Part 2b-Electromagnetism

4 - Electromagnetism

4(1) - Introduction

As stated in, *Sec.1,* each neutropa is constituted at least of two H particle–paths posipa (left-handed spin at the motion direction related to the positive electrical charge) and negapa (right-handed spin at the motion direction related to negative electrical charge). Assuming the H-system of these H particle-paths is isolated from the interactions of other fields; thus, this system has two kinds of motions as:

I) Linear motion at intrinsic speed *c*, related to single direction H particle-paths.

II) Circular or closed motion at intrinsic speed *c*, related to reversible H particle-paths.

Therefore, the energy and speed of these H particle–paths remain constant respect to time as an inherent characteristic according to constancy speed of the light.

Note 4(1)1 –All over this article, the word singlet is applied to both negapa and posipa (i.e. left-, or right-handed H particle-paths) field-lines.

4(2) - Mechanism of motion

This part dealing with the mechanism of linear and circular motions; moreover, the directions of electric, and magnetic fields of these particles are the same as the conventional ones in electromagnetism, *Note 4(2)1.*

I) Linear motion

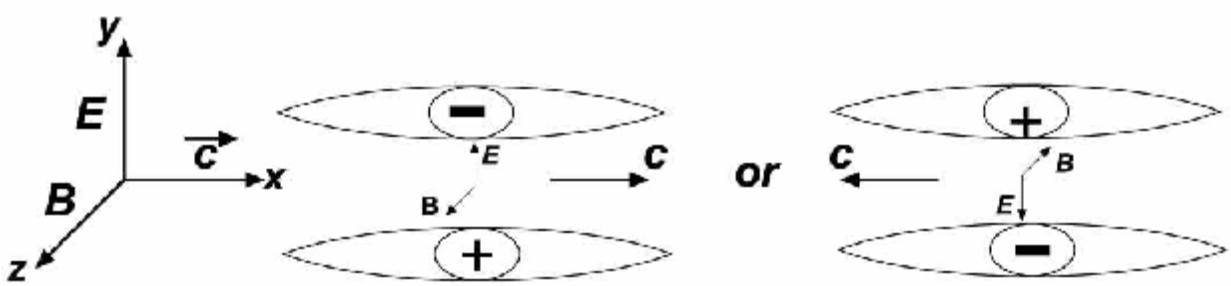


Fig 4(1) - the symbolic common linear motion of posipa (+) and negapa (-) in neutropa system and related fields $\vec{E}$ *and* $\vec{B}$

II) Circular motion

Fig. 4(2) -the symbolic common circular motion of posipa and negapa in a neutropa system and related fields E *and* B
For additional information, please refer to Note 9(3)4.

III) The symbolic combination of a posipa and a negapa to constitute a neutropa unit, Fig. 4(3).
For more information in case of circular motion please refer to *Note 9(3)4.*

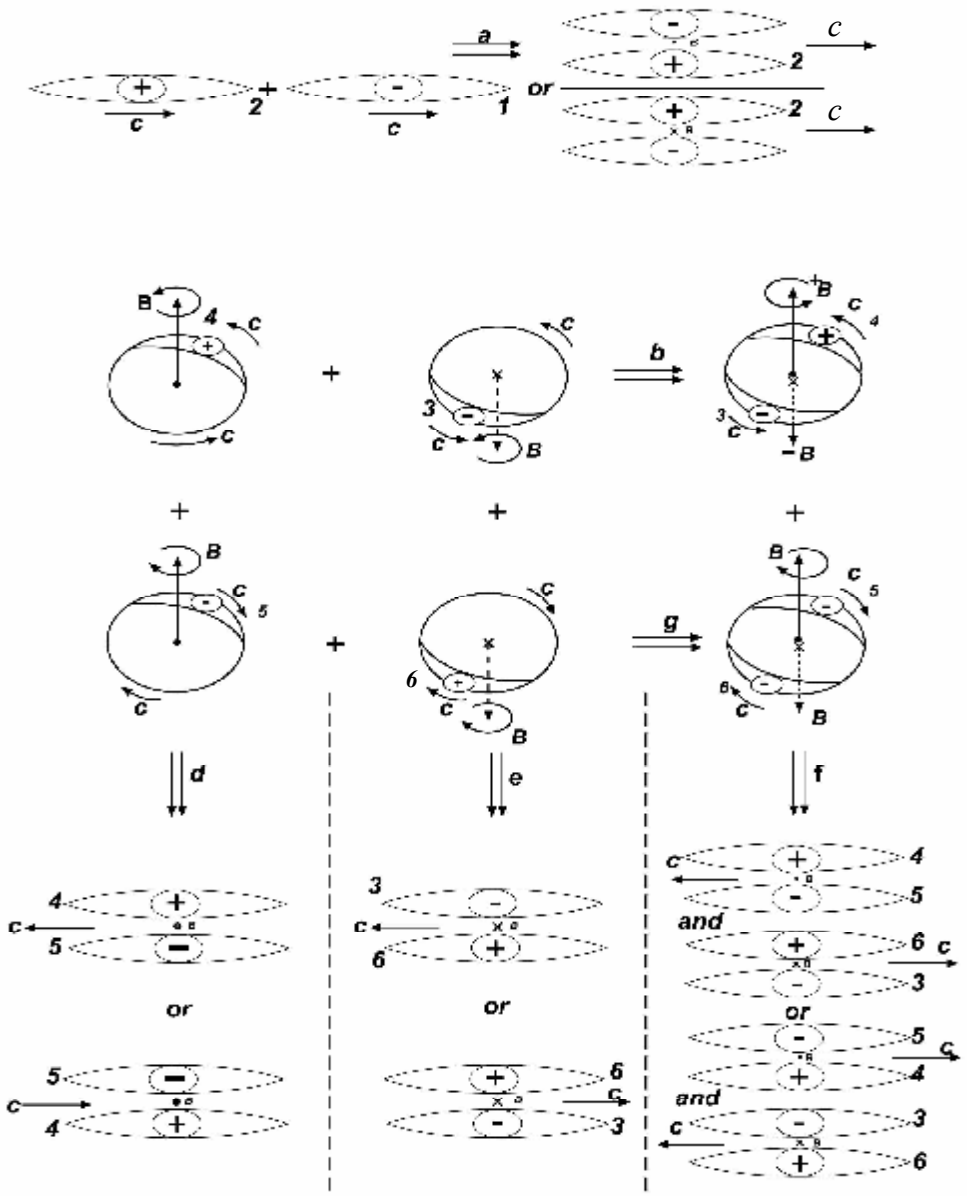


Fig. 4(3)-different modes of symbolic combinations and interactions of posipa and negapa:
(a) in a linear motion or path

(*b*) and (*g*) in a circular motion with opposite $\vec{B}$
(Counterclockwise and clockwise respectively)
(*d*) and (*e*) in a circular motion with the *B* direction upward (*d*) and downward (*e*)
(f) The interaction of two combined circular neutropas at different spins.
● The magnetic fields conserved before and after interactions. Moreover, c is the light speed.

Note 4(2)1- These mechanism are based on the concept of negative or positive charge and their interactions according to the usual or conventional rules of electromagnetism, i.e. negapa and posipa regarded as negative or positive partially charged, *Sec. 1(14).* Thus, right or left-handedness of H particle-paths, counter-currency mode of motions of theirs, *Sec. 3(1)2,* their related electromagnetic interactions acquired alternative view as in the following sections.

Note 4(2)2 - The least amount of $\vec{B}$ is related to a posipa or negapa as in *Fig. 4(2)* at the magnitude $h/2\pi$, or, $\hbar$ in case of $a = a_1$; please refer also to *Sec. 3, Note 3(1)1d, and 9(4)1*.

4(3) - Interaction of two moving charged H- systems
4(3)1- General aspect

A) Preliminary step

A charged H system establishes electric and magnetic fields in each point of the space. Assuming two charged H- system e_1 and e_2 at the velocities v_1 and v_2 and masses m_1 and m_2 respectively (isolated from other H systems) interacts on each other as follows, *Note 4(3)1, A1*; the interaction forces are nominated Lorentz force [1], *part 17*:

H- system 1 *H- system 2*

$$\vec{F}_1 = e_1\vec{E}_2 + \frac{e_1}{c}\vec{v}_1 \times \vec{B}_2 \qquad \vec{F}_2 = e_2\vec{E}_1 + \frac{e_2}{c}\vec{v}_2 \times \vec{B}_1 \qquad 4(1)$$

$$\vec{F}_{B_1} = \frac{e_1}{c}\vec{v}_1 \times \vec{B}_2 \qquad \vec{F}_{B_2} = \frac{e_2}{c}\vec{v}_2 \times \vec{B}_1 \qquad 4(2)$$

$$\vec{B}_1 = \frac{1}{c}\vec{v}_1 \times \vec{E}_1 \qquad \vec{B}_2 = \frac{1}{c}\vec{v}_2 \times \vec{E}_2 \qquad 4(3)$$

e_1 electric charge *system 1* e_2 electric charge *system 2*

v_1 common or external velocity of *system 1* v_2 common or external velocity of *system 2*, *Sec. 1(3)1,*

m_1 the mass of *system 1* m_2 the mass of *system 2*

E_1 electric field of *system 1* at *system 2* E_2 electric field of *system 2* at *system 1*

B_1 magnetic induction field of *system 1* at *system 2* B_2 induction magnetic field of *system 2* at *system 1*, *Comment 4(3)1, A1*

F_1 force acted on sys. 1 by *system 2* F_2 force acted on *system 2* by *system 1*

F_{B_1} magnetic force on *system 1* by *system 2* F_{B_2} magnetic force on *system 2* by *system 1*

IF_{B_1} photon emitted from *system 1* IF_{B_2} photon emitted from *system 2*

Please refer also to Note 4(3)1, A2

Note 4(3)1, A1- In order to facilitate the study of interaction of H systems *1* and *2*, we consider only the magnetic effect of two motions with parallel speed directions, $\vec{v}_1 \| \vec{v}_2$. Moreover, the electric interaction are discussed in, *Sec. 4(5)*. A moving negatively charged H- system has $+\delta e$ (partial electric charge $e \rangle \delta e$ [*]) in the front of motion or system, and $-\delta e$ in the back.

In addition, $-\delta e$ in the front of motion or system and $+\delta e$ in the back; in case of positive charge; essentially $\vec{E}$ and $\vec{B}$ are conventional vectors in order to study and discuss on electromagnetism interaction. In *Figs. 4(3), 4(4), 4(7)* the position and effect of $\vec{B}$ with respect to schematic structure of H particle–paths in an H-system (e.g. electron) are demonstrated; Moreover refer to *Sec. 3(1)2 ,* in which counter -currency of posipa and negapa are discussed.

In fact, $-\delta e$ and $+\delta e$ are the negapa and posipa fluxes or flow densities during the motion of the H system, i.e. in the direction or opposite direction of particle speed. In other words, the degree of right and left-handed selective spatial flux of negapas and posipas as singlet, *Note 4(1)1,* related to moving H system, *Fig. 4(7)b.*

Note 4(3)1, A2 - The reciprocal action of two fields *1&2* on each other or "fields interactions" resulting electromagnetic wave, or, in the other words, mutual action of negapa and posipa, *Fig. 4(3),* due to dipole vibration, generating radiation, *Fig. 4*(6). This figure relates only to one circumstance (*state I*), the other, i.e. *state II*, will be held by inversing the directions of $\vec{E}$ & $\vec{B}$ vectors. According to the H particle-paths hypothesis, there is no action at distance, *Sec. 5(4)5,* of two particles contrary to the classical concept instead of the interaction of a particle in the field, (i.e. potential spheres, *Sec. 4(6)4*), of the other ones take places. Moreover, in non quantized classical relativistic mechanic one can not attribute the specified dimension to fundamental particles, or, in other words, the fundamental particles must be considered as point like [1] *part 15*, contrary to the particle concept in H particle-paths hypothesis that it extended in a path-limit Γ, *Sec. 1(12).*

Comment 4(3)1, A1- The word of magnetic field is applied instead of magnetic induction field in the remaining of the text for the reason of simplicity.

B) Electron structure according to Fig. 4(4)

According to *Sec. 4(2), Sec. 7(4)2e*, a particle, e.g. electron, of n_{0e} H particle-paths at reversible motion, and $n_{\alpha e}$ single direction H particle-paths moving at v speed through vacuum spatial medium is packed in an H hall package, *Sec. 5(16)3a*, of path-length value h, and path-limit Γ. This H system during its motion successively changing its type *R & L* configurations, *Sec. 7(4)2e*. Thus, tracing (or accompanied by) a wave pattern as in *Fig. 4(4)* respect to an observer at rest through traveled path *P, Sec. 3(1)1*, in normal vacuum as following characteristics:

[*] δe Is the absolute value or magnitude of the partial electric charge.

I) Sign (•) means that magnetic field (*B* vector) is perpendicular to the reader page and toward the reader, and sign (×) means *B* vector is perpendicular to the reader page at downward direction.

II) According to $E_{qs.}$ *3(9) to 3(10),* N_f H particle–paths of frequency equivalent n_f , $E_{q.}$ *3(29)* moving on the forward path in the direction of wavelength λ , or velocity *v*, and in the backward paths respect to the direction of λ' .

III) Moving electron, *Remark 4(3)1, B1*, is composed of main-body axeon of successive configurations (e.g. *A,B,C, …* etc). N_f H particle-paths related to electron shell, *Sec. 10(6),* moving in an elliptical orbit ($\lambda + \lambda'$), that at it's focus located on an axial, (*x*-axis), constituted of rotating H-particle-path (neutropa), *Note 3(1)2a,* related to electron's axeon, *Sec. 10(8),* of the related cell. Moreover, they consecutively changing their paths in successive track texture cell, *Sec. 9(4)7,* in orbits or transferring from an orbit, e.g. *A*, to the other *B* …etc, *Comment 4(3)1, B1*. Thus, *Fig. 4(4)* shows *5* successive reversed handed track texture cells of type *R* or *L* of a moving electron in a path *P*.

IV) The path difference δl , *Eq. 3(9)* or $\lambda' - \lambda$ is the path change due to path or length contraction, $E_{qs.}$ *2(13), 2(18),* of the related cells in electron.

V) $(\lambda + \lambda')\upsilon_e$ is the total path per time unit (e.g. one second) of N_f H particle-paths of frequency equivalent n_f that moving about the electron. Thus, according to $E_{qs.}$ *3(29), 3(30)*, the path interval of a circulating H particle-path is obtained as:

$$\frac{(\lambda + \lambda')\upsilon_e}{n_f} = \frac{\lambda + \lambda'}{n_u} \qquad 4(4)$$

VI) Fig. 4(4), in fact is the longitudinal cut of electron's matterwave pattern structure by reader plan that coincides with the velocity vector $\vec{v}$ of electron speed; moreover, to obtain the total structure schema, this plane must be rotated 180° about the *x* or $\vec{v}$ axis.

VII) The partial charge, *Note 4(3)1, B1, Eqs. 4(8), 4(9),* $+\delta e$ at opposite sign of electron charge is in front and $-\delta e$ with the same sign as electron at the back of moving electron structure, i.e. left-handed spin, SP_l of electron. In other words, the electrons' axeon, *Sec. 10(8),* is left-handed. In case of electron at rest state, please refer to paragraph *XVI.*

VIII) Six states *A to F*, *Figs. 4(5)*, of electromagnetic interactions of two H-systems (fundamental particles) according to *table 4(1)* are shown:

In the cases *A* to *F* two H systems or masses *1,2* mutually interact on each others with magnetic forces F_{B_1} and F_{B_2} accompanying by photon *1&2* emissions as impulsions IF_{B1} & IF_{B2} that leaving the H-systems *1* and *2* respectively, *Consequence 4(3)1, B1*. The magnitudes of F_{B_1} , F_{B_2} , IF_{B1} and IF_{B2} are equal

Interaction of system 1 + field 2 ⟶ *Force 1*(F_{B_1}) + *photon 1*(IF_{B1}), *as impulsion,* or

Interaction of system 2 + field 1 ⟶ *Force 2*(F_{B_2}) + *photon 2*(IF_{B2}), *as impulsion* 4(5)

IX) If supposing photon-electron H system is moving along a circle at radius $r = \Gamma/2\pi$ instead of a photon alone as in Sagnac Effect, *Sec. 2(6)4,* in case of the waves of the H particle-paths accompanied by this H system, we have:

A) λ , The initial wavelength of the H system before motion, in two opposite directions of motion, *Case 1* of the *Fig. 2(5).*

B) λ_e , The wavelength of the H system in the direction of motion, (or, axeon, *Sec. 10(8),* wavelength).

C) λ' The H particle-paths wavelength of H system in the opposite direction of motion

Thus, the case *A* is analogous to the wavelength of light emitted in two opposite direction of Sagnac Effect at stationary case of roundtable platform. Moreover, the cases *B* and *C* are analogous to the wavelength of light emitted in the direction of motion and opposite direction to that respectively at the case of moving platform at *v* speed, i.e. electron-photon H system velocity.

X) According to the proposed structural model for an electron, it has a dual-characteristic according to its related interaction, i.e. wave-like or particle-like behavior, *Sec. 7(4)2e*.

XI) Any disturbance of the path-limit Γ , by an external mean (measurement, *Sec. 8(7)2*) affects the structural model of electron, *Fig. 4(4),* in path *P*, e.g., leading to velocity indeterminacy, grace of H particle-paths exchange characteristics (mutual interaction) of the two H systems, i.e. electron and measuring device; please refer to *Secs. 5(16)7,* and *8(4) to 8(7)2.* In fact, any isolated H system at each instant is confined in a quantum state nominated H hall quantized package, *Sec. 5(16)3a,* from viewpoint of H particle-paths hypothesis. As a result, before measurement (or detection) there is a correlation between H particle-paths of electron and emitting source, *Sec. 8(9)1*, due to mutual interchange through normal vacuum texture, *Sec. 5(16)3b, part A*, within related H hall package.

XII) Supposing any part of, *Fig. 4(4),* is considered in a co-moving arbitrary volume, *dV,* each of the H particle-paths path-lines that exits from this volume through its boundary surface will go back, or, in the other words, the total number entering or exiting H particle-paths remain constant due to path-length constancy. According to the location of volume *dV* respect to proposed structural model, *Fig. 4(4),* the population density of H particle-path's path-lines varies according to the volume *dV* location; moreover, if we consider the population density as probability of finding the electron, *Sec. 8(1)1,* in this volume. The above statement can be compared with the probability flux density in quantum mechanics. Please refer also to *Sec. 9(4)7, item 18*.

XIII) According to *Sec. 3(2),* the energy spectrum varies in district-quantized manner for a moving electron regarding the particle path-limit Γ by $h/m_0\Gamma$. Therefore, Γ value can be obtained experimentally from energy spectrum of a free moving particle such as electron.

XIV) In a double slit experiment, *Sec. 8(3),* when both slits *1* and *2* are open and no measurement is made, the H particle-paths of an electron as in, *Fig. 4(4),* superimposed on each other whether the experiment is done with an uncohereted beam of electron or electron passing one by one through double slits. i.e. superimposition of path-length of electron's H particle-paths of, *Fig. 4(4), Sec. 3(1)2, Comment 3(1)2a.* According to *Sec. 8(7)2*, *part G2*, an electron is guided by vacuum track texture, *Sec. 5(16)3b, part B,* during its passage from the slit *1* or *2*. Therefore, the other electron obeys the expanding track texture of the former ones successively at indistinguishable manner, *Remark 4(3)1, B2*; please refer to *Sec. 8(3), , Sec. 8(3)4,* and *Sec. 7(4)2e* in this regards.

XV) The emitted photon during electromagnetical interaction of two moving charged particles is entangled with the related charged particle; please refer to *Sec. 8(1)3, Comment 8(1)3b.*

XVI) According to [250] *section II, Local charge energy field,*" A large team of physicists presented experimental data that indicates the charge of an electron is not localized at a single spherical surface, but is spread out within the particle and may be stronger toward the core". On the basis of H particle-paths hypothesis the negapas as singlet propagates along with expanding gravitational closed surfaces as negatons, *Sec. 4(6)4*, and its density increases toward the ground closed surface at radius *ls*, i.e. Schwarzschild radius; please refer to *Secs. 5(4)1, 5(7)1*.

XVII) The electromagnetic field in case of free moving electron propagate as expanding potential sphere nominated Negatons, *Sec. 4(6)4*. Moreover, any group of magnetic flux lines similarly to expandons, *Sec. 5(16)1c, A3*, is confined in an H hall quantized package, *Sec. 5(16)3a*, of path-length value $2\hbar$, *Sec. 5(16)3g*, just during a measurement, *Sec. 8(7)2,* (or interaction); please refer to *part D*. Noteworthy, a charged mass-body, e.g. electron, and its related field can be regarded as a unique H system, *Sec. 8(5),* that is confined in an H hall package, *Simulation 8(7)2, E5a, Schema E5a*. However, during a measurement with other charged mass-body, *Fig. 4(7)b*, the quanta is taken form through an H hall package.

XVIII) "The extreme time dilation required at the photon capture region indicates that the electron gravitational field has a ring singularity. This ring singularity could be described as a closed-loop vibrating string" [403] *the concept*. This ring puts a lowest limit on closed axeon, *Sec. 10(8),* of an electron at rest state. Moreover, it has contribution in the structure of axeon of a moving electron.

XIX) The path-limit Γ has a constant value, *Remark 4(3)1, B3*, for all of the particles irrespective of their velocities through normal vacuum medium respect to the observer of kind *A* (or detector) at a spatial location. It depends on H particle-paths densities of vacuum medium, e.g. gravity free, *Sec. 7(4)3, part A*, and gravitating, Sec. 7(4)3, part D. Noteworthy, the stay time interval, *Sec. 7(4)2f, part A*, in a medium depends on H particle-paths population of the related particle.

XX) By analogy to *Simulation 7(4)2e1*, in case of a photon, the electron spin handedness is reversed at stay time interval ΔT_e successively during its travel in gravity free vacuum. It exits $WR \,\&\, WL$ expandons along with $PL \,\&\, PR$ contractons and transferred to a new H hall package. Therefore, each cell in *Fig. 4(4),* roughly represents the position of electron in each of its type R or L Spatial H hall package during its travel. The successive $WR \,\&\, WL$ expandons constitute the deBroglie matter wave, *Sec. 5(6),* of an electron that is co-moving at the same speed of electron, *Sec. 5(6)4, part A*. Factually, a free electron in space is constituted of two distinct parts in two different media. The electron main body is confined in an H hall package of path-limit Γ_d of SP_l configuration, i.e. a mass medium, *Sec. 7(4)3, part D*; while, its expandons of SN_r configuration (i.e. its field) is expanding within spatial medium, *Sec. 7(4)3, part A*, of equal magnitude path-length of opposite signs, *Sec. 5(16)11*. Noteworthy, in case of antimatter conjugate of electron, e.g. positron, according to above statement, the positron main-body similarly to that of electron is confined in an H hall package of path-length limit Γ_d of contracting SN_r configuration in related mass-medium, *Sec. 7(4)3, part D*. While, its expandons expanding of SP_l configuration in spatial medium, *Sec. 7(4)3, part A, i.e.* its field of equal magnitude path-length and opposite sign respect to its mass medium. Moreover, the mechanism of energy transfer by electro-magnetic radiation from an accelerated electron also obeys this mechanism. Noteworthy, the electromagnetical field similarity to case of electron has *WR* (or *WL*) H hall package during stay time interval ΔT. The background energy of the field at ground state, *Sec. 8(2)3,* and absolute zero is in the magnitude of $\frac{1}{2}h\upsilon$; please refer also to similar case of gravitational field, *Sec. 5(16)1b, part A, paragraph 26*, and *Note 7(4)2e1.*

XXI) In the center of mass of an electron, there is a reverson that is surrounded by an axeon, *Sec. 7(5)3b, item II*, reverax. In *Fig. 4(4),* it is shown by an axial white space in each of the electron position or cell. Please refer also to *Remark 10(6)2*.

XXII) The electron main body (or its mass medium nominating electron shell e_s, *Sec. 10(6)*) in spatial medium, e.g. vacuum gravity free, has an expanded path-limit Γ_d. While, during its absorption (or measurement, *Sec. 8(7)2*) by mass medium (or detector), its path-limit is contracted to Γ_{mass}, *Remark 4(3)1, B4*, as a contracted point-like particle at the rate of $\frac{\Delta T_{mass}}{\Delta T_d} = \frac{\Gamma_{mass}}{\Gamma_d} = K_\Gamma \approx 10^{-34}$, *Remark 2(3)1b*. Therefore, just after measurement, *Sec. 8(7)2*, electron can be visualized as a discrete material particle. While, the completely free moving electron (i.e. electron main body and its related field) in spatial medium cannot be viewed as a discrete point-like particle*, Remark 4(3)1, B5*. Because of the H particle-paths of electron in spatial medium are extended up to the electron as its field. "His (Einstein) knowledge of nature told him that discrete particles cannot exist because their borders would be an abrupt discontinuity" [501] *Historical Proposals.*

XXIII) In *Fig. 4(4)*, any type *R* or *L* cell in the axis represents an independent state of electron during one of its beat, *Sec. 7(5)3d, part D.* Moreover:

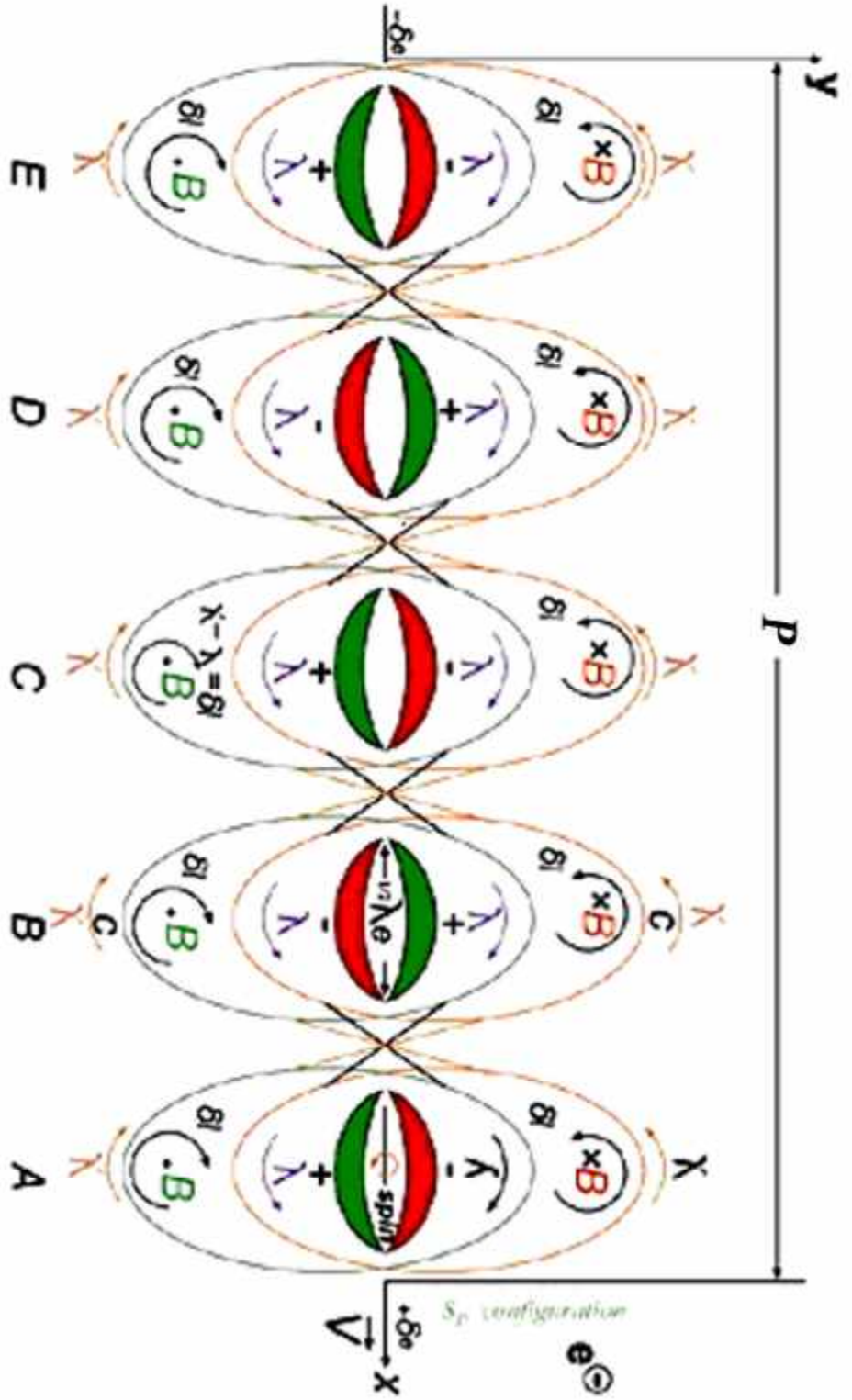
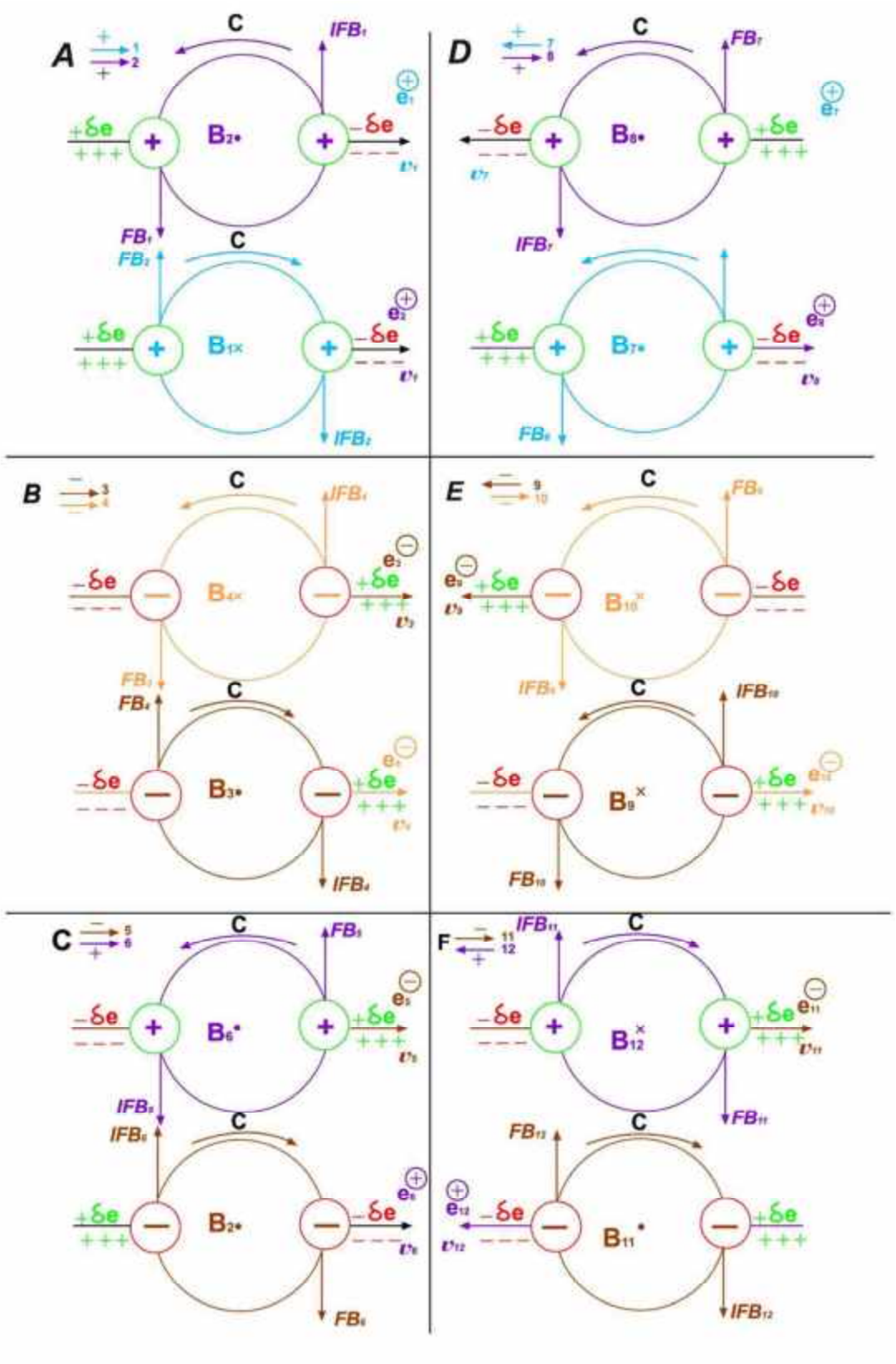


Fig: 4(4) - The Proposed structural model of a moving free electron at v speed in respect of motion of H-particle - paths



C - light speed and it's direction

Refer to page 28 (last paragraph) & page 23

Fig. 4(5)- Interaction of two moving charged 11- systems (cases A to F)

A)

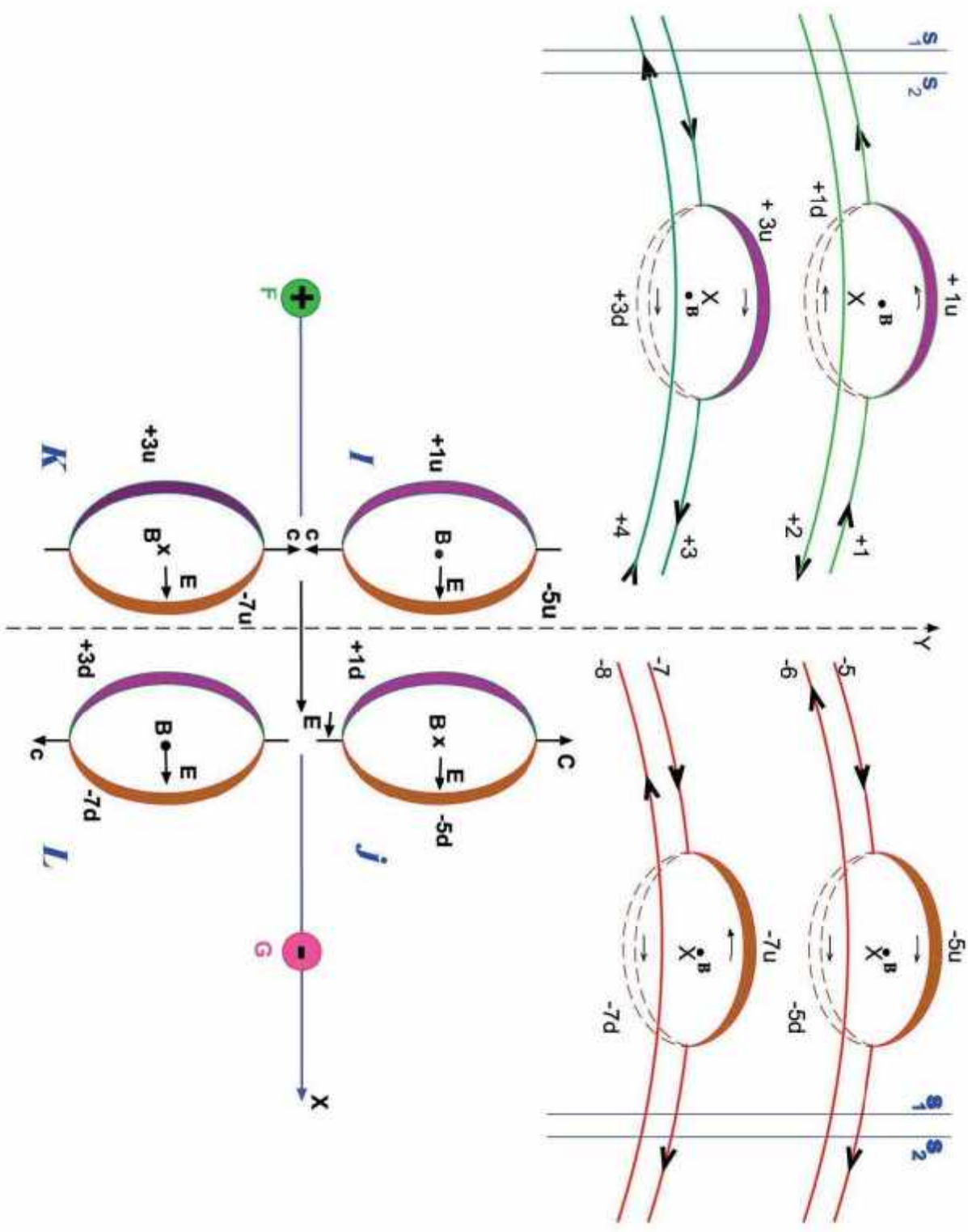


Fig. 4(6)- the successive stages in the emission of an electromagnetic wave from a dipole antenna.

2b

The *R & L* cells at the path-length limit Γ_d, i.e. *WR & WL* cells, *Sec. 7(4)2e1,* in succession represents the electron track texture in in spatial medium, *Sec. 7(4)3, parts A , B*; please refer also to *item XX*.

B) The individual type *R* or *L* cell cells at the path-length limit Γ_{mass}, i.e. $\Gamma_{mass} = K_\Gamma \Gamma_d$, *item XXII*, represents the axeon cell of electron, i.e. electron reverson, *Sec. 7(5)*; please refer also to *item XX*.

C) The type *R* or *L* cell can be viewed of superimposition of R or L sub-cell as in case of photon, *Sec. 9(4)7c*.

Consequence 4(3)1, B1- Factually, according to *Sec. 4(6)4*, photons of the kind *IFB1 & IFB2* are virtual, *Sec. 4(6)5*. These virtual photons that appears during field-particle interactions propagate spontaneously, *Sec. 7(4)2f, part c,* within abstract vacuum, *Sec. 5(16)3h*, via H hall package tunnels, *Sec. 5(9)3d, part c*, between interacting charged particles. They differ from electromagnetical (or normal) photons, that take their existence through field-field interactions, *Sec. 4(3)1, part c* in normal vacuum space. Therefore, propagating at *c* speed through normal quantized texture, *Sec. 5(16)3b, part A.,* the normal photon is confined in an H hall package, *Sec. 5(16)3a*, of path-length value *h*, *Sec. 5(16)3g*, and path-limit Γ , *Sec. 1(12)*. Please refer to *Simulation 8(7)2, E5a, item 10.*

Note 4(3)1, B1- The partial charge *(e)* in a moving charged H system is obtained as:

$$\delta e = \alpha |e| \qquad 4(8)$$

According to $E_{qs.}$ *4(2), 4(6), and 4(8):*

$$\vec{F}_B = \alpha e(\frac{\vec{v}}{|v|} \times \vec{B}) = \frac{e}{|e|}\delta e(\frac{\vec{v}}{|v|} \times \vec{B}). \qquad 4(9)$$

Comment 4(3)1, B1- Noteworthy, ''the electron doesn't travel within that (its) or orbital. Rather, it occupies all places within the orbital at the same time'' [360]. According to H particle-paths hypothesis the electron orbital is occupied by its wave-like track texture cells, of different densities electron transfer from a cell to another one during stay time interval $\Delta T_{(PE)}$, *Sec. 9(4)7, , item 15*, at finite speed at each instant. Therefore, electron is not a point-like particle, *Comment 7(5)3b1*, contrary to the classical notions, i.e. continuously moving at v speed.

Remark 4(3)1, B1- "Amongst the proton, neutron and electron, those fermions which constitute the vast majority of matter, the standard Model considers only the electron a fundamental particle. The proton and neutron are aggregates of smaller particles known as quarks, which are held together by the strong interactions"[213].

Table 4(1) - comparison table of electromagnetic interaction of two moving isolated H-systems.

State	*Speed v Direction & Charge sign*	$\vec{E}$	$\vec{B}$	$\vec{F}_e$	$\vec{F}_B$	Dipole	*Electromagnetic Force*
A	1 $\xrightarrow[+]{}$ 2 $\xrightarrow[+]{}$	E_2 E_1	$\bullet B_2$ $\times B_1$	F_{e1} F_{e2}	F_{B1} F_{B2}	$-\delta$ $+\delta$ $+\delta$ $-\delta$	$F_1 = e_1 E_2 (1 - \frac{v_1 v_2}{c2})$ $F_2 = e_2 E_1 (1 - \frac{v_1 v_2}{c2})$
B	3 $\xrightarrow[-]{}$ 4 $\xrightarrow[-]{}$	E_4 E_3	$\times B_4$ $\bullet B_3$	F_{e3} F_{e4}	F_{B3} F_{B4}	$+\delta$ $-\delta$ $-\delta$ $+\delta$	$F_3 = e_3 E_4 (1 - \frac{v_3 v_4}{c2})$ $F_4 = e_4 E_3 (1 - \frac{v_3 v_4}{c2})$
C	5 $\xrightarrow[-]{}$ 6 $\xrightarrow[+]{}$	E_6 E_5	$\bullet B_6$ $\bullet B_5$	F_{e5} F_{e6}	F_{B5} F_{B6}	$+\delta$ $-\delta$ $+\delta$ $-\delta$	$F_5 = e_5 E_6 (1 - \frac{v_5 v_6}{c2})$ $F_6 = e_5 E_6 (1 - \frac{v_5 v_6}{c2})$
D	7 $\xleftarrow[+]{}$ 8 $\xrightarrow[+]{}$	E_8 E_7	$\bullet B_8$ $\bullet B_7$	F_{e7} F_{e8}	F_{B7} F_{B8}	$+\delta$ $-\delta$ $+\delta$ $-\delta$	$F_7 = e_7 E_8 (1 + \frac{v_7 v_8}{c2})$ $F_8 = e_8 E_7 (1 + \frac{v_7 v_8}{c2})$
E	9 $\xleftarrow[-]{}$ 10 $\xrightarrow[-]{}$	E_{10} E_9	$\times B_{10}$ $\times B_9$	F_{e9} F_{e10}	F_{B9} F_{B10}	$+\delta$ $-\delta$ $+\delta$ $-\delta$	$F_9 = e_9 E_{10} (1 + \frac{v_9 v_{10}}{c2})$ $F_{10} = e_{10} E_9 (1 + \frac{v_9 v_{10}}{c2})$
F	11 $\xrightarrow[-]{}$ 12 $\xleftarrow[+]{}$	E_{12} E_{11}	$\times B_{12}$ $\bullet B_{11}$	F_{e11} F_{e12}	F_{B11} F_{B12}	$-\delta$ $+\delta$ $+\delta$ $-\delta$	$F_{11} = e_{11} E_{12} (1 + \frac{v_{11} v_{12}}{c2})$ $F_{12} = e_{12} E_{11} (1 + \frac{v_{11} v_{12}}{c2})$

Remark 4(3)1, B2- One the electron pair is reversed handedness spin, *Sec. 5(16)9b*, of the other one based on bi-universe hypothesis as in case of entangled pair of particle, *Sec. 8(7),* by the difference that the two electrons of the pair are moving towards slit; therefore, we encountered with an interference. Noteworthy, an electron before measurement can be considered as zero spin due to indeterministic behavior of its H particle-paths, item *XX*. According to *Sec. 5(16)11*, one electron has SN_r configuration spin, whereas the other one has SP_l one along with slight preference of the former, *Consequence 5(16)8b1*. Thus, the two electrons are entangled to the source up to an interaction (or measurement, *Sec. 8(7)2*) with a detector. Please refer also to *Secs. 7(4)2d, e*.

Remark 4(3)1, B3- According to *Sec. 5(16)3b, part D2* in case of *Fig. 4(4),* the a^{-1} (or the coefficient *a*) depends on the combined admixture of vacuum quantized texture, *Sec. 5(16)3b, part A,* and gravitational field texture, *Sec. 5(16)1b, part A*, and *Sec. 7(4)3, part B*. Therefore, the path-limit Γ is determined based on *Eq. 7(31)* of *Sec. 7(4)3* for a particle respect to *CMPRF's* observer of kind *A, Sec. 8(9)2*, located at its origin. In that case, the origin o is coinciding with the center of mass of the Earth due to huge inertia of the latter, *Sec. 8(9)3*. Please refer also to *Comment 3(1)1a*.

Remark 4(3)1, B4- "A simple calculation using *Principle II* also yields an eye opening relationship between the effective radius r of the electron waves, the radius R of the Hubble universe and the number N of particles in the universe, termed the *Equation of the Cosmos*:

$$r^2 = R^2 / \sqrt{3N} \qquad 4(8)1$$

The computed value of r corresponds with the classical electron radius, approximately $10^{-15} m$." [501] *Equation of Cosmos*. Comparing the path-limit Γ_{mass} with the electron radius r in mass medium, and $R = H_0^{-1}.c$, *Remark 5(16)1a2*, the *Eq. 4(8)1* can be written as following:

$$\Gamma_{mass} \propto c\, H_0^{-1} \times \sqrt[4]{3N}$$

Remark 4(3)1, B5- "Albert Einstein was also aware of this problem (renormalization) as he explains in his critique of Lorentz's electromagnetic field theory for electrons (as it is still the same fundamental problem of the particle / electromagnetic field duality). The inadequacy of this point of view manifested itself in the necessity of assuming finite dimensions for the particles in order to prevent the electromagnetic field existing at their surfaces from becoming infinitely large." (Albert Einstein, 1936)."[504] *History*. From viewpoint of H particle-paths hypothesis, a free moving particle main-body is confined in path-limit Γ_d ; while, the H particle-paths of its field are extended up to infinity. Please refer also to *Sec. 8(8)3, item F*.

C) – Electromagnetical expandons

I) Figure *4(6)* gives a schematic picture of how the radiation, *Note 4(3)1, c1*, of electromagnetic field is formed on the basis of posipa and negapa field interactions *Fig. 4(3),* The electric field can be deduced from the locations of the positive and negative charges of the dipole *FG* . Moreover, the magnetic field is perpendicular to reader page and its directions shown as spot $\bullet$ in the case toward the reader and as $\times$ in opposite direction.

II) Schema is related only to one stage, pole *F* positive and pole *G* negative (state *I*), the other stage may be obtained by inversing the electric charges of dipole, (state *II*).

III) On the left hand of the *Fig. 4(6),* the H particle–paths field-lines related to posipa moving at *c* speed from positive pole at *F* due to different directions on *y, x* plane nominated as *+1* to *+4,* are shown. The field-line *+1* has δl path length; i.e. it undergoes Delta Effect, *Sec. 2(1)1b, Fig. 2(3),* effect relative to field-line *+2* at its opposite direction ; so the field-line *+3* on *+4* . On the right hand of *Fig 4(6)* , the H particle-paths (negapa) at *C* speed related to negative pole at *G* is shown, at this stage the field lines *–5* and *–7* have δl effects on field lines *–6* and *–8* respectively. The interaction related to δl revealed at *FG* region as neutropas *i, j, k ,l* formation related to cells of magnetic wave (or *P*-expandons, *Comment 5(2)1c1*); by interchanging the charges sings at poles *F* and *G* successively. We encountered with 4 types of electromagnetic waves on the basis of mentioned above cells at the direction of *y* - axis (*j,k*) and at opposite of its direction *(i , l).*

IV) The neutropa cells (e.g. *i, j, k, l)* are obtained by the interactions of $\delta l's$ path difference (*+1u,-5u), ,(+1d,-5d), (+3u ,-7u*) and *(+3d , –7d*) respectively as is shown in *Fig. 4(6)* relating to one stage of dipole , positive pole *F* end negative pole *G* (stage I). For more detailed on manner of interactions refer to cases *d* and *e, Fig. 4(3),* that have the main effect on neutropa cell formation from a posipa and negapa H- particle-path with the same $\vec{B}$ vectors.

V) Two parallel sheets S_1 and S_2 perpendicular to *x*-axis for evaluating of the charge density change during the time are imagined.

VI) By interchanging the charge sign of *F* and *G*, poles the cell related to stage *II* are formed .Thus, by quantized H hall, *Sec. 5(16)3a,* space units, successive superposition of any two cells of stages *I* and *II* according to *Sec. 7(2),* an electromagnetic wave generates.

VII) In case of non-stationary *F, G* poles, (e.g. these poles rotate around a central location) a rotating electromagnetic wave front is formed. Please refer to *Sec. 2(6)4c*,

VIII) In the above *Cases VI, VII*, the expanding track texture, *Sec. 5(16)3b, part B*, of the charges of two poles *F*, and *G* trace the geometrical shape of electromagnetic waves. In other words, expanding spheres of the wave front taken form which in *Case VII* has a rotating feature.

IX) The stated above neutropa cells as in *Fig. 4(6)*, are the electromagnetical expandons, nominating *E*-expandons. It is analogous to expandons of gravitational field, of matter wave counterpart of photon, *Comment 5(2)1c1*. The *E*-expandon similarly to other types of expandons is the main expandon generating in electromagnetical waves. It splits to sub-expandons, *Note 4(3)1, C2*, by analogy to other types of expandons, *Sec. 5(16)1a, part B*.

Note 4(3)1, c1- The electromagnetic radiation of the kind field-field interaction contrary to that of field-particle interaction, *Consequence 4(3)1, B1*, is real. In other means, it propagates at c speed through vacuum quantized texture, *Sec. 5(16)3b, part A*.

Note 4(3)1, c2- According to *Sec. 7(1), Eq. 7(8),* and *Sec. 7(4)2e*, a signal (or main E-expandons) of energy E has a stay time (or life-time) ΔT in an H hall package, *Sec. 8(7)2, part E2*. Therefore, it transfers to an other H hall package of reversed handedness along with sub-expandons generation, and so on. The sub-expandon similarly to main expandon occupies an H hall package; thus, depending on it energy has a stay time ΔT , *Sec. 7(4)2f*. Therefore, any sub-expandon split to lower energy sub-expandons, and so on. Noteworthy, the path-length of any main or sub expandon as a close-ended particle has $2\hbar$ value irrespective of their attached energy in order to create an track texture as in item *VIII*, please refer to *Comment 5(16)3a1*.

D) – Magnetic flux quantum

Considering the *Fig. 4(3), item b* (top), of the left side *model 3, or, 4,* assuming the arbitrary electric charge *q* moving in a circulating mode, the magnetic flux, Φ_m , defined as following:

$$\Phi_m = \iint \vec{B}.\, d\vec{S} = \iint \left(\vec{\nabla} \times \vec{A}\right) d\vec{S} = \oint_0 \vec{A}.d\vec{r} \qquad 4(5)1$$

Where:

$\vec{B}$, is the magnetic field density on the area element $d\vec{S}$ of surface *S*.

$\vec{A}$, vector potential, *Sec. 4(6)3*, that denotes H particle-paths as singlet on the boundary o ; please refer also to *Secs. 4(6)3, 8(1)3*.

$d\vec{S}$, is the area element vector on the surface *S*.

dr , is a tangential segment vector on the boundary o .

Φ_m , is magnetic flux through the surface *S* enclosed by the boundary o .

Therefore, according to the conventional definition of $\vec{B}$ and $\vec{E}$; Φ_m is electromagnetical equivalent of path-length value h on a closed path of boundary *o* of a charge unit, i.e. $q = 1$. According to experimental results for particles, e.g., electron, proton, this path-length is equal to *h* (Planck constant, *Sec. 2(1)2*) as a physical fact; therefore, on the basis of above statements and considering $q = e$ for such particles, Φ_m will be equal to h/e , or, in other words, the path-length of a real charged particle in physical (or natural) world will be $h = e\,\Phi_m$. In addition, for systems of pair of charged particles, i.e. $q = 2e$, it is equal to $h/2e$. According to [284] "*I)* the unit of flux quantization in super conductors is $\phi = h/2e$ ". Please refer to *Sec. 4(6)3, Note 4(6)3b*. This finding has the first experimental proof of the famous *BCS*-theory."; "*II)* The characteristic flux in the Aharanov-Bohm Effect is quantized in units of $\phi = h/e$. According to discussion held on *Sec. 2(4)*, $e.\Phi_m$ can be considered as path-length in the electromagnetic part of action, *S*, relationships, *Sec. 5(16)3g*; please refer to [1] *part16, equation 16(1)* in this regards.

4(3)2-Discussion

According to *Fig. 4(5)* and *table 4(1),* we conclude:

1) Two H-systems with equal sign of the electrical charge:

A) At the same speed directions e.g. *A* and *B* have two attracting magnetic forces at equal magnitude.

B) At opposite speed direction e.g. *E* and *D* have two equal repelling magnetic forces at equal magnitude.

2) Two H systems with different sign electrical charges:

A) At same direction, e.g., *c*, have two repelling magnetic forces at equal magnitude.

B) At opposite direction, e.g., *F,* have two attracting magnetic forces at equal magnitude.

In all of the cases *1&2,* the direction of magnetic forces is compatible with the partial charges sign of related dipoles.

3) If the electric charge of a set of H-systems are inversed or multiplied by *(-1)*, (e.g. $e^- \to e^+$ and $e^+ \to e^-$), there, will be no change in interaction of moving H-systems *(C –symmetry,* due to charge conjugation*), Comment 4(3)2a.* Please refer also to *Sec. 2(1)1d.*

4) In the states of *A,B,C* the total electromagnetic force is decreased by increasing the speed v_1 and v_2 of H-systems as v_1 and $v_2 \to c$ the electromagnetic forces, F_1 and F_2 , decrease. In the states *D, E, F* the total electromagnetic force is increased by increasing the speeds v_1 , v_2 of the H-systems; as v_1 and $v_2 \to c$, electromagnetic forces F_1 and F_2 increase.

As it is shown in *Fig. 4(5),* the path difference ΔL has main effect on appearance of magnetic field and is identified by an arrow $\vec{c}$. Any charged H-system, e.g. electron, proton, etc., constitutes fields of H particle-paths at the same (or identical) sign as their charges, (i.e. the same handedness), in the path difference ΔL that strike with the partial charge $+\delta e$ and $-\delta e$ (or charged particle) of the other H-system as following:

The striking H particle-paths of H system I* combine with H particle-paths of the same sign in H-system *II* to make force $\vec{F}_{B_2}$ and with the H particle-paths of opposite sign to make neutropa of impulsion photon IF_{B_2} and vice versa , i.e. H system II and H system I interaction). According to $E_{qs.}$ *2(85) , 3(9),* ΔL is proportional to α , *Sec. 2(1)1a*, or the speed *v* of related H-system and increased or decreased by incoming or outgoing H-particle –paths in that H-systems. Moreover, it has inherent effect in establishment of magnetic field, $E_{q.}$ *4(3),* thus:

$$\vec{B} = \alpha(\frac{\vec{v}}{|v|} \times \vec{E}) \text{ or } \vec{B} = (\frac{\vec{v}}{|v|} \times \alpha\vec{E}) \qquad 4(6)$$

Where, α , is the ratio of single direction H particle-paths to the total one, *Eq. 2(7).*
According to $E_{q.}$ *2(85):*

$$\vec{B} = \frac{\Delta L}{2c}(\frac{\vec{v}}{|v|} \times \vec{E}) \quad 4(7)$$

and in case of low speed $c \rangle\rangle v$ $E_{q.}$ *4(6)* reduce to:

$$B = \frac{|v|}{c}(\frac{\vec{v}}{|v|} \times \vec{E}) \; or \; B = \frac{1}{c}(\vec{v} \times \vec{E}) \;\; , \;\; E_{q.} \; 4(3)$$

According to $E_{q.}$ *4(6),* $\alpha\vec{E}$ will be the result of partial charges (δe) interactions.
The manner of ΔL effect in a charged moving H-system at *v* speed is shown *Fig. 4(7)*

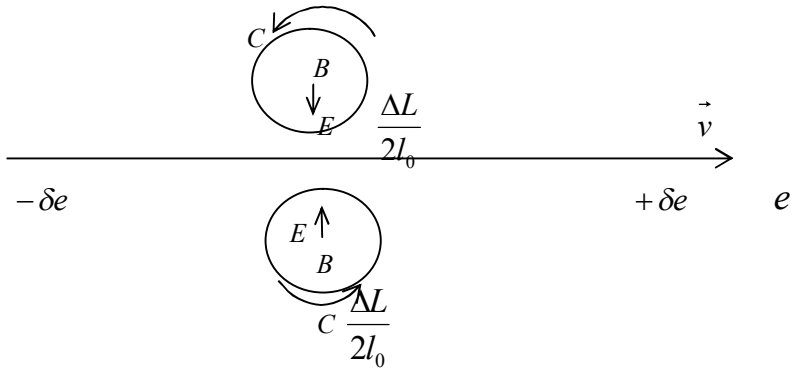


Fig. 4(7)a - the ΔL *effect, Sec. 2(1)1b*

Comment 4(3)2a - "Our Universe is not invariant under charge conjugation (it's possible for a solution to be less symmetric than the laws describing it), owing to the fact that (at least the nearby part of) our physical Universe is made up of matter and not antimatter, though, in principle the choice of positiveness or negativeness is only a convention, in reality asymmetry of charge is an observed fact" [140]. Please refer to *Secs. 5(16)6 to 5(16)9b,* for additional information.

4(3)3 – Spin dependence of field interactions
Considering *Fig. 4 (5)* state *B,* model $B_3(e^-)$ and $B_4(e^-)$,of two negative charged particles on the basis of counter –currency mode of H particle-paths motions*, Sec. 3(1)2*, and referring to *Fig. 4 (7) b,* and *Note 4(3)3a,* we have:
I) The incoming negapa field–line from $B_3(e^-)$, [e. g., toward. $B_4(e^-)$], has a single downward direction *SNr* (type *R*) configuration, (i.e. Negapa with right–handed spin, *Sec. 9(2)*, *Note 9(2)2,* respect to the oy_2 direction). This field- line returned clockwiselly according to *Delta Effect, Sec. 2(1)1b,* as in *Sec. 4 (3)1* at upward direction, oy_1, whereas conserving its SN_r (type *R*) right-handedness configuration.
II) The neutropa axeon (or framework) of $B_4(e^-)$, *Sec. 10(8),* and *Note 3(1)1d,* and *Fig. 4(4),* at its speed *V4* (ox_1 direction) has *SPl* (type *L*) posipa- negapa countercurrent configuration, along $x_2\, x_1$ axis, i.e. left–handed spin along ox_1 axis, *Fig.4(7)b*. Moreover, the posipa and negapa related to this axeon moving at clockwise spin direction respect to ox_1 and *ox2* directions respectively. In other words, posipa at V_4 direction and negapa at $-V_4$ as if you are unscrewing a left–handed screwed bolt (posipa) and nut (axeon) and a right-handed bolt (negapa) and nut (axeon) at two opposite directions, whereas the two nuts rotate together according to left-handed rule at same direction and equal speed], refer to *Sec. 3(1)2.*

* *field - line*

III) The incoming negapa of B_3 (e^-) field–line (i.e. type *R paragraph I*) interact with posipa of B_4 (e^-) axeon at SP_l , (type *L*) to form *I F* B_4, photon.
IV) On the other hand, the B_3 (e^-) field –line interacts with negapa of B_4 (e^-) axeon in its returned paths, to form *F* B_4 upward magnetic force with negapa –negapa SN_r (type *R*) with right-handed configuration.
V) Similar steps as *I* to *IV* occurs in case of *B3* (e^-) respect to incoming negapa field-line from B_4 (e^-), i.e. interchanging *B3* (e^-) & B_4 (e^-).
VI) Analogous to electron as in *Fig. 4(4), Sec. 4(3)1, part B, item XXIII,* any cell of red & green colors in the axis of charged particle B_4 (e^-) in *Fig. 4(7)b* represents type *R* or *L* state or spin configuration of this particle during a beat, *Sec. 7(5)3d, part D.*

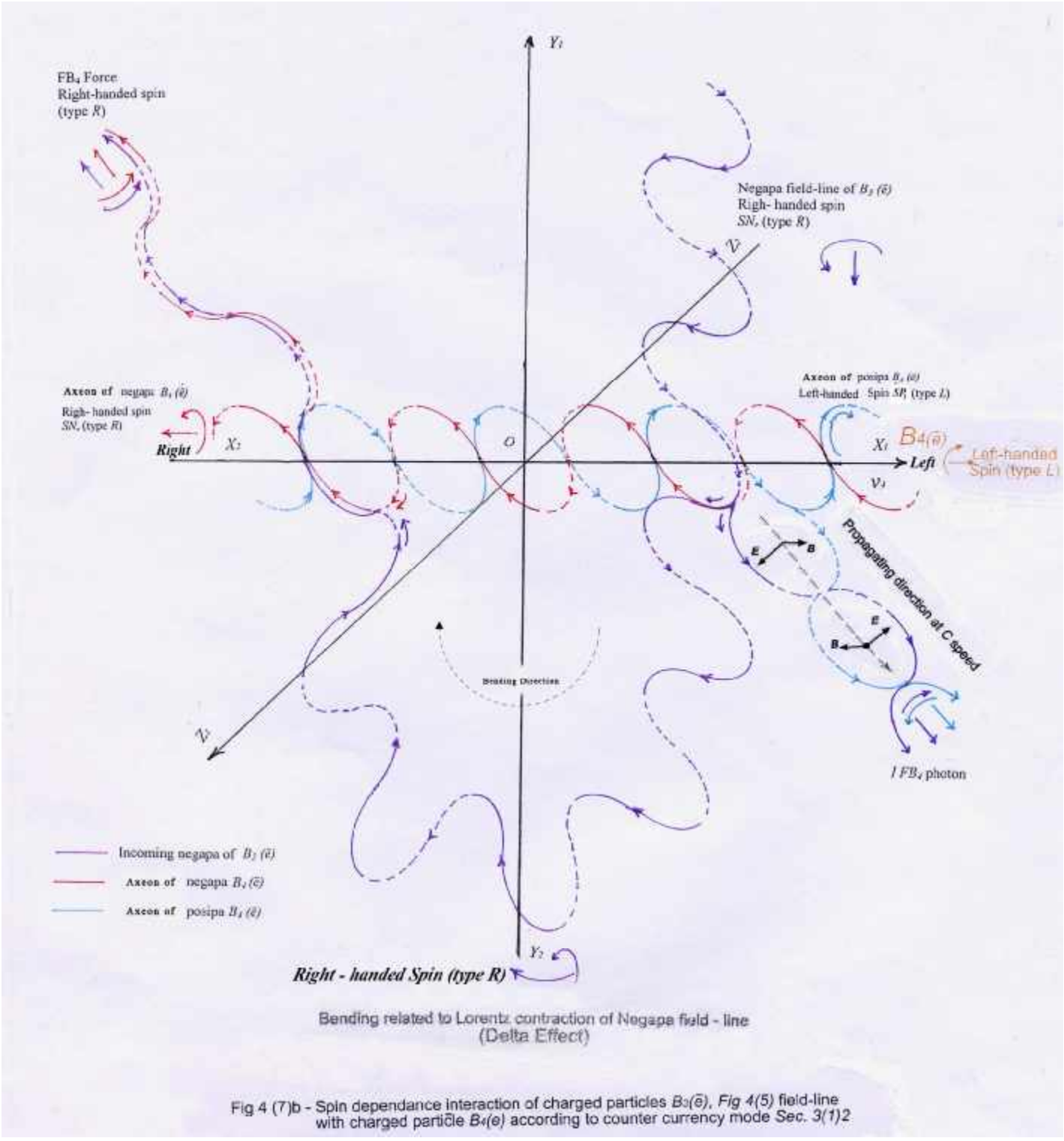


Fig 4 (7)b - Spin dependance interaction of charged particles $B_3(\bar{e})$, *Fig 4(5)* field-line with charged particle $B_4(e)$ according to counter currency mode *Sec. 3(1)2*

Moreover, at the all stages *A* to *F* of two interacting charged particles similar results analogous to the case of *Fig. 4(7) b*, will be obtained on the basis of, *Fig. 4(5).* Moreover, the single direction *IF* photon type *R* or *L* is emitted; therefore, magnetic force (*e.g.FB4*) at co-direction negapa- negapa (type *R-R*) configuration applied to the interacted particles. This force nominated bosonic, i.e. negapa or posipa at the same direction; in return, the axeon B_4 (e^-) with its *SP* configuration *Sec. 3(1)2, Fig. 3(5) a* is nominated fermionic due to posipa and negapa in a forward and backward motions at opposite directions and spins. Thus, the bosonic style is related to single direction or irreversible motion of H particle –paths, *Sec. 1(3)1* e.g. forces, virtual photon, *Note*

4(3)3a, (no rest mass), *Sec. 4(6)5b*. At the case of collision, force application, *Sec. 6,* or photon absorption, the entered bosonic neutropas are split to its components as follow:
In return, at the case of photon emission or exits of neutropas during collision and force application, the reverse process takes place.
Similarly, the comparable result as above at the case of a binary H system of two free moving particles at opposite charges (e.g. electron and positron) will be occurred, i.e. the electron axeon has left-handed spin (type *L*), whereas the negapa field–line of electron and the resulting force, have right–handed (type *R*) as steps *I* to *IV*. Moreover, the positron as electron antiparticle has reversed axeon and field–line spin configurations. In this case, B_3 particle is a positive charged (e^+), *Fig. 4(5)c,* instead of being negative $_{as}$ in *Fig. 4 (7)b*; thus, the incoming field –line from B_3 (e^+) toward B_4 (e^-) is posipa with left–handed spin (type *L*). On the basis of the above statements, a photon, type *L,* emitted from B_4 (e^-) toward B_3 (e^+) and vice–versa. Moreover, repelling magnetic forces are in the same direction as in *Fig. 4 (5), c_5, c_6.*
As a result, assuming that negapa has a right-handed spin (type *R*), whereas posipa has spin (type *L*) configuration. Now, we can analysis the interaction of two free moving charged particle, *Sec. 4(3), Fig 4(5)* in respect of the magnetic forces and emitted virtual photons, *Note 4(3)3a*, simply according to *R, L* type spin configuration as above. In other means, a type *R* force is accompanied by a type *L* photon at opposite direction and vice versa as follows:
A) Two identical types spin i.e. *R-R or L-L,* co-direction H particle–paths making forces type *R* or *L* respectively. In other words, two co-direction negapa-negapa or posipa-posipa is making forces.
B) Two opposite type spins, i.e. *R,* (or *L*), making photons. In other words, two co-direction negapa-posipa (or posipa-negapa) of *SM* configuration related to bosonic group making *R* (or *L* photon), *Fig. 3(4)c* of *Sec. 3(1)2*. Thus, free moving photon has two types, *L,* or *R* configurations, i.e. at the same spin as particle (or axeon) that emit it. On the other hand photon has no internal motion in accordance with the constancy speed of light respect to an observer at rest, *Sec. 4(3)4*. In return, photon during its interactions with other particles splitting to negapa and posipa, as if it has a left–handed or right-handed spin $1\hbar$ configuration, *Sec. 9(4)7c.* According to the stated above discussion, the annihilation of electron and positron resulting two photons with types *L & R* configurations emitting at opposite directions.
Remarkably, the electromagnetic field propagated similar to the gravitational one on the expanding sphere, *Sec. 5(4).*

Note 4(3)3a- The electromagnetical field-line of a charged particle similarly to case of gravitational field acts like an expandon, *Sec. 5(16)1a, part B,* during its expanding propagation, i.e. negatons, and positons, *Sec. 4(6)4*. Therefore, its *P*-contracton conjugate, *Comment 5(2)1c1*, i.e. *IF* photons play the role of virtual photon force carrier, please refer to *Sec. 4(6)5b* for further information.

4(3)4- Photon spins

Supposing photon passing through an imaginary flat surface *S* perpendicular to its velocity axis; thus, according to its spin, one can deduced the clockwise (type *R*) or counter-clockwise (type *L*) track of its H particle-paths on this surface. As if you are passing a spring wire at rectilinear straight motion with no rotation, i.e. zero internal energy, through the surface *S*; thus you can imagine the circular motion of the intersection point of the spring wire with that surface.

Note 4(3)3a- In the *Fig. 4(7)b* for the reason of simplicity, the counter-currency mode of posipa and negapa motion are supposed as if the particle at a non moving state, i.e. the case of an axeon at rest, *Fig. 3(4).* Whereas, the *Fig. 3(5)* must be considered, i.e. a moving particle (or axeon) at translational motion. In other words, according to constancy of the light speed there is a contraction in the direction of translational motion (e.g. posipa) and dilation in its opposite direction (e.g. negapa) of particle axeon in case of *Fig. 4(7)b* due to the particle spin or spinning motion of the related axeon. Please refer to Delta Effect, *Sec. 2(1)1b.*

4(4)- Photon regarded as a moving H system

Photon [13] speed at vacuum is equal to c and similar to electron, its structure consist of main-body superimposed cells, *Sec. 9(4)7c,* of single direction, *Comment 4(4)1*. It is along with *type R & L* neutropas of its matterwave counterpart, *Simulation 7(4)2e1* of frequency υ moving at velocity c along x-axis of reference frame *R* respect to tits observer *A* (at rest), *Fig. 4(8)*. Now, supposing two parallel sheets S_1, S_2 perpendicular to the direction of emission (x-axis). According to *Sec. 4(2)* each matterwave neutropa cell (*WR* or *WL* expandon) consists of two co-direction posipa and negapa, *Fig. 4(8),* with electric field *E* and as the cell passing through $S_1 S_2$ respect to observer *A* at rest. Thus, we encounter with a moving partial charge with variable neutropa (or expandon) density between S_1, S_2 that its density and sign varies with time in the direction of arrows. Referring to *Fig. 4(1) to 4(3)* and $E_{q.}$ *4(3)*, a variable magnetic field $\vec{B}$ according to $\vec{E}$ variation with the same magnitude will be obtained. The directing of $\vec{B}$ depends on posipa and negapa position in cells a to d during passion through S_1, S_2; moreover, the direction of magnetic field vectors is perpendicular to the page of reader and according to posipa and negapa position in *yx*-plane is toward and downward the reader. According to *Delta Effect*, *Sec. 2 (1)1b, Fig. 2(3),* and *Fig. 4(8) we* have*:*

$$\frac{\lambda}{2} = OD'P = l' \ , \ ODP = l_0 \ , \ \delta l = \overset{\frown}{ODP} - \overline{OD'P} = l_0 - l' \qquad 4(10)$$

In the, *Fig. 4(8),* the longitudinal component of the vector potential, A_x, i.e. the component pointing in the direction of matterwave propagation, or, in other words, its single direction (or irreversible) part of H particle-paths flow rate; please refer to *Sec. 2(4)1, Sec. 2(4)2b,* and *Consequence 4(4)1.*

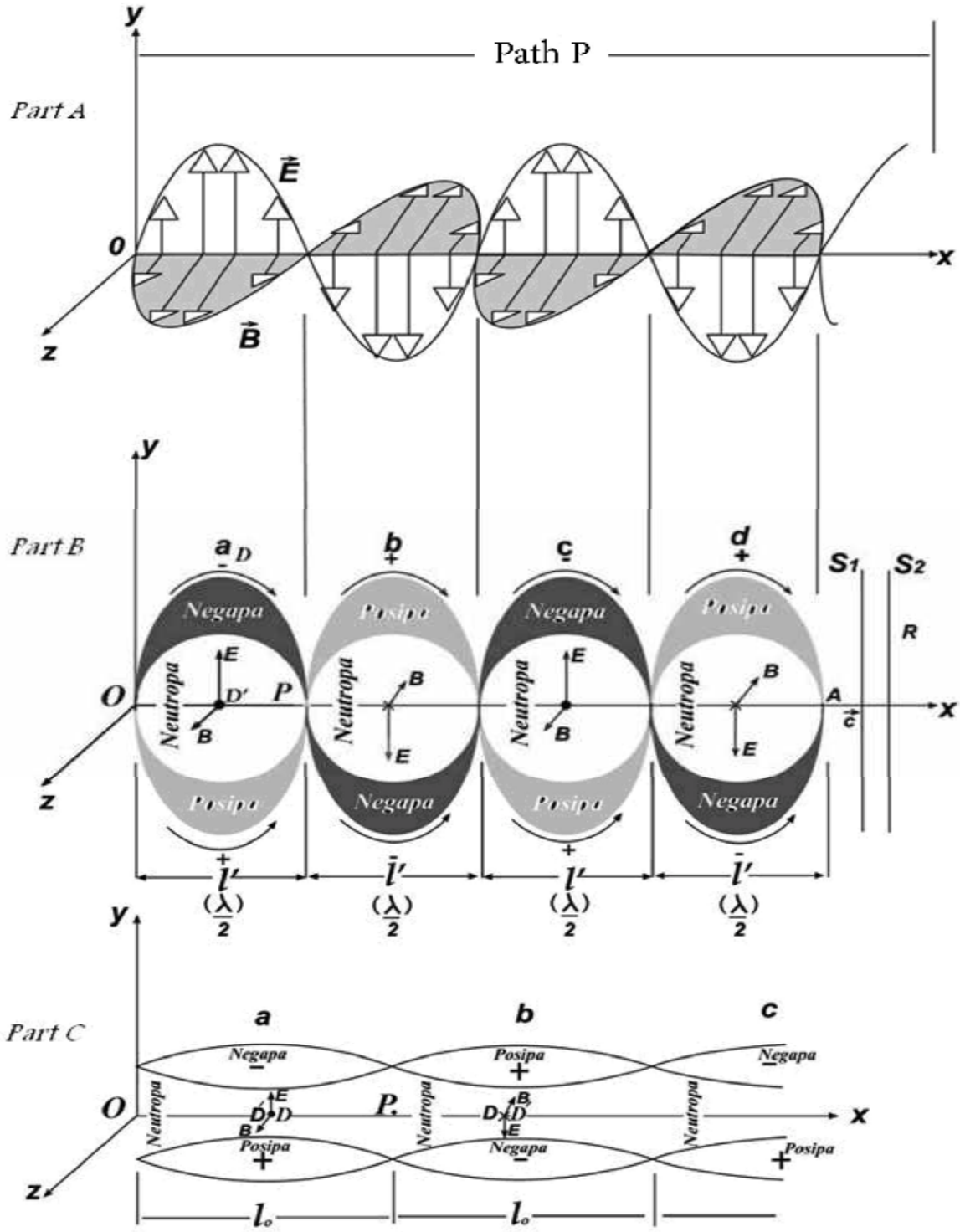


Fig. 4(8)- H particle- path (posipa & negapa in a neutropa unit) in a photon H- system respect to an observer at rest.

Consequence 4(4)1. The transverse component, A_y ($A_z = 0$) pointing normal to the direction of wave propagation undergoes oscillation, or, in other words, the reversible part of H particle-paths flow rate from viewpoint of vector potential concept, *Sec. 4(6)3*.

Supposing that *xy-plane* of, *Fig. 4(8),* is a plane of polarized waves propagate at *x* direction. The polarized wave undergoes Faraday rotation in a magnetic field, *Fig. 4(2) or 4(3)*. "The plane of linearly polarized light is rotated when a magnetic field is applied parallel to the propagation direction"[120]. According to H particle-paths hypothesis the negapa and posipa of, *Fig. 4(8), part B* is at right angle respect to that of magnetic field $\vec{B}$, *Fig. 4(2) or 4(3)* that leads to a rotation of the handedness direction that depends on the direction of magnetic field respect to the direction of rotation. Moreover, according to the following equation [114], part related to *Faraday rotation*:

$$\theta(\lambda) = \alpha\,\lambda^2 + \chi \qquad 4(10)1$$

Where, θ is the observed orientation of the polarization plane that depends on λ^2. In other words, more population of negapa-posipa of, *Fig. 4(8), Part B,* due to shorter wavelength of λ , leads to small angle rotation θ in its interaction with a constant number of negapa-posipa of the magnetic field, *Fig. 4(2) or 4(3).* As an example assuming the magnetic field is related to an accelerated negatively charged particle, i.e. right-handed negapa circulating at counterclockwise mode with magnetic vector downward to the reader page, *Fig. 4(3)b.* Therefore, the right-handed negapa according to H particle-paths rules combine with the negapa of the applied magnetic field and at the same direction of its propagation, i.e. at perpendicularly downward to the reader page, and twist the polarization plan at right-handed angle θ respect to the reader, i.e. counterclockwise mode. This combination is ended after exit of electromagnetic wave from the magnetic field. Thus, the angle θ depends on the magnetic field strength and the path of the electromagnetic waves through the magnetic field. Moreover, according to *Eq. 3(17)2,* the amplitude high of a wave is proportional to its wavelength; thus, the cross section (or duration) of interaction in the plane of polarization (*xy-plane*) is proportional to $r\lambda$, or, in other words, to λ^2.

Note 4(4)1- Considering, *Fig. 4(8),* a packed photon main-body, *Sec. 9(4)7c,* in a path-limit Γ , *Sec. 1(12),* of an H hall package along with its matter wave counterpart extended in path *P*, *Sec. 3(1)1*, has a dual-characteristics, *Sec. 7(4)2e*, according to its related interaction, i.e. wave-like, *Sec. 4*, or particle-like, *Sec. 3*. According to Bohr's principle of complementary which state that a quantum system may exhibit both wave and particle properties, but not both in the same experiment, *Remark 4(4)1*. However, recently an optical non-destructive which-way experiment nominated " Afshar experiment: [146]. If it is proved, seems to contradict the principle of complementary, since it shown both complementary wave and particle characteristics simultaneously in the same experiment for the same photon. In other words, "it is established that in the same experiment, sharp complementary wave and particle behavior can coexist so that violating principle of Complementarity" [146], *part 5*; please refer also to *Sec. 5(16)6, Experiment 5(16)6a*, and *Sec. 8(3)3*. Noteworthy, the path-limit Γ , and path P in successive positions of the main photon and its matter-wave counterpart during stay time intervals is shown in *Fig. 4(8)*. Any cell related to photon half-wavelength $\frac{\lambda}{2}$ is the cell of a photon matter-wave, i.e. type *WR* or *WL* expandon. In other words, an expandon cell in a position of type R or L (related to WR or WL expandon, *Simulation 7(4)2e1*) that is confined within a type R or L H hall package of path-limit P successively during photon travel in spatial medium, *Sec. 7(4)3, part A*. Factually the photon during its propagation is confined in an H hall package of path-length magnitude h within main photon medium (analogous to mass-medium *Sec. 7(4)3, part D* nominating zero rest mass medium of SM configuration). While, the expandon is limited in an H hall package of path-length magnitude $2\hbar$ in spatial medium, *Sec. 2(4)4b*. The path-length of H hall package of expandon due to type R and L configurations have two opposite sign path-lengths of equal magnitude and opposite sign. Similarly, the path-length of zero rest mass H hall package due to type R and L configurations have two opposite sign path-lengths of equal magnitude and opposite sign. The photon and its matter wave cell (or their H hall packages) have a common reverson that is surrounded by photon main-body axeon, *Sec. 7(5)3b, item II*, within photon main-body. Moreover, according to *Not 7(4)2e1*, the *WR* or *WL* expandon of matterwave cells are spindle-like as in *Fig. 4(8), part c*, the expandons are propagating in planes through spatial medium, *Note 8(7)3a*.

Note 4(4)2- According to *HPPH*, the photon main-body is linked to mass medium, *Sec. 7(4)3, part D*, via an H hall package tunnel, *Sec. 5(9)3d, part c*; while, its matter counterpart is related to spatial medium, *Sec. 7(4)3, part A*. According to Bohr complementarity, both mass and spatial media of contracting and expanding characteristics respectively cannot be involved at once in a same experiment.

Comment 4(4)1 – According to [292] *part 4*, [293] *part 6*, "(*1*) the experiment would provide a second kind electromagnetic radiation. The penetration depth of these magnetic photon rays is roughly one million times greater than that of electric photon light of the same wavelength". According to [293], *part 6*, "The experiment would confirm the existence of a new vector gauge boson, Salam's magnetic photon from 1966. It has the same quantum number as Einstein's electric photon, i.e. spin one, negative, parity, zero rest mass and zero charge"; "A positive result would provide evidence of an extension of quantum electrodynamics which include a symmetrization of Maxwell's equations from *1873*". Each process that produces electric photons does creates also magnetic photons [293] *part 2*. Considering the above statements based on *HPPH*, a closed circulating single direction motions models of neutropas on the basis of *Fig. 4(2)* of *Sec. 4(2)* can be referred to magnetic photon; whereas, the open linear single direction motions of neutropas such as in *Sec. 4(4), Fig. 4(8)* during photon travel can be attributed to electric photon.

Remark 4(4)1- According to *Simulation 7(4)2e1*, the photon main-body is linked to mass-medium*, Sec. 7(4)3, part D***,** via an H hall-package tunnel, *Sec. 5(9)3d, part c*. While, its matterwave counterpart is related to spatial medium, *Sec. 7(4)3, part* A. According to Bohr complementary, the two mass and spatial medium of different contracting and expanding characteristics cannot be involved at once in a same experiment.

4(5) - Interactions of two charges at rest

Assuming two charged H systems at rest respect to reference frame *R* of charge q_A at point *A* , charge q_B at point *B* , respectively, or, in other words, their external or common motions, *Sec. 1(3), v* = 0, *Fig. 4(9).* Thus the internal velocities of their H-particle-paths are equal to *c* in all directions of *x, y, z* axis, *Note 4(5)1*.
According to the previous parts:

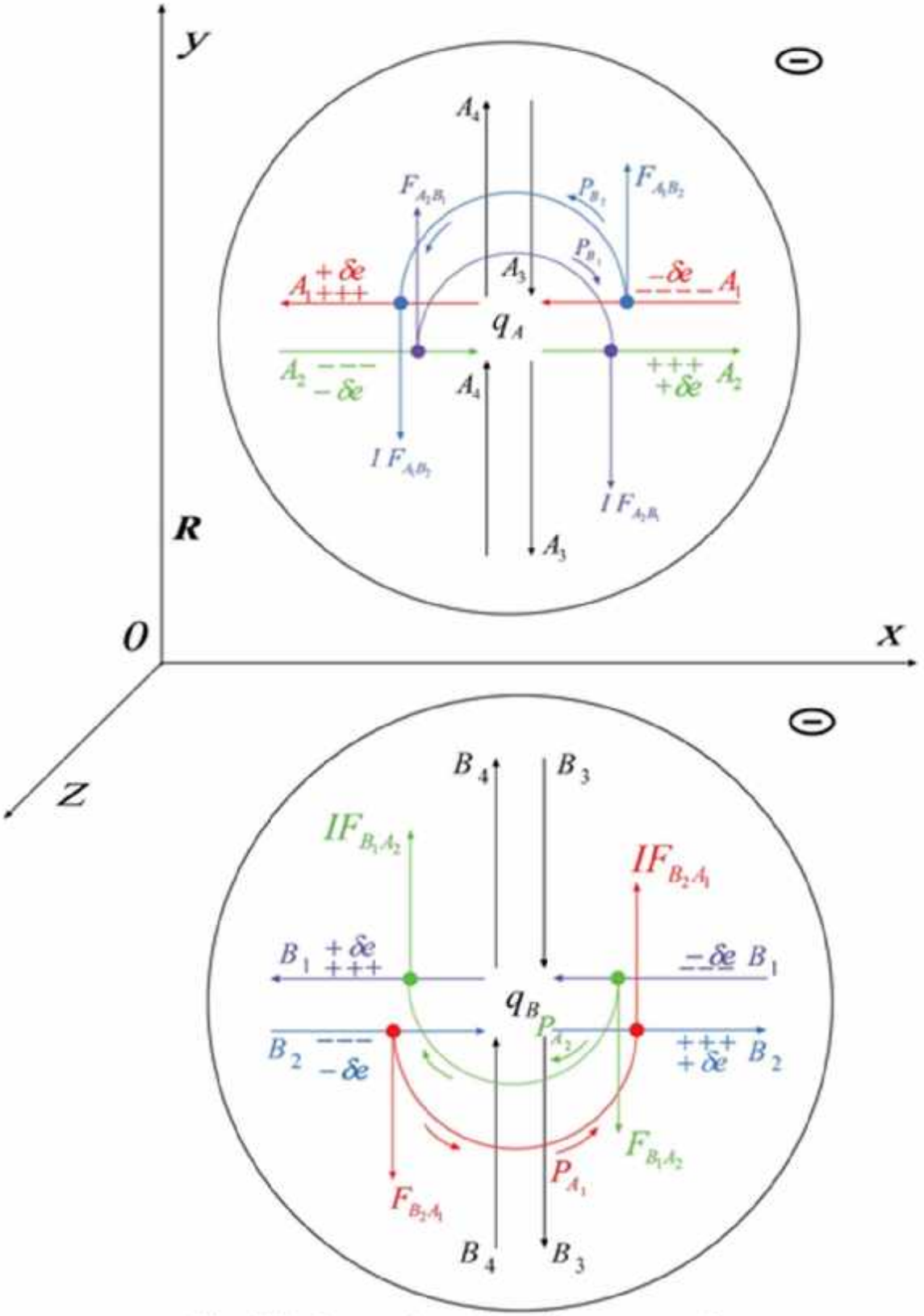


Fig.4(9) - Interaction of two charges q_A and q_B at rest.

I) The motion direction of H system *A* H particle-paths in the direction of *x*-axes of reference frame *R* is A_1 (backward) and A_2 (forward) and at its *y* or *z* axes A_3 and A_4 respectively; similarly B_1 and B_2 in the direction of *x*-axis and B_3 and B_4 in the direction of *y* or *z* axes for H system *B*.

II) Assuming the paths p_{B_1} and p_{B_2} due to H particle-paths fields of internal motions B_1 and B_2 (H-system *B*) at the location of H system *A* of internal paths A_2 and A_1 motions respectively; thus, the related forces applied on A_1 and A_2 by p_{B_2} and p_{B_1} are $F_{A_1B_2}$ and $F_{A_2B_1}$ accordingly. Similarly, there is p_{A_1} and p_{A_2} paths and their related force $F_{A_2B_1}$ and $F_{A_1B_2}$ on B_2 and B_1 of H system *B* respectively.

III) The impulsion (photon) related to forces $F_{A_1B_2}$, $F_{A_2B_1}$ and $F_{B_2A_1}$, $F_{B_1A_2}$ is $I_{A_1B_2}, I_{A_2B_1}, I_{B_2A_1}, I_{B_1A_2}$ respectively that emitted at opposite directions and spins of the related forces by similarity to *Fig. 4(5).*

IV) There is no field effect of internal motion A_1 H-system *A* on internal paths motion B_1 H system *B* as there is no ΔL effect for the reason of internal speed *C* at the same relative direction, similarly in the cases of internal paths A_2, B_2 ; B_1, A_1 and B_2, A_2, we have; $\Delta L = 0$.

V) The internal paths A_3, A_4 for the reason of symmetry is not affected by field B_1 and B_2; similarly B_3, B_4 are not affected by A_1 and A_2.

VI) As shown in *Fig. 4(9)* the field B_1 interact on internal path A_2 by the force $F_{A_2B_1}$ and impulsion $IF_{A_2B_1}$ due to photon emission for reason of presence ΔL in the paths p_{B_1} respect to internal paths A_2 of opposite direction at *C* speed; similarly the same situation as $B_2 onA_1$ and $A_1 onB_2$ and $A_2 onB_1$

VII) Assuming two H systems *A* and *B* are negatively charged (e.g. electron) as in case of *Fig. 4(9);* forces $F_{A_2B_1}$ and $F_{A_1B_2}$ on H system *A* act on same direction of *y*- axis and two forces $F_{B_2A_1}, F_{B_1A_2}$ apply on H systems *B* in opposite direction of *y* -axis that cause a repelling effect on the two H systems. According to $IF_{A_2B_1}$ and $IF_{A_1B_2}$ directions, the virtual photons emitted from H system *A* toward H-system *B* in opposite direction of *y*-axis. Similarly, the virtual photon emitted form H-system *B* toward H-system A in the direction of *y*-axis (*i.e.* $IF_{B_1A_2}$ and $IF_{B_2A_1}$)

VIII) Assuming q_A and q_B are positive (e.g. proton, positron), according to *Sec. 4(3)2, case3,* the same situation as above will be occurred.

IX) Assuming q_A and q_B are two charge of different signs (e.g. electron and positron), there will be attractive forces that apply by *A* and *B*; moreover, photons emitted at two opposites directions, *Sec. 4(3)1, Fig. 4(5), states C,F, Sec. 4(3)2, case2*.

X) On the basis of above discussion the fragments of a charge in a particle, e.g., electron, do not repel each other, but contributing in an internal common motion as does H particle-paths singlet. On the other hand, two like-charge particles at a separating distance repel each other through Coulomb force. Please refer also to *Sec. 5(16)4, Remark 5(16)4a*.

XI) The electric field of charged particles at rest expand as expanding potential spheres nominated negaton and positon in case of negatively and positively charged particles respectively, *Sec. 4(6)4.*

XII) According to discussion held in this section, electric field is consequence of H particle-paths as singlet at fully reversible motion. In other words, it is the summation of magnetic fields due to single direction of H particle-paths as singlet. Therefore, instead of searching for a magnetic monopoles (or charges) by its comparison to electric charges, the reverse speculation must be considered as stated above in this paragraph. Comparing the energy and momentum from viewpoint of H particle-paths hypothesis, *Sec. 2(1)3*, by the similar analogy and argument we can refer to electric charge and magnetic field that depends to the direction of motion. According to [325] *Background*, "Since all known form of magnetic phenomena involve the motion of electrically charged particles, and vice versa no theory suggests that pole is, inn that context, a thing rather than a covenant fiction, it may well be that nothing that could be called a magnetic monopole exist ever did or could".

As a result, according to the above statements, the concept of unlimited potential energy at the point of charge of the particle due to $1/r^2$ singularity lost its validity According to *Sec. 5(16)3b,* any particle, e.g. charged one, is confined in an H hall quantized package of path-length of path-length value *h, Sec. 5(16)3g*, and V_{HP} volume. In the other words, the particle with its charge cannot be considered as a point like object as it is revealed in the experiments such as Aharonov-Bohm [79]; please refer to *Sec. 4(6)3, Note 4(6)3b*. In this effect a magnetic field isolated inside a solenoid changes the phase of an electron double slits (Fraunhofer) interference pattern, *Sec. 8(3)4*. The magnetic field accounts for the phase shift through their interactions, with that of the electrons of the beam. Moreover, the total energy of a charged particle, e.g. electron, is equal to the total number of its H particle-paths (negapa and posipa) of the charged particle and its related field that is multiplied by *H*, *Eq. 1(1);* thus, the $1/r^2$ singularity due to the infinity of energy related to electrical charge has no sense. Factually, according to the above discussion electrical permittivity, ε_0, of coulomb law (due to reversible motion of H particle-paths in all directions) and magnetic

permeability, μ_0, of Bio-Savart law (due to single direction motion of H particle-paths) are related to each other, *Sec. 5(16)4, Eq. 5(70)4.*

XIII) According to above discussion, supposing mutual conversion of posipa to negapa or vice versa in interacting charged particles q_A, q_B, their electric charges are also interchanged accordingly.

Note 4(5)1- According to this statement and following paragraphs *I* to *IX*, there is no Lorentz force interacting to a charged parallel-plate capacitor charged at high voltage, i.e. no motion detected (null result) respect to it's own observer *O* at reference frame *R* at rest as in *Trouton-Noble experiment* [71]. But, respect to other observer *O'* at reference frame *R'* moving straightly and uniformly at *v* speed respect to *R*; there is a modified electrical charges interactions with no apparent Lorentz force according to state *c* of *Fig. 4(5).* Generally, *"The Trouton-Noble experiment* is regarded as the electrostatic equivalent of the Michelson-Morley optical experiment"[72], part related to *Fall out*. In both of these experiment the test frame is looked as an *In the Frame*, *Sec. 2(8)2,* reference frame in which the H particle-paths moving at *c* speed at all direction in a reversible mode of motion.

4 (6) - Electric charge and its interactions

4(6)1- General aspect

Charged objects or H-systems at rest, *Sec. 9(5),* respect to a reference frame *R, Note 4(6)1a,* in the environment exert a radial force $\vec{E}$ on a positive unit charge q_0 at point *P*.

Assuming the center of a *q* charged H system is located at the origin o of *R*; thus, supposing concentric spheres around *o* nominated as potential spheres, *Sec. 4(6)4,* with radius r from origin o and dr from two successive ones, *Fig. 4(10).* The electric field $\vec{E}$ at a point *P* of sphere is perpendicular to the sphere surface at that point. Now, supposing the H particle–paths of the field of H system q_0 is moving at c speed in all directions along the geodesic of potential spheres*, Fig. 4(11).* Each geodesic path on the surface of the sphere is a circle with the same center as that (e.g. origin o)

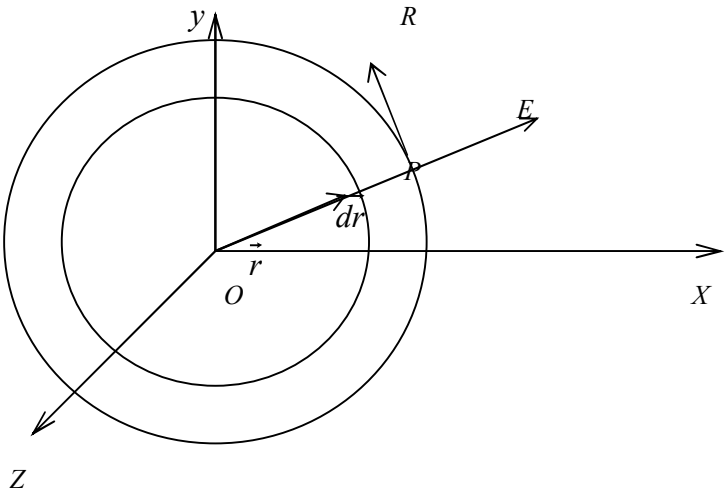


Fig 4(10) - Schema of two successive potential spheres at distance, dr, from each other

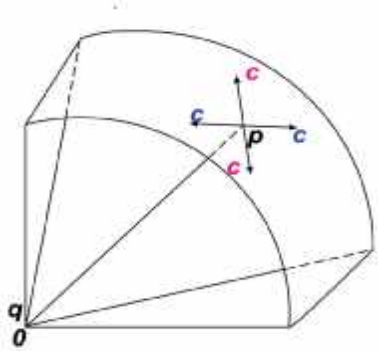


Fig 4(11) – A section of sphere surface in order to indicate H-particle – paths moving at different directions at c *speed*

The total number of single direction H particle–paths as singlet (N_ε), *Sec. 1(1), Note 1(1)1,* that located on the sphere. In other words, rotate along the geodesics of that is independent of it's radius *r,* thus the total energy, E_ε, related to each potential sphere is constant or it is the same for other spheres, *Comment 4(6)1a;* please refer also to *Sec. 5(16)1c part A3.*

$$E_\varepsilon = N_\varepsilon H = N_\varepsilon ah \qquad 4(11)$$

Assuming ρ_r, the density or number of H particle–paths per surface unit, *Fig. 4(12)*:

$$\rho_r = \frac{N_\varepsilon}{4\pi r^2} \qquad 4(12)$$

Thus:

$$N_\varepsilon = k_1 q \qquad 4(13)$$

k_1 is a constant or the number of H particle-paths on the sphere surface per unit of charge

According to E_{qs}. *4(12), 4(13):*

$$\rho_r = \frac{k_1 q}{4\pi r^2} = \frac{k_1}{4\pi} \times \frac{q}{r^2} \qquad 4(14)$$

According to *Eq. 4(12),* E_u the energy per density or unit surface:

$$E_u = h\rho_r = \frac{a_1 h N_\varepsilon}{4\pi r^2} = \frac{E_\varepsilon}{4\pi r^2} = \frac{k_1 a_1 h}{4\pi} \times \frac{q}{r^2} \qquad 4(15)$$

Assuming an unit charge q_0 located at the point *P* of the middle of the unit surface, *Fig. 4(12).* According to the moving characteristics of H particle-paths at c speed, the interacted H particle–paths are proportional to the total number of H particle-paths of that, N_u, moving or located in two segments surfaces (circular band) with periphery $2\pi r$, and with unit width perpendicular to each segment at point *P, Fig . 4(13).* Thus:

$$N_u = 2 \times \rho_r \times 2\pi r = 4\pi r \rho_r \qquad 4(16)$$

According to *Eq. 4(12):*

$$N_u = \frac{N_\varepsilon}{r} = k_1 \frac{q}{r} \qquad 4(17)$$

According to E_q. *4(17),* the energy of interacted H-particle-paths V_r :

$$V_r = k_2 N_u h = k_1 k_2 a_1 h \frac{q}{r} \qquad 4(18)$$

Supposing constant k_3 as:

$$k_2 = ck_3 \qquad 4(19)$$

k_3 is a constant since k_2 is a constant of proportionality of interaction of N_u particle-paths and depend on the light speed c or speed of the probability of interaction. According to the conventional aspect of scalar potential, V_r of charged particles at distance r from the charge location, and *Eqs. 4(13), 4(18)* we have:

$$V_r = ck_1 k_3 a_1 h \frac{q}{r} = \frac{1}{4\pi\varepsilon_0} \frac{q}{r} = a_1 hc\, k_3 \frac{N_\varepsilon}{r} = a_1 h\, k_2 \frac{N_\varepsilon}{r} \quad \text{or} \qquad 4(20)$$

Where:

$$k_1 = \frac{N_\varepsilon}{q} = \eta_s = \frac{N_{\varepsilon e}}{e} = \frac{1}{4\pi\, \varepsilon_0\, a_1 h\, k_2} = \frac{1}{4\pi\, \varepsilon_0\, a_1 hc\, k_3} \qquad 4(21)$$

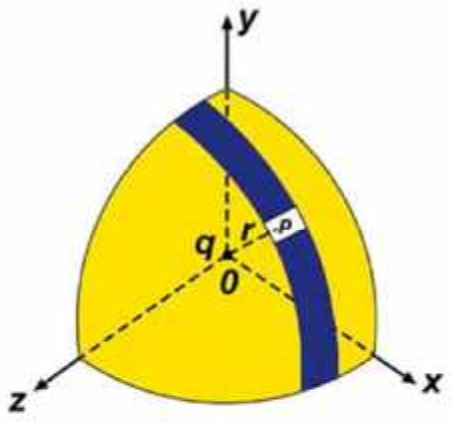


Fig 4(12) - Unit surface in a potential sphere

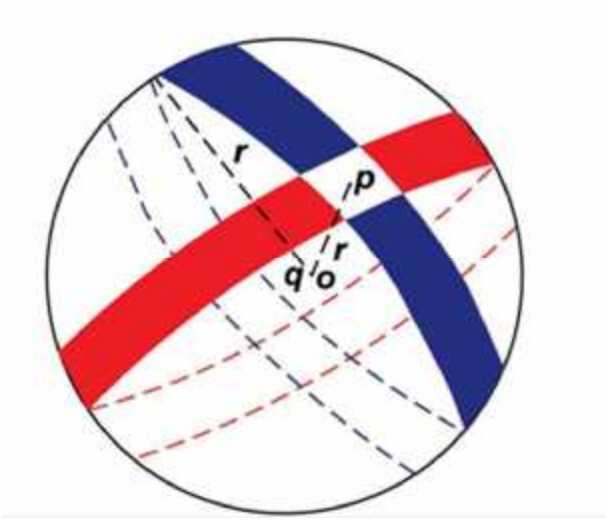


Fig 4(13) –Two circular bands on the surface of sphere (the bandwidth is equal to unit of length) perpendicular at point P.

Where:

η_s - The total number of single direction H particle-paths as singlet on the potential sphere related to unit of charge.

$N_{\varepsilon e}$ - The total number of single direction H particle-paths as singlet on the potential sphere related to charge *e*, i.e. electron charge. Moreover, $N_{\varepsilon e}$ can be regarded as a universal constant; please refer to *Sec. 9(3)1, Eq. 9(38).*

ε_0 - Permittivity constant of free space, *Sec. 5(16)4.*

a_1 - Constant of media coefficient, *Note 1(2)1*.

According to E_{qs}, *4(17), 4(20), 4(23),* the potential energy difference, ΔV_r, between two successive spheres r and $r + dr$:

$$\Delta V_r = k_1 k_3 c\, a_1 h \frac{q}{r^2} dr = k_3 c\, a_1 h \frac{N_s}{r^2} dr = \frac{k_3 c\, a_1 h}{N_s} N_u{}^2 dr = \frac{1}{4\pi\, \varepsilon_0} \frac{q}{r^2} dr \qquad 4(22)$$

as N_ε is constant for a given H-system with charge *q*, the potential energy variation is quantized or function of square of integer number N_u; thus, *dr* can have only distinct values.

Remarkably, the outward electric flux of a stationary point electric charge, *q* in vacuum space at the origin of a sphere at fixed radius *R* is comparable with flux of H particle-paths flow of an expanding sphere from the surface of the former sphere. In other words, the outwards electric flux, ϕ_E through closed surface (here sphere *R*) is as following:

$$\phi_E = \int_s \vec{E}.d\vec{S} \qquad 4(22)1$$

$$\phi_E = 4\pi\, R^2 E = \frac{q}{\varepsilon_0} \quad \text{"Gauss law for the electric field"}$$

This is an expression of "Gauss law" for the electric field

Where:

I) ε_0, *Sec. 5(16)4*, is the electric permittivity in vacuum space

II) E, is electric field related to expanding potential sphere at radius *R* , or, in other words, related to scalar potential.

III) ϕ_E, magnetic flux that depends on the rate of expansion of potential sphere.

Similarly in case of many charges, the magnetic flux ϕ_B through surface *dS* can be considered as magnetic field passing through that surface, or, in other words, the vector potential $\vec{A}$ variation on that surface that has a hard link with the H particle-paths flow rate:

$\phi_B = \int_s \vec{B}.d\vec{S} = \int_s \left(\nabla \times \vec{A}\right) d\vec{S} = \oint_c \vec{A}.d\vec{r}$; please refer to *Sec. 4(3)1, part D* 4(22)2

As a result of the Bio-Savat law; moreover, the outward magnetic flux, ϕ_B through a closed surface is equal to zero " Gauss's law for magnetism "that depend on single direction aspect of H particle-paths flow in case of magnetic field; please refer to *Secs.4(3),4(5), 4(6)3* for additional information.

Note 4(6)1a - The common (or external) velocity, *Sec. 1(3),* of the H particle-paths in the H system at rest respect to *x,y,z* axis are zero. In other words, the zero external velocity of an H system means that the internal reversible motions or velocities of its H particle-paths in that H system are the same as in reference frame *R* 's H system i.e. light speed *c*.

Note 4(6)1b - According to *Eq. 4(24)* by increasing $v_e \to c$, $K_\Gamma\ d\ n_{oe} \to \upsilon$; we have, $dr \to dct$, i.e. the distance traveled by particle *m* tends to that of the photon υ. In fact, *Eq. 4(24)*, can be interpreted as:

$$\frac{v_e}{\lambda_e} = \frac{c}{\lambda} \qquad 4(28)$$

Where, λ_e, λ are matter wavelength of the particle and its wavelength of the related emitted or (absorbed) photon respectively, *Eq. 2(77),* i.e. at low speed, the ratio of particle *m* velocity to its wavelength is equal to that of the related photon. In other words, the H particle-paths of the photon wrapped, overlapped or contracted, *Sec. 9(3)1*, till, λ_e of the charged particle during to its absorption by that and vice versa.
As a result of the above discussion, in an H system consisted of two opposite signs charges, e.g. hydrogen atom, the magnitude of the wavelength of emitted or absorbed photon respect to the atomic scale can be explained, *Secs. 6(2)3, 9(3)2.*

Comment 4(6)1a - Here, we encountered with a space expansion along with time's arrow generation, *Sec. 5(16)7a*, due to photon emission in the extended path cdt in the expense of conversion of mass to energy; please refer also to *Sec. 2(6)4b, Remark 2(6)4b1.*

4(6)2- Matter wave frequency relationship of a charged particle with that of the related emitting photon in an external electrical field

According to *Eqs.4(12),4(13),4(21),4(22)*, the frequency, υ of emitted photon during interaction of a charged particle of mass *m,* initially at rest (e.g., *Noe* initial H particle-paths and charge *e*), and the field of a fixed charge *q* (at rest) at *r* distance respect to each other is obtained as following:

$$W = e\Delta Vr = F\,dr = 4\pi\ k_2 a_1 he \rho_r\, dr = h\upsilon \qquad 4(23)$$

Where:
-*F, W*, the applied force and work down by *m* at *dr* length respectively.
- a_1, constant of media coefficient, *Note 1(2)1*.
On the other hand, according to *Eqs. 3(10), 4(23), 6(3),* we have:

$$\upsilon = K_\Gamma d\, n_{oe} \frac{dr}{cdt} = \frac{v_e}{c} K_\Gamma\ d\, n_{oe} = \frac{v_e \upsilon_e}{c} \qquad \textit{Note 4(6)1b} \qquad 4(24)$$

Where:
- v_e, υ_e, are the mean velocity and matter wave frequency of particle *m,* respectively; please refer to *Sec. 4(3)1, part B,* Explanation of *Fig. 4(4).*
- $d\, n_{oe}$ is the frequency equivalent number of H particle-paths returned to single direction, *Sec. 2(2), Eqs. 2(22), 2(44),* during dt time of interaction. In other words, during the time interval dt of photon generation, *Remark 4(6)2a*, the displacement, dr of charged particle *m* take place.
- K_Γ, the proportionality factor of matter wave frequency υ with that of frequency equivalent n of related particle main-body, *Note 2(3)1a*.
Thus, according to *Eq. 4(23)*, the frequency, υ, [i.e. the number of emitted photon's H particle-paths (neutropa) matter wave in a path *P*, *Sec. 3(1)1*, per time unit] is proportional to the magnitude of charge *e*. Moreover, it is proportional to the number of H particle-paths in a region, containing $\rho_r dr$, number of H particle-paths of the charge *q* field (i.e. extended in a displacement dr of particle *m* during time interval dt). On the other hand, according to *Eq. 4(24),* the number of the H particle-paths of the photon in a path cdt, is equal to the number of returned single direction H particle-paths after dr, displacement of the particle *m*, i.e. during time interval dt, *Eq. 2(56), Comment 4(6)1a.*
According to *Eqs. 2(22),4(23),4(24)*

$$d\, n_{oe} = noe\ d\,\alpha_e = 4\pi\ a_1\ k_2\ e\,\rho_r\, dct \quad \text{or} \qquad 4(25)$$

$$\upsilon_e = 4\pi\, a_1 c\, k_2 e\, \rho_r K_\Gamma$$

Thus, $d\, n_{oe}$, is proportional to the magnitude of charge *e* and the total H particle-paths of charge *q* field in a cylinder of volume of length dct ,or , in the other words, the $e\,\rho_r\, dct$ is a factor of interaction in order to generate $d\, n_{oe}$,or υ_e single direction H particle-paths of charged particle *m,* accompanied by photon generation at frequency, υ.
According to *Eqs. 4(8), 4(25):*

$$\delta e = 4\pi\ a_1 k_2\ e^2 \rho_r\ \frac{dct}{n_{0e}} = 4\pi\ k_2\ e^2 \rho_r\ \frac{dct}{N_{0e}} \qquad 4(26)$$

Where:

- δe *Note 4(3)1, B1,* is the partial charge equivalent generated in the moving particle m, i .e. the posipa or negapa flux during motion of the particle due to their spin behavior, *Secs. 4(3)2*, *3*, and *Sec. 4(3)3, Fig. 4(7) b.*
- N_{0e} , the total number of H particle paths of electron at rest state related to frequency equivalent n_{0e} , *Sec. 2(1)3, Eq. 2(35).*
According to *Eqs. 4(25), 4(26)*, the partial charge, or, better to say spin behavior association, related to a single direction H particle-path, *Sec. 1, Eq. 1(2)1:*

$$\varepsilon = \delta e / \, d\, N_{oe} = \, e / Noe \qquad 4(27)$$

Or in other words, any $d\, N_{oe}$ H particle-paths variation of total N_{0e} H particle paths of a particle of mass m is accompanied by a spin interacting behavior coefficient ε, *Eq. 1(3)1,* variation.

Remark 4(6)2a – Photon emission is accompanied by time's arrow and space expansion and photon absorption is along with time's arrow reversal and space contraction, *Sec. 5(16)3f, part B, Sec. 5(16)3f, part B*; please refer to *Sec. 5(16)9b*.

4(6)3- Vector potential from viewpoint of H particle-paths hypothesis

In case of the electric field of an isolated point-like charge *q* in the reference frame in which it is stationary, the H particle-paths singlet, *Sec.1(14)*, (i.e. posipa or negapa, according to the charge sings) moving on a potential surface, *Sec. 4(6)4.* It can be regarded as scalar potential, i.e. ϕ , *case I*; since ϕ is actually the time like component of the four-potential. We infer that the four-potential due to a charge is tangent to the world line of charged particle [131] from viewpoint of four-dimension. By the way, the three-spatial component of four-potential vector form an three-dimensional vector $\vec{A}$, nominated potential vector of the related field of a moving charge, *case II*, please refer to *Remark 4(6)3a*.

As an example general momentum, $\vec{P}$ of a moving particle as derivation of $\frac{\partial L}{\partial \vec{v}}$ can be obtained [1] *part 16*:

$$\vec{P} = m\vec{v} / \sqrt{1 - \frac{v^2}{c^2}} + \frac{e}{c}\vec{A} = \vec{P} + \frac{e}{c}\vec{A} \qquad 4(29)$$

Where, *L*, $\vec{v}$, $\vec{A}$, are Lagrangian, particle velocity and vector potential respectively.

According to *Eq. 2(30), 2(35):*

$$\vec{P} = m_0 \vec{\alpha} c + \frac{e}{c}\vec{A} \quad \text{or} \qquad 4(30)$$

$$\overrightarrow{\alpha_t} = \vec{\alpha} + \frac{e}{m_0 c^2}\vec{A} = \vec{\alpha} + \frac{e}{N_0 a_1 h}\vec{A} = \vec{\alpha} + \overrightarrow{\alpha_t} \quad \text{or} \qquad 4(31)$$

According to *Sec. 2(1)1b, Eq. 2(22),* we have:

$$\overrightarrow{\alpha_A} = \frac{e}{N_0 a_1 h}\vec{A} \quad \text{or} \quad \overrightarrow{N_{\alpha A}} = \frac{e}{a_1 h}\vec{A} \qquad 4(32)$$

Where:

- $\overrightarrow{\alpha_t}, \vec{\alpha}, \overrightarrow{\alpha_A}$, are dimensionless total, mechanical, electromagnetical ratio of single direction or returned H particle-paths to the initial reversible one of a moving charged particle, *e* in an electromagnetical fields respectively.
- $\overrightarrow{N_{\alpha A}}$, is the single direction (or returned) H particle-paths of initial N_0 H particle-paths related to rest mass m_0 .
- a_1 , Constant of media coefficient, *Note 1(2)1*.

As a result, vector potential is a measure of single direction H particle-paths induced by electromagnetical interaction in a field regarded as potential surface on which singlet, *Note 4(1)1*, H particle-paths moving at *c* speed; moreover, the strength of the field is related to the flow rate of H particle-paths on potential surface, *Sec. 4.* According to *Eqs. 4(31), 4(32),* the H particle-paths flow rate direction in macroscopic scale, *Sec. 5(4)2, paragraph 2II*, is specified with that of potential vector, *Note 4(6)3a;* please refer also to *Sec. 8(1)3*.

Generally speaking, if a charged particle q :

I) is at rest in a reference frame and located at its origin (*case I*); thus the H particle-paths on its field potential sphere interacts with the second charge at the location of the latter sphere. This kind of interaction is electrical one the force related to this interaction assuming second charge, *e* as charge unit is nominated as electrical vector $\vec{E}$.

II) is at motion respect to the observer in reference frame (*case II*), the related potential sphere deforms according to its motion nominated as potential closed surface, e.g., an ellipse, the H particle-paths on it interact with second charge at the appropriate location. The force related to this directional deformation part on the second charge assuming as charge unit is called magnetic field vector $\vec{H}$

As a summation, the variation of $\vec{A}$, *Eq. 4(29),* in a field of a charged particle respect to time and space in a reference frame is depended on flow variation of H particle-paths of that field on its potential surfaces, *Note 4(6)3a*. Moreover, its effect on the motion of second charged particle can be visualized by inducing single direction H particle-paths on the second particle, i.e. $\overrightarrow{\alpha_A}$,

Eq. 4(32), formed during this kind of interaction (nominated as electromagnetic interaction) and its related variation. The $\overrightarrow{\alpha_A}$ variation to some extent is similar to $\vec{\alpha}$ variation, *Note 2(8)2a*, or, in other words, considered as the single direction H particle-paths variation that is regarded as force, *Sec.6*, generation.
As a result, the vector potential of a moving charged particle is tangent to the path of its related field, i.e. H particle-paths flow. It can be viewed proportional to the average of the sum of this directional flow, i.e. parallel to the direction of particle motion, *Sec. 4, Fig. 4(5), table 4(1);* moreover, according to *Sec. 4(5);* this directional H particle-paths flow reveal its presence in the Aharonov-Bohm Experiment [79], *Note 4(6)3b.*
The potential variation with time is related to a reversible motion of H particle-paths, i.e. this flow variation can be estimated as electrical field. In other words the algebraic, the vector potential produced by a charge at rest is zero.

Note 4(6)3a - The paths and direction of H particle-paths singlet on potential sphere is determined by the direction and magnitude of vector potential at each point on the potential sphere regarding the charge sign, and according to discussion hold on, *Sec. 5(4)2.*

Note 4(6)3b – At the middle of cases *A, B, F,* of *Fig. 4(5)*, the total magnetic field is zero ($B = 0$). In other words, based on H particle-paths hypothesis viewpoint, there are two overlapped closed H particle-paths circular flows at opposite directions. Alternately, imagine the superposition of two circles on the reader sheet, or, in other words, the center of sign due to *B* field • upward and × related to $-B$ downward accordingly are coincide on each other. Therefore, it is in contradiction with classical concept of electromagnetic. According to [312], "A particle with charge *q* traveling along some path *P* in a region with zero magnetic field ($B = 0 = \nabla \times A$) must acquire a phase φ, given in *SI* units by $\varphi = \frac{q}{h}\int_P A.dx$, with a phase difference $\Delta\varphi$ between any two paths with the same endpoints therefore determined by the magnetic flux Φ through the area between the paths given by $\Delta\varphi = \frac{q}{h}\Phi$ ". This phase difference can be observed through Aharonov-Bohm Experiment [79]. Noteworthy, the acquired phase φ from viewpoint of H particle-paths has a physical meaning that can be linked with expansion of potential spheres as Negaton and Positon; please refer to *Sec. 4(6)4*.

Remark 4(6)3a – Similarly to *Sec. 5(2)1d*, the potential momentum of the field (here vector potential) propagate at *c* speed through vacuum texture, *Sec. 5(16)3b, part A*, whereas the force propagate through abstract vacuum, S*ec. 5(16)3h*, via H hall package tunnels between interacting particles spontaneously, *Sec. 7(4)2f, part c*.

4(6)4 - Negatons and positons as expanding potential spheres
The potential sphere of a charge assuming as expanding is similar to that of gravitational field, *Sec. 5(4).* According to this assumption there is no action at distance, *Sec. 5(4)5*; moreover, the potential sphere is one of the result of coulomb and Bio-Savart's inverse-square laws. The expansion of potential sphere of a charge (along with time's arrow, *Sec. 5(16)7a*), causes electromagnetic waves to be diverging. The fact that electromagnetic waves are mostly seen diverging rather than converging creates another arrow of time, i.e. radiative time's arrow. It has many similarities with the thermodynamic one. "The probability of initial conditions that produce a convergent wave is much lower than the probability of initials conditions that produce a radiative wave. In fact, normally a radiative wave increases entropy, whereas a convergent wave decreases it"[209]. Noteworthy, the radiative time's arrow follows the thermodynamic arrow. According to [225], "Another (time's arrow) is the electromagnetic arrow, the fact that the Universe is described by retarded solutions of Maxwell's equations and not advanced one". In fact vector potential, *Sec. 4(6)3,* related to fields H particle-paths has no counter-current conjugate, *Sec. 8(1)3,* i.e. merely constituted of negapa or posipas, (H particle-paths in its singlet forms); therefore, the mathematical formalism failed in this regards. According to [180], "a block diagram of the relationships of the various arrows of time postulated by two models *A* and *B* are illustrated that is based on thermodynamic and electromagnetic concepts". The expanding potential spheres due to negative and positive charges are nominated Negaton (of SN_r configuration) and positon (of SP_l configuration) respectively; please refer also to *Sec. 3(1)2, Comment 3(1)2b*; *Secs. 4(2), 4(3)*. Negaton similar to expandon, *Sec. 5(16)1c, part A3,* in matter Universe is right-handedly expanding, whereas positon is left-handed expanding.
By analogy with expandons, according to *Sec. 5(2)1d,* negatons and positons are electromagnetic potential expanding spheres of charged particles. That are propagating at finite speed analogous to expandons through vacuum textures, *Sec. 5(16)3b*. But, with difference that negatons (or positons) are constituted of singlet right (or left-handed) H particle-paths moving at finite speed on potential sphere, whereas expandons are formed from counter-current right- and left-handed ones. In other words, the negatons and positons can be overlapped on each other during expansion. Noteworthy, as in case of expandon, negaton is associated with a positively charged contracton nominated posictron, and positon with negatively charged contracton nominated negactron, *Sec. 5(2)1c, parts c,* and *c3, Remark 4(6)4a,* related to advanced solution. Moreover, there are H hall package tunnels *Sec. 5(9)3d, part c,* formations between any two interacting charges, *Comment 4(6)4a*, through which electrodynamics' forces propagate spontaneously, *Sec. 4(6)5, Remarks 4(6)5a, b.* "If a charged particle is moving at a constant velocity, it exerts a force that points toward its present position, not its retarded position, even though electromagnetic interactions certainly moves at the speed of light" [428] and *c3*. It is analogous to the case of gravitational attraction of mass-bodies, *Note 4(6)4a.* Noteworthy, virtual photon formation during an electromagnetical interactions of charged particle are taken place in the stated above tunnels, *Sec. 4(3)1, part B, paragraph VIII*, through subsequent annihilation of negactron and posictron. Every propagated photon is confined in an H hall package at path-length value *h*, *Sec. 5(16)3g*. Noteworthy by analogy with expandons, the rate of generation of negatons and positons depends on their propagation speed through vacuum texture, *Sec. 5(16)3b, part A*, i.e. light speed *c*. Therefore, according

to *Sec. 5(16)1b*, *part B*, *Remark 5(16)1b, B1*, if, we imagine that the light speed increased/decreased more/less than the light speed *c*, the population of negatons and positons along their conjugate negactron and posictron are also increased/decreased accordingly. In other words, the electromagnetical interactions increased/decreased according to this assumption. As a result, the energy loss in an isolated system that constitutes of positive and negative charges depends on the propagation speed of their fields through vacuum medium, *Sec. 7(4)3, part A*.

Example 4(6)4a – Supposing potassium atom is ionized by *UV* light. Therefore, an electron (or a beam of that) is ejected from potassium atom, and a potassium ion is remained. Therefore, according to *Secs, 8(7), 8(9)1*, there is a correlation between the electron and potassium ion through related H hall package tunnel. The posictron and negactron that remain as Mirror Image Effect, *Sec. 6(2)3*, conjugates of negaton and positon respectively during exit of their, are connected through this tunnel. In other words, the right-handed H particle-paths (i.e. negapas) of negactrons and left-handed H particle-paths (i.e. posipas) of posictrons that are equivalent to partial charges $-\delta e$, and $+\delta e$ are combined with each other in this tunnel in order to form counter-current H particle-paths that are equivalent to zero charge. This cycle is continued by further exit of negaton and positon from electron and potassium ion respectively. Generally speaking, there is a correlation between any two negatively and positively charged particles all over the Universe. Factually, the exit of expanding negatons and position are fed by dark matter (or free moving H particle-paths) consumption through related charged particles in the world, *Sec. 5(15)2,* the same manner as expandons, *Sec. 8(7)2, part G, item G*. Every isolated charged particle is in equilibrium in vacuum space based on path-length constancy, *Sec. 2(4).* But, by entrance of another charged particle, *Sec. 4(3)1, part B, Fig. 4(5),* this equilibrium is broken due to the mutual interaction of their negatons, or positons with each other through a tunnel of H hall-package between interacting charged particles.

Note 4(6)4a- Factually, the advanced solution of Maxwell's equation related to negactron and pisctron (i.e. virtual photon) that are releasing via H hall package tunnel spontaneously. They induce forces and they are not detected experimentally as advanced wave because of superluminality.

Comment 4(6)4a- The H hall package tunnel, *Sec. 5(9)3d, part c*, (an alternate to wormhole) is extending along the force-line, e.g. electromagnetical and gravitational. This tunnel acts as singularity in these cases. Inside this tunnel merely electromagnetical negactron, posictron and gravitation contractons in the related cases can be traveled within abstract vacuum, *Sec. 5(16)3h*, spontaneously, *Sec. 7(4)2f, part c*. In fact, the force-lines act as electromagnetical or gravitational potentials that moving at finite speed equal or less than light speed in spatial medium; while, its electromagnetical and gravitational contractons act as related virtual particles, *Sec. 4(6)5,* and propagating spontaneously within related tunnels; please refer to *Sec. 4(6)6*.

Remark 4(6)4a - *"*According to recent measurements by Purdue University physicists, the tiny particle may not be a single negative point charge, as scientist often describing it". "According to this data, surrounding the electron's core is a fuzzy *cloud* of virtual particles, which wink in and out of existence in pairs. One particle in the pair is positively charged, the other negatively charges". "The (electron) is polarized, which means that the strong negatively charge at the core *pushes* the negatively charged particle in a pair slightly farther away from the core than positively charged particle. The polarization is strongest toward the center of the cloud. The polarized pair essentially cancels each other out, so that they do not add any net electric charge to the electron" [414]. This can be compared with negatively charged expandons (i.e. negaton) associated with positively charged contracton, i.e. posictron. Factually, the posictron of a negatively charged particle must be correlated mutually with a negactron of a positively charged one through vacuum texture, *Sec. 5(16)3b*, in order to compensate each others. According to *Sec. 8(9),* this correlation must perform spontaneously through an H hall package tunnel, *Example 4(6)4a*.

As a result, there is a restriction that more or less partial charge of the same sign can be accepted in an H hall package of a charged particle. In other words, the H hall package of path-length value *h* of a isolated particle accept merely integer charges e^- , or e^+ has a dependence to Planck constant *h*. In case of a moving charged particle, e.g., electron, *Sec. 4(3)1, part B*, the total charge of electron confined in an H hall package is equal to e^- irrespective of partial charges $-\delta e$ or $+\delta e$ of equal magnitude, i.e. charge conservation. Factually, an H hall package accepts a constant right (or left) handedness H particle-paths singlet of fundamental particles. Moreover, the H particle-paths geometrically has the same right- or left- helicity as its confined particle, *Sec. 5(16)3a, Sec.* In the cases of atoms, and molecules right-handed H particle-paths of the negatons and combine with left-handed H particle-paths of positons compensate each other (or superimposing on each other) in order to establish a counter-current H particle-paths on expanding potential spheres of zero total charge of SN_r configuration in our matter Universe, *Sec. 5(16)9b*.

4(6)5 – Virtual particle

4(6)5a – General aspect

"In physics, a virtual particle is a particle that exists for a limited time and space, so its energy and momentum values cannot be defined with unlimited precision". "Virtual particles are viewed as the quanta that describe fields of the basic force interactions, which cannot be described in terms of real particles" [418] *introduction*. Interactions (essentially forces) between real particles are described in terms of exchanges of virtual particles. They can be considered a manifestation of quantum tunneling. The range of forces carried by virtual particles is limited by uncertainty principle" [418] *properties*. "Interactions (essentially forces) between real particles are described in terms of exchanges of virtual particles. They can be considered a manifestation of quantum tunneling. The range of forces carried by virtual particle is limited by uncertainty principle" [418] *properties*. Considering the above statements, and by analogy with that, the interacting forces between two particles (e.g. electromagnetical, *Sec. 4(6)4,* gravitational, *Sec. 5(2)1d,* forces are propagating spontaneously, *Sec. 7(4)2f, part c,* through tunnels of H hall packages, *Sec. 5(16)3a*, between the interacting particles, *Note 4(6)5a1*. The idea of force at a distance is inconsistent with the theory of

relativity. This means that momentum and energy must be carried between interacting particles by another type of particle, which we call an intermediary particle. "These particles are virtual in the sense that they don't have their real-world mass when acting in this role"[423]. Factually, according to above discussion, the virtual particles cannot be propagated as ordinary one through vacuum texture, *Sec. 5(16)3b, part B*, at speed $v \leq c$. Therefore, the virtual particles transfer through H hall package tunnel at superluminal speed. Thus, these particles cannot be detected in normal vacuum. In other words, they have no rest masses as ordinary ones, i.e. purely reversible H particle-paths moving at c speed. Please refer also to *Sec. 4(3)1, Consequence 4(3)1,B1,* and *Sec. 4(6)5b*. Therefore, before a measurement, *Sec. 8(7)2,* there is an indistinguishable counter-current flow of H particle-paths through abstract vacuum, *Sec. 5(16)3h*, of these tunnels, *Comment 5(16)2a1*, analogous to entangled pair of particles as following:
I) In case of electromagnetic field and gravity this pair of particle, has no rest mass and can be extended to infinity.
II) In case of weak and strong interactions due to the lack of axeon (or zero axeon), i.e. pseudo-particles are limited by uncertainty principle. In this case pseudo-particles play the role of virtual particles.

Note 4(6)5a1- "In special relativity, one cannot assume the instantaneous action at a distance that is implicit in the inverse square laws of gravity and electricity. Instead, the force must be mediated by a field and consistency of whole set-up requires that an uncertainty relation analogous to Heisenberg formula $[p,x] = -i\hbar$ must be applied to the field. From the uncertainty relation one deduces that the field comes in quanta which are observed as particle of new kind-photons in case of the electromagnetic field. Much of the development of physics since *1930* had to do with the $1/r^2$ problem in the light of quantum mechanics plus special relativity"[461] *Quantum field theory*. According to H particle-paths hypothesis, the quanta is taken form just during a measurement, *Sec. 8(7)2*, (or interaction) of the field with a charged mass-body based on uncertainty relationship in an H hall package. Please refer to *Sec. 4(3)1, part B, item XVII*.

4(6)5b- Virtual photon
A) In case of electromagnetical interaction, the *IF* photons, *Sec. 4(3)1, Consequence 4(3)1,B1*, play the role of virtual particles (or electromagnetical contractons, *Note 6(2)1a2, item 1B*) through H hall package tunneling, *Sec. 4(6)4*. It is analogous to the case of gravitational interaction, the gravitational forces transfer the contractons, *Sec. 5(2)1c, part c* (that are affected by expandons, *Sec. 5(16)1c, part A3*) acts as force carrier through H hall package tunnels, *Sec. 5(2)1d*, and *Sec. 5(9)3d, part c*. According to *Comment 5(2)1c1*, it is nominating *P*-contracton.
B) Similarly to the case of gravity, *Sec. 2(1)d*, "the electric field from a uniformly moving source is not aberrated. The force on a test charge is directed towards the instantaneous-not the retarded- position of the source" [419] *apparent cancellation*. In the latter reference, the results obtained merely through calculation and experimental results without invoking to superluminality. "Charges respond to each other's instantaneous positions, and not to the left-behind hill. When they are accelerated" [436]. "This demonstrates that electrodynamic forces must likewise propagate at faster than light speed more convincly than earlier experiments showing angular momentum conservation" [437]. Experiments measuring the speed of gravity, "if the field propagation speed were light speed, we would be forced to interpret momentum transfers as applied in a different direction from the direction of travel of the momentum carries because of aberration. That is why, when the details are examined closely, we hear statements such as virtual photons (the hypothetical carries of electrodynamic forces, not to be confused with real photons) travel a infinite speed" [437] *part 4*. According to *Sec. 5(9)3a*, the correlation, *Sec. 8(7),* between two objects solves the problem of finite speed of spherically (or closed surface) expanding, *Sec. 4(6)1*, field propagation at the instant of interaction. Noteworthy, vector potential and one computed from solving Maxwell's equation is retarded, i.e. propagating to finite speed. In other words, analogous to gravitation potential, the electromagnetical one propagates through vacuum texture, *Sec. (16)3b, part A*, at finite speed, *Sec. 4(6)1*, contrary to spontaneous*, Sec. 7(4)2f, part c,* electromagnetical forces through abstract vacuum of H hall package tunnel, *Sec. 4(6)6*.

4(6)6- Speed of electromagnetical interaction
"They discussed this with Einstein who suggested a proposal by Tetrode that light was two-way communication exchange between source and receiver utilizing in- and out-waves. Tetrode wrote an atom that emits light from a star one hundred light years away, knew then, one hundred years ago, that it would enter my eye today, before I was even born. They considered this proposal realizing it was controversial because in-waves appear to violate the causality principle". "Their accelerated electron generated both in- and out-waves. The out-waves then stimulated absorber charges elsewhere in the universe whose waves returned to the initial charge, a *response of the Universe*". "W&F described the wave behavior: Absorber charges at a large distance produce spherical waves headed towards the source. At the moment the source is accelerated these waves just touch the source. Thus, all the waves from the absorber charges form an array of approximately plane waves marching towards the source. The Huygens envelope of these plane waves is a spherical in-going wave. The sphere collapses on the source, and then pours out again as a divergent outward wave*"."* They were also forced to assume an illogical behavior of the absorber – the absorber out-waves began before the initial acceleration - in order to arrive at the electron at the moment of acceleration". [501] *Wheeler and Feynman's Calculation to Find Energy Transfer.* According to *Sec. 5(9)3d, part c*, and by analogy to case of gravitational interactions, *Sec. 5(2)1d*, the electromagnetic field of electron is propagated at divergent mode through spatial medium, *Sec. 7(4)3, part A,* at c speed, as an outward wave from the accelerating electron towards the absorber charge. Just during the interaction (or measurement, *Sec. 8(7)2)*, the contractons are released spontaneously, *Sec. 7(4)2f, part* c ,and transferred via the common H hall package tunnel, *Sec. 5(9)3d, part c*, towards the mass medium, *Sec. 7(4)3, part D,* of the emitter electron at a contracting (or converging) manner. Therefore, non-causal controversial stated above discussion of in-warding wave behavior is respond from viewpoint of H particle-paths hypothesis. As a result, the electromagnetical contractons as force carrier can be compared with virtual photons, *Sec. 4(6)5b*, during electromagnetical interactions; please refer also to *Comment 8(1)3a*, and *Sec. 8(6)2a*. "There is always a wave medium involved such as, water, a string, a rope, and for micro-atomic matter, basic to all

oscillators, the medium in space". "The waves as continually expanding and converging bubbles of energy" [501] *Principle 1*. Resuming, by analogy to outward wave, expandon is transferred at c speed in spatial medium; while, its contracton conjugate is transferred within mass medium of interacted via common H hall package to the mass medium of the emitter particle at a contracting manner spontaneously. The travel time in mass medium is K_Γ times shorter than in spatial medium, Pleas refer also to *Sec. 4(3)1, part B*, items *XXII*, and *XX* in this regards.

4 (7) - Concepts of electrical charge and electromagnetic interactions

Considering, the *Secs. 4(3), 4(5), 4(6),* one can deduced that electrical charge of a particle is a conventional factor to explain the intrinsic spin characteristic behavior of its H particle-paths. In the other words, the posipas with type *L* and negapas with type *R* configuration related to a charged particle field interact with the axeon, *Sec. 10(8),* of posipas and negapas of other one according to *Sec. 4(3), Fig. 4(5)*; *Secs. 4(3)3, Fig. 4(7)b; Sec. 4(5), Fig. 4(9)*. Moreover, spatial spin behavior of the charged particles interactions give rise to photon emission or absorption at its bosonic type *R ,or, L* configuration (zero charge) and related electromagnetic forces.

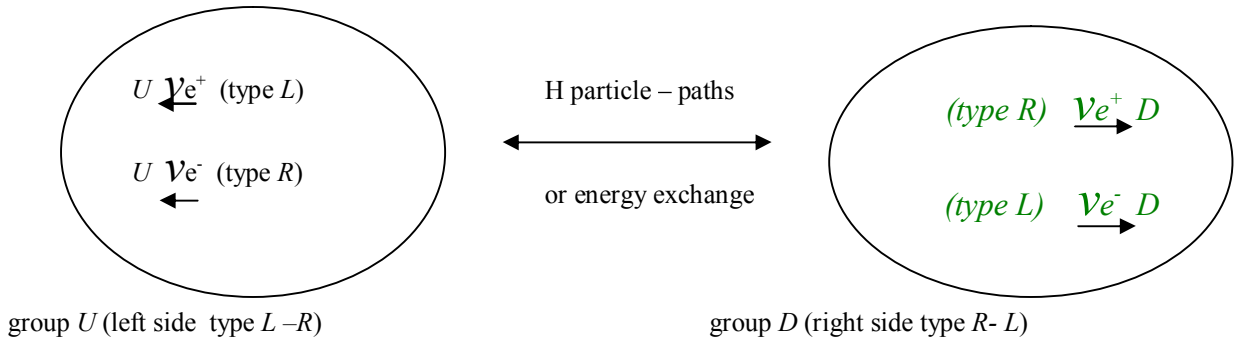
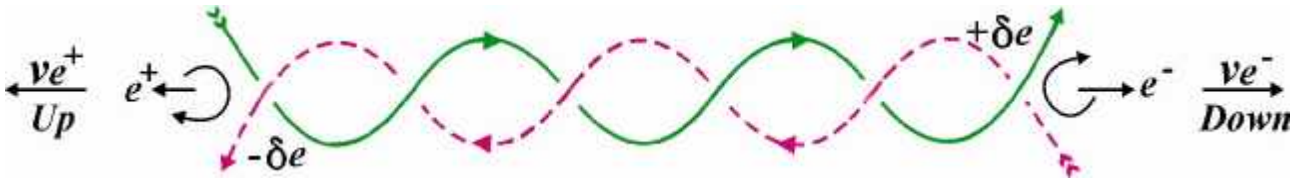


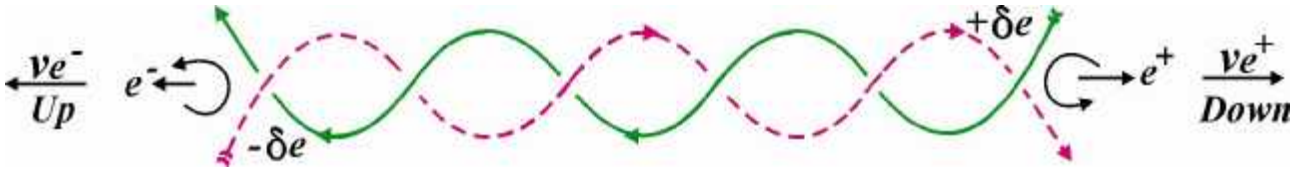
Fig. 4 (14) –Schema of groups U and D classifications

The energy released (i.e. *4.47 eV*) to flip the electron spin from down (free electron) to up (chemically bonded electron) or vice-versa may be estimated from the bond dissociation energy for a diatomic molecule (e.g., H_2) which is bonded by two electron bonds, *Note 4(7)2.*

Spin up electron + H particle -paths (energy) ⟶⟵ *Spin down electron* *Note 4(7)3, Remark 4(7)1* 4 (33)



a)– Axeon's, *Sec.10(8),* speed direction of positron to the left (type *L*) or electron direction to the right (type *L*)



b) – Axeon's direction of electron direction to the left (type *R*) or positron to the right (type *R*)

posipa negapa

Fig 4 (15) – groups U, D (e.g., up, down) configurations related to electron and positron spins, Sec. 4, Comment 4(7)1

By considering the spin direction of negapa, *Fig. 4(15)a*, posipa, *Fig. 4(15)b,* related to group *U* , one can visualized the photon structure, *Sec. 9(4)7c*, of two type at different spins *L & R,* according to *Sec. 4(3)3*. Similar result will be obtained in case of negapa, *Fig. 4(15)b,* posipa, *Fig. 4(15)a*, related to group *D*. Thus, two photons generated during annihilation process with different spins and at two opposite directions related to reversible H particle-paths motions, *Sec. 7(4)4,* inner the positron and

electron. Moreover, "photon can not individually create particles in empty space"[77] *Q&A, No. 172,* for the reason of the reversibility of H particle-paths motion of that particles; please refer to *Example 4(7)1*.

Example 4(7)1- Considering the annihilation process [16] of an electron of integer negative charge $\bar{e}$ and positron of integer positive charge e^{+}; the type *R* negapas of the electron interact with type *L* posipas of the positron to generate photons with neutral charge ,type *L & R, i.e.* propagating in opposite directions at left and right-handed spins. Moreover, according to left and right-handed rule, *Sec. 4 (3), Fig. 4* (*5); Sec. 4(3)3, Fig. 4 (7) b*, posipas and negapas having spins types *L & R* respectively. In return during a pair production, depends on their opposite speed directions, two groups *D* and *U* generated that according to the positron (or electron) speed direction, are conventionally in the up and down spins configurations (here, left and right side of the paper for simplicity of explanations), *Fig. 4 (14).*
However, considering this kind of classification, electron and positron having the type *L* or *R* spin, *Comment 4(7)1*, in each group, i.e. having the same type in a non isolating system respect to each other (e. g. positronium) , or, other interacting particles. As a result a spin up electron would always be accompanied by a spin up positron and spin down electron would always be accompanied by a spin down positron, [32]. It is consistent with *R&L* configurations of photons generated during annihilation process respectively; please refer also to *Sec. 5(16), Comment 5(16)6a,* and *Sec. 5(16)3b, part E1.*

Note 4(7)1 - In the cases of hydrogen atom and molecule (neutral charge), according to *Secs .9(3)1, 9(3)2*; the negapas , posipas of electron axeon and negapas of the remainder electron mass are in an equilibrium state with negapas, posipas , of proton quarks, *Sec. 10(4),* in its ground state. Thus, we encountered with a neutral charge H system.

Note 4(7)2- In complicated polyatomic H systems, e.g., polymer molecule, "we encounter with cleavage of covalent bonding at different dissociation energies of the outer electrons of opposite spins of homo and hetero atoms during a pyrolysis or thermal degradation process "[49]. The author of this article does it, and we are not dealing with it in the present article.

Note 4(7)3- According to standard model, "mass is really a coupling between a left-handed fermion and a right-handed fermion. For example the mass of an electron is really a coupling between a left-handed electron and a right-handed electron, which is the anti particle of a left-handed positron"[56], *table footnote*; whereas, according to H particle-paths hypothesis, mass is the result of reversible motion of *L&R* H particle-paths, i.e. posipa and negapa; please refer to *Note 2(1)3b*. Therefore, in the stated above coupling we encountered with two kinds of *L & R* configurations on the basis of counter-currency mode of motion, *Sec. 3(1)2*. Moreover, the Hall Effect causes 'spin up' and 'spin-down' electrons to build up on opposite sides of a sample in the presence of an electric field [58].

Comment 4(7)1- Fig. 4(15)a, and *Fig. 4(7)b,* are one-dimensional time reversal of each other; please refer to *Sec. 5(16)9.*

Remark 4(7)1- According to *Sec. 5(16)11*, the type *R* (or type *R-L*) is attributed to type R_e of SN_r configuration, and type *L* (or type *L-R*) to type L_c of SP_l configuration due to expanding and contracting characteristics of types R_e & L_c respectively in our matter Universe. Please refer also to *Sec. 3(1)2, Figs. 3(4), 3(5).*