Part 3b- Matter and wave

5(5) - Big Bang Remnants

5(5)1 - Primordial expanding spheres remnant

The preliminary expanding spheres, *Sec.5(4),* are relating to an enormous gravitational fields during the Big Bang era, *Note 5(1)1a*, that constructs ultimately the quantized texture of normal vacuum, *Sec. 5(16)3b, part A*. Moreover, *Eq. 5(6)* must be considered for these spheres or closed surfaces. Factually, the more inflation, *Sec. 5(15)3a*, is depends on more mass density in the Universe, or, in other words, to the rate of gravitational expanding spheres generation, i.e. H hall quantized package generation, *Sec. 5(16)3a*, please refer also to *Sec. 5(16)3b*. According to [272], *part 4*, A, *The horizon problem*, "At the time of recombination ($Z \approx$ 1100), when the Universe was matter dominate, there was a value of 10^{83} states. Compared with a value today of 10^{88} state, this difference by a factor of 10^5 , there are approximately 10^5 causally disconnected regions to be accounted for in the observable Universe today. The hot Big-Bang offers no resolution for this paradox, especially since it is assumed to be an adiabatic (constant entropy) expansion". On the other hands, alternately forgetting about the history of celebrated Big bang and referring the local inflation due to gravitational spheres generating by local mass dsensities in each region of the Universe, we can find a new interpretation considering H particle-paths hypothesis in this regards. According to [272] *part4, B*, *the problem of large scale structure*, "In contrast to the horizon problem, the fact that the Big-Bang predicts no inhomogenity is a problem as well. How are galactic structures to form in a perfectly homogeneous Universe?", *Note 5(5)1a*,This question is responded by referring to *Sec. 5(5)2, Consequence 5(5)2a.*

Note 5(5)1a- According to ketab-e-sharif, “Do not those who disbelieve see that the heavens and the Earth were closed up; but, we open that.”[110] A, *Surah 21, The prophet, verse 30.*

5(5)2 - Cosmic microwave background remnant

"Cosmic microwave background (*CMB*) is now playing a central role in precision cosmology and enables us to extract wealth of information on cosmological; parameters and the primordial Universe"[254]. The anisotropy of *CMB* are signature (or fingerprint) of the formation of the earliest structures in the Universe. What we see in *CMB* is a snapshot of the Universe at red shift *1000*"[264]. Please refer also in *Sec. 7(4)2e* in case of early radiation red-shifting, and *Sec. 5(5)3d*. "The black body radiation left over from the Big-Bang has been transformed by the expansion of the Universe into nearly isotopic *2.73 K* Cosmic Microwave background tiny inhomogenity in the early Universe left their imprint on the microwave background in the form of small anisotropies in its temperature. This anisotropy contains information about basic cosmological parameters, particularly the total energy density and curvature of the Universe. We compute the angular power spectrum of the *CMB* and find a peak at Legendre l = 197 ± 6 [angular multipole]. This is consistent with that expected for cold matter models in a flat (Euclidean] Universe, as favored by standard inflationary scenario"[259].

"The angular spectrum of the fluctuations in the *WMAP* full-sky map. This shown the relative brightness of the spot in the map vs. the size of the spots"[257] *CMB Angular spectrum*; please refer to *Fig. 5(4)1*. According to [251 B], *section 6(3),* "Tegmark and Zaldarriaga shows a compilations of measurements of anisotropies in the Cosmic Microwave Background along with curves from inflation models as a function of inverse angular scale on the sky, the left-right locations of the peak structure is very sensitive to the overall density of the Universe", *Fig. 5(4)1*. In other words, referring to [253, 254] *part II* related to *Measuring $P_{(k)}$, when the transfer functions are Known.* The temperature fluctuations of *CMB* anisotropy interpreted as its angular power spectra in micro Kelvin versus left to right l-values multipoles (e.g., l = *2, 4, 8, ... 1600*) is given; considering, *Fig. 5(4)1*, a damping of the acoustics peaks at small angular scales (large l) is viewed on this temperature power spectrum. Moreover, "the relation between l and k (i.e. wavenumber k per *H/Mpc*) are seen to be roughly linear as expected, and tighten with increasing l"; according to [275], *part2*" we consider the *CMB* as being generated at last scattering ($z \approx 1200$) and then projected onto the sky. The projection is controlled by angular diameter distance to last scattering, r, through:

$$l_{feature} = k_{feature}$$

Where, the feature can be any of acoustic peaks, the damping tail, the peak separation etc".

Assuming Universe at instant of Big Bang is constituted of equal magnitude of right-and left-handed H particle-paths, *Remark 5(5)2b*, during an inflation epoch, *Sec. 5(15)3a*; please refer to *Sec. 8(9)1, paragraph 3*. The Universe expands right-handedly through abstract vacuum, *Sec. 5(16)3h,* (inflation) at the expense of H particle-paths along with time's arrow and space formation (dark energy began to increase) through an infinitesimal time interval. On the other hand matter and dark matter take form during a contraction of remained H particle-paths at left-handed manner along with time's arrow reversal to reach an equilibrium, *Sec. 7(4)3, part J*. Therefore, an anisotropy appear in this new medium, *Note 5(5)2a*. This equilibrium shifted to the preference of expanding matter Universe. In other words, from this stage the whole Universe (matter and vacuum) continue its expansion at the expense of remaining dark matter via baryonic matter in the form of gravitational expanding spheres, *Sec. 5(4)1,* along with vacuum quantized texture generation, *Sec. 5(16)3b, part A*. According to *Sec. 5(15)2,* this phenomenon revealed as dark energy; please refer also to *Secs. 5(1), 5(16)9*, in this regards.

Referring to [255] "Acoustic, the most prominent and useful features in the anisotropy of the *CMB* come from acoustic oscillations of the photon-baryon fluid. Radiation pressure from the photons resists the gravitational compression of the fluid into potential wells and set up acoustic oscillation in the fluid", *Remark 5(5)2c*. Based on H particle-paths hypothesis, the pressure [or force, *Sec. 6(2)*] can be attributed to single direction H particle-paths (e.g., photon] and the gravitational compression can be imparted to reversible one (e.g., mass, *Sec. 5(1)*]. Therefore, in the early Universe there was a competition between single-direction reversible H particle-paths of the matter Universe (due to time's arrow, *Sec. 5(16)7a* along with space generation, *Sec. 5(16)3*, during expansion) with that of antimatter one (related to time's arrow reversal and space contraction during compression). It is

accompanied by the preference of matter Universe during expansion, *Sec. 5(16)9*. In this stage, the primordial baryon-radiation fluid can be regarded as unique H system, *Sec. 8(5),* along with a huge wave function, *Sec. 11(1), Note 11(1)3;* please refer to *Note 5(5)2b*. Factually, each expansion is accompanied by the exit of gravitational sphere that share in the process of expansion; please refer also to *Sec. 5(16)2a, Eq. 5(67)15a.* Moreover, the rate of expansion in the fluid stage depends on the rate with which the space and time quantized texture is woven through abstract vacuum. Please refer also to *Sec. 5(16)9a, Comment 5(16)9a1*, for a historical, traditional case.
"As the Universe expanded it cooled; after roughly 400000 years, the intensity of the radiation fields no longer sufficient to keep the Universe ionized, and its *CMB* photons decoupled from the baryons as the first atom formed. *CMB* polarization thus directly probes the dynamics at the epoch of decoupling"[265] *Introduction*. "*DASI* reported the first detection of polarization in the *CMB*. *E-E* power and *TE* correlations wee seen in this data"[266].
Referring to *Fig. 5(4)1a*, The "angular spectrum" of the fluctuations in the *WMAP* full-sky map. This shows the relative brightness of the "spots" in the map vs. the size of the spots. The shape of this curve contains a wealth of information about the history the universe. In the *Fig. 5(4)1b* like the graph *(a)*, this shows the relative polarization strength of the spots in the map vs. the size of the spots (red, green, and blue curves). *WMAP* has now measured the red and green curves. This new information helps to pinpoint when the first stars formed and provides new clues about events that transpired in the first trillionth of a second of the universe [502] *Angular spectrum graph*. "The second peak in the power is lower than the first. And by comparing the heights of the two peaks, cosmologist can gauge the relative strengths of gravity and radiation pressure in the early Universe baryons had about the same energy density as photons at the time of recombination and hence constitute about 5% of the critical density today"[258] *page 49*.
It implies that at this stage the reversible H particle-paths (i.e. as in baryons) density is the same as single directions ones (i.e. as in photons) of the early Universe regardless of H particle-paths related to dark matter, *Sec. 5(1)2*;

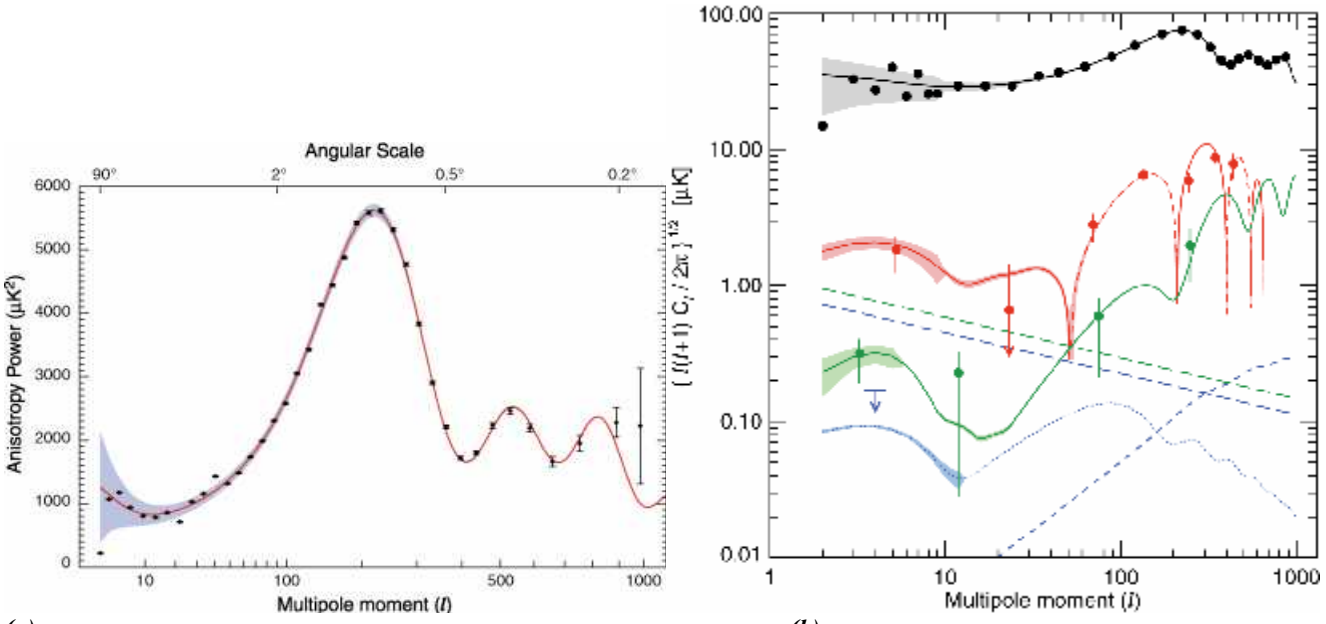

Fig. 5(4)1- The CMB Angular Spectrum

Consequence 5(5)2a – The quantized space vacuum magnitude is depended on the amount of mass-bodies formation during the gravitational collapse; thus, at very large scale, the Universe is uniform, Sec. therefore, the large-scale structure and existence of galaxies are explained. Factually, prior to the above phenomenon, the early Universe was smooth and homogeneous because the microwave afterglow light from the Big Bang has an extraordinary uniform temperature across the sky. According to [268B], first part, "The *SDSS* researchers detected ripples in the galaxy distribution made by the sound waves generated soon after Big-Bang. These sound waves left their imprint in the Cosmic Microwave Background, remnant radiation from the Big Bang seen when the Universe was 400000 years old. We are seeing the corresponding cosmic ripples in the *SDSS* galaxy maps. According to *Sec. 5(15)2b, Diagram 5(1),* the inhomogenity increment of the Universe during its evolution time that is along with entropy increment is interpreted.

Example 5(5)2a – According to [268 A] part related to *cosmic ripples seen by galaxy survey* "Both the Sloan Digital Survey and the *2* Degree field Galaxy Red-shift Survey reported the discovery of features in the distribution of nearby galaxies that correspond to the oscillations seen in the anisotropy of the Cosmic Microwave Background for several years".

Note 5(5)2a:
A) At this stage at each location of the medium, there is an expansion due to quantized vacuum formation further expansion (i.e. H hall quantized package, *Sec. 5(16)3,* generations). On other hand, there is a contraction due to gravitational collapse in the related H hall quantized packages, *Consequence 5(5)2a*, at the expense of a part of primordial dark matter (i.e. reversible H particle-paths)

to baryons, *part B*, before rarefaction up to stars and galaxies formation, *Example 5(5)2a.* Therefore, the excess of dark matter residual remained in the Universe. Noteworthy, during the expansion and contraction that are accompanied by time's arrow and time's arrow reversal respectively, the total time rate remained nil; thus, this epoch is a long period that look approximately spontaneously, (e.g., trillionth of a second, respect to our time scale, *Sec. 7(4)2f, part c*), nominated H particle-paths rearrangement epoch. Thus, contrary to inflation theory, there is no expansion rate at the speed larger than light speed c through quantized texture, *Sec. 5(16)3b, part A*, of normal vacuum space at this stage ; please refer to *Sec. 5(16)10, Sec. 5(16)3e, Remark 5(16)3e3,* in this respect (*case I*). As an alternate interpretation during inflation, the expansion is performed spontaneously through abstract vacuum, *Sec. 5(16)3h*, of no quantized texture comparing to that of normal vacuum texture at c speed (*case II*).
B) Similarly to dismantling of muon and tau particles, *Sec. 2(7), Example 2(7)1,* to related *W*-boson and neutrino. There may be a reverse process during which the baryons is formed through non-baryonic dark matter, *Sec. 5(1)2,* and neutrino (or quarks) combination at the high pressure and temperature under action of strong force during the early moments of the Big-Bang related to Planck Epoch (Baryogenesis). Noteworthy, referring to *Sec. 5(16)9c*, *part A*, we conclude that matter Universe is not the result of excess of matter over antimatter during annihilation but it depends on expanding characteristic of the Universe that support matter rather than antimatter. According to [276], *sections 1&5,* " The acoustic signature in the large-scale clustering of galaxies would give another conformation of the existence of dark matter at $z \sim 1000$ that does not interact with the photon-baryon fluid, since a fully baryonic model produces an effect much larger than observed".

Note 5(5)2b- Universe at its early state has a path-length value h, *Sec. 5(16)3g*, within time interval ΔT_Γ , *Sec. 7(4)1*, through a sound wave wavelength Γ, i.e. path-limit, *Sec. 1(12); Sec. 5(16)3b, part D2*. Therefore, it was confined in a quantized H hall package, *Sec. 5(16)3a*, that splits successively to newborn H hall packages during inflation era, *Sec. 5(15)3a*, and Universe expansion analogous to a chain reaction. Noteworthy, each appearance of H hall package is along with a quantized space of V_{HP} volume, *Eq. 5(70)2*, and time's arrow ΔT_Γ generation through abstract vacuum, *Sec. 5(16)3h*.

Remark 5(5)2b – At this stage, we encounter with a single phase constituted of H particle-paths of SM configuration, *Sec. 5(15)2b.* During the Universe evolution, the different aspects of H particle-paths appeared due to phase transition, e.g., mass and energy, *Sec. 2,* motion, *Sec. 3*, electromagnetism, *Sec. 4*, gravitation, *Sec. 5*, vacuum quantized texture, *Sec. 5(16)3b*, collision, applying force, *Sec. 6,* etc. According to *Diagram 5(1)*, the H particle-paths of SM configuration is split to:

1) H particle-paths of SN_r configuration in the spatial medium, *Sec. 7(4)3, part A*, of expanding type R_e path-length accompanied by time's arrow and spatial expansion related to entropy increment.

2) H particle-paths of SP_l configuration within mass medium, *Sec. 7(4)3, part D,* of contracting type L_c path-length along with time's arrow reversal and mass medium contraction related to negentropy increment.

Noteworthy, the two types R_e and L_c path-length are increasing of equal magnitude and opposite signs, *Sec. 5(16)11*. According to above discussion, the Universe tends to inhomogenity during expansion phenomenon, *Sec. 7(4)3, part J*. However, the equality of two type path-lengths leading to homogeneity of the Universe at large cosmic scale that is in accordance with Friedman basic idea (or equations).

Remark 5(5)2c- The baryon-radiation fluid can be regarded as a feature of imprinted existence of entities during the Universe evolution, *Sec. 5(15)3d*.

5(6)- Matter wave
5(6)1- Preliminary aspect

"According to de Broglie a particle in motion is accompanied by a wave, the wavelength of which is given by $\lambda = \frac{h}{mv} = \frac{h}{p}$,
Where, h is Planck's constant, m is the mass of the particle and v its velocity or p its momentum. Moreover, de Broglie did not specify the physical nature of the wave"[490] *Introduction*. de Broglie's wave concept is manifest in numerous most beautiful experiments of interferences and diffraction using electrons and neutrons". "de Broglie reemphasizes the physical nature of his wave"[494] *Introduction*. According to *Sec. 2(3)1, Eq. 2(57),* the wavelength of intrinsic real matter wave is proportional to wavelength equivalent number of H particle-paths of the related particle within mass-body inversely of $K_\Gamma \approx 2\times10^{-34}$ factor, *Sec. 5(16)1a, Eq. 5(52).* Referring to *Sec. 2(4)4b*, a mass-body at rest state has also a stationary matter wave counterpart that leading to its gravitational field. Similarly, the matterwave counterpart of a moving object or particle also leading to gravitomagnetism, *Sec. 5(2)1c*. Please refer also to *Remark 5(16)3b, B1*.
In case of a particle of zero rest mass, e.g. photon, its matter wave counterpart frequency υ_p of its single direction H particle-paths in vacuum medium is equal by K_Γ factor to its frequency equivalent n_p that is contracted in path-limit Γ_{mass} before emission within mass medium, i.e. $\upsilon_p = K_\Gamma n_p$, *Remark 2(3)1b*. Because of photon is constituted merely of single direction H particle-paths, that is extended through path-limit Γ_d after emission in vacuum medium. Therefore, the energy ε_p of each of the WR , or, WL cell (or expandon of path-length $2\hbar$), *Simulation 7(4)2e1*, of the matter wave counterpart of photon (as wave) is K_Γ time lower than that of the main photon $E_p = h\upsilon_p$. Thus:

$\varepsilon_p \geq h n_p K_\Gamma N_p^{-1} = h \upsilon_p N_p^{-1}$, *Note 5(6)1a* 5(19)1

Where, N_p is the total H particle-paths of the main photon as particle in the form of expandons.

By analogy to case of photon, an isolated particle of rest mass m_0 at rest state, and n_0 frequency equivalent has a total energy $E = m_0 c^2 = h n_0$, *Sec. 2(3)1, Eq. 2(55)1*, and matter wave energy cell (or expandon). Where, $\upsilon_0 = n_0 K_\Gamma$, the stationary matter wave, *Sec. 2(4)4b*, frequency of particle m_0 (or expandons) through vacuum medium. Moreover, contrary to case of photon the particle of rest mass is confined merely through a closed or curved path-limit Γ_{mass} within mass medium.

According to *Sec. 2(2)1, Eq. 2(42),* the isolated particle of rest mass m_0 that is moving at v speed has an external energy E_{ex}, *Sec. 5(6)4, part A*, related to its motion as following:

$$E_{ex} = \vec{p}.\vec{v} = \frac{m_0 v^2}{\sqrt{1-\frac{v^2}{c^2}}} = h n_{ex} K_\Gamma = h \upsilon_{ex} \text{ (in free vacuum medium)} \quad 5(19)2$$

The energy of related expandon is:

$\varepsilon_{ex} \geq h n_{ex} K_\Gamma N_{ex}^{-1} = h \upsilon_{ex} N_{ex}^{-1}$, 5(19)3

In this case, the external energy, or, better to say single direction H particle-paths is extended along path-limit Γ_d in vacuum medium.

Where, $\vec{p}$ is the particle linear momentum vector, υ_{ex}, the matter wave frequency of the moving particle . Please refer to *Sec. 1(3).* Factually, υ_{ex} is the frequency of its N_{ex} external H particle-paths component as stated above in case of main photon as particle. Thus, the energy ε_{ex} is the energy of each of W_R, or, W_L expandon emitted by the moving component of the particle during its motion in spatial medium.

In case of stated above particle of rest mass m_0 at motion, according to *Sec. 2(2)1, Fig. 2(41),* there is also a component related to internal H particle-paths motion, *Sec. 7(4)4,* and *Sec. 1(3),* of energy $E_{in} = -L$ that differs from external one, E_{ex}. The component E_{in} is related to internal motion of H particle-paths within the particle mass medium of frequency equivalent n_{in} that is restricted to a curved or contracted in path-limit $\Gamma_{mass(in)}$. Therefore, by analogy to case of a particle at rest state, its energy is $E_{in} = h n_{in}$, and its stationary matter wave of its expandon frequency is $\upsilon_{in} = K_\Gamma n_{in}$. In other words, the energy ε_{in} related to each of W_R, or, W_L expandon of matter wave counterpart is K_Γ time smaller than E_{in}, *Note 5(6)1a*. Thus:

$\varepsilon_{in} \geq h n_{in} K_\Gamma N_{in}^{-1} = h \upsilon_{in} N_{in}^{-1}$ 5(19)4

As result, the relationship of energy and de Broglie frequency of a particle is depending on the medium and following conditions:

In vacuum medium, the external (or common) single direction H particle-paths of the moving particle is extended through path-limit Γ_d in this medium. Moreover, the external energy related to external component is $E_{ex} = h \upsilon_{ex}$. Where, υ_{ex} is the frequency of matter wave counterpart expandon of the particle in vacuum medium related to its external component. Please refer also to *Note 6(2)1a2* in case of external energy of a particle.

In case of mass medium of a particle (or mass-body) of mass m_0, the N_0 reversible H particle-paths of the particle is confined through curled or contracted path-limit Γ_{mass} in this medium, the energy of reversible H particle-paths of the particle is $E_0 = h n_0$. Where, n_0 is the frequency equivalent of a particle within its mass medium. Moreover, the frequency of its stationary matter wave counterparts (or expandons), *Sec. 2(4)4b*, in vacuum medium is equal to $\upsilon_0 = K_\Gamma n_0$. Moreover, its energy $\varepsilon_p = h \upsilon_p N_p^{-1}$ through normal vacuum medium is

$$\varepsilon_0 \geq h n_0 K_\Gamma N_0^{-1} = h \upsilon_0 N_0^{-1} \quad 5(19)5$$

In case of a moving particle, it can be analyzed to its external (or common) single direction motion component through vacuum medium, and its internal reversible motion component within its mass medium, i.e. a combination of cases *I, II*. Resuming, the energy of the external component in vacuum medium is $E_{ex} = h n_{ex}$. While, the energy of external component in mass medium $E_{in} = h n_{in}$. Where, n_{ex} is the frequency equivalent of external component, and n_{in} is the frequency equivalent of particle through mass medium; please refer to *Example 7(4)2f, A1*, and *Note 6(2)1a2*, in case of internal energy of a particle.

The de Broglie wave wavelength is depended inversely to the mass (and momentum) of a particle or mass-body irrespective of their atomic structure. Therefore, a particle or mass-body can be regarded as a unique H system, *Sec. 8(5),* with a combined axeon, *Sec. 10(8),* that surrounds its common reverson, *Sec. 7(5)3b*, along with lack of preference of motion of its H particle-paths.

The frequency of expandon emission of matter wave counterpart of a particle (or its de Broglie frequency) is depending on the mutual interaction of N, the total number of H particle-paths (of n frequency equivalent) of a particle with the H particle-paths (of d_N population density) of the related medium, e.g. free vacuum, gravitational vacuum, *Sec. 7(4)3, parts A, B*. Please refer also to *Sec. 7(4)2f, part A*, and *Sec. 2(4)4*, in this regards.

Please refer also to *Note 2(3)1a, Remark 5(16)3b, B1, Comment 7(4)2e1, Sec. 8(7)3, Sec. 8(7)4, item GII.*

Note 5(6)1a- The energy of expandon in each of the components is K_Γ time lower than energy of emitting components in one hand. In other words, the energy of expandon is depending on inversely to the number of H particle-paths in the related components. Moreover, depending on that, the expandon is constituted of one or more H particle-paths; its energy is equal or more in the related relationships.

5(6)2- Dual gravitational and electromagnetical aspects of de Broglie wave

According to *Sec. 2(4)4b*, a particle or a mass-body matter wave counterpart has stationary and non-stationary characters. It is leading to gravity of a mass body or a particle at rest state and their gravitomagnetism, *Sec. 5(2)1c*, at motion. "Obviously, the rapid oscillation (particle part of electron) would set up gravitational waves, and in the case of the electron at rest, a standing wave would appear around the electron"[493]. Please refer also to *Sec. 2(3)1, Remark 5(16)3b, B1, and Comment 7(4)2e1*. "The wave develops in a process of proper-to-kinetic mass transformation when the particle is given a momentum. The time part of the *4*-wave vector is related to the proper mass oscillation while the spatial part is due to the momentum"[495] *Abstract*. Please refer also to *Sec. 5(16)2a*. "These standing de Broglie waves are the wave representation of all matter and their standing wave nature means that matter is quantized" [490] *Equivalence between de Broglie waves and rest-energy*. Please refer also to *Sec. 5(7)7*. "The standing de Broglie waves of a particle are projected in two-dimensions normal to the axis of motion of the particle. The E and H vectors of electromagnetic fields are mapped into the same plane as the de Broglie waves, with interaction occurring as energy displacement inside the space-time fabric"[490] *Conclusions*. Please refer also to *Sec. 4(4), Fig. 4(8)*. Moreover, "The energy in de Broglie waves is shown to be equivalent to gravitational potential energy"[490] *Abstract*. Contrary to quantum theory, the general relativity that is dealing with mass and gravity is developed without taking advantage of the de Broglie matter wave as an intrinsic character of the mass. "We assume that all particles including elementary particles, atoms and molecules are little quantized pendulum with some periodic internal undulation. In *Eq. 5(19)6*:

$$\upsilon_L = \alpha\,\upsilon_0 + \beta\,\upsilon_{dB} + \gamma\,\upsilon_{nd}\,, \qquad 5(19)6$$

Where:

- The de Broglie frequency (of a particle moving at v speed), $\upsilon_{dB} = v/\lambda_{dB}$ is the inverse of the time the particle takes to traverse a distance λ_{dB} (de Broglie wavelength) while finishing one complete internal undulation period.
- α, β and γ are yet to be determined
- υ_0 is the internal undulation period when the mean velocity of the particle is zero
- $\gamma\,\upsilon_{nl}$ is the contribution under non linear condition like relativistic velocities and, or when the cosmic medium itself become highly distorted due to presence of other fields ".[496] *section 3*.

According to *Sec. 5(6)1, item II*, υ_0, is the stationary matterwave frequency of the particle , *Sec. 2(4)4b*, , υ_{dB}, the de Broglie frequency is the equivalent of υ_{ex}, *Eq. 5(19)2*, frequency of external motion of H particle-paths of the particle moving at v speed from viewpoint of H particle-paths hypothesis.

As the results obtained according to above discussions:

The gravitational theory based on stationary matter wave that is consistent with one of the great law of nature, i.e. de Broglie wave considered as real wave, can solve the problem of inconsistency of the fourth force with the three other ones. The concept of gravity from viewpoint of H particle-paths hypothesis that is based on the mass loss dM , *Sec. 5(1)1*, can perform this message in a right way. According to *Sec. 5(15)2a*, the dark matter conversion to dark energy is the origin of matter wave appearance.

5(6)3- Wave-like motion of H particle-paths in a medium

"A wave is a disturbance that propagates through space and time, usually with transference of energy. There also exist wave capable of traveling through a vacuum including electromagnetic radiation and probably gravitational radiation. Waves travel and transfer energy from one point to another, often with no permanent displacement of the particles of the medium (that is, with little or no associated mass transport"[505] *Definition*. According to H particle-paths hypothesis, the cells behavior related to expandons of type $R\,\&\,L$ including the $WR\,\&\,WL$ expandons, *Simulation 7(4)2e1*, of photon matter wave, the types $R\,\&\,L$ expandons of n_s cells of a gravitational sphere, *Sec. 5(1)1,* the electromagnetical expandons can be regarded as wave-like motion of H particle-paths in a medium. These main expandons along with sub-expandons, *Sec. 5(16)1a, part B*, that generate due to mutual interaction of main expandons with H particle-paths of medium H hall packages can be regarded as a propagating front wave, *Comment 5(16)3b, B1*, based on Huygens's principle, *Sec. 7(4)2f, part E*. As a result, the population density or path-length densities of H particle-paths, e.g. in free vacuum, gravitating vacuum, and total path-length or total number of H particle-paths of the particles affects on the rate of emission of expandons during mutual interaction of both particle and the related medium, *Sec. 5(16)1a, part B*. Therefore, the medium has direct effect on the frequency of expandon emission by the particle. In other means, the frequency of expandons emission towards denser gravitational field, i.e. higher H particle-paths population densities increases accordingly (blue shifting), or, vice versa (red shifting); while, in case of photon, its speed of propagation remained unchanged, i.e. c . In case of a gravitational sphere of n_s cells and dM mass equivalent, *Sec. 5(1)1,* the partial mass dM is converted gradually to its equivalent energy $c^2\,dM$ during expandon formation which is along with contracton conjugate releasing towards the source (or related mass-body) during a full expansion phenomenon; please refer to *Sec. 5(15)2b, Diagram 5(1)*. Therefore, an newly born gravitational sphere of partial mass dM on Schwarzschild surface leaving some parts of its equivalent energy during its passage from first to n^{th} gravitational sphere position as track and sub-track textures (potential gradient) that attenuates up to $n \to \infty$, *Sec. 5(16)3b, part B* .

5(6)4- Matter wave speed scenario

A) Instead of kinetic energy, E_k, of a particle, its external energy, E_{ex} must be considered . At low speed, and considering the kinetic energy is $E_k = \frac{1}{2} m v^2$, "The matter wave moves at one half speed of the particle. That is obviously absurd as they move together each merely an alternative aspect of the same real entity. For them not to move together would be as absurd as far the particle aspect of light to move at a different speed than its wave aspect, the photon not arriving coincident with the *E-M* wave."[499] *The matter wave problem*. Factually, according to *Sec. 2(2)1, Eq. 2(42),* at low speed, $E_{ex} = m v^2$ on the behalf of H particle-paths hypothesis. Therefore, the group velocity is equal to the velocity v of the related particle.

B) "It is also no help to hypothesis that it is the total energy, not just the kinetic energy that yields the matter wave. Such an attempt attributes a matter wave to a particle at rest. It also gives the resulting matterwave velocity as $\frac{c^2}{v}$ which has the matter wave racing ahead of its particle"[499] *Matter wave problem*. According to [507] Matter wave phase $v_p = \frac{c^2}{v} > c$, where v_p is phase velocity of matter wave. However, this problematic result can be solved based on H particle-paths hypothesis as following:
The expandons of matter wave of a particle of zero rest mass contrary to case of photon, *Simulation 7(4)2e1*, is not single direction in the propagation direction, but have a combination of both single direction and reversible motions. Therefore, in case of an electron moving at v speed, the product of electron matter wave apparent frequency and wavelength related to common or external motion, *Sec. 1(3),* of H particle-paths of electron (group velocity of electron as in *part A*) is equal to v. While, the product of total frequency υ_e and wavelength λ_e of combined internal and external motions of expandons is equal to c. In other words, $\upsilon_e . \lambda_e = c$, *Note 5(6)4a*, in case of individual types R & L expandons moving at the same speed as electron main body translational motion, i.e. group velocity v. As a result, these expandons are constituted of type R & L counter-current H particle-paths moving in combined rotational and translational mode of motion, i.e. a stationary wave-like movement of H particle-paths that are propagating at translational motion at v speed, i.e. co-moving with related particle, *Example 5(6)4a.* During the motion of the particle through spatial medium (or vacuum quantized texture), a common H hall package tunnel, *Sec. 5(9)3d, part c*, is constructed by particle from its reverson up to the emitting source of particle at v speed. Moreover, the reverson of emitted counter-current expandons of particle during expanding process extending a common H hall package tunnel up to the particle reverson. Therefore, contracton that are generating during sub-expandon formation from the main ones are transferred spontaneously, *Sec. 7(4)2f, part c*, by network of common H hall package tunnels, *Note 5(9)3b1*, of both particle and its matter wave expandons to the particle emitter source. As a result, a particle track texture by stated above process is extended from particle main body to the source, and the particle common H hall package tunnel acting as central reverson of the particle track texture, *Sec. 5(16)3b, part B*, that is surrounded by an axeon, *Sec. 7(5)3b, item II*. Thus, during particle detection by a measuring device (i.e. measurement, *Sec. 8(7)2*), the signals (or released contractons) of interaction are transferred spontaneously to the source; please refer also to *Sec. 7(5)2b, partA.*

C) Similarly to a moving particle at motion its wave matter counterpart, Sec.5 *(6),* can be viewed as its stationary wave at rest state,*fig.5 (8)* nominating gravity flower.

Example 5(6)4a- As a far analogy considering a dot on the periphery of a wheel, when the axel of the latter is moving at straight motion at v speed, the dot has a combination of both circulating and translational motion, e.g. at c speed. Now, supposing another wheel is circulating with a dot on its periphery at the same speed of the former wheel but in opposite circulating direction, but co-moving at the same translational speed, i.e. v. Therefore, we have a counter-current wave-like motion of two dots. According to this analogy, the counter-current expandons at a wave-like motion are co-moving at translation v speed with the related particle during their expanding evolution, similarly to *Fig. 5(8)* of *Sec. 5(16)1b, part A*. Please refer also to *Sec. 2(6)4b* for further information.

Note 5(6)4a- In the path evaluation as in *Note 3(1)c, items I to III*, we must use the relationship $\upsilon_e . \lambda_e = c$, *Eq. 3(17)* instead of $\upsilon . \lambda = v$, in case of electron.

5(7) - Black hole

5(7)1- Total number of H particle-paths on a potential sphere

Assuming a length, l_s, "called Schwarzschild radius", *Eq. 5(31)* , associated to an H system mass, *Sec. 5(8)1;* Now, dividing the surface *Ss*, of a sphere with, l_s, radius into n_G, *Eq. 5(1),* equal parts of Planck's area, *Eq. 5(33);* thus according to *Eqs. 5(5)* for N_G of unit of mass we have:

$$S_s = 4\pi l_s^2 \qquad 5(20)$$

$N_G b^{-1} = Ss$ / *Planck' area*$= \frac{4\pi G}{\hbar c} . b^{-2} = \frac{8\pi^2 N_G a_1}{ic} (b^{-2})$, *Note 5(7)1a*

By substituting *G* from *Sec. 5(1)1, Eq. 5(5),* we have:

$$i = \frac{8\pi^2 a_1}{c} (b^{-1}) = 2.63 \times 10^{-7}\ a_1 (a_s^{-1} b^{-1} u) \qquad 5(21)a$$

Where:

- a_1 , constant of media coefficient, *Note 1(2)1.*
- $a_s = 1 s^{-1}$, *Note 1(2)1,* $b = 1 kg^{-1}, u = 1 m^{-1}$ of inverse dimensions based on units of dimensions in *SI* units.
- $n_G = N_G b$, in case of *M=1kg.*, *Sec. 5(7)6.* or $n_G = M\ N_G$, in case of $M \neq 1$

As a result, to each of the n_G, the total number of Planck area on the sphere surface, *Ss, Note 5(7)1b,* is related an H particle-path at c speed. The Schwarzschild surface i.e. S_s is supposed as a medium of generating expanding potential surface with n_G moving H particle-paths on it. During n_G calculation of a sphere at radius r , we must take into account the H particle-paths of its preceding potential spheres at radius lesser than r, as an expanded form of the mass *M,* and its equivalent mass must be added as a correction factor to the existing mass *M*, refer to *Sec. 5(1)1, Note 5(1)1b.*

The total number of interacting H particle-paths on an potential expanding sphere, n_G, *Eq. 5(1),* is independent of the atomic or molecular structure or the density of related mass-body; thus it is proportional exclusively to the total number of H particle-paths of the mass M, i.e. N_0.

Note 5(7)1a- In fact, the Schwarzschild radius l_s , is related to interacting parts of H particle-paths in a gravitational sphere, i.e. n_G, (or N_G for unit of mass) of total n_s ones, *Sec. 5(1)1.*

Note 5(7)1b- All of the mass of a black hole can be situated on a hollow sphere surface that is constituted of reverax, *Sec. 7(5)3b*, *item II*, on event horizon of the black hole. It separates the spatial medium, *Sec. 7(4)3, part A,* at its outer surface from reverson at is inner surface (or inner volume). Therefore, a black hole can be constituted of a reverson of abstract vacuum that is confined by a sphere surface nominating Schwarzschild closed surface that is shielded by a compact H particle-paths texture nominating reverax. It is simulated like a game ball. In case of a mass-body on the Earth, its reverax can be constituted nearly all of its volume. Factually, in case of a mass-body the Schwarzschild sphere as singularity is the inner horizon, i.e. interface of mass-medium, *Sec. 7(4)3, part D*, with abstract vacuum medium, *Sec. 7(4)3, part F*. While, the outer horizon of the mass is the interface of mass-medium with vacuum medium.

5(7)2- General aspect based on H particle-paths hypothesis

The pre Big Bang expanding spheres, *Sec. 5(5)1*, are in contradiction with merely space-time geometry conception in general relativity *that according to that the initial mass must be exist in order it's related space-time to be curved .In addition the straight or radial single propagation of the gravitational field at *C* speed must be considered accordingly.

Generally, a huge amount of mass (contracted form, *Note 2(1)3b,* of moving H particle-paths) is converted to gravitational field, *Sec. 5(1),* (the expanded form, *Note 2(1)3b,* of moving H particle-paths or the related spheres), in the whole Universe. Dark matter in respect of its quantity challenged with existing normal mass in the Universe and must taken into account. Therefore, the black holes can be media of accumulating this compact form of H particle-paths (mass) and releasing it as its expanded form (gravitational field). Moreover, in the center of galaxies the mass in the form of gases are spinning up during their attraction by black hole, *Example 5(7)2a.* Please refer to *Sec. 5(2)1c, part c2, Sec. 5(15)2b*, in this regards.

The H particle-paths of an H system (e.g. photon, atom,…) at the stage of black hole lost their initial wave structural shape, *Sec. 5(16).* Moreover the H particle-paths reaches their minimum volume, V_{min}, according to *Eq. 5(37)2,* at the event zone, *Sec. 5(16)2a*; the matter wavelength "λ" as in *Fig. 5(8)* reaches to its minimum values of Planck length, lp, *Eq. 5(33)* at this stage accordingly. Noteworthy, to a perfect black hole is belonged an H hall quantized package *Sec. 5(16)3a*.

According to *Sec. 5 (16)3*, during energy and mass absorption by black hole the H hall quantized package of its related H particle-paths contract, i.e. space contraction along with time's arrow, *Sec. 5(16)7a,* reversal, i.e. path-lengths contract left-handedly. In return during H particle-paths releasing in the form of expanding sphere the reverse process, i.e. space expansion take place along with time's arrow, or, in other words, path-lengths generation right-handedly, *Sec. 5(16)9b*; please refer also to *Sec. 5(16)1c, part A*.

C) Similarly to a particle at motion, Sec.5 *(6),* its wave matter counter part can be viewed as stationary wave shown in *fig.5 (8),* nominating gravity flower.

Example 5(7)2a– Consider a hallow rigid body sphere spinning at relativistic speed along an axis and the H particle-paths (or particles) moving on its surfaces; therefore, on the sphere the H particle-paths has solely a common velocity, *Sec. 1(3),* of light speed c at tangential mode along the equator. Now, the other circles parallel to equator one have a common tangentially velocity $v<c$; therefore, there are two other velocity components at the latter case, i.e. radially and along sphere axis. As a result, the sum of these three components is equal to c. In other words, on the parallel circles besides the tangential component there is a flow of counter-current H particle-paths in the direction of radius of circle (toward sphere axis), zand another flow parallel to sphere axis and toward the sphere's poles. Evidently, there are two flows of H particle-paths at increasing speed along sphere axis up to c speed towards its north and south poles, i.e. two other components decreases accordingly. By a far analogy, it can be compared to an accretion disc jet. According to [337] "Why do the accretion discs surrounding certain astronomical objects, such as the nuclei of active galaxies, exit relativistic jets along their polar axis". Moreover, the sphere at the above discussion can be compared with the Schwarzschild sphere (or event zone) of the astronomical objects such as back holes at the center of galaxies and neutron stars. Alternately, the gases are spinning up to a relativistic speed around the black hole in a center of a galaxy; therefore, making a disc around a black hole along with a flow (or powerful jets) of plasma along the axis of the gases rotation.

5(7)3 – Information loss puzzle

"Take a quantum system in a pure state and thrown it into a black hole. Wait for some amount of time until the hole has evaporated enough to return to its mass previous to throwing anything in" [398]. Considering this quantum system as an H system of mass m that is thrown in black hole initially of mass *M*. According to H particle-paths hypothesis, the H system m can be loss through exit of *N* gravitational spheres of black hole equivalent to the mass m of the H system until the black hole has returned to its initial mass before thrown away in. In other words, mass-body m is converted to *N* gravitational expanding spheres (or expandons, *Sec. 5(16)1c, part A*) each of path-length value $2\hbar$, *Sec. 5(16)3g*, confined in an H hall package, *Sec. 5(16)3a*. Therefore, the black hole entropy, *Sec. 5(7)6,* increment depends on the total number *N* of related H hall packages. As a result, the mass m initially confined in an H hall package of h value is converted finally to *N* H hall packages related to its mass equivalent conversion of expanding gravitational spheres (or expandons, *Sec. 5(16)1c, part A3*) of black hole *M*, i.e. *N* black hole expandons. "I think what people are getting at when they say that black hole entropy is responsible for the information loss. I would say it the other way, that black hole information loss is responsible for black hole entropy"[398].

Noteworthy, the expandons of mass-body m are shared (or combined) with that of black hole *M* until complete evaporation (or radiation away) of the latter. In other words, the H particle-paths of masses m *&M* shared as a new expandon after thrown of mass m in black hole *M, Sec. 5(7)4*. Now, supposing black hole *M* support information after the latter stage. Therefore, there is no full access to pure information through existing lifetime of black hole *M, Example 5(7)3a.*

Resuming, the entropy increment is equivalent to a non-reversible process as discussed in *Sec. 5(16)9d, part A*. Therefore, there is no reversible access to the pure information thrown in black hole. In other words, the thrown information constitutes non-separable mixed state with the black hole, *Sec. 5(7)4*. Thus, the latter cannot throw away purely accepted information. Note that, according to *Sec. 5(2)1c, part c*, an expandon of right-handed SN_r configuration, and $+\delta e$ partial charge characteristic is accompanied by its conjugate, i.e. contracton of left-handed SP_l configuration, and $-\delta e$ partial charge characteristics that are comparable with virtual pair production. "Black hole has Hair theorem, which states that no matter what falls into a black hole, the only properties that remain are the total mass, charge, and the angular momentum of the object. Thus if, say, an encyclopedia falls into a black hole all the information in the encyclopedia is lost" [399] *Black holes and information;* please refer to *Proposal 5(7)3a*. Noteworthy, expandon and contracton of black hole also have these three characteristics mass, charge, and angular momentum as stated above. "Consider a virtual electron-positron pair produced just outside the event horizon. Once the pair is created, the intense curvature of space-time of the black hole can put energy into the pair. Thus, the pair can become non virtual; the electron does not fall back into the hole" [399] *Black hole thermodynamics, Remark 5(7)3b*. Thus, by analogy, the exiting expandons from black hole can have the role of escaping electron of negative charge; whereas, the contractons, *Sec. 5(2)1c, part c*, falling into black hole can be compared to positron in this respect, *Note 5(7)3a*. The black hole applies an attractive force on electron of rest mass, whereas expandons do not affected by black hole gravitational effects.

Example 5(7)3a –Supposing 1000 balls *A* of total mass m, is poured on 100000 balls *B* of total mass *M*. The balls *A* are mixed randomly with the balls *B* (nominated mixed balls c) to reach a homogeneity through an equilibrium along with entropy increment. Thus, by sampling randomly 1000 balls of the mixed balls c. The simple contains approximately 10 balls *A* and 990 balls *B*, but not 1000 balls A. Similarly , the information *A* is spread all over the black hole *B* as mixed state, i.e. body (or black hole) c, and released during the black hole c evaporation as a mixed entity. Supposing now, 1000 H particle-paths *A*, e.g. 500 right-handed negapas, and 500 left-handed posipas, thrown in 100000 H particle-paths of black hole *B*. Therefore, a uniformly mixed right-handed H particle-paths (i.e. negapa), and left-handed H particle-paths (i.e. posipa) in the ratio 1:100 is formed (body c). According to H particle-paths hypothesis in the expandons of body c there are a slight preference of negapas over posipas, i.e. SN_r configuration. Therefore, according to *Sec. 5(2)1c, part c*, there is a slight preference of posipas over negapas, i.e. SP_l configuration, remains in the contractons of body c, and so on.

Proposal 5(7)3a – "When we burn book, it looks as though we are destroying information, but of course the information about the letters remain encoded in the correlations between the particles of the smoke that remains. It is just hard to read a book from its smoke, the smoke otherwise looks universal much like the thermal radiation of a black hole. The same thing must hold for black holes. And the feeling that such a transfer of information is impossible because of the horizon is just an illusion" [404] *Hawking and unitarity*. "If we throw a volume of the encyclopedia in the sun, then for all practical purposes, information is destroyed. But we don't really believe that the information about the initial quantum states has been lost in principle. Even as the encyclopedia burns beyond recognition, all the information that it carried presumably becomes stored in subtle and intricate correlations among the radiation quanta emitted by the sun, or correlations of the emitted quanta with internal state of the sun. Information is lost in practice because we are enable to keep track of all these correlations" [402] *Information regained?* According to *Sec. 5(9)3d, part c, Simulation 7(4)2e1*, and *Consequence 2(4)4b1*, any interaction is accompanied by related P_R & P_L contractons that ultimately are transferred through the H hall package tunnels to the supermassif black hole of the host galaxies or clusters, *Sec. 5(7)8*. Thus, absorbed irreversibly by the latter via a destructive detection (or measurement, *Sec. 8(7)2*). According to *Sec. 5(16)7g*, the information of an event is registering via contractons in the supermassif black hole at the moment of happening, i.e. present time. Therefore, the contractons of any tapping during typing a letter by a typing machine is detected (or registration) by black hole, *Comment 5(7)3a*; Please refer to *Sec. 8(7)2, Simulation E5a, item 12,* and *Sec. 5(9)3d, part D*. Factually, the geometrical shape, *Proposal 5(9)3b, D1a,* of a word, e.g. M , or, L , as a set of P_R & P_L contractons is registered on the black hole, or, in case of a

computer the set of $0,1$ configuration, *Sec. 8(7)2, part E5*, is appeared as P_R & P_L contractons transfer through H hall package tunnels to the black hole; please refer also to *Remark 7(5)2a1*. However, if we throw a volume of the encyclopedia in the Sun, the burning process of its paper at the moment of burning is registered by the black hole at the center of own galaxies spontaneously, *Sec. 7(4)2f, part c.* "If the wave function merely encodes an observer's knowledge of the universe then the wave function collapse corresponds to the receipt of new information"[566] *History and context*. According to *Sec. 5(16)11*, the transfer of a signal or interaction from a medium, e.g. spatial medium, to other one of different characteristic, e.g. mass medium, is along with arrow of time reversal, or, vice versa, i.e. irreversible kind of path-length, *Sec. 2(4)4b*. It is leading to registration of an information as stated above; please refer also to *Sec. 7(4)3, parts A, D*.
Resuming, the black hole specifies one of the possible way towards the future through its contractons absorption at present time. The regeneration of the past time to present time is based on this mode of registration, i.e. remembering the past time.

Note 5(7)3a- "Earlier in 2004, Samir Mathur of Ohio State University in Columbus and his colleagues showed that if a black hole is modeled according to string theory - in which the universe is made of tiny, vibrating strings rather than point-like particles - then the black hole becomes a giant tangle of strings. And the Hawking radiation emitted by this "fuzzball" does contain information about the insides of a black hole (**New Scientist** print edition, 13 March)"[536]. According to *HPPH*, the black hole emits the H particle-paths of SN_r configuration part (or expandons), and retains its SP_l configuration part (or contractons) in the form of gravitational field or charged particle field.

Comment 5(7)3a- The registration of information also becoming in religions. "And with the God are the key of the unseen; no one knows them but God; and God alone knows whatever is in the land and in the sea. Moreover, nor does a leaf falls [of a tree] but He knows it, nor a grain in the darkness of the deepest [parts] of the ground. Nor anything wet or dry but [it is recorded] in the expository book (preserved book) of truth" [110]*B Surah 6 verse 59*. This expository book can be resembled to a black hole in preservation of information. “Do you know that God knows what is in the heaven and the Earth? Surely this is in book (preserved book), surely this is easy to God”[110]*A, Surah 22, verse 70*.

Remark 5(7)3b – “It seems unlikely we will have a convincing theoretical answer to the question, *do black hole radiate?* The hawking process would explain the temperature of a black hole but not itself, explain the nature of black hole entropy. Just what black hole entropy is, and how it relates to other notion of entropy, remains matter of speculation. The main attempt to link the two is the generalized second law (for thermodynamics)” [404] *Conclusion.* “There are equally plausible speculation about physics at such scales which result in no radiation at all, or in non-thermal spectra”, “A number of arguments have been put forwards of the Hawking’s mechanism are not really direct evidence for the existence of thermal radiation, but rather are arguments for interpreting black hole’s area as entropies” [404] *Appendix*. Factually, we should note here that Hawking radiation emitted by larger, and thus effectively four-dimensional, astrophysical black holes never been observed" [454] *Section 3*. According to H particle-paths hypothesis there is a probable existing radiation, *Sec. 5(16)3b, part E*, that is far from Hawking radiation, but the main amount of the mass of black hole is diminished through exit of expandons. Therefore, contrary to hawking radiation rate that depends inversely to the black hole square mass, the related mass loss of black hole depends directly on its initial mass, *Sec. 5(1)1, Note 5(1)1b, Eq. 5(7).*

5(7)4 – H particle-paths arrangement on event Horizon
The negapa and posipa arrangement in escaping expandons can be supposed roughly as information carrier. In this case, the negapa & posipa in each expandon can play the role of yes or no.
Factually, according to *Sec. 5(15)2,* the black hole convert the acquired information, e.g. *SM* configuration, to expandon of SN_r configuration associated with related contracton of SP_l configuration, *Sec. 5(2)1c, part c2*. Whereas, black hole converts the dark matter, *Sec. 5(1)2,* and previously acquired masses as total mass *M, Note 5(7)4a*. In other words, each escaping expandon is representative of three masses:
I) The acquired information of mass m.
II) The dark matter mass
III) The previously captured mass-bodies by black hole.
Therefore, the two masses *II, III*, constitute the mass *M* through the *Sec. 5(7),* during lifetime of black hole. The three categories of masses *I, II, III,* participate in expandon formation on the surface of Schwarzschild sphere, S_s, *Sec. 5(7)1, Eq. 5(21)d*.
As a result, the expandons generation can be compared with a far analogy with the slowly radiation away energy assumption of black hole. Therefore, the thrown information is obtained slowly through expandon generation as a mixed entity during lifetime of the black hole. Thus, information m of *SM* configuration split to two parts as following:
1) Accessible expandons that leave the black hole event horizon to normal vacuum space
2) Non-accessible contractons that remain in black hole as mirror Image, *Sec. 6(2)3*, of expandons.
According to above statement, the H particle-paths initial arrangement of an H system of mass m, is converted to a mixed arrangement with H particle-paths of black hole. Now, a question arises as following:
If the H hall package of the mass m is participated uniformly with that of black hole as in *Example 5(7)3a*, or, it occupies a specified area of the even horizon due to its correlation, *Secs. 8(7), 8(9),* outside the region of event horizon, otherwise the correlation outside the Horizon is affected accordingly.

Note 5(7)4a- According to *Sec. 5(15)2b, Diagram 1*, after full consumption of dark matter and normal matter falling in black hole to spatial SN_r configuration related to dark energy, *Sec. 5(15)2*, the black hole acquires its ultimate SP_l configuration. Therefore, the black hole dissipation has no sense according to H particle-paths hypothesis.

5(7)5 – An interpretation based on bi-Universes Hypothesis

"It (Bertrand Russell) suggests that all physical entities, all events acting upon them, and the context of space-time itself, arise from information processing. That information is the basic underlying stuff of the universe is today not so easily dismissed" [583] *Discussion.* According to bi-Universes hypothesis, *Sec. 5(16)9*, the information registration is belong to counter-current, type *L* (or antimatter) Universe. In other words, the reversed handedness conjugate of information may be stored in type *L* Universe. Thus, it is correlated with the main information in the both universes as mixed states. Therefore, it release slowly through expandons outside event horizon, but it's conjugate counterpart remain as contracton in black hole body, *Sec. 5(7)4*. "Perhaps, the most satisfying explanation for the loss of information in black hole physics was offered by Dayson, Zeldovich and Hawking. Their picture described in (rather misleading) classical language, is that quantum gravity effects prevent the collapsing body from producing a true singularity inside the black hole. Instead, the collapse induces the nucleation of a closed baby universe. This new universe carries away the collapsing matter, and hence all detailed information about its quantum state" [402] *Can information escapes to a baby universe?* It is to same extent is comparable to type *L* universe of H particle-paths bi-Universe hypothesis. In this case, black holes produce correlation between this two universe states, and its because of these correlations that both type *R&L* universes are described as mixed quantum states. Therefore, the reversed handedness conjugate of information, *Example 5(7)5a*, merely transferred (or better to say remained instead of exit from black hole) from one universe to another, *Note 5(7)3a;* please refer also to *Note 5(15)3a1,* and *Sec. 5(15)3d.*

Example 5(7)5a– Supposing a set of radio signal in a x-axis direction containing information is reflected successively by a reflecting mass-body *R* initially at rest in vacuum medium respect to observer o. According to Mirror Image Effect, *Sec. 6(2)3,* the reversed handedness of colliding signals is reflected back the initial handedness is absorbed by reflector *R* mass-body. Now, the reflector *R* is beginning to move in the x-direction. Therefore, its spherical expandon respect to observer o deforms successively to spherical surface in the x-direction. In other words, the H particle-paths of colliding signals are shared in expandon geometrical shape. Moreover, according to *Secs. 8(7), 8(9),* there are correlations between the reflected signals and reflector *R* at all the time. Now, supposing mass-body *R* is a black hole. Therefore, there are no reflecting signals in this case. Thus, black hole moves also in the x direction without releasing the reversed handed signals, *Sec. 5(7)5*. In addition, it has relatively different speed respect to the first case of the same mass. Note that, the expandons of black hole also change its spherical shape successively due to contribution of absorbed signals. In this case, the H particle-paths of absorbed signal shared along with that of black hole. Thus, black hole acquired the total handedness of colliding signals that affect on its expandons configurations. According to *Sec. 5(7)3, Eq. 5(21)d5*, the entropy variation is discrete per black hole unit area, δS_u, during signal or information acceptance.

5(7)6- Black hole entropy

"Jacob Bekenstein found that every black hole must have entropy proportional to the area of its horizon. Stephen Hawking then showing that the constant of proportionality must be, in units in which area is measured by Planck length squared, exactly one quarter"[237]. Moreover, according to Loop quantum gravity "The area of a black hole horizon is quantized as space is, it is made of discrete Units"[237]; please refer to *Sec. 5(16)2a, Remark 5(16)2a1.* By analogy, to these statements at the event zone of a black hole or on the area of Schwarzschild, *Ss*, the entropy *S* of a normal mass is proportional to N_G (or n_G, *Sec. 5(1)1*), i.e. the number of H hall quantized Unit, *Sec. 5(16)3a,* on a gravitational expanding sphere (or expandon, *Sec. 5(16)1c, part A3*). Therefore according to [244A]" This entropy *S*, is given by the famous Bekenstein-Hawking formula:

$$S = \frac{A k_B c^3}{4\hbar G} \qquad 5(21)c$$

Where, *A*, (here *Ss*) is the area of the black hole and k_B is Boltzman's constant".

A, is the area of the event horizon units. This elegant result relegates the area theorem of classical general relativity to a special case of the second law of thermodynamics" [402] *Introduction*.

According to *Eqs. 5(20), 5(21)b, c*, and *Sec. 5(33),* in case of mass unit, i.e. $M = 1kg$, (or $n_G = N_G$), in *SI* system that is base on H particle-paths hypothesis. Therefore, by an analogy with black hole entropy, *Comment 5(7)6a*, in case of expanding gravitational spheres (*or expandons, Sec. 5(16)c1, part A3*) on the event horizon we have:

$$S = \frac{S_s k_B}{4} l_p^{-2} = \frac{k_B}{4} \frac{S_s}{Planck'area} = \frac{k_B}{4} N_G \cdot b^{-1} \qquad 5(21)d1$$

Or:

$$S = \frac{k_B}{4} n_G \qquad 5(21)d3$$

Moreover, the H particle-paths confining in any n_s (or n_G) cell on Schwarzschild surface of a mass-body are in their compactified forms, *Consequence 5(16)1b, A2,* just before born and exit of related gravitation sphere on Schwarzschild surface.

According to above statements, a group of n_G (or n_s), *Sec. 5(1)1, Eq. 5(1)1*, H particle-paths in the form of expanding sphere (expandon) is the only entity that can be escaped from the black horizon, it can be compared by far analogy with Hawking's radiation from viewpoint of mass losing, *Sec. 5(7)3, Remark 5(7)3b*.

By differentiating *Eq. 5(20), Sec. 5(7)1*, according to *Sec. 5(16)2a, Eq. 5(67)15b*, we have:

$$\frac{d S_s}{S_s} = \frac{dA}{A} = \frac{2 d l_s}{l_s} = \frac{16\pi^2 G}{c^3}\left(\frac{a_s}{b}\right) \qquad 5(21)d4$$

According to *Eq. 5(21)d4*, and *Eq. 5(21)c,* we obtain:

$$\delta S_u = \frac{dS}{A} = \frac{4\pi^2 k_B}{\hbar}\left(\frac{a_s}{b}\right) = Constant \qquad Remark\ 5(7)6a \qquad 5(21)d5$$

Where:

- S_s – A black hole is surrounded by this spherical surface of the event horizon situated at the Schwarzschild radius.
- k_B – Boltzman constant
- $\hbar$ – Reduced Planck constant
- a_1 , constant of media coefficient, *Note 1(2)1*.
- $a_s = 1 s^{-1}$, *Note 1(2)1,* $b = 1 kg^{-1}, u = 1 m^{-1}$ of inverse dimensions based on units of dimensions in *SI* units.

Therefore, the entropy increment per unit of area of black hole has a discrete value, δS_u, that is directly independent of gravitational constant *G*.

In case of a quantum black hole considering $A = a_0 n$, *Remark 5(7)6b*, we have:

$$\delta S_q = \frac{dS}{n} = \frac{4\pi^2 a_0 k_B}{\hbar}\left(\frac{a_s}{b}\right) = Constant \qquad 5(21)d6$$

Where, δS_q is the entropy-quantized variation in a_0 units.

According to H particle-paths hypothesis instead of considering the area *A* of black hole is quantized with equal spacing between level, i.e. $A = a_0 n$, *Remark 5(7)6b*, we can perform two kinds of assumptions as following:

The entropy of black holes are integer number of δS_q units.

The gravitational expanding spheres (or expandons), *Sec. 5(16)1c, part A3* has n_G (or n_S) stored cells each of *h* value that are revealed during expansion of expandons as real path-length. To each of the latter is attributed an equivalent unit of entropy such as δS_q. In other words, during expansion of expandons at appropriate spacing levels its entropy is increased through δS_q units.

According to above assumption, and considering $A = a_0 n$, by manipulation of *Eqs. 5(21)c, 5(21)d3*, we have:

$$a_0 = \frac{\hbar G n_G}{n c^3} \quad \text{or} \quad Q = \frac{a_0 c^3}{\hbar G} = Constant, \quad \text{or} \quad \frac{n_G}{n} = a_0 \frac{c^3}{\hbar G}\left(\frac{a_1}{a_s}\right) = Q, \ Remark\ 5(7)6b$$

Where:

n_G - is the total equivalent number of H particle-paths related to the gravitational field of mass *M* on a unit of mass $m = 1$, *Sec. 5(1)1*. Please refer to *Remark 5(7)6c*.

N_G - n_G, related to a unit of mass $M = b^{-1}$. Therefore, $N_G = \frac{n_G}{M}$.

Q – is the proportionality factor, i.e. $n_G = Qn$ at maximum expansion.

Comment 5(7)6a – "The analogy between black holes and thermodynamics seem to be more complete. Nevertheless, it is still only an analogy. Still many physicist, believe that such a striking analogy cannot be a pure formal coincidence. It is believed that this could be a key to a deeper understanding of the relationship between relativity and quantum theory. As the correct theory of quantum gravity is not yet known, there is a belief that this deeper meaning will be revealed one day when better understand quantum gravity proportional to the surface *A* of the black hole boundary. Indeed, as entropy is an extensive quantity, one expects that it should be proportional to the black hole volume, rather than to its surface" [410] *section 10B*. "The quantity *S* (black hole) is only analogous to entropy" [410] *section 11*. "The Bekenstein-Hawking entropy of a black hole, like the entropy of any other quantum mechanical system, will turn out to equal the logarithm of the number of quantum states of the black hole"[460]. Based on this discussion we have utilize the stated above analogy in the developing the concept of gravitational expanding sphere of the mass-bodies (or expandons, *Sec. 5(16)1c, part A3*).

Remark 5(7)6a – "A key in black physics is the surface gravity κ, which may be defined for example as the acceleration measured by red-shifts of light ray passing close to the horizon (Helfer 2001)., for a Schwarzschild black hole, one has $\kappa = c^4/4GM$. Since the Schwarzschild radius $R_{Sch} = 2GM/c^2$ (here $l_s = R_{Sch}$), one can think of $c/\kappa = 2R_{Sch}/c$ as the light-crossing time of the hole", "According to Hawking, a free massless field will radiate at a temperature $T_H = (\hbar/2\pi c k_B)\kappa$" [404] *part 2*. Therefore, according to *Sec. 5(7)3, Eq. 5(21)d5*, we have:

$$\delta S_u = \frac{2\pi\kappa}{c T_H}\left(\frac{a_s}{b}\right) = Constant \qquad 5(21)d7$$

Remark 5(7)6b- "A less ambitious program involves attempting to quantize the black hole. As early, as 1974 Bekenstein made the case that the area *A* of the quantum black hole is quantized with equal spacing between levels

$A = a_0 n \quad n = 1,2,3....$

In units where $G = \hbar = `k_B = 1$, and a_0 is constant [406]"

As a result, in the two equations *Eq. 5(21)c, Eq. 5(21)d3,* there is a proportionality between two integer numbers n, n_G respectively.

Remark 5(7)6c – "In classical general relativity the mass spectrum of black holes is a continuum. The scheme suggests that in quantum theory the black hole mass spectrum must be discrete and highly degenerate in the sense that the black hole horizon area is restricted to equispaced levels whose degeneracy corresponds, by the usual Boltzman-Einstein formula, to the black hole entropy associated with each area eigenvalue" [452] *Introduction*. According to H particle-paths hypothesis based on discussion held in this section, the mass is converted to correlated discretized expandons during the time, *Secs. 5(1)1, 5(2)1*; please refer also to *Sec. 5(16)1b, part A, paragraph 18 of Fig. 5(8),* and *Sec. 5(7)7*, *Example 5(7)7a.*

5(7)7 – Black hole discreteness scenario

"In some respect the black hole plays the same role in gravitation that atom played in the nascent quantum mechanics. This analogy suggest that black hole mass *M* might have a discrete spectrum" [452] *Abstract*. "For zero charge and angular momentum the mass spectrum is of the form $M \propto \sqrt{n};\ \ n = 1, 2$ implying the level spacing $\omega_0 = \Delta M / \hbar = \left(8\pi M\right)^{-1} Ln2$ " [452] *The black hole line emission spectrum*. Please refer also to *Comment 5(7)6a*.

By analogy with the above statement from viewpoint of H particle-paths hypothesis, beyond event zone of black hole, and Schwarzschild radius of a normal mass, the gravitational field, and the mass are proportional to Planck constant, and frequencies of some particular entities in nature. Noteworthy, expandons, *Sec. 5(16)1c, part A3*, and contractons, *Sec. 5(2)1c, part c*, that are constituents of H particle-paths ply the role of these entities. According to *Sec. 2(1)3, Eqs. 2(33) to 2(34*), there is a relationship between the mass, Planck constant, and H particle-paths arrangement frequencies. Factually, the frequency of expandon emission (or expandon beat, *Sec. 7(5)3d, part D*) can be deduced based on *Eq. 5(35) of Sec. 5(8)1*. Moreover, the time's arrow interval $d\tau$ between two successive expandons can be obtained from *Eq. 5(51) of Sec. 5(16)1a*. By the way, an emitted expandon in vacuum space is along with a contracton releasing in the related mass at equal frequency of emission. Note that, expandons (of SN_r configuration) propagate in spatial medium on right-handed spirally expanding gravitational sphere, *Sec. 5(16)5* of the gravitational field. Please refer to *Sec. 5(2)1d, part A1,* and *Sec. 5(2)1c, part B* in this respect.

Referring to *Sec. 5(16)1b, part A, Fig. 5(8),* and by analogy with atomic transition, the expandons which are taken form on Schwarzschild surface, i.e. expand through spaced level, $n = 1,2,3,...\infty$, i.e. up to a continuous levels. In other words, according to Delta Effect, *Sec. 2(1)1b,* and path-length constancy, *Sec. 2(1)2*, the spacing between levels is diminished at higher levels. Noteworthy, to each cell, *Sec. 5(16)1b, part A, item 7A*, on a level is appropriate an H hall package, *Sec. 5(16)3a*, of path-length value h, *Sec. 5(16)3g*, and path-limit Γ, *Sec. 5(16)3b, part D2*, just after a measurement (or interaction), *Secs. 8(6)2c, 8(7)2, 8(7)6, part A*. Factually, before the measurement the successive expandons on each level (or state) are correlated together as a unique H system, *Sec. 8(5).* Moreover, the delay time at each level as stated above is equal to $d\tau$, *Eq. 5(5)1*. Please refer also to *Sec. 7(4)1, Comment 7(4)1*, in this regards. "By the usual argument the broadening of a line, $\delta\omega$, should be order τ (here $d\tau$). The typical time (as measured at infinity) between transitions of the black hole from level to level. One may thus estimate the rate of loss of black hole mass as:

$$\frac{dM}{dt} \approx -\frac{\hbar\omega_0}{\tau} = -\frac{\hbar Ln2}{8\pi M\tau}$$ "[452] *the black hole line emission*.

Noteworthy, based on H particle-paths hypothesis the mass diminution is taken place through formation of expandons related to gravitational field generation which is proportional to the mass magnitude, *Sec. 5(1)1, Note 5(1)2.*

Resuming, the mass of a black hole is constructed of superposition of multiple compact H hall packages as shell (or level) as a unique one, *Sec. 7(2)*, of path-length value h. Moreover, according to *Sec. 3(1)1, Figs, 3(2), 3(3),* the total of curled free H particle-paths occupies this unique (or single) H hall package (in a Planck area of black hole) is arranged successively at equal spacing. During the expansion phenomenon, the correlated H hall packages are formed successively from single one, *Example 5(7)7*. This based on idea the mass is contracted form of gravitational field (or vacuum texture, *Sec. 5(16)3b*) and the latter is expanded form of its mass, *Sec. 2(1)3, Note 2(1)3b*.

Example 5(7)7a – The mass can be compared by a far analogy to a play card package that is constituted of superposition of individual cards. Thus, during an expansion simulation, these cards can be arranged successively side by side up to a full expansion. Therefore, the R_n shells in *Eq. 5(55)4 of Sec. 5(16)1a* can be collated with the cards in its package. Please refer also to *Sec. 5(16)3b, part H*.

Remark 5(7)7a- The spacing between the levels in case of contractons is much sharper than the related expandons. It imparts a high frequency to the set (or packet) of contractons respect to the latter ones.

5(7)8- Black hole in the stellar clusters and normal galaxies

"The detection of a *BH* (back hole) in the low-mass stellar suggests that, the most likely candidates for seed massive *BHs* come from stellar clusters. There is a direct link between massive stellar clusters, *Comment 5(7)8a*, and normal galaxies and the formation process of both bulges and massive clusters is similar because of their concordance in the $M_{\bullet}-\sigma$ relation" [476] *abstract*. "The question of how the nuclei of galaxies form and why they contain massive black holes (*BHs*) remain unsolved. However, the recent discovery of a tight correlation between the central *BH* mass and the bulge velocity dispersion (the $M_{\bullet}-\sigma$ relation)" [476] *introduction*. The number of N_{in} H particle-paths towards the center of mass (or central *CMPRF*) and through the mass medium of an H system, (here, back hole mass medium of host galaxy), is related to the number of N_{out} H particle-paths outward that center (here mass-bodies of host galaxy excluding black hole) through the spatial medium. It is based on path-constancy, *Sec. 2(1)2*, according to the following relationship:

$$N_{in}.c\Delta T_{in}=\sum_{n}\overrightarrow{N}_{\alpha out(n)}.cd\,t_{out(n)}\propto\sum_{n}N_{0out(n)}.\overrightarrow{\alpha}_{out(n)}.cd\,t_{out(n)}+\sum_{m}N_{Pout(m)}\overrightarrow{cd}\,t_{out(m)} \qquad 5(25)$$

According to *Sec. 5(16)11*, there is an expanding path-length outward the spatial medium. It is compensated by equal magnitude and opposite sign inward path-length through the mass medium of the black hole that is not shown in *Eq. 5(25)* for the reason of simplicity. According to *Eq. 2(25)*, through increment of the N_{in} total number of H particle-paths of the mass of the black hole (as a form of normal matter), based on the velocity dispersion σ the galaxies' bulge speed at radial direction from the black hole center of mass will be increased. It is in accordance with the self-accelerating of a mass-body cited in *Note 5(16)3g, C1*, and black hole mass growth, *Sec. 5(15)2b*, during long period of time that leading to expansion of the Universe. Please refer also to *Sec. 5(15)1*, and *Sec. 8(7)2, part E5, Schema E5a*. At non-relativistic level in *Eq. 5(25)* $\alpha\rightarrow v/c$, Moreover in case of particle of zero rest mass constituted of N_P H particle-paths, the path-length is the left-side last summation of *Eq. 5(25)* . Please refer to *Sec. 2(1)1b, Eq. 2(22),* and *Sec. 5(9)3d, part A, Eq. 5(38)1*. Moreover, according to *Sec. 2(1)3, Eqs. 2(33), 2(35)*, there is a relationship between total number of the H particle-paths of the mass of the bulge and black hole as following:

$$\frac{N_{in}}{N_{out}}=\frac{M_{bh}}{M_{bulge}}\quad,\ Note\ 5(7)8a \qquad 5(26)$$

In other words, the path traveled by H particle-paths inward the black hole at its mass medium is proportional to the total algebraic sum of paths traveled by H particle-paths of the bulge at spatial medium.

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 ", please refer to *Sec. 2(1)1a, Eq. 2(7)*
- N_{α}, single direction (or returned) H particle-paths of a mass-body of the bulge of N_{out} total number of H particle-paths, *Sec. 2(1)1b, Eq. 2(22)*
- ΔT_{in}, the partial time interval of internal motion of H particle paths through black hole mass medium constituted of N_{in} total number of H particle-paths
- dt_{out}, proper time of *LFRF* of a mass-body of the bulge of N_{out} total number of H particle-paths respect to *CMPRF*'s observer at the center of mass of the bulge (or its black hole)
- v_{out}, the velocity of a mass-body or particle of N_0 initial H particle-paths at rest state of the bulge at non relativistic level related to external (or common) motion of its H particle-paths, *Sec. 1(3)*
- M_{bulge}, the mass of the host galaxy (excluding black hole mass)
- $M_{\bullet}$ (alternatively M_{bh}), the mass of black hole in host galaxy (or cluster)

Noteworthy, according to *Sec. 5(9)3, part c*, at equilibrium stage of gravitational interaction of two mass-bodies, *Fig. 5(5)2,* there is a flow of contractons exchange between the mass-bodies at equal magnitude and opposite signs. In case of mass-body *1* regarded as black hole, it absorbs the received contractons L_{c2} from the mass-body *2* along with its mass increment. Therefore, it is leading to radial velocity increment of the mass-body *2* in opposite direction to black hole, i.e. mass-body *1*. It is in accordance with the acceleration of a mass-body cited in *Sec. 5(15)1*, *Note 5(7)8b*. According to *Sec. 5(15)2b*, the stated above process is performed at the expense of dark matter, and the black hole and host galaxy act as normal matter convector, *Sec. 5(7)9*.

Any of two-mass-bodies has a common *CMPRF, Sec. 5(9)3*, in a system of mass-bodies, the *CMPRF* of any two mass-bodies has also a common *CMPRF* of its mass-bodies, and so on up to a system of stars in a galaxy (or cluster), that have a common *CMPRF* with its origin on the related center of mass. On the other hand, according to *Sec. 5(9)3c*, and *Sec. 5(9)3d, part c*, the mass-bodies are correlated through their common H hall package, *Comment 5(16)2a1*, that leading ultimately to the center of masses of galaxy, please refer also to *Secs. 5(9)3b, d*. As a result, the contractons generated through the correlated mass-bodies of a system of cluster or galaxy finally are conducted to the black hole formed in the origin of *CMPRF* of the whole cluster or galaxy, *Note 5(7)8*c. Therefore, absorbed at irreversible manner by the black hole, thus its mass increased and gained an appropriate motion in opposite direction to the central black hole, and leading to a relationship as in *Eq. 5(25)*. On the other hand, the black hole mass is also

decrease through exit of its gravitational field expandons. In other words, there is a trend of left-handedness increment in its mass medium, *Sec. 7(4)3, part D*, and galaxy (or cluster) mass-bodies accompanied by an equal trend to right-handedness in the spatial medium, *Sec. 7(4)3, part A*, please refer to *Sec. 5(16)11*.

Resuming, as stated above based on path-constancy, any inward of contracting path-length of H particle-paths of type L_c towards back hole is equal to outward expanding path-length of type R_e of host galaxy mass-bodies and particles including black hole expandons, but at opposite signs. In other means, there is a network of common H hall package tunnels, *Sec. 5(9)3b*, between the mass-bodies and particles in a system of galaxy (or cluster) that conducts spontaneously, *Sec. 7(4)2f, part c*, their generated contracton by mass-bodies and particles to black hole as an absorbing entity, *Example 5(7)8a*.

Example 5(7)8a- By a far analogy, the black hole in host galaxy acts as the brain in a human body. Moreover, the nerves in the latter act as common H hall package tunnels in the former one. Therefore, any Planck area on the Schwarzschild surface (or event zone, *Sec. 5(16)2*) of the black hole through its related cone-like cavity, *Sec. 5(2)1d, part D*, is correlated individually to a mass-body as an H hall package tunnel. It is analogous to a nerve (as tunnel) in neural system (tunnels network) that is attached to a neuron cell (as Planck area) in the brain. As a result, the mass-bodies motion information of host galaxy are accepted (or absorbed) by its central black hole, please refer also to *Sec. 5(7)3*. According to *Sec. 8(7)2, part E5*, analogous to the nerves in neural system, any particle that have an individual (or single) reverson, *Sec. 7(5)3*, is attached to the black hole by a common H hall package. Therefore, any information related to particle history is registered successively by contractons that are transferred by particle to a single n_s (or n_G) cell, *Sec. 5(7)6,* of black hole in such a manner that to each particle of the mass-body is related an individual H hall package tunnel. *Example 5(7)8a-* By a far analogy, the black hole in host galaxy acts as the brain in a human body. Moreover, the nerves in the latter act as common H hall package tunnels in the former one. Therefore, any Planck area on the Schwarzschild surface (or event zone, *Sec. 5(16)2*) of the black hole through its related cone-like cavity, *Sec. 5(2)1d, part D*, is correlated individually to a mass-body as an H hall package tunnel. It is analogous to a nerve (as tunnel) in neural system (tunnels network) that is attached to a neuron cell (as Planck area) in the brain. As a result, the mass-bodies motion information of host galaxy are accepted (or absorbed) by its central black hole, please refer also to *Sec. 5(7)3*. According to *Sec. 8(7)2, part E5*, analogous to the nerves in neural system, any particle that have an individual (or single) reverson, *Sec. 7(5)3*, is attached to the black hole by a common H hall package. Therefore, any information related to particle history is registered successively by contractons that are transferred by particle to a single n_s (or n_G) cell, *Sec. 5(7)6,* of black hole in such a manner that to each particle of the mass-body is related an individual H hall package tunnel. Sophistically, the neuron cells of a brain in a body are attached to the related cells in the black hole via H hall package tunnels. Thus, the information of a brain in a body is linked to related cells in the black hole. In other words, there is no information interchangeability between two brains of two bodies. Thus, I can never be you or vice versa in this regards, i.e. two separate spirits in two separate bodies. Noteworthy, you and I can never exist in a single body, but in two separate ones. Resuming, the spirit (or information of human being) can be conserved after the death of a human being by black hole based on imprinted existence of entities during Universe evolution, *Sec. 5(15)3d*.

Note 5(7)8a- "These black hole effects arise as a space-self-interaction dynamical effects, and that the observed correlation is simply the $M_{bh}/M_{bulge} = \alpha/2$ for spherical system, where α is the fine structure constant ($\alpha = e^2/\hbar c = 1/137.036$)"[477] *introduction*. Please refer to *Sec. 9(4)6* for an interpretation of fine structure constant α from viewpoint of H particle-paths hypothesis. "If black hole mass is assumed to be proportional to bulge mass, it follows that M_{bh} should scale approximately as σ^5, which is the $M_{bh} - \sigma$ relation. (There is independent evidence for proportionality between M_{bh} and M_{bulge} the so-called black hole mass-bulge mass relation") [478] *origin*. "The M-sigma (or $M_{bh} - \sigma$) relation is an empirical correlation between the stellar velocity dispersion σ of a galaxy bulge and mass M_{bh} of the super-massive black hole at the galaxy's center. The relation can be expressed mathematically as $M \propto \sigma^{\alpha}$, the most recent estimation of the value α, based on a comprehensive survey of all known black hole masses gives $\alpha = 4.86 \pm 0.43$ roughly" [478] *introduction*. The M-sigma relation is based on path constancy and correlation of galaxy mass-bodies through their common H hall package tunnels to their central *CMPRF*, i.e. black hole. "It is likely that $M_{bh} - \sigma$ relation is established during the active galactic nucleus (*AGN*) phase of galaxy's life cycle, since energy emitted by the *BH* may simultaneously limit the gas supply for building both the bulge and *BH* itself"[479] *introduction*. Note that, the path of H particle-paths of particles of zero rest mass, and the H particle-paths of gravitational fields (expandons) act the same role as H particle-paths of mass-bodies in *Eq. 5(25).*

Note 5(7)8b-

*Note 5(7)8*c- Generally, any irreversible (or destructive) interaction (or measurement, Sec. *8(7)2*) e.g. gravitational, glass smash, fuel burning, leading to contracton formation, that are absorbing (or detecting) spontaneously by super massif black hole in host galaxies or clusters. The irreversible absorption of contracton related to generation of expandons of gravitational sphere makes the spatial expansion related to expandons also irreversible based on path-constancy, *Sec. 2(1)2*; i.e. birth of type *R* H hall package of irreversible path-length of value $2\hbar$, *Sec. 2(4)4,* related to each of expandons accompanied by time's arrow, *Sec. 5(16)7*. In other words, generation of expanding type R_e path-length related to entropy in spatial medium is along with contracting type L_c path-length related to negentropy, *Sec. 5(16)9d*, in mass medium of galaxies mass-bodies, particle and related black hole at equal magnitude, but at opposite sign, *Sec. 5(16)11*. Noteworthy, the irreversible absorption (or trapping) of a particle by black hole can be regarded as a kind of detection (or measurement, *Sec. 8(7)2*).

Comment 5(7)8a- According to Ketab-e-sharrif, the clusters are resembled to group of stars in the heavens. “Blessed is he who made the constellations (or clusters) in the heavens and made therein a lamp (light) and shining moon.

5(7)9- Self-accelerating particles

The first right side of *Eq. 5(25)* of *Sec. 5(7)8,* is related to contracting type L_c path-length, while the left side of that is depending on expanding type R_e path-length at equal magnitude and opposite signs. Therefore, the algebraic sum of type R_e path-length in the whole galaxy (or cluster) is zero, *Sec. 5(16)11*. Therefore, any mass increment in the black hole is along with velocity dispersion increment of ingredients in the bulge side of equation at the expense of dark matter, *Sec. 5(1)2*, to dark energy, *Sec. 5(15)2*. Factually, the whole bulge can be regarded as an expanding H system at an average radial rate. The initially energetic particles of cosmic rays are accelerated according to this process along with velocity increment. Therefore, becoming gradually as ultra high energy cosmic rays during their travel along with apparent energy, *Sec. 5(15)1* due to self-acceleration in addition to their initial energies; please refer also to *Note 5(15)3d, B4*." Prof Subir Sarkar of Oxford University, a member of the Collaboration, said: 'The Auger data indicate that the sources of ultrahigh energy cosmic rays are associated with nearby 'active galaxies' which harbour supermassive black holes that are gobbling up stellar matter." As the black holes swallow gas, dust, and other material from their host galaxies, they spew out particles and energy. "Our own galaxy too has such a black hole at its centre but, fortunately for us, it is not 'feeding' at the moment!"[591]. Thus, according to this idea and above discussion, the suppermassive black hole of host galaxies and clustersbot throw out and accelerate the the energetic cosmic rays' particles. "If these ultra-high energy cosmic rays (*UHECRs*) are protons, they are likely to originate in extragalactic sources, since at these high energies the Galactic magnetic field cannot confine protons in the Galaxy."[593] *Introduction*. Therefore, the cosmic rays during high intergalactic time travel increase highly the apparent energy of initially lower energy cosmic ray particles based on discussion held in *Sec. 5(15)1*."We do not know what the origin of the knee (at $4\times10^{15}eV$) is, and what physical processes can give rise to particle energies in the energy range from the knee to the ankle (at $5\times10^{18}eV$). The particles beyond the ankle have to be extragalactic, it is usually assumed, because the Larmor radii in the Galactic magnetic field are too large"[594] *Abstract.* The *HPPH*, based on self-accelerating particles has a convenient response to this problem.

5(8) – Planck and Schwarzschild scales

5(8)1 – Preliminary step

According to the general theory of relativity, associated to any mass *M* there is a length” called Schwarzschild radius l_s such that supposing compressing an object of mass m to a size smaller than this result in the formation of black hole.

$ls = GM/C^2$ *Note 5(8)1a* 5(31)

According to *Eq. 2(7), Eqs. 5(2) to 5(5), Eq. 5(31), Eqs. 6(6)* to *6(8),* at any arbitrary time and distance of interacting masses, m_1, m_2, we have:

$$\alpha_1 l_{S1} = \alpha_2 l_{S2} \qquad 5(32)$$

Where:

1) α_1 , α_2 are the ratio number of altered shape, i.e. number of affected, H particle-paths during interaction to the total number of H particle-paths of masses m_1, m_2, respectively.

2) l_{S1} , l_{S2} are the Schwarzschild radius of masses m_1, m_2 respectively, please refer to *Sec. 2(1)1a, Eq. 2(7).*

The Planck length, l_p, is extremely small about $1.6\times10^{-35}m$ and obtained according to the following equation:

$$l_P = \sqrt{\frac{\hbar G}{c^3}} \quad \text{, Note 1(12)2,} \qquad 5(33)$$

According to [310], "In physics, the Planck time (t_p), is the unit of time in the system of natural units kwon as Planck unit. It is the time would take a photon traveling at the speed of light c to cross a distance equal to Planck length, it is defined as:

$$t_p = \sqrt{\frac{\hbar G}{c^5}} \approx 5.39121(40)\times10^{-44}s \qquad 5(33)1$$

Therefore, according to *Eq. 5(33):*

$$t_p = \frac{1}{c} l_p \qquad 5(33)2$$

Referring to *Sec. 5(16)1a, Eq. 5(49),* l_p , l_s , *Eq. 5(31),* can be deduced as following:

$$l_p = \frac{\sqrt{A}}{2\pi}\hbar\left(\frac{bu}{a_s}\right), \qquad l_s = \frac{mA\hbar c}{4\pi^2}\left(\frac{bu}{a_s}\right)^2 \qquad 5(33)3$$

According to *Eq. 3(9),* the Compton wavelength, $lc,$ is obtained as follows:

$$l_C = \frac{\delta l}{2} = \frac{h}{mc} \qquad 5(34)$$

Thus, the Planck area is the square of Planck length, i.e. l_p^2.

$$M_p = \sqrt{\frac{\hbar c}{G}} \qquad 5(34)1$$

The two length l_s, l_c become equal when m is the Planck mass, M_P, and when this happens, they both equal to Planck length, lp.

By manipulation of *Eqs. 5(31), 5(34)1*, it can be expressed in terms of l_p, M_p, t_p:

$$G = \frac{l_p^{\,3}}{M_p \cdot t_p^2} \qquad 5(34)2$$

Noteworthy, According to [290], *part 4,* "the only thing that counts in the definition of worlds, are the value of the dimensionless constant of Nature. If all masses were doubled in value [including Planck mass m_p] you can not tell because all the pure numbers defined by the ratios of any pair of masses are unchanged"

"The dimensions assigned to gravitational constant (length cube divided by mass, and by time squared) are those needed to make gravitational equations come out. However, these dimensions have fundamental significance in terms of Planck units: when expressed in *SI* units, the gravitational constant is dimensionally and numerically equal to cube of the Planck length divided by Planck mass and by square of Planck time"[390].

The ratio R_n (i.e. the number of n_s collection) of the total H particle-paths of a mass m to its n_s, is obtained by dividing the total number of H particle-paths, N_0, *Eq. 2(35)* of a mass m to its total number of H particle-paths in a gravitational expanding sphere, n_s, *Eq. 5(1), 5(5).* According to that, and referring to *Sec. 5(2)1c, Eq. 5(11)b1*, we have:

$$\frac{M}{dM} = R_n = \frac{N_o}{n_s} = \frac{N_o}{K_G n_G} = \frac{c^3}{8\pi^2 G}\left(\frac{b}{a_s}\right) = 1.71\times 10^{33} = \quad \textit{dimensionless constant} \qquad 5(35)$$

.

According to *Eqs. 5(37)2, 5(33), 5(35),* we have:

$$V_{\min} = \frac{h}{16\pi^3 R_n}\,\Gamma\left(\frac{b}{a_s}\right) \qquad \text{or} \qquad 5(36)$$

$$l_p = \frac{1}{4\pi}\sqrt{\frac{2\hbar}{R_n}\left(\frac{b}{a_s}\right)} \qquad 5(37)$$

Supposing, V_s is the symbolic volume of a particle(e.g. electron, proton,…) with N_0 initial H particle-paths, according to *Eqs.1(3), 5(36),*we have:

$$V_s = N_0 V_{\min} = \frac{N_0 h}{16\pi^3 R_n}\,\Gamma\left(\frac{b}{a_s}\right) = \frac{h K_G n_G}{16\pi^3}\,\Gamma\left(\frac{b}{a_s}\right) = \frac{hc K_G n_G}{16\pi^3 a}\left(\frac{b}{a_s}\right) \qquad 5(37)1$$

Where:

- $a_s = 1s^{-1}$, *Note 1(2)1,* $b = 1kg^{-1}, u = 1m^{-1}$ of inverse dimensions based on units of dimensions in *SI* units. Please refer to *Sec. 5(7)1, Eq. 5(21).*

- a, media coefficient, *Note 1(2)1*, in case of vacuum gravitational field free, $a = a_d \approx 3.5\times 10^{-12} s^{-1}$, *Sec. 7(4)3, part H.*

Therefore in case of free moving electron and proton their V_s volumes are equal to $0.83\times 10^{-29} m^3$ and $1.77\times 10^{-26} m^3$ respectively.

As the result the gravitation is independent of the shape of atoms, molecules, leptons, etc… and exclusively related to the mass of the total number of H particle-paths, N_0 or, the total number of H particle-paths on gravitational spheres n_s, *Eq. 5(35).*

Note 5(8)1a- The Schwarzschild radius is related to a 3-dimension space and one-dimension time at macroscopic level. Factually, according to *Sec. 2(1)1d*, our world at microscopic level has 5-dimensional characteristic. In other words, the spin of H particle-paths can be regarded as fifth dimension. Based on an assumption any extra dimension setting an appropriate radius in this regards that leading to Schwarzschild radius in 4-dimensional space and one-dimensional time coordinates. "Of particular importance and simplicity, are the higher dimensional black holes that have a horizon radius (r_H) much smaller than the size of extra dimension *(R)*, i.e. $r_H << R$ ". "The fact that the Schwarzschild radius in *D>4* dimensions is larger than the one in *D = 4* for a given mass M_{BH} (of black hole)". "If we further assume that the produced black hole is spherical symmetric, i.e. non-rotating, the gravitational background around this black hole is given by a generalized Schwarzschild line-element"[454] *Properties of the higher-dimensional mini-black holes*. According to *Sec. 5(2)1c, part c*, contractons leading to micro black holes formation. Noteworthy, the H hall package, *Sec. 5(16)3a*, of path-length value h, *Sec. 5(16)3g*, will be putting a constraint to an H system at microscopic level.

5(8)2 - Maximum density referred to a mass

The minimum volume, V_{min}, *Note 5(8)2a*, or space that can be specified to an H particle-path of an H system moving at c speed per unit of time is obtained
according to *Eqs. 1(1), 1(3), Eq. 2(86), Eq. 5(33),* and Planck's area:

$$V_{min} = \Gamma \times Planck's\ \ area = \Gamma \times l_P^2 = \frac{hG}{2\pi a c^2} = 7.77\times10^{-62} a^{-1}(u^{-3}) \qquad 5(37)2$$

Where:

- l_p is Planck length, *Eq. 5(33),* Γ is path-limit, *Sec. 1(12).*

- $a_s = 1s^{-1}$, *Note 1(2)1,* $b = 1kg^{-1}, u = 1m^{-1}$ of inverse dimensions based on units of dimensions in *SI* units.
- a, media coefficient, *Note 1(2)1.*

Therefore, in case of vacuum gravitational field free, $a = a_d \approx 3.5\times10^{-12}s^{-1}$, *Sec. 7(4)3, part H,* $V_{min} = 2.22\times10^{-50}m^3$

According to *Eq. 2(86), Notes 2(3)2, 2(3)3*:

$$\Gamma = \frac{c}{a} = =N_{max}\times l_p = \frac{M_{\max} c^2}{a_1 h} l_p, \text{ or, } N_{\max} = \frac{c}{a} l_p^{-1} = \frac{1}{a}\sqrt{\frac{c^5}{\hbar G}} \qquad 5(37)3$$

According to *Eqs.5 (20) , 5(37)2:*

$$D_{max} = \frac{M_{\max}}{V_{\min}} = \frac{a_1 h}{c^2} l_p^{-3} = \frac{a_1 h}{c^2}\left(PlanckVolume\right)^{-3} \qquad 5(37)4$$

Where:

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

-D_{max}, is the maximum density (a constant value) before transition to black hole stage, or, in other words, mass of an H particle-path per one Planck volume. Since, $a_1 h/c^2 orH/c^2$ means mass related to one unit of H particle-path.

-N_{max}, is the maximum number of H particle-paths in a path-limit, Γ, *Eq. 5(37)2.* Please refer to *Sec. 5(8)1*, in the cases of length, time, and mass at Planck scale.
As a result, according to *Eq. 5(37)4,* D_{max} has a constant value.

Note 5(8)2a- "The possible values of volume and area are measured in units of a quantity called, the Planck length. Thus, length is related to the strength of gravity, the size of quanta and the speed of light. It measures the scale at which the geometry of space in no longer continuous. The smallest possible non zero area is about a square of Planck Length. The smallest non zero volume is approximately a cubic Planck Length."[585] *a big loophole*.