Part 2

Part 2a- Microcosm

3-Mechanic of Microscopic object

3(1) - Motion of fundamental particles (Compton Effect)

3(1)1-General aspect

The electron is assumed to be initially at rest [168] and essentially free, shat is, not bound to the atoms of the scatterer, on the basis of this assumption it may be consist as an independent H system of N_{0e} H particle-paths with internal velocity *c* at different directions engaged in a reversible motion.

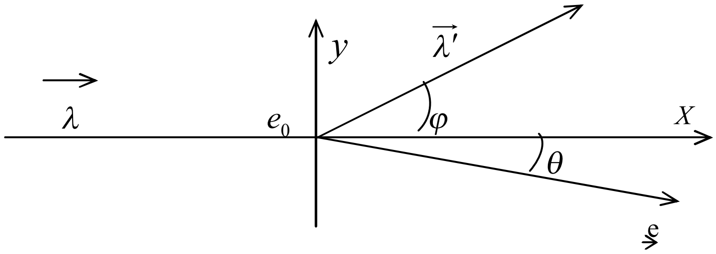

Fig 3(1) – Compton Effect [168]

According to $E_{q.}$ *2(35):*

$$N_{0e} = \frac{m_0 c^2}{a_1 h}$$

Where:

- a_1 , constant of media coefficient a per an H particle-path, *Note 1(2)1*

- m_{0e} , is the rest mass of electron with external velocity $V = 0$.

In *Fig. 3(1)* a photon of λ wavelength (another H system) strikes an electron at rest, the photon is scattered at an angle φ with an increased wavelength λ' .The electron moves off with speed *V* at the angle θ . In special case of $\theta = 0, \varphi = 180^\circ$, the electron moving along *x*-axis and photon λ' emit (another H system) in its opposite direction.

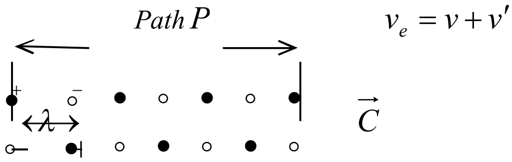

Fig 3(2) - Posipa and negapa (neutropa) arrangements in an H system (e.g. photon) within a constant spatial path P, Remark 3(1)1a.

This assumption that photon λ in the form of a zero rest mass particle lost a part of its initial energy $h\upsilon$ and scattered with lower energy $h\upsilon'$ is not under consideration, *Sec.6(2)3*. However, supposing a constant path *P*, *Comment 3(1)1a,* and assuming that H particle–paths of striking photon's matterwave, *Sec. 5(6),* are arranged at distances λ from each other successively, *Fig. 3(2)* and the whole H system (photon) moves at *c* velocity, i.e. single direction H particle-paths with no internal motion. Please refer to *Sec. 7(4)2e*.

At the moment of striking, N_{0e} H particle-paths, *Remark 3(1)1b*, of H-system at rest (electron) surround the N_λ H particle – paths of photon's main-body and an unstable H system (photon-electron) is appeared and after exit of $N_{\lambda'}$ H particle–paths (photon λ' H system) as impulsion in opposite direction, it become stable as a new H system (moving electron). Please refer also to *Sec. 9(4)7*, and *Remark 3(1)1c*.

In this system $N_\alpha, E_{q.}$ *2(22),* H particle–paths that are packed in path-limit Γ , $E_{q.}$ *1(3),* change successively its type *R & L* configurations at a travel distance $\lambda_e, E_{q.}$ *2(77)* form each other and are surrounded with the remained initial H particle–paths of electron, so that N_e the total number of H particle– paths of moving H system (electron) obtained according to , $E_{q.}$ *2(21),* as:

$N_e = N_{0e}\gamma$ 3(1)

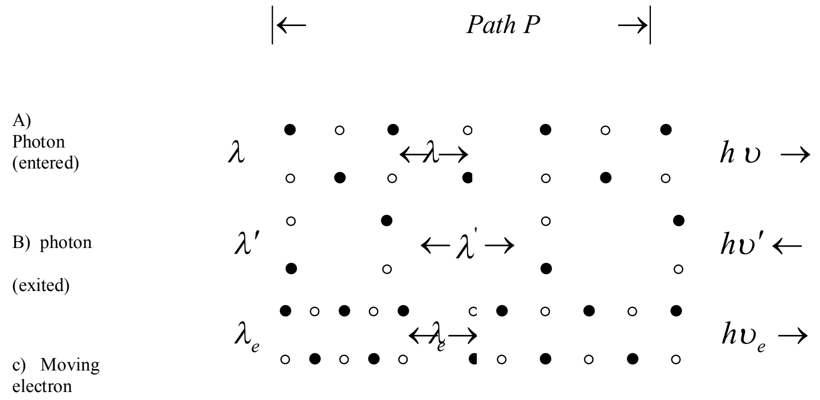

Fig. 3(3) – Arrangement of H particle–paths (neutropa) of photon λ and impulsion photon λ' in order to establish N_α H particle –paths in the direction of electron speed within constant path P

In fact, the interacting H systems constitutes an unique H system, *Note 8(5),* or paths, *Note 3(1)1e,* by their mutually H particle-paths exchange, i.e. .the action *S, Sec. 2(4),* of the latter is the sum of the former interacting H system one.
In two cases of *A* and *B*, *Fig. 3(3),* the H particle-path's neutropa cells (or type *R & L* expandon, *Simulation 7(4)2e1*) are traveling at *c* speed. However, in the third case since moving H system (electron) has a lower speed than light ($v\langle c$) the neutropas have rotational motion around *v* or *x*-axis (electron spin) in such a manner that the sum of rotational and translational motion speeds are equal to *c*, *Fig. 4(4).*
Considering *Fig. 3(3)* , N_λ neutropas related to striking photon λ entrance (*case A*) plus $n_{\lambda'}$ neutropas remained as a result of impulsion due to leaving photon λ' (case *B*) rearranged as N_α neutropas (case c) of the moving electron, *Proposal 3(1)1a*. Moreover, this phenomenon is performed along the motion direction of an H system as discussed above; please refer to *Sec. 2(1)1b. Comment 2(1)1b3.* Please refer also to *Note 3(1)1a.*

Proposal 3(1)1a- According to *Sec. 9(4)7, item 17*, the single direction neutropa of striking photon main-body sticks to the moving electron as single direction H particle-paths related to a combined H hall package of electron and attached photon, i.e. photon-electron H system. Similarly, to case of excited electron of *Sec. 9(4)7,* this H system emits impulsion photon λ' along with moving electron. Factually, photon λ' main-body acquires its single direction neutropas from both striking photon λ and electron in related H system. In other words, the moving electron moving with the lack of single direction H particle-paths, *Note 2(1)4b*, respect to the rest state, i.e. negative energy.

Note 3(1)1a– Referring to *Note 2(1)4a*, each motion is due to a previous or past, i.e. *History*, impulsive interaction (impulsion motion). In case of $\theta = 0, \varphi = 180^\circ$, the incoming photon λ ; i.e. ($+\alpha c$), is the result of a impulsive interaction ($-\alpha c$) in the past or a former H system . For example the outgoing or (impulsive) photon λ' in Compton Effect ($-\alpha' c$) has a positive or propellant effect in the motion of electron ($+\alpha' c$)

System I		*System II*	
before striking photon λ		*after striking photon*	3(2)
with electron at rest	=	*with the moving electron*	
$\left(-\alpha_\lambda + \alpha_\lambda\right)$	=	$-\alpha_\lambda - \alpha'_{\lambda'} + (\alpha_\lambda + \alpha'_{\lambda'})_e$	3(3)
*linear momentum I=0**		*linear momentum II=0[1]**	

Thus, $(\alpha_\lambda + \alpha'_{\lambda'}) = \left(\alpha_\lambda + \alpha'_{\lambda'}\right)_e$ or: 3(4)

$\upsilon + \upsilon' = \upsilon_e$ 3(5)

As the result, υ_e is the frequency of moving electron wave nature and υ, υ' are the incoming and outgoing photon frequencies, *Note 3(1)1c.* Please refer also to *Sec. 7(5)2*, in case of reverson, a particle of negative energy through mass medium of interacting electron.

Note 3(1)1b – The path-limit Γ is the path of the particle main-body in its H hall package, *Sec. 5(16)3a,* unit or space limit effect along which the structure of photon, electron and other fundamental particles (or an isolated H system), are spread or expanded. Please refer also to *Sec. 5(16)3b, part D2, Remark 5(16)3b, D2.*

**Including previous or past momentum.*

Note 3(1)1c – Supposing $\upsilon_\lambda = a_1 N_\lambda K_\Gamma = n_\lambda K_\Gamma$ and $\upsilon_e = a_1 N_\alpha K_\Gamma = n_\alpha K_\Gamma$ in which N_λ is the number of neutropas in photon λ main-body as particle of frequency equivalent n_λ, and N_α is the number of single direction neutropas due to moving of electron as particle of frequency equivalent n_α in an H hall package, *Sec. 5(16)3a,* of path-limit Γ. Please refer also to *Note 1(2)1*, and Sec. *7(4)2e*.

According to $E_{q_\bullet}$ *2(77)*:

$$\lambda_e = \frac{h}{p_e} = \frac{h}{m_{0e}\alpha c} \qquad 3(8)$$

$$\Delta\lambda = \lambda' - \lambda = 2\alpha\lambda_e = 2\alpha\frac{c}{\upsilon_e} = \frac{2c}{K_\Gamma n_{0e}} = \delta l = \frac{2h}{m_{0e}c} \quad \text{or} \qquad 3(9)$$

$$\upsilon_e(\lambda' - \lambda) = 2\alpha C = \Delta L = 2\alpha P = 2\alpha K_P \Gamma = 2\alpha\frac{a_d}{a_s}\Gamma$$

In the above case, the path $P = C$ is the path per time unit through normal vacuum medium. Thus, according to *Note 2(6)4b1,* $K_p = \frac{a_d}{a_s}$.

Noteworthy, $\Delta\lambda$ is nominating the "Compton shift" or Compton wavelength as a constant in Compton Experiment. It depends inversely to coefficient factor K_Γ as ratio of matter-wave, *Sec. 5(6),* counterpart energy to the total energy of related particle or mass-body. The Compton wavelength is independent of striking photon energy, and depends inversely to electron rest mass.

Where:

- $\lambda_e, \upsilon_e, p_e, m_{0e}$, are the wavelength, frequency, linear momentum and rest mass of electron respectively
- C capital, the path traveled by a light photon per second in *SI* system of units
- K_p, the proportionality factor of path P with the path-limit Γ in vacuum medium, *Sec. 7(4)3, part A*.
- a_d, a_s, are the media coefficients according to *Note 1(2)1*

According to $E_{q_\bullet}$ *3(9)* to any of separated unit of υ_e neutropa cells through path P of electron's matter-wave belongs a path difference δl, *Figs. 3(4), 4(4)*, during a reversible motion. The total path difference according to $E_{q_\bullet}$ *3(9),* ΔL is proportional to first order of magnitude α and has the principal act in producing magnetic effect due to moving electron at *v* speed on other charged H systems or particles. Considering that the length or path of each H system (e.g. photon, electron …) is equal to *P = C* consequently, the frequency υ_e of configuration changing, *Sec. 7(4)2e*, in this path is obtained as follows:

$$\upsilon_e = K_\Gamma n_\alpha = K_\Gamma n_{0e}\alpha = \frac{c}{\lambda_e} \qquad 3(10)$$

δl or $\Delta\lambda$ dependence that related to electron main-body structure is not affected by scattering angle θ of electron and initial wave length λ; thus, in the special case $\theta = 0^\circ$ and $\varphi = 180^\circ$ according to $E_{qs_\bullet}$ *3(9) , 3(10)* the following results will be obtained:

$$\lambda = \frac{c}{v n_{0e} K_\Gamma}(c - v + \sqrt{c^2 - v^2}) = \frac{c}{n_{0e} K_\Gamma \alpha}(\gamma - \alpha + 1) = \frac{c}{n_\alpha K_\Gamma}(\gamma - \alpha + 1)$$
$$= \frac{c}{\upsilon_e}(\gamma - \alpha + 1) = \lambda_e(\gamma - \alpha + 1) \qquad 3(11)$$

$$\lambda' = \frac{c}{v n_{0e} K_\Gamma}(c + v + \sqrt{c^2 - v^2}) = \frac{c}{n_{0e} K_\Gamma \alpha}(\gamma + \alpha + 1)$$
$$= \frac{c}{\upsilon_e}(\gamma + \alpha + 1) = \lambda_e(\gamma + \alpha + 1) \qquad 3(12)$$

Where, K_Γ is the proportionality factor, *Note 2(3)1, Eq. 2(56).*

Therefore:

I) the total backward or returned path related to N_{0e} initial number of H particle-paths at *c* speed of electron main-body and in opposite direction of its speed $\vec{v}$:

$$L_{\lambda'} = \lambda' \upsilon_e a_s^{-1} = C(\gamma + \alpha + 1) \qquad 3(13)$$

by dividing $L_{\lambda'}$ by N_{0e}, $l_{\lambda'}$ the portion of the path that belonged to each initial particle-path is obtained according to $E_{qs.}$ *3(9), 3(11), 3(18)*:

$$l_{\lambda'} = \frac{L_{\lambda'}}{N_{0e}} = \frac{C}{N_{0e}}(\gamma + \alpha + 1) = \frac{a_1 h}{a_s m_{0e} c}(\gamma + \alpha + 1) = \frac{a_1 \delta l}{2}(\gamma + \alpha + 1) \qquad 3(14)$$

II) The total forward paths of N_{0e} initial H particle-paths with speed *c* and in the same direction of electron speed $\vec{v}$:

$$L_\lambda = \lambda \upsilon_e a_s^{-1} = C(\gamma - \alpha + 1) \qquad 3(15)$$

a portion of the path per a single N_{0e} is obtained according to $E_{qs.}$ *3(5), 3(8), 3(15) as:*

$$l_\lambda = \frac{L_\lambda}{N_{0e}} = \frac{C}{N_{0e}}(\gamma - \alpha + 1) = \frac{a_1 h}{a_s m_{0e} c}(\gamma - \alpha + 1) \qquad 3(16)$$

III) The path that belonged to N_α H particle-paths in the direction of electron velocity $\vec{v}$ (*x* -axis) consisting of neutropa cells, i.e. axeon, *Sec. 10(8):*

$$L_e = \upsilon_e \lambda_e a_s^{-1} = C = a_d a_s^{-1}\Gamma \text{, Note 1(2)1} \qquad 3(17)$$

Thus, a portion of the path per any cell unit of $N_{e\alpha}$ units of single direction H particle-paths of a moving electron is obtained:

$$l_e = \frac{L_e}{N_{\alpha e}} = \frac{\lambda_e \upsilon_e}{N_{\alpha e}} = \frac{c}{N_{\alpha e}} = \frac{a_d \Gamma}{N_{\alpha e}} = \frac{a_d \Gamma}{\alpha N_{0e}}$$

Please refer to *Sec. 5(6)4, item B.*

IV) The circular or rotating path, l_r *Eq. 3(25),* in the plane surface perpendicular to $\vec{v}$ (*y, z plane*):

According to $E_{qs.}$ *3(27),* the spin of a free electron [17, 18]:

$$\vec{S} = \vec{r} \times \vec{p}_e = \hbar \vec{i} \text{ , } (\vec{i} \text{ is the unity vector}) \quad \textit{Comment 3(1)1b} \qquad 3(17)1$$

Based on the above discussions, a structural model for free electron moving at *v* speed and the participation of H particle-paths according to *Eqs. 3(13)* to *3(17)* is illustrated in, *Fig. 4(4)*, of, *Sec. 4(3)1*, *Part B*, accompanied by explanation. In case of expanded engaged electron in an atom orbit, please refer to *Simulation 7(4)3, E2a*.

Note 3(1)1d – Here, the path-limit Γ, is electron path-limit in a medium, e.g. vacuum, *Sec. 7(4)3*. Moreover, the central axial part of an electron with its neutropa cells arrangement in the speed direction, *Fig. 4(4)*, is nominated the axeon of electron, *Sec. 10(8).* It is confining in path-limit Γ, *Sec. 7(4)2e*.

Note 3(1)1e - According to stated above discussions and $E_{qs.}$ *2(77), 2(86) and 3(9)*

$$\Delta\lambda = \lambda' - \lambda = \frac{2c}{K_\Gamma n_{0e}} = 2\alpha\lambda_e = \frac{2h}{m_{0e}c} = 2\lambda_0 \qquad 3(18)$$

$$\alpha\lambda_e = \lambda_0 \qquad 3(19)$$

$$\upsilon_e = \alpha\upsilon_0 = (\alpha c)\frac{m_{0e}c}{h} = \alpha K_\Gamma n_{0e} = n_\alpha K_\Gamma \qquad 3(20)$$

$$h\upsilon_e = h(\upsilon + \upsilon') = \frac{mvc}{\sqrt{1 - v^2/c^2}} = cp_e = \alpha E_{0e} = m_0 c^2 \alpha = \frac{hc}{\lambda_e} \qquad 3(21)$$

According to $E_{q.}$ *2(59), 3(21):*

$$\Delta E_{FB} = \frac{\varepsilon_F - \varepsilon_B}{2} = h\upsilon_e = \alpha E_{0e} \qquad 3(22)$$

ΔE_{FB} is the energy difference of forward and backward motions of H particle-paths of a moving H system (electron) and E_{0e} is the electron energy at rest. In case of photon, there is $\varepsilon_B = 0$ (no backward motion) and $\Delta E_{FB} = \varepsilon_F = h\upsilon$ respectively.
According to stated above equation and discussions:

$$\frac{\upsilon'}{\upsilon} = \frac{\lambda}{\lambda'} = \frac{\sqrt{c - v}}{\sqrt{c + v}} \qquad 3(23)$$

υ_0, the frequency of electron matter wave, *Sec. 5(6),* at rest frame it is equal by factor *2* to Compton frequency υ_c. "one can easily show that if the electron really does oscillate at the Compton frequency in its rest frame, when you view the electron from a moving frame a beat frequency become superimposed on this oscillation due to Doppler shift. It turns out that this beat frequency proves exactly the de Broglie wavelength of a moving electron"[492] *origin of the de Broglie wavelength*. The de Broglie frequency of moving electron υ_e is superimposed on Compton frequency υ_c. At low speed, the Compton wavelength is very short respect to de Broglie wavelength λ_e, and is undetectable respect to the latter by measuring device.

Comment 3(1)1a – Path *P*, is an invariant of transformation of an inertial reference frame to other one as a result obtained from the present section, i.e. the wavelength dilate (or contract) accompanied by decreased (or increased) of H particle-paths in such a way that path *P* remain invariant (or constant), regarding path-constancy, *Sec. 2(1)2*. Therefore, the exit of photon λ' can be regarded as a result of the Newton third law in quantum scale as in this section. Please refer also to *Comment 2(1)1b2*, and *Mirror Image Effect, Sec. 6(2)3*. Noteworthy, the path *P* is proportional to path-limit Γ, *Remark 3(1)1a,* in a medium, e.g. normal vacuum, *Sec. 7(4)3, part A*. The path-limit Γ is related to the texture structure of a medium, and is independent from the particle velocity, *Sec. 7(4)3*.

Comment 3(1)1b- According to [17], "new physics considers, that the angular momentum of an electron and photon is identical and is peer $\hbar$, and official physics, accordingly, $\hbar/2$ and $\hbar$. Nevertheless, for calculation of a wavelength of an electron official physics substrates in a de Broglie formula not $\hbar/2$, and $\hbar$ and receives, naturally, exact value of a wavelength". Similarly, to case of gravitational closed-end expandon's angular momentum, i.e. $2\hbar$, *Sec. 2(4)4a*, the spin of a free moving particle, i.e. $\hbar$, can be regarded as minimum path-length value, *Sec. 5(16)3g*, of the particle open-end that varied during any stay time ΔT, *Sec. 7(4)2f, part A,* successively. Please refer also to *Note 5(16)3g, A1*.

Remark 3(1)1a- For reason of simplicity, the path *P* is chosen to $P = N_\alpha \lambda = N_{\alpha'} \lambda' = N_{\alpha e} \lambda_e$. Moreover, the path *P* is proportional to path-limit Γ in a medium, e.g. vacuum medium. Thus, $P = K_P \Gamma = K_P \dfrac{c}{a}$.

Remark 3(1)1b- All over this part everywhere dealing with an H particle-path, it means an H particle-path or a group of their according to *Sec. 7(4).*

Remark 3(1)1c- The arrangement of expandons (or better to say neutropas) in the particle, e.g. photon, and electron, main-body H hall package unit, *Sec. 5(16)3b*, also obeys the similar arrangement as in path *P* in spatial medium, *Sec. 7(4)3, part A,* at K_Γ proportionality factor; thus:

$\Lambda_{mass} = K_\Gamma \lambda_d$

Where:

- λ_d the wavelength of particle matter wave in spatial medium
- Λ_{mass}, the wavelength of internal motion of H particle-paths in particle main-body related to frequency equivalent n_τ; please refer also to *Note 2(3)1a*.
- K_Γ - The proportionality factor of matter wave frequency υ_τ with that of n_τ frequency equivalent related to main-body of particle (or mass-body), please refer to *Sec. 7(4)2f*, and *Sec. 9(4)7c* in this regards.

Factually, n_τ can be related to frequency of particle state changing in particle main-body (or mass medium, *Sec. 7(4)3, part D*). Thus, particle has stay time interval ΔT_{mass}, *Sec. 7(4)2f, part A,* in this medium. Please refer also to *Simulation 8(7)2, E5a.*

Factually, the particle is composed of N_{mass} states, *Sec. 7(4)4*, in mass medium are assumed as superimposed within stay time intervals ΔT_{mass}; while, the particle of n_d states in spatial medium are assumed as superimposed within stay time intervals ΔT_d in such a manner that according to path-constancy we have:

$c\,\Delta T_{mass} \cdot N_{mass} = c\,\Delta T_d \cdot n_d$ or

$\Lambda_{mass} \cdot N_{mass} = \lambda_d \cdot n_d$

As the result, the schema of *Figs. 3(2), 3(3),* can be regarded as superimposition of particle, e.g. photon, electron, states normal to the direction of its motion.

3(1)2- Counter currency of negapa & posipa mode of motion

A)- Supposing a white cylinder (e.g. pencil) in a translational motion along *V*-axis *Fig. 3 (4),* at *v* speed. At the surface of the cylinder drawn two narrow spirals with the tendency of transferring at the ends as follows:

I) A blue spiral in the counterclockwise direction

II) A red one in the clockwise direction

As the cylinder rotates along its axis counterclockwisely, i.e. at the same direction as blue one, one can see the blue spiral spinning at forward direction [e.g. $+\delta e$ in *Fig. 4(4)*], i.e. left-hand rule at *v* speed direction and the red one backward [e.g. $-\delta e$ in *Fig. 4(4)*], i.e. right-handed rule at opposite speed $-v$ direction.

In the counter-currency, the, SN and SP spin modes are nominated to negapa and posipa configurations respectively in accordance to the spin rotating directions respect to their translational motions. Thus to any particle spin, we can relate two configurations according to the twisting directions of posipa and negapa as above (spin mode or color). As an example in

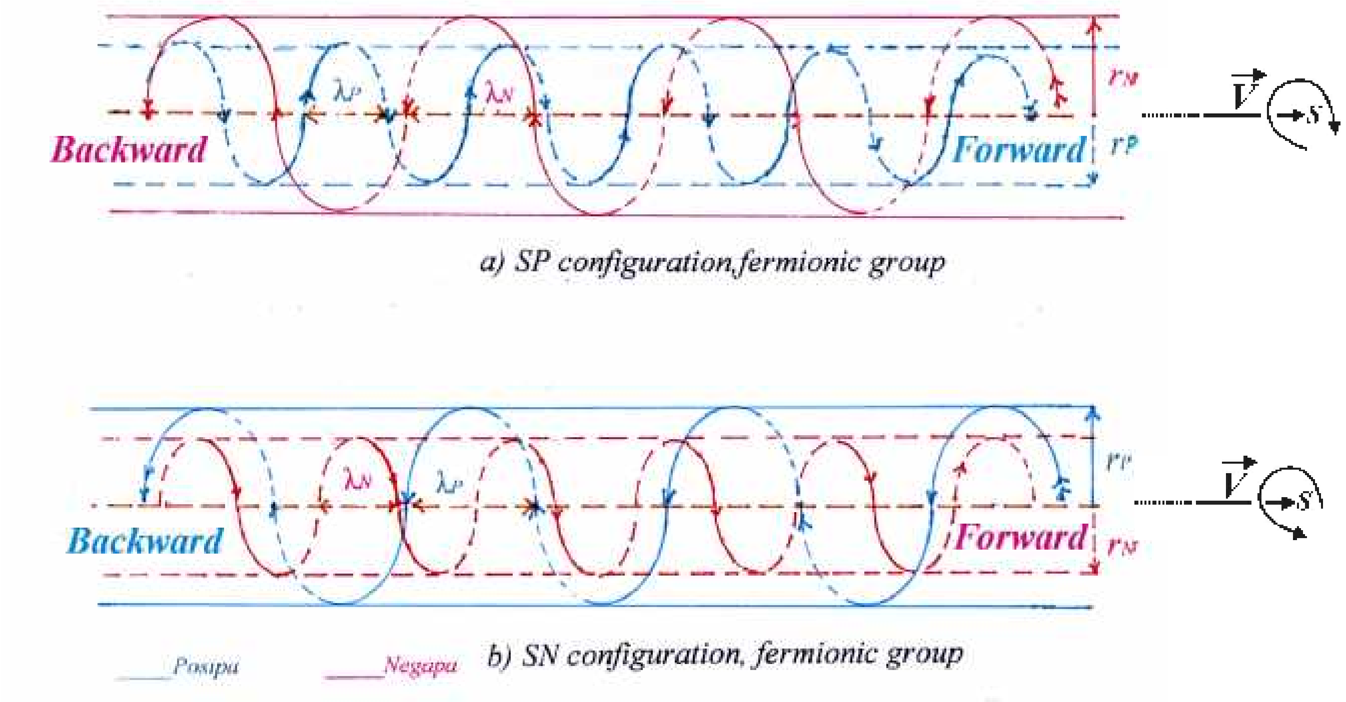

Fig.3(5)- Counter-currency mode of posipa and negapa motions; (moving state)

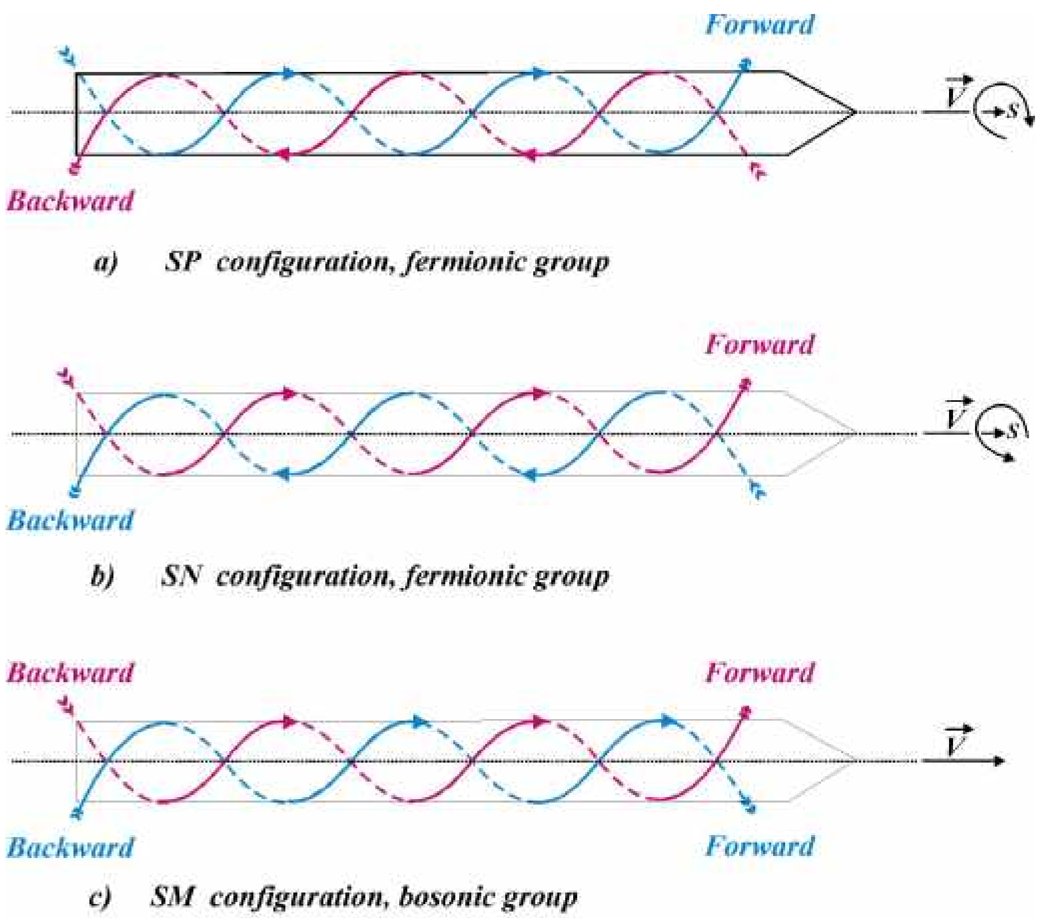

Fig 3(4)- Counter - currency mode of posipa and negapa motions (rest state)

the SP mode, the posipa twisting in a forwarding motion in accordance with its spin direction similar to that of *Fig. 4(4),* i.e. left-hand rule. Whereas, negapa spinning at the opposite direction of H system spin i.e. moving in opposite direction of common motion of H system *Fig. 4(4), 4(15),* i.e. right-hand rule, *Comment 3(1)2a.* Please refer to *Simulation 3(1)2a.*

B)- By considering the *Fig. 4(4),* of the moving electron, the H particle-paths related to forwarding λ , *Eq. 2(73),* at the speed direction, has smaller radius (i.e. the radius of λ peak from *V*-axis) respect to that of backwarding H particle-paths related to λ', *Eq. 2(74).* Thus, by analogy with this, the axeon's forwarding posipa (i.e. at the speed direction), in case of *Fig. 3(5)a* has smaller radius (respect to *V*-axis). Moreover, the forwarding posipas have higher frequency respect to that of backwarding negapa, i.e. opposite of *V*-axis *Fig. 3(5)a*, according to Doppler Effect, *Sec. 2, Eqs. 2(50)-(59)* based on path-constancy, *Sec. 2(1)2*

According to *Sec. 8(1)2*, any countercurrent negapa (or posipa) H particle-path is complex conjugate of its related posipa (or negapa) H particle-paths and vice versa, or, in other words, the right-handed negapa is complex conjugate of its counter-current left-handed partner posipa or vice versa.

Now, in case of negative charge particle considering, *Fig. 3(5)a, i.e.* SP , configuration at the direction of *v* speed, the blue spiral (posipa) is surrounded by a greater diameter i.e. red spiral (negapa), or, in other words, the posipa motion paths is overlapped by negapa paths one at its opposite direction. In case of positive charged particles the reverse case occurred*, Fig. 3(5)b, i.e. SN* configuration, *Example 3(1)2a*.

According to *Eqs. 2(73),2(74), 2(82*), regarding spin or path constancy, *Note 3(1)2a:*

$$\frac{r_P}{r_N}=\frac{\lambda_P}{\lambda_N}=\frac{(\gamma-\beta)}{(\gamma+\beta)} \qquad 3(23)a$$

Where, r_P , r_N are the posipa and negapa spiral spin radii; Moreover, λ_P , λ_N are wavelengths of posipa and negapa respectively.

Considering *Figs. 3(4),3(5), Note 2(4)4b1*, the H particle-paths configurations of a mass-body at rest, i.e. *SP* configuration, at *c* speed, and, are fermionic, i.e. counter-direction posipa & negapa, related to particle with rest mass that make up matter. Similarly, the H particle-paths configuration of an anti mass-body at rest is *SN* at c speed, i.e. antifermionic. Moreover, massless particle such as photon constituted of single direction H particle-paths are bosonic, *Remark 3(1)2a*, i.e. *SM* configuration at *c* speed, i.e. co-direction posipa & negapa, which transmit forces respectively. Note that a moving body is the intermediate combination of the two stated above configurations, *Fig. 3(5).* Moreover, an H system at rest on the basis of counter-currency mode is at stationary wave state as postulated in Schrödinger equation, *Sec. 8.*

Factually, the *Figs. 3(4)a, 3(5)a,* are related to *SP* configuration of left-handed (type *L*) fermionic group at rest and motion states respectively; the *Figs. 3(4)b, 3(5)b*, are related to *SN* configuration of right-handed (type *R*) antifermionic group at rest and motion states respectively, *Comment 3(1)2b*. Factually, the *Fig. 3(5),* is a mixed stage of single direction (or non reversible), and purely reversible mode of motion of H particle-paths. "Particles were divided into bosons (like light wave) and fermions (like electrons, or neutrinos). Quantities like space, time and electric field that can be measured by numbers are bosonic" [420] *the fuzziness of space-time*. According to *Sec. 5(16)9b*, there is a non reversible spatial expansion along with time's arrow in matter Universe related to *SN* configuration, *Fig. 3(5)b*, please refer also to *Sec. 5(16)1b, part A, paragraph 15*.

The application of fermionic, bosonic nomination to the counter-currency mode of H particle-paths configurations, are independent of the intrinsic spin of the particle and photon. Moreover, it is merely a nomination, as massless photons are bosonic and most of the stable particles with rest mass in the Universe are fermionic from point of view of their intrinsic spins. Please also refer to *Note 3(1)2b.*

Simulation 3(1)2a- In *Fig. 3(5),* the countercurrent negapas and posipa propagate through each other unperturbed. Moreover, in Fig. *3(6),* superposed waves of opposite phase can become un-manifest at some physical space or time domain but the wave energy continues to propagate unperturbed even though the energy at these locations cannot be detected. The cartoon (a) shows rope waves of opposite phase passing through each other and becoming un-manifest for a moment during perfect superposition.

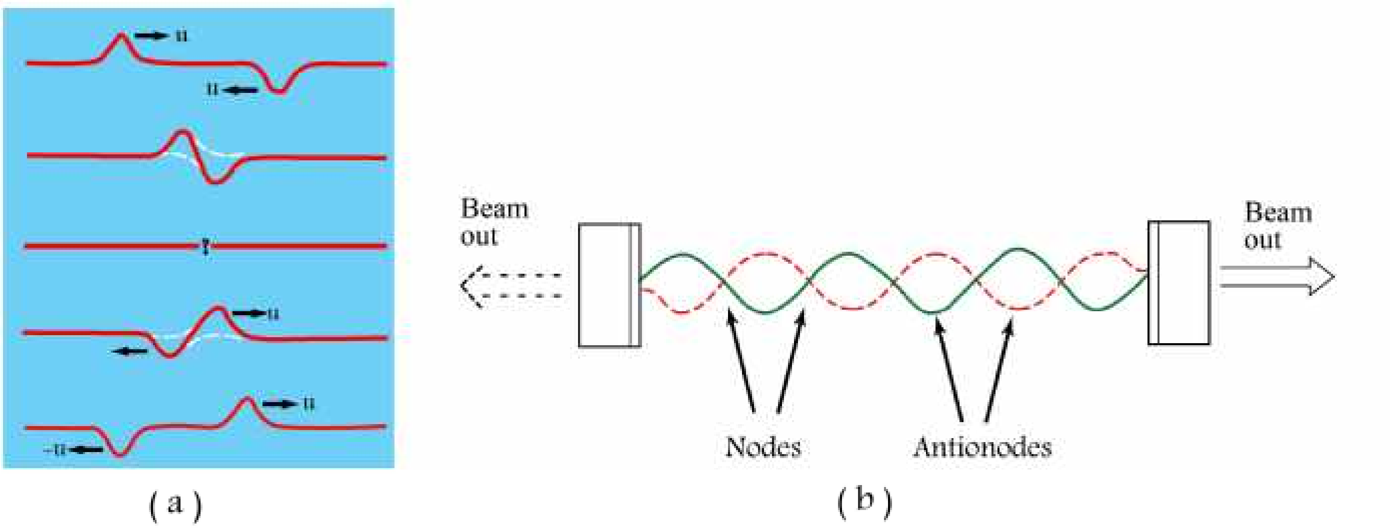

Fig. 3(6)- Superposed waves of opposite phase

The cartoon (b) shows the nodes and antinodes inside a laser cavity. At the nodes, with the oppositely moving field energies always out of phase, no stimulated emission action takes place. The antinodes are known as regions of "spatial hole burning" as the stimulated emission activity is strongest here due to the fields being in phase. [496] *section 1-2*. Please refer also to *Simulation 7(4)2e1*.

Example 3(1)2a - In case of hydrogen atom, "whatever the complicated the electronic motions there were that produced observed spectralisms, the application of a uniform magnetic field should produce changes because of the Lamor precession; a general vibration can be resolved into three harmonic components at right angle. Suppose the magnetic field is in the +*z* direction will be unaffected by magnetic field. Whereas, the *x, y* direction will precess with the Larmor angular velocity $\left(e/2mc\right)B$ in a right-handed sense about the *v*-axis. "An *x*-vibration $x = a\cos\omega t$ can be expressed as the sum of two circular motion $\left(a/2\right)e^{i\omega t}$ and $\left(a/2\right)e^{-i\omega t}$ rotating in opposite direction (i.e. counter-currency mode of motion, *Sec. 3(1)2*), and similarly for a *y*-vibration. The clockwise motion will be speed up by the Larmor precession to $\omega + \omega_L$ and anticlockwise motion will be slowed down by the same amount" [93] part related to *Zeeman Effect*. As a result of the *Zeeman Effect* analogous to the case of a freely moving electron at *v* speed , *Sec. 4, Fig. 4(4),* and interaction of two moving charged H systems, *Sec.4, Fig.4(5).*

Note 3(1)2a - According to the constancy of paths, *Sec. 2(1)2,* of fundamental H systems (refer to *Note 2(1)4a),* in case of Compton Effect, $\theta = 0$ and $\varphi = 180^\circ$, we have:

I) The total path of electron at rest ($n_0\lambda_0 = c$) and striking photon λ , ($\lambda\upsilon = c$) at spatial *Sec. 7(4)3, part A*.

II) The total path of moving electron $\lambda_e\upsilon_e = c$ and scattered photon $\lambda', \upsilon'\lambda' = c$ at spatial medium.

Thus: $\upsilon_0\lambda_0 + \upsilon\lambda = \upsilon_e\lambda_e + \upsilon'\lambda' = 2c$ 3(24)

(*before striking)* , (*after striking)*
H system I path = *H system II path*

Considering that photon λ' with path $\upsilon'\lambda'$ left the H system *II* after striking and according to $E_{qs.}$ *2(25)* to *2(27)* and *Eqs. 3(2), 3(3),* the total path due to rotational motion [*Note 3(1)1c*], l_r, must be equal to the path of photon λ' .

$$l_r = \upsilon_e \times 2\pi r = c = a_d\Gamma \qquad 3(25)$$

According to $E_{qs.}$ *3(21), 3(25):*

$$\lambda_e = 2\pi r$$

$$r = \frac{\lambda_e}{2\pi} = \frac{h}{2\pi p_e} = \frac{\hbar}{p_e} \qquad 3(26)$$

$$S = rp_e = \hbar \qquad 3(27)$$

Where:

- r , is the radius of rotational motion, *S,* p_e are spin and linear momentum of electron respectively.
- a_d , is the media coefficient of vacuum, *Note 1(2)1*.

As a result, the path-length constancy, *Sec. 2(1)2,* of a free moving particle, regardless of its mass and velocity defines its intrinsic spin angular momentum; please refer to *Sec. 9(4)2,* and *Sec. 8(7)1*. Noteworthy, υ_0, λ_0 are the stationary matter wave, *Sec. 2(4)4b,* counterpart in spatial medium, *Sec. 7(4)3, part A*, .of electron at rest state of n_0 frequency equivalent and Λ_0 related wavelength through electron mass medium, *Sec. 7(4)3, part D*, such that:

$$\upsilon_0\Lambda_0 = n_0\Lambda_0 = c, \qquad \frac{\upsilon_0}{n_0} = \frac{\Lambda_0}{\lambda_0} = K_\Gamma \qquad 3(27)a$$

Please refer to *Note 2(3)1a*. The similar case is applied to de Broglie frequency and wavelength, *Sec. 5(6)*. Therefore, the *Eq. 3(24)*, also is valid within mass medium of interacting particles.

Note 3(1)2b - The above discussion on the counter-currency has a rough analogy with a basic feature of modern physics as revealed by the equation used in quantum electrodynamics and announced by Baron von Stuckberg and Richard Feynman back in the mid 1940's is that matter and anti-matter enjoy a peculiar-reversal symmetry. "A matter particle traveling forward in time between T_1 and T_2 , is mathematically equivalent to the same antimatter particle traveling backward in time T_2 and T_1 "[77], *Q &A No. 186*. Or, in other feature a posipa (left-handed H particle-path) is in counter-current reversible mode of motion with its anti, i.e. negapa (right-handed H particle-paths) and vice versa; please refer to *Sec. 2(3)3,* time reversal symmetry.

Comment 3(1)2a- From view point of H particle-paths hypothesis, the right- and left-handed H particle-paths (or groups of their, *Sec. 7(4)*) of an H system at rest state moving internally in counter-current mode respect to each other, can be considered as simultaneously superimposed on each other, i.e. two superposition states. Moreover, anywhere in this article the *SN* configuration is relative preference of negapa respect to posipa that is equivalent to the preference of *SN* configuration over *SP* one (or vice versa)

Comment 3(1)2b- The fermions related to fermionic group of *SP,* or, *SN* configuration are the constituents of matter. Therefore, it has the capability of spin coupling, *Sec. 9(2), Fig. 9(2)*, through interchanging of their reversible counter-current H particle-paths. Whereas, bosons related to bosonic group of *SM* configuration are the constituent of radiation, e.g. photon, due to the single structure of related H particle-paths. In the *Figs. 3(4), 3(5),* normally particles spins are in the direction of their motions; therefore, to the *SN* and *SP* configurations must insert additional suffixes *r, l* respectively, i.e. SN_r, SP_l, and in case of counter- direction spins, we have SN_l, SP_r configurations respectively that are not shown in *Figs. 3(4), 3(5).* Noteworthy, in our matter universe, SP_l configuration is related to left-handed path-length (type *L*), and SN_r configuration is related to right-handed path-length (type *R*) respectively, *Note 5(16)9b1*, for more information please refer to *Sec. 5(16)11,* and *Sec. 5(16)9a*. Thus, the former leading to left-handed spin, and the latter to right-handed one in case of particle in microcosm of matter Universe. Moreover, *SP* or, *SN* configuration is related to counter-currency mode of motion of H particle paths as posipas & negapas. Factually, in rest state, *Fig. 3(4),* superimposition of two types *SP,* and, *SN* configurations at equal magnitude and opposite directions must be considered without any preference. In moving states, *Fig. 3(5),* there is a preference of *SP* over *SN* configuration, *Fig. 3(5)a*, in a direction of motion and proportional to it, that is nominating simply *SP* configuration, or vice versa in case of *Fig. 3(5)b*.

Remark 3(1)2a- A bosonic particle of rest mass has also *SM* configuration. In other words, the superposition of reversible counter-current H particle-paths of *Fig. 3(4)c* at two opposite directions and at equal preference (indistinguishability, *Sec. 8(9)1*, and *Sec. 7(4)2f, part B*) that is not shown for the reason of simplicity. In case of particles in micro-world, the configurations shown in *Figs. 3(4), 3(5)* are related to just during the detection (or measurement, *Sec. 8(7)2*); while, the SM configuration, *Fig. 3(4)c* is related to post measurement co-direction posipa & negapa of bosonic particles.

3(2) - Study of H particle- path of an H system (e.g. electron)

Assuming a moving electron at *v* speed of υ_e matter wave frequency (or υ_e neutropa cells) arranged in a path $P = c$, *Remark 3(1)1a,* successively at λ_e distance from each other changes its type R & L configurations and is surrounded with $N_f = a_1^{-1} n_f$, *Eq. 2(35)* the remained initial H particle- paths of frequency equivalent n_f $E_{q.}$ *3(29),* thus:

$a_d \Gamma = \upsilon_e \lambda_e = c$,

According to $E_{qs.}$ *2(86), 3(18):*

$$n_{0e} = \frac{c}{\lambda_{0e}} = \upsilon_{0e} \qquad 3(27)1$$

The total number of H particle–paths, n_e of a moving electron after exit of photon λ' is calculated as:

$E_{et} = h(\upsilon_{0e} + \upsilon) - h\upsilon'$

According to *Sec. 2(2)1, Eq. 2(49),* $E_{qs.}$ *3(12), 3(18) to 3(21):*

$$\frac{E_{et}}{h} K_\Gamma = n_e K_\Gamma = \upsilon_{0e} + \upsilon_e - 2\upsilon' = n_{0e} + \alpha n_{0e} - 2 \times \frac{n_{0e}\alpha}{\gamma + \alpha + 1} \qquad 3(28)$$

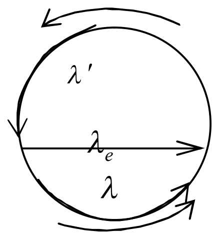

Fig 3(7) – The situation of curved λ *and* λ' *wavelength in relation to* λ_e *of a moving electron.*

According to *Fig. 4(4),* υ_e track texture cells, *Sec. 9(4)7,* are located along path *P*. The path of each cell is divided by wavelength, λ_e of moving electron in two parts; the curved wavelength of stroked photon λ in the direction of motion and the curved wavelength λ' in the opposite direction *Fig. 3(7).*

Considering the stated above discussions and, $E_{q.}$ *3(28):*

$$n_f = n_e - \upsilon_e K_\Gamma^{-1} = n_{0e}\gamma - \alpha n_{0e} = n_{0e}(\gamma - \alpha) \qquad 3(29)$$

n_u, the frequency equivalent number of H particle-paths of electron that is shared per one cell of υ_e cells calculated as:

$$n_u = \frac{K_\Gamma n_f}{\upsilon_e} = \frac{n_{0e}(\gamma - \alpha)}{n_{0e}\alpha} = \frac{\gamma - \alpha}{\alpha} = \frac{\gamma}{\alpha} - 1 = \frac{c}{v} - 1 = \frac{c - v}{v} \qquad 3(30)$$

In the high velocity when $v \to c$, the number $n_u \to o$ and in case of $n_u = 1$:

$$\frac{c-v}{v} = 1 \quad 3(31)$$

$$v = \frac{c}{2} \quad 3(32)$$

$c - v = vn_u$ (Refer to $E_{q.}$ *3(30))*

$$v = \frac{c}{n_u + 1} \qquad n_{0e} \rangle n_u \rangle 0 \quad 3(33)$$

According to $E_{q.}$ *3(20)*, as υ_e is changed at least by one unit or (an H particle-path neutropa) e.g. $\Delta\upsilon_e = 1$, the total energy change is calculated as below:

$$\upsilon_{e_1} = \alpha_1 n_{0e} K_\Gamma \quad 3(34)$$

$$\upsilon_{e_2} = \alpha_2 n_{0e} K_\Gamma \quad 3(35)$$

$$\Delta\upsilon_e = \upsilon_{e_2} - \upsilon_{e_1} = n_{0e} K_\Gamma(\alpha_2 - \alpha_1) = n_{0e} K_\Gamma \Delta\alpha = 1 \quad 3(36)$$

$$\Delta\alpha = (n_{0e} K_\Gamma)^{-1} = \frac{a_1 h}{m_{0e}c^2} \quad \text{or} \quad (\Delta\alpha)c = \frac{a_1 h}{m_{0e}c} = \frac{\lambda' - \lambda}{2}, \quad \textit{Note 3(2)1} \quad 3(37)$$

and according to $E_{q.}$ *2(30)* , and *Sec. 1(2).*

$$\Delta p_e = m_{0e}(c\Delta\alpha) = \frac{a_1 h}{c} = \frac{H}{c} \quad 3(38)$$

$\Delta E_e = c\Delta p_e = a_1 h = H$ Please refer to *Sec. 7(1); Sec. 7(4),* for complementary information 3(39)

That is, the energy and linear momentum change, *Secs. 6,7,* of a free electron is *quantized* or α cannot take any arbitrary value and is changed by $\frac{a_1 h}{m_{0e} c^2} = \frac{1}{N_{0e}}$ factor, *Note 3(2)2*. According to $E_{q.}$ *3(39)* as υ_e changes by one unit, the total energy will change by one H unit. According to this statement the total number of N_{0e} initial H particle-paths of electron's H system remain constant, or, in other words, its electrical charge *e* remain constant during energy or momentum change, thus $\frac{e}{N_{0e}}$ or $\frac{e}{m_{0e}}$ has constant value for each fundamental charged particles (H system) during motion, since only υ_e changes in a constant interval Γ .

Where:

- a_1, Constant of media coefficient, *Note 1(2)1*
- n_{0e}, n_e the frequencies equivalent of electron at rest state, and at motion respectively
- N_{0e}, the total number of N_{0e}, *Eq. 2(35),* initial H particle – paths of electron's H system of frequency equivalent n_{0e}
- K_Γ, the proportionality factor as in *Remark 2(3)1b*
- *H*, the energy attributed to an H particle path through free vacuum

Note 3(2)1- Referring to $E_{q.}$ *3(18)*, by increasing m_0 the initial mass of the particle, $\Delta\lambda$ decreases accordingly (e.g. proton respect to electron). In other words, $\lambda' \to \lambda$ and the total number of H particle-paths variation, δN_t (related to variation of frequency equivalent δn_t , $E_{q.}$ *2(95)*) of the moving H-system respect to its initial H particle-paths decreases to zero at equal velocity *v* respectively and at the case of macro-body [*Sec. 2, Note 2(1)4a*] δN_t and $\Delta\lambda$, shift to zero. In other means, the number of entered H particle-paths is equal to the number of the H particle-paths that left the H system (macro-body) during impulsion, as it is revealed according to *Eq. 2(48).* Therefore, we encountered with returned of internal energy or, in other words, the change of the paths shapes of the total H particle-paths of an H system [refer to *Note 5(2)1b1*, for comparison].

Note 3(2)2- The Compton wavelength, *Eq. 5(34),* l_c is an essential factor that is used in many equation, e.g., as in Klein-Gordon and Dirac equations [189].

3(3) -Constancy of the path-limit Γ

A) Free moving particle:

The path-limit, Γ , *Sec. 1(12),* conserved in all the stages during the motion of free moving particle in a uniform medium, Sec. 7(4)3, e.g. vacuum gravitational field free, *Sec. 3; Figs. 3(2), 3(3); Sec. 4, Figs. 4(4); Sec. 5, Figs. 5(6), 5(7).* Please refer to *Sec. 7(4)3*, in case of medium dependence of path-limit Γ .

B) Bound particle:
The path-limit, Γ is also remain constant in the bound H system e.g. electron, proton neutron in atoms orbits, *Note 9(3)1a.*
Assuming, *n,* the total H particle-paths of a particle; thus, according to *Sec. 3, Eq. 3(17), 3(24), 3(86)*, and *Note 2(*3)*2b*, i.e. :

$$n\lambda = \Gamma \qquad 3(40)$$

Where, λ is the wavelength or distance of two adjacent H particle-paths configuration in the particle matterwave.
The constancy of path-limit Γ assumption is consistent with Kennedy-Thorndike experiment [70].