Journal of Theoretics

Journal Home Page

THE MAGNETIC INTERACTION

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PACS No: 41.20.-q, 21.10.Hw, 21.30.-x, 94.20.Qq, 94.10.Rk, 34.20.Cf, 32.10.Dk, 34.50.Fa, 32.30.-r

[Note: All figures are located at the end of the article.]

ABSTRACT

A magnetic interaction hypothesis ***(MIH)*** is suggested which leads to a re-interpretation of the interaction mechanism for the magnetic force. This ***MIH*** is used to explain energization of charged particles on micro scale. Further considerations including the nuclear force, inter-atomic stability, and the reproduction of spectral lines, are reported.

1- INTRODUCTION

Energization mechanism for charged particles has been a subject of much interest in the plasma physics [1]. The Sun emits these particles during various phenomena (such as, the solar flares, and the solar wind), [2,3] all of which interact with the geomagnetic field giving rise to several phenomena such as, the ring current, the Van Allan radiation belt, and the aurora in which the particles are highly accelerated, [4,5,6]. Many theories have tried to explain such accelerations. Among them are: acceleration by hydromagnetics shock waves, acceleration through atmospheric dynamo process, and the electric field acceleration [3]. But they have not been able to explain the energization mechanism causing these phenomena [7]. Disclosing of this mechanism could help unlocking many of present unsolved mysteries, such as, the nuclear force formula [8], nuclear fusion mechanism [9], aurora mechanisms [10] and several other phenomena [11]. It is known that the force keeping both the electrons around nucleus, and that bonding atoms together is the electromagnetism [12], but no mechanism had been suggested for it. This paper however tries to tackle these problems by (I) re-interpreting the nature and mechanism of the magnetic force, and (ii) suggesting a magnetic interaction hypothesis (***MIH***), through which any generalised magnetic field interacts with a circular magnetic field (***CMF***) and (iii) re-defining the spinning magnetic field (***SMF***) interaction in terms of the nuclear force that binds the nucleons. Using both the ***CMF*** and ***SMF*** the inter-atomic energization processes and the reproduction of the spectral lines are considered.

2: THE MAGNETIC FORCE

2:1 THE CIRCULAR MAGNETIC FIELD (CMF)

Through experience [13], the attractive and repulsive forces between two conductors C_1 and C_2 carrying electric currents I_1 and I_2 separated by distance d metre, adopted for the definition of electric current [13], is given electrically by

$$F_{e.e.} = \frac{2k\, l_1\, I_1\, I_2}{d}\ N \quad (1)$$

But since the above conductors (C_1 and C_2) carrying electric currents (I_1 and I_2), if both currents are equal, the produced circular magnetic field CMF at a distance r_C from the conductor is given by

$$B_{C1} = B_{C2} = \frac{2k\, I_{1(2)}}{r}\ T \qquad (2)$$

Where, k= $2x10^{-7}$ Newton per square ampere [12].
As supposed by Faraday [14] magnetic lines of force tends to shorten in length or repelling one another sideways, such that the force obtained by Eq.(1) could be conceived as due to both conductor’s CMF shorten or repelling each other, as shown in Fig.1 and Fig.2, such that the repulsive and attractive force is give magnetically by

$$F_m = \frac{B_{c1}\ B_{c2}\ r_1\ r_2\ l_1}{2k}\ N \qquad \{3\}$$

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.
The Catapult force or the motor effect [12] is given by:

$$F_{e.m.} = B_1\, I_1\, l_2 \quad N \qquad (4)$$

Where, B_1 is the magnetic field, l_2 is the length of the conductor cutting the field in metre; I_1 is the current in the conductor in Ampere and the magnetic force $F_{e.m.}$ given by electric-magnetic parameters is in Newton.

The repulsive and attractive nature of magnetic lines of force causing Catapult force above, is express magnetically by

$$F_m = \frac{B_1 \, B_{C2} \, l_3 \, r_2}{2k} \quad N \quad \{5\}$$

Where, B_1 is a general magnetic field, B_{C2} is the CMF produced by the conductor, r_2 is the radius of the CMF, l_1 is the length of the conductor producing the CMF that interact with B_1, the magnetic force F_m is in Newton. Table.1. Shows the parameters relating magnetic force given by Eqs.(1), {3}, (4) and {5}.

$I_1=I_2$ A	l_1 m	d m	r m	$B_1=B_{C1}=B_{C2}$ T	$r_1=r_2=l_3$ m	$F_e=F_m=F_{e.m.}=F_m$ N
1	1	2.0	1.0	$2x10^{-7}$	0.707106781	$1.0\ x10^{-7}$
1	1	1.6	0.8	$2.5x10^{-7}$	0.632455532	$1.25x10^{-7}$
1	1	1.2	0.6	$3.333333333x10^{-7}$	0.547722557	$1.666666667x10^{-7}$
1	1	1.0	0.5	$4x10^{-7}$	0.5	$2x10^{-7}$
1	1	0.6	0.3	$6.666666667x10^{-7}$	0.387298334	$3.333333333x10^{-7}$
1	1	0.4	0.2	$1x10^{-7}$	0.316227766	$5x10^{-7}$
1	1	0.2	0.1	$2x10^{-7}$	0.223606797	$1x10^{-6}$

Table.1. Samples of parameters that gives an equivalent magnetic force in Eqs.(1), {3}, (4) and {5}, when used in its proper equation.

From both Maxwell's and Einstein's theories about magnetic field produced by charge in motion [15], it can be deduced that the magnitude of the CMF (or B_{2e} and B_{2p} for electron and proton respectively) produced by a charged particle in motion [16,17,18]

$$B_2 = \frac{q\,v}{r_m^{\,2}\,c} \quad T \quad (6)$$

is given by
Where, c is the speed of light, q is the particle's charge in coulomb's, v is the charged particles velocity in ms^{-1}, r_m is the magnetic radius at which the CMF is measured (representing r_{me} and r_{mp} or electron's and proton's magnetic radius respectively). The circular magnetic field B_2 is given in Tesla.
The Lorentz force ascribed to the existence of electrostatic field, used in explaining the characteristics of the magnetic force [19], while the magnetic force as associated with moving source charges is related to interaction of current bearing wire [20] shown by Eq.(1), the force is given by:

$$F_{e.m.} = q\,v\,B_1 \sin\theta \quad N \quad (7)$$

Where, θ is the angle between the trajectory and the fields. This force, is given with electric-magnetic parameters can be conceived to be caused by the magnetic interaction, where, as shown in Fig.3 the CMF (B_2) given by Eq.(6) interact magnetically with the general magnetic field B_1 such that

$$F_m = B_1\ B_2\ r_m^{\ 2}\ c \sin\theta \quad N \qquad \{8\}$$

Where, θ is the angle between the two fields. While Fig.3 shows the magnetic interaction patterns between both the electron's ***CMF*** and the proton's ***CMF*** with the general magnetic field B_1, Fig.4, shows variation of F_m with r_m.

2:2 THE SPINNING MAGNETIC FIELD (SMF) and NUCLEAR FORCE
2:2:1 THE SPINNING MAGNETIC FIELD

The magnetic field produced above the poles of the spinning nucleon [21] is due to total magnetic field (B_T), and is here identified as the spinning magnetic field (***SMF***). For proton, the magnitude of the total magnetic field (B_{Tp}) produced above each pole as shown in Fig.5.a, is derived from Newton's second law, Coulomb's electrostatic law and Biot-Savart law for magnetic field outside a loop [13], given by:

$$B_{TP} = B_{1P}\ r_r^{\ 2} = \frac{\mu_O\ q}{4\pi}\sqrt{\frac{q^2\ r_O}{\varepsilon_o\ f_{PS}\ m_P\ r_P^{\ 2}}} = 1.525710414x10^{-18}\ \ T.m^2 \qquad \{9\}$$

Where, B_{1p} is proton's ***SMF*** (B_{1U} for nucleus hydrogen atom), f_{ps} is the proton's spinning frequency, r_O is the radial distance from proton surface to a point at which B_{TP} is produced (r_o=0.468 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 permitivity of free space.

2:2:2 THE NUCLEAR FORCE

When opposite proton's spinning magnetic field ***PSMF*** comes under the field influence of each other as shown in Fig.5:a, an attractive force F_{NA} is established as in Fig.5:b, and derived from Eq.{8}, this force is given by:

$$F_{NA} = (\frac{B_{TP}^{\ 2}}{r_r^{\ 2}})\ c \quad N \qquad \{10\}$$

Which we here interpret as the nuclear force, In according to characteristics given [8]. The nuclear force F_N varies as shown in Fig.5.b, whereby at relatively large distances the attraction of both ***SMF*** dominates up to r_r = 0.468fm (r =0.936fm), (fm = 10^{-15}) as given by Eq.{10}.
Thereafter, for r_r smaller than 0.468 fm, magnitude of the ***SMF***

starts to decrease and so does $\boldsymbol{F_{NA}}$ given by the right hand part of Eq.{11}.
For smaller values than $\boldsymbol{r_r}$ = 0.468 fm, the preceding parts of the poles with similar ***SMFs*** interact with each other thus producing an $\boldsymbol{F_{NR}}$ opposing the two protons from fusing together, given by the left part of Eq.{11}. This repulsive force ($\boldsymbol{F_{NR}}$) is the resultant of both two forces, as shown in Fig.5b, given by:

$$F_{RN} = \{n^2 (\frac{B_{TP}{}^2}{r_o (2\,(r_o + r_P) - (nr_x))})\, c\} - \{(\frac{B_{TP}{}^2}{((r_o + r_x) + r_o)^2}) c\} \quad N \; \{11\}$$

Where, ***n*** is the number of steps moved by ***SMF*** starting from r = 0.8 fm (r_r = 0.4fm), $\boldsymbol{r_x}$ is the distance moved at each step (r = 0.05fm), the characteristics are shown in Fig.5.

Combining Eqs.{10} and {11}, the nuclear force ($\boldsymbol{F_N}$) is given by:

$$F_N = \{n^2 (\frac{B_{TP}{}^2}{r_o (2(r_o + r_P) - (nr_x))}) c\} - \{(\frac{B_{TP}{}^2}{r_r{}^2})\, c\} + \{(\frac{B_{TP}{}^2}{((r_o - r_x) + r_o)^2}) c\} \quad N \; \{12\}$$

3 ENERGIZATION OF CHARGED PARTICLES

Assuming a system (such as that of Fig.3) if the magnetic field which is denoted by B_1 is rotating or in motion, when an electron's or proton's ***CMF*** ($\boldsymbol{B_{2e}}$ and $\boldsymbol{B_{2p}}$ respectively) interacts with the B_1, then the resulting magnetic force between both fields also joins the charged particles such that they all move with the magnetic field (B_1). Thus if the magnetic force travels a distance ***d*** in unit time, then the work done is given by [22]

$$W = B_1 \; B_2 \; r_m{}^2 \; c \; d \; \sin\theta \qquad J \qquad \{13\}$$

Which is equal to the total (kinetic and potential) change in energy of the body acted on by the force [23] since the displacement and the magnetic force are in the same sense and direction, therefore from Eq.{13} the kinetic energy ***K*** of the charged particles is given by:

$$K = B_1 \; B_2 \; r_m{}^2 \; c \; d \; \sin\theta \qquad J \qquad \{14\}$$

Where, $\boldsymbol{B_1}$ is the rotating magnetic field, $\boldsymbol{B_2}$ is the ***CMF***, $\boldsymbol{r_m}$ is the radius of gyration, θ is the angle between the two fields at interaction moment. Fig.6, shows the relationship between different solar wind electrons velocities verses values at which it has been energized ***at microscopic level,*** at the magnetopause boundaries, where $\theta = 90^0$.

4: MAGNETIC INTERACTION AND ATOMIC MODEL

4:1 INTER-ATOMIC FORCES AND STABILITY

Based on this hypothesis, whenever an electron comes under the influence of a nucleus electric field at an electrostatic distance r_{ee} the electron is accelerated by the electrostatic force such that its velocity v_c and ***CMF*** increases. Thus at a specific radius regulated by μ_e in Eq.{24}, the electron will interact magnetically with the nucleus spin magnetic field (***NSMF***) forming an atom, or increasing the nucleus constituent. ***NSMF*** in its simplest form comprising the proton spinning magnetic field ***PSMF*** to form a hydrogen atom when interacted with electron's ***CMF.***

At specific r_{ee} the electrostatic force F_e is balanced with the produced magnetic force F_m, {or consequently also with the centripetal force (F_C)}, leading to the stability of the atom as shown in Fig.7, for hydrogen atom and given generally by Eq.{15} bellow, while the degree of this stability is determined by μ_e in Eq.{24}. The balance of forces is such that

$$F_e = F_m = F_c = \{\frac{Z\,e\,Q}{4\pi\,\varepsilon_o\,r_{ee}^{\;2}}\} = \{(B_{1U}\;B_{2e}\;r_{me}^{\;2}\;c = q\,v_O\;B_{1U}) = (\frac{m_e\,v_O^{\;2}}{r_{me}})\} \quad N \quad \{15\}$$

Where, B_{1U} is the nucleus SMF, B_{2e} is orbital electron’ CMF, m_e is electron's mass, r_{ee} is the electron's electrostatic radius, r_{me} is the electron's magnetic radius, v_o is electron's natural orbital velocity around the nucleus, ε_O is the permittivity of the free space. From the balance of electrostatic and magnetic forces above, the electrostatic orbital radius r_{ee} at which an electron stabilised is given by

$$r_{ee} = \sqrt{\frac{q}{4\pi\varepsilon_O B_{1U} v_O}} \quad m \quad (16)$$

Relating Eq.{15} with angular momentum introduced by Bohr, in his atomic hypothesis [24], the electrostatic orbital radius r_{ee} is also given by

$$r_{ee} = \frac{\varepsilon_O\,h^3}{4\pi^2\,m_e^{\;2}\,\mu_e\,q} \quad m \qquad \{17\}$$

While the orbital velocity v_O could be derived from Eq.{30}, or from Bohr atomic hypothesis [24]

$$v_O = \frac{h}{2\pi\,m_e\,r_{ee}} \quad m.s^{-1} \qquad \{18\}$$

Where, ***h*** is Planck's constant.

4:2 ELECTRONS' PARAMETERS AT ORBITAL LEVEL

We assumed that the stability of an atom at certain orbital radius is due to the balance of both F_e and F_m (or F_C), as shown in Fig.7. with parameters given in Table.2. Hence the electrostatic radius r_{ee} (all of the following parameters are derived from Eq.{15}, as given in Table.2.) at orbital level take the form

$$r_{ee} = \sqrt{\{(B_{TP}) + (\frac{q}{4\pi\,\varepsilon_O\, v_O})\}\{\frac{q^3}{4\pi\,\varepsilon_O\, m_e^{\,2}\, v_O^{\,3}}\}} \quad m \qquad \{19\}$$

While the magnetic radius r_{me} (equal to Bohr radius r_B) takes the form

$$r_{me} = \frac{4\pi\,\varepsilon_O\, m_e\, v_O^{\,2}\, r_{ee}^{\,2}}{q^2} = \frac{2\,\mu_e}{q\, v_O} = r_B = \frac{\varepsilon_O\, h^2}{\pi\, m_e\, q^2} \quad m \qquad \{20\}$$

Where, r_B is Bohr radius, and the ***SMF*** radius r_r is given by:

$$r_r = \sqrt{\frac{4\pi\,\varepsilon_O\, v_O\, r_{ee}^{\,2}\, B_{TP}}{q}} \quad m \qquad \{21\}$$

And the ***NSMF*** (B_{1U}) or B_{1p} for hydrogen atom, is given by:

$$B_{1U} = \frac{q}{4\pi\,\varepsilon_O\, v_O\, r_{ee}^{\,2}} \qquad T \qquad \{22\}$$

For hydrogen atom, parameters obtained due to the balance of both forces are given in Table.2. From Eq.{20}, the electrostatic radius also could be given by

$$r_{ee} = \sqrt{\frac{h^2}{4\pi^2\, v_O^{\,2}\, m_e^{\,2}}} \quad m \qquad \{23\}$$

r_{ee} X10^{-10} m	F_e=F_m=F_c X10^{-8} N	V_O m.s^{-1}	r_{me}=r_B X10^{-10} M	r_r X10^{-12} M	B_{1U} T	B_{2e} T	μ_e x10^{-24} J/T
0.528566407	8.257749961	2190219.655	0.5291793603	2.546269208	235322.5112	0.417706473	9.284770122

Table.2. Electron's parameters at natural in for hydrogen atom. This Table should be read in connection with Fig.7, and Eqs.{15,16,17,18,19,20,21,22,23,24 and 30}

4:3 THE MAGNETIC MOMENT

The flipping effect (i.e. the magnetic moment) produced in magnetic resonance experiments [9] are seen as, the response of an energetic charged particle's CMF to any specific magnetic field. For an electron in an atom, this magnetic moment ($\mu_e = E_O/B_U$) is obtained by substituting electron's orbital energy and nucleus SMF given by Eq.{22 } in the following sequence

$$\mu_e = \frac{m_e v_O^2}{2 B_{1U}} = \frac{2\pi \varepsilon_O v_O^3 m_e r_{ee}^2}{q} = \mu_B = \frac{q v_O r_{me}}{2} \; J/T \; \{24\}$$

Where, ***B$_{1U}$*** is nucleus spinning magnetic field (***NSMF***), μ_B is Bohr magneton, μ_e is atomic electron magnetic moment related to atom stability.
Eq.{24} can be used to determine the stability orbit for both the electron's ***CMF*** and ***NSMF*** as shown in Fig.7, and numerically as in Table.2, for atomic hydrogen.

5: INTER-ATOMIC ENERGIZATION and the REPRODUCTION of SPECTRAL LINE

From the magnetic interaction hypothesis based on Eqs.{8}, {14} and {13}, any electron gyrating at its natural orbit in an atom under the influence of the spinning magnetic force continually undergoes an energization process so that it acquires an amount of orbital energy

$$E_O = \frac{r_{me} q v_O B_{1U}}{2} \quad J \quad \{25\}$$

With reference to Fig.8, whenever such an electron is subjected to an excitation potential, both its kinetic energy and the ***CMF***

$$E_n = \frac{r_n q v_D B_{1U}}{2} \quad J \quad \{26\}$$

(***B$_{2e}$***) increases and hence the magnetic force increases as well. This force increases the orbital radius so that the radial energy change is obtained as
Where, ***v_D*** is the excitation velocity, ***r_n*** is the excited orbital

radius. The quanta of energy acquired by the electron at that radius will be radiated as an electromagnetic radiation, the sequence of which is shown in Table,3., with the wavelength given by

$$\lambda = \frac{2hc}{r_n \, q \, v_D \, B_{1U}} \quad Å \quad \{27\}$$

From Eqs.{15} and {25}, the general excitation energy at any radial distance within the atomic excitation range becomes

$$E_n = \frac{m_e \, v_n \, v_D}{2} \quad J \quad \{28\}$$

Where, $\boldsymbol{v_n = v_D + v_O}$, i.e. the excited radial velocity.

E_D Ve	**V_D** m.s	**V_n** m.s	**B_{2n}** T	**F_n** $X10^{-7}$ N	**r_n** $x10^{-11}$ m	**F_r** $X10^{-8}$ N	**E_n** Ve	λ Å
5.0	132620 4.968	351642 4.623	0.6706 328886	1.3257 91924	8.4960 39785	5.0001 69275	13.257 470411	0935.8 503044
3.39 9525	109354 0.238	328375 9.893	0.6262 60367	1.2380 70714	7.9338 98117	4.1229 57183	10.208 33388	1215.3 80283
1.0	593096 .892	278331 6.547	0.5308 18604	1.0493 89364	6.7247 76059	2.2361 43679	4.6928 53031	2643.8 09136

Table.3. Samples of sequences through which an excited electron in hydrogen atom transverse, before radiating specific wavelength using Eq.{27}, as shown in Fig.8.

Thus the radiated wavelength λ due to such a specific energy quantum (an example of which is shown in Table.4, to be compared with Table.3.) is given by

$$\lambda = \frac{2hc}{m_e \, v_n \, v_D} \quad Å \quad \{29\}$$

E_D Ve	**V_D** m.s	**V_n** m.s	λ Å
5.0	1326204.968	3516424.623	0935.8503044
3.399525	1093540.238	3283759.893	1215.380284
1.0	0593096.892	2783316.547	2643.809137

Table.4 Reproduction of spectral lines by excited electrons, using Eq.{29} and Eq.{30}, reducing steps used in Table.3.

Hence,

$$v_O = \frac{2hc}{m_e v_D \lambda} - v_D \quad m.s^{-1} \qquad \{30\}$$

6: DISCUSSION

1- Although magnetic fields are produced due to relative motion of charged particles, the direct cause of the magnetic force is here considered to result from the interaction of magnetic fields. This interaction explains the mechanism behind the attractive and the repulsive forces between any two wires carrying electric currents as shown in Fig.2. It also explains the orbital excitation energy characteristics for charged particles and why the direction gyration of an electron is opposite to that of a proton, as shown in Fig.3.
2- The exponential nature of Fig.5 is due to the production of spinning magnetic fields, and above proton's surface (r = 0.468fm) as proved for neutron’s SMF [25], compared with Fig.4.
3- The exact measured magnitude of the nuclear force for the proton is determined by the magnitude of produced $\boldsymbol{B_{Tp}}$ given by Eq.{9}. In this case it is related to the magnetic moment value. Since the value of the proton's angular frequency (ω_p) has been determined as 0.5 rad. sec. (i.e. from Eqs.{24},{25},{26},{27},{28}, and {29}), therefore its spinning frequency (f_{ps}) is of the magnitude of 0.079577471 s^{-1}, from which $\boldsymbol{B_{Tp}}$ is derived.
4- The CMF interaction with the magnetic field ($\boldsymbol{B_1}$) is represented in Fig.3. The same mechanism occurred inside an atom where the balance of both the $\boldsymbol{F_e}$ and $\boldsymbol{F_m}$ at specific $\boldsymbol{r_{ee}}$ and $\boldsymbol{r_{me}}$ brings stability to the atom, as shown in Fig.7.
5- The nature of the magnetic interaction is that, the weaker CMF ($\boldsymbol{B_2}$) interacts with the stronger magnetic field ($\boldsymbol{B_1}$) at two specific points. These two points arise due to the variation in the strength of $\boldsymbol{B_{1p}}$ as shown in Fig.7, for hydrogen atom.
6- From Eqs.{16}, {18} and {22}, the value of $\boldsymbol{r_{ee}}$ include proton's radius $\boldsymbol{r_p}$, and electron's radius $\boldsymbol{r_e}$. Both are thought to be equal, and derived from Eq.{9}.
7- The Bohr radius ($\boldsymbol{r_B}$), giving in the right hand side of Eq.{20}, is resulted from the balance of both the Coulomb's electrostatic and centripetal forces, (with value of $0.5291793603\text{x}10^{-10}$ m) [26,27], it gives the same value given by the magnetic radius ($\boldsymbol{r_{me}}$), therefore both are equal and given by Eq.{20} and shown in Table.2.
8- The known value for electron's orbital angular momentum ($\boldsymbol{L_o}$) [28] is $1.054\text{x}10^{-34}$ $kg.m^2s^{-1}$. While the value obtained from Table.2, parameters are $1.054572669\text{x}10^{-34}$ $kg.m^2s^{-1}$ using $\boldsymbol{r_{ee}}$.
9- Electron's magnetic moment $\mu_e = 9.284770119\text{x}10^{-24}$ j/T obtained from multiplication of Bohr magneton (μ_B) [29] by 1.001159652193 as predicted by quantum theory of electrodynamics and verified by experiments [21,30], is obtained with the same value using any of

Eq.{24}, thus Bohr magneton (μ_B) gives correct magnetic moment value when using correct parameters (v_O and r_{me}).

10- The electrostatic radius, r_{ee} which determined v_o, F_e, r_{me}, r_r, and B_{1U} is derived by Eq.{17} using (μ_e and h), or Eq.{19}, or Eq.{23}, all of which give the value of $0.528566407 \times 10^{-10}$m, and given in Table.2.

11- The v_o is derived either from Planck's relation Eq.{18} or the radiated spectral line, given by Eq.{30}.

12- The known proton's radius (r_p) [21], is 1×10^{-15} m, while from Eq.{10}, $r_p = 1.1060236231 \times 10^{-15}$ m.

13- The excitation energy (E_D) is relative to the ionisation energy [26,27], for hydrogen atom the ionisation energy, used in Eqs.{25}, {26},{27},{28} and {29} is 13.5981 eV [25].

14- For any atom if both the radiated wavelength λ and the excitation velocity v_D is known then the ***electron's natural orbital velocity v_o (at natural orbital radius)*** can be obtained using Eqs.{18} or {30}.

15- With reference to two points above, atomic spectral lines can be reproduced as shown in Fig.8. While Table.3, shows the reproduction sequential mechanism, and Table.4, summarised all of Table.3., using only Eq.{29}, both tables gives the same results.

16- Energy changes for charged particles therefore takes the following two forms:

(a) The normal work done due to the displacement of the magnetic force from the normal orbital radius (r_{me}) to the excitation orbital radius (r_n) inside an atom, the energy of which is radiated, as shown in Fig.8.

(b)Starting from the single particle ***micro-level,*** energy as given by Eq.{14} and shown in Fig.6, electrons and protons can proceed to higher radial energy because it is linked with other subjects. The several steps of energization may lead to acceleration mechanisms, such as those found in the magnetopause boundary in the transition region [3,31], both aurora oval [6], and stable auroral red arc system (SAR-arc) [32], radiation belts [3], and the ring current's [6] comprising charged particles.

17- From Fig.5:b. The degree of stability for two nucleons depends on the equilibrium distance, where attraction and repulsion forces are balanced, similar to forces between two atoms [33]. Relative unbalance of the nuclear force magnitude cause the vibration (or oscillation) motion of both nucleons (around 0.7 Fm, as shown in Fig.5.b.). Similar to the molecule's vibration motion of the spring form, associated with energy [34,35]. Larger nucleus B_{TU} magnitudes, give higher oscillations and lower nucleus nuclear stability, with the associated energy and consequently leading to decay processes.

18- From point (15), the smallest excitation potential of $1.982807168 \times 10^{-3}$ eV can reproduce Pfund series of 74599.21569Å in hydrogen atom. This therefore reveals the precision of all natural phenomena.

19- The 1922, silver atoms beam experiment carried out by Otto Stern and Walther Gerlach, where the beam split into two sub-beams on the detecting plate by the action of the

electromagnetic field [28].
The experiment is re-interpreted as:
(a) While in motion, the silver atom ***NSMF*** foreheads consist of both ***NSMF***.
(b) In uniform field, each forward ***NSMF*** detected the field as relatively equal magnitude of ***B***.
Thus $F = (B_1)(B_{2N}) r^2 c$, gives net $F = 0$.
(c) In no uniform field, each of the ***NSMF*** interacted as follow:
-***NSMF*** is attracted upward by $-F = (+B_1)(-B_{2U}) r^2 c$.
+***NSMF*** is repelled downward by $+F = (+B_1)(+B_{2U}) r^2 c$.
Therefore the silver atoms formed split on the detected glass.
20- The measured nuclear force between two protons which is $(45)^2$ times greater than the electric force [8], is re-interpreted as kinetic energy phase of great accelerated nucleons.
21- The MIH open the door for several new ideas in many fields.
22- Physical constant used, are: q = $1.60217733\text{x}10^{-19}$ C,
m = $9.1093897\text{x}10^{-31}$ kg. h = $6.6260755\text{x}10^{-34}$ J.s [12],
ε_0 = $8.854223\text{x}10^{-12}$ $C^2.N^{-1}.m^{-2}$ [36].

ACKNOWLEDGEMENT

My gratitude to my sister Sophya and her husband Abubakar Mohamad and children for their hospitality. The Chairman of Physics Department, University of Nairobi, Prof. B.O. Kola for providing the scientific umbrella, and Dr John Buers Awuor and Dr Lino Gwaki in the Physics Department without whom this work could not have taken the present form. Late Cdr Yousif Kuwa Makki, SPLA/M commander in the Nuba Mountains, for his moral supports, Cdr. Malik Agar, Cdr Abdulaziz A. Alhilu, Dr. Tajudeen Abdul-Raheem, Ms Fatma Abdulgadir, the stuff of Nuba Relief Rehabilitation and Development Organization (NRRDO), particularly Mr Ali Abdulrahman , Amar Amon and Jacob Idriss. Brothers and sisters, Mustafa, Mahamad, Halima, and Hukmalla. Finally, Dr Ali Khogali, Prof.John O. Owino, Dr C. Oludha, Dr P. Baki, Shiekh-Eldien Mousa, Katoo T. Nzivo, Chiromo Library Stuff, Kenya National Library and University of Makerery Library (Uganda).

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FIGURES

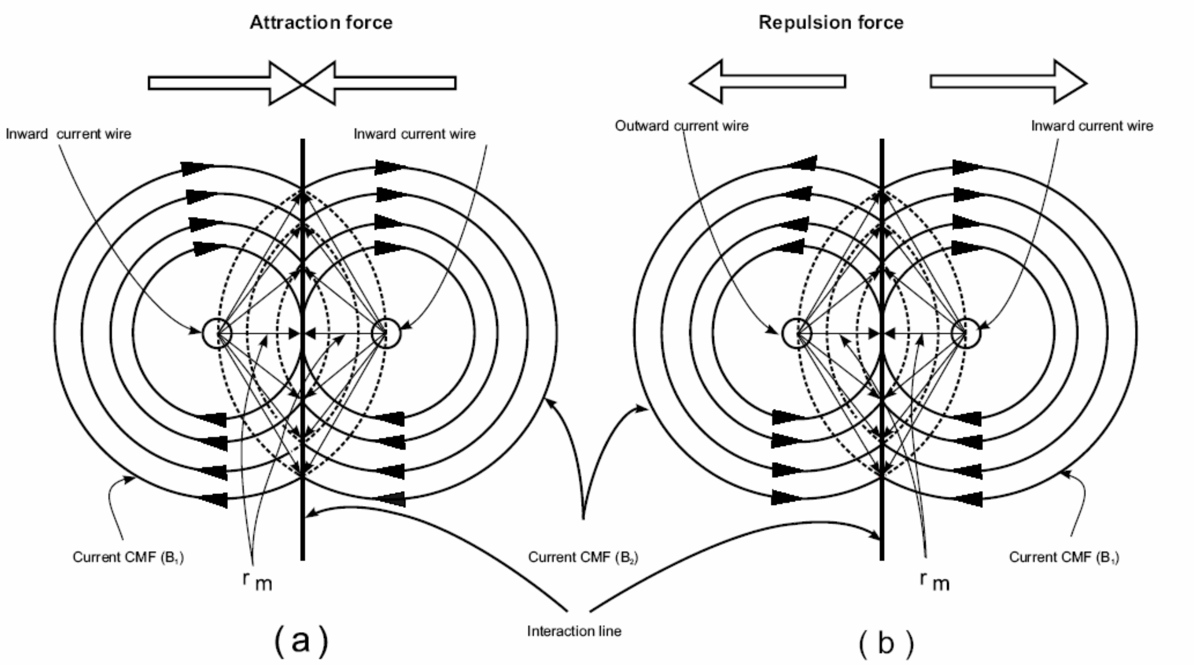

Fig .1. Production of circular magnetic field (CMF) (12), the figure also shows the directin of CMF, the interaction line and direction of the produced force .

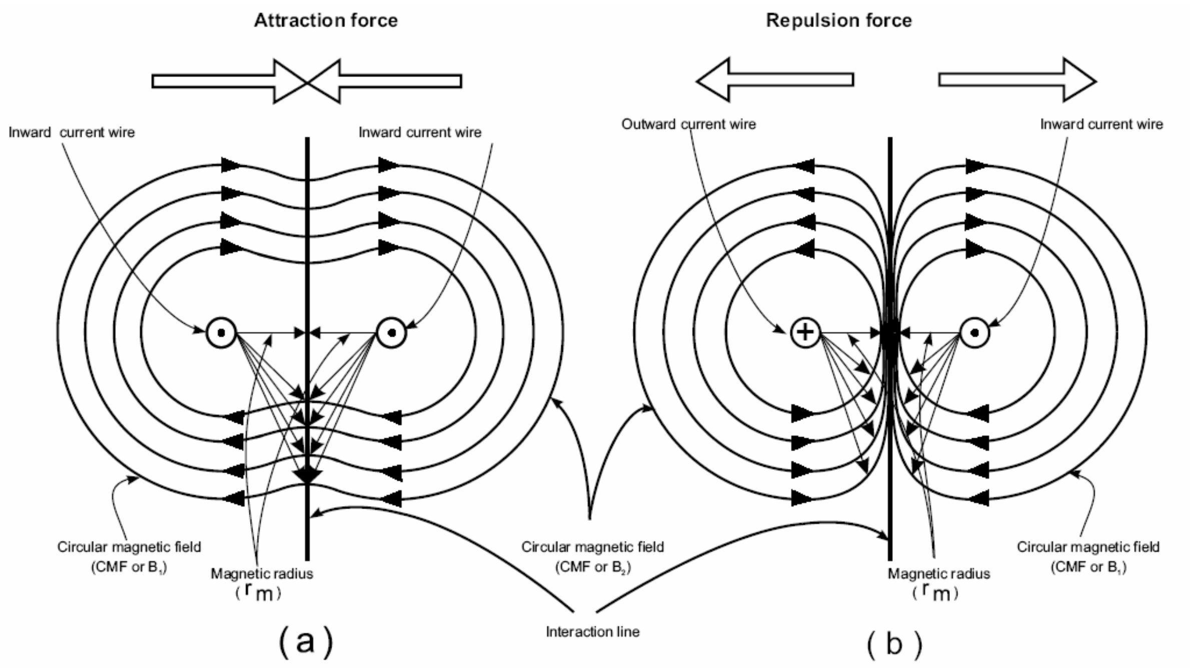

***Fig .2.** Cross-section views of conductors carrying electric current. Produced circular magnetic field (CMF) [12] interacted magnetically producing the magnetic force. Direction of both CMF's determined the direction of the force [12], in (a) it is attractive, while repulsive in (b).*

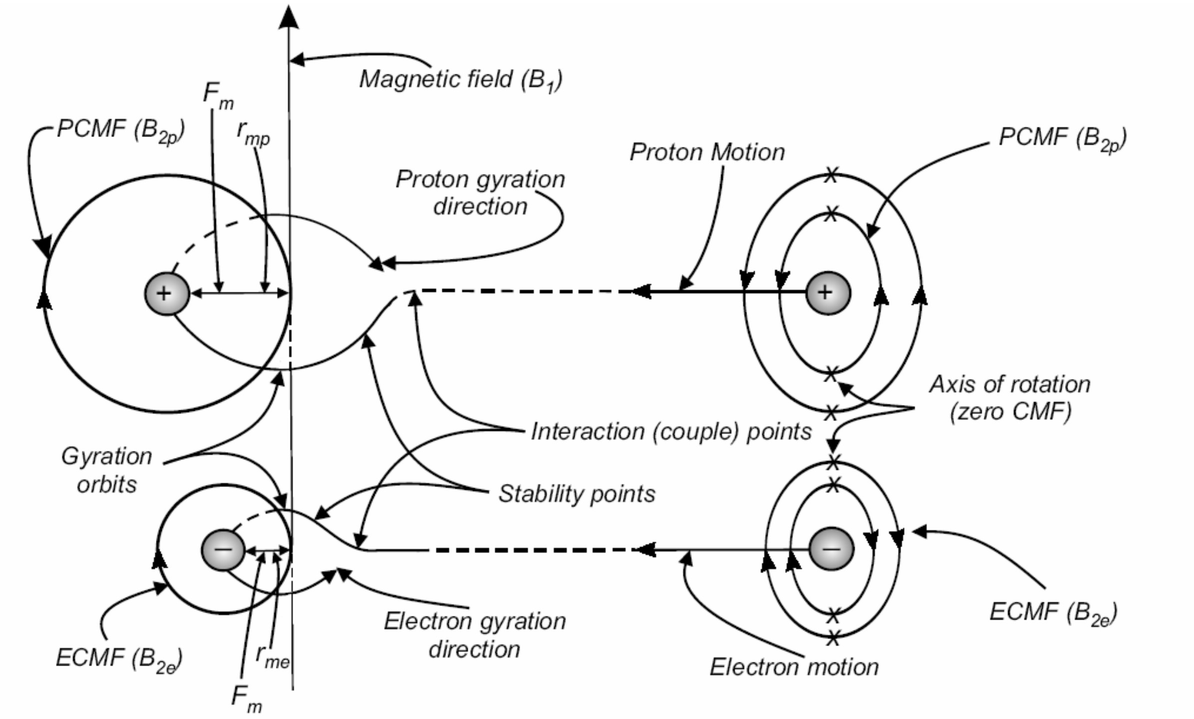

Fig.3. *ECMF and PCMF [16,17,18]* ($\boldsymbol{B_{2e}}$ *and* $\boldsymbol{B_{2p}}$ *respectively) of equal energies, interacted with magnetic field* ($\boldsymbol{B_1}$)*, at specific points. Resulted Magnetic force* (F_m) *caused electron and proton to gyrate oppositely at specific radius.*

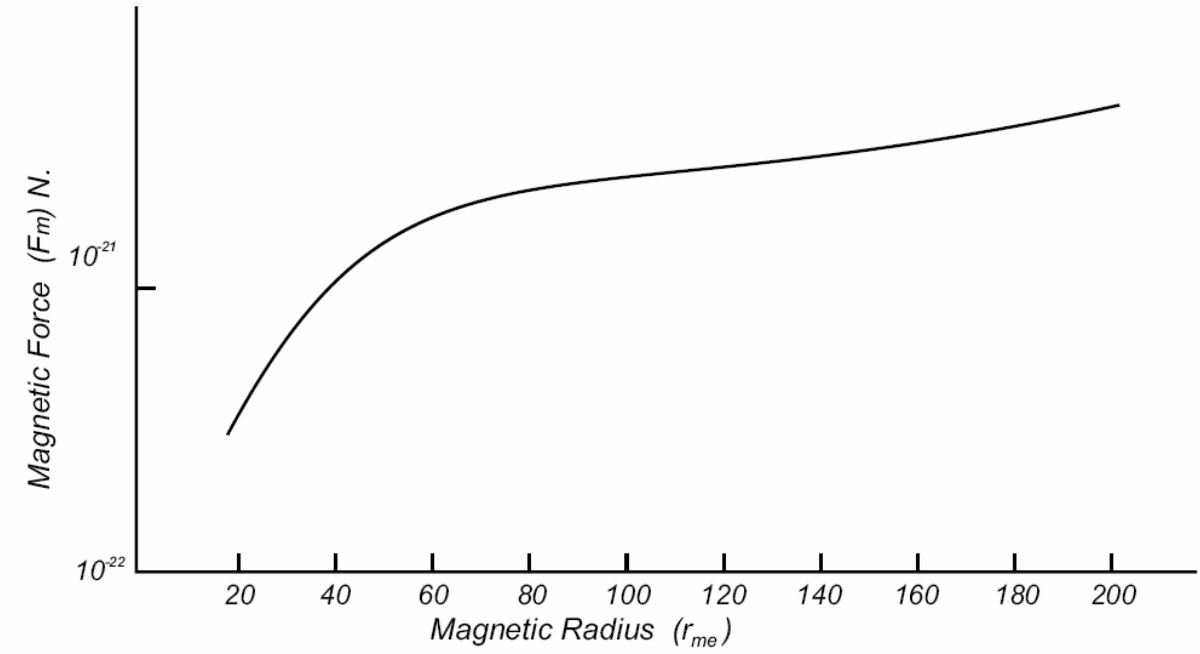

Fig.4. *The relationship between magnetic force* (F_m) *and magnetic radius* (r_{me})*, for solar wind electrons of different energies, at magnetopouse boundaries at* $12R_e$ *[31], using Eq.{8}.*

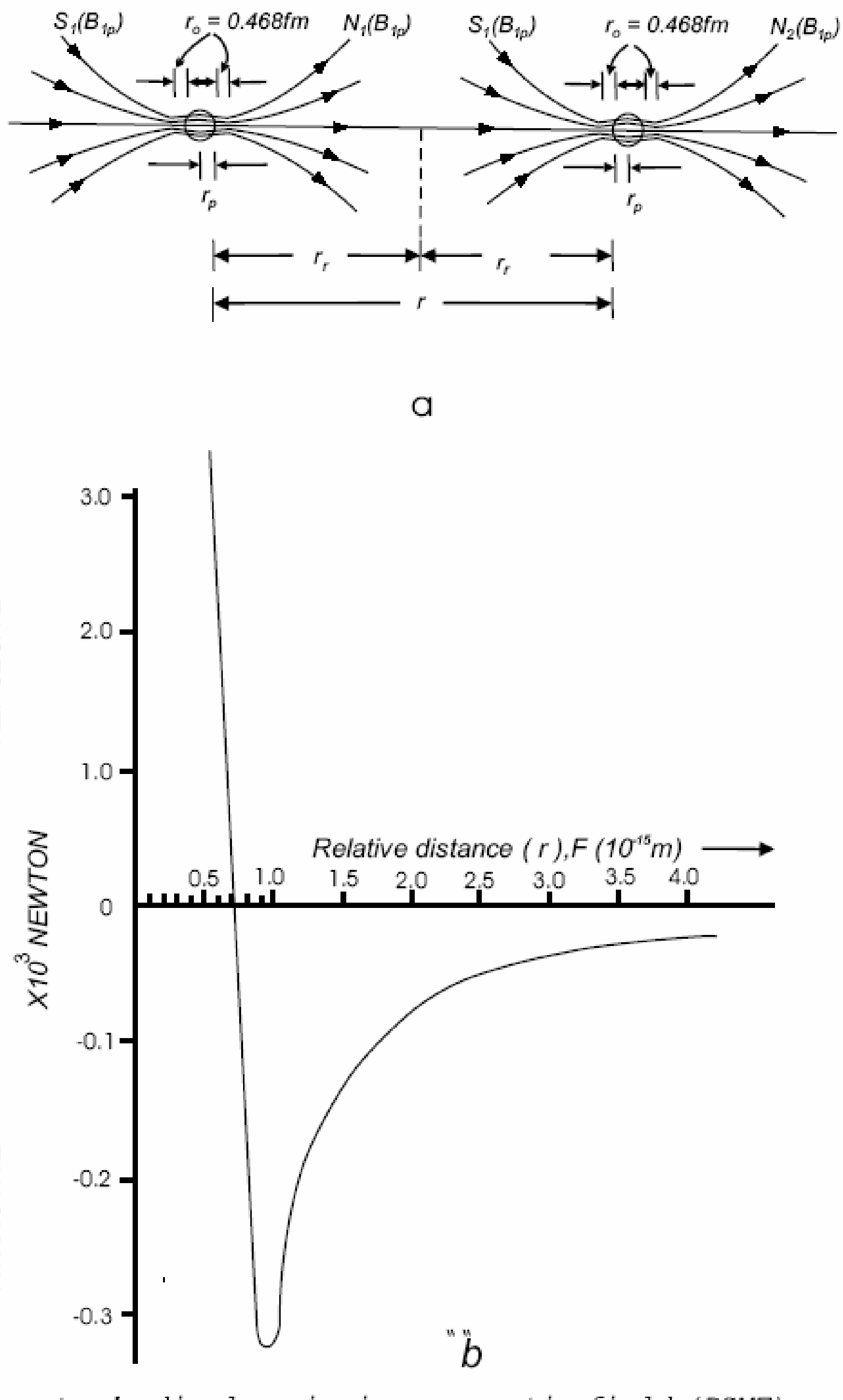

Fig.5. *The proton's dipole spinning, magnetic field (PSMF) production [21], above the surface in (a) it also shows two PSMF interacted magnetically. In (b) attractive produced magnetic force increased exponentially till r = 0.936 fm (r_r =0.468fm), then the force decreased, where it becomes repulsive, due to PSMF characteristics, using Eqs. {12}, all of which showing nuclear force (F_n) characteristics.*

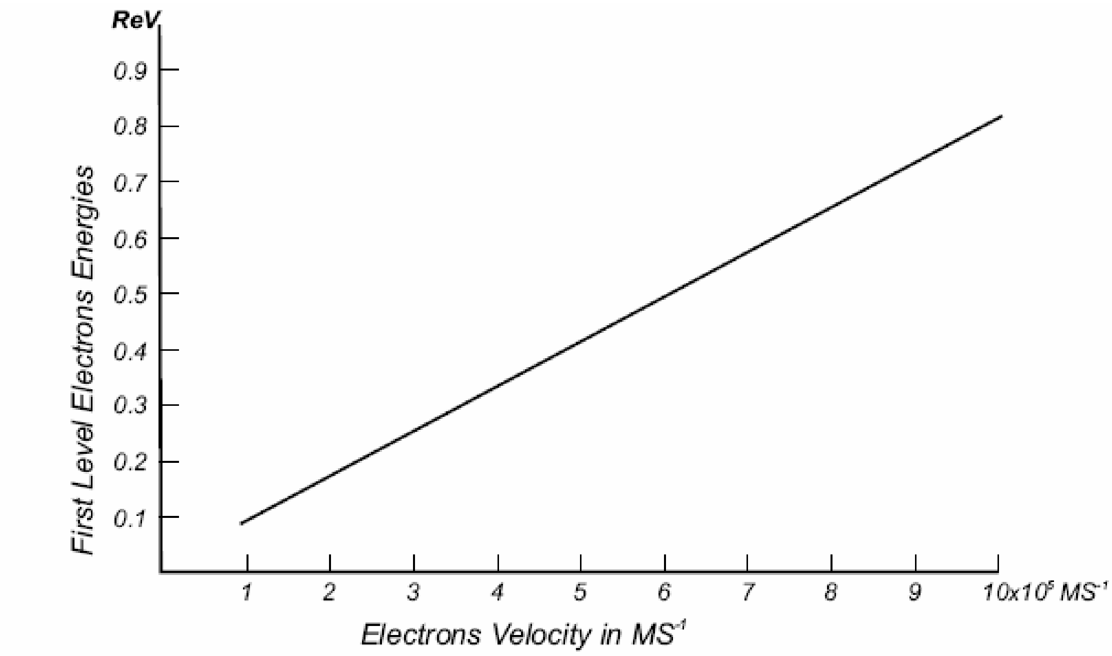

Fig.6. ***First level energization process*** *verses electrons velocity, due to data shown in* ***Fig.4.***

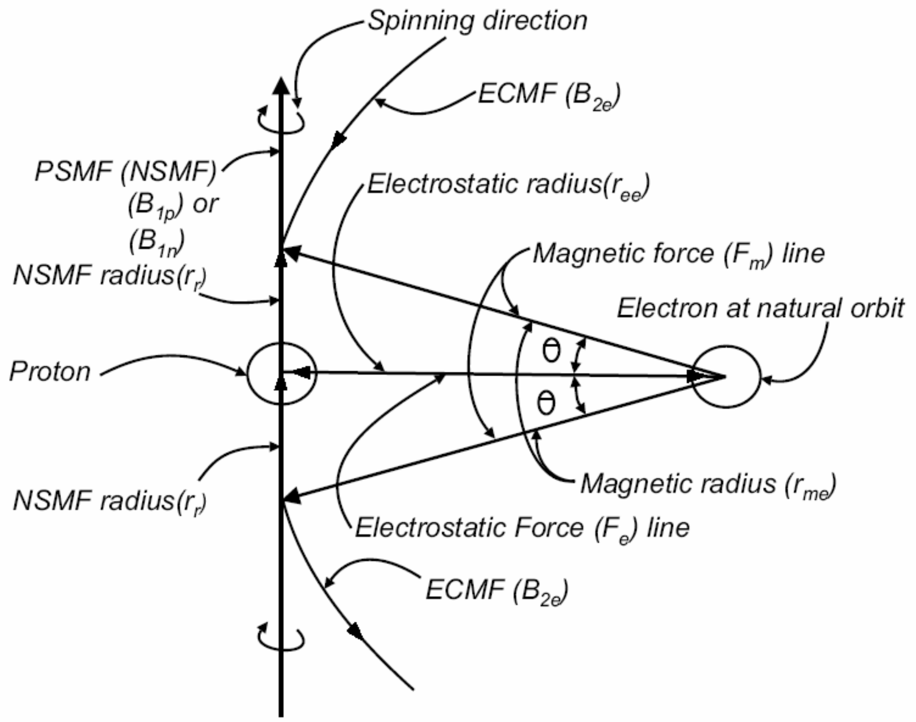

Fig.7. *Stable hydrogen atom, where ECMF* ($\boldsymbol{B_{2e}}$) *interacted with PSMF* ($\boldsymbol{B_{1p}}$) *at specific* r_{me} *and* r_{ee}*, producing a balance of both* F_m *and* F_e*, parameters of which is given in Table.1.*

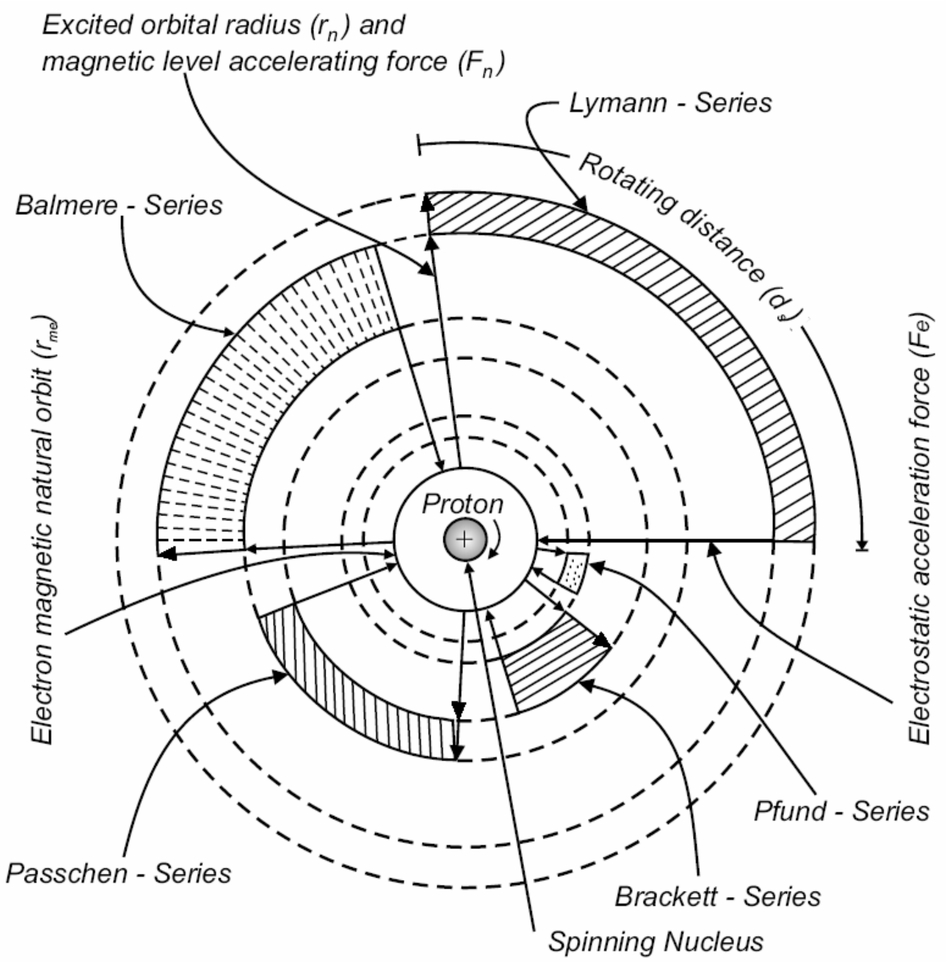

Fig.8. Spectral line sequential reproduction for hydrogen atom. Each quanta of series energy is due to multiplication of both the magnetic level accelerating force (F_n) by the spinning distance (d_s). After radiating the quanta of energy, electron is accelerated back to the natural orbit by F_{ee}.

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