Explaining the Stern-Gerlach Experiment: Using the Spinning Magnetic Field (SMF)

Mahmoud E. Yousif

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

Abstract: *The mechanism behind Stern-Gerlach experiment was covered by layers of blurred concepts; to unveil that, we revisited the dynamic of electric current discovered by Ørsted in 1820, which related electricity to magnetism and the production of Circular Magnetic Field (CMF), originally produced by charged in motion; the CMF never incorporated into theoretical models; while the former was mathematized by Ampere, strengthening the "action at distance" enigma, resulted in entanglement, exacerbated by quanta (photon), and wave particle duality hence created the Quantum Mechanics, thus quantized the Stern-Gerlach experiment, and sealed the believe in QM; but after field's interaction formula was discovered, it suggested the production of Spinning Magnetic Field (SMF) by electrons, protons and neutrons, explaining nuclear force, atomic model, stability and spectral lines; thus in the original experiment by Stern & Gerlach, the flow of silver atom (Ag) from the furnace across the inhomogeneous magnetic field (B_I), is explained as due to attraction of the leading +ve SMF of Ag by the -ve B_I forcing all +ve Ag to strike on the right of screen, while the attraction of leading -ve SMF Ag by the +ve B_I forced all -ve Ag to strike on the left; Ag strike on right or left of screen at one of six areas designated by the angle θ, while its position from the center is determined by its velocity; the experiment fit in the classical physics, similar to the double slits experiment; therefore this work will help restoring the common sense to the physical science.*

Results*: Electrons, protons and neutrons, produced Spinning Magnetic Field (SMF), its shape and magnitude in proton which is the nucleus of hydrogen atom, is the reason behind the seven series of the spectral lines, while the summation of SMF by neutrons and protons in atoms gives each its unique SMF, the interaction of the ±ve SMF of silver atom (Ag) with the opposite ±ve of the inhomogeneous magnetic field in the original Stern-Gerlach Experiment is realized to resulted in attracting the Ag to right or left of monitoring screen, which is the main reason for the separation.*

Conclusion: *The separation of silver atom (Ag) in the original experiment by both Stern and Gerlach in 1922, is realized as due to the interaction of the leading ±ve of the dipole moment of the previously unknown Spinning Magnetic Field (SMF) by Ag with the opposite ±ve of the inhomogeneous magnetic field, while the structural shape and magnitude of this SMF in hydrogen atom, is the reason behind the radiation of seven series of the spectral lines in hydrogen atom.*

Key Word*: Keywords: Stern-Gerlach experiment, Magnetic Force, Circular Magnetic Field (CMF), Spinning Magnetic Field (SMF), Field's Interaction Formula, Atomic Model, Spectral Line.*

I. Introduction

The Stern-Gerlach Experiment was conducted in 1922 [1], to compare between the Larmor's classical theory based on Ampere's electrodynamics versus the Sommerfeld's quantum theory, to determine the direction of the magnetic moment in an inhomogeneous magnetic field [1], the experimenters found the initial beam split into two distinct parts, interpreted as correspond to the two opposite spin orientations in the magnetic field permitted by space quantization [2], latter it was stated that, the experiment on simple bases shows atoms can only be in one of three spin states Up (+1/2) Zero (0) or Down (−1/2) [3]; thus the experiment demonstrated the spatial orientation of angular momentum is quantized [4] later it was justified to test the 'space-quantization' associated with the orbital angular momentum of atomic electrons [5]. Afterwards, the Stern-Gerlach experiment thought to measure the angular momentum or spin on atomic scale, where a particle (particle-like wave function) is shot into a magnetic field and the field exerts different forces on the parts of the wave functions having different values of spin [6], atoms emerged from the inhomogeneous magnetic field in two possible beams corresponding to S . n = ±1/2 ħ, the positive sign is spin up in the $\widehat{n}$ direction, the negative sign is spin down in the $\widehat{n}$ direction [5]. The experiment is among the strongest evidence for Quantum Mechanics (QM), viewed as highly successful theory, accurately describes physical reality in a wide range of situations [6], while classic interpretation was ruled out due to the claim by Kronig that, the internal velocities of spins would

reach close to the speed of light [7]; although Kronig himself invented the concept of electron spin in January 7, 1925 [8], but endorsing the quantization of spin was due to the general impression that classical concepts were insufficient for proper description of microscopic phenomena [7], thus the interpretation of Stern-Gerlach experiment not only diverted the truth about the nature of science, it casted great shadow on one of the most important characteristics of charged particles, that's the Spinning Magnetic Field (SMF), it limited prospects and opportunities that could have been realized, only if extra efforts exerted to resolve and correct some historical disputes which twisted the course of the physical science, instead each is describing from his perspective [9].

The turning point in physical science which created the current reality, started in 1820, when Hans Christian Ørsted discovered the relation between electricity and magnetism, he also discovered electric current produced Circular Magnetic Field (CMF) [10]; instantly Ampere derived his electrodynamics based on the relation between the electric current in conductor and miniature electric current he supposed to exist in the compass [10], Ampere's analytical approach to the problem of interaction between currents was retracing the Newtonian approach to the law of universal gravitation [11], where the Ampère's force is a force of instantaneous *action at a distance*, fundamentally inconsistent with Maxwell's theory based on the continuous propagation of electromagnetic action [12]; when criticized by Ørsted, Biot, Faraday, Savart and Grassmann, Ampere empowered by his formula, challenged them to derive an alternative formula stating "*Mathematic is important than Mechanism*"; that started the mathematization of the physical science [10], others like Poisson, Cauchy, Green, Stokes and Hamilton contributed with analytical tools, paved the way into this mathematisation [11], as Ampere was pioneer, in trusting mathematical form over physical content, he was followed by Gauss and Weber in writing electrodynamics in algebraic equations, and tightly connected their mathematical form with the physical content, then Maxwell extended the process into electromagnetism through partial differential equations of elasticity and hydrodynamics [11]; although Maxwell was pioneer in new field theory of electricity and magnetism, and in search *for physical theory* [11], but failure to response to Ampere's challenge, and seeks "*field's interaction,*" based on the Circular Magnetic Field (CMF), greatly studied by Faraday as Lines of Magnetic Force (LMF), while seeking its *physical* existence, as he knows its importance for advancement of science [13, 14], Maxwell too seemed to know the importance of LMF on human knowledge [15], but others thinks the materialistic version of the lines of force, which's like ropes under tension, is a fatal misconception [7], thus instead of following Faraday's, Maxwell connected the LMF with his vortices [15], and saw the continuous fields as derivative features of bits of matter, hence he put Faraday's ideas of the continuous field concept into an explicit mathematical form as partial differential equations [16], thus he expanded the mathematization into Faraday's theories of LMF [17], this led to the concept of EM-R been based on electrostatic fields surrounded by fields of force that superposed to give the electromagnetic wave of Maxwell's classical theory [16], that's why Electromagnetic Radiation (EM-R) by Maxwell's [18] and the developed Electrodynamics [10], couldn't showed *what's the "in-between" mechanics that causes an atom's motion to be turned into an* **Electromagnetic Wave (EM-W)** [19]; such loopholes provoked J. J. Thomson to comment "*the detection of a train of waves associated with the movement of electrons was not predicted by Maxwell's equations, emphasizing that, such a view of the electron had to be wrong*" [20]; that was the state of physics in 1900, when Planck suggested "*radiation energy is a discrete quantity ε and proportional to the number of frequency ν*" [21].

Five years after Planck's formula, when Einstein suggested in 1905 "*energy quanta is constituent of incident light*" [22], he developed *quanta* into wave-particle duality in 1909 [23], to remove photoelectrons from atoms [16], *the photon raised the concept of duality, associated electromagnetic fields of light with singular points, similar to electrostatic fields*, and surrounded by *fields of force* that superposed to give the electromagnetic wave of Maxwell's classical theory [24]; Planck's idea lead into two lines: The electromagnetic waves/particles duality by Einstein-de Broglie-Schrödinger and the quantization of the structure of atoms by Bohr-Heisenberg-Born [25]. Einstein quanta was rejected by Millikan, Lorenz, Planck [26], and Bohr [27]; until Compton explained the scattering of electron by X-rays and γ-rays in 1922 [28], stated "*scattering is a quantum phenomenon; and a radiation quantum carries with it* **momentum as well as energy**" [28], that provided great credibility to Einstein and his quanta (photon) [22], de Broglie misinterpreted Einstein's idea and extended duality to particles in 1924 [29], it was supported by the electron diffraction experiment [28], in which Davisson and Germer bombarded Nickel crystalline with electrons beam, a diffraction peak wave generated by "*electron wave,*" it was interpreted as the wavelength of Bragg formula resulted in diffraction pattern [30, 31], later it was confirmed separately by Thomson and Rupp [32, 3].

The Stern-Gerlach Experiment was conducted in an era (1922) dominated by the triumph of the photon [4, 1], when Einstein won the Noble Prize for photoelectric effect [22], following Compton's experiment, where wave particle duality became acceptable reality [28], as he bestowed photon with credibility, experimental scientists were searching for more proof to back the new puzzle science, that's why after carrying the experiment Gerlach and Stern, stated, "*silver atoms in a magnetic field have only* two discrete *values of the*

component of the magnetic moment in the direction of the field strength; both have the same absolute value with each half of the atoms having a positive and a negative sign respectively" [1], this resembles Compton's explanation [28] it didn't seek an alternative interpretation, while twisted the truth [33], Raman once expressed this point that "*the classical wave-principles are not easily reconcilable with Compton effect because they have not been correctly interpreted,*" [34], whereas the truth about Compton effect is a bit complicated [35], instead a simple answer was chosen, just like Einstein knocking photoelectron with quanta (photon) [22], or billiard ball concept; although the truth is different [36], which could be the reason why Einstein spent fifty years thinking about photon saying before his death "*Every physicist thinks that he knows what a photon is, I spent my life to find out what a photon is and I still don't know it*" and that "*All the fifty years of conscious brooding have brought me no closer to the answer to the question: What are light quanta? Of course today every rascal thinks he knows the answer, but he is deluding himself*" [37], what forced Einstein to make such radical statement? Or maybe he knows Compton twisted his formula? [33]; and why Pauli opposed the rotational spin [7], while endorsed the view that: Stern-Gerlach Experiment demonstrated "*the spatial orientation of angular momentum is quantized*" [4], and the discovery of electron's spin, lead to the development of a more general version of quantum mechanics [5], thus the Stern-Gerlach experiment was a turning point which strengthened the foundation of QM, while the double-slit experiment was thought to illustrate and prove the nature of quantum mechanics [38, 39], although Schrodinger claimed "*his new wave-theory is more adequate than a theory of particles*"[16], but the interpretation of double-slit experiment as featuring wave particle duality was regarded as an absolute, it gave Feynman the triumph to state that "*we choose to examine a phenomenon which is impossible, absolutely impossible, to explain in any classical way, and which is in the heart of quantum mechanics*" [40], these experiments were decisive endorsing wave particle duality, making it acceptable, leading to new form of physics, contradicting the common sense and norms of life [41], within that euphoria and misinterpretations, no scientist currently care much about the original shape of the Stern-Gerlach result, as in [42]; thus since Ampere time, some scientists have been carrying the role of the blind men [9], only Planck was absolutely correct, but how can we explain the past successful developments? These were simply attained by experimental scientists, who forced theoretical physicists to explain their discoveries; unfortunately they resorted to mathematics, which complicated the physical science.

The above storyline of QM can be summarized in that "*The Quantum mechanics, was discovered in the search for a mathematical scheme to explain classically unsolvable problems like the photoelectric effect, and why hydrogen atom radiates certain colors of light; it was formulated by dozen major physicists over 25 years, each discovered an essential piece of the puzzle, the mathematics moved farther with each piece away from our reality*" [6], comparing this with the perceived impression that, the spin was the first instance where a genuine quantum degree of freedom without a classically corresponding one were postulated to exist, if this were the general situation, our understanding of a quantum theory as the quantization of a classical theory cannot be fundamentally correct [7]; so is there any truth in this statement? Or what was perceived as progress was merely an invented mathematical set up, that doesn't reflect the reality!

While searching for logical answers to these puzzles, and after four years investigating the discrepancy in the magnetic force, we derived the formula for *field's interaction* requested by Ampere in "*The Magnetic Interaction*" [43], later generalized in "*The Unified Force of Nature: 1-The Electric & Magnetic Forces*" [44], it suggested "*The Electromagnetic Radiation Mechanism*" [45], its energy and relation to Planck's in "*Electromagnetic Radiation Energy and Planck' Constant*" [46], it explained the photoelectric effect, illustrated the existence of radiation magnetic force in EM-R given by Eq. (24) in "*The Photoelectric Effects-Radiation Based With Atomic Model*" [36], the Compton Effect is explained in "*The Compton Effect Re-Visited*" [35], and the fault by Compton clarified in "*Compton was Greatly Mistaken Using the Quantum*" [33], the two slits experiment explained classically in "*The Double Slit Experiment-Explained*" [47], then diffraction explained in "*Electron Diffraction Re-Explained (The Intense Magnetic Fields Interactions within Crystals)*" [48].

Four of these nine papers are in the core of QM experiments, explained classically, but this can't be done without two vital papers: "*The Magnetic Interaction*" [43] and "*The Electromagnetic Radiation Mechanism*" [45], thus, without knowing the really mechanisms one is blind [9]!

Since the Stern-Gerlach Experiment is the last among six experiments, thought to prove the nature of QM, it had been complicated by been extended to the discrete values of the angular momentum, or spin, and regarded as one of the hallmarks of quantum mechanics [6], the result of the experiment interpreted the two components as corresponding to an angular momentum of ½ (with allowed values +½ and −½)! [6], which's regarded as measurement of the spin illustrating ideas in quantum mechanics [6] and as the discovery of electron spin also illustrated the history of Quantum Mechanics, it also related to the understanding of the Special Relativity [7]. But why this experiment was misinterpreted? Simply, because Bohr's claimed, electron spin cannot be measured by classically experiments and must be considered as an essential quantum-mechanical property of the electron [7] and the concern that a classical model for the electron contradict Special Relativity [7], and to consolidate QM and finally the interpreters lacked alternative version, which means ignorance or

blindness about specific facts absence to him/them, in addition to fact that Wolfgang Pauli was against relating it to any kind of state of rotation [7]; but Dehmelt claime to have observed the spin of an electron [42], that experiment and several observations of the spin of free electrons at a particular point in space using a very sharp magnet, forced many to raise many questions about the possibility of Stern-Gerlach experiment with electrons [49], all these brought us to the current status, where the theory of the physical universe, as it currently stands, is *incomplete*, and some thinks there must be some 'mechanism' that singles out just one version as the one corresponding to our perceptions [6], but as the past 100 years showed among others, minds could be manipulated and controlled by false interpretations; therefore based on our above nine papers in replay to the historical experiments that had established QM, for sure QM is not a mechanism based dogma, rather the lack of knowledge of the *field's interaction* derived in "*The Unified Force of Nature: 1-The Electric & Magnetic Forces*" [44], the radiation magnetic force as given by Eq. (24) in "*The Photoelectric Effects-Radiation Based With Atomic Model*" [36], and *the Electromagnetic Radiation* [45], led theorists to fatal misinterpretation, while the broad knowledge of the Spinning Magnetic Field (SMF) produced by electrons, protons, neutrons and atoms including silver atom, its magnitudes, the interaction of its SMF's in both protons and electrons caused them to integrated and produce neutrons, the interaction of SMF by protons and neutrons produced Spinning Magnetic Force (SMFs) or the nuclear force in [50], modified in [51], the structure of hydrogen atom and the stability of its forces [43], and example of higher structural atom of potassium [36]; lacking all these knowledge were behind the interpretation which created the QM, based on mathematical interpretation; and Faraday's perception on Ampere's force, reflects Stern-Gerlach Experiment, that "*it protected itself as an ideal theory from any review, but other alternative exist, the discovery of which would be rewarded*" [52], therefore, Stern-Gerlach Experiment is explained based on the characteristics of SMF and magnetic force, distorted by Stern-Gerlach interpretation!

Two centuries elapsed since *action at distance* was strengthened, and three generations since QM which lacks clear correspondence with the natural reality started, while it needs mathematical *interpretation* to be related to the perceived physical world [6], and such description was farther extended by some like Domenico that any quantum theory in some sense is the quantization of a classical theory [7]; regardless of these, quantum had established itself confidently, reflected the sad remark by Planck, "*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*" [53], and as Sachs put it "It is a lesson of history that we should never accept a *scientific truth as a final truth*." [16], strange enough, the reason for the existence of three major interpretations and perhaps a dozen others for QM, was justified by the claim that, the theorists apparently not aware of *all* the relevant properties of the theory itself [6], if so then which one express the essence of micro world? And how can we differentiate a false theory from genuine, when confirmed by spurious experimental data [54], particularly with impression that, *it is not possible to gain a proper understanding of what underlies the quantum theory* [6], in fact this can only be done by knowing how to guide mathematical tools using new ideas [11].

In this paper, we reviewed some unknown, neglected fields and how they are related to Stern-Gerlach experiment, some are new, while others were published before but brought to link ideas, in chapter two we explained as much about the Circular Magnetic Field (CMF), in section three we gave background about the Spinning Magnetic Field (SMF), showed several examples and how interactions resulted in Spinning Magnetic Force (SMFs), we also included the shape of proton's SMF and the related magnitudes of SMF, in section four we showed some of the unknown characteristics of charged particles, including neutrons and silver atom (Ag), in section five we showed the inter-atomic interaction between Circular Magnetic Field (CMF) and Spinning Magnetic Field (SMF), the formation of the atom including the capture of electron by proton to form hydrogen atom, forces of stability in atom, spectral lines and relations with SMF (B_{1U}), then we explained the original Stern-Gerlach experiment result in section six, showing how it's irrelevant to the current interpretation and how silver atoms interacted with the inhomogeneous magnetic field and resulted in the separation of the Ag, although we interpreted the Stern-Gerlach experiment by free electron [49] in section seven, showing its separation due to the interaction between the CMF and the inhomogeneous magnetic lines of force, unfortunately I couldn't get permission to publish a figure, the author also forbid using his data, hence it was omitted. One can start with section six if interested in the interpretation of the Stern-Gerlach Experiment, but our sequence is intended to illustrate how the interactions of SMF existed in micro world, the process intended to give broad understanding to the phenomenon; we hope this explanation will be regarded as aimed at the benefit of humanity, criticisms expressing contrary ideas are welcome, as we aimed at restoring the common sense to the physical science.

Finally, since the quest to deduce the true nature of the physical world from physics perspective, is based on the truthful connections between the *mathematics* and our *perceptions* [6], therefore anyone can imply this as guidelines on our nine papers verses the five by quantum mechanics, so as to draw a final conclusion about the true nature of the physical world each to follow his consciousness; while for those who would insist to

be glued into the QM for single known unscientific reason, they should be awakened not to follow the necked emperor [55] in this era of human advancement. (10)

II. The Circular Magnetic Field (CMF): The Train of Wave Associated with Electron's Movement

After criticized by Ørsted, Biot, Faraday, Savart and Grassmann, Ampere dared an alternative formula stating "*Mathematic is important than Mechanism*" [10]; many scientists investigated the Circular Magnetic Field (CMF), started by Ørsted in Fig. 1 (A) [10], then Faraday in Fig. 1 (B) [52], even Feynman draw Fig. 1 (C) [56], but why he didn't sketched the second conductor, to produced CMF shown in Fig. 1 (D)?

Such mechanism will produced the required magnetic force, but it required the formula demanded by Ampere [10]; from these three examples, one can imagine many other scientists tried to solve that challenge, particularly as it could have been realized that, although the CMF is what described by J. J. Thomson as the "***train of waves associated with the movement of electrons***" he criticized Maxwell for not including it in his equations, saying "*since it's not predicted by Maxwell's equations, then his view of the electron had to be wrong*" [20], but without the formula the Circular Magnetic Field (CMF) couldn't be incorporated in any theoretical model; but as the response to Ampere's challenge finally materialized [43], thus the repulsive and attractive magnetic lines of force supposed by Faraday [57] causing the magnetic force, is magnetically express by [43, 44]

$$F_m = \frac{B_{C1}\, B_{C2}\, r_1\, r_2\, l_1}{2\, k} = \frac{B_{C1}\, B_{C2}\, r_{C1\&2}^2\, l_1}{2\, k} \qquad (1)$$

Where, both B_{c1} and B_{C2} are **CMF** (in Tesla) produced by conductors C_1 and C_2 respectively, while r_1 and r_2 are the **CMF's** radii in metre, l_1 is the length of the conductor in metre, k = 2×10^{-7} Newton per square ampere and the magnetic force F_m is in Newton; although the CMF is used in Figs. 5,6,7,8&9, but the CMF described as "***train of waves***" [20], will be explored more. The important role of the Circular Magnetic Field (CMF) is that it's the main factor for the "*field's interaction*" [44], and it's the envelop integrating both the electric and magnetic fields to constitute and radiated as an Electromagnetic Radiation (EM-R) [45], in addition to other phenomena; unfortunately the concept of wave particle duality interpreted the passing of electrons near a solenoid as a shift in electron's wave [42].
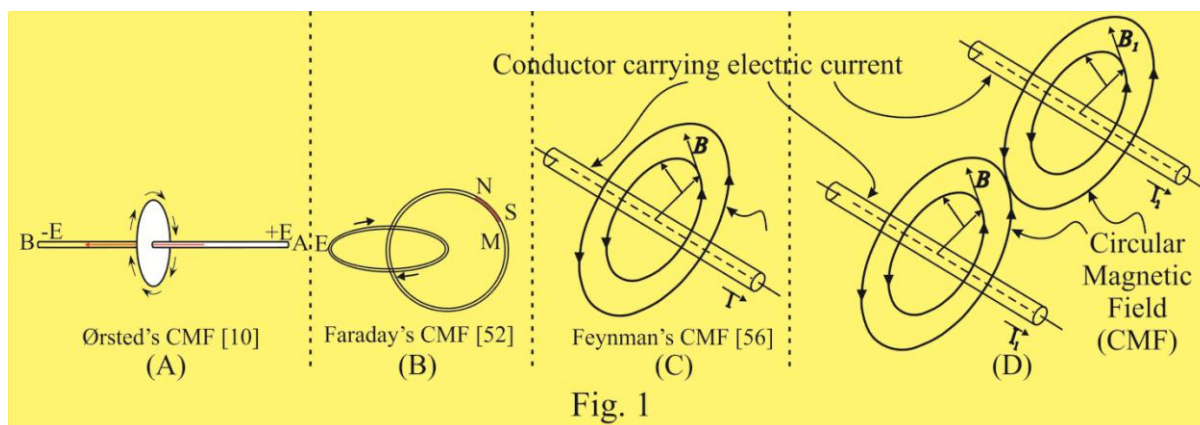

Fig. 1. In 1820 Ørsted discovered electric current produced Circular Magnetic Field (CMF) as in (A) [10], Faraday worked on that as in (B) [52], while Feynman's is in (C) [56], but Feynman should have thought about (D), the force is derived using Eq. (1) [43, 44].

III. The Spinning Magnetic Field (SMF) and Atomic Structure

Our investigation into the spins showed a field rich with unexplored hidden characteristics, which should have been studied intensively, to shade lights on the atomic structures with an expected scientific advancement; unfortunately all were blocked when spin was quantized; and as spin is no less natural in classical physics than in QT [7], spin was first discovered in the context of the emission spectrum of alkali metals, in 1924, Pauli introduced what he called a "*two-valuedness not describable classically*" associated with the electron in the outermost shell, this allowed him to formulate the Pauli exclusion principle, stating that no two electrons can have the same quantum state in the same quantum system [58], forming spin *an inner degree of freedom of the electron* [7], Kronig, a Landé's assistants, suggested in early 1925 that it was produced by the self-rotation of the electron, but criticized by Pauli as violate the theory of relativity [58], but Kronig, Goudsmit and Uhlenbeck took up a less radical stance by suggesting that this degree of freedom somehow corresponded to an inner rotational motion [7]; while the electron spin electric dipole moment (EDM), has been sought for

more than half a century but still eludes observation [8], and the spin angular momentum of a fundamental fermion, was regarded as an observable with no classical analog, is considered by many physicists to be describable only by abstract mathematical expressions, with no possibility of intuitive visualization [7], but our investigation into spin's characteristics as revealed by hydrogen atom, which consist of single proton in its nucleus, orbited by an electron, showed that, the emission of spectral lines with specific wavelength, is suggested as due to the release of the energetic Circular Magnetic Field-Electric Field (CMF-EF) by electron during the Flip-Flop (F-F) mechanism, which's *pulled by specific magnitude of Spinning Magnetic Field (SMF)* [59, 43, 36], this relation between the released EM-R and the high magnetic field, was also suggested by high energy scientists, to explain the x-rays and γ-rays produced by the highest power laser [60], thus the required SMF's (B_{1U}) for each wavelength to be released is given in Table 1, which gives the parameters of the atomic spectra lines for the seven n' series of hydrogen atom.

Table. 1. Some parameters of the Atomic Spectra for the seven n' series of hydrogen atom, the wavelength and the Spinning Magnetic Field (B_{U1}) linking each Circular Magnetic Field (CMF).

| Lyman series (n' = 1) λ (nm)	N	2	3	4	5	6	7
	λ	121.5026	102.5178	097.2021	094.9239	093.7306	093.0254
	B_{1U}	176,313.895	208,964.616	220,392.369	225,681.786	228,555.049	230,287.536
Balmer series (n' =2) λ (nm)	N	3	4	5	6	7	8
	λ	656.1142	486.0105	433.9379	410.0714	396.9086	388.8084
	B_{1U}	32,650.721	44,078.474	49,367.891	52,269.733	54,003.168	55,128.234
Paschen series (n'=3) λ (nm)	N	4	5	6	7	8	9
	λ	1874.6119	1281.473	1093.5236	1004.6748	954.3479	922.6605
	B_{1U}	11,427.752	16,717.169	19,590.433	21,322.920	22,447.371	23,218.291
Brackett series (n'=4) λ (nm)	N	5	6	7	8	9	10
	λ	4050.0874	2624.4566	2164.9558	1944.042	1816.9315	1735.7517
	B_{1U}	5,289.4168	8,162.680	9,895.167	11,019.618	11,796.988	12,341.972
Pfund series (n'=5) λ (nm)	N	6	7	8	9	10	11
	λ	7,455.8428	4,651.2723	3,738.5422	3,295.2162	3,037.5656	2,871.4487
	B_{1U}	2,873.263	4,605.751	5,730.201	6,501.121	7,052.556	7,460.555
Humphreys series (n'= 6) λ (nm)	N	7	8	9	10	11	12
	λ	1,2365.2285	7,498.4476	5,905.0275	5,125.8919	4,669.9890	4,374.0944
	B_{1U}	1,732.487	2,856.938	3,627.858	4,179.292	4,587.291	4,897.608
Seventh series (n'= 7) λ (nm)	N	8	9	10	11	12	13
	λ	19,051.6112	11,302.5916	8,755.336	7,504.05262	6,768.33558	6,288.52013
	B_{1U}	1,125.066	1,896.407	2,448.144	2,856.366	3,166.852	3,408.484
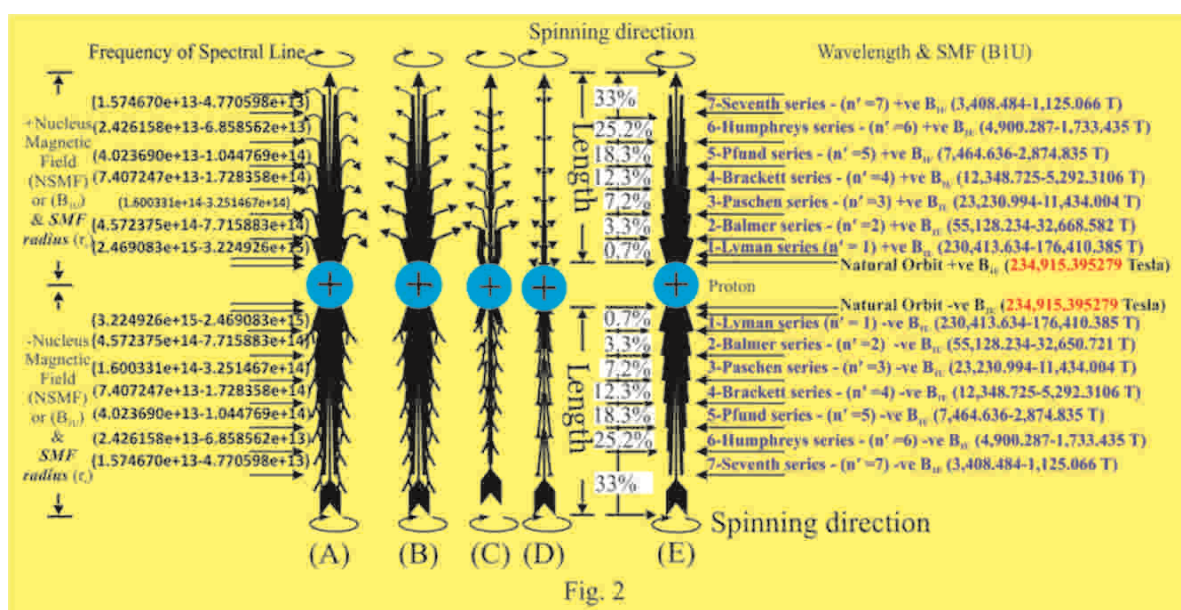
Fig. 2. The seven structural divisions of the Spinning Magnetic Field (SMF) in the proton atom, it also represents the nucleus of hydrogen atom; each division consist of specific magnitudes of SMF, produced specific series of spectral lines given in Table. 1, each SMF can cause the Flip-Flop (F-F) mechanism, integrated both the Circular Magnetic Field (CMF) and related Electric Field (E-F), then both CMF-EF are pulled by B_{1U} to produced the spectral lines with specific wavelength, the magnitude of B_{1U} for specific series is given by Eq. (29) [59]

The wavelength and reciprocal peculiarity of spectral lines in hydrogen atom is suggested as due to the link between the wavelength and magnetic field as given by Eq. (20), this relation helped in suggesting the shape and magnitudes of Spinning Magnetic Field (SMF) for the proton particle as nucleus of hydrogen atom shown in Fig. 2 [59], the SMF is structured from eight Lines of Magnetic Force (LMF), each contain slop of progressive varriable magnitudes of SMF, representing the production of one of the seven spectral series, while specific magnitude produced specific spectral line, the greatest magnitude nearer the nucleus is the Lyman series (n′ = 1) +ve B_{1U} (230,413.634-176,410.385 T), Balmer series - (n′ =2) +ve B_{1U} (55,128.234-32,668.582 T), Paschen series - (n′ =3) +ve B_{1U} (23,230.994-11,434.004 T), Brackett series - (n′ =4) +ve B_{1U} (12,348.725-5,292.3106 T), Pfund series - (n′ =5) +ve B_{1U} (7,464.636-2,874.835 T), Humphreys series - (n′ =6) +ve B_{1U} (4,900.287-1,733.435 T) and Seventh series - (n′ =7) +ve B_{1U} (3,408.484-1,125.066 T); Fig. 2 also shows the limit for each of the seven series, where each magnitude is responsible of radiating specific wavelength, and each level radiated a package of series of spectral lines, the details of these characteristics are given in Table. 1 [59]..

The spins is an important factor to unlock the mechanism of an atom, it was alleged that spin is a kind of intrinsic angular momentum, which has no classical counterpart [61], even Pauli rejected the classical spins because of its *"superluminal velocities"* [7], he thinks if electron with sphere and classical radius $r\_0 = e^2/m\_e c^2$, the surface velocity would be hundreds of times the velocity of light [8] in addition to the perception that *the inner rotational motion of the electron would lead to serious problems with Special Relativity* [7], this line of thought clearly says that a classical electron model cannot reproduce the observable quantities, mass, charge, angular momentum, & magnetic moment, without running into severe contradictions with Special Relativity [7].

As Uhlenbeck under influence from Lorentz, became convinced that the equatorial velocity of the spherical hollow electron, will greatly exceed the velocity of light [7], while Pauli stated clearly that "*we do not regard the conception of a rotating material structure to be essential, and it does not even recommend itself for reasons of superluminal velocities one then has to accept*" [7] in addition to these, Bohr, Pauli, and Mott believed that "*the impossibility of observation of free electron spin is a general principle and the Stern-Gerlach experiment can never be expressed in terms of the classical approach*" [49]; but is it true the classical models for electron are not capable to account for the actual values of the four electron parameters: mass, charge, angular momentum, and the gyromagnetic factor? [7]
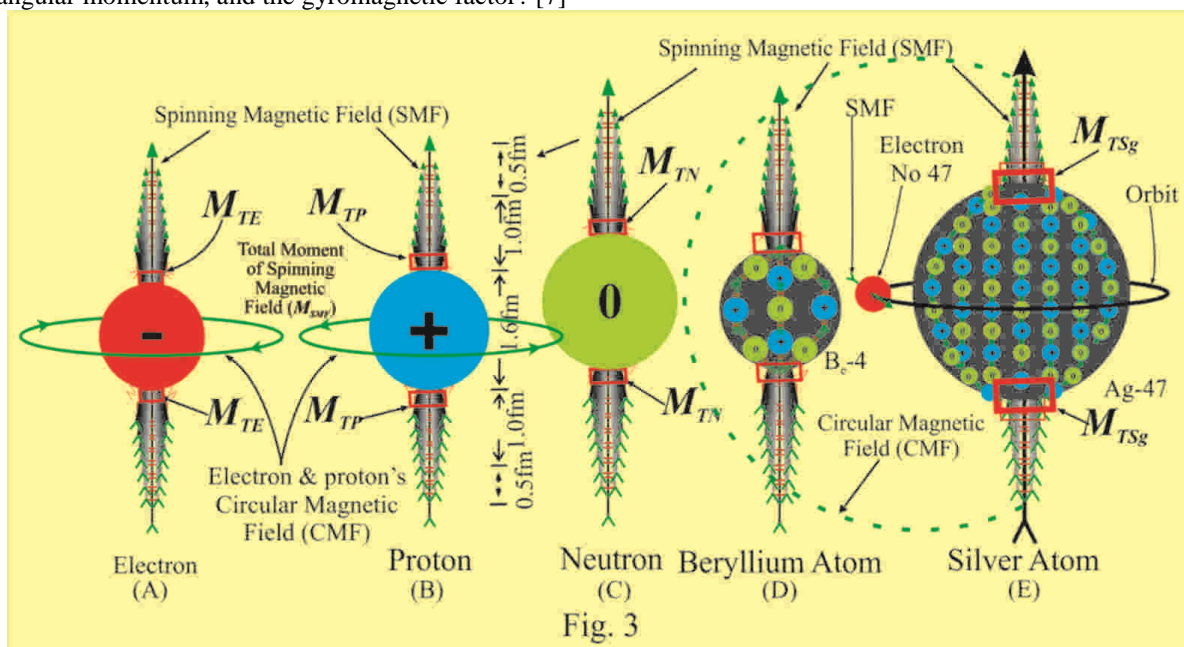

Fig. 3. The magnetic shapes of (A) Electron with CMF, (B) Proton with CMF, (C) Neutron, (D) Beryllium atom (Be) and (E) Silver atom (Ag), for (A), (B) & (C), each particle is spinning around its axis, producing the Spinning Magnetic Field (SMF) [59], for Be and Ag, the spinning nucleus is a summation of all proton's and neutron's SMF, while for proton the magnitude of the produced magnetic moment (M_{TP}) is given by Eq. (2), for electron and neutron it's given in [50] and modified in [51].

Although in our model given by Eq. (2) in which the spinning frequency v_{ps} = 0.079577471 S^{-1}, thus spinning is an intrinsic characteristics of electrons, protons and neutrons they continually spinning around their axis [62], and this is the bases for the suggested produced Spinning Magnetic Field (SMF) [43, 50, 51], the Total dipole moment of the Spinning Magnetic Field (M_T) for proton, first suggested in [43], then developed for electrons, protons and neutrons [50], then modified [51], the moment is suggested to be produced above the

poles of the spinning nucleons [63], as the shape of the SMF for a proton is shown in Fig. 2, the same is implying for electron as shown in Fig. 3, where each particle spin around its axis, but in opposite direction, thus suggested to produced the Spinning Magnetic Field (SMF) or dipole moment (M_T), the magnitude for the proton is given by [51]

$$M_P = B_{1P} r_r^2 = \frac{\mu_0\, q}{2\,\pi} \sqrt{\frac{q^2\, r_o}{\varepsilon_0\, v_{PS}\, m_P\, r_P^2}} \qquad (2)$$

Where, B_{IP} is the SMF (B_{1P} for proton and B_{IU} for nucleus hydrogen atom), v_{ps} is the proton's spinning frequency (v_{ps} = 0.079577471 S), r_O is the radial distance from proton surface to a point at which M_{TP} is produced (r_o=0.53 fm), r_r is distance from proton's surface along the magnetic field, μ_o is the permeability of the free space, ε_o is the permittivity of free space, and M_{TP} is the produced magnetic moment = 3.11283418310993e-18 T.m^2, in this formula, the spins as given can't be compared with the speed of light [7]. The interaction of both electron's and proton's SMF produced the Spinning Magnetic Force (SMFs) or the nuclear force, resulted in the integration of both particles to form the neutron particle shown in Fig. 3-(C), its details is given in [50] and modified in [51], the structure of higher atoms such as Beryllium (B_e) in Fig. 3-(D) consist of 4 protons and 5 neutrons, while for silver atom (Ag) it consist from 47 protons and 61 neutrons [63], as in Fig. 3-(D) [59] under study based on the above characteristics [64], the arrangement of each atom is conditioned that no two protons should be near each other, as illustrated for both particles in Fig. 3-(D&E).

IV. The Characteristics of Electrons-Protons-Neutrons and Neutral Atoms

The characteristics of charged particles which help understanding the Stern-Gerlach experiment have been explained in "*The Magnetic Interaction*" [43], "*The Unified Force of Nature: 1-The Electric & Magnetic Forces*" [44], "*The Field's Interaction and Atomic Model, Poster*" [59], "*THE SPINNING MAGNETIC FORCE*" [50] modified in "*The Grand Unification: 2-The Nuclear (F_N) and Weak (F_W) Forces*" [51] and "The Weak Spinning Magnetic Force (F_W) (The Weak Interaction)" [65], in these papers we explained the nature of charged particles and the produced Circular Magnetic Field (CMF), its characteristics and interaction with CMF and with magnetic fields, and with each other to produce the Spinning Magnetic Force (SMFs) or the Nuclear Force (F_N) which also produced the neutron in which both charges are neutralized and it doesn't produced CMF although it produced SMF, the disintegration of nucleus and the production of Weak Force (F_W) [65], each of these papers with related formulas help forming the bases to explain the characteristics exhibited by the Stern-Gerlach experiment.
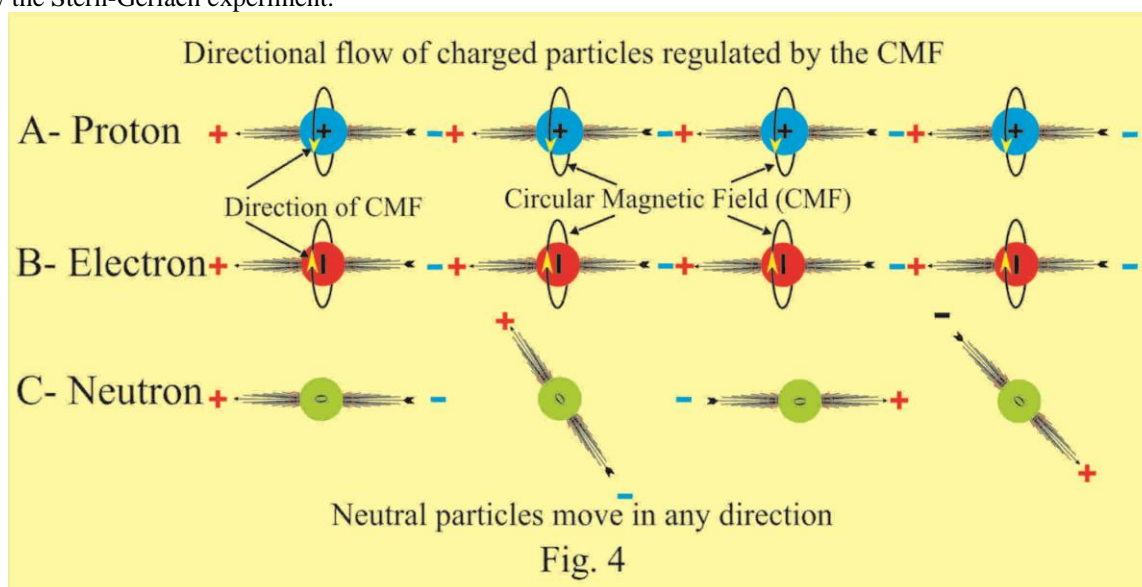

Fig. 4. The direction of flow for protons in (A) and electrons in (B) is guided by the positive Spinning Magnetic Field (SMF) which is always leading, due to the production of Circular Magnetic Field (CMF), while for neutrons and neutral atoms, as it doesn't produced CMF, its flow can take any direction as shown in (C).

When in motion, the positive Spinning Magnetic Field (SMF) will be leading and the negative SMF will be trailing, this is thought due to the CMF's factor, while for neutrons and neutral atoms like silver, an ejected beam of atoms or neutrons, can move with either the +ve or −ve SMF in lead, thus at any given beam, it would contain mix numbers of positive and negative leading SMF and at various angles; thus the direction of

the flow for both the electrons and protons shown in Fig. 4 (A&B), its determined by the positive part of the SMF, which's always leading; while for neutrons and neutral atoms, since they are neutrals, and doesn't produced CMF, their flow is randomly oriented, not regulated by any rules, hence as shown in Fig. 4-(C), for the neutrons, any probability among the four states can occur or one polarity may lead by 1-5%; thus the magnetic dipole moment of the atoms, are not randomly oriented in space *due to random thermal effects in the oven* [5], but rather its due to the production or non production of the CMF.

V. Inter-Atomic Interaction Between Circular Magnetic Field (CMF) and Spinning Magnetic Field (SMF)

a.   Orientation of Electron Spin

First we will analyze the current concept of Bohr atom, and then compare it with our model. The movement of an electron around the nucleus (proton) in Bohr's model of the hydrogen atom in Fig. 5 (b), is regarded as analogous to current flowing through a circular wire as shown in Fig. 5 (a), and since current-carrying wire produced magnetic fields, therefore, hydrogen atom produces a magnetic field *and interacts with other magnetic fields* [66]; the orbital magnetic dipole moment is a measure of the strength of the magnetic field produced by the orbital angular momentum of an electron, thus from force and torque on a current loop, and the current associated with an electron in orbit around proton in a hydrogen atom, the absolute magnetic moment is [66]

$$\mu = IA = \frac{e}{\frac{2\pi r}{V}} \pi r^2 = \frac{eVr}{2} \qquad (3)$$

Where, *I* is the current and *A* is the area of the loop, *e* is the magnitude of the electron charge and *r* is the radius of the orbit and *V* is the speed of the electron in its orbit. The magnetic momentum *μ* in Eq. (3), can be expressed in terms of the magnitude of the orbital angular momentum *L*, given by

$$L = |\vec{L}| = |\vec{r} \times \vec{p}| = rp \sin \theta = rp = rmV \qquad (4)$$

Where, r is the radial distance in m, and p is the momentum in kg. s^{-3}, and the angular momentum L is in kg m^2 s^{-1}. Thus combining Eq. (3) and Eq. (4), the magnetic moment is [66]

$$\mu = \left(\frac{e}{2m_e}\right) L \qquad (5)$$

In full vector form, this expression is written as

$$\vec{\mu} = -\left(\frac{e}{2m_e}\right) \vec{L} \qquad (6)$$

The negative sign appears because the electron has a negative charge; the direction of the magnetic moment of the electron is anti-parallel to the orbital angular momentum, as shown in Fig. 5 (b). In the Bohr model of the atom, the relationship between →μ and →L in Eq. 6 is independent of the radius of the orbit; the magnetic moment *μ* can also be expressed in terms of the orbital angular quantum number *l*, the *z*-component of the magnetic moment is

$$\mu_z = \left(\frac{e}{2m_e}\right) L_z = -\left(\frac{e}{2m_e}\right) m\hbar = \mu_B m \qquad (7)$$

The quantity μ_B is a fundamental unit of magnetism called the **Bohr magneton**, which has the value 9.3e-24 J/T or 5.8e-5 eV/T. Quantization of the magnetic moment is the result of quantization of the orbital angular momentum [66].
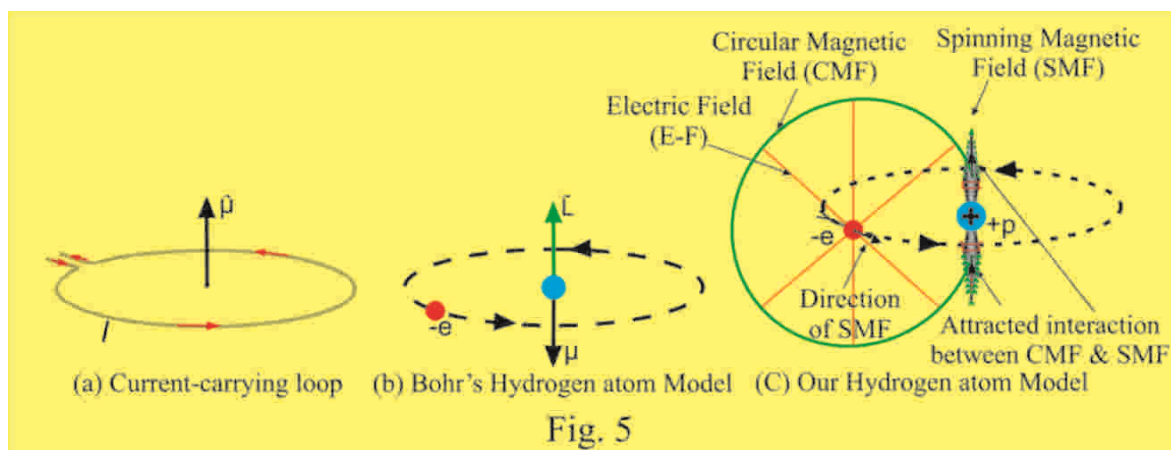

Fig. 5. In (a) Current flowing through a circular wire is analogous to (b) an electron that orbits a proton in Bohr's hydrogen atom [66], while in (c) electron in hydrogen atom produced Circular Magnetic Field (CMF)

discovered by Ørsted in 1820, as due to electric current shown in Fig. 1 (A) [10]; the CMF interacted and attracted to the Spinning Magnetic Field (SMF) produced by the spinning proton; shown also direction of electron's SMF.

Reviewing Eq. (7), derived from Fig. 5 (b) which's based on the treatment of electron in hydrogen atom as an electric current, its realized that, the really shape of magnetic field produced in the atom due to electron's movement, is completely different from the above formulas and as depicted in Fig. 5 (b), because as discovered by Ørsted in 1820, electric current produced Circular Magnetic Field (CMF) shown in Fig. 1 (A) [10]; analyzing this point, it's clear there's a shortage in the fundamental physics, related that's with the lack of knowledge about electron as the source of the CMF since Ampere time, then the question which most physicists wouldn't dare to tackle, is if they know this fact? Then how this CMF interacted with nucleus at micro level? The CMF was known since the time of J.J. Thomson [20], but due to the failure to get the field's formula, scientists couldn't incorporate CMF into their works.

From this background, it's clear that, since the mindset was fixed into the knowledge of Ohm's law, Ampere's circuit law and Faraday's law of induction [67], while for Weber the galvanic and electrodynamic phenomena arise from movement of electrical fluids which causes reciprocal actions on the molecules of these ponderable bodies [68], thus these fluids and laws couldn't create the simple mathematical approaches that could reproduce the really mechanisms governed the basic magnetic forces in simple manner reflecting its characteristics on the macro levels, regardless of great efforts by Maxwell, who envision electric current involves motion of some kind [18], this is the electron's motion, which produced the Circular Magnetic Field (CMF), described as, "*a magnetic field encircles an electric charge in motion*; the lines of flux are closed concentric circles in a plane perpendicular to the conductor with the axis of the conductor as their center" [69], although the CMF is produced by charged particle in motion (electrons, protons and ions) [43], while the current theory suggests that "*magnetism is a property of a charge in motion*" and it's also stated that "*magnetic phenomena are interpreted in terms of the forces associated with electric charge in motion*" [69], but what produced the "***train of waves associated with the movement of electrons***" suggested by J. J. Thomson and neglected by scientists [20]? Clearly the CMF is produced by electrons, and accepting this will distort Bohr's atom model in Fig. 5 (b) and contradict those who advocated for Eq. (7) and related concepts, but is it justified scientifically?
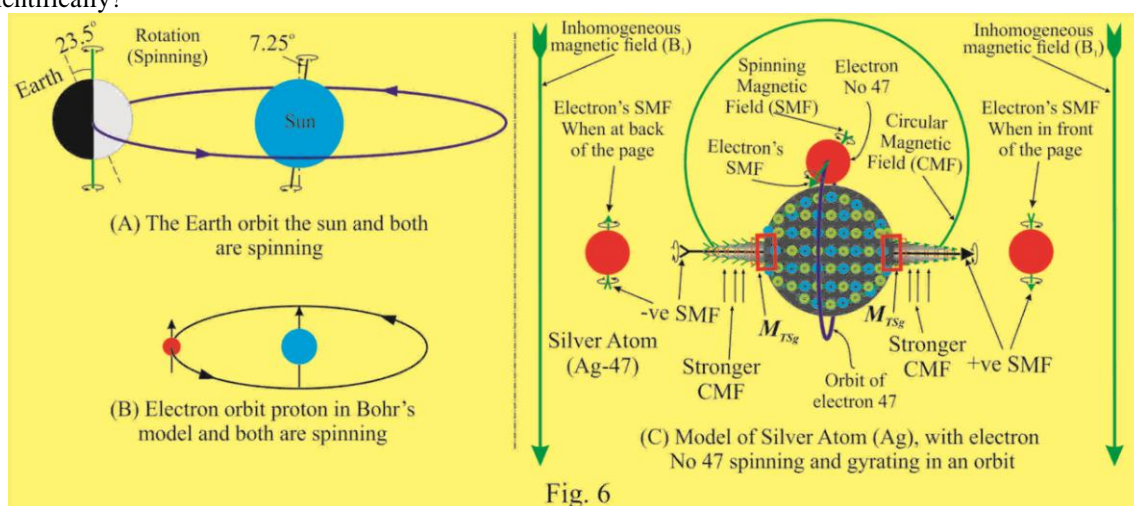

Fig. 6. The visual perspective of the earth spinning around its axis while orbit the sun in (A), influenced Bohr's model in (B), while as shown in (C) the silver atom (Ag) perceived to cross the inhomogeneous magnetic field (B_1), while its electron number 47, gyrate in natural orbit while attached by the Circular Magnetic Field (CMF) in green color to the weaker magnitudes of the Spinning Magnetic Field (SMF), the direction of +ve SMF is in front of gyrating electron doesn't cut B_1, thus no force produced, contrary to Ag which cuts B_1.

Therefore we can concluded that, electrons, protons and ions while in motion produced CMF, as showed in Fig. 7 [43, 44], thus the electron in Fig. 5 (c), while orbiting the proton in hydrogen atom, it produced the CMF in the same way it's produced outside an atom, and it has been found experimentally and theoretically using Coulomb's law and Einstein's theory of special relativity about magnetic field produced by charge in motion [70], the magnitude of the ***CMF*** or B_{2e} for an electron, produced by a charged particle in motion [71, 72, 73] is given by [70]

$$B_{CMF} = B_{2e} = \frac{Zq\, V\, sin\theta}{r_m^2\, c} \qquad (8)$$

Where, q is the particle's charge in coulombs, c is the speed of light in m.s^{-1}, V is the electron's velocity in m.s^{-1}, r_m is the magnetic radius at which the CMF is measured (representing r_{me} or electron's magnetic radius), Z is the number of charges, and the circular magnetic field B$_{CMF}$ (B_2) is in Tesla.

Since the fast moving nuclei with electric charges in the Heavy Ion Colliders like RHIC or LHC, is the origin of strong magnetic fields and the produced strong fields lasted only very short period and have maximum strength of $\sim$ 1.e+13 Tesla at RHIC and $\sim$ 1.e+14 Tesla at LHC [74], the magnitude of the strong magnetic fields generated in the heavy-ion collisions, shortly after the collision reaches 1.e+14 – 1.e+15 Tesla [75], this strong magnetic field is the Circular Magnetic Field (CMF), it's the magnetic part of the electromagnetic radiation and contain its energy [46], different magnitudes of B$_{CMF}$ are given in Table. 2, thus since B$_{CMF}$ is given ($\sim$ 1.e+13, 1.e+14 and 1.e+15 T) and if V and Z, in Eq. (8) are known, hence the radius can be derived, thus theoretically if such intense CMF is interacted with an intense magnetic field, a radiation with extremely shorter wavelength will be produced.

As the spin, is defined as the angular momentum associate with a rotating object such as golf ball, or the Earth [5], the spinning of electron around the proton in hydrogen atom shown in Fig. 6 (B) is visually perceived from the bigger picture of the spinning of the earth as it orbits the sun as shown in Fig. 6 (A) in which the direction of axis of rotation is directed to the northern star, thus the model in Fig. 6 (B) resulted from Pauli's fourth quantum number described the direction of the spin [2], but mainly because CMF was not accommodated by physicists in early twentieth century, although scientists showed great interests in CMF as illustrated by their shapes in Fig. (1) [10, 52, 56]; but the failure to use the CMF due to unavailability of field's interaction formula given by Eq. (1) [44], created a mathematical model, which led to the current status, but as any laboratory worldwide can check the fact that, electron produced CMF, and researchers discovered that "*hydrogen atom produces a magnetic field and it interacts with other magnetic fields*" [66], the question is, which other magnetic field? And with what field does the CMF interacted inside atom? What's the position of electron while rotating inside an atom? What's the direction of axis of spinning for the electron inside and outside an atom?
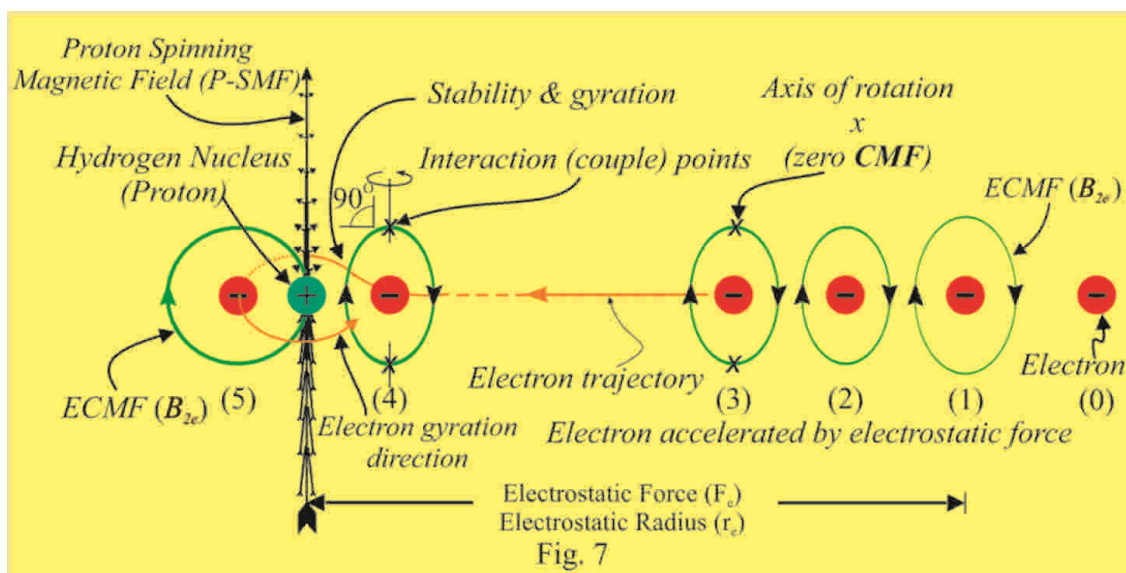

Fig. 7. A static electron at point (0) is influenced by proton's mutual electrostatic lines of force and attracted by electrostatic force, it's accelerated and produced Circular Magnetic Field (CMF), at (1), when it reached point (4), it detected proton's Spinning Magnetic Field (SMF) and interacted with it, then gyrate around the proton to form hydrogen atom [43].

We explained in Fig. 4 (A&B) that the direction of the +ve Spinning Magnetic Field (SMF) for an electron and proton is governed by the produced CMF, while for neutron in Fig. 4 (C), as it doesn't produce CMF, its directional flow can be lead by either +ve SMF or –ve SMF as shown in Fig. 4 (C); therefore when an energetic electron is captured by a proton or a magnetic field, as shown in Fig. 5 (C), it continued producing the CMF, thus it rotates around the proton in hydrogen atom while attached to the proton through its Spinning Magnetic Field (SMF), the gyration of the electron around proton shown in Fig. 5 (C) for hydrogen atom, is also shown for silver atom (Ag) in Fig. 6 (C), where the last electron No 47 is shown gyrating around the Ag, with the +ve polarity of the electron's SMF leading and the CMF encircled the electron, it also attached to the SMF, which gives electron the elastic force to exhibit different characteristics, therefore the remaining 46 inner

electrons, close to the core are also gyrating with their CMF attached to the SMF similar to the electron 47 in Fig. 6 (C), and above all the CMF is the magnetic part of the electromagnetic radiation [45], understanding these characteristics, is the first step to understand the spectral line emission; Fig. 6 (C) also shows the direction of the spinning electron in front directed to the right, and at the back directed to the left.

b.   **The Formation of Hydrogen Atom: An Interaction Between electron's CMF & Proton's SMF**
        The capture of an electron by a proton to form hydrogen atom, is shown in Fig. 7, where a static electron is shown at point (0), when a proton approached that area, their mutual electrostatic field detect and attracted each other, then electrostatic force is produced [44], as electron's mass is 1/1,835.55 of proton, it accelerated towards the proton and produced CMF while moving to point (1) as given in "*The Magnetic Interaction*" [43], and "*The Photoelectric Effects-Radiation Based With Atomic Model*" [36], the magnitude of the CMF is given by Eq. (8) [71, 72, 73]. When the electron reach the couple at point (4), that's where the CMF sensed the Spinning Magnetic Field (SMF), produced by the spinning proton and the electron turned counter clock around the proton as in Fig. 7-(4) to star gyrating at Fig. 7-(5).

        Since the emission frequencies established to coincided with the absorption frequencies [76], therefore, we suggested that, the ionization potential is equal the orbital potential; where the experimental value of the ionization potential calculated from spectroscopic data of hydrogen atom is V_i = 13.5978 V [76], this value is equal to 13.5978 eV or 2.17860774338052e-18 J, using Planck's energy formula, this energy gives frequency v = 3.2879334116022300186483839142572e+15 Hz; and since this frequency is responsible for the removal of electron from an atom in photoelectric effect, therefore using this frequency in the formula for the Radiation Magnetic Force (F_{mR}) [36, 77], the derived force is equal to the magnitude of electrostatic force which derived the electron until point (5) in Fig. 7, therefore, the precise magnitude of the natural orbital force (also the Electrostatic Radius (r_{ee}) can be derived from it) for hydrogen atom its derived by the balance of F_{mR} and F_e, it's given by

$$F_{mRH} = \sqrt{y\, v_R^3} = \frac{Z\, e\, Q}{4\pi\varepsilon_o r_{ee}^2} \qquad (9)$$

Where, r_{ee} is the electrostatic radius in m, ε_O is the permittivity of the free space, v_R is the radiation frequency in Hz, y is constant of radiation force with magnitude equal to 1.9063181614361072009999849625463e-61 N^2. Hz^{-3} (or $N^2.s^3$.) (an apology for previously named it Yousif in [36]), from Eq. (9), the Radiation Magnetic Force for hydrogen atom F_{mRH} = 8.2315612280615297912622948044732e-8 Newton [36], r_{ee} can easily be derived from Eq. (9).
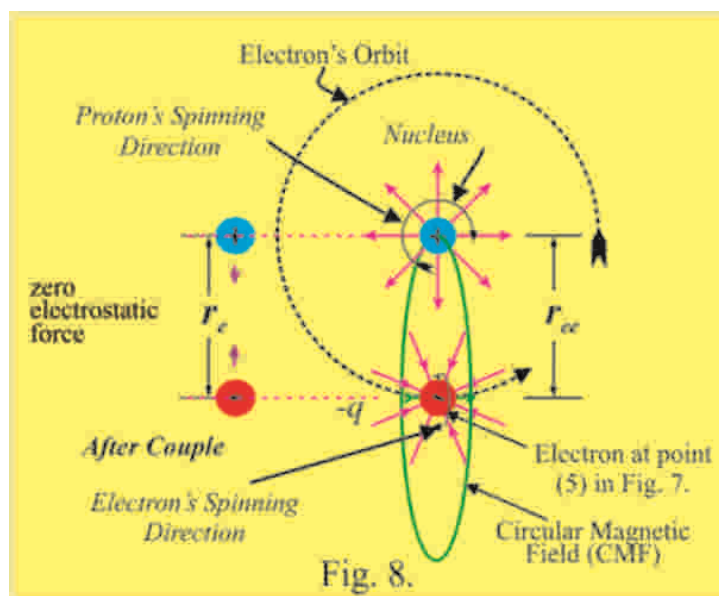

Fig. 8. An electron attracted to proton forming hydrogen atom, the different spinning orientation of both particles, wouldn't allow electrostatic lines of force to join both particles continually to establish the Electrostatic Force (F_e) [44], in addition an electron gyrate at high velocity doesn't produce F_e [78], therefore there's no electrostatic force existed in the atom after point 5 in Fig. 7 [59].

        At point (4) in Fig. 7, the CMF is twisted 90° and attracted to the SMF at point (5), at this point the electrostatic force ceased to exist due to high velocity of electron [78] and due to the different spinning orientation of both particles as illustrated in Fig. 8, electrostatic lines of force are not connected then no force is produced; thus the interaction of the CMF with the SMF or B_{1U}, produced the magnetic force, given by [43]

$$F_m = B_{1U} \, B_{2e} \, r_m^2 \, c = (q \, V_O \, B_{1U}) \tag{10}$$

Where, B_{IU} is the nucleus *SMF*, B_{2e} is orbital electron' *CMF*, r_{me} is the electron's magnetic radius, c is the speed of light, V_o is the orbital velocity of the electron in ms^{-1}, and F_m is the magnetic force, as shown its equivalent to the Lorentz force [43]. At that radius at (5) electron start gyrating around the proton, with high velocity, in this case the Magnetic Force (F_m) is balanced with the Centripetal Force (F_C) creating stability of the atom and the formation of the hydrogen atom; the balance of both forces is given by [59]

$$F_S = \{\mathbf{F_m} = \mathbf{F_C}\} = \{(B_{1U} \, B_{2e} r_m^2 \, c) = (\frac{m_e V_o^2}{r_m})\} = \{(q \, v_0 \, B_{1U}) = (\frac{m_e \, v_0^2}{r_m})\} \tag{11}$$

Where, B_{1U} is the Nucleus Spinning Magnetic Field (*SMF*), B_{2e} is orbital electron' *CMF*, m_e is electron's mass, r_m is the magnetic radius, V_o is electron's velocity at natural orbit around the nucleus, q is the charge in C, F_m is the Magnetic Force in Newton, F_C is the Centripetal Force in Newton and the resulted Stability of both Forces F_S is zero.

It had been realized that, since the justification of Laplace's law by using the Lorentz force has been challenged [12], and as shown in the above examples, the CMF is important for the formation of atoms, as given by Eqs. (9,10&11), and although Lorentz formula in the RHS of Eq. (10) can solve the magnitude of the force but it can't explain its mechanism and to realize its characteristics, as we did, therefore the LHS of Eq. (10) constitute the bases for the *field's interaction*, the generalized version can solve any equation of force related to fields, including Lorentz [43] and electrostatic forces [44], the strong [51] and the weak force [65], the formula been seeks by scientists since Ampere era [10]; thus this hint illustrate how logical the detailed mechanism of capturing an electron by proton to form hydrogen atom, while its details in [43], if the CMF can be regarded as an important missing factor in the modeling theoretical physics, then how QM can be regarded as a perfect and final theory? And we will show how Stern-Gerlach experiment is interpreted based on these and related ideas and characteristics of charged particles.
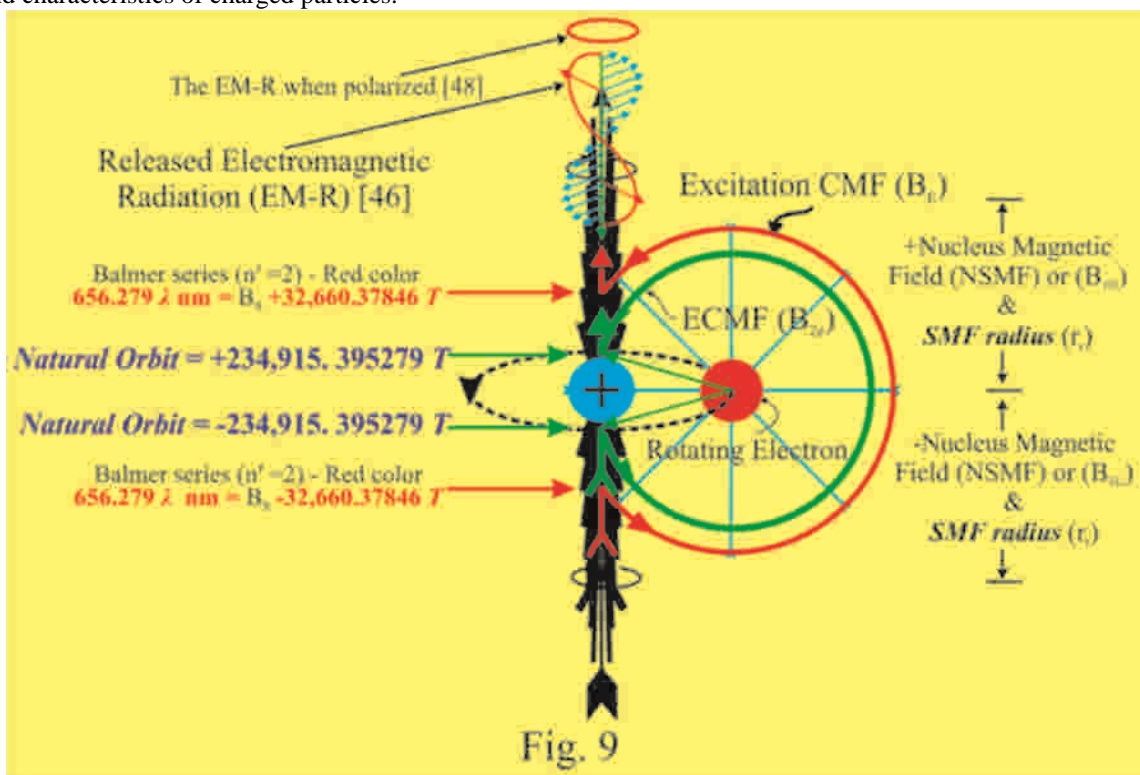

Fig. 9. An electron in hydrogen atom rotating in natural orbit, attached by the Circular Magnetic Force (CMF) in green color to the Spinning Magnetic Field (SMF), when the electron is excited, the energy is transformed into an equivalent CMF in red color attached to related SMF in Fig. 2, and in Tables. 1&2, which determined the wavelength, this specific SMF pulled and integrated CMF-EF along the Z-axis, to appear as Electromagnetic Radiation (EM-R), if polarized by removal of EF, then the wave will collapse into CMF as given in [47].

The stability of an atom was first suggested as due to the balance of three forces in hydrogen atom given in [43] and for potassium atom in [36], and since at gyration the electrostatic force ceased to exist due to the electron's fast rotation and proton's spins the different spinning orientation of both particles, thus their electrostatic fields are not connected, in addition to that, moving charges doesn't produce Coulomb's force [78], thus the model is modified, hence the stability is attained by the balance of only two forces, the magnetic and

centripetal forces [59], as demonstrated above and by Eq. (11), the CMF is well known to exist, while its role can be accomplished by the SMF.

c.   The SMF and the Production of the Spectral Lines
    The relationship between the electromagnetic radiation and magnetic field have been suggested as the missing piece that can resolve a discrepancy between the theoretical models and the experimental data [75], and although Quantum Electrodynamic (QED) was born in 1927 when Dirac showed how to quantize the electromagnetic field [8], but the theory couldn't explain how magnetic field is integrated with electric field to produce the Electromagnetic Radiation (EM-R), nor the condition required to produced EM-R or even why it required the nucleus to produced shorter wavelength, leave alone why it moves with speed of light, or the vita; relationship between radiation of spectral line and the Spinning Magnetic Field (SMF-B_{1U}),

    Fig. 9, shows an electron in hydrogen atom, it have both the CMF and an electric field (EF), its linked with the SMF by this CMF in green color while at the natural stable orbit, its connected at two points on B_{1U} with magnitude $= \pm234,915.395279$ T, its gyrating around the nucleus, at stable orbit governed by the balance of both the Magnetic Force (F_m) and the Centripetal Force (F_C) as given by Eq. (11), when the electron is exited, the extra energy is transformed into another CMF, as shown in Fig. 9, which as an example in this case, equivalent to $\lambda = 656.279$ nm (4.571226566749812198775216028548e+14 Hz), using Eq. (19) the magnitude of the CMF $= 1.61788256389780554324137$6e-8 T, while using Eq. (21), this derived the related $B_{1U} = \pm32,660.37846292393553034050499272$06   T,   this   means   the   CMF   with   magnitude $=$ 1.61788256389780554324137$6e-8 T is attached at both B_{1U} at magnitude $= \pm32,660.378462935$ T, by referring to Table. 1, and looking for this B_{1U} in Fig. 2, its in Balmer series, while in Fig. 9, its electric field also cover the red CMF but with relevant magnitude as in Table.2; the general regulation for the production of spectral line, or Electromagnetic Radiation (EM-R), is that, when the combined CMF and E-F, are ready, the F-F mechanism occurred [45, 35], the magnetic force given by Eq. (12), pulled the combined CMF and E-E, then the integrated is released as EM-R [35], along the z axis in Fig. 9, the force causing this is [46]

$$F_{EMR} = B_{1US}\ B_{CMFS}\ r_{mFS}^2\ c \tag{12}$$

Where, F_{EMF} is Electromagnetic Radiation Force in Newton. The electromagnetic radiated energy in terms of CMF is given by [46]

$$E_R = \ h\nu = \ \frac{B_{CMF}^2\ m\ c^6}{2\ (4)^4\ q^2\ \nu^4} = \frac{B_{CMF}^2\ m\ c^2\lambda^4}{2\ (4)^4\ q^2} \tag{13}$$

While, in terms of SMF (B_{1U}), the radiation energy is given by [46]

$$E_R = h\ v = \frac{2\ \pi\ m^2\nu^2v}{q\ B_{1U}} \tag{14}$$

Where, v is the Flipping Frequency. The Rydberg formula to derive the spectra lines for hydrogen atom is

$$\frac{1}{\lambda} = ZR\left(\frac{1}{n'^2} - \frac{1}{n^2}\right) \tag{15}$$

Where, R is the Rydberg constant (1.09737e+7 m^{-1}), Z is atomic number, n' is the lower energy level, n is the upper energy level, λ is the wevelength of the EM-R.
When this spectral lines is pulled, by the SMF force given by Eq. (12), the resulted EM-R, will be released by the speed of light, given by [46, 35]

$$c = \frac{qB_{1U}\ \lambda}{4\pi\ m} = \frac{1}{\sqrt{\epsilon\mu}} = \lambda\nu \tag{16}$$

Where, ε is the permittivity of free space, μ is the permeability of free space. The Spinning Magnetic Field (B_{1U}) in Eqs. (12, 16&19), is derived from the dipole moment (M_{TP}) of SMF given by Eq. (2), it can also be derived from magnitudes in Figs. 2&8 for hydrogen atom, using Eq. (21). If we divide each side in Eq. (16) by wavelength, we got an interested relation for the frequency of EM-R given by

$$v = \frac{c}{\lambda} = \frac{qB_{1U}}{4\pi\ m} = \frac{1}{\lambda\sqrt{\epsilon\mu}} \tag{17}$$

Eq. (17) shows the frequency is proportional to the SMF, its maximum limit is where the natural orbit of an electron in atom.
Maxwell succeeded in deriving the two constants in the second formula in Eq. (16) which are the permeability of free space and the permittivity of free space ($\varepsilon\mu$), but these two parameters couldn't explain what caused light to be radiated with the speed of light, while our above formula explained the force pulling the integrated CMF-EF to be released as EM-R with speed of light c, and as shown in Fig. 9, the spectral line is released along the z axis, and when polarized, by removing its electric field, the wave returned back to its CMF once again as shown in Fig. 9 [47].

Since the CMF is the main magnetic part of the Electromagnetic Radiation (EM-R), the magnitude of the CMF which is related to EM-R, in term of frequency as derived from Eq. (30) in [46], its rearranged so that, the B_{CMF}, is given by [35]

$$B_{CMF} = \sqrt{\frac{2(4)^4 \, q^2 h v^5}{m \, c^6}} \qquad (18)$$

From Eq. (18) [35], solving parameters with fix value and constants, the CMF is given by

$$B_{CMF} = \sqrt{C_B v^5} \qquad (19)$$

Where, C_B is the constant of B_{CMF} it is equal to 1.31138512731530855105580915498 7e-89 T^2. Hz^{-5} (T^2. s^5), the magnitude of BCMF and other parameters are given in Table. 2.

Table. 2. Parameters of Electromagnetic Radiation (EM-R), from left energy (E), velocity (V), frequency (v), wavelength (λ), radius r ($\lambda/4$), Circular Magnetic Field (CMF-B_{CMF}), Electric Field (E-E) and Spinning Magnetic Field (SMF-B_{1U}), these can be tested with the given formulas.

E	V	v	Λ	$r_m (\lambda/4)$	B_{CMF}	EF	B_{1U}
6.6260755 e-21	1.2061422956252 77935879782301 1235e+5	1.0 e+13	3.e-5	7.5e-6	1.1451573353066 3154289e-12	4.102590226 4956550947 2e-18	7.1447735057564 19112327787587 06e+2
6.6260755 e-20	3.8141568364400 21581956544294 8061e+5	1.0e+14	3.e-6	7.5e-7	3.6213054588181 110050764e-10	4.102590226 4956550947 2e-16	7.1447735057564 19112327787587 06e+3
6.6260755 e-19	1.2061422956252 77935879782301 1235e+6	1.0 e+15	3.e-7	7.5e-8	1.1451573353066 315428873111e-7	4.102590226 4956550947 2e-14	7.1447735057564 19112327787587 06e+4
6.6260755 e-18	3.8141568364400 21581956544294 8061e+6	1.0 e+16	3.e-8	7.5e-9	3.6213054588181 11005076439273 e-5	4.102590226 4956550947 2e-12	7.1447735057564 19112327787587 06e+5
6.6260755 e-17	1.2061422956252 77935879782301 1235e+7	1.0 e+17	3.e-9	7.5e-10	1.1451573353066 31542887311073 106e-2	4.102590226 4956550947 2e-10	7.1447735057564 19112327787587 06e+6
6.6260755 e-16	3.8141568364400 21581956544294 8061e+7	1.0 e+18	3.e-10	7.5e-11	3.6213054588181 11005076439272 607e+0	4.102590226 4956550947 2e-8	7.1447735057564 19112327787587 06e+7
6.6260755 e-15	1.2061422956252 77935879782301 1235e+8	1.0 e+19	3.e-11	7.5e-12	1.1451573353066 31542887311073 1063e+3	4.102590226 4956550947 2e-6	7.1447735057564 19112327787587 06e+8
6.6260755 e-14	3.8141568364400 21581956544294 8061e+8	1.0 e+20	3.e-12	7.5e-13	3.6213054588181 11005076439272 607e+5	4.102590226 4956550947 2e-4	7.1447735057564 19112327787587 06e+9
6.6260755 e-13	1.2061422956252 77935879782301 1235e+9	1.0 e+21	3.e-13	7.5e-14	1.1451573353066 31542887311073 1063e+8	4.102590226 4956550947 2e-2	7.1447735057564 19112327787587 06e+10
E	V	v	Λ	$r_m (\lambda/4)$	B_{CMF}	EF	B_{1U}

Since it has been argued that electromagnetic radiation increases with the magnetic field strength and plasma temperature [75], this result was deduced from experiments, but as given in Eqs. (17, 19, 20, 21, 22, 23, 24 & 25), the frequency of electromagnetic radiation is proportional to the Spinning Magnetic Field (SMF), as illustrated in Fig. 2 for hydrogen atom, therefore the relation between the magnitude of the magnetic field required to initiate the Flip-Flop (F-F) mechanism and to pull the electromagnetic radiation first developed in Eq. (7) in [46], then improved in [35], and for the spectral line energy in hydrogen atom in [59], it's the same formula given by Eq. (16) therefore atoms and any system that radiated specific wavelength required specific magnitude of magnetic field or SMF, to pull it, given by

$$B_{1U} = \frac{4\pi mc}{q\lambda} \qquad (20)$$

Eq. (20) shows the magnitude of SMF-B_{1U}, increased with the reduction in the wavelength, this is the reason particle bursts of x-rays and γ-rays required the highest power laser [60].

Solving the constants in Eq. (20), the SMF-B_{1U} is given by

$$B_{1U} = \frac{C_\lambda}{\lambda} \qquad (21)$$

Where, λ is the wavelength of an excited and radiated energy, and C_r is the Constant State of Radiation equal *0.02143432051726925733698336276118* T.m. [46]. In tem of frequency Eq. (20), is give as

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$$B_{1U} = \frac{4\pi mv}{q} \qquad (22)$$

From Eq. (22), the formula can be reduced by solving the constants, it's given by

$$B_{1U} = kv \qquad (23)$$

Where, k is the constant of magnetic frequency equal 7.14477350575641911232778758705e-11 T. Hz^{-1}, v is frequency in Hz and the SMF in T, from Eq. (23) the frequency is given by

$$v = \frac{B_{1U}}{k} \qquad (24)$$

The frequency of electromagnetic radiation is given in terms of B$_{CMF}$ and B$_{1U}$ [47], by

$$v = \sqrt[4]{\frac{2\pi B_{CMF}^2 \, m_e^2 \, c^6}{(4^4)\, B_{1U}\, q^3\, h}} \qquad (25)$$

Solving the constants in Eq. (25), the frequency is given by

$$v = \sqrt[4]{\frac{5.4482648589917511043045527597 19e{+}78\, B_{CMF}^2}{B_{1U}}} \qquad (26)$$

The relationship between B_{CMF} and B_{1U} is given by [47]

$$B_{1U} = \sqrt[5]{1.41975079394711256869870811573 1e{+}38\, B_{CMF}^2} \qquad (27)$$

From Eq. (27), B$_{CMF}$ is

$$B_{CMF} = \sqrt{\frac{B_{1U}^5}{1.41975079394711256869870811573 1e{+}38}} \qquad (28)$$

Replacing the λ in Eq. (20), with the RHS of Eq. (15), the Spinning Magnetic Field (SMF-B$_{1U}$), for each of the radioated spectral line in Table 1, is given by

$$B_{1U} = \frac{4\pi mcR}{q}\left(\frac{1}{n'^2} - \frac{1}{n^2}\right) \qquad (29)$$

Since the values of parameters in Eq. (20) are known, then Eq. (29) is given by

$$B_{1U} = RT\left(\frac{1}{n'^2} - \frac{1}{n^2}\right) \qquad (30)$$

Where, T is a constant equal (0.02143432051726925733698336276118kg . ms^{-1}.C^{-1}), and R is the Rydberg constant (1.09737e+7 m^{-1}), both as RT is (235,213.79940667983483741566137405 m^{-1}. Kg . ms^{-1}.C^{-1}).

The radial distance r$_r$ at which the specific wavelength extending the B$_{1U}$, and the spectral line is radiated or pull by it, is given by

$$r_r = \sqrt{\frac{M_{TP}\, \lambda}{C_r}} \qquad (31)$$

Where, M_{TP} is the produced magnetic moment = 3.11283418310993e-18 T.m^2, C$_r$ is the Constant State of Radiation equal in Eq. (21) *0.02143432051726925733698336276118* T.m [46].

VI.   The Original Stern-Gerlach Experiment Explained
a.   Basic Analysis on the Results of the Original Stern-Gerlach Experiment

Although it was stated that, the experimenters found the initial beam in the Stern-Gerlach experiment split into two distinct parts that correspond to the two opposite spin orientations in the magnetic field permitted by space quantization [2], latter it was claimed that, the result showed atoms can only be in one of three spin states Up (+1/2) Zero (0) or Down (−1/2) [3], but surprisingly, in looking into the original experiment setup and result of Stern-Gerlach shown in Fig. 10-(A, B&C) [42], in which a beam of silver atoms (Ag) was sent through an inhomogeneous magnetic field, the Ag was split into two beams, while Fig. 10-(B) left shows the image of the deposited detectors obtained in the Stern-Gerlach experiment, showing the intensity and dimension profile of the silver atoms without the magnetic field, and Fig. 10-(B) right shows the resulted image when the inhomogeneous magnetic field was switched on, the result shows Ag is separated into two distinctive layers as enlarged in (C) then interpreted as the quantization of spin angular momentum of the electron [42], an interpretation which constitute the strongest bases in the foundation of the QM, and the only remaining experiment which we didn't re-interpreted, but does the current interpretation correct and sound logical?

As shown in Fig. 10-(B) left, when the silver atoms (Ag) flows to the screen without an external magnetic field, it resulted in a straight rectangular shape with nearly equal width, except at both ends of ±y axis, but when the Ag was subjected to an inhomogeneous magnetic field, the resulted image in Fig. 10-(B) right, shows the Ag is widen at both ± x axis, while it decreased towards the end of ±y axis, as enlarged in Fig. 10-(C),

the separation of the beam into two distinct beams was interpreted as an indication of the quantization of spin angular momentum of the 5s state electron of the silver atom [42], but what caused this separation, on what base and does it resulted in only two distinct beams or more beams? First, the following descriptions and analysis of the Ag flows in Figs. 10-(A, B&C) are given:
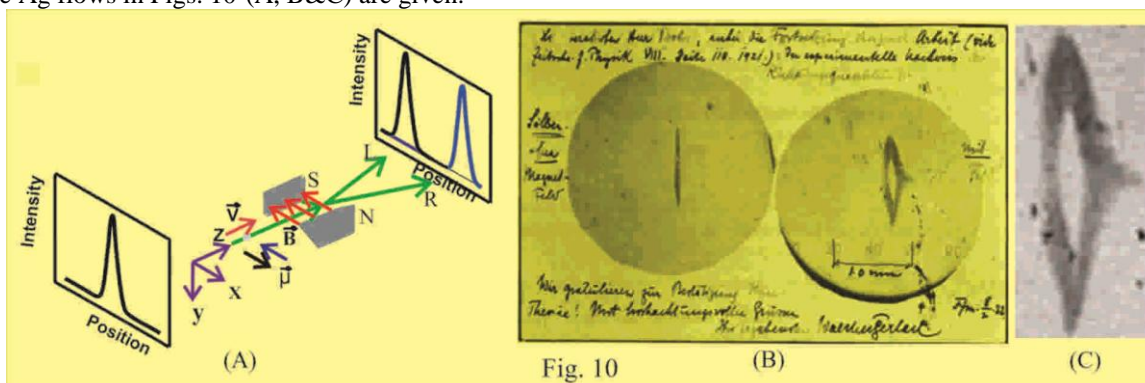

Fig. 10. Redrawing the original structure of the Stern-Gerlach Experiment in (A), while (B) left is a straight vertical rectangular shape resulted from silver atoms (Ag) without external magnetic field, and (B) right is a shape looks like two large semi-triangles joined together, the shape is obtained when Ag is subjected to inhomogeneous magnetic field then (C) is an enlarged part of this shape [42].

A)   The Silver Atoms (Ag) were sent through a small rectangular outlet in the furnace, as illustrated by the enlarged image in Fig. 10-(B) left, reflected the source.
B)   Based on the image and the outlet, the Ag is imagined to emerge from the furnace to the screen in a beam of single unorganized Ag of different polarities, velocities and angles.
C)   Therefore, based on the above two points the structural image in Fig. 10-(B) left was not formed in an organized sequential structural similar to scanning process, rather each is strike at specific point while randomly coming.
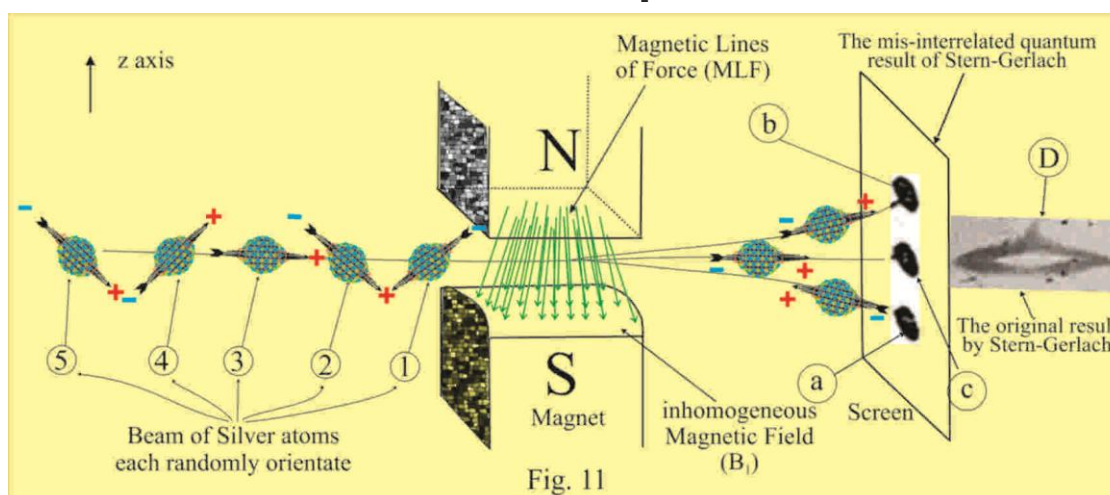

Fig. 11. Modified version of the Stern-Gerlach experiment [1], based on the characteristics of the Spinning Magnetic Field (SMF), and the interaction of silver atom's SMF with the inhomogeneous magnetic field (B_1); the mis-interpretation given by the three patches is completely different from the original result of the experiment in (D) [42], or fully shown in Fig. 10-(C).

A)   Based on the distribution of the Ag in Fig. 10-(B) right, its suggested to be divided into four parts:
a.   Ag at +ve y axis at top.
b.   Ag at +ve x axis on right.
c.   Ag at −ve x axis on left.
d.   Ag at −ve y axis at bottom.
B)   At the central cross of y and x axis in Fig. 10-(C), there's no single Ag existed.
C)   Therefore, placing Ag at center of the screen in Fig. 11-(C) is incorrect interpretation of the fact.
D)   At the center of y axis in Fig. 10-(C), Ag diverged and existed at both ±x axis.
E)   At the center of y axis, there is more Ag along the +x axes than its −ve side.

F)   At ends of ±y axis in Fig. 10-(C), Ags are met at a central point.

G)   Based on these, we suggested the distribution of the Ag is based on:

a.   Polarity of the Ag.

b.   Trajectory of the Ag from the furnace.

c.   Interaction of the Ag's with the inhomogeneous external magnetic fields.

d.   The angle θ at which Ag interacted with the inhomogeneous magnetic fields.

e.   The magnitude of the inhomogeneous magnetic field.

H)   Thus, Ag will emerge from any part of a rectangular outlet of the furnace and interacted with the inhomogeneous magnetic field, but it will only hit the screen at specific point in the shape shown in Fig. 10-(C).

I)   The movement of the Ag is not only determined by two choices, rather several factors.

Therefore, Ag is guided by the magnitude of the magnetic force produced by the interaction between Ag and the inhomogeneous magnetic field, given by Eq. (32) increased or decreased by the entry angle θ.

Therefore, from the above mentioned points, we concluded that, the Stern-Gerlach experiment was an excellent experiment; unfortunately not properly interpreted.

b.   The Classical Interpretation of the Stern-Gerlach Experiment

From the historical development of the Stern-Gerlach experiment, five important facts can be established, all of which were intended to illustrate the process that followed in the quantization of spin [2], and these are:

-       The original Stern-Gerlach experiment shown in Fig. 10, gave a result of a shape looks like two large semi-triangles joined together, the separation is stated as due to the interaction between the magnetic moment of the silver atom and the applied magnetic field [42].

-       Then the experiment was explained as an interaction between silver atoms (Ag) and inhomogeneous magnetic field, the Ag is alleged to accumulated at three points +1 0 -1 [3] as shown in Fig. 11-(C) [1].

-       The separation of the beam into two distinct beams was interpreted as indicating the quantization of spin angular momentum of the 5s state electron of the silver atom [42].

Later, the experiment was reinterpreted, as an interaction between electron's spin's and the inhomogeneous magnetic field, and as evidence that electrons possess spin ± ½ or +ve spin up or -ve spin down [5].
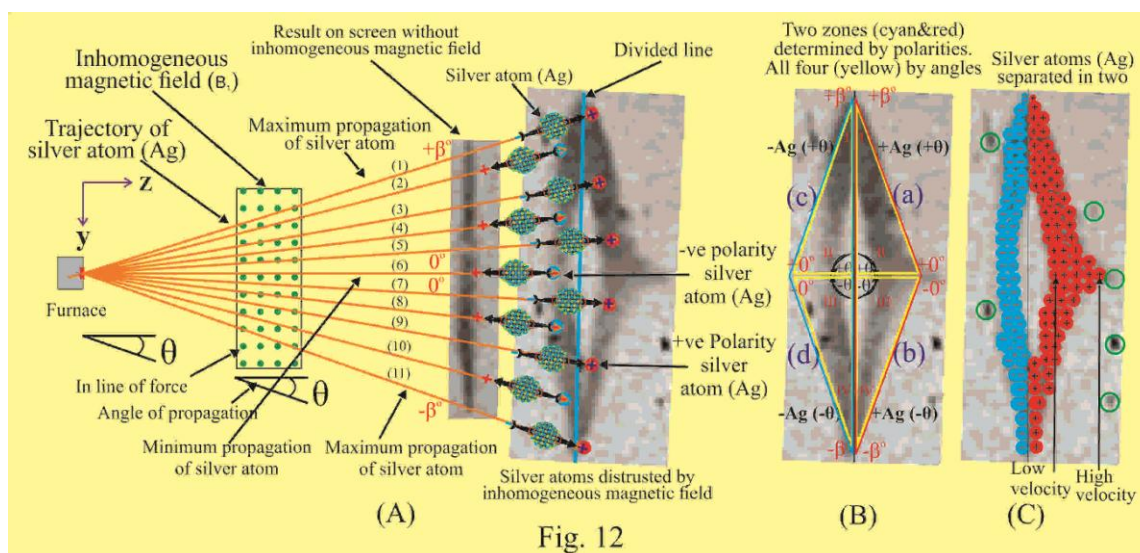

Fig. 12. The mechanism of the Stern-Gerlach experiment [42], where silver atoms (AG) emitted by the furnace on left, with specific angle led by either +ve Spinning Magnetic Field (SMF) or –ve SMF, when the Inhomogeneous Magnetic Field (B_1) is turned off, Ag hits the screen and formed a long rectangular dark image, when B_1 is turned on, each leading ±ve polarity SMF of Ag interacted and attracted with the opposite polarity of the ± B_1, resulted in the separation of Ag into two, the +ve leading Ag attracted to the right and –ve leading Ag attracted to the left, (B) shows the two zones in cyan & red determined by polarities, while the four sectors in yellow by angles, representing the conditions guided Ag and (C) shows the polarity based division, +ve on right (red) and –ve on left (cyan).

The above interpretations of the result of the experiment shown in Fig. 10-(A, C&D), is a clear manipulation of the data as the figures can testify and will be seen; and as mentioned in the "*Basic Analysis on the Original Stern-Gerlach Experiment,*" thus knowing these facts about the original experiment, and as shown in Figs. 2&3, charged particles have many characteristics and roles that it carries, the failure to understand that, had blocked the truth about many phenomena, among which is the Stern-Gerlach experiment; and since the

CMF was defined by Faraday and Maxwell as *a region of space with magnetic field in the neighborhood of magnetized body* [14], and Faraday discovered that similar Lines of Magnetic Force (LMF) repel each other, while different lines attract each other [79, 57], which's the factor behind the magnetic force [43, 44] and since silver atoms, like protons, also produced the Spinning Magnetic Field (SMF-B_{1U}), as shown and explained in Figs. 3&6-(C) (section 3&5 respectively), therefore the above definition by both Faraday and Maxwell imply that the SMF is also *a region of space with magnetic field in the neighborhood of magnetized body*, and since Ag consists from 47 protons and 61 neutrons [80], therefore the magnitude of the silver's atom SMF is a summation of series and parallel arrangements of proton's and neutron's based on Eq. (2) [51], and from the ionization potential, several wavelength of spectral lines, the dipole moment of silver atom could be derived, so as to help in knowing the magnitude of interaction between SMF with inhomogeneous magnetic field.

To study the experiment, we must first realized that, the Stern-Gerlach experiment in its basis, *is a spatial separation of beam of silver atoms into two beams*, due to the interaction between the magnetic moment of the silver atom and the applied inhomogeneous magnetic field [42], and since in the original Stern-Gerlach experiment shown in Fig. 10, the result represents a shape looks like two large semi-triangles joined together, while as shown in Fig. 12-(A) the shape is separated in two by a central blue line and this separation is due to the interaction between the magnetic moment of the silver atom and the applied inhomogeneous magnetic field [42], although it was later claimed the separation is caused by utilizing the force exerted in an inhomogeneous magnetic field on the magnetic moment of the unpaired <u>electron</u> in silver atom [81], but as shown in Fig. 10, what happen is different from this interpretation, because as stated in our analysis of the Stern-Gerlach experiment in section six-a, it's realized that the Ag distribution in the screen, is based on division into four groups, the existence of Ag at the center of the screen in Fig. 11 is incorrect interpretation of the fact, the distribution of the Ag is guided by 1) *polarity* of the Ag, 2) trajectory of the Ag from the furnace, representing the *angle* θ at which Ag interacted with the inhomogeneous magnetic fields 3) *interaction* of the Ag's with the inhomogeneous magnetic fields, 4) velocity of Ag, 5) the magnitude of the inhomogeneous magnetic field, and the movement of the Ag is not only determined by two choices, rather several factors; in addition to that, its realized that, the gyrating electron number 47 in the silver atom shown in Fig. 6-(C) can't interact with the inhomogeneous magnetic field, because the direction of the SMF is parallel to the inhomogeneous magnetic field, leave alone to produce a force, to divert the trajectory of the heavier silver atom; as Ag massive than electron by (Ag/e) = 196,631.3 times! Even if it produces the force, but since Lorentz force is greater than the spin force [49], then the separation can't be due to the *magnetic moment of the unpaired electron in silver atom*; thus Fig. 12 shows the mechanism through which the Stern-Gerlach experiment was carried out, reflecting the original experiment in Fig. 10 [42].

In Fig. 12, the furnace is shown on the left side, it's emitting the silver atoms (Ag) at a range of angles, thus there's minimum angle = 0° and maximum angle of propagation = β^o (depending on distance to the magnet), and there's a minimum and maximum speed (V_{Ag}), thus when the inhomogeneous magnetic field (B_1) is not switched on, Ag is not influenced by the B_1, thus the emitted Ag strikes the monitor screen according to the trajectory of each Ag and produced the rectangular shape shown in Fig. 12 or left of Fig. 10-(B), in which the equal distribution of Ag over the area reflected the true emission from the source; but when B_1 is switched on, any Ag will be interacted with B_1, and since the leading SMF of an Ag is either the +ve head or the −ve tail, and it constitute the +ve and -ve Spinning Magnetic Field (SMF) respectively, as shown in Fig. 3-(E), thus using the characteristics of the SMF and Faraday's discovery that similar Lines of Magnetic Force (LMF) repel each other, while different lines attract each other [79], and as stated in section 3, the SMF of hydrogen atom shown in Fig. 2, consist of layers of Lines of Magnetic Force (LMF), and as shown in Fig. 4-(C), the direction of the SMF for the neutrons and neutral atoms in motion is not guided by rules, hence theoretically the leading +ve or −ve SMF polarity may be in the lead of Ag at any time for nearly 50% of the total numbers, but practically one type can be more by ±?%, therefore each +ve or −ve leading SMF of the emitted Ag will interacted with the −ve or +ve B_1, and strike at specific spot, hence the mechanism carried out to produce the shape in Fig. 12-(C), is carried in the following two sequences of the two types of the Ag, which's either +ve SMF of Ag or −ve SMF of AG emitted at any time, using Eq. (32):

(A)　　　The silver atoms (Ag) with leading +ve SMF: When any of these Ag enter B_1, the +ve leading SMF of Ag is attracted by the -ve B_1, forcing Ag to move to the right side of the inhomogeneous magnetic lines of force, these are Ag numbers 1,3,5,7,9&11 in Fig. 12-(A), when looking from the furnace, each +ve Ag will strike the screen in one of major three areas within each of the two zones a&b in Fig. 12-(B) according to six ranges of angles, these are:

I.　　　When the angle θ of the Ag (1) is +β^o (maximum angle), the resulted large angle will produce low magnitude of force, it will put Ag on the left side of upper right part of (a) in +y in Figs. 12-(B), velocity of Ag determined how far from centerline to the right it will strike.

II.   When the angle θ of the Ag (5) is ≈+0°, the small angle will produce high magnitude of force, and it will put Ag around the center of the upper right part of + x axis in (a) in Figs. 12-(B), the velocity of the Ag determined how far from the centerline to right it will strike.

III.   When the angle θ of the Ag (3) is between <+β° and >+0°, these angles will produce different magnitudes of forces, and it will put Ag in the distance between +y and +x in (a) in Figs. 12-(B), the velocity of the Ag determined how far from the centerline to right it will strike.

IV.   When the angle θ of the Ag (7) is ≈-0°, the small angle will produce high magnitude of force, and it will put Ag around the lower right of the center +x axis in (b) of Figs. 12-(B), the velocity of Ag determined how far from the centerline to right it will strike.

V.   When the angle θ of the Ag (9) is between <-β° and >-0°, these angles will produce different magnitudes of forces, and it will put Ag in the distance between -y and +x in (b) in Figs. 12-(B), the velocity of the Ag determined how far from the centerline to right it will strike.

VI.   When the angle θ of the Ag (11) is -β° (maximum angle), the large angle will produce low magnitude of force, and it will put Ag on the lower right part end -y in (b) of Figs. 12-(B), velocity of Ag determined how far from centerline to the right it will strike.

(B)   Silver atoms (Ag) with leading -ve SMF: When any of these Ag enter B_1, the -ve leading SMF is attracted by the +ve B_1 moving Ag to the left side of magnetic lines of force, these are Ag numbers 2,4,6,8&10 in Fig. 12-(A), when looking from the furnace, each -ve Ag will strike the screen in one of major three areas within each of the two zones c&d in Fig. 12-(B) according to four ranges of angles, these are:

I.   When the angle θ of the Ag (2) is +β° (maximum angle), the resulted large angle will produce low magnitude of force, it will put Ag on the upper right of the left part in (c) of Figs. 12-(B), velocity of Ag determined how far from centerline to left it will strike.

II.   When the angle θ of the Ag (6) is ≈+0°, the resulted small angle will produce high magnitude of force, it will put Ag at the left side of the upper left part of the -x axis in (c) of Figs. 12-(B), velocity of Ag determined how far to the left of centerline it will strike.

III.   When the angle θ of the Ag (4) is between <+β° and >+0°, these angles will produce different magnitudes of forces, and it will put Ag in the distance between +y and -x in (c) in Figs. 12-(B), the velocity of the Ag determined how far from the centerline to right it will strike.

IV.   When the angle θ of the Ag (6) is ≈-0°, the resulted small angle will produce high magnitude of force, it will put Ag around the lower right center of the left part -x axis in (d) of Figs. 12-(B), velocity of Ag determined how far on left from centerline it will strike.

V.   When the angle θ of the Ag (8) is between <-β° and >-0°, these angles will produce different magnitudes of forces, and it will put Ag in the distance between -y and -x in (d) in Figs. 12-(B), the velocity of the Ag determined how far from the centerline to right it will strike.

VI.   When the angle θ of the Ag (10) is -β° (maximum angle), the resulted large angle will produce low magnitude of force, it will put Ag on the lower left of the left part in (d) of Figs. 12-(B), the velocity of Ag determined how far to the left from centerline it will strike.

Therefore the final result of the image is as shown in Fig. 12-(C), red are +ve SMF on right and cyan are −ve SMF on the left, the distribution in each side depends on the above six points, between them are many others. Other characteristics are

(C)   Each Ag enters the homogeneous magnetic field (B_1) at maximum angle ±β° equivalent to ±y axis and minimum angle ±0° equivalent to ±x axis.

(D)   As the velocity at which Ag V_{Ag} enter B_1 differ for each Ag, this increased the magnitude of B_{CMF} as given by Eq. (8), both V_{Ag} and B_{CMF} increasing the magnitude of the force in Eq. (32), thus gives how far left or right Ag strike from the center. As indicated in Fig. 12-(C) by low and high velocity.

(E)   The existence of more Ag on the right of +ve x axis, than on the left of −ve x axis, is due to presence of more +ve leading energetic Ag than the −ve leading Ag, by +3-5%.

(F)   The black patches encircled by green color circles in Fig. 12-(C), are more energetic Ag than the average ones.

Thus the separation of the silver atom into two parts shown in Fig. 12-(C) by the red and cyan colors, showed the interpretation is capable to replicate the original Stern-Gerlach experiment shown in Fig. 10-(C), therefore this separation is mainly due to the distribution of Ag into two areas as a result of the attraction of the −ve and +ve leading SMF polarity of the Ag by +ve and −ve polarity of the inhomogeneous magnetic field (B_1) respectively, while the main force behind that is the field's formula given by Eq. (32), which is capable of deriving the force, thus the interaction of the Silver Atom Spinning Magnetic Field (Ag-SMF) (Ag-B_{1U}) with the inhomogeneous magnetic field (B_1) produced the Stern-Gerlach magnetic Force (F_{mSG}), in form of an attractive force which control and divert the atom position, the angle θ of the Ag shown in Eq. (32), determined the

position and magnitude of the force and since field's interaction is equivalent to Lorentz force, both forces are given in Eq. (32) by [43, 44]

$$+F_{mSG} = \pm B_I \pm B_{1USMF} \; r_m^2 \; c \; cosin\,\theta = (q \; V_{AG} \; B_1 \; cosin\,\theta) \qquad (32)$$

Where, B_I is the inhomogeneous magnetic field in T, B_{1USMF} is the magnitude of the SMF in T, c is the speed of light in m s^{-1}, r_m is the distance between the two fields in m and F_{mSG} is the Stern-Gerlach magnetic force in Newton. And as stated before, the experiment showed that particles with non-zero magnetic field are deflected, from a straight path, due to the magnetic field gradient [4], this alone explained the truth about the experiment, which is an interaction between two magnetic fields. The final result of the Ag interaction with B_1 is the distribution of the Ag on the monitoring screen in the shape shown in Fig. 12-(C), where the red color + Ag represents the Ag leading by the +SMF, while cyan color –Ag represent the Ag leading by the –SMF. This separation mechanism is clearly a reflection of the original Stern-Gerlach experiment carried in 1922.

c.   The production of Spinning Magnetic Field (SMF) challenge the Stern-Gerlach Interpretation

When the interpretation of the Stern-Gerlach experiment was changed to claimed, "*it's an interaction between electron's spin's and the inhomogeneous magnetic field, and as evidence that electrons possess spin ± ½ or +ve spin up or -ve spin down*" [5], this means for Ag's *electron* number 47 possess spin and moment, thus by stating that, "*the separation is caused by utilizing the force exerted in an inhomogeneous magnetic field on the magnetic moment of the unpaired electron in silver atom*" [81], this interpretation justify the separation due to the last single electron in the AG, but the consequence of this interpretations is that, the entire magnetic moment of a silver atom, in its normal state, is due to the spin of only one of its electrons [2], but if the direction of the flow of the silver atom (Ag) in the inhomogeneous magnetic field is as shown in Fig. 6-(C), and the Ag is perceived as passing across the inhomogeneous magnetic field as shown in Fig. 6-(C) and Fig. 12, and since Fig. 6-(C) also shows the last electron number 47 at periphery of the Ag, gyrating inside the Ag while attached to it by the Circular Magnetic Field (CMF) in green color, this attachment is attained by connecting the CMF to the weaker magnitude of the Spinning Magnetic Field (SMF), as more stronger SMF are connected to the 46 electrons at the inner part of the atom, nearer the nucleus, as electrons are spinning, while gyrating counterclockwise around the atom, as shown in the front of the atom in Fig. 6-(C) with electron's +ve SMF moving downward, and the –ve SMF is shown at the back of the atom moving upward while trailing, the crossing of the silver atom in the inhomogeneous magnetic field (B_1) (two lines are shown for comparison), with an electron gyrating around it as shown in Fig. 6-(C), clearly illustrated that, the SMF (B_{1U}) of the electron will be moving along the Lines of Magnetic Force (LMF), therefore the electron's SMF will never cut the lines, thus never produce a force, from this we can state that, the spin's based interpretation in Fig.10, can't produced the force to divert the trajectory of the silver atom, thus the claim that elementary particles in nature, like electron, proton, neutron, quark (all of which have spin *s* = 1 2), for which *s* = 1/2, 3/2 , 5/2 . . . and more exotic particles of higher half-integer spin [5], a claim have no merit of support, and as showed in Fig. 12, in section six-b, the interaction of the Stern-Gerlach, is between B_{1U} and the inhomogeneous magnetic field B_I, and only one attractive force of two directions is produced, the force depends on the polarity of the incoming Ag, while the angle determined the magnitude and position of the Ag within the monitoring screen, finally the experiment resulted in the separation of the Ag into two parts, each is due to four probabilities, but not as previously interpreted.

VII.   Results and discussion

Although we also got two results from the re-interpretation of the Stern-Gerlach Experiment, but for completely different reason from the previous historical results [1], and based on completely different concept; but first what led to that wrong interpretation and what does it differ from our interpretation? Our analysis resulted in the follows:

1.   Although gravitational theory started with the work of Galileo Galilei in the late 16th and early 17th centuries [82], but the first important discovery in science, but not properly interpreted, and started the mathematization of the physical science and created the ground for the current quantum mechanics, was the Newton's gravitational law [82], it doesn't have any *model except the mathematical form* [83], and it was based on the inverse square law, and the first force to be conceived as "*action at distance*" [14], as it created that phrase, where the mechanism and nature of gravitation is not known [53], for these and others, it was perceived as wrong [84], with an alternative as "*The Hydrostatic Force (F_H) of Gravity (The Atmospheric Force of Gravity)*" in [85].

-      Then followed in 1785, by Augustine Coulomb's two formulas of the force between electrified bodies and the force between magnetic poles, both are based on the inverse square laws [10], lacking mechanism.

-      Then in 1820, Ørsted made two discoveries on characteristics of electric current, these are [10]:

A)   Relation between electricity and magnetism.

B)   Electric current produced Circular Magnetic Field (CMF).

-        The first was explained by Ampere in his electrodynamics, in which he though the interaction is carried between two currents elements, one in conductor the other in the compass, with a formula lacking convincing mechanism [10].

-        Ørsted, Biot, Faraday, Savart and Grassmann criticized that claim, but Ampere challenged them to produce a formula like his [10].

-        When they failed, Ampere asserted "*mathematic is important than mechanism*" [10].

-        The failure to get the requested formula for field's interaction led to the mathematical based explanation and the mathematization of physics, in which most explained phenomena, doesn't give sequential process and common sense, this led to the consolidation of the concept of "*action at distance*" [14].

2.   Failure to know the basics mechanisms, led to misinterpretation of important experiments, like the Photoelectric Effect [22], Compton Effect [28], Electron Diffraction by Davisson and Germer [30], Electron Diffraction by Thomson and Rupp [32], and the double-slit experiment [86], these five experiments and its interpretation prepared the ground for Stern-Gerlach Experiment to quantized atoms, then the spin of charged particles, neutrons and atoms [4].

-        Many scientists worked on the Circular Magnetic Field (CMF), produced by conductor carrying electric current, started by Ørsted in Fig 3 (A) [10], then Faraday in Fig. 1 (B) [52], even Feynman draw Fig. 1 (C) [56], but lacking the field's formula, their drawings couldn't draw attention and generate debate.

-        The magnitude of the CMF was derived from Coulomb's law and Einstein's theory of special relativity about magnetic field produced by charge in motion [70], which means Einstein had tried that and he succeeded in getting part of the result [44].

-        Most scientists, influenced by the inverse square law, couldn't imagine the "*field's interaction*" as based on different concept of formula.

-        The failure to derive the formula for the field's interaction [44], strengthened the concept of "*action at distance*" [10], forced physicists to introduce the *force carrier* or *messenger particles* or *intermediate particles* [87], that complicated the description of force; it distorted both its relation with particles and the fields produced by particles.

-        The Stern-Gerlach Experiment was conducted in 1922 [1, 4], a year witness the start of the consolidation of the new dogma of quantum mechanics.

-        Classical explanation of the spin of electron thought to create serious problems with Special Relativity [7].

-        The dilemma in the Stern-Gerlach Experiment is that it can't be resolved without the knowledge of the Spinning Magnetic Field (SMF), which the experiment had exterminated, and hide from existence, and make it impossible to revive! Any unfortunate tray revival it, will never be heard.

-        In this context, the Stern-Gerlach Experiment can reminds us of Faraday's criticism of Ampere's force, saying "*it protected itself as an ideal theory from any review*, *but other alternative exist*, *the discovery of which would be rewarded*" [52].

-        After the formula for Field's Interaction was derived [43], then generalized [44], the Spinning Magnetic Force (SMF) was suggested [50] then modified [51], these papers provided the following suggestions, which helped in the *proper explanation* of the Stern-Gerlach Experiment:

A)   Electrons, protons and neutrons produced Spinning Magnetic Force (SMF), the magnitude for proton is given by Eq. (2), and for neutron and electron it's given in [50], these magnitudes were modified in [51].

B)   If the related specific parameters for electrons and neutrons are used in Eq. (2), the magnitude for different atoms can be derived, by organize all protons and neutrons structure in parallel and series.

C)   The Lines of Magnetic Force (LMF) of the SMF for proton as the nucleus of the hydrogen atom in Fig. 2 is the factor behind the division of its spectral lines into seven series, each produced unique spectral lines.

D)   The mechanism to radiate Electromagnetic Radiation (EM-R) is based on the integration of both CMF-EF in the Flip-Flop (F-F) mechanism [45], then both CMF-EF are pulled by the SMF and released at the speed of light as given by Eq. (16).

E)   Any EM-R required strong magnetic field, the shorter the wavelength the higher the magnitude of the SMF (B_{1U}) as given by Eq. (21).

F)   The crowd of spectral lines at higher frequencies is due to the intense magnitudes of B_{1U} at higher LMF in SMF as in Fig. 2 and Table. 1.

G)   The interaction of SMF of two nucleons or proton and electron, produced the Spinning Magnetic Force (SMFs) or the nuclear force.

H)   The interaction of both SMF for electrons and protons produced strong Spinning Magnetic Force (SMFs) which integrated both particles to form neutron particle, which have SMF with double magnitude.

I)   The structure of different nucleus is carried by the interactions of SMF and the resulted SMFs.

J)   The SMF for different atoms, are a combination of series and parallel summation of proton's and neutron's SMF.

K)   The formation of atoms is carried by the interaction of CMF with the SMF.

L)   Since moving charges doesn't produce Coulomb's force [78], the stability of any atom at the natural orbit is attained by the balance of both the Magnetic Force (F_m) with the Centripetal Force (F_C) [59].

M)   The SMF in each nucleus is the field which integrated both the CMF and the electric field in the Flip-Flop (F-F) mechanism to produce the spectral lines or EM-R, then the integrated EM-R is pulled by the B_{1U} [36, 45].

N)   The fusion of light elements in nuclear reaction is carried by both the SMF and SMFs [50].

O)   Charged particles and ions produced Circular Magnetic Field (CMF) its intensity is given by Eq. (8), while neutrons and neutral atoms doesn't produced CMF.

P)   The intense strong magnetic field with strength of ~ 1.e+13 Tesla at RHIC and ~ 1.e+14 Tesla at LHC, produced by the fast moving nuclei with electric charges [74], are the CMF and can be derived using Eq. (8).

Q)   The leading polarity of SMF in charged particles and ions is determined by the CMF in which the +ve SMF is leads, while for neutrons and neutral atoms like silver atom, any polarity can lead randomly.

R)   Silver atoms possessed the Spinning Magnetic Field (SMF) at ends of both poles, the magnitude of which is a summation of series and parallel arrangements of its internal protons and neutrons.

S)   When a beam of silver atom is released, the passing of each Ag across the inhomogeneous magnetic field (B_I) resulted in the interaction of the leading ±ve SMF B_{1U} with the ±ve B_I.

T)   The interaction of ±B_{1U} with the ±B_I is carried by the -ve&+ve or +ve &–ve, which always resulted in a positive Magnetic Force (F_m), which forced Ag to move either to the right or to the left, in the original experiment shown in Fig. 10-(A).

U)   The angle θ of Ag during the interaction determined the position within the four sectors in Fig. 12-(B).

V)   The velocity of Ag determined how far the striking point can be allocated from the central line.

W)   The experiment resulted in a shape looks like two large semi-triangles joined together, determined by four main factors, including the ±ve SMF pole of the heading Ag, direction and magnitude of the inhomogeneous magnetic field (B_I), the angle of the trajectory and the velocity of the Ag.

X)   The Stern-Gerlach experiment is an interaction between the SMF and the inhomogeneous magnetic field based on Faraday attractive and repulsive magnetic lines of force.

Y)   The SMF by an electron can't change the direction of the trajectory of the Ag.

Z)   The Stern-Gerlach experiment by free electrons doesn't represents in any way any relation with the spin, rather it clearly illustrate an interaction between either directions of the CMF and the fixed direction of the inhomogeneous magnetic lines of force, which resulted in either repulsive force diverted electrons to the left, or an attractive force deviated electrons to the right.

AA)   This experiment gives a strong evidence for the classical version of the angular momentum producing the Spinning Magnetic Field (SMF), which plays great roles in the micro-world as explained.

-        The Stern-Gerlach experiment distorted the true nature of many phenomena and hide the characteristics of many important phenomena thus materialized the parable of the **blind men and the elephant** [9].

Knowing the true mechanism behind many phenomena, will help inventing many instruments and systems with less cost and energy efficient, including the alternative renewable energy.

VIII.   Conclusion

The Stern-Gerlach experiment was carried in a period which shaped our current knowledge of the physical world through some decisive experiments, the interpretation helped strengthened then newly born Quantum Mechanics (QM), therefore the experiment can't be reinterpreted independently from some important related experiments which created the results upon which the Stern-Gerlach experiment is based; where the experiment was conducted after results of an important experiments were announced which created the ground among scientists to accept the photon, that's when Compton interpreted the Compton Effect in 1922 as "*radiation quantum carries with it momentum*" [28] which then endorsed Einstein's quanta (photon) claim [22], then the electron diffraction was carried by Davisson and Kunsman's in 1923-27 [68, 30, 31], and confirmed separately by Thomson and Rupp 1928 [32, 3], which confirmed wave particle duality by de Broglie of 1924 [29], then the Stern-Gerlach Experiment which confirmed spin is quantized 1922 [4], and the double-slit experiment first carried with low intensity light in 1909, then with electrons in 1960 [86] which protected QM as the fundamental in understanding physics at the micro level [38], these experiments eliminated any doubt about correctness of quanta (photon) and wave particle duality [40]. In addition to that, the Stern-Gerlach experiment can't be reinterpreted unless we understood the background and circumstances which created the quanta (photon) and wave particle duality; this took us back to when the relation between electricity and magnetism was discovered by Ørsted in 1820, he also discovered that electric current produced Circular Magnetic Field (CMF) around a conductor, Ampere mathematized the first relation in his electrodynamics in addition to the failure of scientists to derived an alternative formula [10], which is in form of "*field's interaction*," and the

failure to incorporate the CMF described by J. J. Thomson as "*train of waves associated with the movement of electrons*" in the theoretical works [20], all led to mathematization of the physical science.

Since the CMF is produced by charged particles and existed in different interactions, thus the failure to incorporate it caused shortage in the understanding of the true nature of most phenomena, thus each false interpretation created similarity with the five men and the elephant [9]; while at the announcement of each of these interpretations, they were faced with great critics and oppositions, such as quanta by Einstein opposed by Millikan, Lorenz, Planck [26], and Bohr [27], even Compton effect was opposed by great scientists like Raman who envisioned that "*the classical wave-principles are not easily reconcilable with Compton effect because they have not been correctly interpreted,*" [34], thus not correctly understood due to the failure to get the field's formula and the failure to incorporate CMF.

Therefore, some of our papers were in response to these shortages, including "*The Magnetic Interaction*" [43], and "*The Unified Force of Nature: 1-The Electric & Magnetic Forces* " [44], both provided the field's interaction, while in the first we suggested the Spinning Magnetic Field (SMF) with a dipole moment formula, it also includes a model for hydrogen atom; while in "*The Electromagnetic Radiation Mechanism*" [45], we showed the role the CMF carried in electromagnetic radiation, then in explaining photoelectric effect in "*The Photoelectric Effects-Radiation Based With Atomic Model*" we presented a formula for radiation force, showing it have force to expel photoelectron in addition to the higher model of potassium atom [36], the Compton effect is explained classically in "*The Compton Effect Re-Visited*" [35], and showed mistake by Compton in "*Compton was Greatly Mistaken Using the Quantum*" [33], we explained the two slits experiment in "*The Double Slit Experiment-Explained*" [47], then we explained diffraction in "*Electron Diffraction Re-Explained (The Intense Magnetic Fields Interactions within Crystals)*" [48]; and the production of Spinning Magnetic Field (SMF), the interaction of SMF of two nucleons to produced the Spinning Magnetic Force (SMFs) or the nuclear force in [50] modified in [51].

These papers help in building the bases that explained the Stern-Gerlach experiment, in the current paper we presented some characteristics relevant to the experiment, some were published before, but modifies in frameworks of new ideas, while others are presented for the first time, the most important of which is the Circular Magnetic Field (CMF), it's the Train of wave associated with electron's movement as described by J. J. Thomson [20], the CMF although discovered by Ørsted [10] but many scientists draw it, including Faraday [52] and Feynman [56], it can't be used unless the relevant field's interaction formula is derived, the CMF joined charged particles together, it's the magnetic envelop for electromagnetic radiation; while the Spinning Magnetic Field (SMF) produced by electrons, protons and neutrons play big roles particularly in the atomic structure, the shape of proton's lines of magnetic force was suggested and presented in this paper, the shape is responsible of producing the seven series of spectral lines by the hydrogen atom, while the characteristics of the charged particles related to its motion is linked with the direction of the SMF as always in front regulated by the CMF, for neutrons and neutral atoms the SMF can be headed by a +ve or −ve polarity, which help in understanding of the Stern-Gerlach experiment, we showed the inter-atomic interaction between Circular Magnetic Field (CMF) and Spinning Magnetic Field (SMF) the types of resulted force and the resulted interaction among which is the production of neutrons, we explained the orientation of electron spin and the formation of hydrogen atom which's in the core of an interaction between electron's CMF & Proton's SMF and the stability of atom, attained by the balance of the magnetic force with the centripetal force, the role of the SMF in the production of the Spectral Lines, we showed the original figure of Stern-Gerlach Experiment and how it differ from the current perceived interpretation, with basic analysis on the results of the original Stern-Gerlach Experiment, then we give the Classical Interpretation of the Stern-Gerlach Experiment as a separation of the silver atom (Ag) caused by the attraction of the −ve pole of the AG by the +ve inhomogeneous magnetic field (B_1) moving Ag to the right, while the interaction of +ve pole of Ag by -ve B_1 attracted Ag to the left, the angle θ by which Ag enter B_1 determined the force and the point at which Ag strike the screen within six parts of the left or right sections; the magnitude of the produced force is increased by the velocity of the Ag, we showed how the production of the Spinning Magnetic Field (SMF) challenge the Stern-Gerlach Interpretation.

Acknowledgment

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