Part 3c Gravitational interactions

5 (9) – Gravitation interaction at macroscopic case

5(9)1- Falling of a mass-body (macroscopic case)

Supposing a mass-body *A* of mass, m, in the gravitational field of mass *M, (M>>m)* like a coin at the origin *B* of Euclidean reference frame *R* far enough from the Earth *M* at the relative velocity $v = v_o = 0$; thus, the gravitational attraction is extremely low (*Nil*) at point *B*. As the coin *(A)* starts to fall toward the Earth surface, its velocity v increased and its internal H particle-paths shapes varied based on *Sec. 2(1)1b*, *Delta Effect, Fig. 2(3)* accordingly, *Sec. 5(2)3*, and *Sec. 5(16)2c, part B,* within the mass medium of the coin, *Sec. 7(4)3, part D*. When the coin reach the Earth surface, its ultimate H particle-paths shapes reach the same as that on the Earth surface. From this analogy, we concluded that the shape of H particle-paths of a mass in an external gravitational field is in equivalence with that of the same accelerating mode of motion in a spatial medium of *nil* gravitation fields, (Euclidean continuum). By this statement, we choose a Euclidean coordinate reference frame *R* looking at the falling coin by it's observer at *B* position as an object with following conceptions:

1) - At rest, accompanied by an external gravitational field, respect to observer *B*.

2) - At accelerating motion, without or nil gravitational fields, respect to observer *B*.

According to *Sec. 5(2)3, Fig. 5(3)*, the shape of the inner H particle-paths of the falling H system e.g. coin, *Sec. 5(3),* varies during its falling, according to gravitational field strength at each position of falling, *r, Note 5(9)1a.* In other words, it is also the same as an equivalent imaginary mass in the gravitational field at each falling point coordinate, *r,* from the Earth center of gravity, *Note 5(9)1b*. By the way, to each point of gravitational field that joins the coin m to the center of gravity of the Earth *M* respect to the observer *B*, is related a coin velocity, or, better to say, the returned energy E_R, *Eq. 2(44),* of the coin. According to the above statements, supposing an isolated mass *M* (located at a point *M*) at rest respect to the observer *B* of the reference frame *R*. Therefore, we are encountering with concentric spheres of the H particle-paths around the mass *M* at the shape and velocity components as in *Fig. 5(8), Sec. 5(16)1b, part A*, nominating equishaped (or unispeed) area.

Note 5(9)1a - Assuming λ_α, the matter wave wavelength due to inner single direction motion of H particle-paths of mass m during its falling and at the direction of the falling, that decreases according to *Sec. 2, Eq. 2(82).*
For additional information in the case mass m as a particle; please refer to *Sec. 5(10)2.*

Note 5(9)1b- Respect to an observer in an accelerating reference frame, the inner shape of H particle-paths of a test mass-body is altered. It is the same respect to an observer at *CMPRF*, *Sec. 2(6)2b*, of a mass-body of equivalent true gravitational field, *Sec. 6(2)2, item IV*.

5(9)2-Discussion

As a result:

A) To a low mass object, m, initially at rest in nil gravitational field during it's falling in a true gravitational field of mass *M>>m*, we can specified an equivalent gravitational field the same as that at point of interaction (falling point), *Sec. 5(9)1.*
According to the equivalency, the speed of expansion of expanding sphere surface ,*Sec. 5(4)*,of mass *M* is the same magnitude as that of the falling object m, and perpendicular to the surface, (i.e. at radial direction), i.e. proportional to its curvature, $1/r$, but at an opposite direction. In other words, the gravitational sphere's expanding speed decreased radially in a decelerated rate proportional to $1/r$, i.e. sphere geodesic curvature; where r, is the radius of expanding sphere at the point of location of mass *m.* It is in contradiction with the general theory of relativity, that postulate motion of a mass causes ripple radially at c speed in the space-time curvature regardless of an acceptable reason, merely by an analogy based on the electromagnetic wave propagation.

B) The single direction H particle-paths variation, dN_α, per time interval dt in case of a mass-body of N_0 initial H particle-paths at an accelerating motion, *Note 2(1)4b*, can be visualized as flow of H particle-paths through a plane of area dS in the direction of motion during time intervals dt. This can be regarded as flow rate $\frac{dN_\alpha}{dt}$, *Comment 5(9)2a,* that varies successively through a step-like manner of the deviation degree from reversibility α, *Sec. 2(1)1a*, (or velocity) variation through time intervals dt. It can be compared to $d n_s$ (or dn_G, *Sec. 5(1)1*) expandons flow through an area dS of gravitational ground sphere surface, *Sec. 5(16)1a, part B*, during time interval dt between two successive expanding gravitational spheres emission at that location. The area dS can be considered as a rectilinear plane at a limited small spatial medium (e.g., plane confined by a cone-like cavity, *Sec. 5(2)1d, part D*, at that location).
Factually, any dN_α entrance of H particle-paths during time interval dt is accompanied by exit of dN_α H particle-paths, *Sec. 6(2)2,* of reversed handedness at opposite direction based on Mirror Image Effect, *Sec. 6(2)3,* according to bi-Universe hypothesis, *Sec. 5(16)9*, up to reach an equilibrium by analogy to *Sec. 5(2)1b, Fig. 5(2).* Therefore, here is no mass increment in case of mass-mass interaction of this kind, *Note 2(1)4a*, analogous to case of mass-gravitational field interaction, *Sec. 5(2)1b*.
The main results obtained from this comparison are as following:

I) The non gravitational accelerating motion, e.g. due to collision, propulsion, analogous to gravitational one is depending on entrance of groups of H particle-paths and their handedness reversal (i.e. right- and left-handed

particles) in the direction of motion successively during stay time ΔT (here dt), *Sec. 7(4)2e*. It is along with exit of left-, and right-handed H particle-paths at equal population (or magnitude) and opposite handedness respectively. According to paragraph *E* of the *Sec. 7(4)2e*, the stay time ΔT by analogy to gravity case is depended inversely on mass magnitude; therefore, ΔT is nil in case of macro-bodies. Please refer also to *Sec. 6(2)2*.

II) The path-length of non-gravitational acceleration of *T*-symmetry characteristic is of reversible kind. While, the path-length of gravitational acceleration (e.g. true gravity) is reversible along with time's arrow, *Sec. 2(4)4b*, and *Consequence 2(8)3a*.

Comment 5(9)2a- According to *Sec. 2(1)1b, Eq. 2(22),* and *Sec. 6(2)1a*, we have:

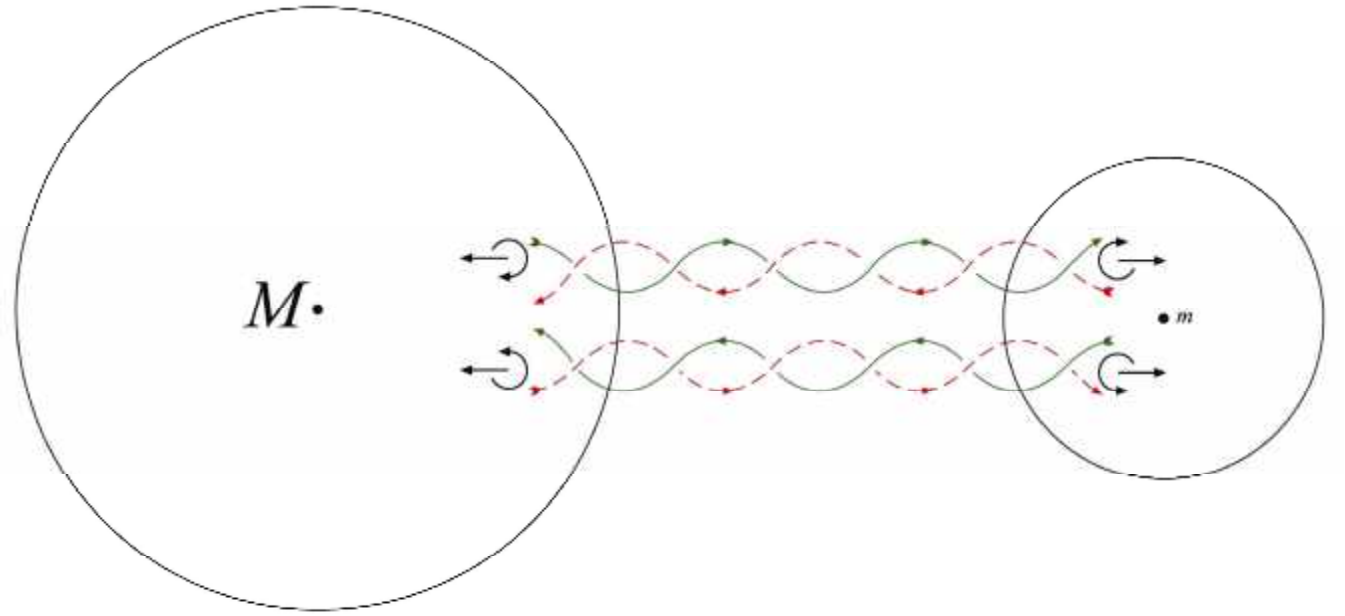
$$\frac{d\,N_\alpha}{dt} = N_0 \frac{d\alpha}{dt}$$

Where:

- α , the ratio of single direction or returned H particle-paths to the initial reversible ones; moreover, it can be nominated as "deviation degree from reversibility ".

5(9)3- Two orbiting masses correlation

5(9)3a – General aspect



_____ ***Posipa;*** _ _ _ _ ***Negapa***

Fig. 5(5)1- H particle-paths counter-current reversible flow between two orbiting masses as an entangled unique H system.

Assuming now, the center of gravity of the mass, *M,* is moving at v speed respect to observer *B* of reference frame ***R***, *Sec. 5(9)1;* the geometry of these equishaped area varies according to the individual paths shape of H particle-paths based on *Sec. 2(1)1b, Delta Effect, Fig. 2(3*), along the geodesic of these surfaces. Moreover, the velocity vector at each point of equishaped area combined with the common motion v velocity vector of the center of gravity of mass *M* that leading to a newly equishaped surfaces (e.g. ellipsoid) around the mass *M*; thus:

I) At the equilibrium state, *Sec. 5(2)1b,* of two orbiting masses *m & M*, the interaction of equishaped surfaces (or expandons, *Sec. 5(16)1c, part A3*) of mass *M* take place at the local of the mass m and vice versa.

Generally speaking, there are a steady counter-current flow of H particle-paths [analogous to *Sec. 3(1)2*] through the field and mass of two interacting objects at the equilibrium state as in, *Fig. 5(2);* please refer to *Remark 5(9)3a1*. Therefore, a closed flow loop of counter-current H particle-paths take place as a unique H system, *Sec. 8(5),* correlating two masses and via their related fields, *Sec. 5(9)3c,* as if there are no interacting gravitational forces between the masses. Factually, according to *Sec. 5(9)3d, part c*, *Fig. 5(5)2,* the two orbiting masses are correlated through H hall package tunnels via superluminal contractons transfer at equal magnitude as force carrier particle due to mutual expandon front *CF*-lines interaction of two masses, *Sec. 5(2)1a*. In other words, the H particle-paths entered in each of the masses are equal in number with that leaving them individually during any infinitesimal time interval; please refer to *Sec. 5(9)3b, Sec. 8(6)2, Remark 8(6)2a,* and *Sec. 5(16)1b, part F2*. In fact, the gravitational fields (or expandons) of the both masses update continuously immediately, *Sec. 5(2)1d, part c, item3*. According to these statements, the concept of couple of attractive forces between two orbiting masses at finite speed of gravitational force, *Sec. 5(2)1d*, have no sense by this assumption, *Note 5(9)3a1*. As a rough analogy, supposing a narrow rubber belt correlates the two above masses; thus, we have a reversible H particle-paths flow through this belt, *Secs. 8(7), 8(9)1.*

II) At the case of non-equilibrium state of two interacting masses an appropriate amount of H particle-paths exit from the unique H system, *Sec. 8(5),* of two masses as *CI* impulsion-line, *Fig. 5(1),* in the form of expandons front *CF*-lines, *Proposal 5(2)1a1,* to reach equilibrium as in the *case I.*

By referring to *Sec. 5(2)2,* the concept of gravipetal and gravifugal forces on the bases of H particle-paths hypothesis in case of two orbiting masses can be viewed.

Noteworthy, the H particle-paths of each of the two orbiting masses during their motions have equal path-length, *Sec. 5(9)3d.*

Note 5(9)3a1– "This couple will tend to increase the angular momentum of the system, and acting cumulatively, will soon cause an approach change of the period disagreeing with the observation if the speed is at all comparable with that of light" [104] *page 94*; please refer also to [103] *introduction*. This couple formation is related to the finite speed of force propagation (technically called retardation] that contradict the observations.

Remark 5(9)3a1– The preferred reference frame in this case is a unique one, i.e. *CMPRF, Sec. 2(6)2b*. Therefore, the frequency of photon, i.e. single direction H particle-paths, emitted by each of these mass-bodies must be considered through this *CMPRF*. In other cases, the frequency of emitted photon by one of the mass-body after the measurement, *Secs. 8(4), 8(7)2,* by an observer on the other one is affected by the internal H particle-paths of the latter. Factually, at quantum level the particle must be regarded merely after measurement in a reference frame by its observer. Thus, in this case both the effect of reference frame and the particle interaction must be considered contrary to macro-bodies. Noteworthy, the measuring device, i.e. observer and reference frame, disturbs the motion of particle before measurement.

5(9)3b –Mach's principle

This counter-current flow of H particle-paths between two masses, e.g., the Sun and the Earth, may be disturbed by entrance of the third body, e.g., the Moon during a full eclipse. According to [247]" An abnormal lunar and solar influence also became apparent in the form of a remarkable disturbance of the motions of the paraconical pendulum (which gave the very definite impression of a screen effect) during the total eclipse of June 30, 1954. The plane of oscillation of the paraconical pendulum shifted approximately 15 centesimal degrees during the eclipse (20 minutes before the maximum of the eclipse). The forces involved were the same order of magnitude as those which correspond to the Foucault Effect" According to [321], *part 2*, Gravity shielding, "During the total solar eclipse in 1977, a Chinese team performed measurement with a high-precision gravimeter. However, in contrast to the Allais Effect, they detected a decrease in the Earth's gravity. Moreover, the effect occurred immediately before and after the eclipse but not at it height". According to this statement and discussion held in *Sec. 5(9)3,* an equilibrium reestablished during eclipse between the two disturbances (i.e. before and after eclipse) between Sun-Moon-Earth system that is disturbed just after eclipse to reach an equilibrium as in before eclipse, *Sec. 5(2)1*. Please refer also to [321], for further information on gravity shielding experiments. As a result, this abnormally may relate to the interaction of H particle-paths flow between the Earth and the Sun by that of the Moon main body. Resuming, particles and mass-bodies in the whole Universe correlate through counter-current H particle-paths analogous to *Fig. 5(5)1* by each other. Therefore, constituting as unique correlated H system, i.e. Universe, *Example 5(9)3b1*; please refer to *Sec. 8(7)2, Remark 8(7)2, B2*. Moreover, these correlations are performed through abstract vacuum of H hall package tunnels between mass-bodies at superluminality, i.e. instantaneously. In other words, the interacting forces, e.g., gravitational, electromagnetical, etc. are propagated spontaneously, *Sec. 7(4)2f, part c,* i.e. action at a distance, *Sec. 5(2)1d*. Noteworthy, according to Mach's principle, if someone strikes his hand to the wall, it hands hit to the whole galaxies in the Universe, please refer to *Note 5(9)3b1*, and *Example 5(7)8a*. A very general statement of Mach's principle is "*Local physical laws are determined by the large-scale structure of the universe*".[512] *Introduction*. This statement confirms the basic constructing blocks of the Universe as a single stuff, i.e. H particle-paths. According to *HPPH*, the path-length of a mass-body in an isolated system constituting of N mass-bodies is equal to the algebraic sum of the path-length of other bodies respect to the center of masses of the system (or *CMPRF* observer located at center of mass of the system), *Sec. 2(6)2b*; please refer to *Example 5(9)3b2*. Referring to *Sec. 5(2)1c, part B*, and according to Mach's principle (as an alternate to Newton's absolute space) that the axes of non-rotating frame (i.e. axis of gyroscopes) in their time evolution are determined by *some average* of the motion of matter in the Universe. Today one generalizes matter to matter energy and motion of matter to energy currents, i.e. the principle states that there is exact frame dragging for the axis directions of inertial frames by some average of the energy currents in the Universe"[395] *Introduction.*

Example 5(9)3b1:

A) According to [321] *part 1, section 2,* "Why all the planets orbit the sun in planes which form only small angles to the Sun's equatorial plane, or why all the planets circle the sun in the same direction as the sun's sense of rotation". According to H particle-paths hypothesis, the solar system and its planets can be regarded as a unique H system. In other words, it is constituted as reversible and single direction (or common motion) of H particle-paths, *Sec. 1(3).* Therefore, before the Sun and its planets formation, this correlated system is governed also. Moreover, the Sun and its planets after formation preserving their correlation though mutually flow of H particle-paths as in *Sec. 5(9)3.*

B) As another example considering a proton and neutron, each one has its H hall packages, *Sec. 5(16)3a*, the H particle-paths of each of them can be regarded as two parts. In other words, a reversible part (or group) moving at all direction due to rest mass and a common motion part, *Sec. 1(3), case I*, according to *Mirror Image Effect, Sec. 6(2)3*. Therefore, after interaction, a photon with an H hall package exits through system and a deuterium nucleus remained. The former also has an H hall package and its H particle-paths contribute in reversible and common motion according to case *I*. Therefore, equilibrium is established at the final stage. Noteworthy, if in the above reaction more than one photon is generated, according to *Sec. 5(16)7*, there is a time arrow along with space expansion, i.e. entropy of the system increase accordingly, *Sec. 5(16)9d, part A*.

As a result, the above examples *A, B* are somehow similar at both macroscopic and microscopic worlds respectively.

Example 5(9)3b2- Based on *Note 2(4)4a1*, considering a fraction dm of a mass m that settled on the surface of the latter, the δN_g number of contractons emitted by dm towards mass m center of mass is along with mutual emission of equal number of δN_g contractons by mass m towards center of fraction of mass dm, *Sec. 5(9)3d, part c*. Similarly, the δN_g contractons emitted by fraction of mass dm of volume dV, within the mass m is along with δN_g contractons by the rest of mass m of volume V. Thus, the whole contractons leaving from fraction dm is equal to the entrance of contractons by the center of mass m. Now, considering m the mass of the Universe, the contractons emitted by fraction of mass dm is along with equal number of contractons exchange by the whole Universe according to Mach principle.

Note 5(9)3b1- According to *Sec. 5(6)4*, there is a network of common H hall package tunnels, *Sec. 5(9)3d, part c*, of all of the particles, or, mass-bodies their track texture, field are correlating via their reversons. The common H hall packages are terminated to the central black hole of the host galaxies and clusters, *Sec. 5(7)8*. Any interaction (or detection related to irreversible path-length, *Sec. 2(4)4b*) of a particle or mass-body is transferred spontaneously via this network to the central black hole. The contractons are the force carrier particles. They are transferring from interacted particles via common H hall package tunnels up to central black hole, thus trapped irreversibly by the latter.

5(9)3c- Correlation between two mass-bodies and field variations

The counter-current flow of H particle-paths as a unique H system between two orbiting masses can be viewed as correlated behavior of two mass bodies at macro world by a loose analogy with that of entangled pair of photons or particles in micro-world, *Secs. 8(4) to 8(7), and Sec. 8(9)1, paragraph3.* In other words, the spacing between two mass-bodies *M* & m is occupied by H hall packages, *Sec. 5(16)3a*, inside their, there are abstract vacuum, *Sec. 5(16)3h*. Please refer also to *Fig. 5(5)1*. Therefore, through abstract vacuum, the interactions are spontaneous contrary to the case of normal vacuum texture, *Sec. 5(16)3b, part A*, that within it interactions propagate at light speed. Please refer also to *Sec. 5(2)1d*, in this regards.

As a result, the correlation between two interacting mass-bodies is performed through mutual exchange of contractons, *Sec. 5(2)1c, part c,* within the H hall package tunnel, *Comment 5(2)1c1*. It induces a directional expansion of expandons, *Sec. 5(16)1c, part A3,* at opposite directions of contractons exchanging between these two objects because of Mirror Image Effect, *Sec. 6(2)3*. In other words, the expandons, of interacting mass-bodies lost their symmetrical (or spherical) shape in this regards, e.g., a dumbbell-like expansion of their Unique (or common) expandons. Therefore, the force exerted by two mass-bodies system on an imaginary unit of mass is normal to the surface of each unique expandon in each location. Noteworthy, in case of a moving mass-body, the expandons take the combined shape of its spherical at rest state due to fully reversible H particle-paths and the mono-dimensional shape due to single direction H particle-paths of the mass-bodies in its mono-directional motions. Please refer also to *Sec. 3(1)2, Fig. 3(5).* Therefore, in case of orbiting binary pair, their common expandon geometrical shape during its expansion will be affected by the pair's orbital shape, i.e. gravitational field variations. Noteworthy, common expandons *CF*-lines induce gravitational interaction on mass-bodies, *Sec. 5(2)1*, through its propagation in vacuum medium at finite speed, i.e. maximum light speed at straight direction. According to *Sec. 5(2)1c, part c*, the directional expansion of expandons of SN_r configuration is accompanied by contraction of contracton of SP_l configuration in opposite direction down to Planck length on Schwarzschild surface, *Sec. 5(16)2a*. Therefore, the single direction part of expandon in the direction of binary pair rotation is along with contraction. In other words, the expandons carry momentum in the same direction of rotation that leading to damping of the latter motion, *Example 5(9)3c1*. Noteworthy, the expandons motion is the fingerprint of the motion of binary pair during time. Moreover, the expandon transfer energy from the binary system. Please refer also to *Sec. 5(11).*

Example 5(9)3c1- According to Mirror Image Effect, *Sec. 6(2)3*, that is based on Newton's third law, any disturbance in a mass-body of a system of two orbiting objects is transparent to other one through this correlation. "Because the Earth's polar axis is tilted, a constant self force along the Earth's axis project into the orbital plane of the Earth-Moon system's motion around the Sun, and the Moon's acceleration relative to the Earth is the negative of the Earth's self-acceleration" [449] *section 3*. This effect is interpreted as violation of Newton third law in the latter article due to a net self-force accelerating the centre of mass of the interacting pair that violates the momentum conservation in physical law. According to H particle-paths hypothesis, it can be related to non-symmetric combined expandons generation of the binary system that is affected by asymmetrical distribution of mass in both Earth and Moon. In other words, the contractons, *Sec. 5(2)1c, part c1*, related to emitted asymmetrical part of combined expandons induce non-zero self-force on the centre of mass of the two orbiting system. Therefore, the asymmetry between two bodies is broken. Summarizing, the Mirror Image Effect governs the motion of the system without any inadequacy. For an alternate interpretation, please refer to *Note 5(2)1b2, item II*, and *Sec. 5(18).*

5(9)3d – Path-length of orbiting mass-bodies

A) path-length of mass-body

Supposing the center of mass of two mass-bodies *M* & m is o, and the distance of the *M* and m from o are of magnitudes *R* and r respectively. Thus, two masses are orbiting around point o (or origin of their *CMPRF, Sec. 2(6)2b*). Now, supposing at an infinitesimal time intervals dt, the two masse-bodies *M* & m are displacing to a new position at an angle of magnitude $d\varphi$ respect to the initial one that is based on instantaneous, *Sec. 7(4)2f, part c*, propagation of speed of gravity, *Sec. 5(2)1d*. Therefore at any time interval dt, the paths of mass-bodies *M* & m, *Note 5(9)3d, A1,* on their orbit are $Rd\varphi$, $rd\varphi$ in angular, and at opposite directions of zero algebraic sum respectively. Moreover, their paths on radial directions have two radial components dR, and

dr at opposite directions of zero algebraic sum respectively. According to path constancy, *Sec. 2(1)2*, of an isolated H system *M* & m, *Sec. 2(4)1*, during time interval dt the total type path-length of N_α single direction H particle-paths of mass *M* is equal to that of n_α single direction H particle-paths of mass m, and in opposite direction (or sign). In other words, the total path-length variation of system *M* & m regarded as isolated is zero.
According to the above statements and *Sec. 2(1)1b, Eq. 2(22),* we have:

$N.\alpha_N.cd\,t'_N = -n.\alpha_n.cd\,t'_n$ or $N_\alpha.d\,t'_N = -n_\alpha.d\,t'_n$ *Consequence 5(9)3d1*, and *Comment 5(9)3d1* 5(38)1

Due to equality of $\alpha_N.c\,dt'_N$, and $\alpha_n.cd\,t'_n$ to *V*, and *v* respectively, the *Eq. 5(38)1* can be written as following:

$N.Vdt = -n.vdt$, or $N.V = -n.v$ 5(38)1a

In other words in an isolated H system its total path-length variations is zero, i.e. an equilibrium stage, *Sec. 5(2)1b*.
Moreover, V, v have angular components $Rd\varphi/dt$, $rd\varphi/dt$, and radial components $dR/dt, dr/dt$ due to non-retarded propagation of speed of gravity, *Sec. 5(2)1d,* respectively. Therefore, *Eq. 5(38)1* can be written as following:

$NR = nr$ *or* $R/r = n/N = Cons.$ 5(38)2

N, n, according to *Eq. 2(34) of Sec. 2(1)3* are equivalent to masses *M* and m respectively; thus, $MR = mr$ because of path-length constancy.
Where:
- N, n are total H particle-paths of mass-bodies *M* & m respectively.
- V, v are the velocities of masse-bodies *M* & m respect to an observer at their common *CMPRF*'s origin at two opposite direction respectively.
- R, r are radial distance of mass-bodies *M* & m respect to an observer in their *CMPRF* location.
- α_N, α_n, are deviation degree from reversibility, *Sec. 2(1)1a, Eq. 2(7),* of mass-bodies *M* & m respectively.
- N_α, n_α, are single direction (or retuned) H particle-paths of mass-bodies *M* & m respectively.
- t'_N, t'_n, are proper time of mass-bodies *M* & m at their *LFRF*, *Sec. 2(6)2c*, respectively, and respect to *CMPRF's* observer of time t, *Note 5(9)3d1*.

Moreover, there are two equals and opposite directions, attractive forces applied on mass-bodies *M* & m respectively, *Sec. 5(2)1, Fig. 5(1),* due to two equivalent gravitational domes formation within each of interacting mass-bodies; please refer also to *Sec. 6(1).*
Factually, the *Eq. 5(38)2*, is independent of the time interval dt. Thus, by increasing *R,* φ decreased accordingly; moreover, by decreasing φ, r also increased (or vice versa), in such a way that *Eq. 5(38)2*, has a constant value. As another results, the masse-bodies *M* & m considered as an isolated system has a constant path-length value that is conforming to *Sec. 2(4), Eq. 2(103)1*, i.e. the path-length magnitude of a closed system is constant at any time interval, the path-length of this type is reversible.
According to above statement, the Earth moving around the Sun, (or a satellite around the Earth) each system is considered as a closed H system of constant action. Thus, their path-length according to *Sec. 5(2)1b*, the system is at an equilibrium stage of constant path-length that corresponds to a curved space-time based on *GRT*. Now, supposing this equilibrium is broken by entrance of an external effect such as a third mass-body, i.e. total path-length changes. Therefore, according to *Sec. 5(2)1a*, there are an interaction of *CF-lines* of each of three mass-bodies with two other ones associated by exit of *CI-lines* up to reach a new equilibrium stage, i.e. a constant path-length.

Note 5(9)3d, A1- According to *Sec. 5(16)3b, part B*, any particle or mass-body, during its motion trace a track texture along its path n vacuum spatial medium. Therefore, according to *Sec. 8(3)4*, in case of interacting particles, or, mass-bodies, e.g. orbiting mass-bodies, their individual track textures are combined. Thus, a single common track texture is appeared in spatial medium. The particles or mass-bodies obey their common track texture as their path during the motion in spatial medium.

B) Path-length of the gravitational fields

According to *Sec. 5(16)1b, part A, paragraph 18, and Secs. 5(9)3a, c,* in an isolated *M-m* system, the type R_e path-length of correlated H particle-paths of the fields of its interacting mass-bodies *M* & m through time interval dt related to the angle $d\varphi$ are equal to each other, and at opposite direction (or sign), i.e. zero total path-length variation, *Remark 5(9)3d1*. Thus, it can be considered as following:

$$N_G.\int_0^R Rd\varphi = -n_G.\int_0^r rd\varphi$$

$$N_G.R^2 d\varphi = -n_G r^2 d\varphi \qquad 5(38)3$$

Therefore, the *Eq. 5(38)3,* according to *Sec. 5(1)1, Eq. 5(5),* can be written as:

$$\frac{R^2}{r^2} = \frac{n_G}{N_G} = \frac{m}{M} \qquad 5(38)4$$

Where:
- N_G, n_G, are total equivalent number of the H particle-paths related to the interaction of the gravitational field of mass-bodies *M*, m respectively
-*M, m,* are the masses of mass-bodies *M* & m respectively

According to *Eq. 5(38)4*, at different angular velocity $\frac{d\varphi}{dt}$ (or $d\varphi$ variations in unit of time), the *Eq. 5(38)3* can be considered as following:

$$M R^2 \frac{d\varphi}{dt} = m r^2 \frac{d\varphi}{dt} \qquad 5(38)5$$

In a unit of time due to the constant rate of expansion of gravitational spheres (expandons, *Sec. 5(16)1c, part A3*) from the mass-bodies *M* and m, the both sides of *Eq. 5(38)5* have a constant value, i.e. constant path-length of the field of a mass-body at equal time interval, the *Eq. 5(38)5*. It is coinciding with angular momentum of mass-body *M* (or m) that has constant value in case of *M* & m system regarded as isolate.

"The expression $\frac{1}{2} r.rd\varphi$ is represented as sector area df formed by two neighboring radius vectors infinitesimally close to each other, and the trajectory arc. Therefore, the angular momentum of a mass-body can be written as:

$$M = 2m\frac{df}{dt} = 2m\overset{o}{f} \qquad 5(38)6$$

Where, $\overset{o}{f}$ is the areolar speed. The conservation of angular momentum is leading to conservation of the latter. The radius vector of moving body sweep equal area in equal time interval (Kepler second law)" [2] *part 14, page 45*.
As a result, this area at equal time intervals corresponds to the number of interacting n_G H particle-paths of mass-body m field on the main-body *M*, or, vice versa. Therefore, respect to the observer at the *CMPRF* of *M* & m system we have:

$$2m\overset{o}{f} = 2M\overset{o}{F}, \text{ or } \quad \frac{\overset{o}{F}}{\overset{o}{f}} = \frac{dF}{df} = \frac{n}{N} = \frac{n_G}{N_G} \qquad 5(38)7$$

As if, the correlated H particle-paths between two orbiting mass-bodies, *Sec. 5(9)3a, Fig. 5(5)1,* is focused on the origin of their common *CMPRF*. Moreover, an expandon of SN_r configuration from mass *M* (or m) just after interacting with mass m (or *M*) is reflected back as contracton of SP_l configuration, *Sec. 5(2)1c, part c2*; please refer also to *Sec. 5(2)1d*.
Where:
- $\overset{o}{F}$ is the area speed by radius *R* of mass-body m per unit of time.
As a result, similarly to the mass, the field of each of orbiting mass-bodies has equal path-length at unit of time respect to an observer at their common *CMPRF's* origin, *Consequence 5(9)3d1*. Noteworthy, in case of path-length within mass medium, *Sec. 7(4)3, part D,* related to *PL & PR* contractons; please refer to *Sec. 5(9)3d, part D*. Factually, the contractons are leading towards the origin of the *CMPRF* of mass-bodies.

C) Common H hall package tunnel

"In 1950, Einstein thought about the mechanism of the transmission of force from one particle to another and concluded that space must possess a property that extends throughout space to connect particles."[501] *Historical proposals.*

According to above discussion, and referring to *Sec. 5(16)11* in our matter Universe, the path-length in the field medium is preferentially of expanding type R_e (related to expandons, *Sec. 5(16)1c, part A3*). Thus, in the related mass medium is of contracting type L_c characteristics (related to contractons, *Sec. 5(2)1c, part c*) of equal magnitude and opposite sign. In other words, the entrance of expanding path-length (or H particle-paths) of type R_e sending by gravitational field of mass-body *1* toward mass-body *2* main-body is accompanied by equal amount, and opposite sign of contracting type L_c path-length related to contracton, *Comment 5(2)1c1*, through the latter. It is along with equal magnitude and opposite sign of expanding type R_e path-length through the gravitational field of mass-body *2* toward the main mass-body *1*, i.e. a continuous loop of H particle-paths between the two orbiting mass-bodies *1, 2* at equilibrium stage. Moreover, the path-lengths of expanding types R_{e1}, R_{e2}, through spatial medium, and contracting types L_{c1}, L_{c2} through mass medium are of equal magnitude of different directions (or signs) as

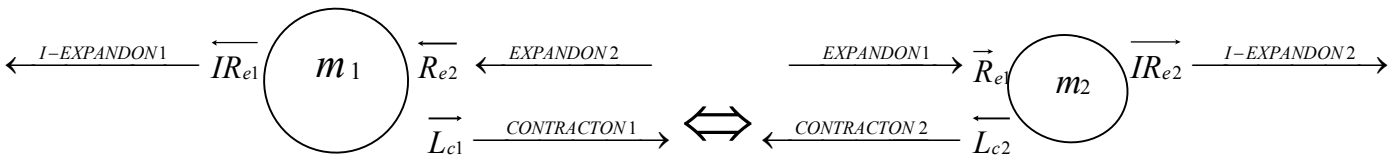


Fig. 5(5)2 - Schema of mutual interaction of mass-bodies m_1, m_2 from viewpoint of expandons-contractons of path-lengths R_{e1}, R_{e2}, L_{c1}, L_{c2} types

in *Fig. 5(5)2* irrespective of magnitude of masses m_1, m_2 .Moreover, any entered *CF*-line, *Sec. 5(2)1a*, of expanding type R_{e1} (or R_{e2}) path-length of SN_r configuration in mass medium is accompanied by exit of *CI*-line of expanding type IR_{e1} (or IR_{e2}) path-length of SN_l configuration at opposite direction , and equal magnitude through normal vacuum medium, *Remark 5(2)1a1*.

Noteworthy, the stated above loops (or cycle) is taken form during a measurement, *Sec. 8(7)2*, (or interaction) related to the both fields m_1, m_2 with that of both measuring devices (i.e. mass-bodies m_1, m_2). In fact, we encounter with increment of two types of path-lengths R_e & L_c at equal magnitude, and opposite sign during this process. Moreover, the path-length R_e increment through the vacuum medium; whereas, type L_c increment is through the masses. Factually, for the reason of equilibrium stage, the both types R_e path-length of expanding characteristic related to the gravitational fields of the two mass-bodies at vacuum medium have equal magnitude, and at opposite directions of each other. Similarly, for the same reason the two types of contracting type L_c path-lengths at mass medium of the two mass-bodies have equal magnitude, and at opposite directions. Moreover, the type L_c path-length in the form of contractons are correlated instantaneously through abstract vacuum, *Sec. 5(16)3h*, inside the related common H hall package perforated, *Comment 5(9)3d2*, *Comment 5(9)3d3,* through vacuum texture medium, *Sec. 5(16)3b,*(an alternate to wormhole)*;* please refer also to *Sec. 5(16)3b, part B, paragraph IX*. This common H hall package is between the two mass-bodies system just during the mutual interaction of expandons of the two mass-bodies, and at opposite directions of interacted expandons*, Sec. 5(9)3d, part D*. According to *Sec. 5(7)8*, the released *I*-contractons *1&2*, in *Fig. 5(5)2*, are ultimately transferred through common H hall tunnels to super massif black hole of related host galaxies and clusters spontaneously, *Comment 5(15)3d, B1*. In other words, they are absorbed at irreversible manner (i.e. a measurement or detection, *Sec. 8(7)2*) by black hole, *Note 5(7)8c*.

Resuming, the expandons of one of the mass-bodies are transferred to the other one at finite speed through vacuum texture. Whereas, the induced contractons in the latter mass-body are propagated through abstract vacuum of H hall packages tunnels between the mass-bodies spontaneously, *Note 5(9)3d, C1,* and at opposite direction of interacted expandons. Please refer to *Note 5(7)8c*, *Sec. 7(4)2f, parts B*, *C, Note 5(16)7, g2,* and *Sec. 8(7)2, part E5, Schema E5a*.

Note 5(9)3d, C1- By a far analogy, the H hall package tunnels can be simulative to wormhole, "A hypothetical tunnel connecting two different points in space-time in such a way that a trip through the wormhole could to be much less time than a journey between the same stating and ending points in normal space" [609]. Please refer also to *Sec. 8(7)2, E5a, item 18*. According to *Consequence 2(10)1b*, any H hall package of an isolated object is linked to the related black hole of host galaxies and clusters, *Sec. 5(7)8*, by an H hall package tunnel.

D) Recurrence of events (proposal)

According to [465] *introduction*. "In standard model, the interactions between particles are produced by boson exchange. While, general relativity views gravity not as a force but as a distortion of space-time". Based on H particle-paths hypothesis, the contractons are massless particles of SP_l configuration; *Note 5(2)1c2*. Their existence are on the basis of Mirror Image Effect, *Sec. 6(2)3* (a modification of Newton third law) that is not considered in *GRT*. Please refer also to *Consequence 5(2)1c1, part III.* According to *Sec. 2(4)4a*, any expandon generation in spatial medium of SN_r configuration and expanding type R_e path-length of $+2\hbar$ value is along with its contracton conjugate within mass medium, *Sec. 7(4)3*, *part D,* of SP_l configuration, and contracting type L_c path-length of $-2\hbar$ value at an external mass-body. This leading to disconnection of expandon from the related contracton conjugate, i.e. contracton is released. In other words, referring to *Fig. 5(5)2,* during gravitational interaction of expandon 1 (or 2) with a particle or mass-body 2 (or 1) its contracton conjugate 1 (or 2) is released through the common H hall package between two mass-bodies $1\&2$ as mutual contractons $1\&2$ exchange. The contractons $1\&2$ are transferred spontaneously, *Sec. 7(4)2f, part c*, within H hall package tunnels to the related super massif black hole of the host galaxies, or clusters, *Sec. 5(7)8*, and irreversibly absorbed (or detected, *Sec. 8(7)2*) by the black hole. Therefore, the irreversible path-lengths, *Sec. 2(4)4b*, are taken form during mutual interactions. Noteworthy, based on bi-Universe hypothesis, *Sec. 5(16)9*, and referring to *Simulation 7(4)2e1*, if the contracton 1 is a *PR* configuration, *Simulation 7(4)2e1*, the contracton 2 will be at *PL* configuration or vice versa, *Note 5(9)3d3*. Factually, the contracton 1, e.g. *PR1*, is ultimately absorbed by supermassif black hole via H hall package tunnel that is passing through mass-body 2 that is leading to contracton 2, i.e. *PL2*, releasing via mass- body 2 towards the mass-body 1. Similarly, the *WR1* expandon emitted by mass-body 1 is along with *WL2* expandon emission by mass-body 2 or vice versa. The rearrangement of contracton during their absorption by supermassif black hole of the host galaxies, *Sec. 5(7)8*, can be simulated to a record disk or tape that records the events successively. These events are regenerated again via imprinted existence of the entities during the Universe evolution, *Sec. 5(15)3d, part A*; please3 refer to *Remark 5(15)3d, A1*, and *Proposal 5(7)3a*. As the results according to above discussion:

A) A mass-body and its related gravitational field act as a unique H system, *Sec. 8(5).*

B) An external gravitational field interaction leading to irreversible path-length increment through both spatial and mass medium at equal magnitude and opposite signs that leading to H hall packages formation.

C) The events are repeated again during each cycle of the Universe evolution by similarity to a computer with its preserved programs, and order of a record disc during similar time elapse in cycles of Universe evolution, i.e. same expanded volume; please refer to *Example 5(17)1, item* ***B***. In other words, the events are appeared successively from viewpoint of the time in a cycle. Therefore, all of the events in the Universe are programmed previously (or by previous cycles). Thus, conducted via contracton absorption and its conjugate emission by the related black hole. Noteworthy, according to *Note 2(1)4a*, any event

depends on its previous one via a history, i.e. history of the past events down to big bang, and its previous cycle of Universe evolution, and so on to other previous cycles, *Sec. 5(15)3d, part B, Proposal 1*. Thus, an event in our present time and cycle has copies in previous cycles and times by similarity to a movie frame during each of its play or show.

D) The *PL & PR* contractons have irreversible path-length of equal magnitude, but at opposite signs. Similarly, *WR & WL* expandons have reversible path-lengths of equal magnitude, but at opposite signs. Noteworthy, *WR & PL* (or *WL & PR*) expandon-contracton have irreversible path-lengths of equal magnitude, but at opposite signs. Please refer to *Sec. 2(4)4b*.

E) In case of no interaction (e.g. as collision, tapping a machine, *Proposal 5(7)3a, etc),* there is merely an smooth an homogenous absorption of contractons by black hole, i.e. a background absorption; while, in case of interaction, there is an additional absorption of contracton besides the background one as in case of recording by record disc. At the end of a cycle or complete period, that additional contracton during a reversed process due to big crunch will be emitted towards the particles or mass-bodies as information releasing in order to reach equilibrium, i.e. a smooth background. In other words, a program for the related particles, *Sec. 8(7)2, Schema E5a*, e.g. in the human brain.

F) By Similarity to the right-handed spirally expanding track texture constructed of expandons in spatial medium, *Sec. 7(4)3, part A,* of SN_r configuration. According to *Sec. 5(16)3b, part D1*, there are contracting track texture constructed of contractons within mass-medium, *Sec. 7(4)3, part D,* on black hole horizon of SP_l configuration at contracting left-handed spirally geometrical shape by analogy to a recording disc or sphere (similarly to phonograph). Thus it records the information of events related to particles , and mass-bodies that can be revealed (or repeated) in a reversed process in cyclic Universe, e.g. big crunch, *Sec. 5(15)3*, or antimatter stage of the Universe, *Sec. 5(16)9*. In other words, the event can be repeated as a program in the Universe as computer, i.e. human life, natural events, prediction of accidents; please refer to *Remark 5(15)3d, A1.*

Consequence 5(9)3d1– The *CMPRF*'s origin of a system of isolated mass-bodies, *Sec. 5(9)3a*, is a location within vacuum quantized texture, *Sec. 5(16)3b, part A*. Respect to an observer at this location, the path-length of any of ingredients (e.g. mass-body and related gravitational field of a mass-body) of the whole system is equal to algebraic sum of path-lengths of other ingredients, but at opposite signs. These path-lengths are at opposite directions respect to the observer at that location, and during any related time interval, i.e. zero path-length variation. Moreover, according to *Sec. 5(2)1c*, *Comment 5(2)1c, B1*, any main mass-body in its direction of motion (or velocity) in matter Universe, *Sec. 5(16)9a*, has an excess of SP_l, and SN_r configurations of equal magnitude in co-, and counter-direction of motion respectively. This depends on the velocity of motion respect to an observer at rest, or, in this case respect to observer A at the *CMPRF's* origin, *Sec. 8(9)2*, of the whole system.

Note 5(9)3d1- The proper times t'_N, t'_n are the times of *LFRF, Sec. 2(6)2c*, of mass-bodies *M* & m respect to their common *CMPRF*'s observer at origin o. Factually, the proper time's of a mass-body in this system is constituted of two parts as following:

- *A)* The intrinsic gravitational time's arrow, *Sec. 5(16)7c*, of a mass-body excluding part related to Delta Effect, *Sec. 2(1)1b*, respect to observer o.
- *B)* The background time's arrow, *Sec. 5(16)7*, at the location o.
- *C)* Noteworthy, in above case, the observer o is regarded as an inertial observer of *kind B, Sec. 8(9)2, item II*. Please refer also to *Consequence 2(3)1a.*

Note 5(9)3d2-

Note 5(9)3d3- In fact, the mutual releasing and exchange of *PR* or *PL* contractons is a law of nature within mass medium, *Sec. 7(4)3, part D*, that is based on mirror image effect, *Sec. 6(2)3* (a modification of Newton's third law based on *HPPH*) that is not previewed in *GRT*. The spontaneous, *Sec. 7(4)2f, part C,* mutual emission of contractons within H hall package tunnel, *Sec. 5(9)3d, part C*, between two mass-bodies in spatial medium implies the action at a distance scenario as in Newton's law.

Comment 5(9)3d1- The *Eq. 5(38)1* is based on *Eq. 2(121)* of *Sec. 2(10)2*. Therefore, the following relationship is hold:

$E_N \Delta T_N = E_n \Delta T_n = E_{CMPRF} \Delta T_{CMPRF} = h K_r$ or

$N \Delta T_N = n \Delta T_n = (N+n) \Delta T_{CMPRF} = a^{-1} K_r$

Where:

- E_N, E_n, are the total energy of mass-bodies *M* & m respect to an observer at their *CMPRF's* origin (or location)
- E_{CMPRF}, is total energy of the whole system, i.e. $E_N + E_n$, respect to an observer at *CMPRF's* location
- $\Delta T_N, \Delta T_n$, are time intervals according to *Sec. 2(10)2* related to mass-bodies *M* & m respect to an observer at *CMPRF*
- ΔT_{CMPRF}, is equivalent time interval according to *Sec. 2(10)2,* at *CMPRF's* location
- a , is a coefficient of proportionality, *Sec. 1(2).*

Noteworthy, $\Delta T_N, \Delta T_n, \Delta T_{CMPRF}$, are somehow proportional to time intervals dt'_N, dt'_n, dt respectively.

Comment 5(9)3d2- Analogous to case of reverson, *Sec. 7(5)2,* in mass medium that is shielded by reverax, *Sec. 7(5)3b*, *item II*, i.e. Schwarzschild closed surface or sphere. The H hall package in spatial medium, *Sec. 7(4)3, part A*, due to its mass (mass equivalent to its energy, i.e. vacuum energy, *Sec. 5(16)3d*) will construct a hollow tube that is shielded by H hall package reverax. Inside this tube analogous to Schwarzschild surface is abstract vacuum, *Sec. 5(16)3h*, that is shielded by H hall package reverax; please refer also to *Sec. 10(8)*. As the result, the set of these tubes construct a tunnel within H hall packages texture of vacuum

medium nominating H hall package tunnel. Similarly to *Sec. 7(5)2b, part II*, the contracton emission by a mass-body by analogy to ΔN_α transfer is through common H hall packages constituted of cavity reversons, *Comment 5(16)2a1*, with interacting mass-bodies. Noteworthy, the H hall package tunnel is constructed of reverax as singularity in a medium, i.e. an abstract vacuum tunnel, that is confined by counter-current H particle-paths by analogy to a Schwarzschild surface in case of a mass-body (or reverson). Please refer also to *Comment 4(6)4a,* and *Note 8(9)2b*.

Comment 5(9)3d3- Traditionally, according to Ketab-e-sharrif, "God is he who raised the heavens without any pillars that you".[110]A, *Surah 13, verse2.*

Remark 5(9)3d1- According to *Sec. 5(16)11, part c*, a type R_e path-length is along with its equal magnitude of type L_c path-length. Therefore, besides the equality of path-length R_e (or L_c) of the two mass-bodies separately, their magnitude is also equal to each other's. Moreover, just during an interaction (or measurement, *Sec. 8(7)2*) e.g. gravitational, the stated above path-lengths are taken form. Moreover, by analogy to case of front wave as sources of wave formation in Huygens principle, *Comment 5(16)3b, B1*, all points on a $CF-$ line can be considered as point source sources of expandons generation.

5(10)- Gravitational interaction at microscopic case

5(10)1 - Bending of light beam in a gravitational field

According to *Sec. 2*, the H particle-paths of a mass-body engaged in reversible motions; by analogy with that, we can extend that for a single direction or irreversible H system (e.g. photon). If instead of coin *A, Sec. 5(9)1,* we shot a beam of photon, *Fig. 4(8) part B*, from the point *B* toward the Earth, that is passing near the Earth global locating below the (x -*z,* plane). In other words, from viewpoint of *HPPH*, the photon during its passage near a mass *M* obeys the track texture, *Sec. 5(16)3b, part B*, that is formed by H particle paths (i.e. expandons, *Sec. 5(16)1a, part B,* behavior), *Sec. 5(16)2c, part c*, of mass *M* gravitational field in spatial medium, *Sec. 7(4)3, part A*. It is equivalent to curved space-time around mass *M* from viewpoint of *GRT*. Thus, the posipas and negapas of the photon that is located under the x-axis undergo more contraction than the upper ones i.e. former is closer than the latter to the Earth, (e.g. denser gravitational field). For this reason, the light or photon beam, (or, in other means, x-axis) bending downward*, Fig. 5 (6),* in the favor of, *Delta Effect, Sec. 2(1)1b*.

Assuming now, the photon beam is shot at the direction of gravity center of the Earth, the shape of H particle-paths of photon undergo equal contraction, *Comment 5(10)1b*. In other words, the frequency of photon matter-wave beam increased in the gravitational field of the Earth until it collides perpendicularly to mirror (point $\dot{\imath}$), on the Earth surface, at it's ultimate frequency, i.e. wavelength diminution*, Fig. 5(7),* and reflect again, *Note 5(10)1a,* and *Sec. 6(2)3,* in the opposite direction. Thus, the photon frequency gradually diminish during leaving Earth surface (mirror) to obtain its initial frequency at the point *B*. The neutropas cells of a photon, *Sec. 4, Fig. 4(8), part B* according to *Delta Effect*, *Sec. 2(1)1b ,Fig. 2(3),* is contracted during closing toward the gravity center of mass *M* (the Earth); In addition, each cell individually contract and take an egg-like shape, *Fig. 5(7).* Moreover, the total number of neutropa cells, or, in other words, the number of cycles transmitted is conserved [62]; thus, the path-limit Γ , *Sec. 1(12),* be curved along its path *P* according to *Delta Effect, Comment 5(10)1a;* please refer also to *Figs. 5(6), 5(7).* In fact, photons falling in a gravitational field do not increase in energy similar the case of macroscopic mass-bodies, *Sec. 5(2)1.* Even though they do decrease in wavelength the total number of neutropa does not changes. However, the light speed is equal to c as in the vacuum, but time interval contracts (or dilates) according to path-length contraction (or dilation, *Sec. 5(16)3b, part D2*); please refer also to *Sec. 2(10); Sec. 5(4)4,* in this regards, *Note 5(10)1c*.

Supposing, gravitational field is the expanded form of its related mass, *Note 2(1)3b, Sec. 5 (4).* According to Mirror Image Effect, *Sec. 6(2)3,* (based on the third law of *Newton*, *Sec. 2(1)4, Note 2(1)4a),* we are expecting an impulsive reflection of the H particle paths during the light bending phenomena by this field. We can consider the bending process by a rough comparative analogy (only as an example)of bending the light pass through a dense medium(e.g. glass lens); As the former is (photon–field) H particle-paths interaction, the latter is (photon-mass) H particle-paths interaction of photon with atoms and molecules, *Sec. 5(16)2a, Sec. 5(16)2c.* Please refer also to *Sec. 5(16)3f* and *Fig. 5(6).*

Example 5(10)1a – The contract form of Γ (i.e. *OA*) according to *Sec. 5(16)1, Sec. 5(16)2c*, can be simulated to the light passing through a water medium, the molecules of that diminished the wavelength of the incident light. Whereas, Γ of the latter remains constant and undergoes a zigzag paths though the water molecules. Here, the H particle-paths of the gravitational field having the same role of the water molecules respect to the falling photon.

Note 5(10)1a - We must not confuse the impulsive reflection of a photon with that of its absorption or emission by atoms and molecules, *Sec. 9.*

Note 5(10)1b - In, *Fig. 5(7), OA*, is the contracted form of Γ , *Example 5(10)1a*, that will be obtained according to:

$$OA = s\Gamma, \quad s = \sqrt{1 - \frac{2GM}{r c^2}} \qquad 5(38)8$$

Where:

s- Scale factor [62]

G- Newton's gravitation constant

r- Distance from the center of gravitational potential, i.e. *AM*

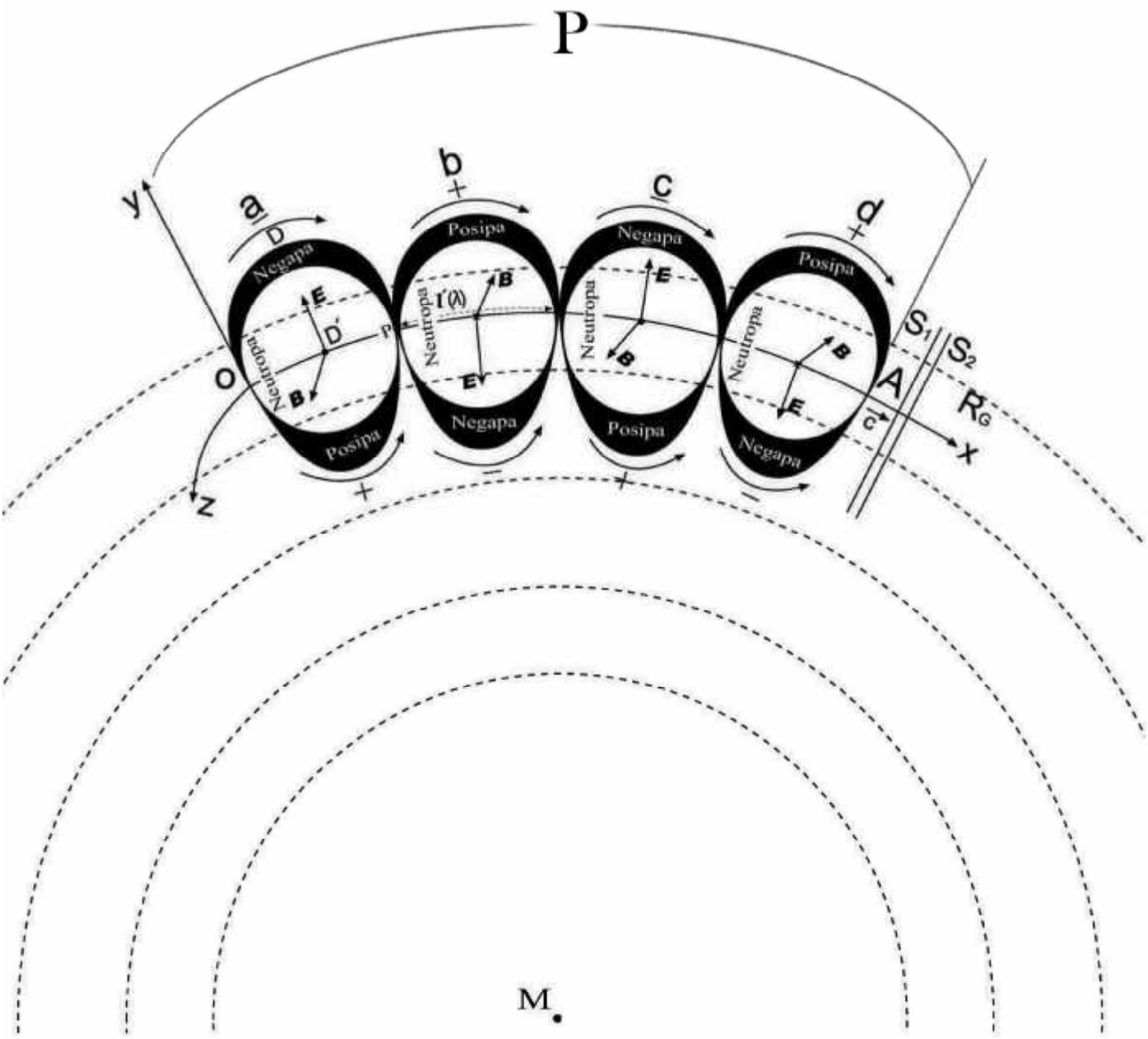


Fig. 5(6)- Types R&L H particle-paths (negapa & posipa) in neutropa units of a photon matterwave, Simulation 7(4)2e1 H system in a gravitational field through a path P, e.g. of 4 neutropas, respect to an observer at rest state.

Note 5(10)1c - According tom [323], *the equilibrium principle*, "The blue-shift of a falling photon can be found by assuming it has an equivalent mass based on its frequency $E = h\upsilon$ along with $E = mc^2$, a result of special relativity. Such simple derivation ignores the fact that in general relativity the experiment compares clock rates, rather than energies. In other words, the higher energy of the photon after its falls can be equivalently ascribed to the slower running of clocks deeper in the gravitational potential well. To fully validate general relativity, it is important to also show that the rate of arrival of the photon is greater than the rate at which they are emitted". Considering the discussion held in *Sec. 5(10)1,* and *Sec. 2(1)1b*, in the both cases the speed of the light is remained unchanged, i.e. from viewpoint of H particle-paths hypothesis, only length (or better to say matter-wave wavelength, *Sec. 7(4)2e*) and time change accordingly.

Comment 5(10)1a- According to *Sec. 2(1)1b, Fig. 2(3)b,* the path P_d in vacuum medium is contracted to its equivalent path P_G in vacuum gravitating medium depending on travel times $\Delta T_d, \Delta T_G$ respectively. Therefore, in case of a photon signal, we have:

$$P = c\Delta T\,, \qquad P' = c\Delta T' \qquad 5(38)9$$

According to *Note 1(2),* and *Sec. 7(4)3*, we conclude:

$$\frac{P_G}{P_d} = \frac{\Gamma_G}{\Gamma_d} = \frac{\Delta T_G}{\Delta T_d} = \frac{a_d}{a_G} \qquad 5(38)10$$

As a result, the light speed in the two media remained unchanged as an immutable constant. Where, a_d, a_G are the media coefficient through free vacuum, and vacuum gravitating field.

Comment 5(10)1b- It is due to increment of H particle-paths (or expandons) densities of the mass *M* gravitational field that increases the frequency of the expandons & contractons emission (i.e. its matter-wave counterpart, *Sec. 5(6),* by the fundamental H system or its beat, *Sec. 5 (9)3d, part D*, frequencies, *Sec. 7(4)2f, part A*. In other words, the contraction of the matter-wave path by increment of gravitational field of mass *M* from viewpoint of *GRT*. Moreover, the rectilinear radial trajectory of photon towards the center of mass *M* is due to radial H particle-paths densities increment of the gravitational field towards the center of mass *M*.

5(10)2 – Falling of a fundamental particle (microscopic case)

Assuming a fundamental H system m at *O* position (e.g. photon, electron) with the initial frequency, υ_i, moving toward the gravity center of the mass *M* in the *OM* direction (e.g., the Earth). The frequency of the H system is increased, *Sec. 7(4)2f, part A,* along *OM* direction (*x*-axis) of reference frame R_G, the *X, Z* -axes are on the geodesic of potential sphere r and vary with radius r variation of the mass *M*, *Fig. 5(3);* please refer also to *Fig. 5(7), Comment 5(10)1b.*

According to *Eq. 2(73):*

$$\upsilon_{Fi}=n_\circ(\gamma_i+\alpha_i)=n_{Fi}$$

$$\upsilon_F=n_\circ(\gamma+\alpha)=n_F, \qquad [\text{At } a=1 \text{ Eq. 1(1)}]$$

According to *Eqs. 2(73), 3(10),* the υ_F is the sum of υ_e frequency of matter waves plus the frequency of internal motion of remaining particle-paths in forwarding motion of an H system.

$$\Delta\upsilon_F=\upsilon_F-\upsilon_{Fi}=n_\circ(\gamma-\gamma_i)+n_\circ(\alpha-\alpha_i)=n_F-n_{Fi}\succ 0 \quad \text{or}$$

$$\Delta\upsilon_F=n_\circ(\Delta\gamma+\Delta\alpha)=\Delta n_F\succ 0 \qquad 5(39)$$

According to *Eq. 2(74)*

$$\upsilon_{Bi}=n_\circ(\gamma_i-\alpha_i)=n_{Bi}$$

$$\upsilon_B=n_\circ(\gamma-\alpha)=n_B$$

$$\Delta\upsilon_B=\upsilon_B-\upsilon_{Bi}=n_\circ(\Delta\gamma-\Delta\alpha)=\Delta n_B<0 \qquad 5(40)$$

Where:

-i index that mean "initial"

- n_0, the total number of initial H particle-paths of mass m

-υ_F, The forward frequency of H particle-paths motion of mass m

-υ_B, the backward frequency of H particle-paths motion of mass m

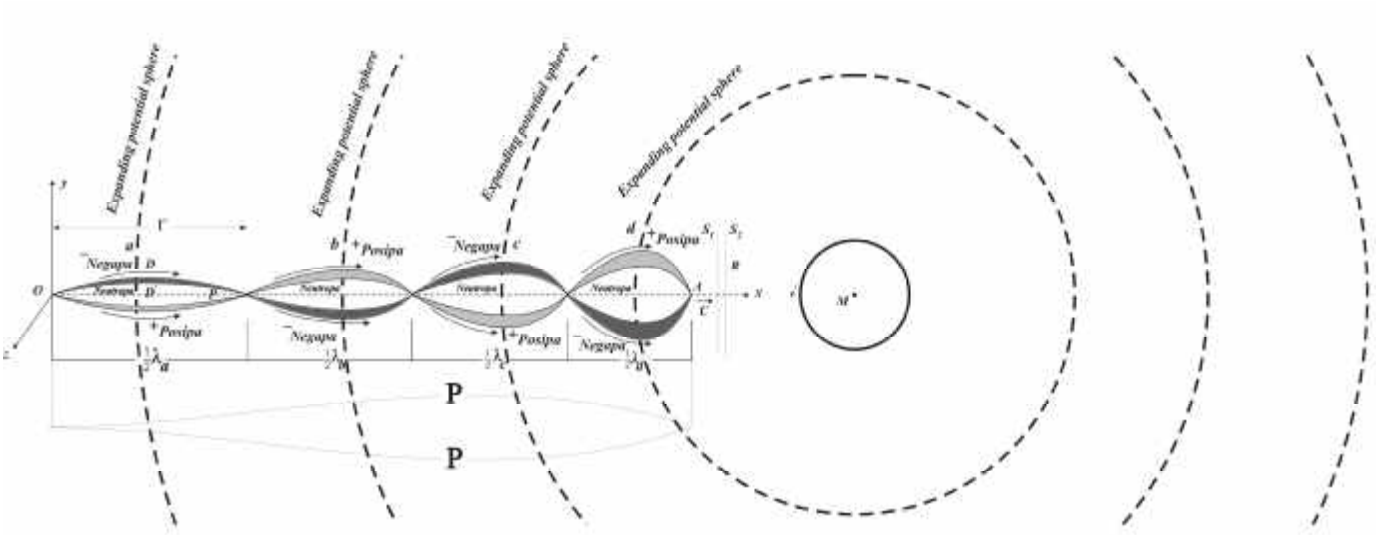


Fig.5 (7) - wavelength decreasing, of striking photon, in a gravitational field, (the H particle-paths of the photon contract)

According to *Eqs. 2(76), 3(10), 5(39), 5(40),* we can deduce:

$$\Delta\upsilon_e=\Delta n_\alpha=n_\circ(\alpha-\alpha_i)=n_\circ\Delta\alpha>0 \qquad 5(41)$$

$\Delta\upsilon_e$ is the increased matter waves frequency due to falling or accelerated motion of mass m .

Similarly according to *Eq. 2(75)*

$$\Delta\upsilon_{\perp} = n_{\circ}\,\Delta\gamma^{-1} = \Delta n_{\perp} \qquad 5(42)$$

Regarding the *Eq.3 (9):*

$$\Delta L - \Delta L_{i} = 2C\Delta\alpha \qquad 5(43)$$

Thus, ΔL increased according to acceleration in gravitational field.

Note 5 (10)2a – In case of photon [63], there is no backward motion; thus, according to *Eqs. 2(49), 2(74),* $\upsilon_B = 0$; moreover, *Eq. 2(59)* leads to:

$$\upsilon_F = \frac{\Delta E_{FB}}{h} = \frac{E}{h}$$
$$\Delta\upsilon = \upsilon - \upsilon_i = \frac{\Delta E}{h} \qquad 5(44)$$

5(11)- The gravitational field configuration

Respect to an observer located in the origin of the *CMPRF*, as in the *Sec. 5(16)1, part A, Fig. 5(8),* there is a counter-current motion of H particle-paths of the field in the both radial, and the tangential direction as in *paragraphs 3, 4* of the above section in the preference of negapa over posipa. In other words, in this case there is a SN_r configuration of gravitational field in matter Universe *paragraph 17* of the above section nominated Geodetic Effect in the language of gravitomagnetism. It is attenuated in $\frac{1}{r^2}$ manner from the origin of the *CMPRF* frame respect to its observer *A*. Considering now, an observer *B* in an inertial *CMPRF's frame B* (i.e. *out of frame* of system *A*, *Sec. 2(8)2*) the motion of a two orbiting mass-bodies system *A* can be analyzed to a translational motion *T*, and rotating motion *R* respect to the observer *B* in inertial *CMPRF's* frame *B*. Thus, the SN_r configuration of gravitational field of the mass-bodies in frame *A* is deformed based on above analysis respect to observer of the frame *B* accordingly, e.g. the Earth (lab); please refer to *Consequence 5(9)3d1* in this regards. Factually, in translational linear motion, the SN_r configuration of mass-bodies field in frame *A* depending on the velocity of the translational motion of whole system *A* respect to observer *B* is deformed in the both direction, and counter-direction of motion, *Comment 5(2)1c, B1*. Similarly, in the rotational motion, the SN_r configuration of the field of mass-bodies in the frame *A* depending on the angular velocity of the whole system *A* is deformed. Moreover, by increasing the radial distance from the origin of rotation, the SN_r configuration of the field is deformed in increasing mode (or vice versa) respect to observer *B*. Resuming, the two translational and rotational mode of motions, the SN_r configuration of the fields of the mass-bodies system *A* respect to its frame *A's* observer, i.e. Geodetic Effect, is deformed respect to observer *B* which leading to Gravitomagnetic Effect. Please refer also to *Sec. 5(2)1c* in this regards. In case of Sun-target example, *Sec. 8(9)2, Fig. 8(2),* the light emitted from the sun (source *S*) to the target *T* must be considered respect to the observer *A* of their *CMPRF* frame. Therefore, by successive transfers, *Note 5(11)1*, this phenomenon can be studied at each instant, *Note 5(11)2*, based on constancy of light speed through normal vacuum (or vacuum quantized texture, *Sec. 5(16)3b*). Factually, in the above example the observer *B* is located in origin *T* of inertial reference frame of target *T*. Conversely, starting with the reverse transformations of coordinate, we can reach to *CMPRF's* that can be regarded naturally as last transformation that conserve the mass and its gravitational fields as non-eliminating entities.

Note 5(11)1– As a result obtained in *Sec. 5(9)3*, any coordinate transformations of an inertial reference frame to other one moving rectilinear at v speed depends on inertia of its ingredients respect to the centre of mass of the system (or *CMPRF's* origin). Please refer also to *Secs. 2(6)2b, f* in this regards.

Note 5(11)2– According to *Sec. 7(4)3* due to quantization of time at quantum level. It is better to say during time interval Δt_{Γ} instead of word of each instant.

5(12) - Spaceman story (optional)

Supposing a rotating drum-like space station far enough from the true gravitational field and a spaceman, named Euclid, standing on the floor of the station. As the station rotate around its axis, he felt a pressure (*case 1*) at his legs that will alter with angular speeds of rotation, as if he is in a variable gravitation field for the reason of action-reaction principle. Suddenly, a manhole opens under his legs (*case2*) and he is thrown from the space station due to removal of the action-reaction phenomena. At the first case, the body of the astronaut is under the reversible radial motion of H particle-paths and in the second case, the irreversible radial single direction H particle-paths gives motion to his body forever. As a result, any single direction rotating motion of H particle-paths in a rigid body is accompanied by proportionate reversible radial motion of H particle–paths, same as, P_r, in *Fig. 9(1)*.

The shape of the former, i.e. single direction rotating H particle-paths, contract according to *Delta Effect, Sec.2(1)1b, Fig. 2(3)*, during tangential speed increasing and vice versa. .If the spaceman has been fastened with a long rope to the body of station; he could be rescued according to an action-reaction phenomenon of his body through the rope with that of station. Moreover, at this stage his body gains again a backward motion of H particle-paths i.e. a steady back and forth motions of H particle-paths along the rope (*case3*). However, fortunately Euclid was equipped with two propellant rockets on it's shoulders and quickly received a

message from the commandment Gauss. "if you fire the rockets in the direction of the center of space station for a time interval, dt seconds you feel an uniform acceleration that is equal to the gravitational field at the station floor according to the equivalence principle(*case 4*). During this time interval the required H particle-paths to compensate the former radial single direction at opposite direction of that, is revealed in your body according to action-reaction of rocket burned fuel gas atoms with that of the H particle-paths motions of your body's H system and you can return back to the station at an appropriate speed again ". But Euclid fire only one of the rockets and during $2dt$ seconds with an half of the required acceleration, but the same as single direction H particle-paths of the command he has done his mission. After reaching to the station, as the station is rotating at high speed he cannot enter in the manhole. The commandment Gauss say to him" you are now in the Euclidean continuum and we are in the Gaussian in which the H particle-paths are in a circulating motion, i.e. contracted curved shaped in proportion to the body edge motion of the station. Moreover, in order to enter into the station, the H particle-paths of your body must have the same shape and motion of that. Unfortunately, by rocket firing along the directions of rotation you have little chance and opportunity entering through the manhole. Thus we will throw out a rope from the manhole to the belt of your space cloth and grace of the third law of Newton the H particle paths of your body will take the Gaussian shape and related motion as that of the station, during an impulsion process.

After being rescued the commandment Gauss say to him" when you have been in the space, as you were taking distance from the station your body looked smaller and smaller until it seemed like a point; The spaceman Euclid answered" this phenomenon is very normal and is well known on the Earth. Moreover the periphery of your station was contracted more and more as the speed of rotation increase by the similar analogy of distance increasing; But now, inside the station regarding the relative contraction of H particle-paths shapes, *Fig. 2(3),* the shape of your space station isn't alter as my body size and yours.

5(13) - Equivalence principle from viewpoint of H particle-paths considering section 5(12)

According to *Sec. 5(12),* the virtual gravitation behavior of the floor (*case I*) of the space station may be applied if the legs or body of the spaceman to be fastened during the start of rotation to space station in order it's body participates in the action-reaction (third law of Newton) of the whole station during acceleration. In other words, the H particle-paths of the spaceman body take the same geometry or shape as that of the space station after entering the force-line and exit of related impulsion-lines H particle-paths accordingly, *Sec. 5, Fig. 5(1), 5(2)* as long as the station rotates. In other words, the participation of the spaceman body in a unified general motion with that of station; in addition, the spaceman in his weightless state*, Sec. 5(2)2,*without attaching to the station body, remains at rest respect to the rotation axis of the station i.e. the station floor moves respect to him.

As a result according to equivalence principle, the action-reaction of the field-mass, *Sec. (5), Figs. 5(1), 5(2),* (e.g. the gravitational field of the Earth and the spaceman mass) is in equivalence with the mass-mass [e.g. spaceman body mass and mass of the station (case1)], *Sec. 5(12)* interaction in the absence of the gravitational field. It is according to the Newton third law; please refer also to *Sec. 5(16)1c, part A*.

As stated above, the H particle-paths of spaceman body engaged in a common motion with the H particle–paths of the space station in such a manner that the spaceman feeling a pressure i.e. virtual gravitational, under his legs. Thus, increasing the speed of rotation of the space station is accompanied by increasing exit of H particle-paths impulsion-line from the spaceman body and naturally increasing H particle-paths flux engaged in a common motion through the contacting area of the two mass-bodies, i.e. spaceman and station; therefore, increasing the virtual gravitational attraction at the ground of station. The same situation is taken place when spaceman instead of space station staying on the surface of a planet or the Earth, *Sec. 5(14).* In other words, more gravitation attraction is accompanied by more flux of H particle-paths between his body and the surface of the planet in a reversible common motion of H particle-paths. Now, assuming the spaceman instead of staying on the planet, located in a height stand O from the planet surface. However, he will felt a lesser gravitation, i.e. mass-field interaction through whole mass of his body and lesser H particle–paths flux in common motion with his body and the whole planet. It is due to a lesser entered H particle- paths of the planet field (field-mass through whole of his body) interaction and lesser body-planet (mass-mass through contact area of his body and the stand) interaction accordingly. Now, supposing the spaceman body released (free falling) in the gravitational field of the planet the reversible mass-mass interaction removed and the spaceman reaches the planet surface with an increasing field-mass interaction, *Sec. 5(2), Fig. 5(2), i.e.* with no common motion (flux) of H particle-paths through mass-mass (body-planet).

The falling speed of a mass m (e.g. coin, *Sec. 5(9)1* that has been initially at rest in a nil gravitation far enough from the center of gravity of the Earth of mass M), is the same for a given r. r is the distance of coin from the Earth during falling on a equipotential sphere surface, *Sec. 5(1),* with a radius r . In other words, the falling speed of mass m varies according to radius r of spheres. Moreover, its H particles-paths shape or geometry varies accordingly.

Assuming the coin is hanged to a high (high enough at nil gravitation fields) a string of a stand on the Earth M surface may occur the following stages:

I) The steady interaction of H particle-paths of Earth field and that of the coin mass m take place as above according to field-mass interactions, *Sec. 5(2).*

II) The common motion of H particle-paths of M & m masses established through the string and stand, (in form of contractons, *Sec. 5(9)3d, part c*) according to *Mirror Image Effect, Sec. 6(2)3,* (based on Newton third law) simultaneously as stage *(I), (Equilibrium).*

III) At this stage , the string is cut and the common reversible motions of H particle-paths between M & m masses is interrupted ; the falling take place as stated above,(stage 1), *Sec. 5 (2), Fig. 5(3).*

IV) Elastic collision take place between two masses according to the third law during striking at the Earth surface, and the curved downward H particle-paths of mass m, *Sec. 5(2)*, i.e. gravitational dome force-lines, is exchanged with that of mass M exactly in a opposite curved shape (upward) and direction as former ,i.e. the dome is reversed.

V) During rising of the mass m in upward direction, the H particle–paths of the gravitational field *M* interact according to *Sec. 5(2), Fig. 5(1)*. Moreover, the upward shaped H particle-paths of mass m altering gradually and tending towards it's initial straight lines at the starting point of nil gravitation field as if, practically coin is out of the gravitational field of *M*.
VI) In all of these stages the third law of Newton is applied during falling according to stages *I* to *IV* on the basis of mass-field and mass-mass interactions; moreover, the above stages repeats again.

5(14) – A man on a planet

According to *Secs. 5 (2), 5(3), Figs. 5 (2), 5(3),* we have:
I) The gravitational field of the mass *M* (Earth, or planet), interact with mass, m, (man) according to the third law that is accompanied by increasing curved downward force-lines *CF* of mass m to reach the field-mass equilibrium state, *Fig. 5 (2)*.
II) The mass (Earth)-mass (man) interaction according to the third law accompanied by exit *IF* impulsion-lines upward at the same curvature magnitude as *CF,* but in opposite direction to it (simultaneous to stage *I*). Thus, a steady upward downward and i.e. back and forth motions of the curved *CF, CI* of H particle-paths takes place between two masses (e.g. man and Earth) respectively until the equilibrium state, *Fig. 5(2)*.

Supposing the man starting to run, *Note 5(14)1,* besides the stated above stage, we encountered with:
1) Single direction H particle-path force-lines parallel to the geodesic of the Earth surface appear in the man body.
2) According to the third law, H particle-paths in the opposite direction and curvature as in the above stage1, appear on the whole mass of the Earth as impulsion force-line of the mass of the man and vice versa.
3) The stage *1*to *3* repeats at each point of contact of the man legs and Earth surface during running.

Note 5(14)1- We are not dealing here with the biochemical reactions that take place in the man body giving rise to the single direction H particle-paths in the direction of running. It must be discussed by opening a new section entitled" chemical reaction in point of view of H particle-paths", however, some of its parts are given in *Sec. 9*.

5(15)-The first law of Newton must be modified?

5(15)1 – General aspect

Considering, *Sec. 2,* the velocity v of an isolated H system remain constant during the time , but according to the *Sec. 5(1), Eq. 5(6),* the H particle-paths of this H system will be diminished during a long period of time due to the loss of its mass, as gravitational spheres *Sec. 5(4)*. Thus, the velocity of the H system that its H particle-paths supposed in forward and backward motions (category *A*) plus single direction one (category *B*), *Sec. 1; Sec. 2, Note 2(1)4b,* can be regarded as follows:
I) The H particle-paths categories *A, B* diminished in such a rate that the α , *Sec.2, Eq. 2(7)*, or v remain unchanged
II) The H particle-paths category *A* diminished faster than *B*, in such a rate that α increases, *Consequence 5(15)1a.*
III) The H particle-paths category *B* diminished faster than *A* in such a rate that α decreased, *Consequence 5(15)1b.*

Considering the three above states of possibilities *I, II, III,* the velocity of the H system remain constant (in accordance with the first law), increased, decreased during long period of time respectively; whereas, at short period of time due to slightly decreasing of H particle paths of the whole H system, the velocity v of the H system remain constant. However, the choosing between one of the three states depends on a very accurate experiment, or, observation. Alternately, please refer also to *Note 5(15)3d, B4*. Now, considering the Universe is expanding at an accelerated rate [41, 42]; thus, the state *II* may be occurred, *Comment 5(15)1a,* and *Sec. 5(15)2b.*. We know that in reality the expansion is accelerating that is consistent with expanding spheres generation hypothesis, *Sec. 5(4),* but it still had to have begun in a Big Bang and a none zero positive cosmological constant that is inconsistent with the principle of the general relativity. In addition, an enormous amount of mass is converted to free moving H particle-path in the Universe as in *Sec. 5(7)*.
The missing mass of galactic rotation of a spiral galaxy may be interpreted by possibility *II* i.e. increasing of α rate along the spiral paths. Thus, the exited H particle-paths are transparent in the observed frequencies and do not radiate and can be regarded as dark matters, i.e. cold massless matter, *Sec. 5(1)2*.

As an isolated H system loss its H particle-paths; thus, the definition of potential energy, *Note 5(4)1b,* respect to a gravitational field must be modified regarding the infinity conception, *Note 5(15)1a.*
According to the stated above discussion , in case of an isolated H system , α ,varies at an accelerated rate, *Sec. 7(4)2e*, *part B*, as following :

$$\frac{d\alpha}{d\tau} = H_o \alpha \qquad \textit{Remarks 5(15)1a, b} \qquad 5(45)$$

In the *Eq. 5(45)*, merely the magnitude of α is increasing, *Comment 5(15)1a*.
Where, α , *Eq . 2(7)*, $d\alpha$, ratio of single direction H particle-paths to that of reversible ones at time τ and its variation during time's arrow interval $d\tau$ respectively. Moreover, H_o , *Sec. 5(1), Eq. 5(7),* is the Hubble constant, please refer to *Sec. 5(16)7a, Consequence 5(16)7*.
Analogous to Hubble Effect related to radial (translational) motion, along with it a Twisting Effect [117-118] due to a tangential (rotational) motion may be arise, *Sec. 5(16)5*. It affects the mass-body e.g., an isolated mass-body moving at uniform and straight motion according to the Newton first law is affected by two slightly accelerated motions due to exit of gravitational surfaces, *Sec. 5(4)*. Generally speaking, according to [164], part related to *Gravitation changes the story,* "the cosmological expansion is a manifestation of the gravitational activity of the Universe. Universe expansion is, of course over simplified description of the cosmological gravitational field".

Considering two non interacting mass-bodies at rest respect to each other, the second object viewed by the observer of first one, will be moved in a opposite direction of the latter due to exit of gravitational spheres at a low acceleration, *Consequence 5(15)1a*. In other words irreversible space expansion, *Sec. 5(16)7a*, (i.e. H hall quantized package increasing, *Sec. 5(16)3a*) will be bubbled and separate the relative spatial distance between the two objects

Consequence 5(15)1a- As a result, the case *II,* i.e. self-acceleration, *Sec. 5(7)9*, occurs according to cosmological observation; thus, inhomogeneous state appears between exits of reversible H particle-paths and single direction ones, or, in other words, their participations in the expanding gravitational spheres surface along with internal geometrical shape of H particle-paths deformation, *Comment 5(15)1a*. Moreover, this introduces a correction parameter, i.e. cosmological constant due to dark energy, *Sec. 5(15)2*, in point of view of general theory of relativity, e.g. Einstein's equations. In fact, there is no truly uniform linear straight motion at all, i.e. each moving H system exhibits acceleration. The equation of gravitational field in this article has the same formalism as *GRT* fundamental equations of general relativity by the difference that the former based on expanding gravitational closed surfaces, *Sec. 5(16)2c*. It can be regarded as a correction due to accelerating expansion of an open Universe regardless of mysterious dark energy; please refer to *Sec. 5(16)2c*. Noteworthy, according to [1], *part 108*, in an open *FLRW* Universe "The curvature radius is time dependent; thus, its variation leading to spatial distance of mass-bodies variation. In other words, scale factor a increase in such a space, i.e. the mass-bodies run away from each other accordingly". Resuming, each mass-body undergoes acceleration due to exit of its expanding gravitational spheres. Please refer also to *Sec. 5(15)2b, Note 5(16)3g, c1* related to interpretation in this respect.

Consequence 5(15)1b- Contrary to *Consequence 5(15)1a*, at small scale as in case of Pioneers, 9, 10, travels, *Comment 5(16)1b, A2,* the $d\tau$ variation in the motion direction is smaller than in counter-motion direction, in the counter-motion direction i.e. $\frac{d\alpha}{d\tau}<0$ due to the clock tick faster in counter-motion. Thus, an isolated moving H system is decelerating in the motion direction.

Note 5(15)1a - An isolated H system, loss its H particle-paths in the form of gravitational spheres. Factually, this H system absorbs and releases the H particle-paths of the vacuum space at an equal rate in an equilibrium state.

Comment 5(15)1a- Factually, the possibility II is due to handedness degree D_h, *Note 7(4)3, j1*, increment through the time of Universe evolution; please refer to *Sec. 5(7)8*. In other words, the geometrical shape of internal motion of H particle-paths within mass medium, *Sec. 7(4)3, part D*, of particles or mass-bodies are deforming during the evolution time that is similar to case of falling object in an external gravitational field, *Sec. 5(2)3*. As a result, in this case α has a negative value related to a repulsive force; thus, its magnitude is increased; please refer to *Sec. 2(1)1a, Eq. 2(7), and Sec. 5(15)2c*. Moreover, the α variation depends merely on internal geometry shape variation of H particle-paths within mass medium. Therefore, the possibility *I* is related merely to expanding sphere generation, i.e. zero α variation. It is in combination with possibility II related to handedness degree increment.

Remark 5(15)1a – The operator $\frac{d}{d\tau}$ by a loose analogy with quantum mechanic can be considered as Hubble time's arrow operator acting on α , i.e. single direction wave-like H particle paths.

Remark 5(15)1b- In *Eq. 5(45),* the $\frac{d\alpha}{d\tau}$, i.e. acceleration, *Note 2(1)4b*, is depending on the magnitude of α , *Eq. 2(7)* of *Sec. 2(1)1a*, of the velocity of an H system. This can by some analogy resemble to Woodward Effect. "One typical criticism is the claim that the Woodward Effect violates Conservation of Momentum and thus is a form of Perpetual Motion Machine. Woodward answers this by explaining that as Mach's Principle says that inertia results from the gravitational influence of the entire universe upon any given mass that creates resistance to its acceleration, that any device that enables mass fluctuations to derive acceleration in this manner is using the mass of the universe as the reaction mass. The whole universe is the "system" in this device, and thus momentum is conserved"[511] *Conservation of momentum*. Factually, the effect of the Universe is revealed as Hubble Constant H_0 in *Eq. 5(45)*. Please refer also to *Sec. 7(4)2f, part D*. According to this notion, the H particle-paths densities of the whole Universe in a location affect the motion. In other means, the rate of emission of gravitational spheres of the test mass-body. Please refer to *Sec. 7(4)2f, part A*.

5(15)2 – Dark energy

5(15)2a- Dark matter conversion to dark energy

According to *Sec. 5(15)1*, the two objects are moving at an self-accelerated motion, *Sec. 6(2)1*, respect to each other additional to other theoretical interpretations, e.g., General relativity and *FLWR* equations, the whole phenomenon can be regarded as dark energy. According to [256], "Dark energy is a truly bizarre form of matter, or perhaps a property of the vacuum itself, that is characterized by a large negative pressure. This is the only form of matter that can cause the expansion of the Universe to accelerate, or speed up"; please refer also to *Secs. 7(2), 7(5).* "The two most conspicuous features of dark energy are smooth spatial distribution and large negative pressure"[274], *Introduction*. Factually, according to above discussion, there is a relation between recession of the galaxies and expansion of the Universe. The high energetic particles of rest mass in the cosmic rays, *Remark 5(16)2a2*, can be attributed to some extent to the phenomenon of self-accelerating, *Sec. 5(7)9*. The assembly of their, that are moving at three spatial directions constitute an H system; please refer also to *Note 5(15)3d, B4*.

The mechanism of explaining the observed accelerating Universe is under disputation of standard, non standard and plasma cosmologist; thus, many attempts have been down to explain it on the basis of dark energy, dark matter, vacuum energy, plasma, magnetic effect that all of them have external effect on the matter [53], *Comment 5(15)2a1*. Whereas, self-accelerating behavior of matter explains the acceleration phenomenon due to dark energy in an alternate manner. The above results based on conservation law of energy irrespective of sophisticated vacuum zero point energy, *Sec. 5(16)3c*. In other words, the sum of equivalent matter energy (including normal matter, dark matter and dark energy (the latter is related to cosmological constant) is conserved; please refer also to *Eq. 5(45)3*. According to above results, the dark energy is a measure of time's arrow and space expansion, *Sec. 5(16)7a*, i.e. path-length or H hall quantized packages generation, *Sec. 5(16)3*. In other words, it is proportional to number of H particle-paths at its expanded form. Please refer also to *Sec. 5(15)2c*.
According to [272], *part5, section B, Inflation*" At the end of inflation, all energy densities have become negligible except the vacuum density, *Sec. 5(16)3c*, (or cosmological constant if you prefer). Where did the energy go?". Please refer to *Sec. 5(16)2a, Remark 5(16)2a2*.

Fully reversible H particle-paths *(R)* $\xrightarrow{EXPANSION}$ returned single direction H particle-paths *(S)* + Gravitational field of reversible H particle-paths *(G)*

$\xleftarrow{CONTRACTION}$

(Matter formation) *(Space-time metric formation), Remark 5(15)2a1* 5(45)3

Where:

R – Primordial normal matter and Primordial dark matter, *Sec. 5(5)2, Note 5(5)2a*, *part B*, mass loss due to exit of gravitational spheres, *Sec. 5(1)1, Note 5(1)1b*; please refer also to *Sec. 5(15)2b*.

S – Photons and self-accelerating forces due to normal matter, as a part of dark energy in an accelerating Universe*, Remark 5(16)2a2*.

G - Expansion due to vacuum space quantized texture, *Sec. 5(16)3b*, formation along with time's arrow, *Sec. 5(16)7a,* (i.e. path-length, *Sec. 2(1)2,* generation) via expandons formation, *Sec. 5(16)1a, part B*.
"Why is dark energy comparable to dark matter in density now and apparently now"[258] *page 53*. According to the above statements and referring to *Secs. 5(1)1*, *5(5)2,* the following equilibrium proposes between three categories of H particle-paths with the preference of expansion:
Resuming, the ordinary matter and dark matter contribute in Universe expansion that is accompanied by increasing dark energy, *Sec. 5(15)2d*, in a closed Universe. In other words, the self-accelerating motion of mass-bodies, *Note 5(16)3g, c1*, in one hand, and the exit of gravitational spheres (Expandons, *Sec. 5(16)1c, part A3*) from normal mass-bodies through consumption of dark matter to dark energy (i.e. Expandons' H hall package formation) in other hand, leading to spatial expansion. Thus, rendering them to accelerate accordingly (assumed as dark energy, *Remark 5(16)2a2*) that is accompanied by time's arrow and space generation, due to path-length, increment*;* please refer to *Secs. 2(1)2*, *5(16)7, 5(16)3*. Factually, the dark matter from H particle-paths hypothesis viewpoint is the midway of conversion mass to energy (potential).

Comment 5(15)2a1- A few physicists think that Einstein's theory of gravity will have to be modified, not at small scales, but at large distances, or, equivalently, small accelerations. They pointed out that dark matter, dark energy and even Pioneer anomaly, *Comment 5(16)1b, A2,* are unexplained by the standard model of particle physics and suggest that some modification of gravity, possibly arising from Modified Newtonian Dynamics or holographic principle". "Most physicists, however think that dark matter and dark energy are not ad hoc, but are supported by a large number of complementary observations and described by a very simple". [462].

Remark 5(15)2a1 - Here, the total mass *(R)* is preferred to fully reversible H particle-paths; but the single direction H particle-paths *(S)* is related solely to the baryonic axeons, *Sec. 10(8)*, of normal part of the mass that is constituted of particles, atoms, and molecules. Since their surrounding dark matter has no baryonic axeon. In other words, the normal matter axeon can be considered as their common axeon; thus, normal mass is speed up during exit of gravitational field *(G)* of the total mass. The conversion of dark matter by normal matter, e.g., atoms, particles, ions, rendered the latter to accelerate up to a high energy related to dark energy. According to [303], *part 12*,"What is the origin and nature of ultra-high-energy cosmic ray? "The record in a *1994* event detected by the Fly's Eye in Utah, which recorded a shower of particles produced by a cosmic ray of about 300 *ev*. A similar event has been detected by Japanese scintillation array *AGASA*". Please refer also to *Sec. 5(7)9*.

5(15)2b- Accelerated expanding Universe

A) Proposal 1 – Noteworthy, the total mass loss is provided by surrounded primordial dark matter in this schema and the atoms of the normal matters compensate their mass loss from the related dark matter through H particle-paths exchange. In other words, according to this phenomenon the normal matter of SP_l configuration acts as intermediate converters of dark matter and remained unchanged, *Sec. 5(16)2b;* please refer also to *Note 5(15)2c*. Thus:

$$\begin{matrix}\text{H particle-paths} \\ \text{of dark matter}\end{matrix} \xrightarrow{through} \text{normal matter} \xrightarrow{converts.to} \begin{matrix}\text{Time's arrow and space expansion of the Universe related to dark energy} \\ + \text{Growth of super massive black hole in host galaxies, or, clusters}\end{matrix} \quad 5(45)4$$

Please refer also to *Sec. 7(4)2f, part E5, Schema E5.*

According to *Sec. 5(7)8*, the growth of super massif black hole in host galaxies is along with acceleration of mass-bodies in host galaxies, or clusters in the radial direction of black hole.

After the fully consumption of dark matter (i.e. De-Sitter space era) in the left side of, *Eq. 5(45)4,* the reverse process will be taken place, *Sec. 5(15)3c*. In other words, from right to left side we have:

A) Time's arrow reversal along with space contraction.

B) Normal matter is converted to antimatter through, *Eq. 5(70)8d of Sec. 5(16)9b* with the preference of antimatter to matter one.

C) The dark antimatter is generating through normal antimatter.

The *A* and *B* stages are terminated by Big-Crunch. In fact, matter and antimatter are related by *CPT* symmetry, *Sec. 5(16)6*, that can be interpreted according to handedness of H particle-paths.

As a far example, this process seems as gradually unrolled a rolled paper sheet right-handedly, *Sec. 5(16)4, Remark 5(16)4b.* In other words, according to *Sec. 5(2)1c, Sec. 5(2)1c, part c*, each right-handed expandon of SN_r configuration, *Sec. 5(16)1c*, *part A3*, is accompanied by its equivalent contracton. The contracton (as a left-handed hypothetical particle of SP_l configuration), according to *Sec. 5(7)8*, is absorbed by super-massif black hole in host galaxies or clusters. After full consumption of dark matter of the universe to dark energy (i.e. full extension) will roll back the extended vacuum texture, *Sec. 5(16)3b*, will roll back left-handedly, as if rolling an unrolled sheet of paper, and so on, *Sec. 5(15)3c*. Thus, there is a correlation, *Sec. 8(7),* between expandon and its conjugate i.e. contracton as a unique H system, *Sec. 8(5)*; please refer also to *Sec. 5(2)1c, part c*, and *Sec. 5(16)9b, Remark 5(16)9e*. Thus, H particle-paths hypothesis is leading to a thought of the fate of the accelerating Universe. It is based on a cyclic model that is accompanied by reverse handedness. It differs from other speculations in this viewpoint; please refer to [313] in this respect. Factually according to above discussion at the stage of Big Crunch to Big Bang, i.e. the end (or conversion) of the Universe in one of its two aspects (i.e. matter or antimatter) to other one, *Note 5(15)2b1*, the whole system is passing through a singularity due to bi-Universe hypothesis, *Sec. 5(16)9*. Please refer to *Sec. 5(7)5*.

Noteworthy, only fermionic particles or atoms of rest mass related to normal matter act as converters; therefore, the following cases have no role in this respect:

I) Particles with bosonic structures (as follows) and integer spin have no role in this conversion:

A) Photon as particle with zero rest mass; moreover, photon due to their coupling characteristic with axion (a kind of dark matter) link to the dark matter. Thus, prevent the latter from escaping; please refer to *Sec. 5(16)3b, part D2*, *Comment 5(16)3b, E1*.

B) Bosonic hadrons, e.g., mesons

C) W^-, W^+, Z^0 Bosons, *Sec. 10(6)*, can be regarded as particles without axeon frameworks.

II) The anti-fermions that acts as left-handedly converters, i.e. space expands left-handedly through their.

Please refer also to *Sec. 5(16)9a, Example 5(16)9a1.*

The above result is one of the necessary conditions of conservation of lepton and baryon numbers in nuclear reactions. In fact, the dark matter is split to right and left-handed H particle-paths through of positive charges (e.g. hadrons), and negative charges (e.g., electron) respectively. Therefore, they weaves the vacuum texture in a right-handed dominance manner through exit of gravitational spheres, *Sec. 5(4)4,* (i.e. Expandons, *Sec. 5(16)1c, part A3*). Analogous to a textile industry that use cotton or silk (i.e. dark matter analogy) as raw materials in order to weave related textiles (i.e. Expanding of vacuum space analogy) through textile machineries (i.e. fermions analogies). As a result, the contribution of baryon and lepton populations in the construction of vacuum quantized space must be conserved according to their types or categories; please refer also to *Sec. 10(6).*

Noteworthy in this note, the dark matter is referred as matter without baryonic structure; moreover, hot dark matter of neutrinos origin is also excluded in this classification. In other words, it means regarded dark matter as particles without axeons structure, *Sec. 10(8),* or, alternately, two conjugate axeons that cancel out each other's. "Suzy neutralinos (the *WIMPs* on which most attention is fixed) are their own antiparticles and the annihilation process can be represented as $x\bar{x} \to f\bar{f}$ or $\to w^- w^+$ and ZZ, where $f = \upsilon, \tau, c, b, r$ with c, b, r being quarks" [361], *section 4.1.*

B) Proposal 2- According to *Eq. 5(45)4*, the expandons in its right-side is accompanied by related contractons, *Sec. 5(2)1c, part c*. In other words, the right-handed expanding type R_e path-length due to expandons generation is along with the left-handed contracting type L_c path-length, *Sec. 5(16)11*, due to related contractons generation. At this stage, a question is raised, if the generated contractons ultimately, *Sec. 5(15)3c*, can convert the remained dark matter to normal matter of type L_c path-lengths including neutrinos. In other means, the dark matter during its conversion to dark energy (or expandons) of type R_e path-lengths is converted to its equivalent normal matter of type L_c path-lengths, i.e. normal mass, up to full conversion of dark matter to dark energy along with related normal mass. It is related to maximum entropy and negentropy respectively, *Sec. 5(16)9d, part B*, i.e.

end of expansion of the Universe. Factually, the increment of normal matter through the time increases the rate of conversion in an accelerating mode.
Noteworthy, the dark matter has bosonic configuration, *Remark 3(1)2a,* of *SM* configuration. In other words, it is constituted of equal magnitude of superimposed types R and L H hall-packages, *Sec. 5(16)3a*, (indistinguishability, *Sec. 7(4)2f, part B*). Thus, during conversion process, its type *R* H hall packages impart to dark energy of expanding type R_e path-length as expandons. Whereas, its type L H hall packages contracted in mass medium of normal matter along with contracting type L_c path-length as in case of contractons. Note that, in the above discussion, the type R (or type R_e) means, the slight preference of this type over type L (or type L_c) in spatial medium. Similarly, the type L_c means the slight preference of this type over type R_e in mass medium. Please refer also to *Sec. 5(16)1b, part A, paragraph 21*, *Sec. 5(16)11*, and, *Note 6(2)6a1*.

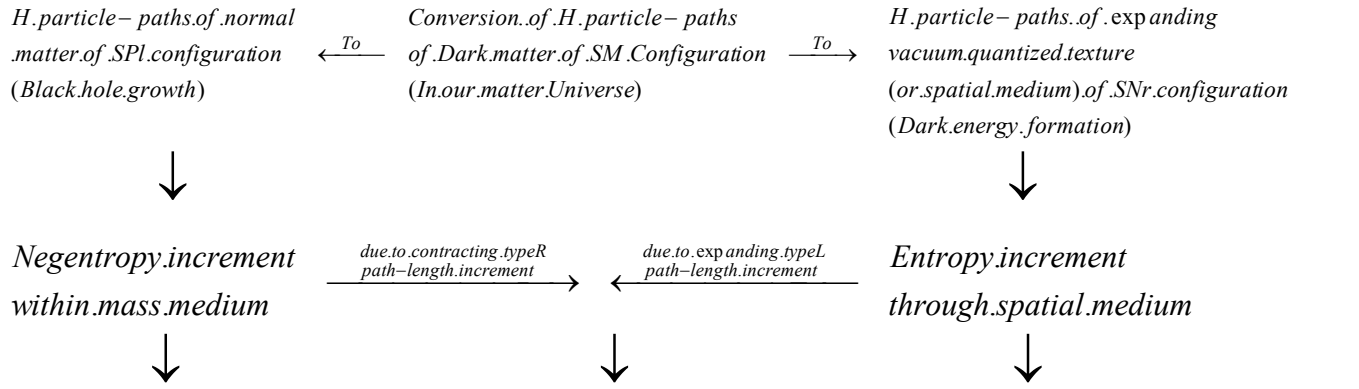


Diagram 5(1) - Schema of conversion of dark matter to dark energy along with entropy & negentropy increment

As a result, obtained from *proposals 1, 2*, besides self-accelerating motion, *Note 5(16)3g, c1*, the dark matter of SM configuration through normal matter contributes to one hand in spatial expansion related to dark energy, *Sec. 5(15)2*, of SN_r configuration (i.e. expandon generation, *Sec. 5(16)1a, part B*). In other hand, to the growth of massive black hole in nucleus of galaxies, and clusters through contractons (of SP_l configuration) absorption, *Sec. 5(7)8*. Please refer also to *Sec. 5(15)2d*, and *Sec. 7(4)2f, part E*. The above phenomenon is in accordance with spatial patches proportionality with matter content, *Sec. 5(16)3b, part H*, in the Universe. Therefore, the Universe from its smoothness (due to low entropy) at the Big Bang era tends to an increasing inhomogenity (or entropy) regardless of homogeneity at large scale discussed in *Sec. 5(16)3b, part H* at an accelerating rate. The above is shown schematically in *Diagram 5(1); please refer also to Example 5(15)2b1*

Example 5(15)2b1- Supposing a homogeneous mixture of oil and water (e.g. emulsion), during the time the oil and water are separating gradually from each other of equal path-length magnitude, but at opposite sign related to the molecules of oil and water.
Note 5(15)2b1- The big-bang, and inflation*, Sec.5 (15)3a,*of the Universe can be considered as a beat *Sec. 7(5)3d, part D*, of Universe in its expanding period, while its big-crunch, *Sec. 5(15)3c*, to a contracting mode of the beat.

5(15)2c- Lambda vacuum

Besides, the expandons related to an external gravitational field that interacts with a mass-body, there is also expandon related to vacuum energy density, *Sec. 5(16)3c*, Similarly to external gravitational field, the expandons of this background spatial medium affects the stated above mass-body that appears as cosmological constant Λ in Einstein's modified field equation. "The constant has the same effect as an intrinsic energy density of the vacuum, ρ_{vac} (and an associated pressure)"[487]. "The cosmological term can be associated with a vacuum energy density $\Lambda = 8\pi G \rho_{vac}$ "[488]. Due to isotropy of vacuum gravity free medium in all direction, there is no attractive force in this case. In other words, "When energy-impulsion tensor T is zero, the Einstein field equation describes empty space (the vacuum)" [487] *Equation*. According to *Sec. 5(15)2a*, there is a spatial expansion related to H hall package generation during expandon emission by vacuum energy density, that can be interpreted as antigravity force. "The cosmological constant behaves gravitationally like matter and energy except that it has negative pressure. The net effect of a positive cosmological constant is then to create a repulsive gravitational force. This repulsion acts to expand the Universe"[488]. It is along with expandons generation of repulsive characteristics (negative pressure) through spatial medium, *Sec. 7(4)3, part A*, that are accompanied by equal opposite sign path-length of contractons generation. The latter are transferred through H hall package tunnel, *Comment 5(16)2a1,* to the mass medium, *Sec. 7(4)3, part D*, of mass-bodies, *Sec. 5(16)3b, part F3.* Therefore, according to *Sec. 5(7)8*, ultimately transferred to supermassive black hole of the host galaxies, and irreversibly absorbed there. The contractons within mass medium of mass-bodies and related black hole has attractive characteristic (positive pressure). It leading to more contraction of the mass medium contrary to expandons that leading to more expansion in related spatial medium, *Sec. 5(15)2b, Diagram 5(1)*. Noteworthy, the path-length through spatial medium is of expanding type R_e of SN_r configuration; while, the path-length within mass medium is of contracting type L_c of SP_l configuration of equal magnitude and opposite sign, *Sec. 5(16)11*. According to Friedman equations, *Sec. 5(16)2a, part B*, that were derived from

Einstein's field equation of gravitation at zero cosmological constant, the mass-bodies are escaped from each other due to expansion of space, This phenomenon nominating red displacement [1] *section 109*. Therefore, the gravitational field has its own expansion that can be added to background spatial expansion related to vacuum energy density. As a results, according to *Sec. 5(16)7c*, there are gravitational and background time's arrows along with their related spatial expansion due to H hall package generation. Therefore, the conjunction of general relativity and H particle-paths hypothesis can give us a new perspective of physical phenomena. During expansion of the spatial medium via expandons generation, an energy of equal magnitude and of opposite sign to the emitted expandons are appeared in the form of *G*-reverson of negative energy increment within mass medium, *Sec. 7(4)3J*. "The vacuum energy density behaves differently from matter and energy densities in another regard. As the Universe expands, matter and energy are spread out over more physical space and thus their gravitational attraction is diminished. For the vacuum energy, however, the PdV work done by the vacuum during adiabatic expansion provides exactly the amount of energy to fill the new volume to the same density. Therefore, the cosmological constant remains truly constant and its gravitation repulsion (or attraction) never changes during the Universe evolution"[488]. According to above discussion, a mass-body loses its energy from its mass medium. Thus, this energy is transferred to spatial medium in the form of expandons that is accompanied by spatial expansion. As the result, the energy variation is zero through mass and related spatial medium system. Please refer also to *Sec. 5(15)2b,* and *Sec. 7(4)2e, part B*.

Note 5(15)2c1- The rate of vacuum spatial medium generation by expandons, i.e. spatial medium volume, is the same as the rate of vacuum spatial medium, *Sec. 7(4)3, part A,* progression in abstract vacuum, *Sec. 5(16)3h*, of equal volume in the border horizon of the Universe. Thus, the cosmological constant Λ remains constant. It is analogous to pouring a specified volume of water, e.g. *10 lit.* in a vessel containing *1000 lit*. of water and augmentation of volume in the vessel border by *10 lit.* It is somehow related to path-length constancy during spatial expansion, i.e. any expandon emission of $+2\hbar$ path-length in spatial medium along with releasing of contracton of $-2\hbar$ path-length in mass medium, *Sec. 7(4)3, part D*, and, *Note 2(4)4a2*. As a result, expandons occupying equal spatial volumes, i.e. types *R & L* H hall packages, *Sec. 5(16)3b,* with slight preference of right-handed type *R* over left-handed one. This preference has a hard link with cosmological constant Λ. Analogous to photon case, *Sec. 9(4)7c*, expandon H hall package is superimposed of stored, *Sec. 7(2)1*, expandon of *WR & WL* conjugates H hall packages of equal path-length, or spin $2\hbar$, *Note 5(16)1b, A5,* but of different texture densities, e.g. in gravitating vacuum, Sec. *5(16)1b, part A*. According to *Simulation 8(7)2, E5a*, any expandon unit analogous to particle is linked to the supermassif black hole through H hall package tunnel, *Sec. 5(9)3d, part c*. Thus, forming the spatial medium analogous to a foam-like structure. Noteworthy, during the motion of a mass-body or particle in spatial medium, the released contractons are transferring spontaneously within these H hall package tunnels to other mass-bodies and ultimately to the black hole, *Sec. 5(7)8*, and *Sec. 5(9)3d*. According to above discussion, the spatial medium has both radially and rotationally expanding characteristics.

5(15)2d- Universe evolution at reversed handedness

"As a consequence, at the early times the vacuum energy was negligible, *Sec. 7(4)2e, part B*, in the comparison to matter and radiation. It is fruitless to try explain the matter/vacuum coincidence by invoking mechanisms which make the dark energy density time-dependent in such a way as to always be proportional to matter; such a scenario would either imply that the dark energy would redshift as $\rho_{dark} \propto a^{-3}$, which would led to a non-accelerating Universe. Recent observations provide some evidence that the Universe has only recently entered an era of acceleration out of a previous era of deceleration"[273], *part 1-3*. According to H particle-paths hypothesis dark energy appears at the expense of dark matter due to exit of gravitational expanding spheres, *Sec. 5(4)1*. "Some physicists have speculated that the invisible gravitating dark matter could be the other side of the invisible dark energy coin, and that suggests the possibility of manipulating the vacuum for energy release"[348], *page 6*. The total density parameter of the Universe at any time from Big Bang era can be denoted by $\Omega_{total} = \Omega_m + \Omega_\Lambda$, *Note 7(4)2e, B1*. Where, Ω_m is the matter (dark plus baryonic) parameter density, Ω_Λ the vacuum (energy) parameter density. According to *Sec. 5(15)2a,* at the Big Bang the total vacuum energy of the Universe E_Λ was negligible. Through consumption of dark matter to dark energy during the time the total mass energy E_m is decreasing; while, E_Λ is increasing in such a manner that the total energy content of the Universe $E_{total} = E_m + E_\Lambda$ remained unchanged. Therefore, we encountered to an accelerated expanding Universe. According to *Sec. 5(15)2b, part B*, and *Sec. 5(15)2c*, the dark matter converts to equal magnitude of dark energy due to constancy of cosmological constant. Therefore, *Sec. 7(4)2f, part A*, implies that the H particle-paths densities which affect the stay time interval are of *SM* configuration related to dark matter in H hall packages of vacuum medium, *Sec. 7(4)3, part A,* before its conversion to dark energy, *Sec. 5(15)2a*, of SN_r configuration; please refer also to *Sec. 3(1)2, Fig. 3(4)*. Thus, the stay time interval of primordial photons increases during the photon redshifting, *Sec. 7(4)2e, part B*. According to above discussion and the result obtained from interference, *Sec. 8(3)4*, the track texture of interfering particles must has of the similar texture of individual particle and *SM* configuration. Therefore, any texture of distinguishable characteristics erase the combined track texture, *Sec. 8(3)4b*. In other words, the track texture must constitute of successive H hall packages of type *R & L* configurations that are based on bi-Universe hypothesis, *Sec. 5(16)9*. In fact, the H particle-paths of *SM* configuration of the bi-Universe are split purely to SN_r configuration in spatial medium and SP_l configuration in mass medium, *Sec. 7(4)3, part D,* at the end of the Universe expansion. Thus, at this stage the physical laws in the whole Universe cannot applied. In other means, the expansion phenomenon is stopped and we encountered with big crunch, *Sec. 5(15)3c*, era down to contraction of the Universe to merely one H hall package of pre big bang. At this stage, the Universe acquire fully *SM* configuration and the big bang starts based on the primordial single H hall package handedness with the slight preference of type *L* over type *R* in spatial medium and type *R* over type *L* in mass medium, i.e. a Universe with antimatter characteristics, i.e. SP_l, and SN_r configurations in spatial and mass

medium respectively. Please refer also to *Note 7(4)3, j1* for more information. In other means, the degree of handedness D_h is zero at the big bang era and one at the moment of Big Crunch. Therefore, D_h has a distinct role in Universe evolution.

5(15)3- The fate of the Universe

5(15)3a – Spontaneous inflation during Big Bang

"The expansion of the Universe over most of its history has been relatively gradual. The notion that a rapid period *inflation* preceded the Big Bang expansion was first put forth 25 years ago. The new *WMAP* observations favor specific inflation scenario over long held ideas" [502] *Time line of the Universe*. "It is not known how long inflation lasted but it is usually thought to be extremely short compared to the age of the universe"[579] *Reheating*. In case of superluminality of inflation; please refer to [579] Overview.The spontaneous inflation at the Big Bang era, *Sec. 5(5)1*, is performed through accelerated expansion of the Universe within abstract vacuum, *Sec. 5(16)3h*, i.e. the path-length, *Sec. 2(1)2*, do not exist outside the Big Bang. During inflation path-length generated along with time's arrow, *Sec. 5(16)7a*, and spatial expansion at superluminal speed that is accompanied by H hall packages, *Sec. 5(16)3a,* formation each of path-length value h, *Sec. 5(16)3g*. In other words, the generated path-length is confined in these packages, please refer also to *Sec. 5(16)2b*, in this regards. According to above statements, the entropy, *Sec. 5(16)9d, part A*, that is low at Big Bang era increases vastly. Noteworthy, the time begins at the instant of inflation, and not prior to it. "So in the No boundary proposal, there is no time before the Big Bang: time itself began with the Big Bang"[561] *The argument of final cause*. As an initial condition, the Universe expands preferentially right-handedly, *Sec. 5(16)9a*, the vacuum texture, *Sec. 5(16)3b, part A*, is woven right-handedly at SN_r configuration, *Sec. 3(1)2*. According to Sec. *4(6)4*, during inflation, the gravitational interaction is enormous due to high generation of expandons, *Sec. 5(16)1c, part A3*, and contractons, *Sec. 5(2)1c, part A3*, and contractons, *Sec. 5(2)1c, part c*, and their related interactions, *Sec. 5(2)1d*. Therefore, presence of gravity will affects the homogeneity of ingredients in expanding Universe leading their in a localized regions, *Comment 5(15)3a1*. According to *Note 5(5)2a, Case I*, due to enormous time's arrow generation, the spontaneous inflation at superluminal speed has a paradoxical equivalent time of expansion of the Universe at c speed at this spontaneous period. Noteworthy, the expansion, collapse, and motion through abstract vacuum is instantaneous, *Comment 5(15)3a2*. Whereas, through normal vacuum that is composed of arrangement of H hall package each of path-length value h, the motion velocity is less or equal to light speed. There is also an idea that dealing with another kind of vacuum other than normal (or true) one by some difference with that of abstract vacuum. "Garriga and Vilinkin have proposed that thermal fluctuations can induce tunneling from a true de Sitter vacuum to a false vacuum at higher energies, thus inducing spontaneous inflation" [433] *part 5*. According to H particle-paths hypothesis the normal vacuum takes form along with expansion of the Universe in the background of abstract vacuum. In other words, there is no normal (or true) vacuum except abstract vacuum without quantized texture prior to inflation, *Note 5(15)3a1*; thus, speed more than light speed is not allowed in normal vacuum. Whereas speed at abstract vacuum is superluminal the same as collapse of the wave function, *Sec. 8(9)1*.

Note 5(15)3a1- "There is no time before the Big Bang: time itself began with the Big Bang. Asking what came before the Big Bang is - in Hawking's words - like asking what lies south of the South Pole". "The argument of First Cause states that every effect within the universe must have had a cause, but as we trace time back to the origin of the universe we would appear to find an initial effect without a cause"[560] The No Boundary Proposal. According to *HPPH*, the imprinted existence of entities, Sec. 5(15)3d, part A, can be regarded as an started point in this respect at the origin of the Universe; please refer also to *Note 2(1)4a*. As the result, at the moment of Big Bang, the Universe profits from all information that are left by its previous cycle; please refer also to Sec. 7(5)5. "Frank Tipler proposes that in the final days of the universe, when the universe collapses in on itself (the "Big Crunch"), the computational capacity of the universe will become infinite. He calls this the Omega Point. Tipler then suggests that this all-powerful intelligence will recreate previous civilizations in virtual reality simulations (the suggestion being that we are inhabitants of one of these simulations)"[561] *The Intelligent Universe.*

Comment 5(15)3a1- According to Quran karim in respect of creation" And we did build the sky (heaven) with the embracing power and we are the Supreme Expander". "And we have spread out the Earth and we are the (best) provider. And for every creature we created its Mate (a pair). This is something that you may think about"[110]B, *Surah, 51, verses 47, 48,49*.

Comment 5(15)3a2- "Do they but wait the Hour of resurrection which comes on them suddenly while they perceive not?"[110] B *Surah 43 verse 66*. "They ask you about the hour (of resurrection), when will be its taking place? Say: The knowledge of it is only with my lord: none but He shall manifest it at its time; it will be momentary in the heavens and the Earth; it will not come on you but of a sudden." [110]A, *Surah 7, verse 187*. "So when the hour (of resurrection) comes to them suddenly" [110]B, *Surah 6, verse 31*.

5(15)3b - Contraction after expansion

The motion of H particle-paths on the expanding gravitational spheres *Sec.5 (4), consist* of two motions that the sum of their speed components is equal to c as following:

I) - The overall speed of expansion of the gravitational spheres, *Sec. 5(9)2,* at radial direction, or, the velocity of common motion, *Sec. 1,* of the H particle-paths.

II) - The speed of the individual motions *(Sec. 1)* of H particle-paths on the expanding surfaces of spheres, *Fig. 5(8).*

The effects of the two above speeds in a small finite volume respect to a local observer are appeared as an isotropic expanding space. Therefore, at each spatial location, the H particle-paths of primordial gravitational spheres reveal as normal quantized vacuum texture, *Sec. 5(16)3b, part A*.

After the stage of full expansion discussed in *Sec. 5(16)4, Remark 5(16)4,* the two stated above speeds *I & II* change theirs signs (or directions) conversely accompanied by increasing accelerated rate of, *Sec. 5(9)2,* contraction of the Universe. In other words, this stage begins at the end of full consumption of dark matter through normal matter to dark energy, *Sec. 5(15)2*, i.e. empty space corresponds to the finite maximum entropy state, *Comment 5(15)3b1*. It is along with supermassive black holes of host galaxies or clusters of finite maximum negentropy within mass medium, *Sec. 7(4)3, part D*. The Universe will be constituted of a set of individual patches, *Sec. 5(16)3b, part H*, in the end of expansion era, *Note 5(15)3b1*. Therefore, it can be compared to an inhomogeneous mixture of ice and water that through melting of the former becomes in the form of homogeneous water. Thus, we encountered with a pulsing (or cyclic) Universe. According to *Sec. 5(16)9b*, the handedness of the Universe will be reversed during its probable contraction, or, in other words, we encountered with a contracting of antimatter Universe down to the Big-Crunch, i.e. a stage before Big-Bang period; please refer to *Sec. 5(16)9b*, and also to *Sec. 5(15)2b*. During contraction of the Universe, the expandons, *Sec. 5(16)1c, part A3*, configuration reversed from SN_r to SP_l one in a contracting manner, and contracton, *Sec. 5(2)1c, part c* from SP_l to SN_r one. Moreover, the particles of SP_l configuration turn to its antiparticles conjugate of SN_r configuration. Note that, the normal vacuum texture wrapped left-handedly during the stated above phenomena in the favor of abstract vacuum, *Sec. 5(16)3h*, please refer to *Note 5(15)3b2, Sec. 5(16)9d, part B*, and *Note 5(15)3b3*. As a result, the path-length decrement along its H hall packages, i.e. spatial contraction accompanied by time's arrow reversal. In other words, the entropy, *Sec. 5(16)9d, part A*, is diminished accordingly. At this stage, the antiparticles annihilate with residual particles in order to form harmful radiations (Spontaneous Grand Catastrophe Era, *Remark 5(15)3b1*) in matter Universe, *Proposal 5(15)3b1*. "Recent loop quantum gravity calculation indicates that the Big Bang is actually a big bounce; before the bounce the Universe was rapidly contracting" [585] *the cosmos*. Noteworthy, by a far analogy, the photon absorption and emission by an atom have similarities with Universe expansion & contration. In other words, according to *Note 5(1)1B,* during photon emission by an excited atom, its type *R* & *L* H particle-paths act like mass fractions *dM;* please refer also to *Sec. 5(16)1b, part A*.

Proposal 5(15)3b1- Alternately, in any spatial patch, *Sec. 5(16)3b, part H*, related to a central supermassif black hole, the consumption of dark matter leading to a process similar to grand catastrophe nominating local catastrophe. Thus, its spatial patch accompanied with related particles, *Sec. 8(7)2, Schema E5a,* and mass-bodies are contracted (or collapsed) down to black hole horizon by analogy to spontaneous Big Crunch to an abstract vacuum that is followed with local Big Bang, (nominating local Bang)i.e. leading to a phenomenon analogous to gamma burst. "Gamma-ray bursts (GRBs) are flashes of gamma rays associated with extremely energetic explosions in distant galaxies. They are the most luminous electromagnetic events known to occur in the universe. Bursts can last from milliseconds to several minutes, although a typical burst lasts a few seconds. The initial burst is usually followed by a longer-lived "afterglow" emitted at longer wavelengths (X-ray, ultraviolet, optical, infrared and radio)." "The sources of most GRBs are billions of light years away from Earth, implying that the explosions are both extremely energetic (a typical burst releases as much energy in a few seconds as the Sun will in its entire 10 billion year lifetime) and extremely rare (a few per galaxy per million years[1]). All observed GRBs have originated from outside the Milky Way galaxy, although a related class of phenomena, soft gamma repeater flares, are associated with magnetars within the Milky Way". "studies of the galaxies and supernovae associated with the bursts, clarified the distance and luminosity of GRBs, definitively placing them in distant galaxies and connecting long GRBs with the deaths of massive stars." .[602] *Introduction.* "The association of some long GRBs with supernovae and the fact that their host galaxies are rapidly star-forming offer very strong evidence that long gamma-ray bursts are associated with massive stars. The most widely-accepted mechanism for the origin of long-duration GRBs is the collapsar model,[56] in which the core of an extremely massive, low-metallicity, rapidly-rotating star collapses into a black hole in the final stages of its evolution. Matter near the star's core rains down challenging. The association of some long GRBs with supernovae and the fact that their host galaxies are rapidly star-forming offer very strong evidence that long gamma-ray bursts are associated with massive stars. The most widely-accepted mechanism for the origin of long-duration GRBs is the collapsar model,[56] in which the core of an extremely massive, low-metallicity, rapidly-rotating star collapses into a black hole in the final stages of its evolution."[602]*Progenitor. "*The means by which gamma-ray bursts convert energy into radiation remains poorly understood, and as of 2007 there is still no generally accepted model for how this process occurs"[603] *Introduction.* According to above statements, and based on the *HPPH*, the burst occurs in galaxies that are more distant than our Milky way galaxy from viewpoint of timeline, i.e. they lies in the future respect to solar system due to full consumption of their dark matter conversion to dark energy, *Sec. 5(15)2a*, in a spatial patch. In other words, these galaxies are more approached to Big Crunch, *Sec. 5(15)3c*, that our Milky Way galaxy. The collapsing model of massive stars to black hole can be simulated to spontaneous big crunch (local crunch, *item 1*) period due to the full consumption of dark matter that is followed with big bang era in the Universe evolution. Therefore, the contraction of the local spatial patch, *Sec. 5(16)3b, part H*, formerly of SN_r configuration of the full system (i.e. mass medium plus its spatial patch) converts the black hole of SP_l configuration to a system of SM configuration in order to promote a local big bang. As the results:

1) There is no definite path to Big Crunch from our present time. In other words, the local Crunches occur as we approach to the main Big Crunch.

2) The number of local Crunches increases as we approach to the main Big Crunch.

3) Based on item *2*, there is an era related to co-existence of multi local Crunch and local Bang of spatial patches.

4) The denser region of local Crunch and local Bang can be related to main Big Crunch and main Big Bang in this era.

5) *A)* From viewpoint of *HPPH*, at the big bang the Universe is composed of H particle-paths of SM configuration of zero total energy, *Sec. 5(15)3e, part c*, and low entropy. During the time, the H particle-paths of spatial medium, *Sec. 7(4)3, part A*, expands of SN_r configuration of increased entropy; while, the mass medium, *Sec. 7(4)3, part D,* contracts of SP_l configuration of increased negentropy, *Sec. 5(16)9d.*

B) Noteworthy, the algebraic sum of entropy & negentropy remained unchanged, *Sec. 5(16)11,* up to maximum entropy. At the Big Crunch, the spatial medium is contracted of SP_l configuration; while, the mass medium is expands of SN_r configuration.

According to above discussion:

A) H particle-paths of *SM* configuration (At the big Bang related to dark matter) $\xrightarrow{CONVERTS.TO}$ H particle-paths of spatial medium that are expanding of SN_r configuration (due to dark matter conversion to dark energy) + mass medium contraction of SP_l configuration.

B) H particle-paths of spatial medium that are contracting of SP_l configuration (dark energy decrement)+ H particle-paths of mass medium that are expanding of SN_r configuration $\xrightarrow{UP.TO}$ Big Crunch

C) The algebraic sum of entropy & negentropy in *items 1 & 2* remains constant.

D) The electric charges H particle-paths are reversed handed during transfer from item *A* to *B* stages. In other words, the particle charges are reversed to their opposite sign, *Sec. 4(5), item XIII.*

Note 5(15)3b1– At this stage of full expansion, the Universe will be collapsed left-handedly at SP_l configuration and superluminal speed in a deflationary mode along with entropy decrement down to Big Crunch, *Sec. 5(15)3c*, i.e. lowest entropy, without invoking to gravitational type collapse related to existing masses of normal and dark matters. Thus, it ended to a minimal inhomogenity in early Big Bang of a cycling Universe, please refer to *Remark 5(16)9d, A1.* "Viewing the expansion from the Big Bang in reverse, that (what will then appear as) the gravitational collapse to the Big Bang must produce inhomogeneity at the time of the transition to the inflationary phase (which will now appear as a deflationary phase, of course)" *Comment 5(15)3b3*. "A universe that collapses without deflation just is a Universe that expands without inflation" [450] *the appeal to inflation*. As a result, the H hall packages, *Sec. 5(16)3a*, of vacuum quantized space patches, *Sec. 5(16)3b, part H*, along with related time's arrow that appears during expansion in the right-handed manner, (i.e. entropy increment) is contracted along with time's arrow reversal in the left-handed mode, i.e. entropy decrement down to Big Crunch.

Note 5(15)3b2 – During the contraction phenomenon of the Universe, its particles, mass-bodies ingredients, along with their related spatial patches, *Sec. 5(16)3b, part H,* are contracted accordingly. Each set of mass-body and its spatial patch is *nominated matter ingredient H system*. Noteworthy, the matter H system is converted to related antimatter conjugates during such a contraction. Moreover, quantized textures of spatial patches related to normal vacuum, *Sec. 5(16)3b*, is replaced by a nullity nominated abstract vacuum, *Sec. 5(16)3h*, during contraction era. "There was no time or space before the big bang"[583] *Where did the universe come from? Note 5(1)1a.* In all of the process of expansion (or dilation), and contraction related to antimatter conjugate H system, Moreover, the correlation between its ingredients through their spatial patches is preserved, please refer also to *Note 5(16)9d, part B*, and *Sec. 8(9).*

Note 5(15)3b3- "on the day (period) when we will roll up heaven like the rolling up of the scroll for writings, as we originated the first creation, [so] we will reproduce it's a promise [binding on us], surely we will bring it about [110]A *The Prophets Surah 21, verse 104*. According to above reference in noble Quran, the Universe is simulated to a rolled paper, if it open (or expand) e.g. right-handedly, *Sec. 5(16)9a*, it will be rolled again (or contracted) left-handedly or vice versa. In other words, the Universe is evolving in cyclic manner. "If the density of the universe exactly equals the critical density, then the geometry of the universe is "flat" with zero curvature like a sheet of paper. If so, the universe has no bounds and will expand forever, but the rate of expansion will gradually approach zero after an infinite amount of time. Recent measurements suggest that the universe is flat with only a 2 percent margin of error" [612] *shape*. Factually, according to *HPPH* the expansion of the universe will be stopped at the moment of dark matter full consumption, *Sec. 5(15)2a*. Noteworthy, the information of any S-patch is preserved on its related patch on the surface area of its black hole event area.

Remark 5(15)3b1- Sophistically this era may be related to the Armageddon from viewpoint of religions that are indicated in the related books, *Comment 5(15)3b2*. This is constructed of tree stages each related to a horn day of resurrection of pre big bang era. According to *Sec. 5(5)2, Fig. 5(4)1,* there are *3* acoustic peaks. In other words, the time is reversed back due to big crunch era in order to re-obtain spontaneously the information of the past times or histories of human being from related black hole, *Sec. 5(15)3d, part D*. Thus, these acoustic stages may be related to pre big bang (big crunch era) as imprinted existence of radiations, *Sec. 5(15)3d*.

Comment 5(15)3b1- "As was only recently seen, by works of' Hoof't, Susskind, a positive cosmological constant has surprising consequences, such as finite entropy of the observable Universe. More recent work has suggested the problem may be indirect evidence of a cyclic universe predicted by string theory. With every cycle of the Universe (Big Bang the eventually a Big Crunch) taking about a trillion (10^{12}) years. The amount of matter and radiation in the Universe is reset, but the cosmological constant is not"[487] *cosmological constant problem*. Please refer also to *Note 7(4)2, B1*, and *Sec. 5(15)3c*.

Comment 5(15)3b2- "The day (or era) on which the trumpet shall be blown so you shall come forth in hosts" [110]A, *Surah 78, verse 18*. "And when the trumpet is blown with a single blast." And the mountains shall be as loosened wool" [110]A, *Surah 101, verse 5*. "When the Earth shall be shaken with a (severe shaking)". " And the mountains shall be made to crumble with (an awful) crumbling". "so that they shall be as scattered dust" [110]A, *Surah 56, verses 4-6*. "On the day when the Earth and the mountains shall quake and the mountains shall become [as] heaps of sand let loose [110]A, *Surah 73, verse 14*. "And the mountain shall be moved off so that they shall remain a mere semblance" [110]A, *Surah 78, verse20* "And on the day when the trumpet shall be blown". "And you see the mountains you think them to be solid, and they shall pass away as the passing away of the cloud" [110]*A*, *Surah 27, verses 87, 88* . These can be related to antigravity character of big crunch era. "And the Earth and the mountains are borne away and crushed with a single crushing". "On that day [are] shall the great event come to pass". "And the heaven shall cleave asunder so that on that day it shall be frail"[110]A, *Surah 69*, *verses 13-16."*And the day when the heaven shall be as molten copper". And the mountains shall be as tufts of wool" [110]A, *Surah 70, verses 8, 9*. "When the sky is rent asunder and it becomes like reddish oil color"[110]B, *Surah 55, verse 37*. This may be related to contraction of H particle-paths of spatial medium. Moreover, "When the heaven bursts asunder" [110]*A, Surah 84, verse 1*."And when the stars become dispersed"[110]*A*, *Surah 82, verse 2."*When the Earth is stretched"[110]*A*, *Surah 84, verse 3*. "On the day of resurrection, the whole Earth will be in the hand of his power and the heavens will be rolled up (Please refer to *Note 5(15)3b2, Surah 21, verse 104*) in his hand of his power [110]B, *Surah 9, verse 67*. "On the day (period) when the trumpet shall be blown, and we will gather the guilty, blue-eyed, on that day". "And they ask you about the mountains say: my lord will carry them away from the roots". "Then leave it a plain, smooth level". "You shall not seen there in any crookedness or unevenness".[110]A, *Surah 20, verses 102, 105, 106, 107*. According to *HPPH*, during big crunch era, *Sec. 5(15)3c,* the mass medium is expanded (stretching); while, the spatial medium is contracted contrary to post big bang era. In other words, the spatial medium, *Sec. 7(4)3, part A,* is contracted of SP_l configuration; while, mass medium, *Sec. 7(4)3, part D*, is expanded of SN_r configuration of path-length of equal magnitude and opposite sign, *Sec. 5(16)11*.

Comment 5(15)3b3- According to Ketab-e- Sharrif "Then he directed Himself to heaven at it is vapor (smoke, gas)" [110]A, *Surah 41, verse 11*.

5(15)3c – The Big Crunch

The second member of the last right side of *Eq. 5(45)4* is related to the growth of black hole during contracton absorption, *Sec. 5(7)8*. Therefore, ultimately the matter Universe is contracting to merely black holes and related spatial patches, *Sec. 5(16)3b, part H*, before the reverse process. At this stage, the entropy and negentropy have their highest values, *Sec. 5(16)11*. Thus, any spatial patch is free of galaxies and dark matter. At this stage, the spatial expansion is ceased, and reversed process begins as following manner and configurations:

I) The single direction parts of H particle-paths in mass medium of black hole are reversed back, and tend to reversible ones respect to *CMPRF* of the Universe. In other words, the *Eq. 5(45)3* is shifted to left side related to contraction. As a result, the black holes are converging during contraction process to the origin of *CMPRF* of the Universe. This process is along with entropy and negentropy decrements through spatial medium, and mass medium *Sec. 7(4)3, parts A, D,* respectively. This process is due to the cease of expansion related to full consumption of dark matter, dominance of gravitational attraction of black holes.

II) The spatial medium is begun to contracts towards the central black hole. Thus, it is absorbed at SP_l configuration along with entropy decrement. Noteworthy, based on Mirror Image Effect, *Sec. 6(2)3*, the black hole of SP_l configuration is shifted to SM configuration, i.e. midway of SN_r configuration, accompanied by its negentropy decrement in such a manner that the algebraic sum of entropy and negentropy is remained unchanged. As a result, the vacuum quantized texture, *Sec. 5(16)3b*, *part A* is replaced by abstract vacuum, *Sec. 5(16)3h*, and the former is rolled down towards the black hole. Therefore, the spatial medium is contracting along with type L_c path-length, and black hole is expanding along with type R_e path-length in the mass medium at equal magnitude and opposite sign at a ratio of K_Γ, *Sec. 5(16)1a, Eq. 5(5)2*, of its total mass content.

III) The right-handed H particle-paths (negapa) are rotating along their central axis (or axeon, *Sec. 10(8)*) to left-handed H particle-paths. Similarly, the left-handed H particle-paths to right-handed ones, i.e. a reversed geometrical configuration respect to the expansion, *Note 5(15)3c1*. In other words, it leading to spatial and time reversal related to handedness reversal, *Sec. 5(15)3b*.

IV) Any particle including its *S*-partner occupying an H hall package of n_s overlapped ones as a final stage or entity, *Sec. 5(15)3e*, at the end of Big Crunch. Moreover, each H hall package can be regarded as an imprinted existence of a contracted particle along with its *S*-partner, *Sec. 5(15)3d, part A*, and its *S*-patch, *Schema E5a.*

V) Sophistically, the contraction of the entire Universe is extended down to full contraction of all of the H hall package units on each other in spatial *S*-patches, *Sec. 8(7)2, part E5, Schema E5*. In other words, the H Hall package units

of the Universe are overlapping up to a single H hall package in the related patch that are converted to type *R & L* configuration successively as in *Sec. 5(16)1b, part A*.

Factually according to *Consequence 2(10)1c, Eq. 2(116)1*, in Big Crunch case, K_m of each of spatial patch is shifted to 1, and ΔT_0 will be at the order $10^{-43}\,s$ in Planck epoch at the of Big Crunch of the whole Universe. "The Planck epoch is an era in traditional (non-inflationary) big bang cosmology in which the temperature is high enough that the four fundamental forces—electromagnetism, gravitation, weak nuclear interaction, and strong nuclear interaction—are all unified in one fundamental force. Little is understood about physics at this temperature, and different theories propose different scenarios. As the results:

A) Entire universe will be converted to agglomeration of H particle-paths of *SM* configuration in related S-patch H hall package units that successively are converting to type *R* or *L* configuration during any stay time interval ΔT_0.

B) The H particle-paths are converted to equal number of type *R* & *L* configurations.

C) The early Universe can be initiated during a Big Bang from a type *R* or *L* agglomeration of H hall package units or spatial patches, i.e. each agglomeration in its type *R* or *L* state initiates a matter or antimatter Universe respectively during pre-Big Bang (or stay time interval ΔT_0).

D) According to *Sec. 7(5)3d, part B*, and similarly to decay process, the aggregated contractons in its critical level in the agglomerate causes Big Bang era. In fact, there is a flow of contractons between universe in Big Crunch and the multiple parallel universes, *Note 5(15)3d, B4*, due to mutual gravitational attraction that leading to contracton aggregates formation.

Resuming, during the two stages *I & II* in any patch of the spatial medium along with related black hole is contracting to the origin of *CMPRF* of the Universe. The stated above contracting process can be compared to Big Crunch i.e. a pre Big Bang era, *Sec. 7(5)3d, part B, item III*, in cyclic universe. Ultimately, there will be an entity that its constituting of H particle-paths of SM configuration in abstract vacuum. At this stage, both entropy, and negentropy are in their minimum possible magnitude at equal magnitude and opposite signs. While, their algebraic sum is remained unchanged all over the expanding and contracting processes. This constancy of algebraic sum of entropy and negentropy solve the problem such as:

"Lemaître and Tolman proposed that a universe undergoing a number of cycles of contraction and expansion could come into thermal equilibrium. Their models failed, however, because of the buildup of entropy over several cycles"[579] *Horizon problem*. Thus, *HPPH* solves the problem of low entropy at the Big Bang era contrary to inflation theory. "Donald Page was an outspoken critic of inflation because of this anomaly.[75] He stressed that the thermodynamic arrow of time necessitates low entropy initial conditions, which would be highly unlikely. According to them, rather than solving this problem, the inflation theory further aggravates it – the reheating at the end of the inflation era increases entropy"[579] *Initial conditions.*Noteworthy, all of the information of the particle, e.g. charge, mass, spin, spatial patch, reversed back at a handedness reversal towards the contracting entity i.e. reserved, *Sec. 5(15)3d, part A*. They appear during the Big Bang in case of cyclic Universe with the same features as in its previous cycle. In other words, all of the atoms, particles spatial patches have permanent signature during evolution of the cyclic Universe; please refer also to *Sec. 5(7)3*, and *Sec. 5(16)7g*.

Note 5(15)3c1- According to *Sec. 8(1)2*, the wave function ψ is complex conjugate of ψ^* (or vice versa). It is equivalent to negapa, posipa as in item *III* of *Sec. 5(15)3c*. Factually, ψ is equivalent to countercurrent negapas and posipa with the preference of former one of expanding characteristic as in retarded wave; while, ψ^* is equivalent to countercurrent negapa and posipa with the preference of the latter one of contracting characteristic as in advanced wave, *Sec. 5(16)3f, part B*.

5(15)3d- Imprinted existence of entities during Universe evolution

A) General aspect

According to *Sec. 5(16)3b, part H,* at macrocosm the space is constituted of sub-spaces, i.e. spatial patches. The spatial patches are intrinsic non-separable characteristics of related group of mass-bodies, *Comment 5(15)3d, A1*. At microcosm, the similar scenario is also valid for particles, i.e. spatial patches of particle *S*-partner, *Comment 6(2)6a1*. Thus, positron and electron have their micro spatial patches individually. During their annihilation, these micro spatial patches are attached as non-separable characteristics to each of the produced correlated photon pair. During the Big Crunch, *Sec. 5(15)3c*, these micro spatial patches are also contracted down to Big Bang. Therefore, inflated or expanded during post Big Bang at a reversed handedness respect to Big Crunch up to related particle generation or nucleosynthesis, *Sec. 7(4)2f, part E3*; please refer also to *Remark 5(15)2c*. As a result, the particles imprint the trace of their existence all over the cyclic universe period of evolution up to reach to antropic fine-tuning of present cycle. Therefore, the imprinted of existence are evolved during each cycle from human viewpoint somehow analogous to the Charles Darwin evolution of species in biology during each generation (Darwinian evolutionary theory). Thus, the appearances of particles are not stochastic or random. In other words, the Universe preserves its information during each cycle of its evolution, *Remark 5(15)3d, A1*, *A2*, towards a completeness (or aim); please refer also to *Secs. 5(7)5* to *Sec. 5(7)5*, *Note 5(15)3d, A1*, and *Sec. 5(15)3d, part B*. The *HPPH* do not subscribes to the controversial conscious observations create reality interpretation of quantum mechanics; please refer to reference [561] the section entitled "How a super-advanced civilization (*SAFC*) create the Universe? "Lewis was adopting what physicists call the 'block universe' picture of spacetime, in which the entire space-time already exists as a complete entity. He conceived of the whole of space and time as viewed externally by God, and so all prayers were known by God before they were made [558] *Comments (Francine)*, *Remark 5(15)3d, A1*. Factually, according to *Sec. 5(16)7g1*, and above discussion, the human accessibility to the information of future history is more logical that it's traveling in time. Please refer also to *Note 5(16)7g1, Note 5(15)3b3*.

Note 5(15)3d, A1- "Digital physics suggests that there exists, at least in principle, a program for a universal computer which computes the evolution of the universe in real time"[572] *Digital physics, Overview.* "A computational universe is also proposed by Jürgen Schmidhuber in a paper based on Konrad Zuse's assumption (1967) that the history of the universe is computable"[572] *Pancomputationalism or the Computational universe theory."*Our universe has not run down after an inconceivable number of microscopic interactions over 14+ billion years, so if it is made of information it must conserve it. If matter, energy, charge, momentum and spin are all information, all the conservation laws could reduce to one. Einstein's transformation of matter into energy (e=mc2) would then be simply information going from one form to another"[583] *A prima facie case*.

Comment 5(15)3d, A1- According to path-constancy, *Sec. 2(1)2*, the contraction and expansion of spatial patches, *Sec. 5(16)3b, part H*, along its mass content leading to homogeneity and isotropy of the Universe in large scale. "By the detailed observations of the cosmic microwave background made by the Wilkinson Microwave Anisotropy Probe (*WMAP*) spacecraft.[44] This analysis shows that the universe is flat to an accuracy of at least a few percent, and that it is homogeneous and isotropic to a part in 10,000"[579] *Observational status*.

Comment 5(15)3d, A2- In Schrödinger cat paradox, *Sec. 8(7)2, part A*, the decay of the radio active source that leading to poison bottle smash is also related to imprinted existence during universe evolution. In fact, there is a trend for events or fate in the universe evolution. Noteworthy, the imprinted existence defines the state appearances through mutual contracton exchange in a system.

Remark 5(15)3d, A1- The complex particles or molecules similarly to case of free particles preserve their information during a cycle of the Universe evolution. Thus, this information are released again during body formation and the birth, e.g. of human being, up to its death during present cycle of the Universe, and will be repeated in the next evolution of the Universe again. In other words, how a body is formed by cellular multiplication and the human behavior in its life or its fate can be directed by such information releasing. Resuming, the human life including its personal behavior can be repeated during each cycle of the Universe evolution. Noteworthy, the registration of the life of human being at the date of birth and death (before death) can be viewed in the Ketab-e-sharif, "And no woman gets pregnant nor she delivers her baby but is known to God. Nor is a man long-lived nor is a part of his life cut off but all is recorded in the preserved book; and all this is easy to God" [110]B *Surah 35 (Al-Fater), verse 11*. "No disaster befalls on the Earth and on you as a notion but has been inscribed before (its occurrence) is the Preserved book, and we bring it into existence and that is easy for God" [110]B *Surah 57, verse 22*. "And there is nothing concealed in the heaven and the Earth but it is in a clear (preserved) book" [110]A, *Surah 27, verse 75*. "And for every nation there is a doom, so when their doom is come they shall not remain behind the least while nor shall they go before" [110] A, *Surah 7, verse 34*. To every people is an appointed term, when come their term, then they shall neither retard nor go before it even an hour" [110] B, *Surah 10, verse 49*. "No people can hasten on their doom, nor can they postpone (it)." [110]A, *Surah 23, verse 43*. "Do you not know that God knows what is in the heaven and the Earth? Surely this is in a book (preserved book), surely this is easy to God" [110] A, *Surah 22, verse 70*. "But God does not grant respite to a person, whose appointed term has arrived, and God is knower of all that you people do."[110]B, *Surah 63, verse 11*. "There does not lie concealed from your Lord the weigh of a particle (atom) in the Earth or in the heaven, nor anything less than that nor greater, but it is in a clear book (preserved book)" [110] A *Surah 10, verse 61*. The preserved (or clear) book can be regarded as a predetermined program by similarity to that of a computer [569]. It can be related to imprinted existence of entities during Universe evolution, *Sec. 5(15)3d, part A*, from viewpoint of *HPPH, Comment 5(15)3d, A2*. Please refer also to *Simulation 8(7)2, E5a*, *Comment 5(7)3a.* The periodicity of particles during a cyclic Universe based on imprinted existence can be extended also according to above discussion to a human being.

Remark 5(15)3d, A2- The Universe evolution information of any spatial patch, *Sec. 5(16)3b, part H*, is preserved in the form reverson microscopic tracks within mass medium of related black hole, *Note 5(16)2c, B1*. Based on *Sec. 8(7)2, parts E4, E5*, comparing the physical world of the Universe with the computer [569], any spatial patch can be regarded as a file. Moreover, its black hole [or black holes] can be considered as computer hard disk that saves the history of past events, *Note 2(1)4a, Fig. 2(4),* of H systems in related spatial patch during the Universe evolution. Noteworthy, the microscopic reverson tracks within mass medium of mass-bodies that leading ultimately at irreversible manner to related black hole is constituted of successive type *R & L* configurations analogous to *0 & 1* bits of computer. Noteworthy, the reverson tracks formation preservation is performed via contractons mutual transfer between mass-bodies in spatial patch and related black hole through H hall package tunnels, *Sec. 5(9)3d, part c*. The reversons tracks of the H hall packages of any H system in spatial medium are dissipated during expansion phenomenon in this medium; while, the reverson tracks in normal mass medium as contracted form of the field, *Note 2(1)3b*, are agglomerated in the mass-body center of mass. In case of black hole, we encountered with a diverse scenario. The reverson tracks are fortified by contracting phenomena in a black hole contrary to reverson tracks (H hall package tunnels) in spatial medium due to expansion phenomenon in the latter medium. Sophistically, the reverson tracks of previous evolution of the Universe in one of its black hole, the latter manages the motion and the fate of H systems in the related spatial patch. In other words, by receiving a contracton of type *R* (or *L*) via H hall package tunnel, *Sec. 5(9)3d, part c*, from an H system, the black hole emits a reversed handed contracton, i.e. type *L* (or *R*) towards the related H system by the same H hall package tunnel and so on up to the next Universe evolution. In fact, the H systems in a spatial patch are linked to the black hole by a bunch of H hall package tunnels; please refer to *Simulation 8(7)2, E5a*.

B) - Proposed mechanisms in cyclic universe

"The weak anthropic principle could then be applied to conclude that we would only consciously exist in those universes which were finely-tuned for our conscious existence"[567] *Anthropic principle, Comment 5(15)3d, Ba,* and *Sec. 5(15)3e, part D.* The fine-tuning as in our Universe may be broken gradually in the cycles of the universe evolution. Factually, if we consider the

universe similar to a human brain, *Example 5(7)8a*, it can be remembered the past exactly at spontaneous fashion, *Sec. 7(4)2f, part c*, and future at a random manner, *Sec. 5(16)7g.* Therefore, our universe has multiple past universe evolution cycles of information (or files of types *R&L*) and multiple files of types *R&L* in future cycles at probable manner. In fact, during each cycle of universe evolution, the information of the previous cycle is conserved and is added as a sub-file to its file of information. Each of the physical fundamental constant in present cycle is shifted at a order of K_Γ factor respect to previous one due to slight preference of type *R* configuration respect to the type *L* one in spatial medium which conserve also as sub-file information energy (i.e. *BIT* energy) participation, *Sec. 8(7)2, part E5*, at the same K_Γ factor. According to *Proposal 8(7)2, E1a*, the new information (or sub-file) acts as a branch (or state) besides the other branches related to the past cycles. In other words, it is added as new state to the states of e.g. a particle, in the new cycle. As a result, the particle reviews (or remembers) all of its possible states during an interaction spontaneously, *Sec. 7(4)2f, part c,* via its common H hall package from the black hole, *Note 5(16)7, g2*. By a far analogy to many-worlds interpretation, one can configure multiverse. "The structure of the multiverse, the nature of each universe within it and the relationship between the various constituent universes, depend on the specific multiverse hypothesis considered"[567] *Introduction*. "One aspect of quantum mechanics is that certain observations cannot be predicted absolutely. Instead, there is a range of possible observations each with a different probability. According to the *MWI* (Everett's many-worlds interpretation), each of these possible observations corresponds to a different universe (or better to say world, *Proposal 2*); please refer also to *Sec. 5(15)3e, part D.* Suppose a die is thrown that contains 6 sides and that the result corresponds to a quantum mechanics observable. All *6* possible ways the die can fall correspond to 6 different universes. (More correctly, in *MWI* there is only a single universe but after the split into many worlds these cannot in general interact.)[6]", "They have physical constants that are different from our universe. Our Universe is just one of the 6 bubble universes" [567] *Level III*.

Proposal 1, based on Universe past histories- According to *HPPH*, as in our present Universe, any system can profits of all possible information that are left from the universe past events (or histories), *Sec. 5(15)3d*. "In the same way that the many-worlds interpretation regards possible futures as having a real existence of their own, the theory of multiple histories reverses this in time to regard the many possible past histories of a given event as having real existence"[578]. "A layman believes that our present world has a unique past and future. According to the *MWI*, a world defined at some moment of time corresponds to a unique world at a time in the past, but to a multitude of worlds at a time in the future"[329] *Part 2.1.*
According to *Note 2(1)4a,* any event is depending to its previous one. Based on *HPPH*, the same scenario is also valid in histories of the cyclic universes, i.e. any information of a universe is depending on its previous one. Noteworthy, the previous (or next cycle) of our type R_e Universe is its reversed handed, i.e. type L_e. In other words, the cyclic universe is successively reversed handed during each cycle of its evolution. Thus, the states of a particle or mass-body are type *R* or *L* successively. Please refer also to *Sec. 8(7)2, part E5*, in this regards. According to above discussion, the state of our universe is changed successively during stay time intervals ΔT, *Sec. 8(7)2, part E2*, at two types R_e and L_e alternatively. Therefore in the die example due to huge inertia, *Sec. 2(1)4,* of the Earth (or universe), any of the six states is related to a state (or parallel universe) during infinitesimal time interval ΔT that can be regarded as a single overlapped states at an appropriate time interval, *Example 8(7)2, E4a*. Moreover according to *part E2,* the stay time intervals ΔT, is depending on decoherence time in each case. If we suppose that universe is passed m complete cycles, during each cycle a parallel copy of two types *R&L* is added to the total one. In other words, the previous cycle of our Universe is composed of $m-1$ copies, and its next cycle of $m+1$ copies respect to the present Universe that is composed of m superimposed types *R&L* copies, and *Sec. 7(2)2*. As results:
1) In a particle , e.g. photon, electron, etc. composing initially of N H particle-paths of type *R&L*, i.e. negapas & posipas, we encounter ultimately with m copies of type *R&L* spins particle each composed of $N.m^{-1}$ H particle-paths. According to above discussion, m is proportional to K_Γ^{-1} factor. Please refer to *Sec. 7(2)1,* and *Sec. 3(1)1* in case of capability of type *R&L* H particle-paths to be rearranged in path-limit Γ of a medium, *Sec. 7(4)3*.
2) According to *Note 3(1)1c, item III, Eq. 3(17)1*, the spin of the particle in any of its copy is equal in magnitude and independent of its H particle-paths number, i.e. $+\hbar$ or $-\hbar$ depending on the type *R* or *L* of the copy.
3) According to *Sec. 7(4)2f, part A*, each copy has its own stay time interval ΔT depending on its total number of its H particle-paths. During stay time ΔT_c, the copy exits its expandon, and released its contracton before transfer to a state of reversed handedness.
4) The summation of *WR* or *WL* expandons and *PL* or *PR* contractons define the total expandon and contracton of the particle during averaged stay time interval, i.e. ΔT_P. Please refer also to *Simulation 7(4)2e1*.
5) According to *Secs. 8(7)2, parts E3, F2*, any copy is appeared in an expanding mode during stay time interval ΔT_e, *Sec. 8(7)2, parts E2;* while, the other copies are contracted to nil. Moreover, a copy of type *R* configuration after stay time interval is converted to its successive reversed handed copy, i.e. type *L* (or vice versa). The expanded type copy is along with time's arrow; while the remained contracted types are accompanied with time arrow reversal $-\Delta T_c$, *Note 5(15)3d, B1*. Thus, all of the copies can be regarded as occurring together at once, i.e. a superimposition of all copies. Because of the total number of H particle-paths is remained unchanged in the particle copies, the stay time interval of the copies ΔT_c are equal and the same as the averaged one ΔT_P; please refer also to *Comment 7(4)2e2* and *Sec. 7(2)2*.
6) Besides the copies that their expanded part are constituted of *N/m* H particle-paths, there are also copies that are constituting of $N.l.m^{-1}$; where l is an integer. Moreover, $l < m$. Therefore, a particle has multitude copies each in e.g. a parallel universe.

7) Referring to *item 6*, any copy of $N.l.m^{-1}$ expanded type *R&L* H particle-paths can be considered as a bit composed of $N.l.m^{-1}$ binary characters of $0,1$ notations by simulation to a computer; please refer also to *Sec. 8(7)2, parts E4, E5*.
8) To each copy is related it's imprinted (or information).
9) According to imprinted existence, the histories of past events in each cycle of our Universe, i.e. a single Universe, are applicable in this case. Therefore, it differs from the existence of simultaneous parallel worlds as in *MWI*.
According to above discussion a particle can be split to all of its copies due to integer characteristic of its H particle-paths number in a causal way. "Parfit considers some artificial situations in which a person splits into several copies, and argues that there is no good answer to the question: Which copy is me? He concludes that personal identity is not what matters when I divide"[329] *Part 2.2.* "Microscopic particles might be in a superposition, while objects within a world (as defined in the *MWI*) cannot be in a superposition"[329] *Part 2.1.*

Proposal 2, based on timeline of the Univese- "When cosmologists say that the open universe model is ruled out at 99.9% confidence, they really mean that if the open universe model were true, then fewer than one out of every thousand Hubble volumes would show *CMB* spots as large as those we observe. The lesson to learn from this example is that multiverse theories *can* be tested and falsified, but only if they predict what the ensemble of parallel universes is and specify a probability distribution over it"[580] *How a multiverse theory can be tested and falsified, Note 5(15)3d, B2.* According to above discussion, the spatial patch of galaxies, *Sec. 5(16)3b, part H*, including related mass-bodies can be substituted with the word of multiverse, *Note 5(15)3d, B2*. Therefore, the individual spatial patches have also imprints in *CMB* spots according to *HPPH*. If this assumption becomes true, somehow all of the *S*-patches, *Sec. 8(7)2, party E5*, *Schema E5*, are correlating to (or affecting) each others, e.g. via reversons, *Sec.7(5)3,* and H hall package tunnels, *Sec. 5(9)3b*, as many worlds. Therefore, a particle, e.g. electron, has an expanded state (or copy) in each of the worlds (or *S*-patch) all over our Universe during any stay time interval, ΔT_P, (*Proposal 3*), according to the following assumptions:

1) According to *Sec. 5(2)1d, part D*, and *Sec. 5(16)1b, Fig. 5(8),* any tangential transfer of a cell (or an expandon) in a cone-like cavity, *Sec. 5(2)1d, part D,* to its adjacent one is along with its handedness reversal.
2) Supposing a timeline of the Universe, *Fig. 5(7)1*, from Big Bang up to the present, there is a trumpet-like (or cone-like by analogy to *item 1*) evolution of the Universe. Factually, any particle *S*-patch of the Universe during its time of evolution has a cone-like cavity shape nominating *T*-cavity from Big Bang up to now. Therefore, similarly to *paragraph 1*, any tangential transfer of a particle from a *T*-cavity in the direction of time of evolution of the Universe during stay time interval ΔT_P, *Proposal 1,* to its adjacent *T*-cavity is accompanied with particle handedness reversal and so on.
3) In our matter Universe, any transfer of a particle from a *S*-patch to its adjacent one as in *item2* is at a slight preference of right-handed manner; please refer also to *Sec. 5(16)5*, and *Sec. 5(16)9a.*
4) The number of the copies (or expanded states) of a particle is equal to the total number of its transferred *S*-patches in the Universe from big bang up to now.
5) Merely a copy can be existed at expanded form during any stay time interval ΔT_P in a world; while, the other copies are in a contracting form; please refer to *Proposal 1*, *Example 5(15)3d, B1,* and *Remark 5(15)3d, B1*.

Resuming, according to above discussion, any copy of a particle in a micro *T*-cavity in our matter universe is transferred at a right-handed manner preference to its adjacent one during stay time interval ΔT_P at two types *R&L* successively, i.e. each of equal path-length magnitude and opposite signs. It is along with expandon of path-length value $+2\hbar$ emission in spatial medium (i.e. spatial expansion and time's arrow) and contracton of path-length value $-2\hbar$ releasing within related mass medium by the particle during its transfer from an expanded state to other one, *Note 8(7)2, E2a*. Therefore, *T*-cavity of a particle is time evolution of its *S*-patch. Moreover, this kind of proposal is in accordance with *Tegmark Level 3*[580].

Example 5(15)3d, B1- Supposing a particle, e.g. electron, photon, constituted of N H particle-paths in non gravitating vacuum, i.e. gravity free spatial medium, *Sec. 7(4)3, part A*, the total number of H particle-paths of its expanded copy is $K_\Gamma.N$ related to WR or WL expandon, *Simulation 7(4)2e1*. In a more denser medium as in vacuum gravitating medium, *Sec. 7(4)3, part B*, depending on H particle-paths densities of the medium, K_Γ is increased to $K_{\Gamma(g)}$, *Sec. 7(4)2f, Part A*. Thus, $K_{\Gamma(g)}.N$ is related to H particle-paths number of WR or WL expandon emitted by particle in gravitating medium in an expanding configuration during a stay time interval $\Delta T_{P(g)}$.

Note 5(15)3d, B1- According to *Sec. 8(7)2, part E2,* during a measurement merely one copy (or state) is per a measurement. In other words, during any stay time interval ΔT_P, *Sec. 5(15)3d, part B, item 5*, there exists only a copy from all of the copies. "In all of these approaches, the postulate is justified by appeal to an analogy with treatments of time, e.g., the measure of existence of a world is analogous to the duration of a time interval"[329] *Part 4, Probability Postulate.* "From the weak probability postulate (the probability is a function of the measure of existence) follows that in case all the worlds in which a particular experiment takes place have equal measures of existence, the probability of an outcome *is* proportional to the number of worlds with this outcome"[329] *Part 6.3.* Therefore, a stay time interval ΔT_P at each instant can be regarded as a measure of existence. "This procedure reconstructs the standard quantum probability rule from the counting worlds approach; see Deutsch 1999 for details"[329] *Part 6.3*. According to above discussions, and *Sec. 5(15)3d, B, item 5*, we must consider two types of flow of time:
1) The forward time flow due to the summation of stay time intervals of existence of expanding copies during related stay time intervals, i.e. time arrow.

2) The backward time flow due to the summation of stay time intervals of existence of remaining contracting copies during related stay time intervals, i.e. time's arrow reversal.
There is a slight preference of time arrow, *Case 1,* respect to time' arrow reversal, *Case 2,* in spatial medium, *Sec. 7(4)3, part A*, of our matter universe that according to *Sec. 5(16)9*, it leading to counter-current bi-Universe hypothesis at expanding mode. According to *Sec. 8(7)2, part D,* there is no wave function collapse; but, contractons of wave function transfer from spatial medium to the mass medium, *Sec. 7(4)3, part D*.

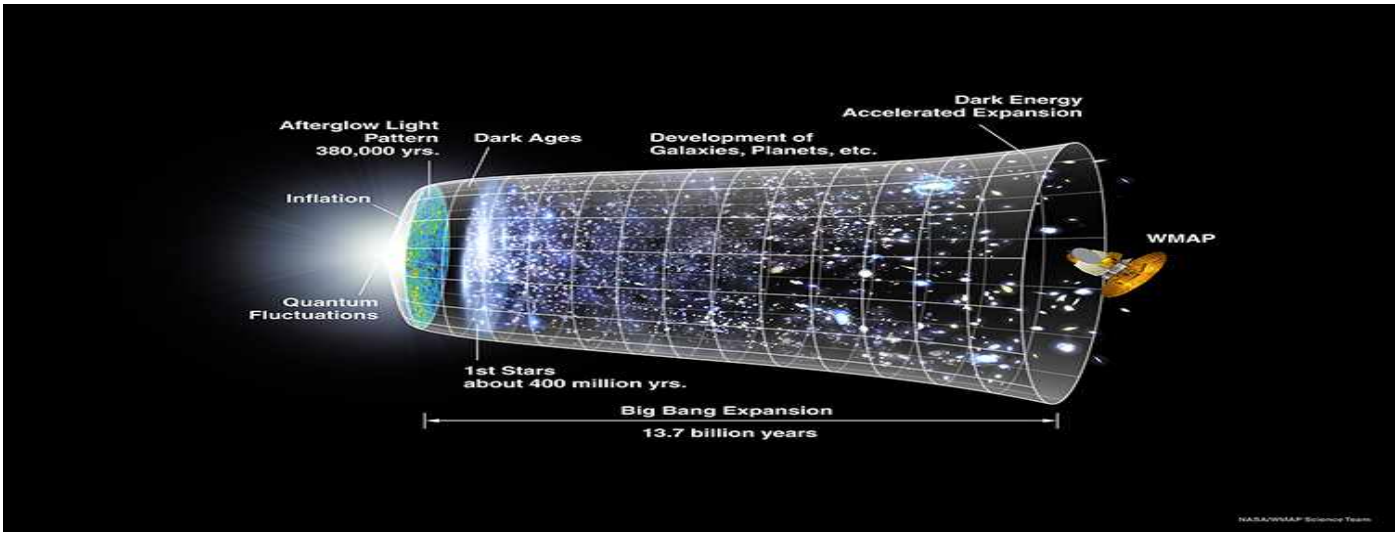


Fig. 5(7)1- Timeline of the Universe [582]

Note 5(15)3d, B2- According to discussion held in *Proposal 2*, the word of universe in multiverse, or better to say world, must be substitutes with the words of *S*-patches. Therefore, the assumptions such as "How many universes are in the multiverses? [581] has no sense.

Comment 5(15)3d, Ba- According to Ketab-e-sharif: "And everything with him has its due proportion and measure."[110]B, *Surah 13 verse 8*. "Who created everything, then ordained for it a measure."[110]B, *Surah 25, verse 2*.

Remark 5(15)3d, B1- In the spatial patch that we are living at present, the stay time interval $\Delta T_{1(c)}$ within mass medium, *Sec. 7(4)3, part D*, is K_Γ times smaller than the stay time interval $\Delta T_{1(e)}$ of the particle in spatial medium, *Sec. 7(4)3, part A,* of a world, e.g. present world, (*first*). According to path constancy, *Sec. 2(1)2*, and *Remark 2(3)1b*:

$N_{1(c)}.\Delta T_{1(c)} = N_{1(e)}.\Delta T_{1(e)} = Cons.$ or 5(47)

$$\frac{N_{1(e)}}{N_{1(c)}} = \frac{\Delta T_{1(c)}}{\Delta T_{1(e)}} = K_\Gamma = 1.95\times10^{-34} \quad 5(48)$$

Similarly, According to *Comment 7(4)2e2*, in each of copies of the particle in n (n=1, 2, 3,.. n) other worlds:

$N_{n(c)} = \sum_1^n N_{n(e)} = n\,N_{1(e)}$, or

$N_{n(e)} = K_\Gamma . N_{n(c)}$, i.e. $n = K_\Gamma^{-1} = 5\times10^{33}$ 5(49)

In other words, in any world $N_{(c)}$ is equal to the sum of $N_{(e)}$ in n other worlds. Thus, there are 5×10^{33} other worlds of a similar behavior of our world. Note that in any world as in our world (*first*), $\Delta T_{1(e)} = n\Delta T_{n(c)}$.

Where:
- n, The total number of the worlds
- $\Delta T_{1(e)}$, $\Delta T_{1(c)}$, are stay time intervals in first World in spatial and mass medium, *Sec. 7(4)3, part D*, respectively
- $\Delta T_{n(e)}$, $\Delta T_{n(c)}$, are stay time intervals in n^{th} World in spatial and mass medium respectively
- K_Γ - The proportionality factor of matter wave frequency υ_τ with that of n_τ frequency equivalent of related particle (or mass-body), please refer to *Sec. 7(4)2f* in this regards
- $N_{1(e)}$, $N_{1(c)}$, the number of H particle-paths in expanded spatial state and in contracted mass medium state of the particle in first world respectively.
- $N_{n(e)}$, $N_{n(c)}$, the number of H particle-paths in expanded spatial state and in contracted mass medium state of the particle in n^{th} world .

As the results:

1) The stay time interval of a particle in expanded state in a world is equal to the sum of stay time intervals of copies of particle in other worlds in contracted state. Noteworthy, the n worlds belong to our single Universe. Please refer also to *Comment 7(4)2e2*

2) Based on *Sec. 5(15)3d, part B, Proposal 3*, each world is related to a spatial patch terminated to a supermassive black hole of the host galaxies. Moreover, the micro *S*-patch of a particle is confined in a cone-like cavity, *Sec. 5(2)1d, part D*, of the black hole. Therefore, the apex of the cone-like cavity is on a cell of n_s cells, *Sec. 5(1)1*, of the black hole horizon (or its Schwarzschild surface). During any beat on this surface, the state of each of the correlated particle is becoming reversed handed of its previous state. Thus, the states of a particles in related cavity also changes (or transferred) to type *R &L* successively, *Comment 5(15)3d, B1*.

3) According to *Simulation 7(4)2e1*, during any configuration (or state) change *WR* or *WL* expandon emits in spatial medium along with *PL* or *PR* contracton releasing within H hall package tunnels up to the related cell on Schwarzschild surface of its super massive black hole of the host galaxy, *Sec. 5(7)8*.

Comment 5(15)3d, B1- Factually, any expanded configuration (or state) of a particle, *Sec. 8(7)2, Part G*, of stay time interval $\Delta T_{d(e)}$ is terminated merely by a single vector of opposite direction respect to that of expanded state during stay time interval $\Delta T_{mass(c)}$ related to the particle at its contracted configuration (or state). While, other N_p particles at their contacted states have also stay time intervals $\Delta T_{mass(c)}$ at the end of their expanded states. In other words, N_p states are interchanging between the N_p particles in the Universe. This phenomenon is due to correlation of all other particles in the Universe based on Mach Principle, *Sec. 5(9)3d*. Moreover, any state changes to its reversed handed state at the end of stay time interval $\Delta T_{d(e)}$; please refer to *item 3* of *Remark 5(15)3d, B1,* and *Sec. 7(4)2h* .

According to *Remark 5(16)1a5,* assuming R_n the total number of correlated gravitation spheres up to the full expansion of the Universe. Now, considering a huge helical surface since the supermassive black hole formation, the total number R_n can be regarded as the total number of successive types *R & L* states changing respect to successive gravitational spheres of types *R&L* (or *WR & WL*). In other words, any cell of n_s cells, *Sec. 5(1)1*, on the surface of Schwarzschild surface supermassive black hole of the host galaxy acts independently from other cells, i.e. a degree of freedom due to compactified H particle-paths, *Sec. 2(1)1d*. Therefore, the configurations (or states) of each of the particles that their micro *S*-patches terminated to an individual cell on the surface of black hole changes successively to types *R* or *L* via related H hall package tunnel. This phenomenon is accomplished during the helical expansion of gravitational spheres of black hole. In other words, besides the types *R & L* of gravitational sphere of black hole, each of the n_s cells on Schwarzschild surface, *Fig. 5(8),* of black hole undergoes an individual type *R* or *L* configuration successively during any beat of black hole gravitational surface emission in a helical manner. Therefore, each of the correlated particles to the black hole undergoes an independent configuration (or state) that differs from the other entire correlated particles during stay time intervals $\Delta T_{d(e)}$. As the results:

I) A particle in spatial medium is confined in related H hall package, *Sec. 5(16)3a*. It is correlated with a cell on Schwarzschild surface of the supermassive black hole via an H hall package tunnel. Therefore, according to *Simulation 8(7)2,E5a, Schema E5a,* this system represents a micro *S*-patch elongated up to the related black hole. Based on this Schema, the more H particle-paths number, e.g. particle main-body, is along with larger spatial part of micro *S*-patch nominating particle H hall package volume V_{HP} .

II) Noteworthy, the correlated particle at the end of the expanded model releases spontaneously, *Sec. 7(4)2f, part c*, a contracton towards the related cell on black hole Schwarzschild surface that is absorbed by this cell at its contracted mode, i.e. PL (or PR), and vice versa, *Simulation 7(4)2e1*.

III) The vector representation of particle states from related independent cell on Schwarzschild surface of the supermassif black hole by a far analogy can be compared with mathematical state vector, *Sec. 8(1)3*, of a particle in the Hilbert space with a common origin , i.e. similarly to case of black hole center of mass as origin. The state vectors are separated by relative angle that can be comparable also with the angle between vectors (or T-cavity) that their tails are on the related n_s cells on Schwarzschild surface of the black hole, and their tips on the particle configurations (or states).

Proposal 3, based on discrete spatial patches of host galaxies (worlds)

According to *Sec. 5(7)8*, any contracton released by a particle or a mass-body ultimately is transferred to the supermassive black hole of the host galaxies or clusters spontaneously, *Sec. 7(4)2f, part C*. Therefore, any micro *S*-patches of a particle, *Proposal 2*, is connected by an H hall package tunnel, *Sec. 5(9)3d, part C*, to the black hole, *Sec. 8(7)2, Schema E5*. The micro *S*-patch of the particle is confined in a cone-like cavity, *Sec. 5(2)1d, part D*, of the black hole The apex of the cone-like cavity is on a cell of n_s cells, *Sec. 5(1)1*, of the black hole horizon or its Schwarzschild surface. Therefore, a particle that is connected by an H hall package tunnel to a cell on black hole constitutes an independent system from other systems of particles. In other words, any cell on the black hole acts independently from other cells, i.e. a degree of freedom. As the result:

1) The H hall package tunnel can be compared as a vector that its origin is on a cell of the n_s cells of the black hole. This, vector terminating to a particle at its expanded mode during stay time $\Delta T_{d(e)}$ along with expandon emission. This vector changes its direction from particle to the same cell at its origin of the black hole at its contacted form during stay time interval

$\Delta T_{mass(c)}$ along with contracton releasing towards the black hole. Please refer to *Sec. 5(7)8,* and *Comment 5(15)3d, B1, itemIII,* in this regards.

2) According to *item 1*, the vector at the particle expanded mode in a world during stay time interval $\Delta T_{d(e)}$ is balanced with n_P reversed direction vectors related to all of its superimposed contacted states in other worlds, each during stay time interval ΔT_{mass}, i.e. $\Delta T_{d(e)} = n_p \cdot \Delta T_{mass(c)} \cdot K_p$. Because of correlation of the particle with n_p particles in the Universe; please refer also to *Remark 5(15)3d, B1,* and *Sec. 8(7)2, Part G,* and *Sec. 7(2)2.*

3) The total number of the worlds n, *Remark 5(15)3d, B1*, in the Universe can be regarded as total *S*-patches of particles in the Universes, or, total number of H hall package tunnels that connect the particle to the supermassive black holes in the Universe. Noteworthy the particle from viewpoint of *HPPH* is an H system of path-length value h. In case of many particle systems or macro-bodies, the sum of micro *S*-patches of its individual particle constitute the related spatial patches. Noteworthy, all of the micro *S*-patches of the particles are constituting the spatial patch, *Sec. 5(16)3b, part H*, related to their galaxies or clusters along with the central black hole. Thus, any spatial patch is constituted of individual micro *S*-patches of related particles. Moreover, all of the particles in a spatial patch are linked to black hole via their H hall package tunnels of related micro *S*-patches. As the result, black hole and related galaxies in a spatial patch constituting by a far analogy a world as in many-worlds scenario from viewpoint of *HPPH*. Therefore, the black hole manages the states of a particle in related spatial patch via contractons transfer by the particle to one of the n_s cells, *Sec. 5(1)1,* of the black hole during stay time intervals ΔT_P successively. The spatial patch including its galaxies and central black hole i.e. a world is separated from the other worlds. According to *Sec. 5(9)3b*, there is a general correlation in the Universe according to Mach Principle via interchanging of micro *S*-patches of particles of adjacent spatial patches, *Proposal 2, item 3*. In other words, a particle micro *S*-patch of a spatial patch can be exchanged by its equivalent particle micro *S*-patch of neighbor spatial patch based on path constancy. By some analogy considering a company or administration, its general manager (Universe) is in contact with their vice-presidents (black holes). The latter are in contact with their staffs (particles) in related division (spatial patch and its ingredients). Any staff (particle) in a division can be replaced by other one in other divisions under the supervision of the new vice-president (black hole). Supposing now a spacecraft (or meteor, or particle) is entered from a spatial patch to other one with its own (new) black hole. The equivalent *S*-patches of particles constituting the spacecraft are exchanged with *S*-patches of identical particles in the new spatial patch according to above discussion. Therefore, an equivalent copies of information of spacecraft in a distance of light years away from initial spatial patch (first world) of spacecraft departure are transferred to the other one (second world), i.e. *Tegmark Level 1* according to [580] or vice versa based on path constancy, *Sec. 2(1)2*. Noteworthy, the copy of spacecraft in a spatial patch may be in the form of a set of particles (many particle system, *Sec. 8(7)6*) of equivalent configurations, and equal path-lengths and energies despite of the initial geometrical shape of spacecraft.

Now, imagine at the post big bang era, a particle, e.g. photon, travels all the spatial patches of the Universe at *13* billion light years up to present. Thus, it has its copies along with related information all over the spatial patches of the Universe. Again based on idea if imprinted existence in a cycle of Universe evolution, a particle has multiple copies in all of the past cycles of universe histories up to present cycle, i.e. a combination of both *Proposals 1 &2;* please refer to *Note 5(15)3d, B3*. As an incredible suggestion, there is a network of H hall packages between a particle in a world with that of its copies in other worlds in the present cycle of universe evolution. Thus, any particle has a state (or copy of information) that differ from the other copies during any stay time interval ΔT_P via contracton transfer between the copies spontaneously, *Sec. 7(4)2f, part C*, In other words, there is no identical expanding state in the network of copies at each instant during stay time interval ΔT_P. According to *Remark 5(15)3d, B1*, the total H particle-paths of a particle in expanded states of all of the worlds is equal to the total number of H particle-paths of the particle (or any of its copies).

Note 5(15)3d, B3- "In computing terms, objects can be instances of a general class. Likewise, every photon in the universe is exactly identical to every other photon, as is every electron, quark, etc. While the objects we see have individual properties, quantum objects like photons seem all pressed from identical moulds"[583] *A prima facie case*. According to above statement and discussion held in *Sec. 5(15)3d, part C,* the Universe in the primary cycle constituted of merely H particle paths of *SM* configuration, *Sec. 5(15)2b*. Thus, the particles appear according to copy scenario during next cycles progressively along with related information increment (or imprinted existence growth).

Proposal 4- The same as *proposal 3*, but instead of *HPPH* independent worlds that each relates to a spatial patch, *Sec. 8(7)2, part E5* in our Universe. It uses a multiple independent universe (remote universe) in abstract vacuum medium that is correlated merely by mutual contractons emission analogous to *Sec. 5(9)3d, part C*, *Fig. 5(5)2,* as in case of particles to one supermassif black hole of host galaxies and clusters, *Sec. 5(7)8*, of all of the supermassif black holes of our Universe. As a result, any of these independent universes occupy solely an expanded state of all of states at each instant as their wave function states. While, other states are in contracted form; please refer also to *Sec. 5(15)3e*. In other words, any of these remote universes is correlated by contractons emission to a black hole of our Universe, *Note 5(15)3d, B4*, at stay time interval ΔT, *Sec. 7(4)2f, part A*. Thus, any remote universe manages the wave function states of appropriate supermassif black hole of the host galaxies, and clusters, *Sec. 5(7)8,* in our matter Universe at these stay time intervals. Please refer also to *Comment 5(15)3d, B2.*

Factually, the contractons emitted by a neighboring remote universe are focused sharply merely towards one of the black hole of all of the black holes of our Universe, *Comment 5(15)3d, B2.* Thus, all of the black holes of our Universe have correlated to the same number of remote universes in abstract vacuum medium, *Sec. 7(4)3, part F*. Noteworthy, the states of a black hole take the reversed configuration of the related remote universe during stay time interval ΔT. As a result, any black hole of our Universe can be regarded as an independent world as in *Sec. 5(15)3d, part B , proposal 3*.

Note 5(15)3d, B4- Sophistically, according to *Sec. 5(9)3d, part C*, *Fig. 5(5)2,* this kind of correlation induces mutual gravitational attraction. "Another speculation is that the separate worlds remain weakly coupled (e.g. by gravity, *Note 5(15)3d, B5*) permitting communication between parallel universes. A possible test of this is described in a 1997 article by Rainer Plaga" [154]. This interaction is merely between e.g. a black hole of all of black holes of our Universe with that of a remote universe, *Sec. 5(15)3e, part D*, outside the Universe horizons along with their spatial patches and mass ingredients. It is analogous to the action of dark energy, *Sec. 5(15)2*.

Note 5(15)3d, B5- "Like the Many-Worlds theory, string theory demonstrates that parallel universes exist. According to the theory, our own universe is like a bubble that exists alongside similar parallel universes. Unlike the Many-Worlds theory, string theory supposes that these universes can come into contact with one another. String theory says that gravity can flow between these parallel universes. When these universes interact, a Big Bang like the one that created our universe occurs" [619]. Similar resolution as above is obtained based on *HPPH* in this section.

Comment 5(15)3d, B2- "Recent discoveries in quantum physics and in cosmology shed new light on how mind interacts with matter. These discoveries compel acceptance of the idea that these is far more than just one universe and we constantly interest with many of theses hidden universes"[613]. According to *HPPH,* these universes cannot be detected by their emitted light, because in abstract vacuum, merely contractons can be traveled between these universes spontaneously, *Sec. 7(4)2f, part c*. As the results, the characteristic as following can be obtained:

1) Merely contractons can travel within abstract vacuum, *Sec. 5(16)3h*, between the universes
2) Spontaneity travel of contractons
3) Expandon emission by particle as its wave counterpart, e.g. in *Sec. 8(7)2, E5a*, during each infinitesimal stay time interval ΔT. It changes the state of particle to diverse states of type *R* or *L* successively.
4) The emitted expandons as in case *3* reveal as particle wave function that corresponding to particle probability distribution.

The stated above cases globally can be visualized as parallel superimposed universes "Everett claims that the universe has a single quantum state, which he called the universal wavefunction, that always evolves according to the Schrödinger equation or some relativistic equivalent. Now the measurement problem suggests the universal wavefunction will be in a superposition corresponding to many different definite macroscopic realms (macrorealms)" [617] *the many-worlds interpretation*; please refer also to *Note 5(16)1b, A6*. According to ***Dr. Michio Kaku, Theoretical Physicist, Professor and Bestselling Author*** "There are vibrations of different universes right here, right now. We're just not in tune with them. There are probably other parallel universes in our living room—this is modern physics. This is the modern interpretation of quantum theory, that many worlds represent reality" [615]. Noteworthy, during any quantum jumping, e.g. of mind, merely the real universe is split to a parallel universe, and solely contacting with its self-copy. In other words, during each quantum jumping one can recognized with one of its copies randomly. Thus, one cannot meet at each jump with a same copy. Moreover, during jumping any mind disturbance leading to further split of the real world to other parallel universes. Thus, we miss the previous copy, i.e. encountering to a new copy. "The **many-minds interpretation** of quantum mechanics extends the many-worlds interpretation by proposing that the distinction between worlds should be made at the level of the mind of an individual observer. The concept was first introduced in 1970 by H. Dieter Zeh as a variant of the Hugh Everett interpretation in connection with quantum decoherence, and later (in 1981) explicitly called a many or multi-consciousness interpretation"[617] *Introduction*.

5(15)3e- The entire universe as a single object

A) Wave function of the Universe

The principle of the wave function of the Universe imagines the entire universe as a single object, a quantum object. "Michio Kaku explains it well: "When the universe was born, it was smaller than an electron, which is a quantum object that can exist simultaneously in many states. So the universe must also be a quantum object and exist in many states." (See here)[560] *Quantum gravity*. The overlapness as a single object according to *Sec. 8(7)2, part G*, implies that the Universe can exist in any of its states during a infinitesimal stay time interval ΔT, *Sec. 5(15)3d, part B*, that reveals as spontaneous existence of Universe in all of its states. "So we can apply our Hamiltonian operator to our wave function of the universe:

$$\hat{H}\psi = 0$$

This is the *Wheeler-DeWitt equation* - a sort of Schrödinger equation for the gravitational field. It is the most famous equation in quantum gravity"[560] *Quantum gravity*. "There is something remarkable about the Wheeler-DeWitt equation, and it can be seen if we expand the Hamiltonian operator:

$$i\hbar \frac{\delta \psi}{\delta t} = 0 \qquad \text{Which implies that:} \qquad \frac{\delta}{\delta t}\psi = 0$$

Or, expressed in words, *the rate of change of the state of the universe with respect to time is zero*. The universe is not changing with time! But we look around us and we see things changing all the time"[560] *Time and the Wheeler-DeWitt Equation.* Noteworthy, according to many-worlds interpretation, "there is only one wave function, the superposition of the entire universe, and it never collapses -- so there is no measurement problem. Instead the act of measurement is actually an interaction between two quantum entities, which entangle to form a single larger entity, for instance *living cat/happy scientist*"[565] *Interpretation*. "Only the physical interactions between systems then determine a particular decomposition into classical states from the view of

each particular system"[565] *Interpretations*. From viewpoint of *HPPH*, in case of mutual interactions, please refer to *Sec. 7(4)2f, part E*.

B) Total path-length of the entire universe

According to *Sec. 5(16)11*, the time's arrow and entropy increment are due to expanding irreversible type R_e path-length in spatial medium. It is along with time's arrow reversal and negentropy increment due to contracting irreversible type L_c path-length within mass medium of equal magnitude and opposite sign of the former one. Therefore, the changing of path-length of the Universe in a location is accompanied by equal magnitude of path-length of opposite sign in other location *Sec. 2(4)4b*. As a result, the total path-length of the Universe is zero; please refer also to *Note 7(5)2a1*. According to above discussion, the explanation such as {"The notion of evolution is not applicable to the universe as a whole since there is no external observer with respect to the universe, and there is no external clock that does not belong to the universe"[560] *Time and the Wheeler-DeWitt Equation*} has no sense. Factually, the wave function variation respect to time is related to two media of different characteristics, e.g. spatial and mass media, *Sec. 8(1)3*. The stated above discussion leading to relationships between the events in both forward and backward time direction. "So instead of causality which is time-directed, we are just left with a network of **all** the events e.g. in the tennis game. There are still relationships between the events, but these are not causal relationships. Rather, the relationships seem to reveal **mutual dependencies** between the events, which work in both the forward and backward time directions. These relationships hold together and define the structure of spacetime in much the same way as the steel struts of a pylon define and support the structure of the pylon"[560] *Causality in a Block Universe***.**

C) Total energy of the entire universe

"The total energy of the universe is zero! We saw this on the Cosmic Universe (reference [560]) page when we deduced that the Hamiltonian (the total energy) of the universe is zero:

$H = 0$

The explanation is that gravity provides negative energy"[561] *Why is there something rather than nothing?*

In case of negative energy from viewpoint of *HPPH*, please refer also to *Note 7(5)2a2*. As the result, according to bi-Universe hypothesis, *Sec. 5(16)9*, the countercurrent types $R \,\&\, L$ universes have path-length and energy of equal magnitude, but at opposite signs.

D) If there is more than one Universe?

According to *HPPH*, our universe is expanding in abstract vacuum, *Sec. 5(16)3h*, up to consumption of its dark matter, *Sec. 5(15)2a*, the similar scenario is also valid for other universes if these are existing. If for example two universes are exiting, they are correlated as in *Sec. 5(9)3a, Fig. 5(5)1*. Moreover, there may be two cases as following:

Cases I) the two universes are contacting within their spatial media, *Sec. 7(4)3, part A*. Thus, during the universe evolution they will be collapsed in each other, and ultimately becoming a single universe during cycles of their evolution.

Case II) the two universes are non-contacting. Thus, there is no universe collapse as in case *I*. In other words, the travel between the two universes is impossible. An observer in one universe cannot be able to detect the other ones, by no means, e.g. light signal.

Factually, there is no external observer, *Sec. 5(15)3e, part c*, outside the horizon of universes due to the lack of space-time or H particle-paths texture in abstract vacuum medium, i.e nullity, *Note 5(15)3b2*. Therefore, all of universes assumed to be coincides on each others as their states. Thus, no separate locations exists in abstract vacuum.

As the results:

1) There is merely one universe of bi-Universe characteristics, *Sec. 5(16)9,* i.e. the universe has many states, *Sec. 5(15)3e, part A*.

2) The total momentum of the entire universes is also analogous to their energies, *Sec. 5(15)3e, part c*, is zero. In other words, there is no translational motion of the universe within abstract vacuum, *Note 5(15)3e, D1*. Thus, merely there is expansion of the Universe within abstract vacuum medium *Sec. 7(4)3, part F*. There is no spatial medium related to normal vacuum outside the horizon of any universe, merely there is expansion of the universe within abstract vacuum medium. Thus, the expandons cannot travel outside the horizon of universe in order to reach other universes; please refer also to *Note 5(15)3d, B4*. In fact, if there is a neighboring universe, it can solely interact with other one through expansion. Therefore, finally collapsed to a single universe as in *case I, Note 5(15)3d, B5*. Noteworthy, the sum of angular momentum within spatial medium is right-handedly expanding, *Sec. 5(16)9a*.While, the total angular momentum of the mass medium is left-handedly contracting at the same magnitude but at opposite sign of that in spatial medium, *Sec. 7(4)3, part D*.

3) The case of universes that cannot be contacted through expansion in abstract vacuum is ambiguous due to the lack of external observer. They can be regarded as coincident due to spontaneity, *Sec. 7(4)2f, part c*, of contractons travel within abstract vacuum between these universes, nominating case *III*. They can be regarded as states of a single universe due to superluminal contracton travel (or exchange), *Sec. 5(9)3d, part c*, within abstract vacuum medium between these remote universes; please refer also to *Simulation 8(7)2, E5a*. Thus, we have multiple universes that are correlated solely by contracton emission within abstract vacuum, i.e. a multiverse, *Sec. 5(15)3d, part B*. The wave function, *Sec. 5(15)3e, part A*, of any of these remote universes occupies at each instant one state of all of the states during infinitesimal stay time intervals ΔT , *Sec. 7(4)2f*, *Sec. 8(7)2, part E2*, and *Simulation 8(7)2, E5a, items 16, 17.*

“Hawking takes quantum cosmology to its ultimate conclusion, allowing the existence of infinite numbers of parallel universes”.” We begin with a wave function describing the *set of all possible universes*. This means that the starting point of Hawking's theory must be an infinite set of parallel universes, the *wave function of the universe*. Hawking's rather simple analysis, replacing the word *particle* with *universe*, has led to a conceptual revolution in our thinking about cosmology” [610]. In fact, based on *Simulation 8(7)2, E5a, Schema E5a*, the particle can be replaced by a universe in abstract vacuum medium.

Similarly, the released contractons are mutually exchanged, *Sec. 5(9)3d, part c*, between universes. Therefore, the contracton of e.g. two universes, will be absorbed by their supermassif black holes of their host galaxies, and clusters. Thus, the contractons are traveled instead within H hall package tunnel (in case of particles) within abstract vacuum medium spontaneously "If we take Hawking seriously, it means that we must begin our analysis with an infinite number of all possible universes, coexisting with one another"." However, these wormholes are not like the ones ... which connect different parts of three-dimensional space with itself - these wormholes connect different universes with one another" [610]. Considering each universe as soap bubbles. "The difference is that each soap bubble is now an entire ten-dimensional universe. Since space and time can exist only on each bubble, there is no such thing as space and time between the bubbles"[610]. Based on *HPPH*, there is no H hall package tunnel (Wormhole equivalent) as in case of particles through normal vacuum medium. However, instead there is merely a beam (or shower) of contractons travel between the remote universes within abstract vacuum medium regardless of H hall package tunnels and wormhole scenario in normal vacuum medium." On these universes, the laws of physics were different, and hence the physical conditions that made life possible were not satisfied. Perhaps, among the billions of parallel universes, only one (ours) had the right set of physical laws to allow life". Please refer also to Sec. *5(15)3d, parts A, B*.

Note 5(15)3e, D1- The origin of *CMPRF, Sec. 2(6)2b,* of the whole Universe is coincided on the null total angular and translational momenta location of the Universe.

E) Horizon of expanding Universe

Similarly to reverson, *Sec. 7(5)2,* that is shielded by reverax, *Sec. 7(5)3b, item II*, from mass and spatial medium, i.e. interface of abstract vacuum and spatial or mass medium. The front or horizon of expanding universe is shielded also by reverax from abstract vacuum.

5(15)3f- Our Universe as superimposition of parallel universes

Sophistically, by analogy to a particle, *Simulation. 8(7)2, E5a,* and *Sec. 8(7)2, part G*, any parallel universe having states of expanded modes; while, all other of its states can be in contracted modes. Considering the electron in hydrogen atom, *Sec. 9(4)7,* the electron chooses during each stay time interval ΔT a new state that is roughly dictated by the classical law of electrodynamics, *Fig. 9(3)a*. As the results:

1) Our universe chooses also an expanded state during any stay time interval ΔT that is roughly dictated by the law imposed by parallel universes. Therefore, our Universe chooses different states that are dictated by unknown laws by parallel universes.
2) According to *item 1*, the states of our Universe are the superimposition of states of multiple parallel universes, *Comment 5(15)3d, B2*, that are separated by stay time intervals ΔT . Moreover, the wave function of our Universe can be regarded as superimposition of wave function of individual parallel universes.
3) Based on above items, the wave function of our Universe, *Sec. 5(15)3e,* can be split locally to wave function of related parallel universes during a measurement due to related mutual contracton emissions.
4) The parallel universes impose states of a particle in our Universe in an unknown manner.

Factually:

A) The Universe and its parallel counterparts have no translational motion within abstract vacuum, *Sec. 5(16)3h.* In other words, according to *Note 5(16)1b, A5,* and *Sec. 5(16)9*, the universe expands or contracts spirally, i.e. radial and rotational motion, within abstract vacuum, *Sec. 5(16)3h*. Noteworthy, the parallel universes and our Universe mutually interact spontaneously, *Sec. 7(4)2f, part c*, merely through mutual contracton exchanging, *Sec. 5(9)3d, part c*. Mutual emission of contractons are performed successively during stay time intervals ΔT , *Sec. 7(4)2f, part A*. Thus, the absorbed contractons by a particle causes the particle at its expanded mode (or state); while, the emitted contracton by particle leading to contraction mode of particle during stay time interval ΔT . The mutual emission and absorption of contractons leading to mutual gravitational attraction of mass-bodies in our Universe by related parallel universes, *Note 5(15)3d, B4*.

B) Based on *Simulation* 7*(4)2e1*, the contractons emitted by our matter Universe are of *PL & PR* types with slight preference of type *PL* over *PR* one. Therefore, considering handedness reversal principle, the neighboring parallel universes emit *PR & PL* contractons reciprocally with slight preference of types *PR* over *PL* ones, *Note 5(15)2b1*. Thus, we are surrounding with neighboring parallel Universes of antimatter characteristics. Thus, there are successive type *R* & type *L* parallel universes and so on to leave from our Universe. This phenomenon imposes successive type *R* & type *L* to the states of a particle in our matter universe as a part of unknown law.

C) By analogy to case of a particle, *Simulation 7(4)2e1*, our Universe in its node mode releases contractons towards other parallel universes. In other words, there are mutual exchange of contractons, *Sec. 5(9)3d, part D*, between our Universe and parallel ones. Based on *Example 5(9)3b2*, the contractons emitted by a particle of mass dm via related black hole of our Universe towards a parallel universe are equal to the number of contractons that are received to the particle by mutual exchange of the parallel universe. This mutual contracton exchange fingers the states of the particle by related parallel universe. Moreover, the particle state fingerprint is performed by a chain of contracton exchange by related black holes (as mediators) in our Universe. As the result, any parallel universe sends a bunch of contracton (as a fingerprint of its shape, size and handedness) to other ones including our Universe during its expanded state, *Sec. 8(7)2m Part G*, that leading to different states of a particle, *Simulation 8(7)2, E5a, item 9,* in our Universe as another part of unknown law. Thus, emission of contracton by a universe is along with emission of equivalent contracton by absorbing universe to the emitter and vice versa, *Sec. 5(9)3d, part c,* up to reach an equilibrium. Resuming, there is a kind of mutual exchange of information between the two universes, *Example 5(15)3f1*. In other words, any two particles of the emitter and absorber are correlated through contractons exchange.

Example 5(15)3f1- Based on *Comment 5(15)3d, B2*, if a light beam is emitted towards e.g. the horizon (or edge) of our Universe, the photon main-body and the light expandons are remained (or filtered) by our Universe; while, the filtered light signal contractons will leave our universe towards a parallel one within abstract vacuum, *Sec. 5(16)3h*. Therefore, through sending light signals, the traveled contractons will carry spontaneously the information to a particles or mass-body as detector in the parallel universe. The proponents of quantum jumping, e.g. Burt quantum jumping [615], claim that a person in our Universe can meet with its copy (or doppelganger) in a parallel universe.