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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 (E_{mR}) or Planck' formula (hf); both formulas derived and identified the Excited Force (F_{Ex}) and Energy (E_{Ex}), the Interatomic Resistance Force (F_{IR}) and Energy (E_{Ex}), (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 F_{mR} and E_{mR}; the F_{mR} derived Orbital Magnetic Force (F_{Om}) 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, Lorenz 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 exist 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_{mR}), 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 γ-rays, all of which within EM-R spectrum, a relationship is suggested relating the Excited Force (F_{Ex}) and Energy (E_{Ex}), the Interatomic Resistance Force (F_{IR}) and Energy (E_{Ex}), (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_{mR}), 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, Liou, & Batelaan, 2013) Liou, & 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

Figures; knowing the truth is the first step to understand our status of existence in this mighty Universe.

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

$$F_m = B_{1U} B_{2e}\, r_m^2\, c = F_L = B_{1U} q\, v_e \quad (1)$$

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_{2e}) (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, & Bertaloccini, 1967; Ballif, 1969; Fuch, 1967)

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

Where, v_e is electron velocity in $\mathrm{m.s^{-1}}$, 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

$$E_k = \frac{m_e\, v_e^2}{2} \quad (3)$$

Where, $\mathrm{m_e}$ is electron mass in *kg*.

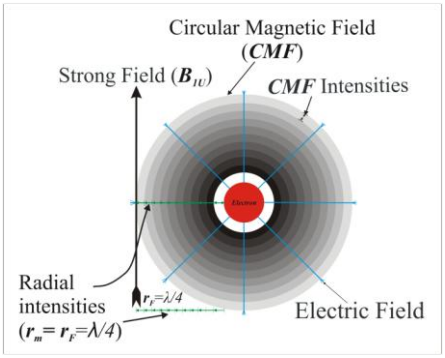

Fig 1a. An energetic electron surrounded by radial intensities of both the Circular Magnetic Field (*CMF*) and Electric Field (*EF*).

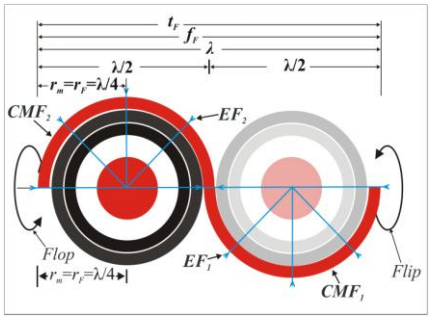

Fig 1b. The first stage of the Flip-Flop (*F-F*) mechanism producing Electromagnetic Radiation (*EM-R*), the figure also shows the relation between Wavelength (λ), Flipping Time (t_F), Flipping Frequency (f_F) and Magnetic Radius (r_m) or Flipping Radius (r_F).

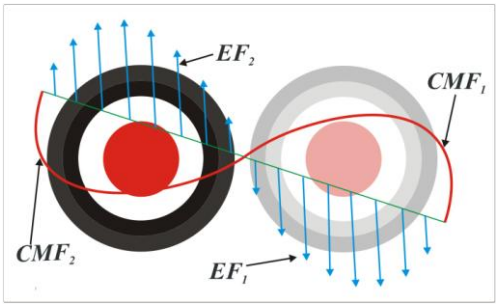

Fig 1c. The second stage Flip-Flop (*F-F*) mechanism producing Electromagnetic Radiation (*EM-R*), before *EM-Wave* is released

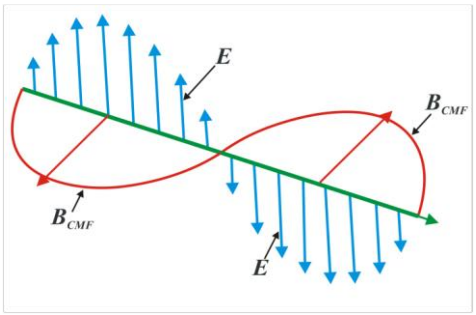

Fig 1d. The released Electromagnetic Wave (*EM-W*), it showed how both Circular Magnetic Field (*CMF*) and Electric Field (*EF*) shown in Fig 1-a are transformed to *EM-R*.

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)

$$E_R = hf = \left\{\left(\frac{m v_e^2}{2}\right) \times \left(\frac{4\,\pi\, m_e}{q B_{1U}} f\right)\right\} = \left\{\frac{B_{CMF}^2 m_e\, c^2 r_F^4}{2 f q^2}\right\} f \quad (4)$$

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 $T_F = (4\,\pi\, m_e)/(q B_{1U})$ given with the kinetic energy on the left hand of Eq(4) is inverse of the frequency (*1/f*) the following is true

$$E_R = \left\{\frac{m_e v_e^2}{2}\right\} = \left\{\frac{B_{CMF}^2 m_e\, c^2 r_F^4}{2q^2}\right\} \quad (5)$$

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

$$E_R = \left\{\frac{m_e v_e^2}{2}\right\} = \left\{\frac{B_{CMF}^2 m_e\, c^2\, \lambda^4}{2(4^4)\, q^2}\right\} \quad (6)$$

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

$$E_R = hf = \left\{\frac{B_{CMF}^2 m_e\, c^6}{2\,(4^4)\, q^2\, f^4}\right\} \quad (7)$$

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_F), 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 $\lambda = 4r_m$ thus $r_m = \lambda/4$ and $\lambda = c/f$ therefore substituting these in Eq(2) a disturbance in B_{CMFD} is given by

$$B_{CMFD} = B_{2eD} = \frac{4^2\, q\, v_e f^2}{c^3} \qquad (8)$$

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_m) 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.

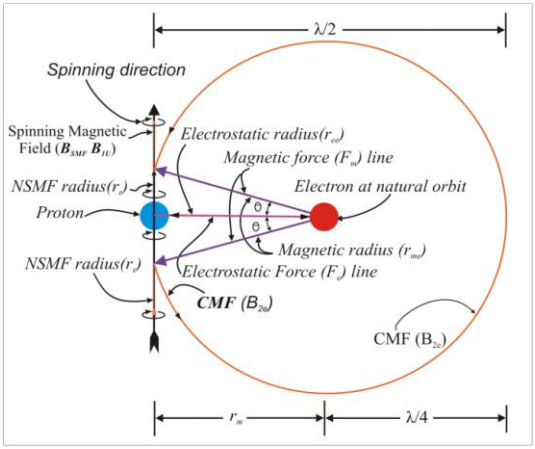

Fig 2a. Stability of interatomic electron shows the Circular Magnetic Field (*CMF or* B_{2e}) linking electron with the Spinning Magnetic Field (B_{SMF} B_{1U}) at specific Magnetic Radius (r_{me}) and Electrostatic Radius (r_e), it balanced the Magnetic Force (F_m), Electrostatic Force (F_e) and Centripetal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

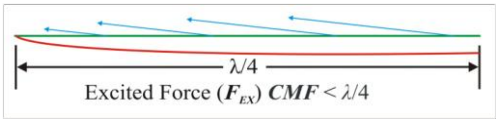

Fig 2b. An impinging Radiation Frequency ($\mathbf{f_R}$), with quarter wavelengths (λ/4), it is larger than the half wavelengths (λ/2) of the gyrating electron in Fig 2-a, producing the Excited Force (F_{EA-n}).

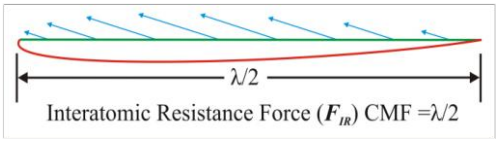

Fig 2c. An impinging Radiation Frequency (f_R), with half wavelengths (λ/2), it is equivalent to the half wavelengths (λ/2) of the gyrating electron in Fig 2-a, producing the Interatomic Resistance Force (F_{IR}), (or work function).

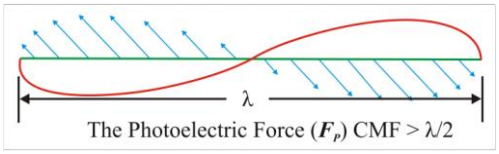

Fig 2d. An impinging Radiation Frequency (f_R), with one wavelengths (λ), it is shorter than the half wavelengths (λ/2) of the gyrating electron in Fig 2-a, producing the Photoelectric Force (F_P).

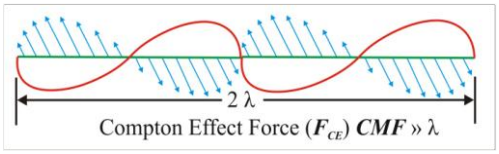

Fig 2e. An impinging Radiation Frequency (f_R), with wavelengths (2λ), much shorter than the half wavelengths (λ/2) of the gyrating electron in Fig 2-a, producing the Compton Effect Force (F_{CE}).

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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

$$(E_{k(MAX)}) = \frac{1}{2}\, m_e\, v_e^2 = hf - \phi \qquad (9)$$

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

$$T = hf - w_P \qquad (10)$$

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

$$(E_{k(MAX)}) = \frac{m_e v_e^2}{2} = \frac{B_{CMF}^2 m_e\, c^6}{2\,(4^4)\, q^2\, f^4} - \phi \qquad (11)$$

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*) of 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)

$$\{F_c = F_e = F_m\} = \left\{\frac{m_e v_o^2}{r_m} = B_{1U}\, B_{2e} r_m^2\, c = \frac{Z\, e\, Q}{4\pi\varepsilon_o r_e^2}\right\} \quad (12)$$

Where, B_{1U} 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_o is electron's velocity at natural orbit around the nucleus, ε_o is the permittivity of the free space

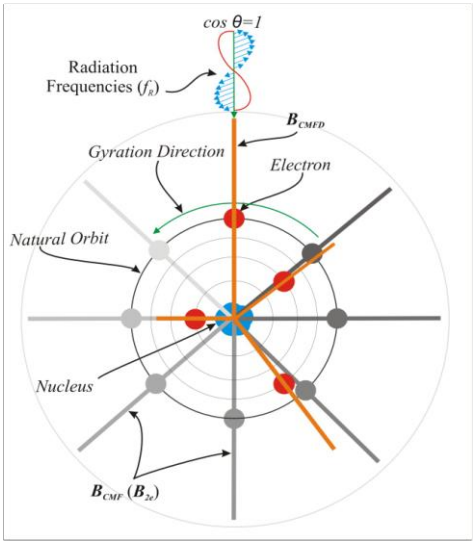

Fig 3-a. Cross sectional plan of Beryllium atom (*Be-4*), the interaction between an impinging Radiation Frequency (f_R) and the *CMF* only occurred when *Cos* θ = *0*, for specific positions among many for the fourth electron. Each electron is linked with the nucleus Spinning Magnetic Field (*SMF or* $B_{1U\text{-}n}$) through the Circular Magnetic Field (*CMF or* B_{2e}).

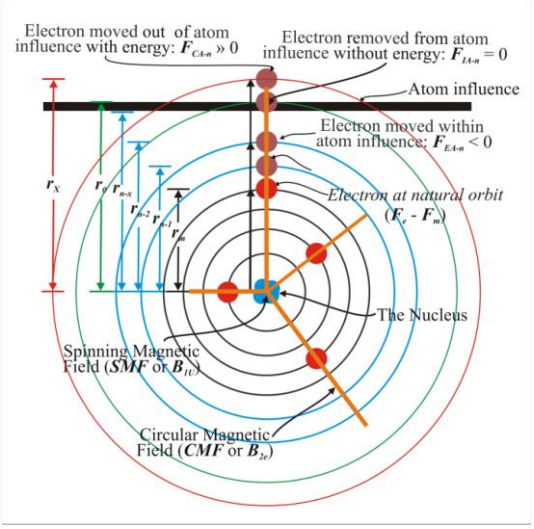

Fig.3-b. Cross sectional plan of Beryllium atom (*Be-4*), any increase in Magnetic Force (F_m) increases the Magnetic Radius (r_m), moving electron to $r_{n\text{-}1}$, $r_{n\text{-}2}$, and $r_{n\text{-}x}$ within nucleus influence; with higher f_R electron is removed from atom influence to r_0 with zero energy, with much higher f_R electron is moved to r_X 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 Fig.2 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' 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_N (B_{CMFN}) is given by

$$B_{CMFN} = B_{2e} + B_{CMFD} \quad (13)$$

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

$$\left(\frac{m_e v_o^2}{r_{me}}\right) = (B_{1U}\,(B_{CMF} + B_{CMFN})\, r_m^2\, c) = \left(\frac{Z\, e\, Q}{4\pi\varepsilon_0 r_e^2}\right) \quad (14)$$

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

$$\left(2\frac{m_e v_o^2}{r_{me}}\right) = \left(\frac{Z\, e\, Q}{4\pi\varepsilon_0 r_{ee}^2}\right) = (B_{1U}(B_{CMF} + \left(\frac{4^2\, q\, v_n\, f^2}{c^3}\right))\, r_{me}^2\, c) \quad (15)$$

THE RADIATION MAGNETIC FORCE (F_{mR})

From Eq(8), electron velocity is given by

$$v_e = \frac{B_{CMFD}\, c^3}{4^2\, q\, f^2}\ m.s^{-1} \quad (16)$$

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

$$F_m = B_{1U}\, q\, \frac{B_{CMF}\, c^3}{4^2\, q\, f^2} \quad (17)$$

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

$$f_F = \frac{qB_{1U}}{4\,\pi\, m_e} = 1.399624179978131870358140925075 \times 10^{10}\, B_{1U} \quad (18)$$

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

$$B_{1U} = \frac{f_F}{1.399624179978131870358140925075\times 10^{10}} \quad (19)$$

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

$$F_m = \frac{f_F\, B_{CMF}\ c^3}{(1.399624179978131870358140925075\times 10^{10})\times(4^2)\ f^2} \quad (20)$$

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

$$F_m = \frac{B_{CMF}\ 1.205680799274535242757263457381\times 10^{14}}{f} \quad (21)$$

Solving the numerical and physical constant, given in Eq(7), the CMF (B_{CMF} or B_{2e}) is given by

$$B_{CMF}^2 = 1.311386461962088469140989628035 4 \times 10^{-89}\, f^5 \quad (22)$$

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

$$F_{mR} = \sqrt{1.906318161436107200999984962546 3 \times 10^{-61}\, f_R^3} \quad (23)$$

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

$$F_{mR} = \sqrt{y\, f_R^3} \quad (24)$$

Where, y is Yousif Constant with magnitude equal to $1.906318161436107200999984962546 3x10^{-61}$ $N^2.Hz^{-3}$ (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_L), therefore the formula is named the Radiation Magnetic Force (F_{mR}); for a frequency of one Hertz the,

$$F_{mR} = 4.366140356695037811276075714222 8 \times 10^{-31}\ N.$$

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

$$W = F_{mR} \cdot d = d\sqrt{y\, f_R^3} \quad (25)$$

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 ($\mathbf{B_{1U}}$) with velocity (v), while radiating Electromagnetic Radiation (EM-R), using Eq.(1), Eq.(24) and Eq.(29), respectively.

v	B_{1U}	$F_m = F_{mR}$	E_{mR}	f_R
1.20614229562527793587979 23011235e+1	7.144775106812060697820820 4881839e-6	1.380694811113631730012735 1577628e-23	4.135669239559144180376088581905e-10	1.0 e+5
1.20614229562527793587979 23011235e+2	7.144775106812060697820820 4881839e-4	1.380694811113631730012735 1577628e-20	4.135669239559144180376088581905e-8	1.0 e+7
3.81415683644002158195654 42948061e+3	7.144775106812060697820820 4881839e-1	4.366140356695037811276075 7142228e-16	4.135669239559144180376088581905e-5	1.0 e+10
3.81415683644002158195654 42948061e+5	7.144775106812060697820820 4881839e+3	4.366140356695037811276075 7142228e-10	0.413566923955914418037608858 1905	1.0e+14
3.81415683644002158195654 42948061e+7	7.144775106812060697820820 4881839e+7	4.366140356695037811276075 7142228e-4	4.135669239559144180376088581905e+3	1.0 e+18
1.20614229562527793587979 23011235e+10	7.144775106812060697820820 4881839e+12	1.380694811113631730012735 1577628e+4	4.135669239559144180376088581905e+8	1.0 e+23
3.81415683644002158195654 42948061e+11	7.144775106812060697820820 4881839e+15	4.366140356695037811276075 7142228e+8	4.135669239559144180376088581905e+11	1.0 e+26

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,

$$E_R = \frac{5.052725258491769110210176825134 1\times 10^{55}\, B_{CMF}^2}{f^4} \quad (26)$$

Substitute B_{CMF}^2 in the right hand side of Eq(26) with B_{CMF}^2 given in Eq(22), the following is obtained

$$E_R = \frac{(5.052725258491769110210176825134 1e+55)(1.311386461962088469140989628035 4\times 10^{-89})f^5}{f^4} \quad (27)$$

Solving Eq(27), the following is obtained

$$E_R = 6.6260755 \times 10^{-34} f \quad (28)$$

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

$$E_{mR} = h\, f \quad (29)$$

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 γ-rays, using Eq.(24) and Eq(29), huge difference existed between *X(γ)*-rays and the rest.

Radiation	Infrared	Red	Green	Violet	Ultraviolet	X-rays	γ-rays
Frequency (Hz)	3.e+12	4.6e+14	5.49e+14	7.41e+14	1.5e+16	1.e+19	1.e+21
Wavelength (Å)	1.e+6	6520	5460	4050	200	0.3	3.e-3
Radiation Magnetic Force ($\mathbf{F_{mR}}$) (N)	2.27e-12	4.31e-9	5.62e-9	8.81e-9	8.02e-7	1.38e-2	1.38e+1
Radiation Magnetic Energy ($\mathbf{E_{mR}}$) (J)	1.99e-21	3.05e-19	3.64e-19	4.91e-19	9.94e-18	6.63e-15	6.63e-13

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 γ-rays, using Eq(1), Eq(24), and Eq(29), while Table2 gives F_{mR} and E_{mR} for frequencies ranging from Infrared, light, to γ-rays, using Eq(24) and Eq(29), huge difference existed between X /γ-rays and the rest. Tables.1 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 γ-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_{CMF}), increases the Magnetic Force (F_m), this is done by adding $B_{CMFD} + B_{2e}$, expressed by in Eqs.(8,13and 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 Figs3-b, therefore any incoming visible light, X-rays or γ-rays added maximum B_{CMFD} (CMF_D) only when it has an angle θ 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 Fig.3-a; hence that is when the impinged CMF added maximum to $\mathbf{B_{2e}}$ 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_e , this is given by

$$\left(\frac{m_e v_o^2}{r_{me}}\right) + \left(\frac{Z\, e\, Q}{4\pi\varepsilon_o r_e^2}\right) = \left\{(B_{1U}\, B_{2e} r_m^2\, c) + \sqrt{y\, f_R^3\, cos\,\theta}\right\} \quad (30)$$

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

Metal	Threshold Frequency, Hz	Orbital Magnetic Force ($\mathbf{F_{Om}}$)
Potassium	5.584e+14	5.76123787498473607272156539260 01e-9
Aluminum	9.846e14	1.34892387007053294659896109519 24e-8
Lead	9.990e14	1.37862428674384125194831400152 54e-8
Zinc	1.038e15	1.46013739271526053209636960846 16e-8
Iron	1.086e15	1.56258060897896003873780482696 93e-8
Copper	1.134e15	1.66731353044565873629886193811 17e-8
Silver	1.141e15	1.68277541844683878620713550939 58e-8
Nickel	1.209e15	1.83542711791017284922689739789 82e-8
Gold	1.231e15	1.88575284716125204614422473084 75e-8
Platinum	1.532e15	2.61809764868281268603539938219 06e-8

INTERATOMIC EXCITED FORCE ($\mathbf{F_{EA-n}}$) AND ENERGY ($\mathbf{E_{mR}}$)

The increases in magnetic force (F_m), due to an increase in Radiation Magnetic Force (F_{mR}) given by Eq(30), increases both the magnetic radius (r_m) 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_{mR}) given by Eq(30), changed electron momentum, this is given by

$$\rho = t\sqrt{y\, f_R^3} \quad (31)$$

Where, t the elapsed is time in second and ρ is the momentum or the impulse. When the EM-R wavelength (λ) given in Eq(30) is large compared to electron's CMF (B_{2e}) as shown in Fig.2-b, the produced F_{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_m to r_{n-1}, r_{n-2}, ... to r_{n-x}, 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 (Yousif, 2003a), this represents the Excited Force (F_{EA-n}), which is generally given by

$$F_{EA-n} = \left(\frac{m_e v_o^2}{r_{me}}\right) + \left(\frac{Z\, e\, Q}{4\pi\varepsilon_0 r_e^2}\right) - \left\{(B_{1U}\, B_{2e} r_m^2\, c) + \sqrt{y\, f_{ER}^3\, cos\,\theta}\right\} =< F_O \quad (32)$$

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

$$F_{EA-n} = \left(\frac{Z\, e\, Q}{4\pi\varepsilon_0 r_e^2}\right) - \left(\sqrt{y\, f_{ER}^3\, cos\,\theta}\right) =< F_O \quad (33)$$

The change in interatomic forces given by Eq.(30) is due to the Radiation Magnetic Force (F_{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 (Arthur Holly Compton, 1922).

$$\frac{1}{2} m_e v^2 = hf \quad (34)$$

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

$$E_{EA-n} = \frac{B_{CMF-n}^2 m_e\, c^2 r_{m-n}^4}{2q^2} \quad (35)$$

Where, B_{CMF-n} is the Circular Magnetic Field of an electron at n^{th} orbit (as for potassium in Appendix 1), r_{m-n} is the magnetic radius of gyration at n^{th} orbit, E_{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_{EH-1}; the last orbit 19 of potassium in Appendix 1 is E_{EK-19}. Therefore, since the Radiation Magnetic Energy (E_{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_{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 (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_R) becomes maximum, as it produced F_{mR} given by Eq(30), it also changed the interatomic electron energy, by adding the impinging Radiation Magnetic Energy (E_{mR}) suggested by Planck to the electron's orbital energy giving by Eq(35), hence the following is obtained

$$E_{EA-n} = \frac{B_{CMF-n}^2 m_e\, c^2 r_{m-n}^4}{2q^2} + hf\, cos\,\theta \quad (36)$$

Table 4. The Hydrogen Atom structural parameters; giving Ionization potential (E_i), then Ionization Frequency (f_{i-n}) is derived, the Orbital Magnetic Force (F_{Om-n}), the Spinning Magnetic Field (B_{1U-n}), orbital velocity (v_{O-n}), Electrostatic Radius (r_{e-n}), Magnetic Radius (r_{m-n}), and the Circular Magnetic Field (B_{2e-n}), these parameters are similar to that obtained at The Magnetic Interaction with different procedures (Yousif, 2003a).

No	E_i(eV)	f_{i-1}	F_{Om-1}	v_{O-1}	B_{1U-1}	r_{ee-1}	r_{m-1}	B_{CMF-1}
1	13.5981	3.28800472482889758802174 83184428e+15	8.231829035663390 8360582961105681 e-8	2187080.47538560 7769858856249819 3	234920.543090379 4700760394059666 3	5.297654924379299 5637864108107739 e-11	5.293250736060082 1769543602782352 e-11	0.416878174180808 9771136211441523 2

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

If the impinging radiation frequency (f_R) is greater than the excitation radiation frequency (f_E) thus the produced force is greater than the Excitation Force (F_{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 (Arthur Holly Compton, 1922)

$$w_P = hv - T \quad (37)$$

Where w_p is the energy required to move electron from its initial position in the *P (K, L, M or N)* energy level and T is the kinetic energy of electron (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_{mR}) is required using Eq.(24), the F_{mR} from sources such infrared to γ-rays radiation are shown in Table2, the interaction of such impinging radiation frequency (f_R) having wavelength equal or nearly equal to the orbital electron's *CMF* as shown in Fig 2-b, produced Radiation Magnetic Force (F_{mR}), which

reduces the electrostatic attractive force (F_e), 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, the F_{IR} is given by

$$F_{RA-n} = W = \left(\frac{Z\,e\,Q}{4\pi\varepsilon_0 r_e^2}\right) - \left(\sqrt{y\,f_R^3\,cos\,\theta}\right) = F_O \qquad (38)$$

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-R* Frequency (f_R) that can produce equivalent Interatomic Resistance Force (F_{IR}), (or work function); for any atom is given by

$$f_{IR} = \sqrt[3]{\frac{1}{y}\left(\frac{Z\,e\,Q}{4\pi\varepsilon_0 r_e^2}\right)^2} = \sqrt[3]{\frac{1}{y}(qB_{1U}\,v_O)^2} \qquad (39)$$

Since an increase in the Radiation Magnetic Force (F_{mR}), reduced the attractive electrostatic force (F_e), 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

$$E_{RA-n} = hf cos\,\theta - \frac{B_{CMF-n}^2 m_e\,c^2 r_{m-n}^4}{2q^2} = F_O \qquad (40)$$

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

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

When an impinging EM-R wavelength (λ) is shorter than electron's B_{2e}or (B_{CMF}) as shown in Fig 2-c, thus with higher Radiation Frequency (f_R) than the Interatomic Resistance Frequency (f_{IR}) given by Eq(39), hence the produced Radiation Magnetic Force F_{mR} is greater than the Interatomic Resistance Force (F_{IR}), moving electrons' magnetic radius from r_0 further to exceed material surface to r_X as shown in Fig3-b, therefore electron emerged with great force and energy, hence the Photoelectric Force (F_P), is given by

$$F_{PA-n} = \left(\frac{Z\,e\,Q}{4\pi\varepsilon_0 r_{ee}^2}\right) - \left(\sqrt{y\,f_R^3\,cos\,\theta}\right) => F_O \qquad (41)$$

The equivalent Photoelectric Energy (E_{PA-n}), is given by

$$E_{PA-n} = \frac{B_{CMF-n}^2 m_e\,c^2 r_{m-n}^4}{2q^2} - hf\,cos\,\theta => F_O \qquad (42)$$

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 extending 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

$$F_{MR} = \left(\frac{Z\,e\,Q}{4\pi\varepsilon_0 r_{ee}^2}\right) - \left(\sqrt{y\,f_R^3\,cos\,\theta}\right) = \begin{Bmatrix} F_{EA-n} < F_O \\ F_{IA-n} = F_O \\ F_{PA-n} > F_O \\ F_{CA-n} \gg F_O \end{Bmatrix} \qquad (43)$$

Where, F_O is the threshold Force, F_{EA-n} is the Excitation Force (F_{Ex}), F_{IA-n} is the Interatomic Resistance Force (F_{IR}), F_{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 (λ) is greater than the gyrating electron's *CMF* (B_{CMF}) radius as shown in Fig.2-a, the f_R is less than the threshold frequency (f_O), producing small magnetic force (F_m), the resulted Excited Force (F_{EA-n}), is smaller than the Interatomic Resistance Force (F_{IR}), hence $F_{EA-n} < F_O$, 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 (λ) is equal to the gyrating electron's *CMF* (B_{CMF}) radius as shown in Fig.2-b, the f_R is equal to the threshold frequency (f_O), where the produced Radiation Magnetic Force (F_{mR}), is equal to the orbital magnetic force (F_m), the resulted Interatomic Resistance Force (F_{RA-n}), is equal to zero ($F_{RA-n} = F_O$), electron emerged at the perephary of the atom, but without kinetic energy.

c) The Photoelectric Force (F_{PA-n})**:** When the impinging EM-R wavelength (λ) is smaller than the *CMF* (B_{CMF}) as shown in Fig 2-c, the f_R is greater than the threshold frequency (f_O), 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 $F_{PA-n} > F_O$, 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_O), thus produced Compton force is greater thus $F_{CA-n} \gg F_O$, 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_{Om-n}), Electrostatic Force (F_{e-n}), Orbit Velocity (v_{O-n}), at specific Magnetic Radius (r_{m-n}), Electrostatic Radius (r_{e-n}) and with specific Circular Magnetic Field (B_{2e-n}), 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

$$f_i = \frac{E_i}{h} \tag{44}$$

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

$$F_{im} = B_{1U}\, B_{2e} r_m^2\, c + \sqrt{y\, f_i^3\, cos\, \theta} \tag{45}$$

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

$$F_{Om} = \left(\frac{Z\, e\, Q}{4\pi\varepsilon_0 r_{ee}^2}\right) = \sqrt{y\, f_i^3\, cos\, \theta} \tag{46}$$

Thus the Orbital Magnetic Force (F_{Om}) which is an equivalent to both the Centripetal Force (F_C) and the Electrostatic Force (F_e), is given by

$$F_{Om} = \sqrt{y\, f_i^3\ cos\, \theta} \tag{47}$$

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

$$f_i = \sqrt[3]{\frac{F_{Om}^2}{y}} \tag{48}$$

The Orbit Velocity (v_O) is

$$v_O = \sqrt{\frac{2E_k}{m_e}} \tag{49}$$

Using Eq (47), specific interatomic Orbital Magnetic Force (F_{Om}) which is equal to Electrostatic Force (F_e), 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

$$qB_{1U}v_o = B_{1U}B_{2e}\, r_m^2\, c\ = \sqrt{y\, f_S^3} \tag{50}$$

While the electrostatic radius is

$$r_e = \sqrt{\frac{Z\, e\, Q}{4\pi\varepsilon_0 F_{Om}}} \tag{51}$$

The Magnetic Radius is

$$r_m = \frac{m_e\, v_o^2}{F_{Om}} \tag{52}$$

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

GENERAL MODEL OF ATOMIC SPECTRAL LINE

The functionality of the suggested F_{mR} and E_{mR} 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_r) 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

$$E_S = 0.5 F_r r_n \tag{53}$$

Where, F_r 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

$$F_r = F_n - F_{Om} \tag{54}$$

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

$$F_n = qB_{1U}v_n \tag{55}$$

Where, v_n is the level velocity, given by

$$v_n = v_O + v_D \tag{56}$$

Where, v_O is the orbit velocity, v_D is the disturbance velocity due to excitation potential, given by

$$v_D = \sqrt{\frac{2E_D}{m_e}} \tag{57}$$

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

$$E_D = \left\{\frac{\left(A\sqrt{y\, f_S^3}\right)+F_O}{qB_1} - v_O\right\}^2 \frac{m_e}{2} \tag{58}$$

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

$$E_D = \left\{\frac{\left(A\sqrt{y\frac{c^3}{\lambda_S^3}}\right)+F_O}{qB_{1U}} - v_O\right\}^2 \frac{m_e}{2} \tag{59}$$

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

$$v_D = \frac{2\, h\, c}{m\, v_n\, \lambda} \tag{60}$$

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

$$E_D = \frac{m_e}{2}\left\{\frac{2\, h\, c}{m_e\, v_n\, \lambda}\right\}^2 \tag{61}$$

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 λ 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

$$F_{ri-1} = \sqrt{y\, f_S^3} \tag{62}$$

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

$$F_n = F_O + F_{ri-1} \tag{63}$$

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

$$v_n = \frac{F_n}{q\, B_{1U-n}} \tag{64}$$

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

$$r_n = \frac{v_n^2\, m_e}{F_n} \tag{67}$$

The spectral line energy is

$$E_S = 0.5\, F_{ri}\, r_n \tag{68}$$

The spectral line frequency is

$$f_S = \frac{E_S}{h} \tag{69}$$

Hence, the first spectral line wavelength is

$$\lambda_1 = \frac{hc}{E_S} \tag{70}$$

Verifying the ratio error by dividing resulted λ_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 λ_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' (hf) 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_{CMFD} *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.

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Appendix

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

No	E_i(eV)	f_{i-n}	F_{Om-n}	v_{O-n}	B_{1U-n}	r_{ee-n}	r_{m-n}	B_{CMF-n}
19	4934.046	1.19304656977983121 38157797930313e+18	5.6896268873816007494 804269263554e-4	4.1660765461560698787 9860179906e+7	8.5240494330304561873 408926750943e+7	6.3722079996515574857 255888482764e-13	2.7788172415696687243 857018585588e-12	2881.355808877286418 7838722870073
18	4610	1.11469262481237951 48425338648797e+18	5.1384292861487290679 035538847555e-4	4.0269488282622487402 732311116182e+7	7.9642281175064851490 321564152795e+7	6.7052757865371438841 163048519037e-13	2.8748230558353606282 396469215649e-12	2602.216870316333059 4368016262404
17	1033	2.49778195538218663 52111442134941e+17	5.4504138365327414242 768268684259e-5	1.9062322334865568220 895610002673e+7	1.7846090337059000344 794398214716e+7	2.0588139293220438231 362421146768e-12	6.0731138277854248221 144250249701e-12	276.0212906668488155 7566112405746
16	968	2.34061271327198128 06238021284243e+17	4.9441544835330681612 420443713863e-5	1.8452844707035384699 26902795491e+7	1.6723151448473487254 366870737507e+7	2.1616522090638035128 228810877402e-12	6.2737022502247102777 861638952441e-12	250.3831713940510600 060906123258
15	861.1	2.08212975970919739 74640041454402e+17	4.1481970662372169207 240724220538e-5	1.7404134979313100974 39787947398e+7	1.4876348876322851110 263752471144e+7	2.3599464428791652695 992766058445e-12	6.6517326772734611583 705072115258e-12	210.0740865746101839 2611377835935
14	786.6	1.90198962836750049 10523582171679e+17	3.6216786195551910188 229983950632e-5	1.6634226825740306863 918932200884e+7	1.3589288150174839952 773740208805e+7	2.5256716096080856283 615359174673e-12	6.9596053110465375715 199875273716e-12	183.4100009525304316 5875810517357
13	714.6	1.72789446787619609 82786869844752e+17	3.1359816585852217167 311152644164e-5	1.5854668070020521381 361078475684e+7	1.2345417381280117760 300171310974e+7	2.7142202113770011015 261125453892e-12	7.3018023997915955490 459648658341e-12	158.8132077436719161 8059624652011
12	629.4	1.52188186129481923 34965093591222e+17	2.5922035678028190923 146235744098e-5	1.4879523290177752639 319139881688e+7	1.0873503638088029832 539781448541e+7	2.9853639565029819087 098264161579e-12	7.7803334894468956380 759333046126e-12	131.2750546867298116 1348233335067
11	564.7	1.36543801568666098 05457242375219e+17	2.2029552632953275490 458651920978e-5	1.4094008922360941936 5790362925e+7	9.7557475443729114179 142271750727e+6	3.2383888702254010002 995442172807e-12	8.2139619748574942994 697580658015e-12	111.5626396991022957 5922675479174
10	503.8	1.21818252577109934 83246606532026e+17	1.8563772646497881822 99313178553e-5	1.3312350077010659485 800500978511e+7	8.7036401856827922301 136668156569e+6	3.5277574416790641278 729142218572e-12	8.6962596905783226737 77545280089e-12	94.011145560864395419 518281172777
9	175.8174	4.25124423196720290 91730089703928e+16	3.827117324858658597 4432207640887e-6	7.8642366707400040420 946461930773e+6	3.0374183961537629111 528118380213e+6	7.7695514868587276558 609380408453e-12	1.4720774336853928273 937297174118e-11	19.381388188551706615 890930113943
8	154.88	3.74498034123517004 89980834054789e+16	3.1642588694611636231 949083976873e-6	7.3811378828141538797 076111819638e+6	2.6757042317557579606 986993180012e+6	8.5446806122201161477 567702616806e-12	1.5684255625561775694 465409738109e-11	16.024522969219267840 389799188853
7	117.56	2.84258709268857561 31212208493549e+16	2.0925139514979255614 356951715e-6	6.4306583509385353231 933907374235e+6	2.0309645498786602909 332327726253e+6	1.0507457836651548109 999800225539e-11	1.8002457453625892822 150705003699e-11	10.596964174710620598 258264992845
6	99.4	2.40348041011606342 24587389624522e+16	1.6268914350066022828 98698558082e-6	5.9131492437490884194 841101588908e+6	1.7172327003907692490 537881728391e+6	1.1916605184482091075 447504789365e-11	1.9578002954002115381 4151845853e-11	8.238946383400305657 7932335154795
5	82.66	1.99870916197378070 92599533464416e+16	1.2337356025614520834 701082146009e-6	5.3922913406391298743 324030346293e+6	1.4280327466227463393 036834040933e+6	1.3684243336980635711 823161218464e-11	2.1469102103050218935 004821775894e-11	6.247916278909306575 493411646325
4	60.91	1.47279669798963202 27561548310157e+16	7.8039035893667906964 341642568449e-7	4.6288163249289856836 751606599461e+6	1.0522801185191323436 606261328735e+6	1.7205840372520801177 541238836475e-11	2.5010206764540090327 719179914042e-11	3.952073375674096972 7813834190668
3	45.806	1.10758373909231791 88042756228781e+16	5.0893527011072237699 747581068972e-7	4.0140874768724368751 232140334414e+6	7.9134367277766173261 728190186182e+5	2.1305933269549640047 331272230742e-11	2.8840341429672832153 07094785007e-11	2.577363377075359256 1682942416194
2	31.63	7.64809711991660825 47655848473203e+15	2.9203021220579119419 379526736815e-7	3.3356098235374689369 733341209754e+6	5.4643933916861198538 804144775554e+5	8.8126645862647049255 843157230384e-11	3.4706593242611790899 924472045161e-11	1.4789070794307568496 907521171868
1	4.34066	1.04956652685859072 9912449684583 3e+15	1.4846109179770698356 917839630319e-8	1.2356729306070350062 205982554233e+6	7.4989167940424511555 310021834159e+4	1.2474567923600548076 881092357749e-10	9.3687941601749880095 268620077441e-11	0.0751840564786927451 5397918368065

Appendix 2. Detail spectral lines 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_r) by half of Level Radius (r_n).

K- Electron & Spectral Line (Å)	**Factor A**	**E_D** Ve	**v_n** $m.s^{-1}$	**F_n** N	**r_n** m	**F_r** N	**E_n** Ve	**λ**
K XIX-2.5650678	0.62763741028179477565700866750605	1831.11599847959483672466 1090044	6.70402955536392392124423 00813943e+7	9.15571914951813449877502 94253991e-4	4.47165881616521323930239 6448013e-12	3.46609226213653374929460 24990437e-4	7.74959101081242923303164 54177868e-16	2.56506781741970456843754 81301231e-10
K XVIII-3.0086	0.67351666916915674905591377566551	1496.89610972876157914881 16339376	6.32162538144642377592406 69866969e+7	8.06646083210919193461102 18859413e-4	4.51298369360671224798227 06067387e-12	2.92803154596046286670746 80011858e-4	6.60707931064281077079775 56064458e-16	3.00862537974680724705925 53949664e-10
K XVII-3.0429	0.19749439138619233837682663829362	2477.48792403898305424576 86986301	4.85833465745302814888643 70068106e+7	1.38912426168851077261510 1672909e-4	1.54782921355921074991376 90675783e-11	8.44082878035236630187418 98606638e-5	6.53248068644037759393610 96024241e-16	3.04298281987449240005219 55828822e-10
K XVI-21.911	0.92482722524231158615547790835388	165.720329289818367677702 5377563	2.60879238294985763237441 65093121e+7	6.98985590652633791822352 75235004e-5	8.86951952564883274089678 55254854e-12	2.04570142299326975698148 31521141e-5	9.07219435744320405723822 37623606e-17	2.19111559087036969662755 69606981e-9
K XV-24.13	0.91112771607998711191500704565429	152.167753892746701105519 3730658	2.47203584664268185635383 76223625e+7	5.89198593257585014314414 39460734e-5	9.44793960748371045098214 42822768e-12	1.74378886633863322242007 15240196e-5	8.23760594868494539765146 82682659e-17	2.41310723331860366216426 77531852e-9
K XIV-25.7	0.89304866717865197313132 72960867	145.010873619630111705436 61781449	2.37763269251319939460804 78571921e+7	5.17668875015311216201836 06748172e-5	9.94779335876724749745499 03323132e-12	1.55501013059792114319536 2279754e-5	7.73445972498889507405250 22347659e-17	2.57008597973254565165941 5960276e-9
K XIII-27.337	0.87090193645400938148661492147445	138.853030577940820443870 50057801	2.28434796143494404914504 67167115e+7	4.51833698267847349663458 30091308e-5	1.05204709131088886679237 78883011e-11	1.38235532409325177990346 77447144e-5	7.27151448935213313994888 4091663e-17	2.73371201131596471824610 15356474e-9
K XII-9.168	0.83191641216602527457458689395787	134.454920459233123239787 6969031	2.17567604048596280490429 72888779e+7	3.79030637241836647855625 45116751e-5	1.13763625553476576000966 25149237e-11	1.19810280461554738624163 09372653e-5	6.81502594194266200069454 46830592e-17	2.91682330622700435388989 45334169e-9
K XI-1.457	0.81184846739171230562355926066109	126.808905824092931541035 18329585	2.07728410227864373239046 87009173e+7	3.24688594400852472748368 66795927e-5	1.21063728007307954234793 54050917e-11	1.04393068071319717843782 14874949e-5	6.31910699941731734298563 99109198e-17	3.14573348763250319180111 31339388e-9
K X-41.151	0.90961488709691947343765276035643	89.3420429231399406193611 51674998	1.89183564573873998079784 61239592e+7	2.63812224054137284175195 72604766e-5	1.23583694629906800557271 51475279e-11	7.81744975891584659452644 08192363e-6	4.83054661895247261722396 10170876e-17	4.11510913112990295453773 8639727e-9
K IX-78.902	0.67361707800839451794765075402136	57.0727262292783483216733 07688757	1.23448756980956906981223 41897938e+7	6.00761264385536195889632 90388813e-6	2.31079171414456953275925 07080453e-11	2.18049531899670336145310 82747926e-6	2.51933525793430105520643 81651407e-17	7.89026646509084110984029 08385584e-9
K VIII-103.086	0.74954095702405902239594774011646	40.8317944761461053244623 52073524	1.11710128440062917001949 03354077e+7	4.78896032477781264320485 88634625e-6	2.37373998187699260047333 29698027e-11	1.62470145531664902000995 04657752e-6	1.92830940154943297401652 2525337e-17	1.03086291463535209047531 78231106e-8
K VII-126.654	0.71098366403032247987781203503842	34.3825490103381967539978 28066721	9.90837891675605653394638 03259998e+6	3.22415217673847816699062 36986345e-6	2.77382439167012189438428 29487476e-11	1.13163822524055260555492 85271345e-6	1.56948285585926610543136 49152897e-17	1.26654626559249653161435 54594522e-8
K VI-256.83	1.05638117942119703329763 30989916	12.7321768553432056904489 24884672	8.02944801357047909272359 80954743e+6	2.20915110757906155228198 21066267e-6	2.65849127848192223971467 23992704e-11	5.82259672572459269383283 54854469e-7	7.73966130672811338083681 56542009e-18	2.56835870617746430611616 95766474e-8
K V-293.33	1.01836279871872198616444 78516701	11.4850778746821194678506 11450385	7.40227543334515072613728 46876556e+6	1.69361226335398175579988 34030092e-6	2.94717397548017271712171 97309735e-11	4.59876660792529672329775 18840833e-7	6.77668263309233275229601 73118807e-18	2.93332705340653922279889 76962243e-8
K IV-342.8	0.91451732734228747218907060952809	10.6791945150032308571142 43998447	6.56699984580335224792588 13672504e+6	1.10715634560877108782483 23995974e-6	3.54825105247036481774270 29860971e-11	3.26765986672092018181415 97391289e-7	5.79723878060383853159272 7157407e-18	3.42891284149063294316037 30822709e-8
KIII-402.1	0.83397925460978098567263518827564	9.73561051601942171573529 2658466	5864664.83302725347322720 93117314	7.43564956693750514342948 0061154e-7	4.21363353762497596681286 04451475e-11	2.34629686583028137345472 19542568e-7	4.94321758154342104874375 11928501e-18	4.02131327866685173144104 95987041e-8
KII-546.12	1.95131630786629515680833 27446671	3.23051362945949351360457 09651358	7.49666873956745615033756 85826418e+6	2.43939003928171941715682 34272661e-6	2.09867252562552316518077 33463825e-11	3.46876087783793855721128 25576611e-7	3.63989657614157666810894 22594225e-18	5.46120640632917274216988 78091664e-8
KI-40169.32	3.51436162258044433463342 94563532	0.01931519184435215329541 428103423	1318101.00630343517839261 27436332	1.58364490836043039099334 74728623e-8	9.99375862697731609967155 93788636e-11	9.90339903833605553015635 09830444e-10	4.94860897878849054814763 50757044e-20	4.01693214905546068544504 87237135e-6