Eq(6) contain wavelength, and
Eq(7) contain the element of frequency, but as shown in Fig1-b all these four elements are interlinked as the time part of Eq(4) proved, therefore changing any of these elements varied the radiation energy, while the intensity of CMF (B_{CMF} = B_{2e}) given by Eq(2), and shown in Fig 1-a, is controlled by the Magnetic Radius (r_m) or the Flipping Radius (r_p), which is synonymous to the wavelength (λ) and frequency (f), thus any changes in these three parameters (r_m,f and λ) changed B_{CMF} given by Eq(2), hence from this, and since λ = 4r_m thus r_m = λ/4 and λ = c/f therefore substituting these in Eq(2) a disturbance in B_{CMF} is given by

$$B_{CMFD} = B_{2eD} = \frac{4^2 e v_e f^2}{c^3} \quad (8)$$

Eq(8) showed that any change in frequency (f) changed the B_{CMF} or B_{2e} to B_{CMFD} or B_{2eD}, which changed the Magnetic Force (F_{cm}) and Lorentz Force (F_{L}), given by Eq(1), as well as the Radiation Energy (E_R) given in Eqs.(4,5,6,7), therefore magnetic force is frequency controlled entity.

Fig 2a. Stability of interatomic electron shows the Circular Magnetic Field (CMF or B_{CM}) linking electron with the Spinning Magnetic Field (B_{SMF} B_{1U}) at specific Magnetic Radius (r_{me}) and Electrostatic Radius (r_{e}), it balanced the Magnetic Force (F_m), Electrostatic Force (F_e) and Centripetal Force (F_C).

Fig 2b. An impinging Radiation Frequency (f_{R}), with quarter wavelengths (λ/4), it is larger than the half wavelengths (λ/2) of the gyrating electron in Fig 2-a, producing the Excited Force (F_{EA-a}).

Fig 2c. An impinging Radiation Frequency (f_{R}), with half wavelengths (λ/2), it is equivalent to the half wavelengths (λ/2) of the gyrating electron in Fig 2-a, producing the Interatomic Resistance Force (F_{IR}), (or work function).

Fig 2d. An impinging Radiation Frequency (f_{R}), with one wavelengths (λ), it is shorter than the half wavelengths (λ/2) of the gyrating electron in Fig 2-a, producing the Photoelectric Force (F_{P}).

Fig 2e. An impinging Radiation Frequency (f_{R}), with wavelengths (2λ), much shorter than the half wavelengths (λ/2) of the gyrating electron in Fig 2-a, producing the Compton Effect Force.

THE PHOTOELECTRIC EFFECTS

In resolving the photoelectric effect Einstein assumed that; at least part of energy quanta of the incident light (hf) been transformed into kinetic energy of electrons, the electron lose some of the energy when reaching the surface, and electron perform some work P(ϕ) characteristic of the substance when leaving the surface (Einstein & into English, 1965), the photoelectric effect equation given by Einstein predicted to have a maximum energy of emission of corpuscles under the influence of light, and given

$$E_{R(MAX)} = \frac{1}{2} m_e v_e^2 = hf - ϕ \quad (9)$$

While the photoelectric equation related Eq(9) to high frequency radiation is given by (Arthur Holly Compton, 1922)

$$T = hf - w_p \quad (10)$$

Where, w_p is the energy required to move electron from its initial position in the P(K, L, M or N) energy level, experimental evidence indicates that the kinetic energy T calculated by equation (10), is the maximum which may be possessed by an electron ejected from the P energy level (Arthur Holly Compton, 1922).

Since relation given by Eq.(4) represents energy given by Planck (Yousif, 2014a), therefore the maximum energy given in Eqs.(9) can be replaced by Eq.(7), as

$$E_{R(MAX)} = \frac{m_e v_e^2}{2} = \frac{b^2_{EMP} m_e c^6}{2(4π)^2 q^2 f^4} - ϕ \quad (11)$$

Eq.(7) contain Planck’s h as it appeared in photoelectric phenomena measured by Millikan (Millikan, 1916), it also showed the square of magnetic energy contained in EM-R. Therefore, Eq.(11) showed the existence of two equal formulas of EM-R energy, the kinetic energy (E_k) and the Radiation Energy (E_R), both equations gives equal result (Yousif, 2014a), but differ in interpretations. Einstein work
to resolve the photoelectric effect was based on availability of Eq.(3), which expressed the kinetic energy (E_k) measured by Planck given as part of Eq. (9); but it failed to recognized the CMF force within that formula, accordingly the only means to resolve that was through the introduction of quanta or photons (Sachs, 1988), due to the lack of the E_R given by Eq.(11), the following is a different interpretation of the photoelectric effect.

**INTERATOMIC DISTURBANCE FORCE**

Failure to address the perceived electron’s acceleration towards the nucleus and related energy depletion in Rutherford atom model; lead Bohr in 1913 to present his atomic model based on electrons having quanta of energy levels (Sachs, 1988; Trinklein, 1990), but as the suggested EM-R transformation/production is based on Flip-Flop (F-F) electrons in atom and transmission radio waves antenna (Yousif, 2014a), rather than particle acceleration (Sachs, 1988) as well as a suggested atomic model for hydrogen atom (Yousif, 2003b), shown in Fig2-a and given in Table.4, based on the balance of the Magnetic Force (F_M), Electrostatic Force (F_e), and the Centripetal Force (F_C), leading to interatomic stability, where electron gyrate at specific electrostatic radius (r_e), and magnetic radius (r_m) the atom stability is generally given by (Yousif, 2003a)

\[
[F_e = F_M = F_e = F_m] = \left(\frac{m_e v_e^2}{r_m} = B_{2U} B_{2e} r_m^2 c = \frac{2 e 0}{4\pi\varepsilon_0 c^2}\right)
\]

Where, B_{2U} is the Nucleus Spinning Magnetic Field (SMF), B_{2e} is orbital electron’ CMF, m_e is electron’s mass, r_e is the electrostatic atomic radius, r_m is the magnetic radius, v_e is electron’s velocity at natural orbit around the nucleus, \varepsilon_0 is the permittivity of the free space.

**Fig 3-a.** Cross sectional plan of Beryllium atom (Be-4), the interaction between an impinging Radiation Frequency (f_p) and the CMF only occurred when Cos θ = 0, for specific positions among many for the fourth electron. Each electron is linked with the nucleus Spinning Magnetic Field (SMF or B_{1U,a}) through the Circular Magnetic Field (CMF or B_C).

**Fig 3-b.** Cross sectional plan of Beryllium atom (Be-4), any increase in Magnetic Force (F_m) increases the Magnetic Radius (r_m), moving electron to r_{n1}, r_{n2}, and r_{n3} within nucleus influence; with higher f_p electron is removed from atom influence to r_o with zero energy, with much higher f_p electron is moved to r_2 outside atom influence with kinetic energy, depicting the photoelectrons phenomenon.

The early discovery and classification of three natural categories of ferromagnetic, paramagnetic and diamagnetic materials, in their response to intense magnetic field (Nightingale E., 1958), is an indication that the attraction-repulsion characteristic of magnetic interaction (Yousif, 2003a) generally occurred due to internal structural composition of electrons within an atom, and their abilities to produce internal CMF, which interacted with the impinging magnetic field, as shown in Fig2 and since the CMF magnitude given by Eq(2) is not governed by electron’s mass, this imply that magnetic field doesn’t interact with particle’s mass, rather with magnetic fields (Yousif, 2003a). Einstein assumed the ionization of a gas by ultraviolet light, is carried by individual light energy quantum (Einstein, 1965), but the discrepancy between theoretical candle time requirement and the observed instant electron ejection (Millikan, 1916) is comparable to a difference between particle and light speed, indicating the existence of other factor for photoelectron ejection rather than the photon; linked with interpretation of photoelectric effect given by Eq(9), subjected to experiment by Millikan who confirmed the role of EM-R frequency in removing the photoelectron (Millikan, 1916), he also found radiation over wide range of frequencies ejected photoelectrons from the highly electropositive alkali metals, lithium, sodium, and potassium (Roger H Stuewer, 2006) and since there is similarity between Eq(9) and Eq(11), and as proved that, the right hand side of Eq(11) is EM-R energy, while Einstein’s Eq(9) used the kinetic energy equation, therefore the mechanism of Eq(11) clearly showed the EM-R energy is bestowed in the CMF (B_{CMF}) which in itself is controlled by frequency as given by Eq(8), therefore, when an atom is subjected to EM-R having B_{CMF} with specific frequency or wavelength as
shown in Fig.1-d, the radiation given by Eq (7) penetrates material surface to periphery electron’s CMF \(B_{2e}\) and if the incoming wavelength is related to electron’s \(B_{2e}\) radius (or wavelength/4) as shown in Fig 2, which in turn related to the magnitude as given by Eq(11), thus both fields interacts magnetically (Yousif, 2003a) resulted in an increase in electron’s CMF magnitude given by Eq(8), the level CMF \(B_{CMF}\) is given by

\[B_{CMF} = B_{2e} + B_{CMFD}\] (13)

When the EM-R \(B_{CMFD}\) is imposed on the CMF \(B_{2e}\), the magnetic force given by Eq (1) increased, thus changed the balance in Eq(12), to become

\[\left(\frac{m_e v_e^2}{r_{me}}\right) = \left(\frac{Ze Q}{4\pi e_0 r_{e}^2}\right)\] (14)

Therefore the subjection of electron to radiation frequency \(f_R\) given in Eq(8), increases the level CMF \(B_{2e}\) given by Eq(13) and shown in Fig.3, thus changing balance of forces given by Eq (14), to become

\[\left(\frac{2m_e v_e^2}{r_{me}}\right) = \left(\frac{Ze Q}{4\pi e_0 r_{e}^2}\right)\left(\frac{4\pi v_a f_a}{\epsilon^2}\right)\] (15)

THE RADIATION MAGNETIC FORCE \(F_{mR}\)

From Eq(8), electron velocity is given by

\[v_e = \frac{B_{CMFD} c^3}{4\pi f^2} \text{ m. s}^{-1}\] (16)

Replacing \(v_e\) in Lorentz Force of Eq.(1) with the right hand side of Eq(16), the Magnetic Force \(F_m\) is given by

\[F_m = B_{1U} q \frac{B_{CMFD} c^3}{4\pi f^2}\] (17)

The Flipping Frequency \(f_f\) was given as (Yousif, 2014a)

\[f_f = \frac{q B_{1U}}{4\pi m_e} = 1.39962417997831870358140925075 \times 10^{10} B_{1U}\] (18)

From Eq.(18), the strong magnetic field \(B_{1U}\), is

\[B_{1U} = \frac{f_f}{4\pi m_e} = \frac{1.39962417997831870358140925075}{10^{10}}\] (19)

<table>
<thead>
<tr>
<th>(v)</th>
<th>(B_{1U})</th>
<th>(F_m)</th>
<th>(E_{mR})</th>
</tr>
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<tbody>
<tr>
<td>1.2604429562527735977823011235 e+1</td>
<td>1.4477510681260697820820488183 e-6</td>
<td>1.3806948111361710012735157762 e-23</td>
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<tr>
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<td>1.4477510681260697820820488183 e-4</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>(E_{mR})</th>
<th>(f_R)</th>
</tr>
</thead>
</table>
| 5.652725258491769110210168251341 \times 10^{15} B_{CMF}^2 | \sqrt{f_R}\] (20)

Substituting \(B_{1U}\) in Eq(17) with \(B_{1U}\) in Eq(19), the following is derived

\[F_m = \frac{f_f B_{CMFD} c^3}{(1.39962417997831870358140925075 \times 10^{10}) \times (4\pi)^{2/2}}\] (21)

Solving the numerical and physical constant in Eq(20), the magnetic force is

\[F_m = \frac{B_{CMFD} 1.2056807927924535242757263457381 \times 10^{14}}{f}\] (22)

Replacing \(B_{CMFD}\) in Eq (21) with the right hand of Eq (22), the following is obtained

\[F_{mR} = \sqrt{1.906318161436107200999849625463 \times 10^{-61} f_R^2}\] (23)

Therefore, the Magnetic Force \(F_{mR}\) given by Eq (1), is also obtained from an impinging EM-R, the force varied with frequency, hence

\[F_{mR} = \sqrt{y f_R^3}\] (24)

Where, \(y\) is Yousif Constant with magnitude equal to 1.906318161436107200999849625463 x 10^{-61} N^2. Hz^2 (or N^2. s^3.), and the Radiation Magnetic Force \(F_{mR}\) is in Newton. Since relationship given by Eq (24) is equivalent to Eq(1) due to Magnetic Force \(F_m\) or Lorentz Force \(F_h\), therefore the formula is named the Radiation Magnetic Force \(F_{mR}\); for a frequency of one Hertz the,

\[F_{mR} = 4.36614035669505378112760757142228 \times 10^{-31} N\]

If a work is done by Eq(24), the transformed energy is given by

\[W = F_{mR} \cdot d = \sqrt{y f_R^3} \cdot d\] (25)

Where, \(d\) is distance traveled by the \(F_{mR}\).

Table.1. Radiation Magnetic Force \(F_{mR}\) and Radiation Magnetic Energy \(E_{mR}\) resulted from electrons gyrating around strong Magnetic Field \(B_{1U}\) with velocity \(v\), while radiating Electromagnetic Radiation (EM-R), using Eq.(1), Eq.(24) and Eq.(29), respectively.

THE RADIATION MAGNETIC ENERGY \(E_{mR}\)

Solving the numerical and physical constant in the right hand side of Radiation Energy \(E_R\) given by Eq(7), the \(E_R\) is given by,

\[E_R = \frac{5.652725258491769110210168251341 \times 10^{15} B_{CMF}^2}{f}\] (26)

Substituting \(B_{1U}\) in the right hand side of Eq(26) with \(B_{1U}\) given in Eq(22), the following is obtained

\[E_{mR} = \frac{5.652725258491769110210168251341 \times 10^{15} B_{CMF}^2}{f}\] (27)
\[ E_R = (5.0527252584917691102101768251341e + 55)(1.3113864619620888496149896280354 \times 10^{-39})f^5 \]

Solving Eq(27), the following is obtained
\[ E_R = 6.6260755 \times 10^{-34}f^4 \] (28)
But the number 6.6260755 \( \times 10^{-34} \) is what is designated as Planck' constant \( h \), therefore from Eq(28) the Frequency controlled Energy relation is given by
\[ E_{mr} = h f \] (29)

Like the Radiation Magnetic Force (\( F_{mr} \)) given by Eq(24), the energy given by Eq(29), discovered by Planck gives the changes in electron energy within an atom due to impinging EM-R, therefore named the Radiation Magnetic Energy (\( E_{mr} \)).

### Table 2. Radiation Magnetic Force (\( F_{mr} \)) and Radiation Magnetic Energy (\( E_{mr} \)) resulted from lower frequency at Infrared to higher frequencies at \( \gamma \)-rays, using Eq(24) and Eq(29), huge difference existed between \( X(\gamma) \)-rays and the rest.

<table>
<thead>
<tr>
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<th>Infrared</th>
<th>Red</th>
<th>Green</th>
<th>Violet</th>
<th>Ultraviolet</th>
<th>X-rays</th>
<th>( \gamma )-rays</th>
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</tr>
<tr>
<td>Wavelength (Å)</td>
<td>1.6e-6</td>
<td>6.520</td>
<td>5460</td>
<td>4050</td>
<td>200</td>
<td>0.3</td>
<td>3.3-3</td>
</tr>
<tr>
<td>( F_{mr} ) (N)</td>
<td>2.27e-12</td>
<td>4.31e-9</td>
<td>5.62e-9</td>
<td>8.81e-9</td>
<td>8.02e-7</td>
<td>1.38e-2</td>
<td>1.38e+1</td>
</tr>
<tr>
<td>( E_{mr} ) (J)</td>
<td>1.99e-21</td>
<td>3.05e-19</td>
<td>3.64e-19</td>
<td>4.91e-19</td>
<td>9.94e-18</td>
<td>6.63e-15</td>
<td>6.63e-13</td>
</tr>
</tbody>
</table>

The magnetic force given by Eq(24) showed the whole force is only controlled by the frequency, while the magnetic energy given by Eq(29), showed the whole energy is controlled by frequency, both are given in Table1 from various frequency spectrum, which gives the Magnetic Force (\( F_m \)) or Lorentz Force (\( F_L \)) and the Radiation Energy (\( E_R \)) resulted from charged particle gyrating around strong Magnetic Field (\( B_{1U} \)), while radiating EM-R, these forces and energies are equal to Radiation Magnetic Force (\( F_{mr} \)) and Radiation Magnetic Energy (\( E_{mr} \)) resulted from frequencies ranging from Infrared to \( \gamma \)-rays, using Eq(1), Eq(24), and Eq(29), while Table2 gives \( F_{mr} \) and \( E_{mr} \) for frequencies ranging from Infrared, light, to \( \gamma \)-rays, using Eq(24) and Eq(29), huge difference existed between X \( \gamma \)-rays and the rest. Tables1 and 2 showed EM-R possessed both force and energy.

### ELECTROMAGNETIC RADIATION AND INTERATOMIC FORCE AND ENERGY

During the X-ray scattering experiment, energy and momentum were spend on some particular electron (Arthur H Compton, 1923), and magnetic spectrum method was used with X and \( \gamma \)-rays. Broglie and Ellis showed that a large part of electrons ejected from different energy levels within the atom absorb one quantum of the incident energy, and emerge with their kinetic energy diminished only by the work required to leave the atom (Arthur Holly Compton, 1922), therefore relating this to Fig 2, any increase in \( B_{2e} \) (\( B_{CMFD} \)), increases the Magnetic Force (\( F_{mr} \)), this is done by adding \( B_{CMFD} + B_{2e} \), expressed by Eqs.(8,13, and 15), and as the radiation waves are received from definite directions (Arthur H. Compton, 1923), and since each electron’s CMF (\( B_{2e} \)) rotates with electron around the nucleus while likened with Nucleus Spinning Magnetic Field (NSMF) as shown in Fig3-b, then any incoming visible light, X-rays or \( \gamma \)-rays added maximum \( B_{CMFD} \) (\( CMFD \)) only when it has an angle \( \theta \) equal zero with the rotating electron’s CMF (\( B_{2e} \)) as shown in Fig3-a; thus electron’s CMF in atom only passes through two of such positions which can give maximum interactions for both CMF; that is when electron is facing the EM-R and when electron is behind the nucleus, hence the only justified position is when \( B_{CMFD} \) is in front as in Fig3-a; hence that is when the impinged CMF added maximum to \( B_{2e} \) showed in Fig2, thus resulted in maximum Magnetic Force (\( F_m \)); therefore the magnetic force in Eq(15) can be substituted by the Radiation Magnetic Force (\( F_{mr} \)) given by Eq(24), added to \( F_m \) and both opposed by \( F_c \) and \( F_{F} \), this given by
\[ \left( F_{mr} \right) + \frac{1}{\gamma} \frac{H_{0} e \beta}{m c} \right] \right) = \{ B_{1U} B_{2e} + \frac{\gamma}{\gamma - 1} \} \right) \] (30)

### Table 3. The Orbital Magnetic Force (\( F_{om} \)) for the last electrons in some elements, using Eq.(47).

<table>
<thead>
<tr>
<th>Metal</th>
<th>Threshold Frequency, Hz</th>
<th>Orbital Magnetic Force (( F_{om} ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium</td>
<td>5.584e+14</td>
<td>5.761237849847360727215653926001e-9</td>
</tr>
<tr>
<td>Alumimum</td>
<td>9.84e+14</td>
<td>1.34892387050753294689619091924e-8</td>
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<tr>
<td>Lead</td>
<td>9.990e+14</td>
<td>1.37862428674384121519431400015254e-8</td>
</tr>
<tr>
<td>Zinc</td>
<td>1.038e+15</td>
<td>1.4601373927152053209636908461e-6</td>
</tr>
<tr>
<td>Iron</td>
<td>1.086e+15</td>
<td>1.56258060897898600387378048269693e-8</td>
</tr>
<tr>
<td>Copper</td>
<td>1.134e+15</td>
<td>1.66731353044565873629861931117e-8</td>
</tr>
<tr>
<td>Silver</td>
<td>1.141e+15</td>
<td>1.682775418446838786021735093958e-8</td>
</tr>
<tr>
<td>Nickel</td>
<td>1.209e+15</td>
<td>1.83542717910171284922689798982e-8</td>
</tr>
<tr>
<td>Gold</td>
<td>1.231e+15</td>
<td>1.88575284716125285064142247308475e-8</td>
</tr>
<tr>
<td>Platinum</td>
<td>1.532e+15</td>
<td>2.61809764862812860353593821906e-9</td>
</tr>
</tbody>
</table>

### INTERATOMIC EXCITED FORCE (\( F_{EA-n} \)) AND ENERGY (\( E_{mr} \))

The increases in magnetic force (\( F_{mr} \)), due to an increase in Radiation Magnetic Force (\( F_{mr} \)) given by Eq(30), increases both the magnetic radius (\( r_{mr} \)) and electrostatic radius (\( r_{e} \)), leading to instability in interatomic forces as shown in Fig.3-b, where both the electrostatic force (\( F_{e} \)) and centripetal force (\( F_{c} \)) opposed such instability, thus any increase in Radiation
Magnetic Force \((F_{\text{mr}})\) given by Eq.(30), changed electron momentum, this is given by

\[
\rho = t \sqrt{y f_{\text{E}}} \quad (31)
\]

Where, \(t\) the elapsed is time in second and \(\rho\) is the momentum or the impulse. When the EM-R wavelength \((\lambda)\) given in Eq(30) is large compared to electron’s CMF \((B_{2e})\) as shown in Fig-2-b, the produced \(F_{\text{mr}}\) forced electron to move away from nucleus as shown in Fig-3-b; if electron still under mutual Electrostatic Force \((F_{e})\), the Magnetic Radius will increase from \(r_{na}\) to \(r_{na}+r_{a} \cdots\) to \(r_{na}\), shown in Fig(3-b), then electron will be energized at the specific radius level, radiating spectral line, then pulled back by \(F_{e}\) to the natural orbit \((\text{Yousif, 2003a})\), this represents the Excited Force \((F_{\text{EA}-n})\), which is generally given by

\[
\begin{align*}
F_{\text{EA}-n} &= \left( \frac{m_e v^2}{r_{me}} \right) + \left( \frac{ZeQ}{4\pi\varepsilon_0 r^2} \right) - \left( \sqrt{y} f_{\text{E}} \cos \theta \right) = < F_0 \\
&= \left( \sqrt{y} f_{\text{E}} \cos \theta \right) = < F_0
\end{align*}
\] (32)

Where \(F_{\text{EAn}}\) is the excitation radiation frequency, \(F_0\) is the threshold Force, and \(F_{\text{EA}-n}\) is the Resulted Excited Force for an electron in \(A\) atomic number and \(n\) the level within the atom, for hydrogen atom in Table 4, this is \(F_{\text{EH}-1}\); for the last electron 19 of the potassium in Appendix 1 is \(F_{\text{EK}-19}\). Thus Eq(32) can be reduced to

\[
F_{\text{EA}-n} = \left( \frac{ZeQ}{4\pi\varepsilon_0 r^2} \right) - \left( \sqrt{y} f_{\text{E}} \cos \theta \right) = < F_0
\] (33)

The change in interatomic forces given by Eq.(30) is due to the Radiation Magnetic Force \((F_{\text{mr}})\) given by Eq(24); and since all experiments showed that the maximum energy of electrons liberated by X-rays having frequency \(f\) is given very closely by \((\text{Arthur Holly Compton, 1922})\).

\[
\frac{1}{2}m_e v^2 = hf
\] (34)

From Eq.(5) and Eq.(7), the energy of any electron within any atom such as shown in Table.4 for Hydrogen atom or Appendix 1 for Potassium atom, and given by Eq. (30), is

\[
E_{\text{EA}-n} = \frac{\hbar^2 F_{\text{CMF-n}} m_e c^2 r_{n\text{h}-n}}{2q^2}
\] (35)

Where, \(B_{\text{CMF-n}}\) is the Circular Magnetic Field of an electron at \(n\)th orbit (as for potassium in Appendix 1), \(r_{n\text{h}-n}\) is the magnetic radius of gyration at \(n\)th orbit, \(E_{\text{EA}-n}\) is the electron’s orbital energy, \(A\) represents the atomic number and \(n\) the radial level of the electron within the atom, for hydrogen atom this is \(E_{\text{EH}-1}\); the last orbit 19 of potassium in Appendix 1 is \(E_{\text{EK}-19}\). Therefore, since the Radiation Magnetic Energy \((E_{\text{mr}})\) discovered by Planck and given by Eq(29), directly gives the change in interatomic electron energy by the impinging EM-R, similar to Eq(24) of the \(F_{\text{mr}}\) which inflected changes in interatomic force as given by Eq(30), and this direct change in interatomic electron energy (like \(yf\)) is the essence of what had been discovered by Planck; instead, it was conceived as a formula for energy transformation equivalent in value to the kinetic energy given in Eq.(7) and Eq.(34), not as a formula deciphering the mechanism that transformed the energy within EM-R into interatomic electron’s CMF, which will then be exhibited in various outcomes based on the amount of the impinging EM-R frequency; hence Planck was correct that his formula is merely a mathematical trick \((\text{Deshmukh & Venkataraman, 2006})\); therefore like the interatomic force given by Eq.(30), when both CMF’s are synchronized and faced each others as shown in Fig3-a, the Radiation Frequency \((f_{\text{p}})\) becomes maximum, as it produced \(F_{\text{mr}}\) given by Eq(30), it also changed the interatomic electron energy, by adding the impinging Radiation Magnetic Energy \((E_{\text{mr}})\) suggested by Planck to the electron’s orbital energy giving by Eq(35), hence the following is obtained

\[
E_{\text{EA}-n} = \frac{\hbar^2 F_{\text{CMF-n}} m_e c^2 r_{n\text{h}-n}}{2q^2} + hf \cos \theta
\] (36)

<table>
<thead>
<tr>
<th>No</th>
<th>(E_i (eV))</th>
<th>(I_{11})</th>
<th>(F_{\text{om-n}})</th>
<th>(v_{\text{p-n}})</th>
<th>(B_{\text{r-n}})</th>
<th>(\gamma_{\text{r-n}})</th>
<th>(r_{\text{m-n}})</th>
<th>(B_{\text{CMF-n}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.28800472482</td>
<td>8.23182903563390</td>
<td>2187080.47538560</td>
<td>234920.543090379</td>
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<td>5.2932580735060082</td>
<td>0.4168781741808088</td>
<td>0.889758802174</td>
</tr>
</tbody>
</table>

\(13.598\)

\(1\)

\(83184428e+15\)

\(e-8\)

\(3\)

\(3\)

\(e-11\)

\(e-11\)

\(2\)

Table 4. The Hydrogen Atom structural parameters; giving Ionization potential \((E_i)\), then Ionization Frequency \((f_{\text{i-n}})\) is derived, the Orbital Magnetic Force \((F_{\text{om-n}})\), the Spinning Magnetic Field \((B_{\text{s-n}})\), orbital velocity \((v_{\text{p-n}})\), Electrostatic Radius \((r_{\text{e-n}})\), Magnetic Radius \((r_{\text{m-n}})\), and the Circular Magnetic Field \((B_{\text{CMF-n}})\), these parameters are similar to that obtained at The Magnetic Interaction with different procedures \((\text{Yousif, 2003a})\).

INTERATOMIC RESISTANCE FORCE \((F_{\text{EA-n}})\) AND ENERGY, OR THE WORK FUNCTION OF THE ATOM

If the impinging radiation frequency \((f_{\text{E}})\) is greater than the excitation radiation frequency \((f_{\text{E}})\) thus the produced force is greater than the Excitation Force \((F_{\text{EA}-n})\) given by Eq.(33), hence a state of equilibrium will be attained, where electron is removed from atom without energy, this was given by \((\text{Arthur Holly Compton, 1922})\).

\[
w_p = h\nu - T
\] (37)

Where \(w_p\) is the energy required to move electron from its initial position in the \(P\) \((K, L, M \text{ or } N)\) energy level and \(T\) is the kinetic energy of electron \((\text{Arthur Holly Compton, 1922})\). In the state given by Eq (37), for an electron to be removed from the Natural Orbit \((O_n)\) to a free state of influence, a minimum Radiation Magnetic Force \((F_{\text{mr}})\) is required using Eq(24), the \(F_{\text{mr}}\) from sources such infrared to \(\gamma\)-rays radiation are shown in Table2, the interaction of such impinging radiation frequency \((f_p)\) having wavelength equal or nearly equal to the orbital electron’s CMF as shown in Fig 2-b, produced Radiation Magnetic Force \((F_{\text{mr}})\), which
reduces the electrostatic attractive force ($F_a$), or the Interatomic Resistance Force ($F_{ir}$), or the work function of the atom to zero, this is the equilibrium state, as shown by $r_0$ in Fig.3-b, $F_{ir}$ is given by

$$F_{RA-n} = W = \frac{Ze Q}{4\pi\epsilon_0 r_0^2} - \sqrt{y f_R \cos \theta} = F_0$$  \hspace{1cm} (38)$$

Where, $F_{RA-n}$ is Interatomic Resistance Force, from Eq(38), the Interatomic Resistance Force $F_{ir}$, (or work function) can be defined as: “The Radiation Magnetic Force ($F_{mr}$) required to move electron from natural orbit to a state at rest in the vacuum adjacent to the atom.” Therefore the EM Frequency ($f_R$) that can produce equivalent Interatomic Resistance Force ($F_{ir}$), (or work function); for any atom is given by

$$f_{ir} = \frac{3}{2} \sqrt{\frac{2Ze Q}{4\pi\epsilon_0 r_0^2}} = \frac{3}{2} \sqrt{\frac{eB_{LU} V_O}{2\alpha^2}}$$  \hspace{1cm} (39)$$

Since an increase in the Radiation Magnetic Force ($F_{mr}$), reduced the attractive electrostatic force ($F_a$), or the Interatomic Resistance Force ($F_{ir}$), or the work function of the atom to zero, the same impinging radiation frequency ($f_R$) also produced the Radiation Magnetic Energy ($E_{mr}$), reducing electron’s orbital energy ($E_o$), hence the Interatomic Resistance Energy ($E_{ir}$), or the work function of the atom is given by

$$E_{RA-n} = \frac{h f \cos \theta - \frac{B_{CMF}^2 m_e c^2 r_{n-h}}{2\alpha^2}}{2} = F_0$$  \hspace{1cm} (40)$$

Where $E_{RA-n}$ is the Interatomic Resistance Energy of the $n^{th}$ electron of A atom.

THE PHOTOELECTRIC EFFECT FORCE ($F_{EA-n}$) AND ENERGY ($E_{EA-n}$)

When an impinging EM-R wavelength ($\lambda$) is greater than the gyration electron’s CMF ($B_{CMF}$) radius as shown in Fig 2-a, the $f_R$ is less than the threshold frequency ($f_0$), producing small magnetic force ($F_m$), the resulted Excited Force ($F_{EA-n}$), is greater than the Interatomic Resistance Force ($F_{ir}$), hence $F_{EA-n} > F_0$, electron is energized within the level radius, radiating the acquired energy as spectral line as given for pot in Appendix 2, then pulled back to natural orbit by $F_e$ (Yousif, 2003a).

a) The Excited Force ($F_{EA-n}$): When the impinging EM-R wavelength ($\lambda$) is greater than the gyration electron’s CMF ($B_{CMF}$) radius as shown in Fig 2-a, the $f_R$ is less than the threshold frequency ($f_0$), producing small magnetic force ($F_m$), the resulted Excited Force ($F_{EA-n}$), is greater than the Interatomic Resistance Force ($F_{ir}$), hence $F_{EA-n} > F_0$, electron is energized within the level radius, radiating the acquired energy as spectral line as given for potassium in Appendix 2, then pulled back to natural orbit by $F_e$ (Yousif, 2003a).

b) The Interatomic Resistance Force ($F_{RA-n}$): When the impinging EM-R wavelength ($\lambda$) is equal to the gyration electron’s CMF ($B_{CMF}$) radius as shown in Fig 2-b, the $f_R$ is equal to the threshold frequency ($f_0$), where the produced Radiation Magnetic Force ($F_{mr}$), is equal to the threshold orbital magnetic force ($F_{om}$), the resulted Interatomic Resistance Force ($F_{RA-n}$), is equal to zero ($F_{RA-n} = F_0$), electron emerged at the periphery of the atom, but without kinetic energy.

c) The Photoelectric Force ($F_{PA-n}$): When the impinging EM-R wavelength ($\lambda$) is smaller than the CMF ($B_{CMF}$) as shown in Fig 2-c, the $f_R$ is greater than the threshold frequency ($f_0$), where the produced Radiation Magnetic Force ($F_{mr}$), is greater than the orbital magnetic force ($F_{om}$), thus produced $F_{PA-n}$ which is greater than the Interatomic Resistance Force ($F_{RA-n}$), thus $F_{PA-n} > F_0$, electron emerged at the periphery with kinetic energy, the level of which is proportional to the $f_R$.

d) Fig.2-d, the $f_R$ is greater than the threshold frequency ($f_0$), thus produced Compton force is greater thus $F_{CA-n} \approx F_0$, with other consequences (Yousif, Unpublished).

THE FOUR PHASES OF ELECTROMAGNETIC RADIATION INTERACTION WITH MATTER

From this analysis, the Photoelectric Effect phenomenon is only one of series of interactions between EM-R and interatomic electron’s CMF, and as Planck correctly stated in his rejection to extend quantum to EM-R, 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,” (Sachs, 1988) but as seen; extending this relation, resulted in different outcome, where in all of the interactions between EM-R and matter, the resulted forces and energies determined stability and the aftermath of both the atom and the electron; therefore all these can generally be expressed by

$$F_{MR} = \frac{Ze Q}{4\pi\epsilon_0 r_0^2} - \sqrt{y f_R \cos \theta} = \begin{cases} F_{EA-n} & < F_0 \\ F_{ir} = F_0 & \sqrt{F_{PA-n} > F_0} \\ F_{CA-n} \approx F_0 & \end{cases}$$  \hspace{1cm} (43)$$

Where, $F_0$ is the threshold Force, $F_{EA-n}$ is the Excitation Force ($F_{ea}$), $F_{ir}$ is the Interatomic Resistance Force ($F_{ir}$), $FP_{PA-n}$ is Photo Electric Force ($F_{pE}$), the $F_{CA-n}$ is the Compton Effect Force ($F_{CE}$), and $F_{MR}$ is the Material Radiation Force. The Material-Radiation Force ($F_{MR}$), given by Eqs (43) depends on the magnitude of Radiation Magnetic Force ($F_{mr}$) given by Eq (24), which is proportional to the impinging Electromagnetic Radiation frequency ($f_R$), as shown in Figs 2 and 3, the produced Material Radiation Force ($F_{MR}$), could be classified into four categories of forces, these are:

a) The Excited Force ($F_{EA-n}$): When the impinging EM-R wavelength ($\lambda$) is greater than the gyration electron’s CMF ($B_{CMF}$) radius as shown in Fig 2-a, the $f_R$ is less than the threshold frequency ($f_0$), producing small magnetic force ($F_m$), the resulted Excited Force ($F_{EA-n}$), is greater than the Interatomic Resistance Force ($F_{ir}$), hence $F_{EA-n} > F_0$, electron is energized within the level radius, radiating the acquired energy as spectral line as given for potassium in Appendix 2, then pulled back to natural orbit by $F_e$ (Yousif, 2003a).

b) The Interatomic Resistance Force ($F_{RA-n}$): When the impinging EM-R wavelength ($\lambda$) is equal to the gyration electron’s CMF ($B_{CMF}$) radius as shown in Fig 2-b, the $f_R$ is equal to the threshold frequency ($f_0$), where the produced Radiation Magnetic Force ($F_{mr}$), is equal to the orbital magnetic force ($F_{om}$), the resulted Interatomic Resistance Force ($F_{RA-n}$), is equal to zero ($F_{RA-n} = F_0$), electron emerged at the periphery of the atom, but without kinetic energy.

c) The Photoelectric Force ($F_{PA-n}$): When the impinging EM-R wavelength ($\lambda$) is smaller than the CMF ($B_{CMF}$) as shown in Fig 2-c, the $f_R$ is greater than the threshold frequency ($f_0$), where the produced Radiation Magnetic Force ($F_{mr}$), is greater than the orbital magnetic force ($F_{om}$), thus produced $F_{PA-n}$ which is greater than the Interatomic Resistance Force ($F_{RA-n}$), thus $F_{PA-n} > F_0$, electron emerged at the periphery with kinetic energy, the level of which is proportional to the $f_R$.

d) Fig.2-d, the $f_R$ is greater than the threshold frequency ($f_0$), thus produced Compton force is greater thus $F_{CA-n} \approx F_0$, with other consequences (Yousif, Unpublished).

THE HIGHER LEVEL ATOMIC MODEL

Based on characteristics explored in this study, and the suggested Hydrogen Atom Model (HAM) (Yousif, 2003a) the
main features of Higher Level Atomic Model (HLAM) is explored, based on characteristics derived from the gyrations of electrons around the nucleus in the Natural Orbit \((O_n)\), with specific Orbital Magnetic Force \((F_{omn})\), Electrostatic Force \((F_{esn})\), Orbit Velocity \((v_{o-n})\), at specific Magnetic Radius \((r_{mn})\), Electrostatic Radius \((r_{en})\) and with specific Circular Magnetic Field \((B_{2en})\), it linked at specific Spinning Magnetic Field \((B_{1U-n})\) magnitude as given in the Magnetic Interaction \((Yousif, 2003a)\). Expanding the atomic model to generalized all atoms, the example of which is shown for potassium atom \((K19)\) in Appendix 1, based on deriving the Radiation Magnetic Force \((F_{mr})\) as an equivalent to Orbital Magnetic Force \((F_{om})\) by transforming the ionization energy \((E_i)\), into an equivalent ionization frequency, given by

\[ f_i = \frac{E_i}{h} \]  

(44)

The Material-Radiation Force \((F_{MR})\), given by Eq.(43), can be expressed for the Ionization Magnetic Force \((F_{im})\) as

\[ F_{im} = B_{1U} B_{2e} r_{im}^2 c + \sqrt{y f_i^3 \cos \theta} \]  

(45)

Where, \((f_i)\) is the ionization frequency given by Eq(44), and \(F_{im}\) is the ionization Magnetic Force. Since the three forces are equal at the natural orbit as given by Eq (30), therefore from Eq(45), the Orbital Magnetic Force \((F_{om})\) is half the magnitude of the ionization Magnetic Force \((F_{im})\) in Eq(45), and given by

\[ F_{om} = \frac{\sqrt{y f_i^3 \cos \theta}}{2} \]  

(46)

Thus the Orbital Magnetic Force \((F_{om})\) which is an equivalent to both the Centripetal Force \((F_c)\) and the Electrostatic Force \((F_{es})\), is given by

\[ F_{om} = \frac{\sqrt{y f_i^3 \cos \theta}}{2} \]  

(47)

From Eq(47) the radiation frequency \(f_i\) that could ionized electron when bonded by Orbit Magnetic Force \((F_{om})\) is given by

\[ f_i = \frac{\sqrt{y f_i^3 \cos \theta}}{3} \]  

(48)

The Orbit Velocity \((v_{o})\) is

\[ v_{o} = \frac{2\pi k}{3 m_e} \]  

(49)

Using Eq (47), specific interatomic Orbital Magnetic Force \((F_{om})\) which is equal to Electrostatic Force \((F_{es})\), and bonds electron to nucleus can be know; this is used to drive interatomic parameters for potassium atom \((K19)\) as shown by Appendix 1, where the Spinning Magnetic Field \((B_{1U})\) used in Appendix 1, can be extracted from

\[ qB_{1U}v_o = B_{1U}B_{2e} r_{om}^2 c = \sqrt{y f_S^3} \]  

(50)

While the electrostatic radius is

\[ r_e = \frac{2 e Q}{4\pi\varepsilon_0 F_{om}} \]  

(51)

The Magnetic Radius is

\[ r_m = \frac{m_e r_e^2}{r_{om}} \]  

(52)

While the CMF \((B_{2e})\) is derived using Eq(2).

**GENERAL MODEL OF ATOMIC SPECTRAL LINE**

The functionality of the suggested \(F_{mr}\) and \(F_{mb}\) are used to derive potassium atom spectral lines given in Appendix 2, each of the 19 lines is generated using one of related 19 level electrons parameters, given in Appendix 1, which finally resulted in the multiplication of both the resultant force \((F_e)\) and the travelled distance, which is equal to half the level radius \((r_n)\) \((Yousif, 2003a)\), therefore each step in Appendix 2, with specific spectral line \((Sansonetti, 2008)\), represents the following sequences as related to Appendix 1; the spectral line energy is given as

\[ E_S = 0.5F_e r_n \]  

(53)

Where, \(F_e\) is the resulted force in Newton, \(r_n\) is the level radius in meter, and the spectral line energy \(E_S\) is in Joule; this resulted force is established from

\[ F_e = F_{om} - F_{om} \]  

(54)

Where, \(F_{om}\) is the Orbit Magnetic Force given by Eq(47), \(F_{om}\) is the level Force, it is given by

\[ F_n = qB_{1U}v_n \]  

(55)

Where, \(v_n\) is the level velocity, given by

\[ v_n = v_o + v_D \]  

(56)

Where, \(v_D\) is the orbit velocity, \(v_o\) is the disturbance velocity due to excitation potential, given by

\[ v_D = \frac{2\pi k}{3 m_e} \]  

(57)

To get the disturbance potential energy \((E_D)\), for each of the enlisted spectral line in Appendix 2, and when the spectral line is given \((Sansonetti, 2008)\); using the Radiation Magnetic Force \((F_{mr})\) given by Eq.(30), the potential Disturbance energy \((E_D)\) is

\[ E_D = \left( \frac{A \sqrt{y f_S^3} + v_o}{qB_{1U}} - v_o \right)^2 m_e \]  

(58)

Where, \(A\) is a factor introduced to relate the frequency with the resultant force, and since \(A = \frac{c}{\lambda}\), substituting in Eq(58), the Disturbance potential \((E_D)\) is given in term of wavelength by

\[ E_D = \left( \frac{A \sqrt{y f_S^3} + v_o}{qB_{1U}} - v_o \right)^2 \]  

(59)

From the Magnetic Interaction \((Yousif, 2003a)\). Wavelengths, Transition Probabilities, and Energy Levels for the Spectra of Potassium (K I through K XIX), J. Phys. Chem. Ref. Data, Vol. 37, No. 1, the Disturbance velocity is given by

\[ v_D = \frac{2 \pi k}{m B_{1U} \lambda} \]  

(60)

From Eq.(60), the Disturbance potential \((E_D)\) is

\[ E_D = \frac{m_e \left( \frac{2 \pi k}{m B_{1U} \lambda} \right)^2}{2} \]  

(61)
The excited potential for the spectral lines are derived using Eq(57) or Eq(59), followed by the energization as given in the Magnetic Interaction (Yousif, 2003a), the procedures of deriving different parameters for Potassium Atom given in Appendix 1, helped in deriving the parameters K1 to K19 for spectral lines in each of the nineteenth electrons in Appendix 2, as given by Sansonetti (Sansonetti, 2008), where each obtained excited potential; allowed for the building of an atomic models for all elements in periodic table using both Eqs.(24, 47) and Eq(59). Each of the excited potential for the 19 electrons of the potassium atom shown in Appendix 2, added the disturbance energy \((E_D)\) to the orbital energy \((E_o)\) given in Appendix 1, thus the disturbance force \((F_D)\) is added to the orbital force \((F_O)\), which when moved to new radial distance \((r_n)\), energized electron to the new level energy, by the level force \((F_n)\) and half of level radius \((r_n)\) which is then radiated. If a spectral wavelength \(\lambda\) is given, the sequential procedure to produced parameters of each wavelength, as given in Appendix 2 starts with getting the Initial Resulted Force \((F_{ri-1})\) as

\[
F_{ri-1} = \sqrt{y f^2} \tag{62}
\]

The \(F_{ri-1}\), is relative to \(f_2\) and doesn’t reflects it; hence the \(F_{ri-1}\) from Eq.(62) is added to \(F_0\) from Appendix 1, as

\[
F_n = F_0 + F_{ri-1} \tag{63}
\]

The level velocity \(v_n\) is obtained from \(F_n\) in Eq(63) using an related level \(B_{1U-n}\) from Appendix 1, as

\[
v_n = \frac{r_n}{q B_{1U-n}} \tag{64}
\]

Then disturbance velocity \((v_D)\) is given by

\[
v_D = v_n - v_O \tag{65}
\]

From which the disturbance energy \((E_D)\) is

\[
E_D = \frac{v_D^2 m_e}{2} \tag{66}
\]

Using \(v_n\) from Eq.(64), the level radius \((r_n)\) is

\[
r_n = \frac{v_n}{m_e q^2} \tag{67}
\]

The spectral line energy is

\[
E_S = 0.5 F_r r_n \tag{68}
\]

The spectral line frequency is

\[
f_S = \frac{E_S}{h} \tag{69}
\]

Hence, the first spectral line wavelength is

\[
\lambda_1 = \frac{hc}{f_S} \tag{70}
\]

Verifying the ratio error by dividing resulted \(\lambda_1\) from Eq.(70) by the given spectral line

\[
R_1 = \frac{\lambda_1}{\lambda} \tag{71}
\]

If the difference existed between the two wavelengths, the first ratio \(R_1\) is multiplied by the first Initial Resulted Force \((F_{ri-1})\) given by Eq (62) and a second Initial Resulted Force \((F_{ri-2})\) is found, it is used to repeat steps from Eq.(63) to Eq(71), as

\[
F_{ri-2} = R_1 F_{ri-1} \tag{72}
\]

The whole procedures from Eq(63) till Eq(71) is repeated, then the second ratio \(R_2\) is multiplied by the second Initial Resulted Force \((F_{ri-2})\) given by Eq (72). The final wavelength which is obtained due to repetition for not less than eight steps, depending on the decimal points on the spectral line, is obtained when the ratio of the final derived wavelength \(\lambda_n\) is equal to one, hence

\[
R_n = \frac{\lambda_n}{\lambda} = 1 \tag{73}
\]

Or from the Magnetic Interaction (Yousif, 2003a), the spectral line level energy is

\[
E_n = \frac{m_e v_n v_D}{2} \tag{74}
\]

The wavelength of which is given by

\[
\lambda = \frac{2 h c}{m_e v_n v_D} \tag{75}
\]

RESULTS AND DISCUSSION and CONCLUSIONS

The interatomic forces and stability is based on the dynamics of Circular Magnetic Field \((B_{2e}\) or \(B_{CMF}\)) produced by energetic electron linking atomic electron with its nucleus through the Spinning Magnetic Field \((SMF\) or \(B_{1U}\)), any increase in electron’s \(B_{CMF}\) reflected in an increase in magnetic force/energy, and this is controlled by the radiation frequency. The establishment of Radiation Magnetic Force \((F_{mR})\), as a new formula for magnetic force, controlled by radiation frequency, helped in the establishment and proved the nature and origin of the Radiation Magnetic Energy \((E_{mR})\) or Planck’ \((h\nu)\) formula. It is been establishment that, both the \(F_{mR}\) and \(E_{mR}\) controlled and changed interatomic forces and energies, through changes in \(B_{2e}\) which linking electrons with the nucleus through the Spinning Magnetic Field \((SMF\) or \(B_{1U}\)), the magnitude of this change is the factor behind the Excitation Force \((F_{EX})\), Interatomic Resistance Force \((F_{IR})\), the Photo Electric Force \((F_{PE})\), including the Compton Effect Force \((F_{CE})\) which exhibits other phenomenon. The \(F_{mR}\) can be used to determine interatomic forces, it showed the relationship between various frequencies and forces in different material, these force gives reasons behind weakness and strength of these material. In the absence of the \(F_{mR}\) and misinterpreted \(E_{mR}\), the unknown nature of discrete energy of Electromagnetic Radiation \((EM-R)\) transformation/production (Yousif, 2014a) process was confused as a quantum, lead to unrelated energy interpretation, and necessitate the introduction of particle to remove photoelectron in the photoelectric effect, but the real action behind both the \(F_{mR}\) and \(E_{mR}\) through \(B_{CMF}\) or \(B_{2e}\) explained the mechanism for this removal. Therefore, the photoelectric effect can be defined as “The ejection of an electron from an atom by the Radiation Magnetic Force \((F_{mR})\) embedded in the Electromagnetic Radiation frequency.”

The introduction of Radiation Magnetic Force \((F_{mR})\), allow for deriving the Orbital Magnetic Force \((F_{om})\), for any electron gyrating around the nucleus in any atom; when the ionization potential for each electron is known; forming a new bases to explore the structure of any atom. The Radiation Magnetic Force \((F_{mR})\) given in Table 4, proved the correctness of Orbital Magnetic Force \((F_{om})\), previously postulated for hydrogen atom, in the Magnetic Interaction (21). The ease by which the model reproduced spectral line for all electrons in higher atoms can further be developed; giving opportunity for a better understanding to mechanism.
prevailed at the micro-atom levels. Although many scientists like Millikan, Lorenz, Raman and Planck opposed Einstein idea about light duality, but few like Raman who enthusiastically continued till the end with clear mind and vision expressed in his classical solution for Compton Effect (Raman, 1928), therefore this work is an indirect extension to the brilliant ideas envisioned by those scientists who clearly envision the essence of science. The solar sails, which is propelled by Electromagnetic Radiation (EM-R), was thought to be driven by the radiation pressure (Wikipedia, 2015), but as Eq(24) showed, the Radiation Magnetic Force (F_{mr}) embedded in the EM-R is the force driven the Solar sails and similar propulsion. The Electromagnetic Radiation (EM-R) contained Radiation Magnetic Energy (E_{mr}) as well as Radiation Magnetic Force (F_{mr}), the F_{mr} is responsible for the displacement and ejection of photoelectrons within and from an atom, while the E_{mr} endow this electron with the related kinetic energy. The F_{mr} facilitate determination of the magnetic force bonding electron to the nucleus, making it possible to reproduce different parameters of interatomic electron. From characteristics of both F_{mr} and E_{mr} as well as the previous two papers (Yousif, 2014a, 2014b), light or EM-R, consist only of series of a discrete units of waves, each unit consist of specific intensity energy of CMF-EF, and carries magnetic force as well as magnetic energy.

REFERENCES


Sachs, M. Einstein Versus Bohr (Open Court, 1988): Chap.


### Appendix

**Appendix 1.** The Potassium Atom structural parameters; giving Ionization potential ($E_i$), Ionization Frequency ($f_{i-n}$) is derived, then the Orbital Magnetic Field ($F_{om-i}$), the Spinning Magnetic Field ($B_{L-i}$), orbital velocity ($v_{o-i}$), Electrostatic Radius ($r_{e-i}$), Magnetic Radius ($r_{m-i}$), and the Circular Magnetic Field ($B_{2e-i}$), these 19 electrons parameters are used to generate the Spectral Parameters in Appendix 2.

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<th>$B_{L-i}$</th>
<th>$v_{o-i}$</th>
<th>$r_{e-i}$</th>
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### Appendix 2

Detail spectral line parameters for each electron of the potassium atom nineteen electrons, with given spectral line (Sansonetti, 2008); each sequence ended with multiplication of Resultant Force (F<sub>r</sub>) by half of Level Radius (r<sub>n</sub>).

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