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H particle-paths hypothesis
(A new thought in theoretical physics)

Volume three

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Part 4a-Forces

6- Acting force on a mass-body

6(1) – Mass-body at rest (static)

I) Supposing an isolated mass-body constituted of N_0 H particle-paths, *Remark 6(1)1*, is divided by an imaginary surface *S* to two parts *A , B, Fig. 6(1),* the total H-particle-paths traveling between parts *A* and *B* through surface *S* are equal to each other: therefore, irrespective of the surface, *S,* shape, considering equilibrium state:

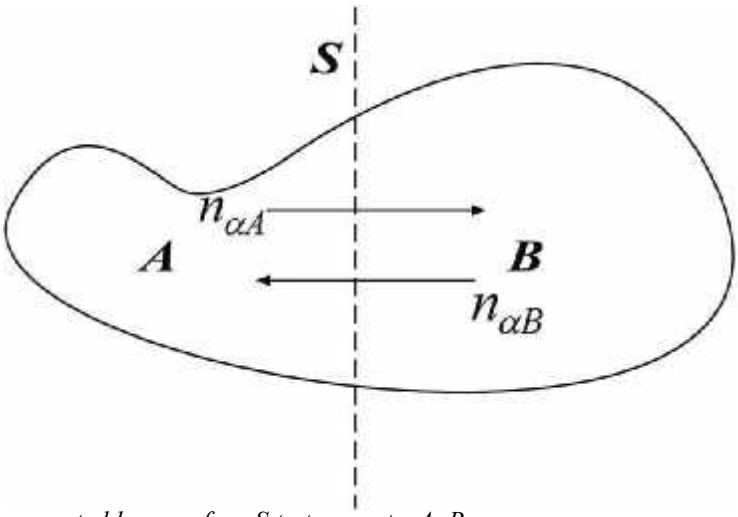

Fig 6(1) –A mass-body separated by a surface S to two parts, A, B

$N_0\,\alpha_A C = N_0\,\alpha_B C$ or $N_{\alpha A} = N_{\alpha B}$ 6(1)

Where:

- α_A, α_B, are the ratio of single direction or returned H particle-paths respect to initial mass-body of parts, *A, B,* respectively, *Eq. 2(7)*
- $N_{\alpha A}, N_{\alpha B}$ are number of single direction H particle-paths of parts *A, B,* of mass-body respectively, *Eq. 2(22).* Please refer also to *Sec. 6(2)6a, part B*.

In the other words, assuming a mass-body is separated by an imaginary surface *S* into two parts *A* and *B,* the flux of H particle-paths through surface *S* in unit of time in a reversible motion are equal, (Mirror Image Effect*, Sec. 6(2)3,* based on Newton third law), *Sec. 6(2)2*. Please refer also to *Example 2(6)5c1* in this regards.

II) Assuming an external force $\vec{F}$ is applied to the mass-body *D* at rest, i.e. $N_{\alpha F}$ H particle-paths (or reversons, *Sec. 7(5)*) enter the body *D* at a time interval Δt of force application. At the same time e. g. Δt, N_{IF}, H particle-paths due to impulsion (or impulsion reverson) left the body *D* toward opposite of $\vec{F}$ direction, (Newton third law), and of reversed handedness of $N_{\alpha F}$, *Remark 6(1)2.* Please refer also to *Note 5(9)3d3*, and *Note 6(2)1a2*, in this regards.

According to E_{qs} *2(22), 2(30)*; *Note 2(1)4b*:

$$F = m_o c \frac{d\alpha_F}{dt} \qquad 6(2)$$

According to *Eq. 2 (35):*

$$F = \frac{a_1 h}{c} \cdot \frac{N_{\alpha F}}{\Delta t} \quad \textit{Note 6(1)1,} \qquad 6(3)$$

Where

- m_0, the rest mass of mass-body D.
- a_1, constant of media coefficient, *Note 1(2)1.*

Considering the numbers of entered H-particle-paths are equal to exit of impulsion ones:

$N_{\alpha F} = N_{IF}$ or $\alpha_F = \alpha_I$ 6(4)

At this state, if body *D* moves as a result of force, *F,* application, i.e. $\alpha_F > \alpha_I$, we are encountering with the dynamic case, *Sec. 6(2),* and in case of rest or no motion (static), e. g., a book rests on a table; the table and book exert action-reaction constant forces on each other.

III) Considering two equal and opposite directions forces F_1 and F_2 applied on body *D* at a time interval Δt, according to *Eqs. 6(1)-6(3):*

$$\vec{F}_1 = -\vec{F}_2 \qquad 6(5)$$

$$F_1 = m_o c \frac{d\alpha_{F1}}{dt} = a_1 h \frac{N_{\alpha 1}}{c\Delta t} \qquad 6(6)$$

$$F_2 = m_o c \frac{d\alpha_{F2}}{dt} = a_1 h \frac{N_{\alpha 2}}{c\Delta t} \qquad 6(7)$$

$$m_\circ \Delta\alpha_{Fi} = m_\circ \Delta\alpha_{F2} \quad \text{or} \qquad 6(8)$$

$$N_{\alpha_1} = N_{\alpha_2} \quad \text{or} \quad \alpha_1 = \alpha_2 \qquad 6(9)$$

The entered H particle-paths to the body *D* through force F_1, *Eq. 6(6),* is equal to that of F_2 in opposite direction *Eq. 6(7)*. Thus, they can be regarded as contractons in mass medium that are along with equal number of expandons emission in spatial medium, *Note 6(2)1a2*. Moreover, according to *case (II),* we have a steady reversible motion of H particles-paths between F_1 and F_2. Considering force application F_1 and F_2 stopped simultaneously, the entered $N_{\alpha i}$ and $N_{\alpha 2}$ left the body *D*, as their impulsion ones; thus, this body remains at rest.

In this case the number, $N_{I1,}$ of H particle-paths due to impulsion force $\vec{F}_1$ are obtained as:

$$N_{I_1} = N_{\alpha_1} = N_{\alpha_2} \qquad 6(10)$$

Similarly N_{I2} related to force F_2

$$N_{I_2} = N_{\alpha_2} = N_{\alpha_1} \qquad 6(11)$$

Where; N_{I1}, N_{I2}, are the impulsion of H particle-paths related to forces F_1, and F_2 applications on body *D*.
According to *Eqs. 6(10), 6(11):*
$N_{\alpha 2}$ acts as impulsion H particle-path N_1 and similarly $N_{\alpha 1}$ acts as N_{I2} one reciprocally.

Note 6(1)1 – At all of stated above equations

$$m_\circ \alpha c = \frac{m_\circ c^2}{a_1 h} \cdot \frac{a_1 h}{c}\alpha = \frac{N_0 a_1 h}{c}\alpha = \frac{N_\alpha a_1 h}{c} \qquad 6(12)$$

Where:
- N_0, the initial particle-path number of body *D*, H system;
- $N_\alpha = N_0\alpha$, the number of entered H particle- paths.

Remark 6(1)1 - Through 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 6(1)2- The entrance and exit of H particle-paths are performed within mass medium, *Sec. 7(4)3, part D*, in the form of group (or package) through H hall package, *Sec. 5(16)3a*, each of path-length value h, *Sec. 5(16)3g,* at time interval ΔT_Γ. In other words, through total time interval $\Delta t = n\Delta T_\Gamma$, n H hall packages interchange in the mass-body *D*.

6(2)- Mass-body at movement (dynamic)
6(2)1- Accelerating motion
6(2)1a- Collision:

During a collision, two objects or H systems *A* and *B* exert forces on each other for a time interval, Δt, *Remark 6(2)1a1*. Before collision, the H-system *A* has $N_{\alpha Ai}$ H particle-paths, *Eq. 2(22)* related to single direction motion; similarly, $N_{\alpha Bi}$ for H system *B, Note 6(2)1a1*. During collision the H systems *A* and *B* exert forces on each other, or, in the other words, $N_{\alpha Ai}$ is entered in *B* and $N_{\alpha Bi}$ in *A*, that are accompanied by exit and exchanges of particle-paths impulsion N_{IA} of *A* and N_{IB} of *B, Remark 6(2)1a2;* please refer also to *Consequence 6(2)3a.* Considering $N_{\alpha Af}$ and $n_{\alpha Bf}$ the number of irreversible particle-paths after collision, we have:

$$N_{IA} = N_{\alpha Ai} - N_{\alpha Af} = \Delta N_{\alpha A} \qquad 6(13)$$

$N_{IB} = N_{\alpha Bi} - N_{\alpha Bf} = \Delta N_{\alpha B}$, *Note 6(2)1a2* 6(14)

According to path-length constancy, *Sec. 2(1)2*, we have:

$N_{0A}.\Delta\alpha_A.c = N_{0B}.\Delta\alpha_B.c$

According to *Sec. 2(1)1b, Eq. 2(22),* and *Eqs. 6(13), 6(14),* we have:

$\Delta N_{\alpha A} = \Delta N_{\alpha B}$, or $N_{IA} = N_{IB}$ 6(14)1

Where:

- N_{0A}, N_{0B} , the initial number of H particle-paths of mass-bodies, A, B respectively
- $\Delta\alpha_A = \Delta\alpha_B$, the variation of α , *Sec. 2(1)1a*, *Eq. 2(7),* the ratio of single direction or returned H particle-paths during collision respect to initial mass-bodies A, B respectively
- N_{IA}, N_{IB} , the single direction number of H particle-paths during collision through mass-bodies A, B , in the form of released contractons, *Note 6(2)1a2*, respectively, i.e. impulsion reversons A, B , *Sec. 7(5)*, of reversed handedness of reversons of $\Delta N_{\alpha A}, \Delta N_{\alpha B}$ respectively

Note 6(2)1a1- In case of H system *B* initially at rest $N_{\alpha Bi}$ is equal to zero, thus, according to *Eq. 6(14):*

$N_{IB} = N_{\alpha Bf} = \Delta N_{\alpha B}$ 6(14)2

Note 6(2)1a2 - The H particle-paths number N_{IA}, N_{IB} (or $\Delta N_{\alpha A}, \Delta N_{\alpha B}$, *Sec.6(2)2*) in case of collision and accelerating motion are H particle-paths in form of contractons based on equivalence principle *Sec. 5(3)1a*. Factually, $\Delta N_{\alpha A}, \Delta N_{\alpha B}$ are equal number of contractons, *Sec. 6(2)2*, that are mutually exchanged between mass-bodies *A, B*, *Sec. 5(9)3d, part c,* during interaction time interval ΔT , please refer also to *Sec. 2(4)4a,* and *Note 5(9)3d3*. Noteworthy, any released contracton is along with related type *R* or *L* expandons (or decaying compact expandons, *Comment 5(16)2c, A1*) emission within spatial medium, *Sec. 7(4)3, part A*. Similarly, in case of accelerating charge, we encounter with additional electromagnetical contractons, e.g. negactron, posictron, respect to uniform motion of the charge that are along with related electromagnetical expandons, e.g. negaton, positon, *Sec. 4(6)4*, emission. The emission of additional electromagnetical expandons based on *Simulation 7(4)2e1,* are equivalent to electromagnetical radiation. Please refer also to *Sec. 4(3)1, part c*. As the results:

1) There is two kind of source of energies for a particle including charged particle as following:

A) Internal source of energy related to dark matter consumption to dark energy *as in Simulation 8(7)2, E5a, it6em 9*. The matter wave, *Sec. 5(6),* in case of a particle at rest state or at uniform motion depends on this source. In this case, the released contractons are emitting in the direction of particle motion, and towards the emitter (source). Please refer to *Sec. 5(6)1* in case of internal energy E_{in} of a particle.

B) External source of energy of a particle due to external interaction of the particle with other particles (as external sources) or a charged particle with other charges. In the latter case, it leading to the electromagnetical radiation as discussed above. In this case the contractons are exchanged mutually between interacting particles, *Sec. 4(6)5b*, (virtual photon). Please refer to *Sec. 5(6)1* in case of external energy E_{ex} of the particle.

2) In *item 1A*, the matter wave is on the particle path, *Sec. 5(6),* and *Simulation 7(4)2e1*; while, in the *item 2B*, the electromagnetical wave is constructed in the spatial medium between the interacting charges, *Sec. 4(3)1, part c*, that is propagating at c speed.

Remark 6(2)1a1– The time interval Δt is infinitesimal, *Note 5(16)3b, D2*, due to *T*-symmetry, *Sec. 2(3)3*, at the instant of intermediate stage of Mirror Image Effect, *Sec. 8(7)6, Example 8(7)6, D2*. Please refer also to *Sec. 7(4)3, part D,* and *Note 6(2)6b1*.

Remark 6(2)1a2- According to *Sec. 5(16)11, and Sec. 5(9)3,* at the moment of collision:

I) The N_{IA} single direction H particle-paths (or reverson) from mass-body *A* are entered to mass-body *B* through collision contact area from mass-body *B*, and vice versa.

II) Similarly, to *case I*, mutually the N_{IB} H particle-paths are entered in mass-body *A* at the moment of collision through contact area in the form of e.g. type L path-length from *B* regarded as particle. The magnitude of path-length of N_{IA} H particle-paths is equal with N_{IB} ones, but of reversed handedness of each other, i.e. type *R,* and vice versa.

III) The single direction H particle-paths during entrance and exit from a mass-body, e.g. *A*, to other one, e.g. *B*, are of SM configuration (or two type *R&L* configurations) related to bosonic group, *Sec. 3(1)2, Fig. 3(4)c*, nominating reversons. In case of particles, the case *II* is applicable

IV) Any reversible path-length during an interaction has an equivalent irreversible one at K_Γ factor within spatial medium, *Sec. 7(4)3, part A*, lower than former one, *Consequence 2(4)3b1*.

In the three above cases, *I, II, III,* the related path-length are of reversible kind, *Sec. 2(4)4b*, related to *T*-symmetry, *Sec. 2(3)3*.

6(2)1b- External force

Assuming H system *B* of $N_{\alpha Bi}$ initial number of irreversible H particle-paths; exerts force $\vec{F}_B$ on H system *A*, and vice versa, after collision, we have:

$$\Delta N_{\alpha B} = N_{\alpha Bf} - N_{\alpha Bi} = N_{oA.}\Delta\alpha_A = \Delta N_{\alpha A} \qquad 6(15)$$

$\Delta n_{\alpha B}$, the number of irreversible H-particle-paths, that entered through *B* in *A* during time interval Δt that is accompanied by leaving $N_{IA} = \Delta N_{\alpha A}$ impulsion particle-paths in the opposite direction of $\vec{F}_B$ from *A* to *B*

$$\Delta N_{\alpha B} = N_{IA} \qquad 6(16)$$

According to *Eqs. 6(1), 6(2):*

$$\vec{F}_B = N_{oA}\frac{a_1 h\Delta\alpha_A}{c\Delta T} = \frac{a_1 h}{c}\frac{\Delta N_{\alpha A}}{\Delta T} \qquad 6(17)$$

Considering the stated above discussion for force $\vec{F}_A$ on *B*:

$$\vec{F}_A = N_{oB}\frac{a_1 h\Delta\alpha_B}{c\Delta T} = \frac{a_1 h}{c}\frac{\Delta N_{\alpha B}}{\Delta T} \qquad 6(18)$$

Where; $\vec{F}_B$ and $\vec{F}_A$ are the collision forces *B* on *A* and, *A* on *B*, respectively; moreover, N_{0A} and N_{0B} are the initial H particle-paths of the bodies *A* and *B* respectively; *Sec. 6(2)6.* Noteworthy, the number of single direction H particle-paths and related path-length is considered respect to *CMPRF* of system *A- B.* Noteworthy, the force application by a mass-body *A* on mass-body *B* based on *Sec. 5(16)2c, part c*, is along with contractons releasing by mass-body *B* towards mass-body *A*, and reciprocal contractons releasing by mass-body *A* towards mass-body *B* at equivalent manner accompanied by an accelerating motion.

6(2)2 - Discussion

The H particle-paths in case of mass medium in *Sec. 6(2)1*, at a good approximation have SM configuration related to reversons, *Sec. 7(5)*; thus, constant flow between two parts *A, B* are in an equilibrium stage. In case of an accelerating motion, this equilibrium is broken at infinitesimal time's arrow interval δT, *Sec. 5(9)2, part B* (or stay time, *Sec. 7(4)2f, part A*). In other words, supposing an accelerating motion in the direction A to B, an excess of $\delta N_{\alpha A}$ over $N_{\alpha A}$ is entered from part A to other part B through rectilinear surface S (or partial surface of dS area) that is perpendicular to the acceleration direction during time interval δt at non-steady step-like manner. Therefore, according to Mirror Image Effect, *Sec. 6(2)3*, an excess of $\delta N_{\alpha B}$ at opposite direction of acceleration motion over $N_{\alpha B}$ is entered from part *B* to *A* one in the form of reversed handedness of $\delta N_{\alpha A}$ at equal magnitude and reversed handedness of the latter, *Note 6(2)2a*; please refer also to *Secs. 6(2)1a, c*. By removal of accelerating mode of motion, *Note 6(2)2b*, the equilibrium between the $N_{\alpha A}, N_{\alpha B}$ H particle-paths (or particles) flows of the two parts is established again, i.e. $\delta N_{\alpha A} = \delta N_{\alpha B} = 0$. Factually, during accelerating motion irrespective of the shape of imaginary surface *S*, in any small area on it, any two parts A, B can be considered as two separate objects, *Sec. 2(6)5c, proposal c* with their own individual Schwarzschild surfaces, but of a common *CMPRF, Sec. 2(6)2b*. The two portions can be regarded as a unique H system, *Sec. 8(5)*, after removal of accelerating motion with a unique Schwarzschild surface and related *CMPRF*. Therefore, $\delta N_{\alpha A}$, *Sec. 5(9)2, part B*, can be simulated as particles generations on Schwarzschild surface of part *A* by analogy to $dn_{s(A)}$ in case of true gravity, *Sec. 5(1)1*. By the difference that, the expandons in case of true gravity has SN_r configuration in spatial medium, *Sec. 7(4)3, part A*. $\delta N_{\alpha A}$ can be also regarded as particles of SN_r configuration, *Sec. 3(1)2, Fig. 3(5)b*, and *Sec. 7(4)2e, part c*, that is emitting on surface *S* (or dS areas) perpendicular to it in the acceleration direction, *Remark 6(2)1a2*, and *Comment 6(2)2a*. If so, regardless of true gravitational field a system of higher inertial mass (or inertia, *Sec. 2(1)4*) at equal acceleration induces more virtual gravitational field, *Sec. 5(16)2c, part c,* due to acceleration than lower one. In other words, to an accelerating lift, *Sec. 5(16)2c*, *part A,* on the Earth is induced more uniform equivalent virtual field due to acceleration respect to the same lift of equal mass and acceleration on the Moon with the same man. Here, the Earth (or the Moon) along with the accelerating lift is regarded as a single object *A* with a single *CMPRF* that coincides with that of the Earth (or Moon) *CMPRF*, *Sec. 2(6)2b*, due to huge inertia of the latter respect to moving lift; while, the man in the lift is regarded as object *B*. In the case of the Earth, its mass M_E is very higher than the lift mass m_L, i.e. $M_E >> m_L$. Therefore, according to *Sec. 2(6)5c, proposal c*, there is a radial acceleration on the center of mass m_L towards, that of M_E. Moreover, the whole M_E - m_L system is regarded as a single object at radial direction with a unique *CMPRF*. The similar scenario is valid for a lift of mass m_L on the surface of a planet of a lower mass M_P, e.g. the Moon, at accelerating motion, and at radial direction of m_L to M_P. Considering the mass of the Earth is higher than the Moon, the inertial effect as in *proposal c* is considerable; moreover, the gravitational field related to gravitational mass also affects the equivalence principle, *Sec. 7(4)2f, part D.* As a result:

I) In an accelerating reference frame (analogous to case of inertial one, *Sec. 2(6) 2a);* the local inertial mass of the system must be taken into account.

II) In case of true gravity the emitting particles (or expandons) on the Schwarzschild surface (or *G*-reverson, *Sec. 7(5)3b*) of a mass-body has SN_r configuration of expanding type R_e, *Sec. 5(16)1a, part B*, and of irreversible path-length

characteristic, *Sec. 2(4)4b,* in spatial medium. While, in case of accelerating mode of motion, the emitting particles (or force carrier particles) on the Schwarzschild surface are bosonic of SM configuration transferring through the mass medium, *Sec. 7(4)3, part D*, at reversible path-length characteristic; please refer also to *Consequence 2(8)3a*.

III) The equivalence principle is valid on the Earth and the Moon surfaces as two individual labs separately. However, due to higher inertia of the Earth respect to the Moon, there is an inconsistency according to *Sec. 2(6)5c, proposal c*. In the other words, the lift experiment on the Moon respect to two separate observers on the Moon, and the Earth labs have some deviations respect to each other nominating Inertial Effect excluding the interfering side effects. Factually, in the stated above case, the test mu st be done respect to an observer at common *CMPRF* of the Earth-Moon system, and taking into account the reduced mass of the system, along with the individual *LFRF* , *Sec. 2(6)2c,* proper times of the Earth, Moon separately.

IV) According to *Sec. 5(2)3*, and *Sec. 5(16)2c, part B* in a true gravitational field, the internal geometrical shape of H particle-paths arrangement of SP_l configuration through mass medium of a falling mass-body is altered according to geometrical shape of gravitational field texture through spatial medium at SN_r configuration in any location of falling. By analogy, in case of accelerating motion, at each instant, the internal shape of H particle-paths deformation, *Note 6(2)2b,* of the falling mass-body is altered respect to the observer *B* at the bottom of the lift the same as in an equivalent gradient of true gravity. While, the true H particle-paths shape of the falling object is altered respect to observer *A* in the origin of *CMPRF* of the Earth-lift system in a nil gravitational field the same as in an equivalent true gravity. It is similar to the case discussed in *Sec. 8(9)2*. Noteworthy, in case of a true gravity, there is no virtual H particle-path shape changing respect to observer *A*.

V) According to above discussion, the preferred reference frame at the center of mass of mass-bodies (or objects), i.e. *CMPRF, Sec. 2(6)2b*, must be considered in this case. In other words, the effect of total reduced inertial masses at the origin of *CMPRF* must be introduced in all of investigations. Therefore, the equivalence principle is valid respect to observer *B*. While, it is violated in case of observer *A* located in the origin of *CMPRF*.

Note 6(2)2a- The expandons flow variation number δN_g is the intrinsic quality of a mass (particles, or mass-bodies) as gravitational of non-reversible path-length of time's arrow characteristic. It cannot truly be eliminated with a transformation; while, the single direction H particle-paths number δN_α depends on mass as inertial. Please refer to *Sec. 2(4)4* in this regards. Moreover, δN_α can be regarded as a particle of SN_r configuration, i.e. a group of single direction H particle-paths, *Sec. 3(1)2, Fig. 3(5)b*, that is transferring from *S*-patch, *Sec. 7(4)2e, part c*, of the accelerating part of mass medium, *Sec. 7(4)3, part D*. By a far analogy, it can be compared with the hypothetical Higgs boson, *Sec. 6(2)6c*, in spatial medium, *part D*. Therefore, N_α can be viewed in the form of n district particles each composed of a group of H particle-paths, i.e. $N_\alpha = n\eta_\alpha$; where, n , the number of η_α (or δN_α) groups of single direction H particle-paths (a constituent of N_α).

Note 6(2)2b- The deformation of H particle-paths in a mass-body is related to reverson formation, *Sec. 7(5)2*, within its mass medium. The reverson as a singularity, *Sec. 7(5)3b*, is surrounded by mass-body's axeon, *Sec. 10(8),* which has a main role in a mass-body. The handedness of axeon is changing from, e.g. type R , to type L (or vice versa) successively at stay time intervals, *Sec. 7(4)2f*. Any $\delta N_{\alpha A}$ flow of H particle-paths from the mass-body A , e.g. lift *A*, to a mass-body B (or man) leaving $\delta R_{\alpha A}$ reverson in the mass-body A . The reverson $\delta R_{\alpha A}$ is occupied at stay time interval by a group of $\delta N_{\alpha B}$ H particle-paths from the mass-body B ; thus, leaving reverson $\delta R_{\alpha B}$ in the mass-body B and so on as a gradient of reverson through the two mass-bodies A, B ; please refer also to *Sec. 7(5)2b, part II*. As a result, during a constant acceleration, there is a constant flow of $\delta N_{\alpha A}$, and $\delta N_{\alpha B}$ at opposite direction of each other along with reversons, $\delta R_{\alpha A}$, $\delta R_{\alpha B}$ in opposite direction of each other within mass media A, B respectively. Noteworthy, the reversons due to their additive characteristic and combination with the related *G*-reverson in each of mass-bodies are accumulated in the related mass-body center of mass; i.e. a combined *G*-reverson, *Sec. 7(5)b, part B*. It is along with a constant flow of $\delta N_{\alpha A}$ H particle-paths in the direction of acceleration. The newly combined *G*-reverson at any stay time intervals ΔT changes its handedness from type R to type L configuration and vice versa during acceleration. It is analogous to the beat, *Sec. 7(5)3d, part D*, in a mass-body as in *Sec. 5(16)2a*. As a result, in the stated above mass-body at uniform acceleration, there is a uniform mono-direction reversons formation along with H particle-paths flow within mass medium of accelerated mass-body that is eliminated at the instant of non-acceleration. It has a similarity at small volume to the case of a gravitational mass that is discussed in *Sec. 5(16)2a*.

Comment 6(2)2a- According to *Note 6(2)2b*, and *Remark 6(2)1a*, during an steady force application, and successive collision on a mass-body, i.e. an accelerating motion, *Sec. 6(2)3*, the reverson is appeared within its mass its mass medium. This mono-direction reverson similarly to stable *G*-reverson of the mass-body induces expandons and contractons, *Sec. 5(16)1b, part A*, in the direction of acceleration. Moreover, the surface of a reverson can be regarded as Schwarzschild surface of singularity in a mass medium.

6(2)3- Mirror image effect

Reflection of a group of single direction H particle-paths, *Remark 6(2)3a*, e.g. photon, by a mass-body surface is accomplished through entrance of H particle-paths of the former and exit of H particle-paths of the latter as reflected photon. Therefore during entrance of a negapa of striking photon a posipa of the mass-body leave that at opposite direction and vice versa, *Sec.1(11),* that is

in accordance with the counter-currency H particle-paths mode of motion of the mass-body, *Sec. 3(1)2, Fig.3(4), 3(5).* Thus, the linear momentum and spin of a left-handed (type *L* of *SP* configuration, i.e. SP_l) or right-handed (type *R* of *SN* configuration, i.e. SN_r) spin photon, *Sec. 4(3)4,* reversed after reflection. In other words, the posipa of striking photon combine with posipa of mass-body at the same direction; in return, the negapa that is in counter-currency with that posipa is released without changing its direction and vice versa. Since, a mirror image reflecting photon is appeared; as an example, right-handed photon, (i.e. SN_r configuration) after the collision convert to left-handed photon (i.e. of SP_l configuration), *Secs. 4(3)4, 4(4),* according to mirror effect, *Example 6(2)3a*, or, in other words, as if, reflecting mirror acts as an absorber and simultaneously as a newly emitting source of a mirror imaged photon, i.e. handedness reversal, *Sec. 5(16)9b*; whereas, light velocity remain unchanged, *Consequence 6(2)3a*. Similarly during the collision, *Sec. 6(2)1a,* or applying forces, *Sec. 6(2)1b,* the single directions H particle-paths of colliding objects are interchanged according to mirror image effect, *Consequence 6(2)3b*. Thus, Newton third law is consequent of counter-currency, *Sec. 3(1)2*, and mirror image effect of H particle-paths in case of a mass-body at macro-world; please refer to *Sec. 2(1)1c*; *Sec. 2(16)2b, Remark 2(16)2b1*. Moreover, at the instant of a collision (or measured, *Sec. 8(7)6. Part DII*) in micro-world the Mirror Image Effect, *Sec. 8(7)6*, intermediate takes form due to collapse stage of *SQM*. Noteworthy, Mirror Image Effect at macro-world revealed as Newton third law.

As a result, the entrance of H particle-paths through H hall package, *Sec. 5(16)3a*, in a mass-body as an external effect, e.g. collision, force applying, photon striking are performed via force carrying particles, i.e. contractons, *Comment 6(2)3a*. It causes acceleration, *Sec. 2(1)4, Note 2(1)4b*, during a contact time's arrow reversal along with spatial contraction, *Sec. 5(16)7a*, $-\Delta t$. Moreover, the reversed handedly H particle-paths (or reversed handed reverson) from the mass-body exit along with contact time's arrow $+\Delta t$ accompanied by space expansion, *Remark 6(2)3b*. In other words, the H particle-paths motion, *Sec. 7(4)4,* of an isolated H system before interaction are in an equilibrium state with that of vacuum texture, *Sec. 5(16)3b, part A*. During an interaction by an external effect or H system, the equilibrium is broken, *Consequence 6(2)3d*. Therefore, an asymmetry is happen due to exit, or, entrance of H particle-paths in the interacting H system because of Mirror Image Effect [related to bi-Universe hypothesis, *Sec. 5(16)9,* and *Note 5(9)3d2*] up to establish a new symmetry, *Sec. 2(1)1d, Remark 2(1)1d1*. Therefore, the Mirror Image Effect can be regarded as modified Newton third law. In the case that the resulting H hall packages are more than initial one before interaction, the asymmetry is along with time's arrow, spatial expansion, and entropy increment, *Sec. 5(16)9d, part A*.

Example 6(2)3a – When we are looking our face in the mirror, we see our image in the antimatter Universe, or, in other words, the light emitted by our face is reversed handedness during reflection on the mirror surface. Since the light beam, or, photons (with zero charge) in matter Universe and its conjugate in antimatter one differ merely by their spin and propagation directions.

Consequence 6(2)3a – In fact according to *Sec. 5(16)9b,* the handedness reversal is taken place during a time's arrow reversal, ΔT (contact time), along with space contraction related to antimatter Universe. This can be regarded as an example of transformation of matter Universe to the antimatter one in a limited single dimension location of energy-space-time; please refer also to *Sec. 5(16)10,* and [77], *Q &A, No. 186,* and *Sec. 5(9)3d, part C & part D* in case of mutual exchange of H particle-paths. According to *Sec. 2(4)4a,* the H particle-paths in spatial medium is in expanded form, e.g. expandons; while, its transfer and travel within mass medium, and between the masses, *Sec. 5(9)3d, part C*, are in its contracted form, i.e. contractons. Please refer also to *Sec. 5(16)c, part c* in this regards.

Sophistically, according to above statement during collision of a particle, e.g. photon, the posipas & negapas that are constituting the photon are converted to *PR & PL* contractons which are followed with mutual emission of reversed handed contractons by stroked mass-body, i.e. *PL & PR* contractons in opposite direction of initial photon's contractons respectively. These contractons are entered in baby (or empty) H hall package unit, *Sec. 7(4)2b, Eq, 7(20)*, after recombination with mutual compact expandons, *Sec. 6(2)6b, part B,* of reversed handed of stroked photon in the form of negapas and posipas respectively. Therefore a photon is taken form, *Sec. 9(4)7b*, of reversed handedness of stroke one and in opposite direction of the latter in spatial medium, *Sec. 7(4)3, part A*, i.e. reflection. In case of collision of mass-bodies, there are mutual exchange of contractons in related mass media, *Sec. 7(4)3, part D*. Please refer also to *Secs. 9(4)7b, c.*

Consequence 6(2)3b – In case of colliding H systems of rest mass (i.e. mass-bodies), merely their single direction part of H particle-paths undergoes reversed direction related to antimatter conjugate (twin Universe) as in case of massless photon. Whereas the reversible part of that due to exit of gravitational expanding spheres, *Sec. 5(4)1,* preserves its matter preference aspect, *Sec. 5(16)9c, part A*. In other words, in the first case we encountered with infinitesimal mono-dimensional time's arrow (or its reversal); whereas, in the second case with scalar steady time's arrow, *Sec. 2(1)1b, Consequence 2(1)1b1, part c*.

Consequence 6(2)3c – Factually, at this stage the whole interacting ingredients of a system are passing in a infinitesimal time interval through a singularity due to bi-Universe hypothesis. At the moment of a collision of two mass-bodies, the system of colliding mass-bodies acts like a unique H system, *Sec. 8(5),* or, single body. Therefore, the center of mass of each of mass-body is shifted to the center of mass of the single body. Thus, single direction H particle-paths of each mass-body are affected in the Schwarzschild surface (i.e. a singularity) of the single body and replaced by equal magnitude of single direction H particle-paths of single body, but at opposite direction due to bi-Universe hypothesis. Noteworthy, at the interaction stage of mass-bodies, their common center of mass plays the main role. While, after interaction at the equilibrium stage, this role is disappeared in each of the mass-body. In other words, the single direction H particle-paths of any mass-body spread uniformly all over the whole mass-body, *Sec. 6(1)*.

Comment 6(2)3a- During the reciprocal striking between two colliding mass-bodies or external force application by a mass-body and acceleration phenomenon, there is a mutual contractons emission by the interacting mass-bodies via their common H hall package tunnel, *Sec. 5(9)3d, part c*.

Remark 6(2)3a- According to *Sec. 8(6)2b*, the H particle-paths transfer through its H hall package, *Sec. 5(16)3*. Therefore, an H hall package, *Sec. 5(16)3a*, that is constituted of a group of H particle-paths, e.g. of *SP* configuration, due to the equilibrium principle is reflected according to mirror Image Effect in the form of its reversed handed conjugate. In other means, the conjugate is in the form of a group of H particle-paths of *SN* configuration (or vice versa) without affecting the initial correlation of incident photon with its emitting source. According to above discussion any kind of posipa and negapa transfer stated in this section is performed through their H hall package. Moreover, according to *Sec. 8(7)6*, *Comment 8(7)6b*, in quantum level, "*the self measurement in a unique H system is impossible due to the lack of intermediate stage related to Mirror Image Effect".*

Remark 6(2)3b – During a collision, force applying, photon absorption, or, reflection, all of the interacting particles, mass-bodies act as single body at the moment of interaction, *Sec. 2(6)5c, proposal c*.

6(2)4 –kind of interactions

A) General aspect

"*QFT* is presently the best starting point for analyzing the fundamental features of matter and interactions. In a rather informal sense *QFT* is the extension of *QM* (dealing with particles) over to fields. (See the entry on quantum mechanics.) The tools of *QFT* allow us to treat physical systems that have an infinite number of degrees of freedom. Its mathematical structure allows analyzing the creation and annihilation of "particles" like electrons and photons. *QFT* is relativistically invariant in a way, which is not possible in *QM*. This can easily be demonstrated in Quantum Electrodynamics, the *QFT* of interactions between charged particles and the electromagnetic field" [597] *Introduction*. In Quantum electrodynamic (*QED*), the *QFT* of interaction between charged particles and the electromagnetic field" [597] *Introduction.*

B) Interactions of irreversible and reversible path-lengths

Any interaction is consisted of two parts as following:

I) Pre-equilibrium stage through which path-length increment is along with time arrow (or time arrow reversal), and space expansion (or contraction) up to reach a total constant path-length due to equilibrium stage. In other words, the time arrows variation is not zero, *part B*.

II) Equilibrium stage through which, the total path-length variation is zero. In other words, the time arrow and spatial variation is also zero. In such a case, there is a *T*-symmetry, *Sec. 2(3)3.*

Factually, an equilibrium in any interaction, e.g., gravitational, electromagnetical, *Sec. 4(3)*, collision, *Sec. 6(2)1a*, is based on bi-Universe hypothesis, *Sec. 5(16)9*, i.e. the slight preference of competitive matter Universe over antimatter one, *Sec. 5(16)9c*

According to *Sec. 5(16)9d, part A*, if a cylinder containing a gas expands we encounter with time's arrow (*case I*), i.e. pre-equilibrium stage. If expansion is stopped at a fixed volume, the time's arrow variation becoming zero (*case II*), therefore, equilibrium stage is established.

During interaction of a measuring device with a particle, i.e. measurement, *Sec. 8(7)2*, the path-length of the particle is changing at least by a path-length value h, *Sec. 7(4)2h*. Moreover, the time's arrow or its reversal is varied by ΔT_{Γ}, *Sec. 7(4)1*. As an example, the absorption of a particle by a a photographic paper (measuring device) is along with diminution of path-length of particle- measuring device system by h value. It is along with time arrow reversal of the magnitude ΔT_{Γ}. This example can be viewed as destructive measurement of irreversible characteristic, i.e entropy increment, Sec. 5(16)9d. In case of collision of two mass-bodies, the total path-length of interacting system unchanged due to a non destructive measurement of reversible characteristic, i.e. constant entropy; please refer to Sec. 2(4)4b.

6(2)4a- Electromagnetic radiation via impact

Considering *Sec. 6(1), paragraph III*, the concept of two opposite acting forces F_1, F_2, means that a linear reversible motion of counter-current H particle-paths, *Sec. 3(1)2*, is performing, *Sec. 6(2)4b*. During the collision, *Sec. 6(2)1a,* of two mass-bodies, we encountered with the similar case. If somehow heat is produced during collision, from viewpoint of H particle-paths hypothesis, appropriate part of the reversible counter-current H particle-paths (regardless of the detailed mechanism related to impact, pressure, friction, scratch, molecular vibration, etc) are converted to exiting single direction *L&R* negapa-posipa H system, *Secs. 4(3)4, 4(4),* (i.e. electromagnetic waves no longer participate in the final H systems), or, in other words, we say that some part of the total kinetic energy of the two mass bodies is diminished and exit in the form of radiations waves. Similarly, during the sonoluminescence phenomenon [126,127], *Note 6(2)4a1,* the counter-current H particle-paths, (in the form of high frequency acoustic standing wave induced by sound regardless of detailed mechanism of imploding liquid bubbles) is converted to non reversible *L&R* H system during contraction, i.e. emission of short burst of light as an electromagnetic radiation. By the way, in, *Sec. 4(3),* we have seen how an electromagnetic radiation is generated during interaction of H particle-paths of the field and particle. Remarkably, in the level at which sonoluminescence begins, however, the radius suddenly shrink at this stage; according to *Sec. 5(16)3a,* H hall quantized packages are exiting from the bubble along with its related photons of the light pulse during a space contraction.

As an another case that we can refer to is triboluminescence, "for example a diamond may begin to glow Whereas being rubbed, i.e. diamond may fluoresce blue or red, also when sugar crystals are crushed, tiny electrical field are created"[128].

Note 6(2)4a1- In case of single bubble sonoluminescence *(SBSL),* a single bubble (in a liquid medium such as water), trapped in the acoustic standing wave, and emits a pulse of light with each compression of the sound wave [127].

6(2)4b – Chaos theory from viewpoint of H particle-paths

Supposing a rigid box with a closed orifice is filled with water, and the water is under a pressure. Thus, single direction H particle-paths of the box walls are transferred to water medium, on the other hand, the water impose a reaction force according to Newton third's law (Mirror Image Effect, *Sec. 6(2)3*) at opposite direction as reversed single direction H particle-paths. Thus, there is a counter-current single direction flow of the latter between water and wall molecules, as action and reaction forces. By removing the stopcock, there is a flow of single direction H particle-paths through the water molecules (i.e. reversible H particle-paths towards the orifice. This can be compared by stochastic diffraction of a light beam (or photons) as single direction H particle-paths by bulk of water molecules at rest, (i.e. reversible H particle-paths), or, in other words, water molecules act as scattering devices of single direction H particle-paths; therefore, we have a turbulent jet. The rapid drop of pressure and velocity of water molecules are along with H hall unit generations, i.e. space expansion accompanied by time's arrow, or, in other words, path-length generation; therefore, the entropy increases. As another example, according to [308], *bifurcations*, "Imagine dropping two identical coins from your fingertips off a 25-story balcony at the same time. Unless they are glued together, they will each take a different path towards the ground. Even though the force of gravity determines their general direction and speed, a host of uncontrollable variables such as wind and dust particles affects each coin independently. The infinitesimal and perhaps unidentifiable differences in starting conditions exponentially amplifies, *Remark 6(2)4b1*, the effect of all other variables encountered which then feed back and add even more variation to the system resulting in very different paths taken to the ground. The moment the two coins split paths is known the bifurcation point. The importance of this point lies in the implication of change and new direction". According to H particle-paths hypothesis, the system constitutes of two initially adjacent coins as a unique H system, *Sec. 8(5),* and by an infinitesimal external interaction as winds or dust particles. This unique H system of $2n$ H particle-paths with a common H hall package, *Sec. 5(16)3a*, of path-length h value is split to two separate unique H systems each of their has a path-length of h value independently, *Sec. 5(16)3g*, and n H particle-paths. It is along with intrinsic space expansion and time's arrow, *Sec. 5(16)7*, generation. In other words, an H hall package is split to two other ones along with entropy increasing. Please refer also to *Sec. 2(4).* Alternately, in case of water jet from the box's orifice , and environment effect such as wind and dust in case of falling coin an explanation according to H particle-paths hypothesis due to expansion of particles and mass-bodies trajectory as in *Sec. 5(16)3b, parts B, C*, can be done. In other words, the mutual effect of expanding track textures in the micro-world reveals in the stochastic trajectories of water molecules in first case, and coin separation in the other one in the macro-world.

Remark 6(2)4b1- According to *Sec. 1(3)*, a system at rest state, e.g., calm weather, is constituted of H particle-paths with nil external or common motion. Therefore, according to *Sec. 2(1), Note 2(1)4a*, history of the event, *Fig. 2(4).* This rest state is equivalent to a turbulent state, i.e. some part of the initial motion of a group of H particle-paths as a moving H system are revealed as internal motion of them with the same total energy, *Sec. 2(2)1, Eqs. 2(40) to 2(44).* In other words, a small variation of a group of H particle-paths of the calm weather, i.e. butterfly wings flapping is amplified by expanding characteristic of their trajectories (or track texture, *Sec. 5(16)3b, part B*) to a stormy one at the same total energy.

6(2)5- Weak nuclear force

A) General aspect

"The role of the weak force in the transmutation of quarks makes it the interaction involved in many decays of nuclear particles which require a change of a quark from one flavor to another. It was in radioactive decay such as beta decay that the existence of the weak interaction was first revealed. The weak interaction is the only process in which a quark can change to another quark, or a lepton to another lepton - the so-called flavor changes"[518] *Fundamental forces*.

According to quantum mechanics, the conservation of parity, *Sec. 5(16)6,* is equivalent to the laws of physics being invariant under mirror reflection, *Sec. 6(2)3*. It has been found that parity is not conserved in the weak force and so the weak force is not invariant under mirror reflection [136], contrary to the common concept of forces simply by entrance of single direction H particle-paths. The *W* and *Z* particles, *part B*, are the massive exchange particles, which are involved, in the nuclear weak interaction as the weak force carriers between electron and neutrino. The *W* bosons can decay by a number of processes and this provides a variety of decay paths for those particles, which decay by the weak interaction [28]. In fact, *W* particles act as force carrier particles, i.e. short life carrier of single direction H particle-paths as applying force, *Sec.6*, that after interaction process accompanied by decay ingredient (reversible H particle-paths) as stated above, *Remark 7(5)3d, B2*. Whereas, zero rest mass photon in case of electromagnetic interaction acts as force carrier in the form of single direction H particle-paths. As an example, weak interaction of the short-range weak force only affect left-handed fermions that to some extent may be due to left-handed concept of posipa related to positive electrical charge of heavy particles, e.g., proton, ions.

Remarkably, up to now, only left-handed neutrino (and right-handed antineutrino) has been observed [138] for the reason of chirability; please refer to *Secs. 5(16)3, 5(16)6, 5(16)8, 10(6),* and *Comment 5(16)6a,* for the related interpretation.

Factually, a weak interaction contrary to electromagnetic and strong interactions is accompanied by path-length generation, i.e. space expansion along with time's arrow. Through this irreversible interaction right-handed H hall package, *Sec. 5(16)3a*, of path-length value h is appeared subsequently; please refer to *Sec. 5(16)9a*. Noteworthy, in weak interaction, The Mirror Image Effect, *Sec. 6(2)3*, through which path-length of the total interacting system is conserved, *Sec. 2(1)2*, has no sense. Instead, the total path-length is increased through an irreversible process, *Sec. 5(16)6, Comment 5(16)6a*.

B) W and Z bosons

"The mass of the W boson is about *80* GeV/c^2, that is about eighty times the mass of the proton or neutron, or roughly the mass of a Bromine atom. There are two types of *W* boson with electric charges *+1* and *-1*, *Remark 7(5)3d, B2*. Each is the antiparticle of the other, but neither of them are matter particles, instead they are carrier particles for weak interactions. Processes where a W boson is emitted or absorbed are the only way that quark flavor can be changed-bosons decay to produce either a quark and a differently charged antiquark or a charged lepton and a neutrino (or antineutrino). The mass of a *Z*-boson is about *91* GeV/c^2 or roughly the same as an Zirconium atom. The *Z* boson has no electric charge and no other distinguishable quantum number so the antiparticle of a *Z* boson is a *Z* boson. Z bosons mediate weak interactions that do not involve charge and flavor changes. Because the mass of the *Z* is large compared to the mass of the photon in most low energy situations the effects of *Z*-exchanges are tiny compared to photon exchanges. Z bosons produced by colliding electron and positron beams with just the right energy to make a single *Z* are the main object of study for the linear collider at *SLAC*. *Z* bosons decay to produce either quark and its matching flavor antiquark or a lepton and its matching anti-lepton. The decays of these particles produce several quite distinct event types"[545]. According to *HPPH*, the real *W* and *Z* bosons, *Sec. 7(5)3d, part A*, are constituted of H particle-paths moving at reversible mode of motion, and *SM* configuration; while, photons are constituted of H particle-paths of single direction mode of motion of *SM* configuration. Moreover, according to *Sec. 10(6),* the *W* and *Z* bosons as pseudo-particle are massless (virtual, *Example 2(7)1*). Thus, pick up their axeons from, e.g. quarks or aggregated contractons, and are converting to real bosons of rest mass, *Comment 7(5)3d, B3*. "The *W, Z* are accurately described by a *SU(2)* Gauge theory, but the bosons in a gauge theory must be massless. The photon is also massless because the photon and electromagnetism are described by a *U(1)* gauge theory. Some mechanism is required to break the *SU(2)* symmetry, giving mass to the *W* and *Z* in the process. The most popular is called the Higgs mechanism, and requires an extra particle, the Higgs Boson"[546]. As a result, according to *HPPH*, the rest mass, or, massless characteristic of a particle is related to its internal reversible and irreversible mode of motion of its H particle-paths respectively without any kind of mediator, e.g. Higgs boson.

6(2)6- Force and matter

6(2)6a- What is the origin of mass and force

From view point of H particle-paths hypothesis the force and rest mass concepts differ from that of the supersymmetric related to Standard Model. According to [209], "In particle physics supersymmetry is a hypothetical symmetry that relates bosons and fermions". "In supersymmetric theories, every fundamental fermion has a superpartner which is a boson and vice versa. Experimentalists have not yet found any superpartners for known particles. Under Standard Model all fundamental particles can be broken into two groups, fermion that make up matter and boson that exchange the forces acting to matter"[209]. Whereas, in H particle-paths hypothesis the matter (or mass) are related to reversible motion of H particle-paths, *Sec. 2(1)3, Note 2(1)3b,* and forces can be attributed to single direction ones, *Sec. 1(3)*; please refer also to *Sec. 7(5)3d,* and *Consequence 6(2)3a.* "According to the Standard Model, Higgs bosons are components of the Higgs field which is though to permeate the Universe and to give mass to other particles"[210]; please refer to *Sec. 6(2)6c*. "The Higgs Boson itself has a characteristic of rest mass, but the evidence is as yet inconclusive"[210]. As a result, the concept of mass and force in H particle-paths hypothesis, *Note 6(2)6a1*, are fully different from that Standard Model in the favor of the former from viewpoint of Okham Razor economy [157]. Besides, there are no experimental evidence of hypothetical elementary particles such as superpartners, *Comment 6(2)6a1,* and Higgs bosons till yet predicted to exist by the Standard Model of particle physics. According to [213]" However, the Standard Model is not a complete theory of fundamentals interactions, primarily because it does not describe the gravitational force". Resuming, the experimentally proved mediating force bosons (gauge bosons) such as photons, which mediate the electromagnetic interactions, *Secs. 4(3) to 4(6), W* and *Z* bosons which mediate weak nuclear force, *Sec. 6(2)5,* gluons which mediate strong force, *Comment 10(4)1a,* can be regarded as carrier of single direction H particle-paths through H hall package of path-length value $\hbar$, *Sec. 1(12),* of bosonic structure, *Sec. 3(1)2, Fig. 3(4)c*, during related interactions, *Note 6(2)6a2*. Factually, in any of *4* kind forces, the mutual contractons, or, their aggregate are realizing via H hall package tunnel, *Sec. 5(9)3d, part C*, between the interacting bodies, *Sec. 6(2)6b, part B,* and *Comment 6(2)3a*. In case of *W and Z* bosons their aggregated (or shell, mantel) of single direction H particle-paths, *Sec. 10(6),* (or H particle-paths of *SM* configuration*, Comment 6(2)6a1*) in spatial medium, *Sec. 7(4)3, part A*, are massless, *Comment 5(7)3d, C2a*. According to *Sec. 9(4)7b*, these single direction H particle-paths will be combined with mutually emitted aggregated contracton forming a low range *W & Z* bosons with mass constituting of reversible H particle-paths, *Sec. 2(1)4*. "Unfortunately, if you try and write down a theory of particles and their interactions then the simplest version requires all the masses of the particles to be zero. So on one hand we have a whole variety of masses and on the other a theory in which all masses should be zero. Such conundrums provide the excitement and the challenges of science" [620]. From viewpoint of *HPPH*, one of the common characteristic of the four fundamental forces is the contracton travel or transfer via the related H hall tunnels during their interactions.

Note 6(2)6a1– "Over the next *15* years, we should begin to find a real understanding of the origin of mass. The interest lies not just in the arcana of accelerator experiments but suffuses everything in the world around us: mass is what determines the range of forces and sets the scale of all the structures we see in nature"[517] *Page 3*. According to H particle-paths hypothesis, mass of a mass-body is due to fully reversible H particle-paths that constitute it; while, energy of photons and forces are related to single direction H particle-paths. Therefore, a moving particle (or mass-body) is an intermediate of the two stated cases. It is somehow analogous to electric charge and field related to H particle-paths at right- or left-handedness as singlet, *Sec. 4(6).* The problem arises when a system of elementary particles of rest masses of opposite charges (or handedness), e.g., electron and positron during annihilation converts to two photons of zero rest mass. This problem is answered according to H particle-paths hypothesis as stated above; please refer also to *Secs. 1, 2*. According to [315], "The idea of one particle giving another mass is a bit counter-intuitive, isn't mass an inherent characteristic of matter? If not, how can one entity impart mass or all others by single floating and interacting with them! According to *HPPH*, the fog of dark matter pervades in the whole Universe. It is constituted of H particle-paths of *SM* configuration. According to *Sec. 7(5)3d,* it interacts with aggregated contractons, *Sec. 7(5)3b, part B*, of the *G-*

reverson of particle, and mass-bodies. Thus, inducing the gravitational spheres emission in a periodic manner, *Sec. 7(5)3d, part B*. Referring to *proposal 7(5)3d, A1*, the Higgs particle is taken form through contraction of particle *S*-partner, *Comment 6(2)6a1*, during its interaction with aggregated contractons that decayed during subsequent expansion (Big Crunch)-(Big Bang) simulation, *Sec. 6(2)6c*, during its stay time interval, *Sec. 7(4)2f, part A*. Please refer also to *Sec. 7(5)3d, part C2*. "It is certainly possible to imagine that the Higgs could be produced in dark-matter annihilation, Says Andy Parker, an experimental high-energy physicists at Cambridge University"[538].

Note 6(2)6a2-"The fundamental forces result from the exchange of force carrier particles, which belong to a broader group called bosons. Matter particles transfer discrete amounts of energy by exchanging bosons with each other. Each fundamental force has its own corresponding boson particle. Although not yet found, the graviton could be corresponding force-carrier particle of gravity."[524] *the standard package, Sec. 2(4)4a*. According to *Note 3(1)2a, Eq. 3(27),* photons and bosonic particles of SM configuration have path-length value $\hbar$ of reversible path-length, *Sec. 2(4)4b*; while, expandon and its contracton conjugate as gravitational force carrying particles have path-length values $+2\hbar$, and $-2\hbar$ respectively, *Sec. 2(4)4*. Noteworthy, contrary to bosonic particles, the expandons and contractons have expanding and contracting irreversible path-lengths.

Comment 6(2)6a1- According to H particle-paths hypothesis, and by analogy to spatial patches, *Sec. 5(16)3b, part H*, related to a Galaxy, or cluster, a mass-body, any particle also have its own spatial patches nominating *S*-patches, *Simulation. 8(7)2, E5a*. Therefore, the total mass content of a particle can be regarded as normal mass, along with the quantity of the mass of dark matter of *SM* configuration in its *S*-patches. In other words, the *S*-patches and its mass content of *SM* configuration related to dark matter can be considered as a group of H particle-paths of *SM* configuration, i.e. as a partner of the particle nominating *S*-partner. The latter has a common axeon (and *G*-reverson, i.e. reverax, *Sec. 7(5)3b*, *item II)* with the particle. In other words, *S*-partner is superposed with the related particle. Thus, by some analogy *S*-partner can be compared with super-partner of the particle according to Standard Model. Factually, *S*-partner by no mean can be separated from its particle. "For every particle, there is a superpartner whose spin differ by $1/2$". "One of the best candidates of dark matter is the lightest supersymmetric particle"[259]; please refer to *Note 6(2)6c1*. "Some physicists attempting to unify gravity with the other fundamental forces have come to a startling prediction: every fundamental matter particle should have a massive shadow force carrier particle, and every force carrier should have a massive shadow matter particle. This relationship between matter particles and force carriers is called **supersymmetry**. For example, for every type of quark there may be a type of particle called a squark. No supersymmetric particle has yet been found, but experiments are underway at *CERN* and Fermilab to detect supersymmetric partner particles"[530].
Factually, according to *HPPH*, both normal matter particle and its dark matter *S*-partner are overlapped on each other, *Simulation 8(7)2 E5a*, the matter particle has SP_l configuration; while, it's *S*-partner has SM configuration that is confined in particle *S*-patch. "If we want to model space accurately, all particle positions must be relative to the other particles. Space then emerges as a result of the positional relationships between the particles. If you removed all the particles from the universe you would not be left with space - there would just be nothing"[571] *Programming Spacetime in a Simulation*.-

6(2)6b-Different forces from view point of H particle-paths

A) General features

"There are four fundamental forces of nature. At the microscopic level, these four forces are not forces in the usual sense of the word. Forces are now considered to be produced by an exchange of boson force particles. These bosons are exchanged between fermion matter particles"[559] *The Four Fundamental Forces*. From viewpoint of *HPPH*, the contractons, *Sec. 5(9)3d, part c*, and their aggregate, *Sec. 7(5)3d*, have essential role in mechanism of fundamental forces, *Sec. 6(2)6a*. Moreover, according to *Simulation 7(4)3, E2a,* the two fermionic particles of successive types $R\,\&\,L$ configurations emit expandons and contractons during a common stay time interval ΔT. The transfer of contractons between particles in mass medium are accomplished via bosons at the intermediate state as stated above; while in spatial medium via common H hall package tunnel, *Sec. 5(9)3d, Part c*. "The concept of force is conspicuously absent in most advanced formulation of the basic laws of modern physics. It doesn't appear in Schrödinger's equation, or in any reasonable of quantum theory or in the foundation of general relativity"[38]. In respect of H particle-paths hypothesis on the basis of counter-currency of motion*, Sec. 3(1)2*, and Mirror Image Effect, *Sec. 6(2)3,* we encounter with three type of forces that changes the relative geometry or shape of H particle-paths accompanied by the mutually interchanging of their as single direction ones as following:

I) Mass-field interaction

A) Gravitational force, during that only the geometry of H particle-paths of H systems alters during their interaction with the H particle-paths of the gravitational field, *Secs. 5(1), 5(2), Fig. 5(3).*

B) Electromagnetic forces as in, *Sec.4*, by interchanging the H particle-paths of the field as singlet with that of charged particles that is accompanied by photon emission or absorption, and electromagnetical contractons as virtual particle, *Sec. 4(6)5a,* between the charges.

II) Mass-mass interaction.

A) As in the present section, by interchanging whole or part of the single-direction H particle-paths of moving mass-bodies, *Note 6(2)6b1*.

B) H particle-paths exchanges of adjacent quarks of the hadrons, *Sec.10, Fig. 10(1),* or between two opposite spins electrons as in chemically bonded ones, *Sec.9, Fig. 9(2)*, and *Secs. 10(4), 10(6).*

C) Generated forces related to the exit of expanding closed surfaces from H system of rest mass as in, *Sec. 5(15),* that can be considered as fifth force according to this article.

As a result, all of the stated above forces are based on interactions or exchanges of H particle-paths (at different aspect and configuration) as single stuff in our Universe.

Note 6(2)6b1- During collision of two mass-bodies at infinitesimal time interval Δt of collision stage, *Remark 6(2)1a1,* the single direction H particle-paths of mass-bodies are in an intermediate state of H particle-paths of *SM* configuration prior to mutual contractons exchange between the mass-bodies that converts the intermediate state to single direction H particle-paths between them. Noteworthy, according to *Sec. 7(4)2h*, the collision time interval Δt is equal or lesser than stay time interval between type *R & L* configurations of striking particles or mass-bodies. Resuming during an interaction (e.g. collision, etc.) a particle is emitted in spatial medium along with contracton releasing towards mass medium, *Sec. 7(4)3, part D*, as an example please refer to *Sec. 5(16)1b, part A, item 21A*.

B) Proposed mechanism of force application

According to *Sec. 2(1)3, Note 2(1)3b,* the mass is contracted form of the field, and field is expanded form of the mass. Noteworthy, during a collision between two mass-bodies *A&B*, their external motion parts, i.e. single direction $N_{\alpha A}, N_{\alpha B}$ H particle-paths based on *Sec. 5(9)3d, part c, Fig. 5(5)2*, in case of field-mass interaction, are converted to related contractons that mutually exchange between the two mass-bodies *A&B* at opposite direction along with appearance of related compactified expandons part. The latter reveals e.g. as massless *W & Z* bosons that at the end of collision combined with *A&B* mass-bodies contractons in order to form single direction H particle-paths at opposite direction of their initial configurations before collision. In other words, during this phenomenon (collision), the reverse process of spontaneously broken symmetry, *Simulation 8(7)2, E5a, item 9(B),* beyond critical condition is occurred. Thus, by a far analogy, a phenomenon analogous to an electroweak interaction is performed at this stage, i.e. a combination of contractons related to electromagnetism, and *W & Z* bosons (or better to say compactified expandons) related to weak interaction is performed at the end of collision. Factually, based on *Sec. 5(9)3d, part c, Fig. 5(5)2, Simulation.7(4)2e1*, and mirror image effect, *Sec, 6(2)3*, during collision. If the mass *A* emits *WR* expandon along with *PL* contracton releasing towards the mass *B*, the latter releases *WL* compactified expandon accompanied with *PR* contracton emission towards mass *A* or vice versa, *Sec. 5(16)2c, part c*. Thus, *WL* compactified expandon *& PR* contracton combined and construct single direction H particle-paths at opposite direction to that of before collision in mass *A*. Similarly, *WR* compactified expandon and *PL* contracton in mass *B* leading to formation of single direction H particle-paths in opposite direction that of before collision of mass-bodies *A&B*. Note that the velocity of *A&B* must be regarded respect to the origin of their *CMPRF, Sec. 2(6)2b*.

I) Before combination $\overrightarrow{A}_{PL}^{WR}, \overleftarrow{B}_{PR}^{WL}$ *II) After combination* $\overleftarrow{A}_{PR}^{WL}, \overrightarrow{B}_{PL}^{WR}$

Fig. 6(2)- Schema of compactified expandons and contractons reciprocal exchange during collision

Noteworthy, at high temperature, or domination of particle high collision, the compactified expandon and normal *E-* or *G-* expandons are in combination of a single combined or super expandon nominating *S*-expandon related to electroweak interaction. During temperature decrement accompanied with spatial vacuum expansion, the *S*-expandons reveals as compactified one along with normal *E-* or *G-* expandons related to electromagnetical and gravitation expandons. As a result, the *S*-expandon and compactified one are related to interaction in mass medium, *Sec. 7(4)3, part D;* while, *E-* or *G-* expandons are related to mass-field interaction mass and spatial medium. In further spatial expansion as in de-Sitter space we will encounter with field-field interaction as a newly force application, e.g. as in case of E-expandon (electromagnetical expandons, *Sec. 4(3)1, part c*) related to interaction of fields of opposite sign charges. Thus, we have a domination of interaction in different stages of universe expansion instead of split, appearance & disappearance of different forces. Moreover, at early big bang, the H particle-paths are in their highest contracted form as compact reveraxes, *Sec. 7(5)3b*, *item II,* (nominating *C-reverax*) that shield the related reversons, *Sec. 7(5)*) which are covered by H particle-paths of *SM* configuration. Noteworthy, any reverax related to a particle in our universe by a n_s cell on Schwarzschild surface, *Sec. 5(1)1*, of a mass-body, or to a fundamental particle's axeon, *Sec. 10(8).* As an example, there is three *C*-reveraxes (or quarks) in case of proton or neutron, *Sec. 10(4).* In these cases, there are no spatial vacuum medium, *Sec. 7(4)3, part A,* and the interaction is transferred via gluons (group of H particle-paths) transfer between the quarks in mass medium. In other words, there is an intra-mass interaction.

6(2)6c- Higgs Bosons

"As the Universe cooled and the temperature fell below a critical value, an invisible force field called the 'Higgs field' was formed together with the associated 'Higgs boson'. The field prevails throughout the cosmos: any particles that interact with it are given a mass via the Higgs boson. The more they interact, the heavier they become, whereas particles that never interact are left with no mass at all."[522]; please refer to *Note 6(2)6c1*. "You need to distinguish between the Higgs boson and the Higgs field. The Higgs field is the stuff that gives all other particles a mass. Every particle in our universe swims through this Higgs field. Through this interaction, every particle gets its mass. Different particles interact with the Higgs field with different strengths, hence some particles are heavier (have a larger mass) than others. (Some particles have no mass. They do not interact with the Higgs field; they do not feel the field). It is the opposite of people swimming in water. As people float in water, they become lighter. Depending on size, shape, etc, some people float better than others". "The Higgs field is not considered a force. It cannot accelerate particles, it does not transfer energy. However, it interacts universally with all particles (except the massless ones), providing their masses"[520]. Please refer to *Sec. 7(5)3d, part B, item V*, in case of the massless particles from viewpoint of H particle-paths hypothesis. "The Higgs boson is a particle. It gets its mass like all other particles: by interacting with (*swimming in*) the Higgs field." The Higgs boson has many more ways of interacting with all other kinds of particles than the Higgs field (which just causes a *drag* = mass)". "The Higgs particle, like many other elementary particles, is not a stable particle. Since it interacts with all kinds of other massive particles, it can be created in collisions "[520]."The interactions of quarks and all other fundamental particles are described by a theoretical framework, called the 'Standard Model'. The Standard Model is an extremely successful theory and has been tested to a high accuracy at previous experiments (for example LEP)". "It gives raise to important unanswered questions, for example: Why are there exactly six quarks or are there more? Why is the heaviest one (the top-quark)

about 600 times heavier than the lightest one? Which leads to the question: How do particle get a mass at all? The Standard Model cannot answer these questions without the Higgs boson, since it assumes that all fundamental particles are massless, while in reality the majority of the particles have mass". "This field fills the complete Universe and all particles couple (interact) to the Higgs field with a coupling strength that depends on the mass of the particle. The existence of a Higgs boson is a necessity for this mechanism, which is currently the only viable solution consistent with the Standard Model. In this sense the Higgs boson is the keystone of the Standard Model and proving its existence is the main focus of present High Energy Physics"[528] *The Higgs boson and the Standard Model*.
This subatomic particle would help explain objects feel inertia and have momentum. Please refer also to *Note 6(2)2a,* according to that the massive W boson can acquire mass and existence during a cycle analogous to (Big Crunch)-(Big Bang), *Sec. 7(5)3d, part C2*. Based on H particle-paths hypothesis, the inertia and mass, *Sec. 2(1)4,* are related to relative competition of reversible and single direction H particle-paths. "The Large Hadron Collider, which will determine the existence of the Higgs boson. If it turns out that we cannot find it, this will leave the field wide open for physicists to develop a completely new theory to explain the origin of particle mass"[522]. From viewpoint of H particle-paths hypothesis, according to *Sec. 4(3)1*, the force carrier particles of electromagnetical interactions are electromagnetical contractons, *Sec. 4(6)4*; while, based on discussion held in *Sec. 7(5)3d, part C2*, the force carrier particle of weak interaction is appeared by an alternative mechanism.

Note 6(2)6c1- "In addition to a Higgs boson, there is a Higgs field. The field permeates the entire universe. In physics, that concept is nothing unusual. Physicists also know of gravitational fields, electromagnetic fields, etc. The Higgs field gives mass to elementary particles such as electrons and quarks, *Note 6(2)6c2*. I like to think of the Higgs field as an invisible fog that fills the universe, and the Higgs bosons are tiny droplets – condensation – in the fog. Elementary particles such as electrons interact with the Higgs field by just being surrounded by it. Different particles interact with the Higgs field with different strength. That is why an electron is much lighter than a top quark"." A Higgs boson does not contain smaller particles, according to our current understanding. Instead, the Higgs boson is the localization of a tiny amount of energy in space". "Once a Higgs boson is produced, it decays quickly into lighter particles, converting some of its mass back into the mass and kinetic energy of lighter particles"[534]. Please refer also to *Sec. 8(7)3.*

Note 6(2)6c2- Alternately based on *HPPH,* the H-particle-paths density, *Sec. 2(4)2b,* in a H hall package in vacuum medium, i.e. in form of dark matter, *Sec. 5(1)2,* can be viewed by far analogy as a Higgs boson. While, their collection existence in a volume of vacuum media as a Higgs field that postponed due to stay time interval ΔT *, Sec. 7(4)2f, part A*. the free motion of a particle e.g. electron in this media., as if giving mass to it. Resuming, the particle adheres to dark matter of the H hall package (or a group of that) during its stay time intervals ΔT before transferring to the next one during its motions. Please refer to *fig. 9(3)a, of Sec. 9(4)7a***. .** Thus, these configurations of H hall packages fills (or spread all over) the vacuum media around the mass media. H particle-path-hypothesis introduces also an alternate concept of **mass or inertia**, *Sec. 2(1)4,* that differs from that of the **Higgs mechanism**, *Sec. 6(2)6c*.

6(2)6d- Superforce
A) General aspect
According to *Sec, 5(15)2b, Diagram 5(1),* initially at the Big Bang, the whole Universe is constituted of a single entity of *SM* configuration, *Comment 7(5)3d, C2a*, of low entropy. During the time, this configuration is split gradually to SP_l & SN_r configurations related to mass and spatial media respectively, *Sec.5(15)2b, part B*. In other words, the initial entity is split to matter, and vacuum media. The mediator between this two different media of the same magnitude of path-length and opposite signs, *Sec. 5(16)11,* is the force. Moreover, the initial force is split also to force of reversible and irreversible path-length characteristics, *Sec. 2(4)4*, during the Universe evolution of SP_l & SN_r configurations. In other words, the gravitational force has both SP_l & SN_r configurations related to expandons and contractons of irreversible path-length related to time's arrow, *Sec. 5(16)7*; while, the collision is along with force of SM configuration of reversible path-length related to *T*-symmetry, *Sec. 2(3)3*. Generally, speaking, based on H particle-paths hypothesis, the four fundamental forces at present time depending on their kind of interaction are related to one of the two stated above main categories. The superforce or initial force (of SM configuration and reversible character) during the Universe evolution is tending to *2, 3*, and ultimately *4* fundamental forces at present time due to increment of handedness degree D_h, *Sec. 7(4)3, part J*, i.e. shift of reversibility of H particle-paths towards the irreversibility. It is along with the deviation degree from reversibility α , *Sec. 2(1)1a, Eq. 2(7),* increment in a location during the evolution time, *Note 7(4)3, j1*. Noteworthy, the gravity is the first force that is separated from the initial superforce after Big Bang. Thus, competes with the radiation pressure (the remnant of superforce) in early Universe. "So will other forces join the club at even higher energies? Experiments already show that the effect of the strong force becomes weaker as energies increase. This is a good indication that at incredibly high energies, the strengths of the electromagnetic, weak and strong forces are probably the same. The energies involved are at least a thousand million times greater than particle accelerators can reach, but such conditions would have existed in the very early Universe, almost immediately (10^{-34} *s*) after the Big Bang. Pushing the concept a step further, theorists even contemplate the possibility of including gravity at still higher energies, thereby unifying all the fundamental forces into a single 'super force'. This would have ruled the first instants of the Universe, before its different components separated out as the Universe cooled"[526] *Superforce*. Factually, according to *Sec. 7(5)3d, Part C2*, the High energy at the moment of collision, i.e. H particle-paths of SM configuration (Maximum reversibility) furnishes the required amounts of H particle-paths of SN_r configuration to the aggregated contractons of interacting particles of SP_l configuration. In other words, pulling the irreversibility due to contracton aggregate into a SM configuration as in early Universe, or, the irreversibility becomes trivial

respect to acquired reversibility of H particle-paths, i.e. the handedness degree D_h tending to zero as in early Universe. As a result, just after Big Bang, the superforce is broken as a function of D_h at a step-like manner to *2, 3, 4* fundamental forces up to present time related to spontaneous supersymmetry breaking in each stage. This step like behavior by a far analogy is comparable to the *CMB* angular spectrum, *Fig. 5(4)1* of *Sec. 5(5)2*. "The universal ratios of baryonic matter, dark matter and the $\Lambda-$term have been tightly constrained by the observation of the first three waves in the fluctuation spectrum of the CMB"[594] *Our Galaxy*.In other words, each peak (or wave) of spectrum is related to a kind of homogeneity breaking. The photons and cosmic background microwaves are the remnant of the superforce at present day. As a result, during the Universe evolution, we have:

$$Superforce \rightarrow \overset{\uparrow gravitational.force}{\rightarrow} remnant.1 \overset{\uparrow strong.force}{\rightarrow} remnant.2(electroweak) \overset{\uparrow weak.force}{\rightarrow} remnant.3(photon\,\&\,CMBR) \quad 6(19)$$

The symbol $\uparrow$ represents the force that is separated from its remnant during the Universe evolution in each step. "The supersymmetry actually makes the unification of three other forces, strong, and electromagnetic also in a reality". "The gravity is believed to be unified with other forces at an extremely small distance called Planck length 10^{-33} cm"[529]. The Universe has passed different stages, *Sec. 6(2)6d, part A* at the beginning of big bang up to present time as following:

A) At the early universe (or bi bang, Superforce related to intra-mass interaction), as stated above, there is merely mass-medium, i.e. no vacuum spatial medium, *Sec. 7(4)3, part A,* without spatial space-time (or spatial H hall package). There is no expandon appearance, the interaction nominating superforce.

B) At the gravitational force (mass-field interaction) and strong force (mass-mass interaction) stages, there is spatial medium. Thus, the particles begin to beat, *Sec. 7(5)3d, part D*, at high frequencies along with expandons emission in spatial medium and contracton releasing towards mass medium. At this stage, the expandons are of compactified type.

C) At the present stage (weak force), the electroweak interaction does no longer exist; it split to weak interaction and electromagnetical one.

In all of above stages except the stage *A*, according to *Sec. 5(15)3f,* the released contractons may be mutually exchanged with parallel universes; while, the expandons are confined in the realm or horizon of our Universe that promote universe expansion along with appearance of increasing dark energy, *Sec. 5(15)2*. The H hall packages of the particles, fields are overlapped based on *Sec. 7(2)1* in the direction of right to left of schema *6(19),* i.e. contraction related to big crunch, *Sec. 5(15)3c*. Similarly, they are split in the left to right of the schema, i.e. expansion related to big bang, *Sec. 5(15)3a*.

B) Grand unification of all the interactions

"The Higgs boson particle is one quantum component of the theoretical Higgs field. In empty space, the Higgs field has an amplitude different from zero; i.e., a non-zero vacuum expectation value. The existence of this non-zero vacuum expectation plays a fundamental role: it gives mass to every elementary particle which has mass, including the Higgs boson itself. In particular, the acquisition of a non-zero vacuum expectation value spontaneously breaks electroweak gauge symmetry, which scientists often refer to as the Higgs mechanism"[533]. If the stated above suggestion is verified through experiment. It means that handedness degree D_h (or Deviation degree from reversibility α) will be decreased or reversed back in *Eq. 6(19)*. Therefore, it is equivalent to increment of H particle-paths density ρ to a critical level along with increment of reversibility of H particle-paths respect to irreversible ones up to full H particle-paths SM configuration along with spatial contraction. In other words, the interacted particle and its *S*-partner, *Comment 6(2)6a1*, are unifying to a single entity.