8(7)2 – Measurement from viewpoints of H particle-paths hypothesis

A) Proposal 1

The intermediate state, $A\cdots B\cdots M$, *Sec. 8(6)1, Eq. 8(8),* is a pseudo-unique H system, *Sec. 7(4)2b, Eq. 7(20)*. It is formed from overlapping of two H hall quantized packages, *Sec. 5(16)3a, A-B* and *M*. At this stage, the intermediate mixed $A\cdots B\cdots M$ H system is converted finally to *(A)* and $(B \Leftrightarrow M)$ during decoherence time (or stay time) ΔT_P, *Sec. 8(7)2, part E2*. As an example we can refer to Schrödinger cat paradox; where, *A-B* state is alive state cat, $A\cdots B\cdots M$ mixed intermediate state (i.e. the cat in the box state), *B-M* is dead cat state. A radioactive decay, *Comment 5(15)3d, A2*, according to *Sec. 5(16)6, Comment 5(16)6a, Eq. 5(70)8a*, is accompanied by exit of an H hall package of *BM* component that can be viewed as thermodynamically irreversible process, *Remark 8(7)2, A1*. Therefore, the intermediate state tends to irreversible *BM* formation, by analogy with chemical reaction equilibrium, which tends to right side of reaction, through exit of one of the components of this side, *Sec. 7(5)3c, Part B*. In other words, the reaction is conducted to the right side, i.e. *B-M* formation, due to the radioactive source decay (β decay) *Eq. 5(70)8a,* and poison flask smash, i.e. thermodynamic irreversibility. Moreover, the remnant H hall quantized packages exit through *A*, i.e. Cat spirit!!!, *Remark 8(7)2, A2;* whereas, *B* is cat body. Factually, the state of *(A)* can be split to two types *R* or *L* according to bi-Universe hypothesis, *Sec. 5(16)6a*, at the moment of measurement of *(B)* by *(M)* up to measurement of *(A)* by a measuring device. Noteworthy, in the left side of, *Eq. 8(8),* two H hall quantized packages related to (*AB*) and *M* is contracted to the intermediate one *A…B…M*, H hall quantized package, *Note 8(7)2, A1*. As the equation proceeds to the right side, *A…B…M*, H hall quantized package converts to two H hall quantized packages related to *A* and *BM* separately through irreversible exit of the latter, *Comment 8(7)2, A1*; therefore, the whole, *Eq. 8(8),* seems to proceed instantaneously, *Sec. 7(4)2f, part c*, to the right side.
Noteworthy, the intermediate state $A\cdots B\cdots M$ can be compared to some extent with the Everett's relative-state (denoted by state *E*), *Comment 8(7)2, A2*. "Let one regard an observer (i.e. *M*) as a subsystem of the composite system *observer + object* (i.e. *M + AB*)"[330] *part 3*. Considering Universe as counter-current matter and antimatter one, *Sec. 5(16)9b*. The slight preference of matter one, *Sec. 5(16)9c* respect to strong interaction (or measurement); there are an equal probability of spin up and down through the measurement. Moreover, an unequal probability during a measurement is related to somehow unaffected part of the system under investigation during measurement according to *Mirror Image Effect*, *Sec. 6(2)3*. In fact, *GR, SR, QM* theories are far from the latter, a modified form of famous Newton's third law considering H particle-paths hypothesis. The measurement in *QMT* is a door that is opened to this region. Therefore, the problematic dice playing can be solved on this basis. "In the state described by *E* there are two observers each occupying a different world and each with a perfectly determine measurement record"[330], *part 5*. Note that (here) *E* state related to spin up and spin down measurement of an entangled pair of particle. The massif aspect of macroscopic measuring device (i.e. lab) is equivalent to fully reversibility of its H particle-paths before and after interaction. Therefore, in case of macro-body measuring device, we encountered with equal probability of counter-current universes during a measurement of micro-body particle that affects the detection.
Factually, the process of measurement in a lab reveals the aspect of the moving particle relative to the lab observer. Therefore, it depends on inertia (or mass) and velocity of the lab if it is moving. In other words, it may be ended to different results other than in stationary lab. Please refer to *Sec. 2(6)4,* and *Sec. 8(7)2,* according to which there are a secondary correlation between entangled pair of particle and the source.
Please refer to *Sec. 8(7)1d* in case of decoherence aspect of a measurement.
Remark 3(1)1, E5d-

Note 8(7)2, A1- According to *Sec. 7(4)2b, Eq. 7(20),* the non stable intermediate state $A\cdots B\cdots M$ by an analogy can be compared to *No. 4* H hall package of the excited electron that is accompanied by a baby H hall *No. 3* related to reversible (or pseudo) expandon, *Remark 7(4)2b2,* each of path-length value h. Therefore, the intermediate state has a stay time ΔT (or lifetime), *Sec. 7(4)2f, part A*.

Comment 8(7)2, A1- At the end of the intermediate stage, *BM* in its ultimate stage, i.e. end of interaction (or measurement), can be regarded as a unique H system, *Sec. 8(5)*; thus, it is analogous to *AB* before interaction. The quantum mechanical interpretation that observations create reality is analogous to a baby that is born from its parents inherits the characters of their. Thus, particle during a measurement inherits the characteristics of both environment and particle before detection.

Comment 8(7)2, A2- The intermediate state $A\cdots B\cdots M$ can be analyzed to two states based on bi-Universe hypothesis. According to *Sec. 7(4)2f, part A*, the alive or dead cat in the intermediate state can be related to type R_e or type L_c Universes during stay time intervals ΔT successively with slight preference of the former one. "In the case of Schrödinger's cat, when we open the box the universe splits into two: the cat is alive in one universe, and dead in the other"[553] *Decoherence and the Many-Worlds Interpretation*. Moreover, the stay time ΔT , *Sec. 8(7)2, part E2*, depends inversely to the inertia of the intermediate state. "The reason we never see Schrödinger cat both dead and alive (in intermediate state) at the same time is because decoherence takes place within the box long before we open it. This is due to the device housing the radioactive nucleus and the position. This is what macroscopic environment immediately surrounding the radioactive nucleus"[553] *How the environment eliminates interference effects.*

Remark 8(7)2, A1- In case of Schrödinger cat paradox, the radiation decay, glass smash, and cat death that are all as irreversible process, i.e. irreversible interactions. Therefore, according to *Sec. 5(7)3*, the contractons related to an irreversible interaction are absorbed, *Sec. 8(7)2,* (or registration) by super-massif black hole of the host galaxies or clusters. Similarly, the related wave functions are collapsed accordingly. As a result, without direct knowledge of human, *Sec. 5(16)7g*, absorption (or measurement) is performed. Thus, the released P_R & P_L contractons will collapsed the related wave function spontaneously, *Sec. 7(4)2f, part c*, through their irreversible absorption by black hole, *Sec. 5(9)3d, part D*.

Remark 8(7)2, A2- According to *Sec. 8(1)5*, The entity *A* can be simulated to expandon branch of cat wave function. It contains the information history packet of the cat brain. While, dead cat body *B* is depends on contracton branch of the cat wave function in mass medium, *Sec. 7(4)3, part D,* that can be absorbed by black hole , *Sec. 5(7)8*, or, transferred to a world of multiverses as imprinted existence of the cat, *Sec. 5(15)3d, Part A*. Factually, *AB* can be regarded as cat alive; it is all the time at intermediate state *ABM* of cat life based on bi-universe hypothesis, *Sec. 5(16)9*. During each infinitesimal time interval ΔT its state changed successively to type *R* or *L* configuration, *Comment 5(15)3d, B2*, i.e. cat alive or dead with slight preference of type *R* over *L* one in our matter Universe. Resuming, at any infinitesimal time interval ΔT , a living body state is at expanded mode, *Sec. 8(7)2, part G*, of the intermediate state *ABM* of a world of many worlds, *Sec. 5(15)3d, part B, proposal 4*; while, other *ABM* states are in contracted mode. The intermediate state alive-dead *ABM* is at slight preference of alive over dead until an interaction as in Schrödinger cat paradox that deteriorate this complex intermediate state at an irreversible manner. Noteworthy, the intermediate state at ordinary (or non-interacting) case has a reversible character as in a living body; while, through an irreversible phenomenon or chain of irreversible phenomena, e.g. radio active decay, poison glass smash, and irreversible biological defects in cat body, the reversibility of intermediate state is broken towards dead cat state *BM* constituting of contracting H particle-paths. While, entity *A* is of expanding H particle-paths equivalent to energy in spatial medium. Factually, the entity A is constituted of two parts, *1*) part related to dead cat body, *2*) part related to living cat body.

B) Proposal 2

Considering:

1) The case of the entangled pair of photon *AB* emitted by source *S*; thus, there are a correlation $A \cdots S \cdots B$ in an H hall package. *2)* H system *B* is detected by *M*; thus before detection (or measurement), we have $A \cdots S \cdots B \cdots M$, *Sec. 8(7)2, part D*, and after detection $A \cdots S \cdots BM$, *Note 8(7)2, E1a*, if the source and detector is related to a massif H system, e.g., the Earth. Therefore, we have $A \cdots SBM$, *Remark 8(7)2, B1*, in the latter example of *SBM* H hall Unit is the same as the Earth, i.e. *SBM = the Earth.* Since, there are a correlated H hall package $A \cdots E$, *Example 8(7)2, B1*, as a unique H system, *Sec. 8(5).* In fact, the wave function of element *A* is entangled with that of the measuring device, *Example 8(7)1a1*. Note that $E = SBM = theEarth$ due to massif mass of the latter, i.e. a unique H hall package *E* (or better to say by definition M) that is linked with that of *A*, *Remark 8(7)2, B1, B2*. Moreover, in this proposal, the Earth (lab) is regarded as emitter and detector during measurement. Resuming, at this stage the undetected photon *A* constitutes a unique H system with the Earth through its propagation. Therefore, its propagation undergoes γ^{-1} contraction factor, *Sec. 2(6)5b*, respect to an observer in the Earth (lab) according to *SRT*; whereas, respect to an observer at a non-correlated moving system at v speed, e.g., a star, it has a virtual velocity $c + v$, *Sec. 2(6)5b, Example 2(6)5b1*, i.e. no γ^{-1} contraction.

Example 8(7)2, B1– If particle *B* is measured (or better to say correlated) by *M* as right-handed (or up spin) configuration, the entangled counterpart *A* is correlated by source *S* as left-handed (or down spin) configuration, and vice versa. Moreover, there are no wave function collapsing of particle *B* during measurement, but instead the *B*'s wave function is dissipated in the Earth, *E*, huge wave function, *Sec. 8(7)2, part E*, and *Sec. 8(1)5,* or, in other words, becoming negligible respect to that of the Earth. Alternately, the H hall packages, *Sec. 5(16)3a*, of *B* and *E* overlapped on each other as a unique H hall package. Noteworthy, a photon that is absorbed by an atom on the Earth, its H particle-paths is contributed with all of the H particle-paths of the Earth as a unique H system, *Sec. 8(5),* (or a unique wave function). In other words, the photon's H particle-paths are interchanged continuously with that of the Earth, i.e. environment, therefore the captured photon by the absorbing atom of the Earth can be regarded as localized due to huge inertia of the Earth; please refer also to *Sec. 5(16)3b, part c*; *Sec. 8(7)6, part c.* Noteworthy, in case of photon-absorption and emission by an isolated atom, a pseudo-unique H system is formed; please refer to *Sec. 7(4)2b, Eq. 7(20).*

"Eberhard proved that (if quantum mechanics is correct) all Quantum Appearance must be local. Here, the term *Quantum Appearance* means *Statical Average*". "So quantum theory is statically local"[346], *Eberhard's proof.* Eberhard's proof shows despite of entanglement "It is impossible in the world of appearance using current physical processes to send faster than light messages via the quantum entanglement channel"[346], *Mind over matter.*

Remark 8(7)2, B1– Referring to *Sec. 8(7)2, proposal 2* and *Example 8(7)2, B1*, "The composite of electron, apparatus and environment will be a sum of a state corresponding to the environment coupling to the apparatus coupling in turn to the value +1/2 for the spin. And of a state corresponding to the environment coupling to the apparatus coupling in turn to the value -1/2 for the spin"[343] *Section 3.1.*

Remark 8(7)2, B2– "Quantum interconnectedness has received some attention in the last decades; physicists have come to realize that the Universe is interconnected in much subtler ways that has once though. In quantum physics the observer and the observed can no longer be separated and the whole is more fundamental that the part"[342] *Welcome*. "You really cannot separate the object being measured from the device performing the measurement or observation - you have to consider them as a single system". "The particle and the environment are bound together as one system"[553] *Introduction*. "What happens in the real world is that a particle is not perfectly isolated: a particle inevitably interacts with the environment. These interactions have the effect of the particle "being observed" by the environment - the "environment" might very well be a man-made measuring device". "What happens to a quantum particle in the real world is that each of its component states gets entangled (separately) with different aspects of its environment"[553] *How the environment eliminates interference effects*.

C) Measurement according to bi-Universe hypothesis

"Yet while one of the most famous foundational problems in quantum mechanics, namely the quantum measurement problem, remains unsolved even within quantum information theory (see Hagar 2003 and Hagar and Hemmo 2006 for a critique of the quantum information theoretic approach to the foundations of quantum mechanics and the role of the quantum measurement problem in this context), quantum information theorists dismiss it as a philosophical quibble (Fuchs 2002). Indeed, in quantum information theory the concept of "measurement" is taken as a primitive, a "black box" which remains unanalyzed (see Dickson 2005 (Other Internet Resources) for a discussion on this view in the context of the "one way" quantum computer). The measurement problem itself, furthermore, is regarded as a misunderstanding of quantum theory. But recent advances in the realization of a large scale quantum computer may eventually prove quantum information theorists wrong: Rather than supporting the dismissal of the quantum measurement problem, these advances may surprisingly lead to its empirical solution"[600] *Experimental metaphysics?*.Passing an electron beam through an analyzer *(I),* the half of the electron have spin up along *z*-axis (or *z*- direction) and other half spin down along *z*- direction. Now, passing the electron beam of spin up along *z*- direction through second analyzer *(II)* as a measuring device, half of the electron initially at *z*- direction split to spin up along *y*- direction and other half spin down in opposite *y*- direction and so on. According to bi-Universe hypothesis both analyzers *I, II* as measuring devices individually split the electron spin to up and down at equal probabilities on the basis of Mirror Image Effect, *Sec. 6(2)3*. Factually, each analyzer as a measuring device that is constituted of counter-current H particle-paths has a main role during each measurement or interaction). "To perform a measurement, one must introduce the degree of freedom of the measuring apparatus, which before the measurement, is described by some state $|\phi\rangle$. In an ideal measurement, the interaction between the measured degree of freedom and the degree of freedom of the measuring apparatus must be such that the total quantum state exhibit entanglement between these two degrees of freedom, so that the total state takes the form:

$$|\psi\rangle = \sum_a C_a |\psi_a\rangle|\phi_a\rangle \qquad 8(8)1 \qquad \text{instead of } |\psi\rangle = \sum_a c_a |\psi_a\rangle \qquad 8(8)2$$

Where, $|\phi_a\rangle$ are orthonormal states of the measuring apparatus. Thus, whenever the measuring apparatus is found in the state $|\phi_a\rangle$, one can be certain (at least theoretically) that the state of the measured degree of freedom is given by $|\psi_a\rangle$. Moreover, from *Eq. 8(8)1* it is clear that the probability for this to happen is equal to $|c_a|^2$, the same probability as that without introducing the measuring apparatus [410] *section 5F*.

According to Mirror Image Effect, the state $|\phi_a\rangle$ can merely specify the dependence of $|\psi\rangle$ state to one of the equally probable matter and antimatter Universes, e.g., the sign of spin $1/2$. "The general solution of Klein-Gordon equation (the simplest relativistic generalization of free Schrödinger equation) can be written as:

$$\psi(x) = \psi^+(x) + \psi^-(x) \qquad 8(8)3$$

Where:

$$\psi^+(x) = \sum_k c_k e^{-i(\omega_k t - kx)}, \qquad \psi^-(x) = \sum_k d_k e^{+i(\omega_k t - kx)}, \qquad 8(8)4$$

Here c_k and d_k are arbitrary complex coefficient, so the quantity $c_k^* c_k$, and $d_k^* d_k$ can be consistently interpreted as probability densities in the momentum space. More precisely, if c_k, and d_k are independent, then these two probably densities refer to particles and antiparticles respectively" [410] *section 7(A, B).* Therefore, the wave function $\psi(x)$ is split to ψ^+, related to matter and ψ^- antimatter parts that is consistent with bi-Universe hypothesis, according to which c_k and d_k has equal magnitude with slight preference of the former over latter one, *Note 8(7)2, c1*. Therefore, there are no need to seeking for a hidden inseparable antimatter counterpart. Noteworthy, the bi-Universe hypothesis is an intrinsic characteristic of the mass. It can be attributed to the electromagnetical potential field; therefore, this field has no conjugate counterpart due to singlet characteristic of electromagnetical field, *Sec. 4(1), Note 4(1)1*. In other words, the electromagnetic field has no counterpart, vector potential has no conjugate counterpart, *Sec. 8(1)3*. Photon is its own counterpart, *Sec. 6(2)3, Example 6(2)3a*, and the counterpart of gravitational field (or expandon) is the contracton that is apart from expandon, *Sec. 5(2)1d*. In the *Eq. 8(8)4*,"The positive and negative frequency solutions are often referred to as positive and negative energy solution respectively. However, such a terminology is misleading

because in field theory, which energy can not be negative so it is better to speak of positive and negative frequency" [410] *section 7A*. "The field energy cannot be negative. This is why, in relativistic *QM*, it is better to speak of negative frequencies than of negative energies" [410] *section 8A*. Please refer to *Sec. 5(16)3c, Remark 5(16)3c2.*

Note 8(7)2, c1- "The physicist E. Ritz and other have claimed that electromagnetism accounts for the thermodynamics arrow, the wave equation for both mechanical and electromagnetic processes is well-known to include both advanced and retarded solution. Despite this symmetry nature seems to contain only process obeying the retarded solutions. The advanced solutions described the radiation sink's receiving waves and this happens all the time. The asymmetry of radiation instead lay with the form (concentrated or dispersed) the source take. If we place an isolated concentrated gas in the middle of a large volume, we would expect the particle to spread out in an expanding sphere about the center of the gas, much as radiation spreads out. It is therefore, tempting to think that there are a relationship between thermodynamics and electromagnetic arrow's of time" [421] *electromagnetism.*
According to above statements that are based on bi-Universe hypothesis, the slight preference of retarded wave over advanced one is not previewed in standard quantum theory's wave functions although it is experimentally proved. Factually, this slight preference is a characteristic of rest mass in matter Universe. Therefore, the stated above radiation emitted by the source (i.e. as a body of rest mass) is also correlated with the source itself, *Secs. 8(7)2, 8(9)1*. In other words, the effect of source can regarded as environmental effect during the radiation propagation through vacuum texture, *Sec. 5(16)3b, part A*. "A time-reversal non invariant law, in contrast to time reversal invariant laws of classical mechanics, must govern the external perturber" [421] interventionism.

D) Time asymmetry in collapse of wave function

"In quantum mechanics, **wave function collapse** (also called **collapse of the state vector** or **reduction of the wave packet**) is the process by which a wave function, initially in a superposition of different eigenstates, appears to reduce to a single one of the states after interaction with an observer"[566] *Introduction*. According to *Sec. 8(7)2, part F1*, there are no wave function collapse from viewpoint of *HPPH*. But, we encounter with an evolution of the wave function during this transfer to a medium of different characteristic of the former one regarded as a measuring device (or observer).

According to *HPPH*, the unique H hall package of $A\cdots S\cdots B$, and H hall package, *Sec. 5(16)3a*, of *M* each of path-length value h, form a single intermediate, i.e. a pseudo-unique H system, *Sec. 8(5)*, of path-length value h. After interaction, the system $A\cdots SBM$ has a correlated H hall package of path-length value h. In other words, a full overlapness takes place due to dissipation of *B* in the huge inertia of the measuring device, i.e. the Earth, as an unique H system that is accompanied by path-length value h decrement. This process is along with spatial V_{HP}, and time's arrow Δt_{Γ} reversal, *Example 8(7)2, B1*; please refer to *Sec. 7(2)*. In this case, according to *HPPH*, the particle *B* during measurement enters from spatial medium, *Sec. 7(4)3, part A*, of expanding characteristic along with time's arrow to the mass medium *Sec. 7(4)3, part D,* of contracting characteristic accompanied by time's arrow reversal. Therefore, the particle of path-length limit Γ_d in spatial medium is contracted to Γ_{mass} in the mass medium M at the ratio $\Gamma_{mass}/\Gamma_d = K_{\Gamma} = 1.95.10^{-34}$, *Remark 2(3)1b*, that is interpreted as particle B localization, *Sec. 7(4)3, part G*. In other words, the extended wave function of particle in spatial medium is contracted in mass medium at the K_{Γ} ratio, i.e. dissipation of particle wave function in Huge wave function of the measuring device, *Sec. 8(7)4, item H1*. "If the wave function is physically real, in some sense and to some extent, then the collapse of the wave function is also seen as a real process, to the same extent"[566] *History and context*; please refer also to *Sec. 8(7)2, part F1*, and *Sec. 8(1)5*. According to Copenhagen interpretation, "when we observe the particle, the wave function "collapses" and we perceive a localized particle. But the crucial thing is that this interpretation says nothing about what the particle is doing when we are not observing it."[557] *The Copenhagen Interpretation*. As stated above, according to *HPPH*, the particle in spatial medium is not point like, but it is extended in path-limit Γ_d as a set of wave-like H particle-paths. "Reality before observation is described by a wave function. Wave functions, unlike particles, are extended in space and so can pass through both slits at once"[557] *Comments*. Please refer also to *Note 8(3)3a.*
"The time-asymmetry of collapse of the wave function the time-asymmetry assumed in standard treatment of measurement interactions, in which systems become entangled after but not before interaction. The time-asymmetry in question is a manifestation of the thermodynamic asymmetry- i.e. dependent on the cosmological boundary condition" [429]. Please refer to *Sec. 8(1)5*. "When we make a measurement of a quantum observable, there are a collapse of the wave function in which a probability wave collapses to generate a single observed value from a range of possible values. This process appears to work in the forward time direction only, i.e., it is irreversible"[558] *The quantum mechanical arrow of time;* please refer to *Sec. 5(16)9d, part c.* "The interference terms are destroyed when a particle interacts with the environment. The dissipation of these terms into the wider environment can be interpreted in terms of increasing entropy. Quantum decoherence can then be understood as a thermodynamic process: after decoherence, the process is said to be thermodynamically irreversible"[558] *The quantum mechanical arrow of time;* please refer to *Sec. 5(16)9d, part A,* and *Sec. 5(16)7.*
According to H particle-paths hypothesis, the H hall packages separation (or overlapness), *Sec. 7(2),* i.e. path-length generation (or dissipation) are responsible of time asymmetry (i.e. time's arrow, *Sec. 5(16)7a*, or, time's arrow reversal) in both thermodynamic and apparent collapse of wave function as their common characteristic.

Note 8(7)2, D1- "The collapse postulate is a physical law that differs from all known physics in two aspects: it is genuinely random and it involves some kind of action at a distance. According to the collapse postulate the outcome of a quantum experiment is not

determined by the initial conditions of the Universe prior to the experiment: only the probabilities are governed by the initial state". "There are no experimental evidence in favor of collapse and against the *MWI*. We need not assume that Nature plays dice"[329] *part 7*. Please refer to *Sec. 5(15)3d, part B*.

E) Effect of inertia

E1) General aspect

Referring to *Sec. 8(7)2, part B*, the wave function of particle *B* get dissipated out into the wider measuring device (environment or media) M and become effectively inaccessible (i.e. a combination due to *Note 8(7)2, E1a*) the truth behind the mysterious collapse of the wave function due to huge inertia of measuring device (or environment). "The interference terms present in the pure state would vanish into the environment when we take a measurement"[553] *Comment*s. According to definition, the particle B is measured by measuring device. While the particle A is decoherated (or correlated) to measuring device from viewpoint of *HPPH*; please refer also to *Sec. 8(7)1d*. "For microscopic systems and, occasionally, even for very macroscopic ones, decoherence times are relatively long. Nevertheless, the macroscopic nature of the object is certainly crucial in facilating the transition from quantum to classical"[552] *Decoherence how long does it takes?* Factually, the particle A is propagating in spatial normal vacuum medium, *Sec. 7(4)3, part A,* along with expanding type R_e path-length, and the measured (e.g. absorbed) particle B accompanied with contracting type L_c path-length within mass medium, *Sec. 7(4)3, part D,* of measuring device M of equal magnitude and opposite sign, *Sec. 5(16)11*. They are correlated via their common H hall package tunnel, *Sec. 5(9)3d, part C*, in spatial medium. Noteworthy, the entangled pair of particles A, B before measurement has expanding type R_e path-length. Noteworthy, during the destructive measurement the measured particle acquires contracting type L_c path-length; while, during the non-destructive measurement the kind of path-length, e.g. type R_e, remained unchanged. In other words, the measured particle entries from a medium, e.g. vacuum of expanding character to a diverse medium, e.g. mass of contracting one. As a result, the decoherence (or measurement, *part E2*) is the effects of environment on particle via its spatial-mass and mass-mass media, *part E2*, on a particle, e.g. particles A, B, respectively in an irreversible manner, *Remark 5(16)3b, B2.* "The process of decoherence is irreversible-and that is a key feature of decoherence, we cannot reverse the process "[553] *How the environment eliminates interference effect*. In other words, in case of decoherence, the particle A (mass or matter) +environment (vacuum + mass) constitute a unique H system, *Sec. 8(5);* while, in case of destructive measurement the particle B (mass or matter) + environment (mass) construct a unique H system at the moment of measurement of particle B.

Note 8(7)2, E1a- Factually the wave function of the particle from spatial medium is entered in mass medium is entered in mass medium related to measuring device. Thus, its expanding characteristic becomes contracting within mass medium at a ratio of K_Γ, *Sec. 8(7)2, part D*. The particle wavefunction superimposed with the huge wave function of the measuring device, or, better to say a combination. According to Many-Worlds Interpretation, "Measurements are treated a subclass of interactions, which induce subject-object correlations in the combined wavefunction. There are nothing special about measurements (they don't trigger any wave function collapse, for example); they are just another unitary time development process"[577] *Common objections and misconceptions;* please refer to *Sec. 8(7)2, part A*. "An observation or measurement of an object by an observer is modeled by applying the wave equation to the entire system comprising the observer *and* the object. One consequence is that every observation can be thought of as causing the combined observer-object's wavefunction to change into a quantum superposition of two or more non-interacting branches"[577] *Relative state.* Noteworthy, according to *Sec. 8(9)2*, the wave function of object and measuring device must be regarded respect to *CMPRF* of the object-measuring device system. Because of huge inertia of the device respect to the object (particle), the origin of *CMPRF* is considered with center of mass of measuring device, i.e. the Earth, *Sec. 8(7)2, part B*. According to above discussion and discussion held in *Sec. 8(7)2, part A*. The correlation between particle *A* in spatial medium, and particle *B* within mass medium *M* (after measurement) are hold with the measuring device *M*, i.e. a single wave function for $A \cdots BM$ system.

E2) Stay time of a system during decoherence

According to *HPPH*, a particle (or a mass-body) irrespective of its inertia can be found in one of its type R and L configurations successively, *Simulation 7(4)2e1*, that can be viewed as superposition of types R & L successively. The stochastic choose of a state has no sense during a measurement in this respect. "Given decoherence, the Schrödinger equation tells you nothing about why the system decides to choose ONE eigenstate in ONE measure. So, given decoherence, the system has a probability distribution of being found in each of his eigenstates"[553] *Comments; Sec. 8(7)2, Part F1*, and *Sec. Sec. 7(2)2b.* Factually, the particle cannot be separated from its medium, e.g. vacuum. Therefore, the H particle-paths of particle during its mutual interaction with that of the H hall packages of vacuum medium induces the stay time interval $\Delta T_{p(E)}, \Delta T_{p(c)}$ *Comment 7(4)2e2*, successively, *Sec. 7(4)2f, part A,* according to bi-Universe hypothesis, *Comment 8(7)2, E2a*. Thus, the *Fig. 8(1)* cannot be configured at a same time (or instantaneously) without regarding ΔT_p; please refer also to *Sec. 8(9)1, item 5*. In case of macro-bodies, according to *Sec. 7(4)2f, part A,* the stay time interval $\Delta T_{p(C)}$, is infinitesimal. It is much lower than that of a particle within normal vacuum, i.e. $\Delta T_p = \Delta T_\Gamma$, *Note 7(4)1a*. Therefore, $\Delta T_{p(C)}$ can be comparable with time interval related to slight preference of type R over type L of related macro-body, *Comment 8(7)2, A2*, In other words, the macro-body is found in its

preferential state in spatial medium. Consequently, the eigen states of a particle or its track textures can be split to two types R (along with time), and L (accompanied by time reversal) with slight preference of the former in our matter Universe. In other words, their algebraic sum of two times is time arrow in spatial medium. According to *Sec. 5(16)11*, the time arrow in spatial medium has time arrow reversal of the same magnitude within related mass medium. As the result:

A) The superposition of e.g. states of an entity, is along with time's arrow, i.e. thermodynamically irreversible from viewpoint of *HPPH*. In other words, the averaged superimposed of type R eigen states have stay time ΔT_{PR}; while, the averaged superimposed type L eigen states have stay time reversal ΔT_{PL} along with slight increment of magnitude ΔT_{PR} over ΔT_{PL} (i.e. time arrow) in spatial medium, *Note 8(7)2, E2a.*

B) The stay time of a particle in the superposed states, e.g. type R or L can be regarded as decoherence time that depends inversely to the medium (or environment) H particle-paths population in one hand and particle H particle-paths number in other hand, *Sec. 7(4)2f, part A, Eqs. 7(29).*

C) According to *Sec. 7(5)3d, part B,* the intermediate state analogous to W boson cannot tolerate the handedness reversal, *Sec. 8(7)2, part E3*. Thus, it is decohered, *Comment 7(5)3d, B4*, i.e. $n=1$ *in Eq. 7(47)* during stay time interval ΔT_{PR} or ΔT_{PL} (i.e. completeness of measurement), *Sec. 8(7)2, part E3*. "This new theoretical framework, called quantum decoherence, supersedes previous notions of instantaneous collapse and provides an explanation for the absence of quantum coherence after measurement. While this theory correctly predicts the form and probability distribution of the final eigenstates, it does not explain the randomness inherent in the choice of final state"[554] *Wave function collapse*. "Quantum decoherence does not describe the actual process of the wave function collapse, but it explains the conversion of the quantum probabilities (that exhibit interference effects) to the ordinary classical probabilities"[565] *Interpretations*.
According to *HPPH*, the stay time type R or L specifies one of the eigenstates type R or L successively that leading to appearance of randomness, *Sec. 8(7)2, part E4*, during a measurement, *Sec. 8(7)2, part E4*. "In order to make the measurement, the measured system described by $|\psi\rangle$ needs to interact with the measuring apparatus described by the quantum state $|\varphi\rangle$, so that the total wave function before the interaction is $|\psi\rangle|\varphi\rangle$"[554] *Wave function collapse*". There are some formal similarities between quantum states $|\psi\rangle$, $|\varphi\rangle$ and n_{0p}, N_{0d} in *Eqs. 7(29)1* to *7(29)3* of *Sec. 7(4)2f, part A,* respectively.

Note 8(7)2, E2a- Factually, the stay time intervals $\Delta T_{P(R)}, \Delta T_{P(L)}$ are comparable with reversible time symmetry, *Sec. 2(3)3*; while, the difference $\Delta T_{P(R-L)} = \Delta T_{P(R)} - \Delta T_{P(L)}$ is related to irreversible time's arrow in spatial medium, Sec. *7(4)3, part A*, and time's arrow reversal $\Delta T_{P(L-R)} = \Delta T_{P(mass)}$ within mass medium, *Comment 7(4)2e2*. The latter is along expandon emission in spatial medium and contracton releasing by the mass-body (or particle) within mass medium, *Sec. 7(4)3, part D*, via H hall package tunnel, *Sec. 5(9)3d, part c*. As a result, any particle transfer from a state to the next one is along with time's arrow and spatial expansion related to expandon emission. It is along with irreversible path-length, *Sec. 2(4)4b*, in spatial medium that is accompanied with irreversible path-length of the same magnitude and opposite sign within related mass medium. Noteworthy, the path-length related to time symmetry is of reversible kind. According to above statement, there are no simply state changing as in quantum theory.

Comment 8(7)2, E2a- "Different components of the quantum superposition form entanglements with the environment"[557] *Beyond Copenhagen*. This is equivalent to the connection of reverson, *Sec. 7(5),* of a particle to reverson of a quantized H hall package via occupation of the latter by the particle, *Note 7(4)1a*, in one of its expanded states, *Sec. 8(7)2, Part G*. Factually, the spatial environment can be regarded as a vacuum medium, *Sec. 7(4)3, Part A,* that connects a reverson of a particle via its H hall package tunnel, *Sec. 5(9)3d, part c*, to the other particle reverson at any stay time interval ΔT.

E3) A proposed mechanism

According to above discussion, and referring to *Sec. 8(7)2, part A,* in spatial medium, we have successively:

$$A\cdots B\cdots M \text{ (type } R\text{)} \Leftrightarrow A\cdots B\cdots M \text{ (type } L\text{)} \qquad 8(8)5$$

At the end of particle B travel in spatial medium, the intermediate state $A\cdots B\cdots M$ finally is converted irreversibly to related state $A...BM$ at the end of decoherence time (or stay time ΔT_P):

$$A\cdots B\cdots M \xrightarrow{IRREVERSIBLE} A...BM \qquad 8(8)6$$

The right side of the *Eq. 8(8)5* is along with type R, and its left side along with type L expandons emission (or vice versa). Moreover, any expandon emission of type R (or L) is accompanied with type L (or R) mutual contractons releasing within H hall package tunnel, *Sec. 5(9)3d, Part c*, of ingredients A, B, M of intermediate state towards the particle A. The true observer, i.e. observer *A*, *Sec. 8(9)2*, is located at the origin *O* of *CMPRF* in both cases of *Eq. 8(8)5, 8(8)6* that due to huge inertia of measuring device M is located at center of mass of the M. Moreover, in both case of measuring device M attached on the Earth or is not attached to that , the discussion held on *Sec. 2(6)5* from viewpoint of *HPPH* are applicable for stay time ΔT_P evaluation.

An isolated particle H system can be regarded as a single system, *Sec. 8(5),* of path-length value h in an H hall package. According to *Consequence 2(10)c*, in *Eq. 2(116),* $K_m \approx 1$, the reverson, *Sec. 7(5),* of the system is constituted of a single n_s cell, i.e. $n_s = 1$, *Eq. 5(5)1,* contrary to case of macro-bodies. During stay time interval $\Delta T_{P(e)}$, *Comment 7(4)2e2*, an eigen state of the system acquires a path-length of magnitude h, *Sec. 8(7)2, Parts F1, G.* While, the remained ingredients acquire path-length magnitude h and at opposite sign of the former, *Note 8(7)2, E3a*. In other means, total path-length of isolated system is zero, *Sec. 2(4)1*, this is due to mutual interaction of H hall package, *Sec. 7(4)2f, part E,* of an eigen state of the system with that of vacuum medium, *Sec. 7(4)2f, part E*, as in case of *Eq, 8(8)5*. "We cannot separate an observed object from the observer: we have to treat the resultant combined system as one system"[553] *How the environment eliminates interference effect*. During the destructive measurement with a measuring device M, first of all, there are a contracton aggregate, *Sec. 7(5)3d, part B*, trigger (or transfer) by the latter via H hall package tunnel, *Sec. 5(9)3d, part c*, to one of the eigen states of the particle system at apparent random manner, *Sec. 8(7)2, part E4*. The latter eigenstate expanded, *Sec. 8(7)2, Part G*, and acquires path-length of magnitude h; while, as stated above during stay time $\Delta T_{P(e)}$, the particle reciprocally emits equivalent contractons to the measuring device M via their common H hall package tunnel, *Sec. 5(9)3d, part c*. During any transfer of contracton to the particle, it jump to a state of its states in a random manner, *Sec. 8(7)2, part F2*. Thus, this state is expanded as stated above. This mechanism is repeated up to the final eigen state that leading to *Eq. 8(8)6* during final stay time ΔT_f, i.e. at the moment of particle detection by measuring device. Factually, the stay time of mutual contracton transfer is diminished down to ΔT_f. Please refer also to *Sec. 8(7)2, part E2, item c*.

Note 8(7)2, E3a- Otherwise, an hybrid of all of the eigen states is obtained during a a measurement instead of a single eigen state.

E4) Appearance of randomness, and discreteness from viewpoint of HPPH

Referring to *Sec. 8(7)2, parts E2, E3*, a particle before a measurement can be found merely in one of its states during an stay time intervals ΔT, successively, and not in all of the superimposed states at a same time. "Many physicists now believe that quantum behaviour is actually fundamentally deterministic after all in processes which are hidden from our analytic methods (we can only see the apparently random results). Hence, to quote Einstein, God does ***not*** play dice"[569] *Arguments against the universe behaving like a computer*. "Einstein never accepted that quantum events were truly random, i.e. no prior world events could predict them. That a radioactive atom decays by pure chance, whenever "it decides" was to him unacceptable, as it was a physical event not predicted by another physical event. He argued that one day quantum random effects would be predicted by as yet unknown hidden properties"[583] *A prima facie case.*

From viewpoint of *HPPH*, a medium is constituted of types *R&L* H hall packages that are linked to each other via common H hall packages tunnels, *Sec. 5(9)3d, part c*, during particle travel analogous to the beads of a chapel. In other words, a set of linked discreteness of successive type *R&L* H hall packages are take form in a medium, e.g. normal vacuum, gravitating vacuum, mass media. In case of gravitating vacuum, please refer to *Sec. 5(16)1b, part A, Fig. 5(8).* "Proponents of digital physics, however, reject the very notion of the continuum, and claim that the existing continuous theories are just approximations of a true discrete theory"[569] *Arguments against the universe behaving like a computer*; please refer also to *Sec. 2(3)2b,* and *Sec. 2(4)2a.* To sum up, according to *Note 2(1)1, a1*, the Universe profits of all of the possibilities that are offered by mathematics in real world. Therefore, the existence and behavior of computer in real world implies the idea that the Universe also may acts like a computer; please refer to [569] in this case. According to *HPPH, Sec. 8(7)2, parts E2, E3*, a particle can exist in one of its type *R* or *L* configuration during stay time ΔT, *Example 8(7)2, E4a*. It is comparable to computer notations **0, 1,** *Sec. 8(7)2, part E5*. "So the particles which compose the universe are in quantum superposition states (i.e., a mixture of both *0* and *1*, or in two places at the same time). But, in quantum theory an object can only be in two places at the same time (i.e., a particle in a superposition state) UNTIL we try to detect the particle. Then we only find the particle in one precise position. We DON'T see superposition states in our physical reality". "So even a quantum computer only gives a single output"[569] *Comments, Andrew Thomas, 15th November 2008*. In this respect, the *HPPH* is in agreement with rationality, i.e. cause and effect. Factually, H particle-paths of a particle, e.g. photon, before measurement with measuring device has mutual interaction, *Sec. 7(4)2f, part E*, with that of the medium, e.g. vacuum medium, during stay time intervals in the H hall package of the latter, e.g. of type $R \,\&\, L$, successively. This is due to inseparability of the particle from its medium, *Sec. 8(7)2f, part E2*. "Recent developments in the quantum gravity fields of string theory (which has a *minimum distance scale*) and loop quantum gravity (see Atoms of Space and Time) suggest that space is composed of incredibly small discrete elements, rather than being continuous. Indeed, Gregory Chaitin devotes a chapter of his book *Meta Maths* to convince us that space is discrete, not infinitely divisible (Chaitin's motive is to gain support for the idea that the universe behaves like a digital computer"[570] *Why there are no such thing as infinity.* Please refer also to *Sec. 8(8).* "If space-time really is discrete, composed of extremely small straight lines at the small scales, then there will be a limit on this subdivision into straight lines. There will always be that minimum distance scale (discussed earlier), the smallest straight line possible in the real world"[570] *Why there are no such thing as infinity.* According to *Sec. 7(4)3, part G*, any medium is composed of H hall packages with path-limit Γ. The former can be regarded as minimum possible line length in related medium.

Example 8(7)2, E4a- In a run racing, the referee measures by an stopwatch the records with an accuracy equal or higher than 0.01 second. Before time measurement, the hundredth digits (0.0**0** to 0.0**9**) are running fast that cannot be distinguished by naked eye. In other words, the second digits of the decimal are overlapped on each other with an eye accuracy of less than 0.01second. Thus, the referee detects the record, e.g. 12'.07". Now supposing, the stopwatch detect only 0.0**0** and 0.0**1** hundredth digits successively

with accuracy better than 0.01 s. The stated above scenario is established again, and the stopwatch identifies the second decimal of hundredth digit 0, 1, during time measurement, e.g. *32.01,* or *32.02*. Similarly, the stay time interval, *Sec. 8(7)2, part E2*, is equal e.g. to $\Delta T = 0.01$, during measurement from viewpoint of *HPPH*; while, quantum theory denies its presence in this case, i.e. $\Delta T = 0.00$. In other words, the particle states are overlapped or superimposed on each other without time interval ΔT. Factually, the stay time is infinitesimal in case of particles and is out of range of the accuracies of measuring device. It depends on both of the H particle-paths densities of particle and H hall package of related medium, *Sec. 7(4)2f, part A*; therefore, the particle states seemed as being overlapped, *Comment 8(7)4a*.

E5) Wheeler It & Bit Scenario

"Some try to identify single physical particles with simple bits. For example, if one particle, such as an electron, is switching from one quantum state to another, it may be the same as if a bit is changed from one value (0, say) to the other (1)". A single bit suffices to describe a single quantum switch of a given particle"[572] *Digital Physics, Overview.* According to *HPPH*, the fields, particles can be regarded as an arrangement of types *R&L* H hall packages within a medium, e.g. spatial medium. Similarly to quantum gravity, *HPPH* supposes both vacuum gravity free and gravitating vacuum media are constituted of types *R&L* cells or H hall packages, *Sec. 5(16)1b, Fig. 5(8),* and *Sec. 7(4)3, parts A, B*. "In one of his free-form essays, Wheeler unpacked the phrase as follows: "... every it--every particle, every field of force, even the spacetime continuum itself--derives its function, its meaning, its very existence entirely--even if in some contexts indirectly--from the apparatus-elicited answers to yes-or-no questions, binary choices, bits_"[574]. "Loop quantum gravity could lend support to digital physics, in that it assumes space-time is quantized"[572] *Digital Physics, Overview.* "Time, among all concepts in the world of physics, puts up the greatest resistance to being dethroned from ideal continuum to the world of the discrete, of information, of bits. ..."[572] *Wheeler's it from bit*; please refer also to *Sec. 5(16)3b, part J*. According to *Sec. 7(4)1,* to any H hall package of type *R* or *L* in a medium, e.g. spatial or mass medium, is related a discrete time interval $\Delta T_\Gamma = a^{-1}$ that is the symbol of path-length limit, and a, the coefficient of the medium, *Note 1(2)1*. According to *Sec. 8(7)2, part D1*, there are no collapse of wavefunction as in Copenhagen interpretation of *QM*. Therefore, there are a transformation of wave function from a medium, e.g. spatial medium, to other one, e.g. mass medium, *Sec. 7(4)2, parts A, D,* at a reversed handedness. "The work of David Bohm and Basil Hiley7 has shown that Bohr's Copenhagen Interpretation with collapse of the wave function, what John Archibald Wheeler referred to as The Smoky Dragon is not necessary. It merely replaces one mystery by another. Wheeler characterizes micro-quantum theory in the sense of Bohr as IT FROM BIT. The material world IT magically comes into being and becoming from a really mystical collapse of BIT into IT. BIT is in Heisenberg's Hegelian idealist words potentia that, through the sacred miracle of "projection", becomes actua or IT"[575] *Quick Review of Recent Progress in Quantum Theory*. As an example considering an isolated particle in an H hall package, e.g. type *R*, in spatial medium as IT. Therefore, its related expandon cell, e.g. *WR* of matter wave counterpart, *Simulation 7(4)2e1*, can be simulated as BIT. Thus, during the jump of IT to the next H hall package of its track texture i.e. BIT. It is transformed by emission of an expandon, i.e. BIT, to a next state of reversed handedness of previous one during stay time interval ΔT, *Sec. 8(7)2, part E2*. According to *HPPH*, the BIT has no metaphysical aspect. But, its energy to that of IT is in the ratio K_Γ. Factually, any IT jump to the next state is along with geometrical rearrangement of its H particle-paths in related medium. In complex case of atoms, and molecules, the geometrical rearrangement can be dictated, e.g. as in Schrödinger equations, *Note 8(7)2, E5a*.

Factually, according to *Example 5(7)3a*, and analogous to $0,1$ bits notations, any type *R* or *L* configuration of released contractons by an isolated particle can be registered (or absorbed) irreversibly by suppermassif back hole of the host galaxies or clusters, *Sec. 5(7)8*, during the life of the particle (or IT). As results:

A) During the post Big Bang era, the characteristics of the particle, e.g. motions, interactions are registered in discrete time intervals (or stay times, *Sec. 7(4)2f, part A*) via its released contractons (BIT), *Comment 7(4)2e2,* i.e. BIT From IT in the entire history of the particle.

B) According to *Sec. 5(15)3d, part A*, during the Universe contraction era (Big Crunch), all of the contractons that are previously absorbed by black holes and expandons in the particle micro spatial patch in spatial medium plus the particle main-bodies contracted to a single entity, *Sec. 5(15)3d, part A*. The correlation between expandons as BITs that are correlated with their related particle via H hall package tunnel, *Sec. 5(9)3d, part c*, during the period of expansion of the Universe also preserved during the contraction era. Please refer also to *Sec. 5(16)1c, part A1*. Thus, the BITs give existence to the related particle and its S-patches, *Comment 6(2)6a1*, again at the moment of Big Bang in a new period of cyclic Universe, i.e. IT From BIT. The stated above discussion is based on viewpoint of *HPPH* that differs from the notions of IT and BIT as illusory entities.

According to *Simulation 7(4)2e1*, there are self-organizing BIT From IT in which BIT has IT as a source in our expanding matter Universe. In the *Schema E5a*, an isolated particle is shown according to this evolution.

Simulation 8(7)2, E5a- A free particle beats, *Sec. 7(5)3d, part D,* with far analogy to a heart, in its expanded mode it emits expandon in spatial medium in finite speed equal or lower than light speed. Moreover, it emits at its contracted mode contracton through tunnel (alternate to wormhole) in spatial medium between interacting mass-bodies instantaneously. According to *Schema E5a:*

1) The *S*-partner (dark matter of *SM* characteristic) is consumed by particle main-body, *Sec. 5(15)2b,* that is along with expandons emission (dark energy of expanding SN_r characteristic) by particle in micro-patch of particle, *item 13*, i.e. *S*-patch (related to dark energy).

2) Any expandon emission of type R_e path-length by the particle main-body (i.e. mass medium, *Sec. 7(4)3, part D*, of contracting SP_l characteristic) is along with contracton releasing of equal path-length magnitude and opposite sign of type L_c respect to former one, *Sec. 5(16)11,* via H hall package tunnel extending from reverson, *Sec. 7(5)3*, of particle main-body towards the black hole (mass medium), and vice versa. Please refer also to *Sec. 8(8)4*

3) The emission of expandons in spatial medium, *Sec. 7(4)3, part A,* by particle has finite speed equal or less than light speed; while, the contracton transfer within abstract vacuum medium, *Sec. 7(4)3, part F*, of H hall package tunnel, *Sec. 5(9)3d, part c*, from particle reverson to black hole is spontaneous, *Sec. 7(4)2f, part c*.

4) In case of mass-body that is constituted of n_p particles, any of n_p particle is linked by an H hall package tunnel, *Sec. 5(9)3d, part c,* to a n_s cell, *Sec. 5(1)1,* of ground sphere of Schwarzschild surface in a cone-like cavity, *Sec. 5(2)1d, part D,* a bunch of n_p individual H hall package tunnels is linked from mass-body reverson to black hole, *Example 5(7)8a*; please refer also to *Comment. 7(4)2f, E2*. Thus, forming a bunch of abstract vacuum H hall package tunnels between them, which link their reversons. It simulates as mass-body (or particle) subspace, *Remark 7(5)2a1,* respect to black hole that evolved during mass-body states changing.

5) The dotted arrow from the particle main-body in the *Schema E5a* is related to expandons emission.

6) The solid arrows in *S*-partner region is the flow of dark matter towards particle main-body.

7) The horizontal tunnel-like arrow shows the H hall package tunnel (or a bunch of it) that is extended from the particle main-body to the black hole. This arrow takes the same geometrical shape of the path of particle respect to the black hole. Please refer to *Sec. 8(9)2, Fig. 8(2),* in case of curved H hall package tunnel of the photon that is overlapped on the photon travel path *OT* respect to observer *B*, but at opposite direction to that, i.e. *TO*, in spatial medium up to the target *T*.

8) The micro spatial patches (*S*-patch) of a particle is not confined similar to geographic map of a country by other maps of neighboring countries; but it is elongated around the particle H hall package up to its black hole of the host galaxies, *Comment 5(15)3d, B1.*

9) A) Based on stated above items, the mechanism of conversion of dark matter to dark energy, *Proposal 5(15)3b1,* along with emission of expandon of SN_r configuration of path-length value $+2\hbar$ and releasing of contracton of SP_l configuration of path-length value $-2\hbar$ specify the behavior of expanded state of the particle via mutual exchange of *G*-contracton between particle and related supermassif black hole of host galaxies, *item 13*. Please refer also to *Sec. 5(15)3f, part c*. It is through common H hall package tunnel, i.e. successive beats of particle. Please refer also to *Note 9(4)6a*. Noteworthy, *G*-expandon emission by black hole is along with its contracton releasing towards the particle or vice versa, in free vacuum, *Remark 8(7)2, E5a*. Moreover, any emitted expandon has energy value, e.g. *H*, *Sec. 1(2)*; while, the released contracton has negative energy *–H*, *Note 7(5)2a2,* i.e. equal magnitude and opposite sign to that of related expandon. Thus, there are a fluctuation of energy during a beat, *Sec. 7(5)3d, part D*. In other words, there are continuous energy increment related to expandon emission in spatial medium; while, in mass medium, there are energy decrement related to contracton releasing. "If it takes so much energy just to try to pin down a particle, then, in theory, all particles should have temporary energy changes around them called quantum fluctuation. This energy translates into mass, since Einstein famously said that mass and energy are interchangeable through the equation $E = mc^2$ "[616].

B) The reciprocal contracton exchange of multiverses *Sec. 5(15)3d, part B*, via black hole through H hall package tunnel, *Sec. 5(9)3d, part c,* towards center of mass or particle's axeon, *Sec. 10(8),* defines the states of particle during stay time interval ΔT. Please refer to *items 13, 17* in this regards. Noteworthy, during longer time interval than stay time interval, there are symmetry in all of directions of particle behavior. "A complete set of quantum states can be built upon each ground state" [417] *Spontaneous symmetry breaking*. Factually, according to *Sec. 8(2)3,* the particle' axeon is its ground state. Factually, the spontaneous symmetry breaking (*SSB*) has a hard link with the ground state or particle's axeon behavior. Note that, the expanded mode of the particle in a state of its states; while, the latter are in contracted mode (or nil) during stay time interval ΔT, *Sec. 8(7)2, part G,* can be viewed as the equilibrium configuration becoming unstable. "When the force (cause) reaches a critical value, the symmetric equilibrium configuration becomes unstable and an infinite number of equivalent lowest energy stable states appear, which are no longer rotationally symmetric but are related to each other by a rotation"[417] *part 4.2*. Please refer also to *Sec. 5(2)2*.

10) The whole system up to black hole as in schema *E5a,* can be regarded as H hall package, *Sec. 5(16)3*, of the particle.

11) According to *Note 3(1)2a, Eq. 3(24),* to any fundamental particle H hall package merely a common H hall package tunnel, *Sec. 5(9)3d, part c*, is attached up to the related supermassif black hole of the host galaxies and clusters, *Sec. 5(7)8*. Moreover, in case of ordinary particles, e.g. proton, the common reverson of its ingredient via a common H hall package tunnel (or a bunch of it) is linked to a cell (or cells in case of a bunch of tunnels) of n_s cells of Schwarzschild surface of the related black hole; please refer also to *Simulation 8(7)2, part E5, item 4*, and *Consequence 2(10)1b*.

12) Referring to above discussion, and according to *Sec. 10(6),* the H hall packages of fundamental particles are of two distinct groups:

1) Group *R* specified to negatively charged leptons.

2) Group *L* specified to positively charged leptons.

Please refer to *Remark 8(7)2, E5c*.

13) According to *Sec. 8(7)2, part E2*, any ground gravitational sphere is consisting of n_s cells, each cell related merely to an state of n_s states of a particle, e.g. matter, antimatter, during stay time interval $\Delta T_{(PE)}$ along with expandon emission, *Remark 8(7)2, E5a*, and contracton releasing to the supermassif black hole, *Sec. 5(7)8.* As the result, a particle can be found in one of its state during stay time intervals $\Delta T_{(PE)}$, all within stay time interval ΔT_{gs} related to two successive gravitational ground spheres infinitesimal time interval, *item 12*.

$$\Delta T_{gs} = \sum_0^{n_s} \Delta T_{(PE)} \qquad 8(8)b$$

Noteworthy, considering the decay products of $\overline{\mu}$, *Eq. 8(8)a*, according to above statement, if the matter ingredients are in expanded form, the antimatter one are in contracted configuration during stay time interval ΔT_{gs}, otherwise, the annihilation of matter and antimatter ingredients is taken place in ordinary particle, e.g. $\overline{\mu}$.

14) According to *Remark 4(3)1, B4*, and referring to *Eq. 4(8)1*, the equation of cosmos, the effective radius r of the electron can be referred to the Hubble Universe of radius *R*. According to *HPPH*, there are an empirical correlation between the spatial patch of particles in a Universe with Hubble volume through the number of particles. In other words, each particle occupies a specified spatial patch in the whole Universe. Better to say a particle occupies a specified surface on gravitational expanding sphere of a supermassif black hole down to Schwarzschild surface of the black hole (the ground sphere), i.e. the surface that an n_s cell of a particle H hall package tunnel occupies on scale of Planck area on black hole horizon; please refer to *Sec. 5(1)1*.

15) An emitted particle, e.g. photon, from an emitter, e.g. source, is correlated to the latter merely by an H hall package tunnel in spatial medium and ultimately to the supermassif black hole of the host galaxies and clusters, *Note 8(9)2b*. According to *Sec. 5(9)3d, part c*, there are a mutual exchange of contractons between particle and emitter. The contractons received by particle from the emitter are agglomerated in particle as aggregated contracton, *Sec. 7(5)3d, part B*, i.e. the particle is in its subjective form, *Sec. 8(9)1*. Therefore, just during an interaction, (e.g. gravitational, collision, based on *Sec. 5(9)3d, part c*) of particle and a detector, i.e. a measurement, the aggregated contracton is released by detector via related H hall packages towards the black hole. Thus, the particle is detected, i.e. in its objective form, *Sec. 8(9)1*. Based on *Sec. 7(5)3d, part B*, an unstable particle may be decayed when the aggregated contracton is reached to its critical value during time interval ΔT_{crit}, *Eq. 7(47).* According to above discussion, an H hall package tunnel is appeared from mass-body (or emitter) by emitted particle from *G*-reverson of emitter up to the particle reverson, i.e. within mass medium. Similarly, the agglomerated expandons on the particle main-body before measurement are corrupted just during the latter in spatial medium. It is equivalent to the wave function collapse, *Sec. 8(7)2, part D*, just during the measurement. As the result, before measurement, the contractons are stayed in particle reverson and conserve their link with related expandons on the horizon of particle-main-body in spatial medium. Thus, forming a unique H system, *Sec. 8(5),* just during an interaction by analogy to case of a particle at rest state, *Remark 8(7)2, E5b*. This link is interrupted and the contractons escaped via H hall package tunnel, and the agglomerated expandons begin to expand in spatial medium and moving away from the particle main-body, i.e. a collapse of wave. Factually, the aggregated contractons according to *Sec. 2(4)4a* is absorbed by detector (as a macro mass-body) and is transferred spontaneously, *Sec. 7(4)2f, part c*, via H hall packages to the black hole of the host galaxies and clusters, *Sec. 5(7)8*. Thus, irreversibly absorbed by black hole. This leading to releasing of relate agglomerated expandons in spatial medium at finite speed c.

16) Any state of the particle of contracting SP_l configuration has its appropriate state of its micro *S*-patch in spatial medium of expanding SN_r configuration of equal path-length magnitude and opposite signs, *Sec. 5(16)11*. According to *Sec. 8(8)2, item 8*, any particle in a state at macro *4*-space plus an extra-dimension of mass medium has its appropriate particle *S*-patch of related extra-dimension in that spatial medium.

17) According to above discussion during a beat of particle, and *Sec. 7(4)2f, Part A,* we have:

A) During stay time interval ΔT_E, *Sec. 8(7)2, E2*, the particle is expanded (antinode, *Simulation 3(1)2a*) accompanied by expandon emission along with path-length increment of h value in spatial medium. While, particle's *S*-patch is contracted down to H hall package tunnel, *Sec. 5(9)3d, part C*.

B) During time interval reversal ΔT_C, the particle main body is contracted (antinode, *Simulation 3(1)2a*) following with particle contracton emission through the tunnel, in item *17 A* to the related supermassif black hole of the host galaxies & cluster, *Sec. 5(7)8,* along with path-length decrement of h value in mass medium. While, particle's *S*-patch is expanded due to particle expandon emission as in *item 17A*.

C) At the end of stage (*17B*) There are an infinitesimal time interval ΔT_{Node} between this stages and next stage *17(A),* related to contracton emission by particle (node *Simulation 3(1)2a*). Noteworthy, if the expandon of first stage *17A* is of *WR* type (and its contracton is of *PL* one). Thus, the next stage *17A* is of *WL* expandon (and its contracton of *PR* one); Please refer to *Simulation 7(4)2e1* in this regards.

D) There are a slight preference of ΔT_C over magnitude of ΔT_C, i.e. $\Delta T_E \cong -\Delta T_C + \Delta T_{Node}$, in our matter Universe. Please refer also to *Sec. 5(16)1b, part G*.

Resuming, a part of particle dark matter, *Sec. 8(7)3,* as its S-partner of SM configuration is split, *Sec. 5(15)2a*, to two parts, the expanded H particle-paths of SN_r configuration as spatial medium, and its SP_l H particle-paths configuration part as contracton that is ultimately absorbed by related supermassif black hole of the host galaxies & clusters; please refer also to *Sec. 5(15)2d*.

18) According to *Schema E5a*, the H hall packages divide the spatial medium to micro spatial patches, i.e. *S*-patch. By a far analogy it can be simulated somehow to quantum foam and tiny wormholes, *Note 5(15)2c1*. "Down at the smallest of scales, smaller even than molecules, smaller than atoms, we get to a place called the quantum foam. This is where wormholes exist. Tiny tunnels or short cuts through space and time constantly form, disappear, and reform within this quantum world. And they actually link two separate places and two different times"[606] *Quantum foam and tiny wormholes*. Factually, according to *HPPH*, the H hall packages in vacuum medium are divided by H hall packages Tunnels, *Sec. 5(16)3b, part B, paragraph IX*. Moreover, the contractons are transferring in these tunnels spontaneously, *Sec. 7(4)2f, part C*. "Wormholes allow superluminal (faster-than-light) travel by ensuring that the speed of light is not exceeded locally at any time. While traveling through a wormhole, subluminal (slower-than-light) speeds are used. If two points are connected by a wormhole, the time taken to traverse it would be less than the time it would take a light beam to make the journey if it took a path through the space *outside* the wormhole"[607] *Faster than light travel.*

19) According to *Comment 5(16)7, g1*, the spatial patch (*S*-path or H Hall package) of a moving particles *A* regarding other low speed particles *B* respect to their *CMPRF* origin, i.e. supermassif black hole of the host galaxies and clusters, *Sec. 5(7)8,* expand faster respect to *B* ones due to faster entropy & negentropy increment related to more expandons emission in spatial medium& contractons releasing within H hall package tunnels *Sec. 5(9)3d, part c*, to the black hole due to higher particles *A* speed.

20) Factually, the spatial medium that is constituted of particles' *S*-patches due to equilibrated motion of particles has an isotropic behavior at small scale or volume. While, it has a radially and right-handed spirally expanding character at large scale, *Sec. 5(16)5*, at low motion around supermassif black hole, *Sec. 5(7)8*, respect to high speed particles or mass-bodies. It can be regarded at good approximation as a stationary medium along with its ingredients, and has steady increasing entropy. In other words, at small volume, it has no significant effect on particles and mass-bodies in all spatial directions.

21) The particle mass medium is confined between spatial medium and its Schwarzschild surface nominating particle reverax; please refer to *Note 5(7)1b*. Moreover, the particle Schwarzschild surface confines the particle reverson, *Sec. 7(5),* constituted of abstract vacuum medium, *Sec. 7(4)3, part F*. Therefore, the particle reverson is linked by its H hall package tunnel to the reverson of black hole as in *Schema E5a*.

22) The wave function can be regarded as particle track texture. The particle in each point of its track texture has an expanding mode, *Sec. 8(7)2, part G*; while, other of its states are in contracting mode; please refer also to *Consequence 8(1)5a.*

23) Based on *Remark 3(1)1c*, there are two kinds of particle state changing as follow:

A) In spatial medium of stay time interval ΔT or ΔT_d, *Sec. 7(4)2f, part A*. It is along with types *R* & *L* expandons emission in spatial medium, and contracton releasing towards mass medium via H hall package tunnels, *Sec. 5(9)3d, part c,* and vice versa. This phenomenon is responsible to irreversible path-length, *Sec. 2(4)4b,* and time's arrow which is happened due to interaction of particle H hall package's H particle-paths densities with that of normal vacuum medium *Sec. 7(4)2f, part A*. Because of this reason, a particle of rest mass is jiggled to a new H hall package unit of vacuum medium, i.e. no rest state, for a new interaction.

Factually, according to *Sec. 5(16)1b, part G*, during a beat of particle, *Sec. 7(5)3d, part D,* and expandon emission, a contracton is released towards mass medium, e.g. source, and ultimately towards the related black hole of the host galaxies & clusters, *Sec. 5(7)8*. It is along with radial receding transfer of the particle from the related black hole in spatial medium. This followed with mutual contracton emission by the black hole to reach the particle. Thus, the latter is backwarding towards black hole with the preference of the receding transfer. Therefore, the particle chooses a new H hall package in spatial medium. In other words, the particle is jiggling about its rest state during any beat.

B) In mass medium within H hall–package unit, *Sec. 5(16)3b*, of particle of stay time interval ΔT_{mass} via contracton emission by black hole of the host galaxies and clusters, or, sophistically by contractons exchange by parallel universes, *Sec. 5(15)3d, part B, Proposal 4.* This phenomenon is related to reversible path-length, *Sec. 2(4)4b*, and *T*-symmetry.

In fact, the case *A* is related to single direction (or irreversible) motion of H particle-paths due to jiggling; while, the case *B* is depending on reversible motion of H particle-paths.

Note 8(7)2, E5a- The qubit is the quantum analogue of the bit, the classical fundamental unit of information. It is a mathematical object with specific properties that can be realized physically in many different ways as an actual physical system. Just as the classical bit has a *state* (either 0 or 1), a qubit also has a state. Yet contrary to the classical bit, $|0\rangle$ and $|1\rangle$ are but two possible

states of the qubit, and any linear combination (superposition) thereof is also physically possible. *In general*, thus, the physical state of a qubit is the superposition $|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$ (where α and β are complex numbers). The state of a qubit can be described as a vector in a two-dimensional Hilbert space, a complex vector space (see the entry on quantum mechanics). The special states $|0\rangle$ and $|1\rangle$ are known as the *computational basis states*, and form an orthonormal basis for this vector space. According to quantum theory, when we try to measure the qubit in this basis in order to determine its state, we get either $|0\rangle$ with probability $|\alpha|^2$ or $|1\rangle$ with probability $|\beta|^2$. Since $|\alpha|^2 + |\beta|^2 = 1$ (i.e., the qubit is a *unit* vector in the aforementioned two-dimensional Hilbert state), we may (ignoring the overall phase factor) effectively write its state as $|\psi\rangle = \cos(\theta)|0\rangle + e^{i\varphi}\sin(\theta)|1\rangle$, where the numbers θ and φ define a point on the unit three-dimensional sphere, as shown here. This sphere is often called *the Bloch sphere*, and it provides a useful means to visualize the state of a single qubit

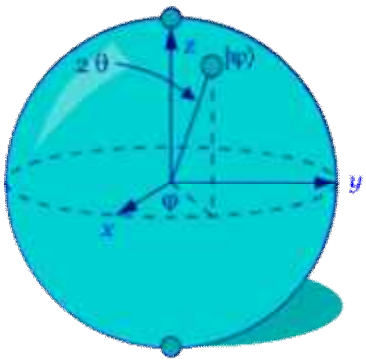


Fig- E5a1-The Bloch sphere

Theoretically, a single qubit can store an infinite amount of information, yet when measured it yields only the classical result (0 or 1) with certain probabilities that are specified by the quantum state. In other words, the measurement *changes* the state of the qubit,"collapsing" it from the superposition to one of its terms. The crucial point is that unless the qubit is measured, the amount of "hidden" information it stores is conserved under the dynamic evolution (namely, Schrödinger's equation). This feature of quantum mechanics allows one to manipulate the information stored in unmeasured qubits with quantum gates, and is one of the sources for the putative power of quantum computers.To see why, let us suppose we have two qubits at our disposal. If these were classical bits, then they could be in four possible states (00, 01, 10, 11). Correspondingly, a pair of qubits has four *computational basis states* ($|00\rangle$, $|01\rangle$, $|10\rangle$, $|11\rangle$). But while a single classical two-bit register can store these numbers only *one at a time*, a pair of qubits can also exist in a superposition of these four basis states, each of which with its own complex coefficient (whose mod square, being interpreted as probability, is normalized). As long as the quantum system evolves unitarily and is unmeasured, all four possible states are simultaneously "stored" in a single two-qubit quantum register. More generally, the amount of information that can be stored in a system of *n* unmeasured qubits grows exponentially in *n*. The difficult task, however, is to retrieve this information efficiently.

Note 8(7)2, E5b- Factually, the group *R* gravitational ground sphere of black hole in a beat is related to type $R_e - L_c$ matter Universe, that is nominating group *R*, *Note 5(16)9b1*; while, the next group *L* ground gravitational sphere related to type $L_e - R_c$ antimatter Universe that is nominating group *L*, for reason of simplicity with slight preference of group *R* over *L* in our matter Universe.

Comment 8(7)2, E5a- The contractons act as entities that bring spontaneously, *Sec. 7(4)2f, part C*, the information such as interaction, spin, charge to the black hole in order to be registered. According to *HPPH*, *Sec. 8(7)2, Part E2*, and *Sec. 8(7)2, part G,* during a measurement merely a qubit can be measured of type *R* (or *L*). Therefore, the particle acquire type *L* (or *R*) qubit accordingly along with path-length variation h or a quanta, *Sec. 7(4)2h*.

Please refer also to *Remark 7(5)2a1*.

Comment 8(7)2, E5b- Based on definition of lepton number, *Sec. 10(6),* the υ_μ (group *R*) H hall package can profit merely from the initial H hall package of $\overline{\mu}$ (group *R*). Moreover, electron and $\overline{\upsilon_e}$ H hall packages that are reversed handed of each other are

borne from H hall package of $\overline{\mu}$ based on *Sec. 7(2)1,* and *Comment 7(2)1a*. Noteworthy, $\overline{\mu}$ as ordinary particle has stored path-length, *Sec. 7(4)1, item 3*.

Remark 3(1)1, E5d

Comment 8(7)2, E5c- By definition in any process, the total baryon number must remain constant [4] *Section 5**6**-3*. The conservation of baryon number in a reaction products implies that the combined H hall package along with related tunnel in a baryon is very stable to becomes split in a reaction. In other words, the three quarks solely are interchanging in a combined H hall package. Therefore, the cleavage of this kind of combination is forbidden. Similarly to *Comment 8(7)2, E5b*, two reversed handed H hall packages of types *R & L* can be born during the baryon and its antimatter conjugate appearance of equal magnitude path-lengths and opposite signs. Thus, conserves the baryon number in that process. Based on bi-Universe hypothesis, the quarks in a baryon are converted to their antimatter conjugates successively, *Remark 3(1)1, E5d* during stay time intervals ΔT in a complete beat with slight preference of the former, *Sec. 5(16)8d.*

Remark 8(7)2, E5a- Any type *L* cell generation on ground gravitational sphere of group *R*, *Note 8(7)2, E5b*, of the particle is expanded and emits a type *WL* expandon that is accompanied with spontaneously releasing of *PR* contracton via group *R* H hall package tunnel towards the group *R* gravitational ground sphere of the black hole. It leading to type *WR* expandon emission along with releasing of *PL* contracton towards the particle based on path-constancy, *Remark 8(7)2,E5d,* during state time interval $\Delta T_{(PE)}$. Or, vice versa in case of type *R* cell of the particle.

Remark 8(7)2, E5b-In this case, as if, the particle is jiggling, *Simulation 8(7)2, E5a, item 23,* around its initial main position at rest state or position, *Sec. 5(16)3b, part G, item A*, and *Sec. 10(6)* during its motion, i.e. particle jiggles around a straight line (or path) as in *Figs. 8(3)4a, A, B, C, D.* Thus, according to *Note 5(16)7, g2, Fig. 5(10),* there are no well-defined path, *Simulation 8(3)4, b1, Fig. 8(3)4a*, up to electron striking on screen (or detector), i.e. a measurement, that is following by particle aggregated contracton releasing towards the emitter (or source).

Remark 8(7)2, E5c- These two groups cannot be interchanged and can be conserved due to conservation of lepton number. Therefore, the group *R* can be occupied merely by negatively charged lepton and lepton's neutrino related to type $R_e - L_c$ Universe, *Note 5(16)9b1*. Similarly, the group *L* by positively charged leptons and lepton's antineutrinos related to type $L_e - R_c$ Universe, or vice versa. As an example in the following equation, *Eq. 8(8)a* based on *Eq. 10(8)* of *Sec. 10(6)* according to above statements we have:

$$\frac{\overline{\mu}}{\left(\frac{groupR}{+1}\right)} \rightarrow \frac{\bar{e}}{\left(\frac{groupR}{+1}\right)} + \frac{\upsilon_{\mu}}{\left(\frac{groupR}{+1}\right)} + \frac{\overline{\upsilon_e}}{\left(\frac{groupL}{-1}\right)} \qquad 8(8)a$$

Where, group *R* is related to group $R_e - L_c$ matter Universe, *Note 5(16)9b1*, of number $+1$ with conventional positive path-length and group *L* related to group $L_e - R_c$ antimatter Universe, i.e. of number -1 with negative path-length. Moreover, the algebraic sum of path-lengths in both sides of *Eq. 8(8)a* are the same. As a result, in case of ordinary particle, e.g. proton (as a baryon, *Comment 8(7)2, E5c*) of uud quarks or SN_l, SN_r, SP_m configurations, *Comment 10(4)1b*. There are *3* combined H hall packages (or a bunch) and related tunnels each depends to a quark. Thus, three axeons of uud quarks in proton or SN_l, SN_r, SP_m configurations can be referred to groups R, R, L respectively. According to *item 11*, a combination of *R&L* groups (or a bunch) of H hall packages of total path-length h is correlated to 3 cells of n_s cells, *Sec. 5(1)1*, on Schwarzschild surface (or horizon) of the black hole via a combined (or bunch of) H hall package tunnel during stay time interval. Noteworthy, referring to *Eq. 8(8)a*, the combined H hall package tunnels of $\overline{\mu}$ can be regarded as a bunch of *R&L* groups of $\overline{\mu}$ decaying products that is extended from common reverson, *Sec. 7(5),* of $\overline{\mu}$ down to the related cells of the supermassif black hole. According to *Note 10(4)2a*, the up and down quarks in an ordinary particle are interchanged to each other in the related H hall packages during stay time interval $\Delta T_{(PE)}$; thus, forming a (bunch or) combined tunnel.

According to *Proposal 5(15)3b, D1a*, any path in spatial medium, *Sec. 7(4)3, part A*, of a mass-body or particle, trace a miniature path of the same shape on Schwarzschild surface of mass-medium, *Sec. 7(4)3, part D* at K_{Γ} proportionality factor, *Remark 2(3)1b*, and of the reversed handed of the former in spatial medium. Therefore, a type *R* (or *L*) H hall package of matter particle in spatial medium has a reversed handed type *L* (or *R*) cell of n_s cells on event zone, *Sec. 5(16)2*, of the supermassif black hole during stay time interval $\Delta T_{(PE)}$ during successive beats, *Sec. 7(5)3d, part D,* along with exchange of type *PL* (or *PR*) contractons spontaneously via group *R* (or *L*) H hall package tunnel, *Sec. 5(9)3d, part c*. According to above discussion, the

transfer of a matter particle from a type *R* to next type *L* H hall package is along with transfer of the related type *L* to type *R* cell on event zone of the black hole. In case of antimatter particle at its expanded state, its H hall package tunnel of group *L* is linked to a cell of n_s cells on event zone, of group *L* ground gravitational sphere, *Note 5(16)1b, A1*, during stay time interval ΔT_{gs}, i.e. infinitesimal stay time interval between two successive gravitational ground spheres generation, *Sec. 5(16)1a, part B*, i.e. a beat in type $R_e - L_c$ Universe, *Note 8(7)2, E5b*. While, the particle at contracted state, the black hole ground sphere is at interface of group *L&R* configuration, *Remark 5(16)1b, A1,* and vice versa in case of antimatter particle. Please refer also to *Proposal 5(7)3a*, in case of registration phenomenon. In other means, in *Eq. 8(8)a*, if the three matter particle of decaying ingredients are in their expanded state, *Sec. 8(7)2, part G*, i.e. black hole at its group *R* gravitational ground sphere during the beat, the electron antineutrino as antimatter is at contracted state, or, vice versa.

Remark 8(7)2,E5d- The black hole in *schemaE5a,* means the central black hole of the host galaxies and clusters, *Sec. 5(7)8*. Thus, the contractons from mass mediums transverse the whole mass-bodies of related galaxies up to this black hole based on mach principle, *Sec.5(9)3b*.

F) Wave function evolution in different media

F1) The two media appearance in wave function

"The wave function in quantum mechanics evolves according to the Schrödinger equation into a linear superposition of different states, but actual measurements always find the physical system in a definite state. Any future evolution is based on the state the system was discovered to be in when the measurement was made, meaning that the measurement did something to the process under examination"[565] *Introduction*.

"There were two processes of wave function change:

1) The probabilistic, non-unitary, non-local, discontinuous change brought about by observation and measurement.

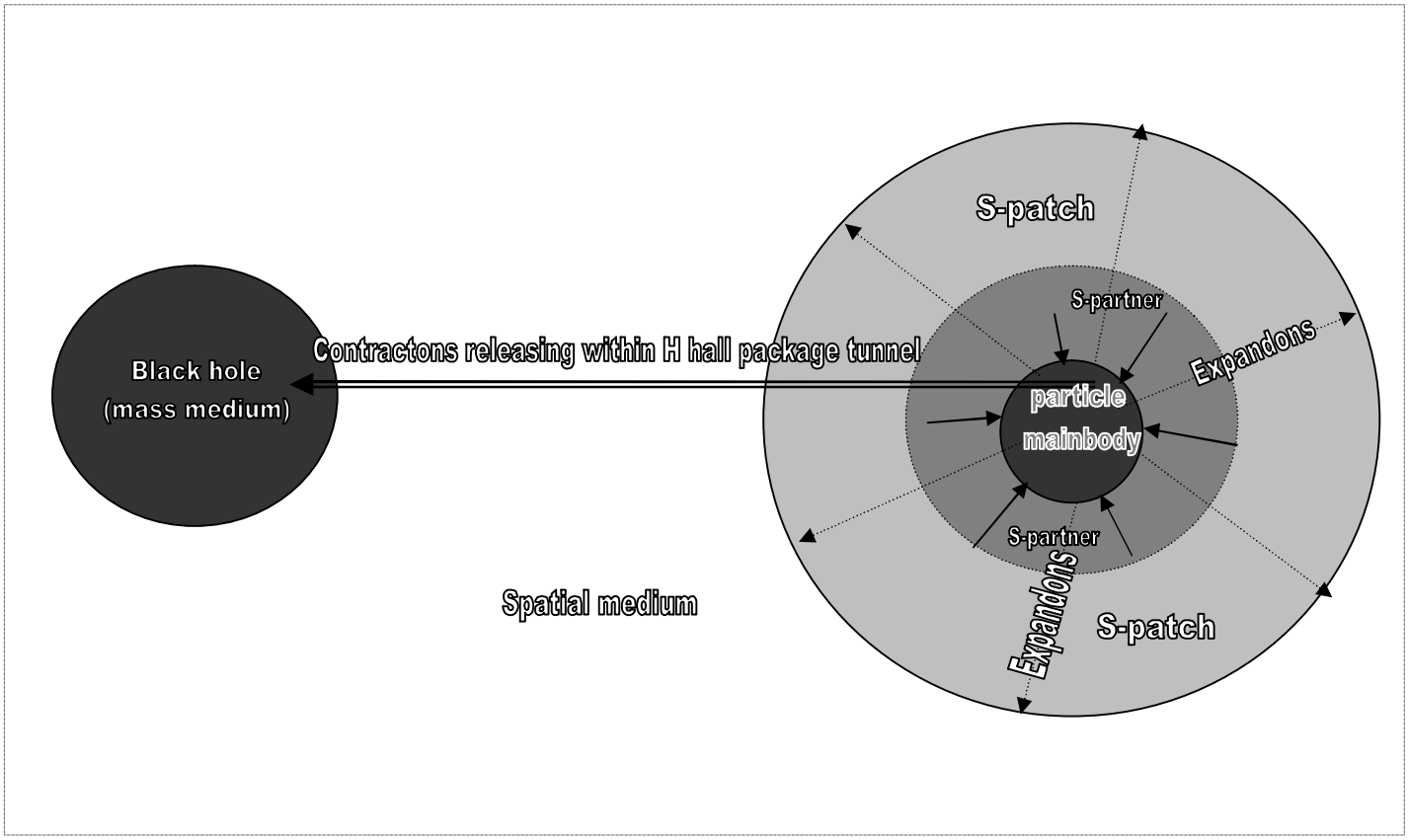
2) The deterministic, unitary, continuous time evolution of an isolated system that obeys Schrödinger's equation"[566] *History and context.*

"To express matters differently (to paraphrase Steven Weinberg [1][2]), the wave function evolves deterministically – knowing the wave function at one moment, the Schrödinger equation determines the wave function at any later time. If observers and their measuring apparatus are themselves described by a deterministic wave function, why can we not predict precise results for measurements, but only probabilities? "[565] *Introduction*. "After the collapse, the system begins to evolve again according to the Schrödinger equation or some equivalent wave equation"[566] *History and context*.

According to *Sec. 8(7)2, part E2*, the wave function of a particle cannot be separated from its medium. It evolves during stay time intervals ΔT from a state to other one at a discontinuous manner successively. Therefore, the *case 1* is acceptable according to *HPPH* based on appearance of randomness, *Sec. 8(7)2, part E4*. Factually, the wave function in any stay time interval ΔT_p can be configured merely in a state, *Sec. 8(7)2, part E3*, and not at all of the states at once, *Comment 8(7)4a*. According to *HPPH*, a referring to *Sec. 8(7)2, part E2,* and *Sec. 8(7)2, part G*, during a measurement merely a qubit can be measured of type *R* (or *L*). Therefore, the particle acquires type *L* (or *R*) qubit accordingly along with path-length variation h or a quanta Sec. . Noteworthy, the evolution of wave function can be performed in two different media of different characteristics, *Sec. 8(7)2, part D*, and *Note 8(7)2, D1*.

A) Spatial medium of expanding characteristic, *Sec. 7(4)3, parts A, B*, along with time's arrow.

B) Mass medium of contracting characteristic, *Sec. 7(4)3, part D* along with time's arrow reversal.



Schema E5a- The particle evolution in spatial medium during the period of expansion

Noteworthy, the path-length of the system in *case* A is of opposite sign to that of *case* B *, Sec. 8(7)2, part F3*. According to *Sec. 8(7)2, part D,* from view point of *HPPH*, the magnitude of spatial scale (path-length limit Γ_d) and stay time intervals of wave function in spatial medium is K_Γ^{-1} time higher than in mass medium. "One of the paradoxes of quantum theory is that wave function seems to be more than just information (otherwise interference effects are hard to explain) and often less than real, since the collapse seems to take place faster-than-light and seems to be triggered by observers"[566] *History and context*. Factually, the stay time in mass medium (observer) as stated above is K_Γ time smaller than spatial one, *Sec. 8(7)2, part E2*. Thus, it seems to be spontaneous, *Sec. 7(4)2f, part c.* Please refer also to *Note 8(9)1a*.
The real parts of a system wave function or its wave function conjugate, *Sec. 8(1)2*, can be related to *T*-symmetry of the spatial medium, e.g. normal vacuum, gravitating vacuum, of expanding characteristic; while, their imaginary complex parts, or states, *Sec. 8(1)3*, are related to mass medium of different characteristics respect the former one, i.e. contracting characteristic. Factually, in the latter case, the H particle-paths of contractons of an H system are transferred within abstract vacuum, *Sec. 5(16)3h*, via common H hall package tunnels, *Sec. 5(9)3d, part c*, and mass-bodies reversons, *Sec. 7(5)3,* at superluminal speed along with time reversal respect to vacuum medium,. As stated above, it is related to two path-lengths of opposite signs in two different media, *Sec. 5(16)11*. As results:
1) The imaginary parts of complex states are related to imaginary parts of complex space, i.e. mass medium. Therefore, the real parts of ψ , and its conjugate ψ^* configure the system that some parts, e.g. fields, are extended in spatial medium and its imaginary parts, i.e. system main-body, is extended in mass medium, e.g. its own mass. In other words, the wave function of a particle includes both its field and mass at any location in a random manner, *Sec. 8(7)2, part E4*. As an example, an electron main-body in an atom is overlapped on its track textures (or its matter wave counterpart), *Sec. 5(16)3b, part B*, at any of its location.
2) According to *paragraph A,* the time reversal of state vector of a system in spatial medium is real, i.e. time reversal evens; while, in mass medium is imaginary , i.e. time reversal odd, *Sec. 8(1)3*. Noteworthy, by the same argument, the complex space can be analyzed to two real and complex related to spatial and mass media respectively. Thus, the wave function is more than a mathematical probability function, *Sec. 8(1)5*. It is representation of realities in two different media.

F2) Dependence of gravity and wave function evolution of an isolated particle in spatial medium
"Quantum mechanics only tells us the probabilities of a measurement outcome taking a particular value "[555] *State space*. "The selection of the particular eigenvalue appears to be a completely random process. Hence, quantum mechanics gives purely statistical predictions: it cannot accurately predict the outcome of a single measurement, it can only give the probabilities of outcomes when we make a series of measurements"[555] *Summary*. Factually, "before measurement (observation), a particle's observable acts as though it is in a mix (superposition) of those possible eigenvalues". "After measurement (observation), a

particle's observable can take one of several possible values called eigenvalues"[555] *Summary*. However, from viewpoint of *HPPH*, in case of an isolated particle in vacuum medium, *Sec. 7(4)3, part A*, before particle measurement with a measuring device, *Sec. 7(4)3, part A,* its state seems to leap (or jump) to just one of the basis states, *Simulation 8(3)4, b1*. The former state uniquely acquire the value of the property being measured, e_i, that is associated with that particular basis state during related stay time interval ΔT, *Sec. 8(7)2, part E2*. Factually, because all the other terms in the expansion of the wave function have vanished into an extremely contracted entity (or nothing). According to *Sec. 7(5)3d, part D*, the beat phenomenon in case of macro-bodies can be extended to the particles, *Simulation, 7(4)2e1*. In other words, during stay time interval ΔT_p, the particle e.g., of type R, at any beat emits a type WR, expandon in spatial medium along with release of type PL contracton towards mass medium. Therefore, the particle acquires a type L configuration. Similarly, the particle emits a type WL expandon, and so on. As results:

According to above process, at any beat a state of an isolated particle in spatial medium is expanded, *Sec. 8(7)2, Part E3*; while, other states are contracted as stated above during a stay time interval $\Delta T_{p(E)}$, *Comment 7(4)2e2*.

The phenomenon of particle finding in a state (or jumping to a state) has a hard link with its matter wave counterpart generation related to gravity of particle, *Sec. 5(6)2*.

Any transition of type *R* to *L* or vice versa can be regarded as jumping from a type e.g. *R* to *L* one during stay time interval $\Delta T_{p(c)}$ or vice versa is along with related expandon and contracton emission that leading to particle matter wave and its gravity aspect.

F3) The probability of finding of electron in a position (or state)

By analogy to an isolated free moving particle that interacts mutually with the H hall packages of the gravity free vacuum. The engaged electron interacts mutually with its track textures in electron shell medium, *Sec. 7(4)3, part E3*, during stay time intervals that depends on both H particles-paths densities of electron main-body and its track texture, *Eq. 7(29)3,* of *Sec. 7(4)2f, part A*. Noteworthy, the H particle-paths number of electron main-body N_{0p} is proportional of H particle-paths number of its track textures in a location by a varying factor, i.e. $K_{\Gamma(gm)} \propto n_{0p}$, or N_{0p}, that depends on H particle-paths density of track texture in that location. Therefore, according to *Eq. 7(29)3*, the stay time interval of electron is proportional inversely to the square of electron total H particle paths number N_{0p} in one hand. In other hand, the magnitude of ψ or ψ^* is proportional to the total number of electron H particle-paths N_{0p}. Thus, the stay time of engaged electron is proportional inversely to square of wave function amplitude. In other words, the frequency of existence of electron in a position (or state) in a unit of time is proportional to square of amplitude of wave function. It is equivalent to the frequency of interaction of the electron with its media, i.e. increment of expandons and contractons emission in a unit of time. The more expandons and contractons emission in a position is equivalent to denser track texture in that position, *Sec. 5(16)3b, part B*. Therefore, the probability of particle choosing a track texture is related to density of that track texture, *Sec. 7(4)3, part E*. Resulting, the frequency of existence of a particle in a unit of time in a position is equivalent to finding the particle at that position. It is proportional to square of magnitude of wave function $|\psi|^2$, *Sec. 8(1)1,* or $|\psi.\psi^*|$.

G) Results and conclusions

G1) General aspect

According to *Sec. 8(7)2, part F2,* during any beat of particle (e.g. electron), merely an eigenstate acquires path-length value h. In other words, the particle exists in this state during a stay time interval $\Delta T_{p(E)}$, *Comment 7(4)2e2,* at an expanding feature, *Sec. 9(4)7*. It is terminating by an expandon emission in spatial medium; while, the remaining states of the particle H system as a single entity obtaining contracting feature, *Simulation 7(4)2e1*, that is terminating by contracton releasing towards mass medium of path-length value $-h$ during particle transfer to the next state, i.e. stay time interval $\Delta T_{p(c)}$, *Comment 7(4)2e2*. Please refer also *to Sec. 7(5)3d, part D, and Secs, 7(4)3, parts A, D.* As the results:

A) The expanded state obscures the remaining (contracting) states of the particle H system based on uncertainty principle. "We failed to "beat" the Uncertainty Principle - we cannot get a true measurement of two property values: when we measure one property, we poison the other reading - see here)"[556] *Bell's inequality*. Therefore, at any stay time, there are only one expanded state. "The multiverse theory says that entire universe freezes during observation, and we see only one reality" [614].

B) Before measurement, an isolated particle appears in each of its individual states successively during individual stay time intervals ΔT that reveals as superposed (or mixed) states from viewpoint of *HPPH* up to a measurement, *Sec. 8(7)2, part E3*. Therefore, each measurement acts merely on the expanded state, *Sec. 8(7)2, part E2*. It is related to mutual interaction of H particle-paths of the particle with that of the environment, or measuring device, *Sec. 7(4)2f, part E.*

C) According to *item A*, assuming the energy of the expanded state ΔE, we have $\Delta E.\Delta T \approx h$ within domain of uncertainty principle; where, ΔT the stay time of expanded state.

D) The expanded state and the entire remaining contracting states are existing separately in two universes, e.g. types $R \,\&\, L$ or $L \,\&\, R$ respectively based on bi-Universe hypothesis, *Sec. 5(16)9*. Noteworthy, the expanded state swallows the path-length value h of the quantized H hall package, *Sec. 5(16)3g, part B, item 2*; while, the contracting part acquires $-h$ path-length value just during both expandon and contracton emission by the particle H system, *Sec. 8(7)2, part F2*.

E) There are a hard link of particle gravity, with its finding in a state of its states related to particle wave function evolution, *Sec. 8(7)2, part F2*.

F) The stay time interval of a particle in its expanded state in tangential direction is related to *T*-symmetry, *Sec. 5(16)1b, part F*, due to antinodes, *Simulation 3(1)2a*. Moreover, particle transfer to upper levels in radial directions are related to time's arrow; while, the infinitesimal stay time interval in the nodes are related to spontaneous, *Sec.7(4)2f, part C,* transfer of contractons from particle to the supermassif black hole of the host galaxies and clusters, *Sec. 5(7)8*. Please refer also to *Comment 7(4)2e2,* and *Sec. 5(16)1b, part A, paragraphs,13, 26, 27*. Factually, according to *Sec. 9(4)7*, in a level or tangential direction, the total number of track textures cells or H hall packages remained constant; while, in the upper levels, the track textures cells increase due to time's arrow increment. In other words any new cell in an upper level imparts a time's arrow the same as its stay time interval. Noteworthy, the time elapse on each level depends on the density of appearance of the cells on that level along with the spatial volume increment (or expansion) related to volume V_{HP} of H hall quantized packages of each new borne track texture cell, *Sec. 5(16)3a*.

G) An elementary particle, e.g. electron, acts as a filtering that split the dark matter H particle-paths of SM configuration, *Sec. 5(15)2b,* to negaton, *Sec. 4(6)4*, i.e. electromagnetical equivalent of expandon in gravitational field of SN_r configuration constituted merely of single direction H particle-paths (or negapas) in spatial medium, *Sec. 7(4)3, part A,* and negactron of SP_l configuration constituted merely of single direction H particle-paths (or posipas) that transfer via H hall packages tunnels, *Sec. 5(9)3d, part c* to supermassif black hole. As the result, the electron field constituted of single direction negapas that configures the negative electric charge in its H hall package in the spatial medium, i.e. $-e$. Similar scenario also is valid for positron as elementary particle of positive electric charge, i.e. $+e$.

G2) Discussion

As a result obtained from path-length constancy, *Sec. 2(1)2*, besides of single photon-object correlation, e.g., $A\cdots E$ (*proposal 2*), there are also a row of successive photons *A*. Therefore, we have for example $A\cdots A\cdots A\cdots E$ configuration. In case of single slit experiment, a gun *E* emits type *A* electrons successively, we have the similar configuration of latter case; whereas, in case of double slits, *Sec. 8(3),* it is proposed a configuration at the entrance of the double slits as $E\cdots A\cdots A\left|\frac{\cdots A\cdots A}{\cdots A\cdots A}\right.$. Therefore, the correlation is split at the entrance of double slits to two individual branches related to two track textures. In other words, the H particle-paths stream is settled on vacuum texture background, *Sec. 5(16)3b*, between the nozzle of the gun and the screen. It is split by double slit to two branches on the vacuum texture background as a media of motion of particles, e.g., electrons (i.e. similar to a stream of water on the ground), *Sec. 5(16)3b*, *Remark 5(16)3b, B1*. Noteworthy, if a branch is right-handed [i.e. *SN* configuration, *Sec. 3(1)2*] by passing an spin up electron, the other will be left-handed [i.e. *SP* configuration] through passing spin down electrons, or vice versa, successively in order to preserve the handedness equilibrium in the main stream that can be viewed as indistinguishability. Please refer *Sec. 7(4)2f, part B,* and *Experiment 8(7)3a*. Please refer also to *Sec. 8(7)5; Sec. 8(9), paragraphs, 4, 5*. Moreover, according to bi-Universe hypothesis, in case of none equilibrated polarized mainstream beam, it is based on equal probable existence of two countercurrent right- and left-handed universes with the slight preference of the former one, *Sec. 5(16)9b*. As an experiment in this respect, according to [332] "The ability to exit in two states at once is another peculiar property of quantum physics, known as superposition. The beryllium *NIST* ions were placed in the most extreme superposition of spin states possible with six ions. All six nuclei are spinning in one direction and the opposite direction simultaneously or what physicists call Schrödinger cat states". Please refer also to *Sec. 5(16)8c*, and *Sec. 8(7)2*.

8(7)3 – Mass scenario based on H particle-paths hypothesis and Higgs theory

"Supersymmetry has long been a favorite candidate for extending the Standard Model, because it would answer numerous open questions, beginning with the nature of dark matter, the unseen mass that keeps galaxies rotating faster than they otherwise would" [628]. According to *HPPH*, if Higgs boson is confirmed at 125 GeV, it may be related to a portion of dark matter of zero rest mass that is confined to an H hall package in spatial medium. "Both experiments (*ATLAS & CMS at CERN*) are said to have seen evidence of the long-sought Higgs, pointing to a particle mass of around 125 billion electron volts, or 125 GeV. (125 billion electron volts is roughly the mass of 125 hydrogen atoms.)" [628], please refer also to Sec 6(2)6. Factually, the H particle-paths population density related to an H hall package (or *S*-patch, *Sec. 8(7)2, part E5, Schema E5*) in gravity free vacuum defines the proportionality factor K_Γ (or $K_{\Gamma d}$), of *Eq. 7(25)4 to 7(29)* of *Sec. 7(4)2f, part A*. In other words, the interaction of H particle-paths in a gravity free H hall package of vacuum medium, *Sec. 7(4)3, part A,* with that of a particle *S*-patch defines the stay time interval ΔT, *Sec. 7(4)2f, part A,* of the particle in the former H hall package. Therefore, the particle inertia or mass depends on magnitude of magnitude of ΔT in spatial medium. The stated above interaction leading to expandon emission of path-length value $+2\hbar$ in spatial medium along with contracton releasing of path-length value $-2\hbar$ towards center of mass of mass medium, *Sec. 7(4)3, part D,* and ultimately leading to the related black hole of host galaxies and clusters, *Sec. 5(7)8*, via H hall package tunnels, *Sec. 5(9)3d, part c*. Moreover, in a denser H particle-paths population density in spatial medium (or *S*-patch) as in a gravitational field, the ΔT according to *Eq. 7(29)3*, i.e. higher $K_{\Gamma gm}$, will be decreased that correspond to higher mass of a particle, e.g. electron, in spatial medium, and also higher mass of Higgs boson in a gravitational field.

As the result, the mass of a particle depends directly on two phenomena as following:

1- The population density of H particle-paths in related H hall package, i.e. spatial medium S-patch.

2- The population density of H particle-paths in the particle H hall package, i.e. particle S-patch in spatial medium. In fact, the H particle-paths of an *S*-patch is of zero rest mass, and *SM* configuration that has no interaction effect other than gravitational as stated above with other entities.

In case of particle of zero rest mass, the stay time interval related to the mass in *Eq. 7(29)3*, lost its meaning, i.e. $n_0 \to 0,\ \Delta T \to \infty$. Factually, according to *Sec. 5(6)1*, there are two kind of matter waves with related frequencies. In other words, the matter wave related to the external and internal motions that are independent of each other. Thus, in case of single direction (or external), *Sec. 1(3),* motion of H particle-paths as in case of zero rest mass particles, e.g. photon, the stay time interval ΔT is related merely to particle external H particle-paths in spatial medium. It is independent of particle S-patch interaction with that of vacuum medium based on $c.\Delta T$ relation in the pendent of particle mass, *Note 8(7)3a*. In other words, it behaves analogous to a photon of zero rest mass, *Sec. 7(4)2e1*. Based on *Eq. 5(19)1*, in case of stay time interval of zero rest mass particle, we have:

$$\Delta T = K_\Gamma^{-1}.N^{-1}$$

$$c.\Delta T = \Gamma$$

Where:

-*N*, the total number of H particle-paths of a zero rest mass of particle in related *S*-patch.

- K_Γ, the proportionality factor as in *Remark 2(3)1b*

- Γ, path-limit of the particle.

Noteworthy, in case of particle of low rest mass, and motion speed comparable to that of the light velocity, e.g. neutrino, there are interference between two kinds of matter waves due to comparable magnitude of their two stay time intervals, i.e. an oscillation." It sounds great, except if a given neutrino is one matter wave, where is the other matter wave which is interfering with it to produce this flip-flopping? The answer is that (in our simplified case of two neutrinos) the neutrino actually interferes with itself. Putting it another way, a neutrino can propagate not as a single wave, but as pre-packaged combination of two" [629] *what's interfering?* Therefore, based on *HPPH*, the idea of neutrino with two different masses is rejected, instead the matter wave of neutrino rest mass interferes with matter wave of external motion of its single direction H particle-paths (of zero rest mass). "There are no question that *if* neutrino have different (non-zero) masses, and *if* they mix so that each neutrino represents a mixture of two or more different masses, neutrino oscillations *will* occur" [629] *Conclusion or Confusion.*

Noteworthy, the single direction H particle-paths of zero rest mass part of neutrino main-body is constituted of counter-current, *Sec. 3(1)2,* portion of neutrino external motion of H particle-paths that constitutes the neutrino axeon, *Sec. 10(8)*. The latter is overlapped on reverson, *Sec. 7(5),* of reversible H particle-paths related to rest mass part of the neutrino that constitute the internal motion of H particle-paths of neutrino main-body. According to *Sec. 7(5)3d, part B*, the contractons released by neutrino and its mutual exchange with that of source constitute aggregated contractons within overlapped reverson that decayed further to lower neutrino and non detectable particles during neutrino critical travel time interval ΔT_{Crit}, *Eq. 7(47);* i.e. after n stay time intervals ΔT_{Stay}."Analysis of the data collected between the beginning of the experiment in January 2010 and March 2011 (the experiment was suspended as a result of the 11 March earthquake) shows that, over the period, the Super-Kamiokande detector recorded a total of 88 neutrinos, of which six were electron neutrinos that probably result from a change of muon neutrinos into electron neutrinos. The remaining 82 neutrinos are thought to be mainly muon neutrinos that underwent no transformation between their production to their detection. Measurements by GPS confirm that the neutrinos identified by the Super-Kamiokande detector were indeed produced on the east coast of Japan. The physicists therefore estimate that the results obtained point to a 99.3% probability that electron neutrino appearance was detected" [630].

Note 8(7)3a- The interaction of single direction H particle-paths with each *S*-patch of vacuum medium is independent of particle mass. It depends to linear longitudinal low cross section of single direction H particle-paths part contrary to rest mass part (related to its three-dimensional ground sphere) of neutrino main-body. In fact, the expandons of zero rest mass photon, *Sec. 4(4), Fig. 4(8),* propagate in a bi-dimensional plan; while, the expandons of rest mass, *Fig. 5(8),* propagate in three-dimensional spheres. Based on above discussion, the two kinds of external and internal motions of H particle-paths are of different geometrical behaviors. In other words, the contractons of single direction motion are released in bi-dimensional manner; while, that of reversible motion are released in three-dimensional manner (or aggregated, *Sec. 7(5)3d, part B*) within reverson, *Sec. 7(5),* and H hall package tunnels, *Sec. 5(9)3d, Part c.*

8(7)4 – Quantum mechanical interpretation based on H particle-paths hypothesis

Approaches to the foundation of Quantum Mechanics through H particle-paths hypothesis (*HPPH*) viewpoint are listed as following:

A) A particle from viewpoint of *HPPH* is not point-like, but it is confined in an H hall package, *Sec. 5(16)3a*, and extended through a path-length-limit Γ, *Sec. 1(12),* and has a path-length value h, *Sec. 5(16)3g*. Please refer also to *Sec. 4(3)1, part B, Fig. 4(4),* in this regards. Noteworthy, *HPPH* has deterministic nature including high energy based on constancy of light speed. Therefore, according to *HPPH*, both light speed c and path-length value h, i.e. unit (or quantum) of action, have finite values.

B) The mass-bodies behavior at macroscopic scale are according to *Sec. 2*; whereas, at quantum level, *Sec. 3*.

C) Free moving particle, e.g., electrons, are paired or pair of entangled during their motion through interchange of their H particle-paths, *Sec. 9(2), Note 9(2)4*.

D) According to *HPPH*, there are a competition between two competitive worlds of matter and antimatter with the slight preference of the former at a good approximation of equal probabilities, *Sec. 8(7)2*, *part G2*, of their single direction (on mono-directional) H particle-paths, e.g., spin, linear momentum, that reveal during measurement, *Sec. 8(7)2*. It is consistent with Mirror Image Effect, *Sec. 6(2)3,* (a modified form of Newton third law), and according to *HPPH*. Moreover, the exit of expanding gravitational spheres, *Sec. 5(4)1a*, prohibits the existence of antimatter aspect of the whole system, *Sec. 6(2)3, Consequence 6(2)3b*. Moreover, according to handedness reversal, *Sec. 5(16)9b*, by simply replacing negapa to posipa and vice versa in a matter, it will be converted to its antimatter conjugate, e.g., $e^- \rightarrow e^+$, *Secs. 4(3)2, 4(5).*

E) A particle confined in an H hall package from viewpoint of *HPPH* has two non-separable characteristic (i.e. wave and particle). Depending on the kind of interaction and its track texture, *Sec. 5(16)3b, part B* one of its two characteristics can revealed contrary to some other quantum mechanical interpretation.

F) The track texture, *Sec. 5(16)3b, part B*, of the particle extended from the source up to measuring device. Therefore, the H hall package of the particle obeys this expanding track and related sub-tracks during its motion in the different media, *Sec. 5(16)3b, part B*. In other words, the H hall package of the particle acquired the shape of its track texture, analogous to light beam bending near the Sun, *Sec. 5(10)1, Fig. 5(6).* The low energetic track texture conducts its high energetic particle, *Sec. 5(16)3b, part c, item B*.

G):

I – The quantum states, *Sec. 8(1)4*, of a particle are indistinguishable before measurement (or detection, *Secs. 8(6), 8(7)6*). In other words, in this stage the particle can be regarded as a unique H system of path-length value $\hbar$, *Sec. 5(16)3g*, that is composed of correlation of its all-possible states, *Secs. 8(7), 8(9)1*. Moreover, the probability of state is equivalent to a set of overlapped identical states. Any single state is differed from other states through special arrangement of their H particle-paths.

II) - The probability of existence of a particle in a state, by different interpretation is replaced by its wave-like H particle-paths population density according to *HPPH*, which is based on in turn to two equal probable existences of matter and antimatter Universes, *paragraph D.* Moreover, the counter-current reversible H particle-paths of an H system, e.g., particle or ensemble of particles can be presented on the basis of a standing wave function analogous to Standard Quantum Theory, *Sec. 8(1)1, Remark 8(1)1a,* and *Sec. 8(1)2, Note 8(1)2a.* Moreover, the probability of finding a particle with a given value of a quantity (e.g., momentum, energy, etc.) independently of its location is replaced by the momentum density, energy density, path-length density, *Sec. 2(4)2*, in an infinitesimal volume of space integrated over all position in space at each instant, as a quantity independent of particle position. In other words, the latter that is based on H particle-paths population density of a wave-like particle, e.g. electron cloud is causal respect to the former that is confined on probability of finding a point-like particle all over the three-dimensional space at each instant, *Comment 8(7)4a*. Please refer to [36], *section 30, Pp.318.*

III) – In quantum mechanics, according to "Copenhagen Interpretation, the wave ψ is not a physical wave but a probability wave"[494] *Introduction*, *Sec. 8(1)5*. While, according to *HPPH*, the H particle-paths that constitute a particle, e.g. electron, have real wave-like aspect, *Sec. 1(2).* Factually, the internal motion of H particle-paths that constituting a particle through particle's mass medium, *Sec. 7(4)3, part D*, can be represented by Λ_τ , i.e. an equivalent of wave ψ ; whereas, the emitted H particle-paths by the latter as expandons in spatial medium, *Sec. 7(4)3, part D*, can be represented by it's de Broglie wave λ_τ . Therefore, the correlation between Λ_τ and λ_τ is determined by proportionality factor K_Γ , *Note 2(3)1a, Eq. 2(57).* According to *Sec. 3(1)2, Figs. 3(4), 3(6),* from viewpoint of *HPPH*, the countercurrent wave-like negapas, and posipas are equivalent of wave ψ and it's conjugate ψ^* in *SQM, Sec. 8(1)2.*

H):

1) In *HPPH* there are no wave function collapse, *Sec. 8(1)5*, during an interaction (measurement), but instead there are dissipation of particle wave function in Huge wave function of measuring device, *Sec. 8(7)2, part D,* and *Example 8(7)2, B1,* or, better to say the two H hall package overlapped on each other.. At a stage that the whole H hall package of the particle swallowed by a huge mass-body, i.e. measurement, (its non-wave characteristic is displayed).

2) The measurement is regarded as an external interaction of a micro quantum system with a massif detecting device that disturb the quantum system configuration, *Sec. 5(16)3b, part c*. Therefore, *HPPH* aimed to approach through a theoretical configuration in this regards.

I) The borderline of quantum and classical theory depends on the inertia (or mass) of particle of rest mass through its motion in vacuum space quantized texture, *Sec. 5(16)3b, part C*. Therefore, there are no exact borderline, or, in other words, it depends on the definition.

J) In an isolated H system, by increment of a path-length of H particle-paths in a region of space; there are a decrement at equal magnitude in other region, *Remark 8(7)4a*. Noteworthy, the path-length increment is accompanied by space dilation time arrow, *Sec. 5(16)3a,* or vice versa*, Sec. 2(4)1, Sec. 2(4)2b, Consequence 2(4)1a.*

K) H particle-paths hypothesis is also a gravity model theory, *Sec. 8(8),* and *Sec. 5(6)2.*

L) According to right- and left-handed behavior of H particle-paths as singlet, the electric charge and their electromagnetical interaction can be visualized, *Sec. 4.*

M) The intrinsic time's arrow of an isolated H system of particles is the background of time's arrow, *Sec. 5(16)7c*, of the vacuum space. Therefore, this time's arrow is affected (or change) during measurement by a massif-measuring device (.e.g. on the Earth) through higher time arrow related to the latter.

N) The problem of ontological reality of wave function to according to *HPPH* implies that due to the propagation of wave (or wave-like H particle-paths) through vacuum texture, *Sec. 5(16)3b, part A,* the speed of information transfer is equal or less than light speed. On the other hand, through a measurement on a particle of the pair, this information can also be returned back within abstract vacuum, *Sec. 5(16)3h*, that is taken form during the previous stage of pair emission inside of the related H hall package, *Sec. 5(16)3a*, at an infinitesimal time interval. Please refer to *Sec. 8(9)1, paragraph 3*.
O) The phenomenon of expansion of the Universe is one of the basis of H particle-paths hypothesis that is not confined merely to expansion of the Universe, but it depends on H hall package generation in micro-world (i.e. increment of path-length that is accompanied by space expansion and time arrow), that leads to expansion of the Universe, *Remark 8(7)4b*.
P) During an interaction between two (or more) H systems regarded initially as isolated, i.e. total path-length of each of them is constant, *Sec. 2(4)1, Sec. 2(4)2b.* After interaction, or, measurement, (i.e. passing through intermediate stage related to Mirror Image Effect), the interacted H systems become correlated as a unique H system, *Sec. 8(5)*, through mutual exchange of their H particle-paths; please refer to *Sec. 8(7)2, Sec. 8(7)6, Comment 8(7)6b*.
Q) According to *HPPH*, time duration is a quantized entity, i.e. ΔT_{Γ}, *Sec. 7(4)3*.
R) Any isolated H system (e.g., many particles system*, Sec. 8(7)6*) has a *CMPRF, Sec. 2(6)2b,* frame at a location in vacuum quantized texture, *Sec. 5(16)3b, part A*. The path-length of any of two of its ingredients, e.g., particles, has a constant value, i.e. h, *Sec. 8(7)6, Example 8(7)6, D1,* at opposite direction of each other at any time interval and respect to an observer at this location, *Consequence 5(9)3d1*. During a measurement, it coincides with the *CMPRF* of the measuring device due to huge inertia of the latter. Therefore, the relativistic γ^{-1} contraction factor, *Sec. 2(6)5b, Example 2(6)5b1*, of measured ingredient is at good approximation the same as that of measuring device respect to the observer at their common *CMPRF*, i.e. $\gamma^{-1} \cong 1$. In other words, its measurement has a non-relativistic aspect; please refer also to *Sec. 2(6)5c, proposal c,* and *Sec. 2(6)6*.

Comment 8(7)4a – "Can wave-particle duality be taken seriously? However, is it possible that the wave-particle duality has a literal meaning: that, in some sense, electrons and photons really are both particle and waves? Most experts for foundation of *QM* will probably say-no! Nevertheless, such a definite no is also an unproved myth. Of course, such a definite is correct if it refers only to the usual formulation of *QM*. Both who say that the usual formulation of *QM* is the ultimate theory that will never be supersedes by an even better theory?" [410] *section 2B*. In *SQM,* the wave is regarded as probability wave, and an ad hoc wave amplitude probability density at any position is established by Max Born as probability of density of position of point-like particle at each instant. Due to outstanding results obtained from *SQM*, some sort of hidden reality may underlie the usual form of this not revealed until yet. "Further, assuming the Bohr concept were true, he asserted the notion of a discrete particle being *everywhere at once* is impossible to imagine" [501] *Historical proposals*.

Remark 8(7)4a- Noteworthy, the path-length density (or action) variation, *Sec. 2(4),* in each infinitesimal volume of the isolated H system of particles ensembles must be visualized instead of velocity or momentum of the point-like classical particles that constitute this H system. The background time's arrow of vacuum quantized texture, *Sec. 5(16)1c, part c; Sec. 5(16)7c* must be considered as time scale (or dimension) in this H system. Factually, the H system evolution of particle ensembles must be regarded on a bed of vacuum quantized texture, *Sec. 5(16)3b*. The other time scale than background one, e.g., lab time scale, means that isolation configuration of the H system is violated by the lab (the Earth) mass-body according to *Sec. 5(16)1b.*

Remark 8(7)4b – The irreversible H hall packages generation is mainly due to gravitation and to some extent depends on the process based on second law of thermodynamics, *Sec. 5(16)7c*, such as beta decay, full burning, glass smash, etc. The lack of expansion phenomenon as stated above can be regarded as a lack in the postulates of standard quantum mechanics interpretation that leads to the contradictory results such as vacuum zero point energy; please refer to *Sec. 5(16)3c, Sec. 8(7)2, part c,* in this regards.

8(7)5 – De Broglie-Bohm theory Standard quantum theory and H particle-paths hypothesis comparison
Some comparative features between three above theories are given as following:
I) According to [333], "What Bohm did was to distinguish between the quantum particle, e.g., an electron, and a hidden *guiding wave* that governs its motion. Thus, in this theory electrons are quite clearly particles. When you perform a double-slit experiment, they go through one slit rather than the other. However, their choice of slit is not random but is governed by the guiding wave, resulting in the wave pattern that is observed". Whereas, According to H particle-paths hypothesis *(HPPH)*, and contrary to Bohm interpretation, the moving electron is not a point-like particle, *Sec. 4(3)1b, part B, item XXII,* and *Fig. 4(4).* Moreover, it is confined in an H hall package of path-limit, Γ, *Sec. 1(12),* and path-length value h, *Sec. 5(16)3g*. Noteworthy, an electron, e.g., spin up, passing through one slit breaks the equilibrium in the main stream and the other electron of spin down will pass through other one. In other words, the main stream track texture is split to two twin braches successively in order to preserve its handedness equilibrium, *Sec. 8(7)2*, *part G2.*
II) According to Bohemian Mechanic, "Apart from a wave function, there are hidden variable to describe the physical system. These variables are n vectors that have to be interpreted as actual position vector associated with n particles in three- dimensional physical space. These vectors are also the position vectors revealed in a position measurement. This is in contrary to standard quantum mechanics when no particle exists as logical entities until a position measurement is performed" [340], *Section 2*.

According to *HPPH*, the measurement (or detection) of a particle is accompanied by related space contraction and time arrow reversal, *Sec. 5(16)7a*, during the process of Mirror Image Effect, *Sec. 6(2)3*. In case of hidden variables please refer to *Note 8(7)5a*.

III) It should pointed out that unlike what happens with Maxwell's equations for example, the Schrödinger equation for the quantum fields does not have sources, nor does it have any other way by which the field could be directly affected by conditions of the particles. This remark is the most important sentence in Boehm's entire book"[334], *Part one*. According to *HPPH* viewpoint any H system, *Sec. 1(1)*, e.g., electron, photon, atom, mass-bodies, are confined in an H hall package, *Sec. 5(16)3a*, of path-limit Γ, *Sec. 1(12)*, and path-length value h, *Sec. 5(16)3g*.

IV) "One baffling is for instance that possible trajectories in de Broglie-Bohm theory differing in their initial conditions cannot cross, because the wave guides the particles by way of a first-order equation, whereas Newton equations are second-order, as well-known, and possible trajectories do cross. However, the non-interfering components produced by Decoherence can indeed cross, and so will be the trajectories of particles trapped inside them."[343], *section 4.2*. On the basis of *HPPH* the law of motion can be obtained according to *Secs. 2, 3*. Please refer also to *Sec. 8(7)1d*

V) According to [343], an experimental test is performed comparing standard quantum mechanics *(SQM)* with de Broglie-Bohm theory, (*dBB*). "We observe a perfect agreement with *SQM* prediction and a coincidence peak almost *8* standard deviation above zero, when the two photon-detectors are well inside the same semi-plane. Thus, our results confirm *SQM* contradicting *dBB* prediction"[341], Abstract; similar result is obtained according to [351]. Based on *HPPH*, we encountered with a correlated expanding trajectories of particles though source, slits, and screen, *Sec. 5(16)3b, part B*.

VI) The empirical prediction of *SQM* follow from mathematical formalism which makes no use of the assumption that matter consist of particle pursuing definite tracks in space time". "But , in the Bohemian quantum mechanics, the additional element that is introduced apart from the wave function is the particle position, conceived in the classical sense as pursuing a definite continuous in space-time"[352], Introduction. According to *HPPH* the particles are not point-like, but wavelike, and their trajectory obey the vacuum track texture, *Sec. 5(16)3b, part B*.

VII) The only difference remains between *dBB* and *SQM* is an interpretational one. In *dBB* $\rho(Q_1,....,Q_n,t_0)$ is interpreted as the probability of particles really being at position $Q_1,....,Q_n$ at time t_0, whereas in *SQM*, $P(Q_1,....,Q_n,t_0)$ is the probability of the particles being detected at the position $Q_1,....,Q_n$ at time t_0, *Remark 8(7)5b*. According to *HPPH*, the density of H particle-paths at each position in the whole H system is meaningful, *Remark 8(7)5a*. Therefore, during detection the equilibrium of the whole H System is broken according to *Mirror Image Effect*, *Sec. 6(2)3*, by massif (of high inertia) detecting device. In other words, a particle is appeared according to this interaction from whole H System in its captured form with the measuring device considering counter-current matter and antimatter Universe based on biUniverses hypothesis, *Sec. 5(16)9*. Please refer also to *Secs. 8(7)2, 8(9)1*. It would appear that because of the orthodox quantum theory (*SQM*) supplies us with probabilities not merely for position, but for a huge class of quantum observables, it is a much richer theory than Bohemian mechanics, which seems exclusively concerned with position [359], *part 10*.

VIII) "It (*dBB*) accounts for all of the phenomena governed by no relativistic quantum mechanics. From spectral lines and scattering theory to superconductivity, the quantum Hall Effect and quantum computing" [359], *Preface*. The *HPPH* based on constancy of the light speed, it has explanation in the nature of electric charges and electromagnetic interactions based on right- and left-handed H particle-paths, *Sec. 4(3)*. It accounts for all phenomena related to gravity, Universe expansion, origin of time's arrow, vacuum quantized texture, particle track texture in vacuum.

Note 8(7)5a- "The particles must have possessed the property values already, albeit hidden from our view in some deeper level of reality. These property values (referred-to as **hidden variables**) only emerged into physical reality when a measurement was taken. However, this would mean the particles possessing more information than quantum theory said they should have. If particles had hidden variables then quantum theory was wrong"[557] *Hidden variables theories*. According to *HPPH*, the mentioned above properties is not related merely to particle, but to both particle and spatial medium, *Sec. 7(4)3, part A*. Please refer also to *Note 8(9)1a*.

Remark 8(7)5a – According to *HPPH*, instead of considering them as point-like particle as in *dBB*, it is proposed that the momentum of flow density must be considered in physical space along with path-length variation, *Sec. 2(4)1*, at that location. Please refer also to *Sec. 2(3), Eq. 2(64) to 2(71).* Moreover, the particle-momentum distribution is affected through expansion of track texture, *Sec. 5(16)3b, part B,* in such a way that the total momentum of the whole H system remain conserved, contrary to the prediction down by *dBB* and in accordance to *SQM*. According to the later, the probability of asymmetrical joint detection of the two particles can be non-zero on the screen of double slit experiment; please refer to [351, 352].

Remark 8(7)5b- From view of Relational Quantum Theory, "Quantum events only happen in interaction between system and the fact that a quantum event has happened is only true with respect to the systems involved in the interaction. In other words, of (Rovelli 1996) Quantum Mechanics is a theory about the description of physical systems relative to other systems, and this is a complete description of the world" [382], *Section 2*. "If one is interested in the quantum theory of the entire Universe, then, by definition, an external observer is not available. In order to write a meaningful quantum state, argue Crane and Smolin, we have to divide the Universe in two components and consider the relative quantum state predicting the outcomes of the observations that one component can make on other" [382], *Section 5.3*.

According to bi-Universes hypothesis, *Sec. 5(16)9a*, in matter Universe along with its observer has a conjugate counterpart observer in antimatter Universe at equal probability. In other words, an interaction is performed because of Mirror Image Effect, *Sec. 6(2)3*, that is known in classical mechanic of massif mass-body as Newton third law. The latter effect is considered as two states of a system, e.g. electron spin and down from point of view of *SQM*. In other words, the electron can be in superposition of its two states; please refer to *Sec. 4(7), Fig. 14*. However, from viewpoint of *HPPH*, this two conjugates (or states) can be regarded as expanding (matter) and contracting (antimatter) respectively. Note that, the Mirror Image Effect, in the above case during an interaction (or collision) only concerns with the single direction part of H particle-paths of the particle, e.g. electron, (related to its external motion) not to the reversible part of it's H particle-paths (related to it's internal motion); please refer to *Sec. 1(3).* Noteworthy, Universe as a unique H system has only an observer in its countercurrent antimatter Universe.

8(7)6 – Many particles system

A) Preliminary step

According to *Secs. 8(7)4, 5,* we have not any access to the magnitude of H particle-paths flows (or current) and density in a location of system of particles, unless through a measurement by an apparatus (or detector) in that location. In other words, an interaction of the system and apparatus based on Mirror Image Effect, *Sec. 6(2)3*, in micro-world that is accompanied by system disturbance. However, we can have a deterministic theoretical schema of H particle-paths flow, and density in a location according Bohemian Mechanics without this disturbance (or measurement). According to the above statements, according to *HPPH*, an isolated system of particles can be regarded as a set of H particle-paths with a flow density at each point of 3-dimension space, *Comment 8(7)6, A1;* please refer also to *Consequence 5(9)3d1*. Moreover, this set can be regarded as spatially expanding according to *Sec. 5(16)1b, part A*, with its own time's arrow. Note that, the particles are not point-like, but wave-like that is constituted of H particle-paths. Therefore, the concept of point-like particle and its wave pattern as two separate entities along with ad hoc probability of particle existence as point-like entity instead of H particle-paths population density distribution are refuted by *HPPH*, *Remark 8(7)6, A1*. Therefore, instead of probability of existence, it is better to say the probability (or ability) of a particle detection at a location. In other means, to some extent it is in accordance to *SQM*. Please refer to *Sec. 2(3)1, item IV, Eqs. 2(73) to 2(77).* Factually, the vacuum track texture of particles and its subtracks in *HPPH* play the role of pilot wave as in *dBB, Sec. 8(7)5*. Please refer also to *Sec. 8(1)1, Remark 8(1)1a.*

In case of particle trapped in a closed rigid box, please refer to *Sec. 8(2)2,* and *Sec. 7(4)3, part E*.

Comment 8(7)6, A1 – "Consider a quantum system *S* with internal parts *s, s',*….that may be considered as subsystems of *S*, and define the correlation among subsystems as the expectation values of products of subsystem's observable. It can be proved that, for any resolution of S into subsystems, the subsystems correlations determine uniquely the state of *S*", [382], *Section 3*. Supposing the many particles system described by *S* and its particle by *s, s'*. Therefore, each particle has its own H particle-paths at reversible mode of motion that are inter-correlated by other particle's H particle-paths. In other words, each particle participates in the system *S* on the basis of its total H particle-paths (or densities). Thus, the products of these number of individual H particle-paths of particles define their contribution in the main system *S* (after normalization); please refer to *Sec. 8(9),* in order to have an idea of a correlated two particles system. Noteworthy, the particle in a system of many particles are correlated with each other in such a way that the whole system can be viewed as a unique H system, *Sec. 8(5).* To this system, we can attribute an H hall package, *Sec. 5(16)3a*, of path-length value h, *Sec. 5(16)3g*, just during a measurement. Factually, just after a measurement, to the detected particle and its detector combination in the system, one can attributes an individual H hall package. "Even a system with many particles is still a single system"[553] *Comments*. Moreover, according to *Consequence 5(9)3d1*, the algebraic sum of path-lengths of the particles respect to observer *A, Sec. 8(9)2,* at the origin of their *CMPRF* through the spatial medium is zero.

Remark 8(7)6, A1– "Ghirardi rightly emphasizes the importance of specifying what he calls, the physical reality of what exist out there. For this he chooses the mass density function, which for the simple *GRW* theory described here can be identified with the mass weighted sum $\sum_i m_i \rho_i(x)$ over all particles, of the one-particle densities ρ_i arising from integrating over the coordinates of all but one of the particles"[356]. Noteworthy, the mass density can be compared with counter-current reversible H particle-paths population density. Noteworthy according to H particle-paths viewpoint, the concept of the probability of finding a particle as point-like at each point of a location during related stay time , *Sec. 7(4)2f, part A,* is replaced by the flow density of H particle-paths of a non point-like particle at different locations and at a same time in a causal way, *Sec. 7(4)3, part E1*. Note that the combination of a classical concept, i.e. point-like particle, with that of non-classical quantum mechanical one is somehow causally incompatible.

B) A proposed mechanism

To this isolated many particles system, one can specify path-lengths, *Sec. 2(1)2*, as following:

I) Total path-length variation, *Remark 8(7)6, B1*, of the system is zero. In other words, a path-length increment at one location is accompanied by an equal path-length decrement in other location; please refer to *Sec. 2(4)1, Sec. 2(4)2b.*

II) Path-length increment of the whole system as a result of expansion along with time's arrow, i.e. expanding gravitational sphere generation; please refer to *Sec. 5(16)1b, part A, paragraph 15*.

III) The probability (or ability) of detection of a particle, *Remark 8(7)6, B2*, in the many particles system, *Sec. 7(4)3, E1*, at a location by a measuring device (or detector) depends on two following cases:

1) Based on equal probable existence of matter and antimatter Universe, (bi-Universes hypothesis), *Sec. 5(16)9*, with the preference of the former, it may be depends on the path-length increment and decrement at that specified location respectively (case *1*); please refer to *Sec. 2(4)1*, *Sec. 2(4)2b,* and *Sec. 8(7)4, paragraph G.*

2) Path-length density, *Sec. 2(4)2*, (or H particle-paths flow density) at a location (case *2*).

Please refer also to *part D, item 2*. Moreover, particles in this system can be confined in H hall packages, *Secs. 5(16)3a, g,* each of path-length value h; please refer to *Sec. 8(7)4, paragraph R*.

According to above discussion, the case *1* specify the configuration of a particle, e.g., spin up or down and the case *2* defines the magnitude (or occurrence) of the probability of detection. Noteworthy, the combination of the two cases*1, 2,* can be regarded as the ability of detection of a particle from a many particles H system by analogy with *SQM.*

Finally, through a measuring device, a particle can be captured by the former due to its huge inertia, *Sec. 5(16)3b*, *part c*, at a location. Therefore, according to *Mirror Image Effect, Sec. 6(2)3,* and paragraph *III* of this section, one of the state (or eigenstate) of the many particles system takes form; please refer also to *part D* of reference [366]. By a far analogy, it can be compared to a picture that is taken from the random motion of balls in a rotating spherical basket at the same instant that is a ball exiting from the porthole of the latter, by the difference that particles must not be considered as point-like. In other words, considering the whole H particle-paths of the particles with different densities as a unique entity that is in motion. Resuming, "The measurement process randomly picks out exactly one of the many possibilities allowed for by the state's wave function" [376] *The Copenhagen Interpretation*.

Remark 8(7)6, B1– The path-length of an H system from viewpoint of H particle-paths hypothesis (i.e. the space-time equivalent in relativity theory) varies as an integer number of h (Planck constant) value, *Sec. 5(15)3g*, through the units of H hall package, *Sec. 5(16)3a*; please refer also to *Secs. 5(16)7a,c*.

Remark 8(7)6, B2– "The interpretation is often indicated as probabilistic rather than statically, the latter term being more appropriate in case of a classical ensemble in which each element has well-defined value for all physical quantities, independent of any measurement"[364], *The Copenhagen (orthodox) interpretation.*

C) A proposed transfer from multi-dimensional micro-world to spatially 3-dimensional macro-world

Considering an isolated system of *N* particles moving freely in vacuum texture, *Sec. 5(16)3b,* medium according to *Sec. 5(16)3a,* each of them are confined in an H hall package that is extended in path-limit, Γ, *Sec. 1(12),* and path-length value h, *Sec. 5(16)3g*. Therefore, we can attribute a *3N* dimension from viewpoint of mathematic formalism to this *N* particles system, *case A*; please refer to *Sec. 8(1)1, Remark 8(1)1a.* Now, supposing:

I) This system in its contracted form constitutes a mass-body with an H hall package, *Sec. 5(16)3a*; that is according to *Sec. 7(2),* the *N* H hall packages are coincide (or overlapped) on each other to constitute finally a unique H hall package of the related mass-body, *Case B*. In other words, each path-limit Γ, *Sec. 1(12),* is contracted (or curled) down to Planck length, *Sec. 5(16)3b, part c;* please refer also to *Sec. 5(8)2, Eq. 5(33)*. Therefore, the system that mathematically constitutes of *3N* dimensions is converted to a 3-dimensions one, which coincides to that of physical macro-world accordingly, *Remark 8(7)6, C1*. According to this discussion, transferring from a micro-world to macro-world terminated to three real spatial dimensions of the whole H system (or mass-body). Note that *N* must be large enough for this transference in order to path-limit, Γ,

II) A mass-body *M* as measuring device interacts with this many particles system mathematically of *3N* dimensions. According to *Sec. 8(7)2, Sec. 5(16)3b, part c*, one of the *N* particles is captured, *Sec. 8(7)2, Example 8(7)2, B1*, by mass-body *M* based on *Sec. 8(7)6*. Therefore, at the end of measurement (or detection), the path-limit Γ, of the captured particle is contracted to the Planck length, l_p, *Sec. 5(8)2, Eq. 5(33)*, or, better to say it is dissipate in mass-body *M*. In other words, its H hall package is overlapped with that of mass-body *M*. Likewise in this case, in this case, we have a 3-dimensions H system (i.e. measuring device plus the captured particle as a unique H system, *Sec. 8(5)*),. As a result, any transfer to a macro-world is accompanied by *3* spatial real dimensions; please refer also to *Example 8(7)6a*.

Noteworthy, the path-length, *Sec. 3(1)2*, in the example of *case B* is expanded to path-length as in *case A*. Therefore, transferring from *case B* to *Case A* is accompanied by spatial expansion and time time's arrow (or vice versa). According to above statement, the space-time (the equivalent of path-length in H particle-paths hypothesis) in the *case B* (macro-world) cannot be applied to that of *case A* (micro-world) merely considering the particle as point-like by analogy with mass-body in macro-world.

Remark 8(7)6, C1– Noteworthy, in case of *N=1*, i.e. an individual particle, attributing of *3*-dimensional mathematical space R_3, e.g., Hilbert space H_3 at real dimension, to a *3*-dimension physical space is not true because of no Γ, contraction (or curling). "Whereas H_3 is complex, it is in fact enough to consider a real three-dimensional Hilbert space R_3, if the assignment is impossible on R_3, then it is impossible on H_3 (or vice versa)". "This space R_3, however does not present physical space for the quantum system at issue. In particular, orthogonality in R_3 is not to be confined with orthogonality in physical space. This becomes obvious if we move to an example of a *QM* system sitting in physical space and at the same time requiring a *QM* representation in H_3, e.g., the spin degree of freedom of a one-particle spin-1 system. Given an arbitrary direction in physical space and an operator S_α representing the observable of a spin component in direction α, H_3 is spanned by the eigen-vectors

of S_α, namely $|S_\alpha = 1\rangle, |S_\alpha = 0\rangle, |S_\alpha = -1\rangle$, which are mutually orthogonal in H_3. The fact that these three vectors corresponding to three possible results of measurement in one spatial direction are mutually orthogonal illustrates the different senses of orthogonality in H_3 and in physical space. (The reason lies, of course, in the structure of *QM*, which represents different values of an observable by different direction in H_3)" [367], *part 3.3.* Factually, *N* must be large enough to have contraction (or curling) of path-limit Γ, of constituting particles of the system in its contraction configurations.

D) Measurement

D1) General aspect

As a result, of *part B*, the many particles system has different aspects (or states) that are separated by a unit (or cell) of path-length of h value, *Sec. 7(4),* increment or decrement at a location. The capturing of one of the particles at that location by a massif mass-body (measuring device), *Example 8(7)6, D1*, corresponds simultaneously to one of these states. Note that, the total path-length variation of the isolated system is zero. Thus, we encountered to path-length variation at a location of path-length value h, *Sec. 5(16)3g,* (along with path-length density, *Sec. 2(4)2*, based on cases *1, 2*. "Dirac emphasized in his book on quantum Mechanics that a measurement will result in the wave function being in an eigenstate" [366]. As a result, the whole isolated many particle H system before measurement (or interaction) can be regarded as a unique H system, *Sec. 8(5),* of path-length value h, *Sec. 5(16)3g,* and stored path-length *Nh*, *Sec. 7(4)1, paragraph 3*. Therefore, just after a measurement a new path-length value h is gained by interacted particle from the stored path-length *Nh*.

According to above statements, the Quantum Mechanical approach from viewpoint of H particle-paths hypothesis is no longer non-causal. Based on this hypothesis there are a competition between quantized texture and the measuring device mass-body respect to many particles system. Therefore, during interaction of the latter and many-particle system, there will be a path-length contraction of measured particle. In other words, there are an appropriate time's arrow reversal along space contraction, that the vacuum texture resist to it, with the dominance of the measuring device due to its high density H particle-paths (or its huge inertia, *Sec. 5(16)3b, part c*) respect to the vacuum texture one; please refer also to *Sec. 8(7)2*. In fact, according to bi-Universe hypothesis, *Sec. 5(16)9*, the concept of counter-current matter and antimatter Universes is based on right- and left-handed Universes, *Sec. 5(16)9a*, respectively. Thus, in case of fermionic particle of half of integer spin plus the ability of H hall unit for integer spin H system, *Sec. 5(16)3a, Example 5(16)3a*. The probability of equal existence of the matter and antimatter Universes also is extended individually in case of fermion to spin configuration. Therefore, the matter and antimatter conjugates spatial configuration must obey fully handedness and handedness reversal arrangement, *Sec. 5(16)2b,* (or indistiguishability) without any common arrangement. Therefore, any two identical H hall packages in the whole may particles system states must be forbidden. In other words, there are a combination of handed and handedness and its reversal of any possible configurations of the whole many particles system and the handedness-handedness reversal of individual H hall packages (or orbital) of each of the pair of fermionic particle. Thus, each combination is related to one of the states of the whole system, *Sec. 1(6), Comment 1(6)1*, that differ from other possible states. According to above discussion based on equal existence of matter and antimatter Universes with the slight preference of the later that can be revealed through *CP* violation, *Sec. 5(16)6*, along with path-length density (or H particle-paths flow density), as in *part B* at a location in case of many particles system. We can approach to some extent to *SQM* postulates, *Sec. 8(7)4*, from viewpoint of H particle-paths hypothesis.

D2) Mirror image effect intermediate

A measurement (or interaction)*, Sec. 8(7)2*, is always along with path-length variation of both system and measuring device, that is based on Mirror Image Effect, *Sec. 6(2)3*. Therefore, an isolated H system that its total path-length is conserved cannot be self-measured. "An apparatus *O* cannot distinguish all the states of a system *S* containing *O*, but in quantum context it implies that no quantum mechanical apparatus can measure itself and an external system. These correlations are only measurable by a second external apparatus, observing both the system at the first apparatus" [389], *Section 4.2*. In fact, the correlation phenomena, *Sec. 8(9)*, of H particle-paths between any systems (regarded as an isolated set) involved path-length constancy as stated above. Noteworthy, a system *S* measured by a measuring device *O*, after measurement of an observable become correlated with each other as a *S+O* composite, i.e. an unique H system, *Sec. 8(5).* A second external apparatus as stated above must measure this correlated composite of constant path-length value. Factually, during an interaction, the two closed isolated H systems *S* and *O* is opened through an intermediate stage based on Mirror Image Effect, *Sec. 6(2)3*. Therefore, the two H systems *S* and *O* are entangled as a unique H system via interacting line; please refer also to *Sec. 8(7)2*. Consequently, the self-measurement in a unique H system is impossible due to the lack of intermediate stage related to Mirror Image Effect. Moreover, a particle at quantum scale, e.g., photon, electron, proton, is confined in an H hall package, *Sec. 5(16)3a,* of path-length value h (i.e. the minimum possible path-length value in a one-dimensional H hall package). Therefore, during a measurement by a measuring apparatus *O*, only a physical component (or element) can be measured through Mirror Image Effect intermediate (non-commutation) based on *Eqs. 7(5), 7(10), Sec. 7(1),* due to one-dimensional correlation of particle and measuring device, contrary to massif mass-body in macro-world. In other words, to a mass-body in macrocosm it is associated more than an H hall package which leading to simultaneous measurement more than one element, (e.g., position, linear momentum) through a measurement without disturbing the whole measured system due to massif inertia of interacted components, *Example 8(7)6a*. Therefore, each element can be measured simultaneously by an individual H hall package without disturbance of other packages; please refer to *Example 8(7)6, D2*.

Example 8(7)6, D1– Considering a particle of a stored path-length of nh value, *Sec. 7(4),* and total energy E_P, that its H hall package (of cell energy ΔE_P, and internal time interval ΔT_P) is extended in path-limit Γ, *Note 8(7)6, D1*. In other words, according to *Sec. 7(4)2b*, (the right-hand side of *Eq. 7(20)*), the H hall packages' cell is a pseudo-unique H system, *Sec. 8(5),* that is extended in a path-limit Γ. Therefore, we can attribute an energy ΔE_P, and time interval ΔT_P, and path-length value h to the cell in such manner that:

$$\Delta E_P.\Delta T_P = h \qquad 8(9)$$

Now, supposing our H system is overlapped of n H hall units, *Sec. 7(2),* of total path-length value nh. In other words, it constituted of n groups of H particle-paths. Therefore, according to *Sec. 2(10)1, Eq. 2(117),* we have:

$$E_P.\Delta T_P = n.\Delta E_P.\Delta T_P = n.h \qquad 8(10)$$

Similarly, for the measuring device of total energy E_m, and internal time interval ΔT_m as m groups of energy ΔE_M. Therefore:

$$E_M.\Delta T_M = m\Delta E_m.\Delta T_M = mh \qquad m >> n \qquad 8(11)$$

After measurement of particle by measuring device, we have a new H hall package of energy $\Delta E_m + \Delta E_P$, thus:

$$(E_M + E_P)\,.\,\Delta T_{MP} = (m+n)\Delta E_{MP}.\Delta T_{MP} = (m+n)h \qquad 8(12)$$

Where, nh, mh is the stored path-lengths, *Sec. 7(2), Comment 7(2)1a*, of particle *P,* and measuring device *M* respectively.

According to *Eq. 8(10),* ΔE_{MP} is the cell energy at final stage (i.e. particle and measuring device), and ΔT_{MP}, is its internal time interval.

As a result, the H hall package of particle overlapped with that of measuring device as a unique H system, *Sec. 8(5),* which is along with space contraction and time's arrow reversal due to this overlapping process. Noteworthy, according to *Sec. 7(4),* an H hall package during its overlapping (or formation) is accompanied by time's arrow, ΔT_Γ reversal (or appearance), and space contraction V_{HP} (or expansion), *Sec. 5(16)3a, Eq. 5(70)2*.

Considering a photon striking a sand grain, grace of huge inertia, *Sec. 2(1)4*, of the latter; according to above discussion $\Delta T_{MP} \cong \Delta T_M$, and ΔE_P has nil effect on magnitude of ΔE_M, i.e. $\Delta E_{MP} \cong \Delta E_M$. Therefore, after striking we have $\Delta E_M\,.\,\Delta T_M \cong h$. In other words, the *CMPRF* of the stroked photon-sand system is coinciding with that of the measuring device, i.e. sand, *Sec. 8(7)4, paragraph R*. Nevertheless, due to comparable total energies of an electron at rest state with that of photon, the *Eq. 8(12*), is held. "To observe any particle, smaller particles must first be reflected off it. To find both the position and the momentum of, say, an electron, at least one photon (the smallest possible quantity of light) must be utilized. The photon must bounce off the electron then reflect back to the measuring device. For larger particles, such as sand grains or buses, the percentage uncertainty in the measurements of position and momentum is insignificant" [372]. Therefore, based on H particle-paths hypothesis, and inner motion of H particle-paths of an H system, we can have a consistent interpretation in this regards. Please refer also to *Secs. 2(10), 3(2), Sec. 5(16)3b*, *part c*. During photon scattering by an electron, *Sec. 3(1)2, Note 3(1)2a*, path-length of each of them remain unchanged. However, during a photon absorption by an atom, the path-length of the former is transferred to the latter. Therefore, during photon emission, the reverse process is performed.

According to above discussion, and because of this example, any H system, e.g., photon, electron, are confine in an H hall package, *Sec. 5(16)3a*, of path-length value h, *Sec. 5(16)3g*. Moreover a photon H system of path-length value h can be splits to multiple photons of lower energy each one has an H hall package of path-length value h, *Sec. 7(2),* therefore it can be regarded as an store of path-length units of value h. Similarly a mass-body can be regarded as store of path-length during appearance of expanding gravitational spheres, *Sec. 5(16)1b*.

Example 8(7)6, D2:

Supposing two objects *A, B*, initially at rest , thus the H particle-paths of each object independently are moving in countercurrent mode of motion, *Sec. 3(1)2*, in all direction without preference.

Now supposing the two objects (Whereas their center of mass is at rest) collides. At the instant of collision, *Sec. 6(2)1a*, the intermediate stage of Mirror image Effect is taken form according to *part D2.* Noteworthy, the H particle-paths at this stage are exchanged through H hall packages of *h* values through these two objects.

After collision, the objects *A, B* become correlated through interchange of their H particle-paths, *Sec. 8(9).* At the quantum level, this effect is significant.

Factually, the intermediate stage of H particle-paths can be compared with collapse postulate according to *SQM*. "In the context of the projection postulate, which asserts that upon measurement of a physical system, its state will collapse (or be projected) to one of the possible value of the measured quantity. This postulate is difficult to accept in any case (What effects this discontinuous change in the physical state of a system? What exactly is a measurement), but it is especially worrying when applied to entangled compound systems whose components are well-separated in space" [385], *section 1*. Therefore, the interchanging H particle-paths between entangled components can be regard as a key to approach to these difficulties. Moreover, the stated above discontinuity can be related to Mirror Image Effect intermediate, according to which the H particle paths at the instant of collision are exchanged through H hall packages of h values, i.e. in discrete values.

Note 8(7)6, D1- Factually, the cell energy of photon ΔE_P, and its related time interval ΔT_P can be regarded as energy dispersion, and time's arrow dispersion of the photon as a particle respectively. Moreover, after measurement of photon by a measuring device of energy dispersion ΔE_M, the energy dispersion of photon and measuring device ΔE_{MP} as a unique H system can be evaluated according to $\Delta E_{MP} = \Delta E_M + \Delta E_P$. Please refer also to *Sec. 5(16)10* in this regards.

8(8)-Quantum gravity theories, wave structure of matter theory and H particle-paths hypothesis comparison

In order to unify quantum and general theory of relativity, there are two candidates' theories of quantum gravity, string and loop quantum gravity. The H particle-paths hypothesis *(HPPH)* matches better with the latter one in the domain of discreteness space at quantum level, *Sec. 5(16)3a*; please refer to [237, 244]. "General relativity describes space as being a smooth surface, but quantum mechanics reveals a discontinuous microscopic world with constant fluctuations and activity". "Quantum mechanics attempts to describe the behaviour of particles as they move **within** a universe composed of spacetime. However, a theory of quantum gravity would seek to describe the behaviour of that background spacetime itself"[560] *Quantum Gravity: The Wheeler-DeWitt Equation*. According to *HPPH*, the vacuum space has a quantized texture along with expanding characteristics constituting of H hall quantized package; please refer to *Sec. 5(16)3b*.

8(8)1- Loop quantum gravity

."Whereas string theory views the curved spacetime of general relativity as an effective modification of a flat (or other fixed) background geometry by a massless spin-two field, the canonical quantum gravity program treats the spacetime metric itself as a kind of field, and attempts to quantize it directly. Technically, most work in this camp proceeds by writing down general relativity in so-called 'canonical' or 'Hamiltonian' form, since there are a more-or-less clear cut way to quantize theories once they are put in this form (Kuchar, 1993; Belot & Earman, 2001). In a canonical description, one chooses a particular set of configuration variables x_i and canonically conjugate momentum variables p_i which describe the state of a system at some time. Then, one obtains the time-evolution of these variables from the Hamiltonian $H(x_i,p_i)$. Quantization proceeds by treating the configuration and momentum variables as operators on a quantum state space (a Hilbert space) obeying certain commutation relations analogous to the classical Poisson-bracket relations, which effectively encode the quantum fuzziness associated with Heisenberg's uncertainty principle[599] *Canonical and Loop Quantum Gravity*.

8(8)1a-General aspect

"The theory of loop quantum gravity predicts that space is like atoms: there are a discrete set of numbers that the volume-measuring experiment can return. Volumes come in distinct pieces". "In other words, space is not continuous. It come only in specific quantum unitsof area and volumes" [585] *a big loophole*. Please refer also to *Sec. 5(8)2* in case of minimum volume $V_{\min}$ in space from viewpoint of *HPPH*. "Loop quantum gravity *(LQG)* is a proposed theory of space-time which is constructed with the idea of space-time quantization via the mathematically rigorous theory of loop quantization. It preserves many of the important features of general relativity, whereas at the same time employing quantization of both space and time at the Planck scale in the tradition of quantum mechanics" [453] *Introduction*. Factually, according to *HPPH*, the normal vacuum has quantized texture, *Sec. 5(16)3b*, the latter is constructed of H hall package, *Sec. 5(16)3a*, each of path-length value h, *Sec. 5(16)3g*. Moreover, a particle is confined in an H hall package, *Sec. 7(2).* Noteworthy, the path-length, *Sec. 2(1)2,* in the language of *HPPH* is equivalent to space-time of relativity theory. "So far only the first generations of fermions (leptons and quarks) with correct charge and parity properties have been modeled using preons constituted of braids of space-time as the building blocks" [453] *LQC and the standard model*. "With the addition of another dimension-time-the lines of the spin network grew to become two dimensional surfaces, and the nodes grew to become lines". "In this way time also becomes district. Time flow not like a river but like the ticking clock with ticks that are about as long as the Planck time 10^{-43} seconds"[585] *Movee and foams*; please refer also to *Note 7(4)1a*. Generally speaking, from viewpoint of HPPH, the H hall packages can be regarded as building blocks of the Universe. According to *Comment 7(4)2e2* in each state, the particle has a stay time interval $\Delta T_{P(E)}$ along with expandon emission. The particle transfer (jumping) from a state to other one has stay time interval $\Delta T_{P(C)}$ much lower than $\Delta T_{P(E)}$ at the ratio, e.g. $K_\Gamma \sim 10^{-34}$ along with contracton releasing. The particle moving in spatial medium on the track texture, *Sec. 5(16)3b, part B,* depending on H particle-paths densities of the latter. Therefore, *HPPH* proposes an alternate method respect to that of Loop quantum gravity**.**

8(8)1b-Quantization of spacetime

According to *HPPH*, the path-limit Γ defines the geometry of spacetime in a medium, e.g. normal vacuum, *Sec. 5(16)3b, part D.* "But, one might well think that one should start with the more fundamental, quantum theory, and then investigate under which circumstances one gets something that looks like a classical spacetime. The nature of the enterprise, in particular its seeming remoteness from experiment, gives rise to significant methodological and epistemological questions as well, focusing on the problem of how to construct or discover a scientific theory for phenomena, which are so remote from observation"[598] *Ontology*. Moreover, the time interval ΔT in each point of spacetime in a medium can be defined according to $\frac{\Gamma}{c} = \Delta T$. Factually, according to *HPPH*, the time evolves according to the densities of H particle-paths in a medium, *Sec. 7(4)2f, part A*.

"The problem of time is closely connected with a general puzzle about the ontology associated with "quantum spacetime". Quantum theory in general resists any straightforward ontological reading, and this goes double for quantum *gravity*. In quantum mechanics, one has particles, albeit with indefinite properties. In quantum field theory, one again has particles (at least in suitably symmetric spacetimes), but these are secondary to the fields, which again are things, albeit with indefinite properties. On the face of it, the only difference in quantum gravity is that spacetime itself becomes a kind of quantum field, and one would perhaps be inclined to say that the properties of spacetime become indefinite. But space and time traditionally play important roles in individuating objects and their properties—in fact a field is in some sense a set of properties of spacetime points — and so the quantization of such raises real problems for ontology. In the loop quantum gravity program, the area and volume operators have *discrete* spectra. Thus, like spins, they can only take certain values. This suggests (but does not imply) that space itself has a discrete nature, and perhaps time as well, (depending on how one resolves the problem of time). This in turn suggests that space does not have the structure of a differential manifold, but rather that it only approximates such a manifold on large scales, or at low energies"[599] *Ontology*. "Whether or not spacetime is discrete, the quantization of spacetime entails that our ordinary notion of the physical world, that of matter distributed in space and time, is at best an approximation. This in turn implies that ordinary quantum theory, in which one calculates probabilities for events to occur in a given world, is inadequate as a fundamental theory. As suggested in the Introduction, this may present us with a vicious circle. At the very least, one must almost certainly generalize the framework of quantum theory. This is an important driving force behind much of the effort in quantum cosmology to provide a well-defined version of the many-worlds or relative-state interpretations. Much work in this area has adopted the so-called 'decoherent histories' or 'consistent histories' formalism, whereby quantum theories are understood to make probabilistic predictions about entire (coarse-grained) 'histories'. Almost all of this work to date construes histories to be histories of spatiotemporal events, and thus presupposes a background spacetime; however, the incorporation of a dynamical, quantized spacetime clearly drives much of the cosmology-inspired work in this area"[599] *Status of quantum theory*. Based on *HPPH*, the concept of path-length in a medium can be comparable to spacetime of relativity with diverse properties. Factually, in vacuum gravitational medium, *Sec. 7(4)3, prts A, B*, the path-length is of expanding configuration in mass medium, *Sec. 7(4)3, part D*, of equal magnitude and opposite sign, *Sec. 5(16)11*, accompanied with contracton releasing of path-length value, $-2\hbar$, *Sec. 2(4)4a*. "More generally, one might step outside the framework of canonical, loop quantum gravity, and ask why one should only quantize the metric. As pointed out by Isham (1994, 2002), it may well be that the extension of quantum theory to general relativity requires one to quantize, in some sense, not only the metric but also the underlying differential structure and topology. This is somewhat unnatural from the standpoint where one begins with classical, canonical general relativity and proceeds to "quantize" (since the topological structure, unlike the metric structure, is not represented by a classical variable). But, one might well think that one should start with the more fundamental, quantum theory, and then investigate under which circumstances one gets something that looks like a classical spacetime"[599] *Status of quantum theory*. Please refer also to *Sec. 2(4)2a*. "The nature of the enterprise, in particular its seeming remoteness from experiment, gives rise to significant methodological and epistemological questions as well, focusing on the problem of how to construct or discover a scientific theory for phenomena, which are so remote from observation. Are beauty and consistency either necessary or sufficient? The pronounced split between the string theory community and the loop quantum gravity community has nothing to do with empirical success or lack thereof, but much to do with factors which might normally play a role only on the periphery of the scientific enterprise. The history of the enterprise of quantum gravity might well be worth historico-philosophical scrutiny, much as the history of cosmology has been, cosmology having also been rather data-starved until recently. (See Kragh (1999) for an excellent account of the big-bang/steady-state controversy.) "[599] *Methodology*.

8(8)2- String theory

".As noted in Section 4.2.2 above, the treatment of time presents special difficulties in canonical quantum gravity. These difficulties are connected with the special role time plays in physics, and in quantum theory in particular. Physical laws are, in general, laws of motion, of change from one time to another. They represent change in the form of differential equations for the evolution of, as the case may be, classical or quantum states; the state represents the way the system is at some *time*, and the laws allow one to predict how it will be in the future (or retrodict how it was in the past). It is not surprising, then, that a theory of quantum spacetime would have a problem of time, because there are no classical time against which to evolve the "state". The problem is not so much that the spacetime is dynamical; there are no problem of time in classical general relativity. Rather, the problem is roughly that in quantizing the structure of spacetime itself, the notion of a quantum state, representing the structure of spacetime at some instant, and the notion of the *evolution* of the state, do not get any traction, since there are no real "instants". (In some approaches to canonical gravity, one fixes a time before quantizing, and quantizes the spatial portions of the metric only. This approach is not without its problems, however; see Isham (1993) for discussion and further references.) One can ask whether the problem of time arising from the canonical program tells us something deep and important about the nature of time. Julian Barbour (2001a,b), for one, thinks that it tells us that time is illusory (see also Earman (2002) in this connection). It is argued that the fact that quantum states do not evolve under the super-Hamiltonian means that there are no change. However, it can also be argued (Weinstein, 1999a,b) that the super-Hamiltonian itself should not be expected to generate time-evolution; rather, one or more "true" Hamiltonians should play this role. (See Butterfield & Isham (1999) and Rovelli (2006) for further discussion.)"[599] *time*. The subject of string theory arose in the late *1960*'s in an attempt to describe strong nuclear forces. This theory aimed to uniting quantum mechanics, *Remark 8(8)2a,* particle physics and gravity. "String theory is an incomplete mathematical approach to theoretical physics, whose building blocks are one dimensional extended objects called strings" [457] *Introduction*. "String theory postulated that particles were not zero-dimensional points, as the standard method supposed, but were instead tiny strings whose vibrations are reflected in the observed properties of the fundamental particles" [217]. A comparison between string theory and *HPPH* model theory can be considered as following:

1)- "Particles in string theory arise as excitations of the string, and included in the excitations of a string in string theory is a particle with zero mass and two units of spins"[188]. Whereas, in *HPPH* all of the particles, fields, forces, interactions, based on wave-like H particle-paths at c speed, *Sec. 1(6),* and left- and right-handed spins in two modes of motion, i.e. reversible related to fermionic group or masses, *Sec. 3(1)2, Figs. 3(4)a, b*. Moreover, to single direction related to bosonic group or forces, *Sec. 3(1)2, Fig. 3(4)c,* that are extended in path-limit, Γ .By the way, this hypothesis is consistent with relativity, therefore there are no partner particles, i.e. fermionic or bosonic, as in string theory. In other words, "In order to include fermions in string theory, there must be a special kind of symmetry called supersymmetry, which means for every boson (particle that transmits a force) there are a corresponding fermion (particle that make up matter" [190]; please refer also to *Sec. 6(2)6*.
2)- Forward and backward motions of H particle-paths in a moving elementary particle of rest mass are performed through axeon, *Sec. 10(8),* and the related field as in, *Fig. 4(4),* and obeys to *Sec. 2(10), Eqs. 2(116) to 2(118);* whereas, "in string theory, the elementary particles we observe in particle accelerators could be tough of as the *musical notes* or excitation mode of elementary strings"[190]. "String theory postulates that all particles are made of the same fabric, as opposed to the particle-physics view that each elementary particle is in effect cut from a different fabric" [216]; whereas, *HPPH* postulates that mass, field, energy, force, are constituted of the same fabric, i.e. H particle-paths, *Sec. 1(6).*
3) – "If string theory is a theory of quantum gravity, then the minimum length scale, i.e. $L_{\min} \approx 2\sqrt{\alpha'}$ should be at least the size of the Planck length"[189], *Comment 8(8)2a*; where, α' is relate to string tension by the relation, $T_{string} = (2\pi\alpha')^{-1}$ [189], i.e. different tensions and minimum lengths according to the kind of particles. "The question of length scales in string theory is complicated by string duality, which can relate two theories with seemingly different length scales"[189]. Whereas, in case of *HPPH* the maximum length of H particle-paths, particles, are constant in a medium, *Sec. 5(16)3b, part D2,* nominated path-length unit, Γ, *Sec. 1(12),* this length can be bended, wrapped down to Planck length, l_p, *Eq. 5(33),* on the basis of path-length constancy, *Sec. 2(1)2.* Moreover, in the latter the field (electromagnetical or gravitational) are constituted of H particle-paths, *Secs. 4, 5*.
4) - "String theory is not based on any experiments, so it is not a fit to experiment and has no testable predictions about our world. String theory is a mathematical framework, based on postulates of special relativity and some of the postulates of quantum mechanics; its mathematical framework is very diverse"[208]. "Of course, string theory might not be the correct description of nature, or its current formulation might not be directly relevant to the cosmological constant problem. For example, a solution may be provided by loop quantum gravity or by a composite graviton"[308], *part 4.2*.
5) - "The proton is not decaying in the way it was predicted, supersymmetry has not be found where it was expected to be. The predicted effects of higher dimensions of space-time have not shown up [244A]. " No single string theory has been discovered that agrees with all of the observation of our Universe: the absence of supersymmetry at low energies, the presence of a cosmological constant with positive sign and the complete absence of a certain kind of field -called a massless scalar field- that string theories predict in abundance [237]. Considering H particle-paths hypothesis, the Universe has a unique stuff, e.g., Right- and left-handed H particle-paths moving at c speed.
6) - "One of the fundamental discoveries of Einstein is that there are no more a fixed background of space-time geometry than there are fixed crystal spheres holding the planet up. The fundamental theory must unifying quantum theory with a completely dynamical description of space and time. It must be what we call a background-independent theory. Loop quantum theory is such a one; string theory is not"[237]. On the basis of *HPPH*, the space steadily generated along with time's arrow, *Sec. 5(16)7a*, in the expense of mass conversion to gravitational expanding closed surface (or sphere) in a dynamical manner give its existence on sphere at Schwarzschild radius, l_s , *Eq. 5(15)2, 5(31),* as ground gravitational sphere; please refer to *Secs. 5(16)3a, 7(5)*, *5(6)2*.
7) – "String theory includes both open strings, which have two distinct endpoints, and close strings, where the endpoints are joined to make a complete loop. The two types of string behave in slightly different ways, yielding two different spectra. For example, in most string theories, one of the closed string modes is the graviton, and one of the pen string modes is the photon."[457] *Bosonic properties*. According to *HPPH*, the particles such as, photon, electron, etc. have two open ends, and are confined in an H hall package, *Sec. 5(16)3a, part A*, of path-limit Γ in the same medium, *Sec. 5(16)3b, part D2*. Whereas, the expandon, *Sec. 5(16)1c, part A3,* which induces gravitational interaction, has an expanding closed surface, e.g., sphere, within an H hall package of path-length value $2\hbar$, *Sec. 5(16)3g,* just during a measurement, *Sec. 8(7)2* (or interaction).
8) – "When the calculation is done, the critical dimensionality is not four as one may expect (three axes of space and one of time). Superstring and M-theories turn out to involve *10* or *11* dimensions for flat solution. Starting from any dimension greater than four, it is necessary to consider how these are reduced to four-dimensional space-time. Two different ways have been proposed to solve this apparent contradiction. The first is to compactify the extra-dimensions, i.e. the *6* or *7* extra-dimensions, *Comment 8(8)2a*, and *Note 2(1)1d1,* are as small as to undetectable in our phenomenal experience. These extra-dimensions are compactified by causing them to loop back upon themselves. The extra compact dimensions are only visible at extremely small distance, or by experimenting with particle with extremely small wavelengths (of the order of the compact dimensions radius). "[457] *Extra-dimensions*.
According to *HPPH* to each of *3* spatial axes, one can related a left- and right-handed spin in the direction (or counter-direction) of the axis considering bi-Universe hypothesis, *Sec. 5(16)9*. Therefore, an H system consisting of left-, and right-handed H particle-paths at different spatial directions, *Sec. 1(1),* can be analyzed through projections (or components) of H particle-paths on these axes. As a result, at microscopic scale, there are *1* time, and *9* spatial components (or dimensions) in a 10 dimensional space-time, *Note 8(8)2a*, which at macroscopic scale they are reduced to one time and *3* spatial dimensions. Please refer also to *Sec. 2(1)1d*.

9) – "Arkani-Hamed et al. assume that, gravity propagates in all of the *7* extra-dimensions of string theory, Standard Model particles are confined to a *4*-dimension brane. Some of the *7* extra-dimensions are large, while the remainders are curled up at the Planck scale". "Only gravity propagates in all the space dimensions. Gravity is a closed string. Standard model particles are open string stuck to the brane. *3+1* dimensional brane embedded in 10+1 dimensional space" [468]. "Much attention recently are confined to the usual 3 spatial dimensions (a 3-brane) while gravity can see all dimensions" [473] *Yukawa Potentials*.
"Gravity acting in the hidden dimensions affects other non-gravitational forces such as electromagnetism. In fact, Kaluza and Klein's early work demonstrated that general relativity with four large dimensions and one small dimension actually predicts the existence of electromagnetism. "[457] *Effect of the hidden dimensions.* Please refer also to *Sec. 2(1)1d*. Factually, according to *HPPH,* and referring to *Sec. 4(3)1,* the electromagnetism is interpreted based on left- and right-handed H particle-paths behavior, which according to paragraph *8* is related to extra-dimensions. Please refer also to *Remark 5(16)1c, A3.*
10) – "Dozens of string-theory conferences have been held, hundreds of new Ph.D.s have been minted, and thousands of paper have been written. Yet, for all this activity, not a single new testable production has been made, not a single theoretical puzzle has been solved. In fact, there are no theory so far –Just set of hunches and calculations suggesting that a theory might exist."[457] *Problems and controversy*. The *HPPH* is based on experimental, and test results rather than mathematical formalism. Its basics depend on assumptions such as Path-length Constancy, *Sec. 2(1)2*, Delta Effect, *Sec. 2(1)1b*, Counter-currency of left-, and right-handed H particle-paths, *Sec. 3(1)2*, bi-Universe hypothesis, *Sec. 5(16)9*, Mirror Image Effect, *Sec. 6(2)3,* etc. "Now string theory, one of today's leading candidates, is in trouble. A growing number of physicists claim it is ill defined and based on crude assumptions. Something fundamental is missing, they say. The main complaint is that rather than describing one Universe, the theory describes 10^{500}, each with different constraint of nature, even different law of physics." [458] *Introduction*. According to *HPPH*'s bi-Universe hypothesis the Universe is constituted of two counter-current Right- and left-handed Universes that are coinciding as a Unique Universe due to slight preference of right-handed one (i.e. matter Universe). Moreover, the Mirror Image Effect has a main role in *HPPH*.
11) – The path-limit Γ of entangled pair of particle is elongated from the source up to a measuring device. Just during an interaction in a medium, e.g. vacuum, the path-limit Γ acquires the normal length of H hall package of that medium, *Sec. 7(4)3, part G.*

Comment 8(8)2a- There are *6* or *7* compact (or curled) extra-dimensions over *4*-dimensional space-time in macro-world. Thus, to each of extra-dimension, one can attribute a spatial medium, *Sec. 7(4)3, part A*, and a mass medium, *Sec. 7(4)3, part D*. Therefore the spatial medium (or mass medium) can be analyzed to a component of *4*-dimentional space-time plus an extra-dimension, i.e. *7* kinds of overlapped (or superimposed) components of spatial-medium and 7 kinds of superimposed components of mass-medium in *4*-space world. From viewpoint of *HPPH*, any of extra-dimension has expanding and contracting characteristic or behavior respect to expandon and contracton emissions in both media; please refer also to *Sec. 2(1)1d* in this regards. Sophistically from viewpoint of religious books, e.g. "Do you not see how God has created the seven heavens one above another" [110]A, *Surah 71, verse 15*. "God is he who created seven heavens and of the Earth the like of them, the decree continuous to descend among them."[110]A, *Surah 65, verse 12*. "And certainly we made above you seven heavens and never are we needless of creation."[110]A, *Surah 23, verse 17*. According to *Simulation 8(7)2, E5a, item 23, case B***,** any dimension is related to a parallel universe. Sophistically due to mutual type *R&L* contractons exchange of a parallel universe and our Universe. Please refer also to *Note 5(15)2b1, Remark 8(7)2, E5c,* and *Consequence 2(1)1b1.*

8(8)2a- Theoretical Frameworks

Known variously as string theory, superstring theory, and M-theory, this program has its roots, indirectly, in the observation, dating back to at least the 1950s, that classical general relativity looks in many ways like the theory of a massless 'spin-two' field propagating on the flat Minkowski space-time of special relativity. [See Rovelli 2001b (Other Internet Resources section below), and 2006 for a capsule history, and Greene 2000 for a popular account.] This observation led to early attempts to formulate a quantum theory of gravity by "quantizing" this spin-two theory. However, it turned out that the theory is not perturbatively renormalizable, meaning that there are ineliminable infinities. Attempts to modify the classical theory to eliminate this problem led to a different problem, non-unitarity, and so this general approach was moribund until the mid-1970s, when it was discovered that a theory of one-dimensional "strings" developed around 1970 to account for the strong interaction, actually provided a framework for a unified theory which included gravity, because one of the modes of oscillation of the string corresponded to a massless spin-two particle (the 'graviton').
The original and still prominent idea behind string theory was to replace the point particles of ordinary quantum field theory (particles like photons, electrons, etc) with one-dimensional extended objects called strings. (See Weingard, 2001 and Witten, 2001 for overviews of the conceptual framework.) In the early development of the theory, it was recognized that construction of a consistent quantum theory of strings required that the strings "live" in a larger number of spatial dimensions than the observed three; eventually, most string theories came to be formulated in nine space dimensions and one time dimension. Strings can be open or closed, and have a characteristic tension and hence vibrational spectrum. The various modes of vibration correspond to various particles, one of which is the graviton. The resulting theories have the advantage of being perturbatively renormalizable, at least to second order. This means that perturbative calculations are at least mathematically tractable. Since perturbation theory is an almost indispensable tool for physicists, this is deemed a good thing.
String theory has undergone several mini-revolutions over the last several years, one of which involved the discovery of various duality relations, mathematical transformations connecting, in this case, what appeared to be mathematically distinct string theories — type I, type IIA, type IIB, HE and HO — to one another and to eleven-dimensional supergravity (a particle theory). The

discovery of these connections led to the conjecture that all of the string theories are really aspects of a single underlying theory, which was given the name 'M-theory' (though M-theory is also used more specifically to describe the unknown theory of which eleven-dimensional supergravity is the low energy limit). The rationale is that what looks like one theory at strong coupling (high energy description) looks like another theory at weak coupling (lower energy, more tractable description), and that if all the theories are related to one another, then they must all be aspects of some more fundamental theory. Though attempts have been made, there has been no successful formulation of this theory: its very existence, much less its nature, is still largely a matter of conjecture"[599] *String theory*.
Although advocates of the canonical approach often accuse string theorists of relying too heavily on classical background spacetime, the canonical approach does something which is arguably quite similar, in that one begins with a theory that conceives time-evolution in terms of evolving some data given on a spacelike surface, and then quantizing the theory. The problem is that if spacetime is quantized, this assumption does not make sense in anything but an approximate way. This issue in particular is decidedly neglected in both the physical and philosophical literature (but see Isham (1993)), and there are more that might be said"[599].

Note 8(8)2a – The path-length of a particle (or system) due to right-handed dimension is of opposite sign respect to left-handed one. Therefore, the algebraic sum of path-length variation of an isolate particle (or system) is zero by a slight preference of right-handed path-length (of expanding type R_e, *Sec. 5(16)11*) through vacuum space respect to the left-handed conjugate at a long period in a type *R* (matter Universe), *Sec. 5(16)9a*. Similarly, there are simultaneously a left-handed path-length (of contracting type L_c) through related mass media related to type *L* universe. Please refer to *Sec. 5(15)1*, and *Sec. 5(15)3g, Note 5(16)3g, c1* in this regards.

Comment 8(8)2a - According to *Sec. 5(16)1c*, the minimum average time's arrow interval of the H particle-paths inner motion of a mass-body is obtained according to *Eq. 5(65)3.* It depends inversely on the mass magnitude (or initial H particle-paths of the mass-body), and Hubble and third power of light speed constants and directly to the gravitational constant.

Remark 8(8)2a - According to [293] *part 6, paragraph 9* "When in *1925* Heisenberg introduced quantum mechanics, he argued that motion does not exist in this theory. This view is taken also in Copenhagen interpretation of quantum mechanics formulated in 1927/1928 by Heisenberg and Bohr". According to H particle-paths hypothesis, the motion is performed on the basis of mutual effect of single direction H particle-paths of an H system with that of vacuum, *Sec. 5(16)3b, part B*, towards an equilibrium state, *Sec. 2(4)2*"[599] *Theoretical frameworks*.

8(8)3-Wave structure of matter theory

The main postulates of *WSM* are as following:

A) "The particle of the *WSM* is a spherical standing wave with an intensity, decreasing with distance from the wave center. This wave has the character of a *quantum wave*. The particle is regarded as the entire wave structure but its location is the quantum wave-center when observed. This fundamental structure, with presence throughout the universe , is an electron or a positron (which have opposite phase waves).The two important basic principles of the *WSM* are:

1- Space exists as a wave mediumfor the propagation of quantum wavesdescribed by a scalar wave equation .

2- The total wave density of all waves from all matter (in our finite spherical universe) creates the wave density and properties of the wave medium (space)."[504] *Concept.*

According To *HPPH* space can be a medium that is constituted of successive type $R\,\&\,L$ H hall packages of path-length value $2\hbar$, and SN_r configuration, *Sec. 7(4)3, part A*. Particle in spatial medium changes successively its handedness during stay time intervals ΔT_P, *Sec. 7(4)2f, part A*, during interaction of its H hall-paths with that of the medium in order to generate expandons and contractons. The rate of interaction depends on population densities of H particle-paths of both particle and the medium.

B) The *Fig. 8(8)1*, shows the dynamic waves of a space resonance. The resonance is composed of a spherical IN wave, which converges to the center, rotates to become an *OUT* wave, and diverges from the center. These two waves combine to form a standing wave whose peaks and nodes are like layers of an onion. The wave amplitude is a scalar number, not an electromagnetic vector. At the center, the wave amplitude is finite, not infinite, in agreement with observation."[503] *Part II.* From viewpoint of *HPPH*, and according to *Sec. 5(16)1b, part A, Fig. 5(8),* the expanding spheres are anaalogous to an standing waves. Any two successive expanding spheres are reversed handedness of each other. Please refer also to *Note 5(16)2a4* for additional information.

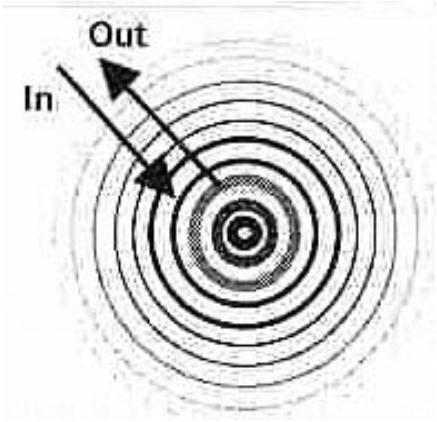


Fig. 8(8)1- The Dynamic Waves of a Space Resonance

A) "At each point in space, waves from all particles in the Universe combine their intensities to form the wave medium of space."[503] *Principle II.* According to *HPPH,* the density of H particle-paths (or expandons) of all matter in a location of spatial medium can specifies the density of H particle-paths at that location.

B) "The total amplitudeamplitude of all particle waves in space everywhere always seeks a minimum."[503] *Principle 3*. According to *HPPH*, an H hall package, *Sec. 5(16)3a,* splits to two or more ones due to spatial expansion. According to *Sec. 5(7)8,* this phenomenon is related to irreversible absorption of contracton by central supermassive black hole of glaxies and clusters.

C) "Spin occurs when the *IN*-wave arrives at the center and rotates continuously in order to become the out-wave."[503] *The mechanism of spin.* According to *Note 3(1)2a*, the spin is the path-length of a particle in a position, e.g. type R H hall package, during stay time ΔT of its rotational motion. By particle transfer to the next position, i.e. type L H hall package, it is along with new path-lengths of equal magnitude of the latter, but at opposite signs, and so on. The fundamental particles has spin $\hbar$ due to path-length of translational motion; while, the expandons and contractons have spin (or better to say path-lengths) $2\hbar$ and $-2\hbar$ respectively, *Sec. 2(4)4a*.

D) "By rejecting both continuous fields and particles, and instead working with standing wave structure, the *WSM* explains the discrete energy states of light and matter found in Quantum theory (which Einstein's relativity could never explain) without introducing the disturbing particle-wave duality of light and matter."[504] *History*. According to *HPPH*, both field and related paricle are regarded as having standing wave structure by the difference that the field and particle are belonged to two different spatial and mass media, *Sec. 7(4)3, parts A,D*. In other words, the field in spatial medium has expanding right-handed characteristic of type R_e path-length; while, the particle in its mass medium has contracting left-handed characteristic of type L_c path-length of equal magnitude and opposite signs, *Sec. 5(16)11*. The two media are separated by a singlurality nominated particle reverson that is surrounded by an axeon, *Sec. 7(5)3b, item II*.

E)

8(8)4- String theory and H particle-paths hypothesis

According *to Sec. 3(1)1, Fig. 3(3),* the free moving electron (or particle) is extended in constant path *P* or path-limit Γ, *Sec. 3(3).* In other word, the whole main body of electron is extended in a constant path *P*, or path-limit Γ, based on *Simulation 8(7)2, E5a*, this extension is performed through hall package tunnel from front motion of particle up to a n_s cell on Schwarzschild surface of the black hole. As if, the particle main body is fixed like a wire between two points on the front of motion and the black hole with a frequency equivalent, of n_α, *Note 3(1)1d ,Eq.3 (20).* At these two points factually, there are mutually contractons exchange and releasing, *Sec. 5(9)3d, part c* of equal path-length magnitude and opposite sign respect to each other, *Simulation 8(7)2, E5a, paragraph 2.*. Factually, during any released contracton, an expandon is emitted of path-length value $+2\hbar$, *Sec. 2(4)4,* that is to some extent equivalent to graviton of *ST* theory from viewpoint of *HPPH, Sec. 5(16)1c, A3.*

8(9) – Explanation of Figs. 8

8(9)1 – Fixed Source, Fig. 8(1)

Considering *Fig. 8(1),* by referring to *Fig. 4(15),* one can conclude that:

1) The types *R&L* H particle-paths of the pair, i.e. the right-handed one (negapa) and left-handed one (posipa) are in a counter-current, *Sec. 3(1)2*, mode of motions and constitute an mono dimensional unique H system, i.e. entangled photons, the center of mass of that is at rest respect to the source. In other words, the both photons H particle-paths are propagated at two opposite sides, and correlated to each other by *P*-contracton H particle-paths, *Sec. 7(4)2f, part B*. Moreover, for the reason of simplicity the two modes of counter-current motions are drawn separately in, *Fig. 8(1),* that must be viewed as overlapping of two mirror images, *Sec. 6(2)3,* entities, i.e. indistinguishably, *Sec. 7(4)3f, part B*. "But quantum theory says that before Bob measures his photon

(photon *A*) it can have no defined value (e.g. for its polarization property) - it is in a superposition state (with that of photon *B* of the pair). Only when Bob measures it does its value become physically real"[556] *Introduction*.

2) During a measurement at one side this unique counter-current motion is interrupted instantaneously, *Sec. 7(4)2f, part c*, as two separate H systems at the ends of each side, *Note 8(9)1a*, in the form of single direction H particle-paths, *Fig. 3(4)c*, as if by a far analogy, we cut a stretched rubber belt. Therefore, the measured particle takes its objective configuration after detection. In other words, the particle exists in two forms before measurement (subjective) and after measurement (objective) contrary to Copenhagen interpretation of *QM* that postulates "quantum mechanics implies that particle cannot exist before being measured"[335], *Benefits*. Please refer also to *Sec. 5(16)3b, part c, item A*, and *Note 5(16)7, g2*. According to *QM*, it is the measurement of a photon of the pair that collapses the common wave function of both photons of the pair.

3) In fact, any kind of measurement randomly, *Sec. 8(7)2, parts F1*, *E4*, at any time with any spatial orientation (i.e. direction of analysis) on a particle has Mirror Image Effect, *Sec. 6(2)3,* on the second one instantaneously, *Note 8(9)1a*. It is faster-than-light speed within abstract vacuum, *Sec. 5(16)3h*, of a unique H hall quantized package of path-limit, Γ, *Sec. 1(12),* in the microcosm level, *Sec. 7(4)2c, Remark 7(4)2c1*, and *Note 8(9)1a*. We can compare this phenomenon, by a loose example of stochastic selection of a scene slide in an animation or movie along with its negative image, *Comment 8(1)3b*. Alternately, the whole H hall package tunnel, *Sec. 5(9)3d, part c,* of the photon pair is extending at two opposite sides at c speed through vacuum texture, *Sec. 5(16)3b*, and *Comment 8(9)1a*. In other words, the H particle-paths of *P*-contractons of photon pair extend at co- and counter-direction of pair propagation all over within this common H hall package as a unique H system, *Note 8(9)1b*, up to a measurement, *Sec. 8(7)2*, i.e. superimposition of upper and lower posipa & negapa green-red lines of *Fig. 8(1)* on each other. However, after the measurement of one photon, the H particle-paths of the second one is traveling inside the H hall package tunnel without interfering by vacuum texture at an infinitesimal time interval (or spontaneously) respect to the whole H hall package during its initial extension through the vacuum texture. Noteworthy, this infinitesimal time arrow is comparable to partial time arrow's, ΔT, *Sec. 7(4),* of H particle-paths internal motion of the emitting source, e.g., the Earth, Sun, that is negligible respect to background time arrow, *Sec. 5(16)9c* through abstract vacuum, *Sec. 5(16)3h*, of vacuum texture. In other words, after measurement, the H hall package tunnel perforated by particle before measurement in the vacuum texture, *Sec. 5(16)3b*, has a abstract vacuum characteristic. According to above discussion in the Big-bang era, the Universe expands in infinitesimal time arrow (i.e. inflation, *Sec. 5(5)2*) through the abstract vacuum, *Sec. 5(16)3h*, that is supposed to be empty of vacuum space texture. As a result, by entering of H particle-paths in the abstract vacuum of an H hall unit it takes form or vice versa, *Sec. 7(2).* In case of gravitational interactions, there are a kind of this tunnel through spatial medium, *Sec. 5(2)1d,* nominating H hall package tunnel*, Comment 5(16)2a1*, that separates the abstract vacuum (cavity reversons) by its axeon, , from normal vacuum medium, *Sec. 7(4)3, part A*.

4A) There are a competition between the negapa-posipa (i.e. type *R*, *SN* configuration, *Sec. 3(1)2, Fig. 3(4)*) and posipa-negapa (i.e. type *L* of *SP* configuration) of entangled pair of photon with slight preference of the former one, *Sec. 5(16)3f, part B*, *Sec. 5(16)9c, part B*. As an example in the top and bottom of emission line as in, *Fig. 8(1),* respectively that are conjugate of each other in viewpoint of spin concept of entangled pair of particles and their translational motions on the basis of H particle-paths counter-currency mode of behavior, *Sec. 3(1)2*, *Fig. 3(4)*. In other worlds, any *SN* configuration is accompanied , or, better to say superimposed with *SP* one or vice versa (indistinguishably, *Sec. 7(4)2f, part B*), *Examples 8(9)1a,b*, that are mirror effect image of each other considering the direction of translational motion, i.e. handedness reversal, *Sec. 5(16)9b*. It can be referred to two conjugates matter (type *R*) and antimatter (type *L*) counter-current Universes. In other words, at each instant before measurement, there are a steady time's arrow and time's arrow reversal along with handedness and handedness reversal respectively, because of this equilibrated superposition, *Remark 8(9)1a*. In fact, there are equilibrium based on indeterminacy between the admixture of counter-current *SN* and *SP* configurations of H particle-paths. Thus, through a photon measurement of *SM* configuration, e.g., single direction left-handed photon, the equilibrium is broken, the above wave-like structure collapsed and its conjugate, e.g., single direction right-handed photon, take its existence, *Remark 8(9)1a*; please refer to *Sec. 3(1)2, Fig. 3(4)c,* and *Secs. 5(16)7, 5(16)9b*. Therefore, the physical reality of the second particle is not defined before random measurement of the first one or vice versa, *paragraph 10*. Please refer also to *Sec. 8(7)2, Example 8(7)2, B1*. Noteworthy after measurement, the relative motion of the source and detector determine the wavelength of photon pair respect to an observer, e.g., at rest respect to the source, detector, or, at straight, and uniform motion respect to the both; please refer to *Sec. 7(4)2e*.

4B) Resuming, according to the simulation as in *Fig. 8(1),* the measurement of one photon determines the position of other one during infinitesimal stay time interval, *Note 8(9)1a*. Moreover, the result of measurement depends on equal probability of existence of matter and antimatter universe, (bi-Universes Hypothesis), *Sec. 5(16)9*, accompanied by slight preference of the former applying on the detecting device and detected photon.

Factually, this is a correlation between the entangled pair through their *P*-contractons counter-current H particle-paths. Noteworthy, the presence of counter-current H particle-paths through vacuum space can be revealed by gravitational effect from viewpoint of H particle-paths hypothesis. However, the single direction H particle-paths reveal as photon, electromagnetic wave that have emitting source, *Remark 8(9)1c*, and can be easily detected by conventional measuring devices.

5) In a which-way double slits experiment, *Secs. 8(3)3, 4*, photon before slits by analogy with top and bottom pictures of *Fig. 8(1)* has zero spin. It splits to two opposite spin up and down (or type *R &L*) during passing the slits (due to a negligible disturbance), or, better to say photon is accompanied by its conjugate in the mainstream before measurement (or observed) on screen. In fact, there are no interference, *Sec. 8(3)4*, if we use right (or left-handed) polarized beam in this experiment; please refer to *Sec. 5(16)6, Experiment 5(16)6a,* and *Sec. 8(7)2*, *part G2*. Noteworthy, photon has equal probable type R (or L) through passing a double slit, *Sec. 8(3).* It is based on equilibrium between two types $R \,\&\, L$ photons configurations and its correlation

with the source. In other words, photon before double slit obeys randomly track texture *1* (or *2*), *Sec. 5(16)3b, part B*, related to slit *1* (or *2*) successively during its propagation. Supposing photon through slit *1* has, e.g. type *R* spin, it emits a *P*-expandon of type WR, and transferred during stay time ΔT, *Sec. 7(4)2f, part A*, to another H hall package of PL configuration and so on up to detection on the screen, *Simulation 7(4)2e1*, *and Simulation 8(3)4, b1*. According to *Sec. 8(7)2, part E2,* the *Fig. 8(1),* cannot be configured at a same time.

6) Considering the simultaneous extension of entangled photons at two opposite sides as a unique H system (constituted of correlated counter-current, *Sec. 3(1)2,* H particle-paths of its *P*-contracton) and spontaneous collapse, *Note 7(4)2f, C2*, within abstract vacuum of their H hall package tunnel solves the problem of faster-than-light during measurement of photon pair H particle-paths, *Sec. 8(9)1*. It is in contrast to non-correlated photons in the cases regarded as point-like particles; therefore, there are no action at a distance in this respect, "The Collapse Postulate is a physical law that differs all known physics in two aspects: it is genuinely random and its involves some kind of motion at a distance"[329], *part 7*. Please refer also to *Sec. 5(16)3h, Sec. 5(16)10,* and *Sec. 8(7)2, Example 8(7)2, B1*.

7) In case of photo ionization of helium atom by laser beam [304], both electrons are emitted in a correlated fashion after the scattering event takes place; please refer also to *Sec. 9(2), Note 9(2)4.*

8) According to *Sec. 5(2)1d*, path-length, *Sec. 2(1)2*, is transferred at c speed through vacuum texture, *Sec. 5(16)3b*, as in case of propagating mass-less pair, e.g., photon, and $v < c$ in case of pair of particle of rest mass. Noteworthy, the interaction transfers or propagates spontaneously during a measurement within abstract vacuum of related H hall package tunnel.

9) The *SM* configuration of entangled pair of photon can be viewed as a unique H system, *Sec. 8(5)*. The pair propagates at two opposite direction state can be regarded as a symmetry (or indeterminacy). Therefore, the measurement of one of the pair by a detector breaks this symmetry. In other words, measurement causes an asymmetry that creates a phenomenon.

10) In our matter Universe, there are a slight preference of photon of SN_r configuration respect to SP_l one. The former has type R_e path-length characteristic, while the latter has a characteristic of type L_c path-length, *Sec. 5(16)8c*. Moreover, please refer to *Sec. 7(4)2d* in case of detection (or measurement, *Sec. 8(7)2*) of an entangled pair of photon based on H particle-paths hypothesis.

11) According to *Simulation 7(4)2e1*, each spindle-like cell in *Fig. 8(1)* is related to successive types $R \,\&\, L$ of H hall packages of photon main-body during its travel. Noteworthy, any type *R* or *L* H hall package is along with type *WL* or *WR* wave matter counterpart cells (or expandons emission) and type *PR* or *PL* contractons releasing. The type *PR & PL* contractons are transferred via H hall package tunnel, *Sec. 5(9)3d, part c*, within the axeon, *Sec. 10(8),* of photon towards the photon's source, i.e. opposite direction of emitted photon, *Note 5(16)7, g2*; please refer also to *Sec.8(9)2.*

Example 8(9)1a – For instance, consider a system consisting of two polarization-correlated *P* and p which are moving apart from one another at the speed of light and are observed with polarization meters located (say) on Earth and Pluto. These meters can be adjusted to measure an infinite number of polarization dichromatics, for instance *H*-or-*V* (horizontal or vertical) or *D* or *S* (Diagonal or slant) or *R*-or-*L* (Right or left circular polarization). An observation of H-polarized photon *P* on Earth tells us instantly that Pluto p will be measured to have polarization h. However, we could have chosen to measure *D/S* polarization at both stations. These results seem to imply that if I make an *H/V* measurement on Earth the photon on Pluto turn into a mixture h and v photons. If I make a *D/S* measurement on Earth, the Pluto photons obediently become an incoherent d/s mixture [346] *Coupled contexts.*

Example 8(9)1b – In case of two entangled electron (instead of photon), please refer to *Sec. 4(7),* and consider *Figs. 4(14), 4(15).* According to these references, and regarding *Fig. 8(1),* in the top of middle of this figure the counter-current H particle-paths can be related to right-handed spin electron moving to left spin, i.e. $\overleftarrow{e_R}$, and left-handed one to the right-handed, i.e. $\overrightarrow{e_L}$. Similarly, in the bottom part, the counter-current H particle-paths can be related to $\overleftarrow{e_R}$, and $\overrightarrow{e_L}$ respectively. Therefore, through the admixture of top and bottom, there are indistinguishability between right-and left-handed electrons. In other words, there are equilibrium due to counter-current single direction H particle-paths of electron pair that is established through their *P*-contractons that is a matter of fact as one of the foundations of H particle-paths hypothesis, *Sec. 1(15).*

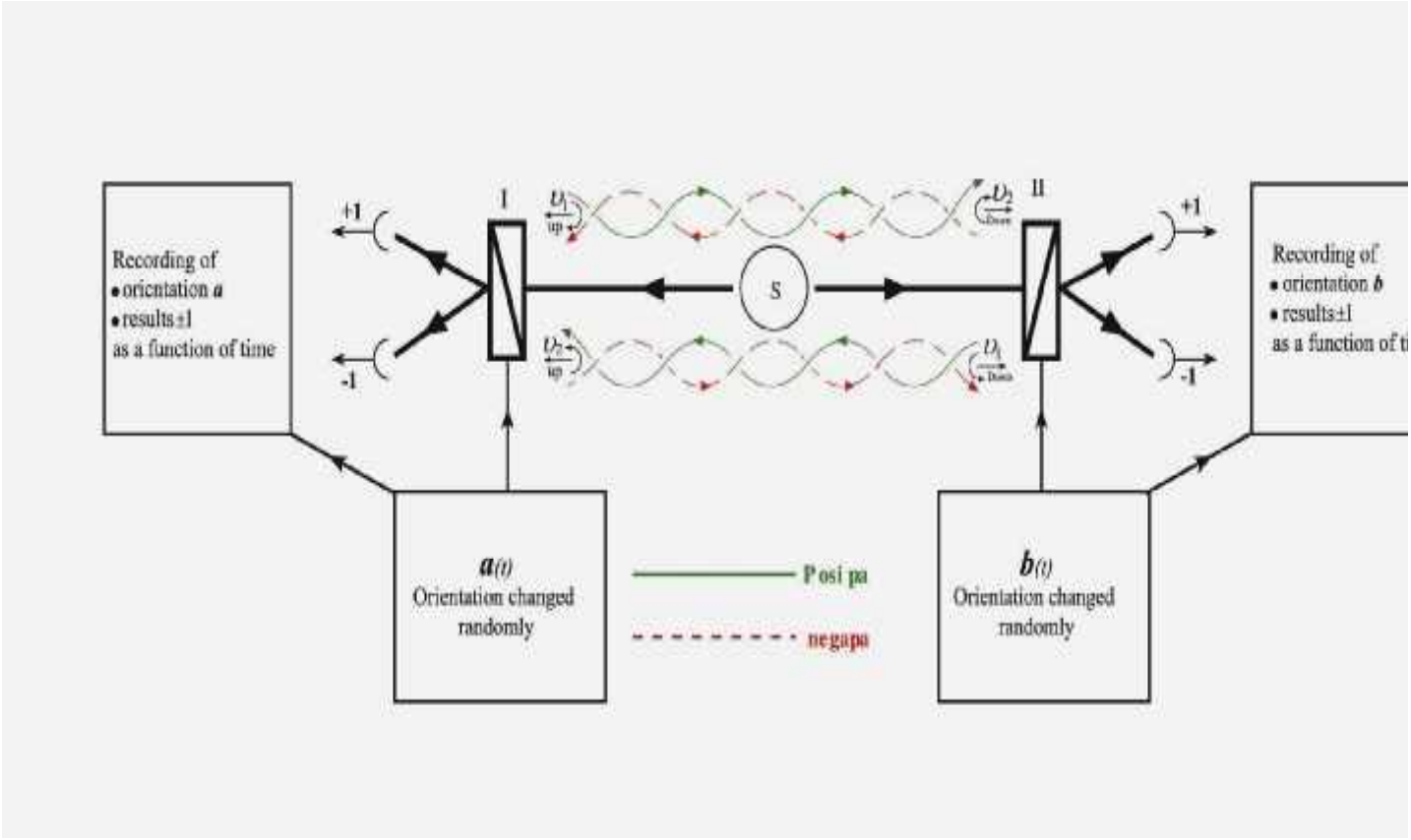


Fig. 8(1) –EPR thought experiment with photons
The two photons, υ_1, υ_2, emitted by the source S are analyzed by linear polarizer I, II, which make polarization measurement along a, b, perpendicular to the photons propagation axis. In this figure, non-locality is shown according to H particle-paths hypothesis. Moreover, each of the posipa-negapa cells specifies a state of particle in a pair. The main particles (the black dots) of the pair are correlated in their common H hall package tunnel through their P-contractons that are shown by red and green lines of related H particle-paths.

Note 8(9)1a- "There are a strange connection between particles which instantaneously informs the undisturbed particle of the type of measurement just carried out on its partner (however Special Relativity is not violated because **no information can be transmitted** using this method" [556] *Summary*. The spontaneous, *Sec. 7(4)2f, part c,* contracton transfer within abstract vacuum via H hall package tunnel can be regarded as hidden variables, *Note 8(7)5a*, from viewpoint of *HPPH*. "Hidden variables theories were plausible if the restriction of locality was relaxed - essentially allowing faster-than-light communication"[557] *Hidden variables theories*. Supposing in *Fig. 8(1),* the polarizer at right and left at equal distance of the source are replaced by two vertical slits R and L parallel of *y*-axis respectively. Thus, the two particles are assumed to propagate along the x-axis towards slits. Moreover, behind any of the slits are placed an array of counters. Subsequently, in *Fig. 8(5),* "the slit at *R* is narrowed so as to produce an uncertainty-principle scatter which appreciably increases the set of counters behind the slit which may be activated with a non-negligible probability. Popper's argument goes then as follows: if the Copenhagen interpretation of quantum mechanics is correct, any increase in the precision of the knowledge of the *y*-position of the particle at *R* should correspond to an analogous increase of the knowledge concerning the *y*-coordinate of the particle at *L*, as a consequence of the assumed strict correlations implied by the entanglement. Hence, also the scatter of the particle at *L* should instantaneously increase, even if the width of the slit at this side has not been modified. This prediction is testable, since new counters would be activated with an appreciable probability, giving rise to a detectable form of superluminal influence at odds with the postulates of special relativity"[562] *Introduction*. "Popper's experiment was realized in 1999 by Kim and Shih using a *SPDC* photon source.[9] Interestingly, they did not observe an extra spread in the momentum of particle *2* (at L) due to particle *1* (at R) passing through a narrow slit"[563]*Realization of Popper's experiment.* According to *Sec. 8(7)2, E2*, the measurement is performed through stay time intervals ΔT that correspond to decoherence, *Sec. 8(7)1d*, time. Therefore, there are no instantaneity in its abstract concept, *Sec. 7(4)2f, part C*, in the above case during a measurement. But, according to *HPPH*, the interactions are transferred during infinitesimal stay time intervals ΔT from measured one to the other particle of the pair that can be revealed overall as finite speed, *Note 7(4)2f, c2*, higher than light speed c. "In brief, either the Copenhagen interpretation or special relativity must be abandoned, and Popper definitively favors the first option"[562] *Introduction*. Therefore, this is based on misuse of basic quantum rules. The experiments based on Popper argument also confirm the effect of the slit gap medium on the particle scatter that depends to the slit width, *Sec. 7(4)3, part c*. Moreover, from viewpoint of *HPPH*, because of non homogeneity of the medium at slit R gap, the

transferred interaction to the particle *2* have different finite speeds due to different stay time intervals ΔT. Thus, the arrangement at slit R region is lost during non-simultaneous transfer at non-equal speeds to the slit L region as if slits R & L act somehow independent of each other.

Note 8(9)1b- "The secret for analyzing entangled systems is that you can no longer talk of the wave function for just a single localized particle, you have to talk of one single wave function for the entire **system**"[556] *Qubits*.

Comment 8(9)1a- The H hall package tunnel links the individual reverson, *Sec. 7(5)3*, of each of the particle of the pair. As if, the pair of photon has a dumbbell-like common H hall package, *Sec. 5(9)3c*, that its two ends are H hall package of the particles of the pair, and its narrow bar is the H hall package tunnel between the particles of the pair. Please refer also to *Sec. 8(7)2, part E*.

Remark 8(9)1a- "Quantum Mechanical systems are described by wave-like mathematical objects (vectors) of which sums (superposition) can be formed. Time evolution (the Schrödinger equation) preserves such sums. A quantum mechanical system (say, an electron) is described by a superposition of two given states, say, spin in x-direction equal +1/2 and spin in x-direction equal -1/2"[343] *Section 3.1*.

Remark 8(9)1c – "Unlike what happens with Maxwell's equations. The Schrödinger equation for the quantum field does not have sources"[345], *Bohm anticipate back activity, Vigierp 87.* According to H particle-paths viewpoints, an H system e.g., non point-like particles, constitute of counter-current H particle-paths confined in an H hall package, *Sec. 5(16)3a*, without source. Therefore, after measurement this extended wave-like H particle-paths in vacuum space reveal as a localized (or captured) in its contracted form by measuring device.

8(9)2 – Moving source, Fig. 8(2)

According to *Fig. 8(2),* a source moves along y to o axis (in opposite direction of *y-axis*) at a uniform speed v. It emits continuously correlated, *Sec. 8(7),* single direction light photons, *Sec. 4(4), Fig. 4(8),* at c speed during its motion through *ST* direction successively which is shown for reason of simplicity in equal intervals at $S_1, S_2, ..., S_8$ positions. The correlation of emitted photons with the source, trace a curved trajectory from intersecting points P_1 to P_8 instead of a straight one in case of non-moving source. In other words, points *P1* to *P8* are the photon light in their travels through the source motion at S_1 to S_8 positions toward the target *T*, and before striking it. Therefore, the point *P8* (or point o) is the actual position of the source, i.e. *S8*, and point *P1* is the incident light at target *T* related to the apparent positon of the Sun at point *S1*. Please refer also to *Sec. 5(16)3b, part D2, item IV*.

The dotted lines *TH* is normal from target to *S1S8* trajectory of the source. It intersects the curve *OT* at *M* position. According to H particle-paths hypothesis, the path-length, *Sec. 2(1)2*, related to the portion *MT* is equal to that of *MO*. Therefore, the portion *MT* is related to the wavelength decrement respect to the source at H position, *MO* is the wavelength increment accordingly in such a way that $n_T.\Delta t_T = n_O.\Delta t_O = n_H.\Delta t_H = \Delta T_\Gamma = cons$, *Sec. 7(4)1*. Where, n_T, n_O, n_H, are averaged numbers of H particle-paths (or frequencies) at *MT, MO,* and *MH* respectively. Moreover, $\Delta t_T, \Delta t_O, \Delta t_H$, are partial time's arrow related to their H hall packages, *Sec. 5(16)3a*. In other words, the photon passes (or sweeps) equal H hall packages (i.e. equal number of quantized time units ΔT_Γ) in the both parts of its trajectory. Please refer to *Eqs. 2(116) to 2(118)* of *Sec. 2(10)1*. Through *S1H* trajectory, the source *S* is approaching, and during *HO* the source is receding respect to the target. Noteworthy, at the curved *OMT* path, the $S_1P_1, S_2P_2, ..., S_8P_8$ lines are tangent to this path at points $P_1, p_2, ..., p_8$, *Note 8(9)2a*, respectively. As a result, the photon travels a shorter path (or track texture, *Sec. 5(16)3b, part B*, in case of approaching source respect to receding one, i.e. *MT<OM*, as if the apparent light velocity is higher in case of approaching respect to receding motion of the emitting source *S*. Resuming, according to Delta Effect, *Sec. 2(1)1b*, respect to an observer at rest frame, the shorter path related to shorter time travel, and longer path related to longer one in such a way that the light speed c is constant in the two cases as in case of Sagnac Effect, *Remark 8(9)2a*. Please refer also to *Sec. 2(6)4b, part A* in this regards. According to above discussion, the path-limit Γ, *Sec. 1(12),* of any of the correlated propagating photon contracts, dilates during approaching, and receding of the emitting source respectively, as if it is contracted, or, dilated by the moving source during photon emission by the latter. Moreover, the path-limit Γ, takes the shape of its path; please refer also to *Sec. 5(16)3b, part D2*.

According to *Sec. 5(11)*, in the *CMPRF* of Sun-Photon-Target system (i.e. reference frame *A*), the all of the S_1 to S_8 positions of the Sun centre of mass are coinciding with the origin of *CMPRF* of the system due to huge inertia of the Sun respect to the target, e.g. the Earth's lab, (*case A*). Therefore, the Sun, photon, and target are in straight line (or path) *OT* at the moment of photon emission by the Sun, up to the moment of its detection by target (or detector) in the reference frame *A*, and respect to its observer *A*, i.e. <u>In the frame,</u> *Sec. 2(8)2, case A*. On the other hand, respect to the observer *B*, i.e. <u>Out of the frame,</u> *Sec. 2(8)2, case B,* of inertial reference frame *B* at straight linear motion (*case B*) through vacuum texture, *Sec. 5(16)3b, part A*, the photon *OT* trajectory has a curved path due to Delta Effect, *Sec. 2(1)1b*, respect to straight line *ST* in *case A*. Please refer to *item IV* and *Note 5(16)7, g2*. Noteworthy, the photon momentum in two above reference frames *A, B* are in the direction of the path *OT*. In other words, the photon momentum is coinciding with straight line *ST* in *case A*, and curved line *ST* in *case B* respect to observers *A, B*

respectively. As a result, the H hall package tunnel, *Comment 5(16)2a1*, that is coinciding with the *OT* path in two *cases A, B* is straight at *case A*, and curved in *case B*. Therefore, at the moment of measurement (or detection) by target *T*, e.g. in *case B*, the photon momentum is in straight direction S_1T , and tangent to the curved path *OT* at the point P_1 (or *T, Fig. 8(2)*), thus the photon at the instant of measurement can be viewed through S_1P_1 (or S_1T) direction respect to observer *B* (aberration). According to *Sec. 8(9)1*, there are an instantaneous*, Sec. 7(4)2f, part c*, effect of measurement during interaction (or photon detection) that transferred in reverse direction from *T* to *O* (i.e. *TO* or P_1S_8 path) actual position (S_8) of the Sun through the correlated curved H hall package tunnel *OT*. Similarly, during the gravitational interaction, e.g. Sun-Earth as two orbiting mass-bodies, *Sec. 5(9)3*, the gravitational effect is transferred through curved tunnel, *Sec. 5(9)3b*, respect to observer *B*, and straight tunnel respect to observer *A* from a mass-body as emitter to other one as detector, or, vice versa, i.e. a mutual interaction. In fact, tunnel *OT*, *Note 8(9)2b*, is perforated through vacuum texture during emission at finite speed by photon in case of light emission, and expandon, *Sec. 5(16)1c, part A3*. In case of gravitational potential that is followed with reversed transfer of interaction due to contractons transfer through abstract vacuum of the perforated tunnel during measurement (or interaction). Please refer also to *Sec. 5(2)1d*.

According to *Sec. 5(16)3b, part B*, an expanding track texture, *Remark 8(9)2b*, takes form during photons emission by the source that is extended to the target as a pilot track of photons. Therefore, the points on the target *OT*, e.g. *P8 to P1*, are moving at c speed along with their *S8P8* to *S1P1* lines towards target *T*, i.e. successively correlated photons motion, *Sec. 8(7)2*, *part G2*, on track *OT*. Each of the latter lines (*SP*) is tangent to the *OT* curve (*case B*) at the moment of measurement by the target, i.e. at point *T*.

Noteworthy, the *SP* straight lines in position *1 to 8* are the projection of a *SP* curved line in the latter position due to Delta Effect, *Sec. 2(1)1b*, respect to the observer *B*. Each of this curved *SP* lines is tangent on the related *P* locations on the final path OT that for the reason of simplicity it is not shown in *Fig. 8(2).* Factually, the *OT* curved line or path at final *position 8*, in *Fig. 8(2),* is the curved *SP* line related to this position, i.e. *S8P8*. Generally speaking, in the Example related to *Fig. 8(2),* the discussion is holding on the relative inertia (or mass) of source and target, and the photon propagation through flat vacuum quantized texture. Therefore, in case of gravitational field related to both source, and target, we encountered with a curved quantized texture of gravitational fields that is superimposed on flat vacuum texture. In other words, the photon pilot track texture obeys a curved path due to the stated above none flat gravitational field texture medium. Factually, the geometry, and population density of the latter define the motion of a particle or mass-body through the medium. Please refer to *Example 5(16)3b, B1*.

Note 8(9)2a – The points $P_1, p_2, ..., p_8$, are also the center of mass of particle, e.g. photon, at positions $P_1, p_2, ..., p_8$, these positions coincide with the origin of particle's *LFRF*, *Sec. 2(6)2c*.

Note 8(9)2b- According to *Comment 5(16)2a1*, the photon emitted from the Sun constitutes a common H hall package of successive type $R \& L$ cavity reversons, Sec. of photon-Sun system. According to *Sec. 5(9)3d, part c, Fig. 5(5)2*. The type $R \& L$ expandons that are emitted by photon and Sun respectively are accompanied by types $L \& R$ contractons, *Sec. 5(2)1c, part c,* that are transferred spontaneously, *Sec. 7(4)2f, part c*, within the common package tunnel of photon-Sun system. Factually, an H hall package tunnel is taken form from particle up to its source on the particle track texture. It is constructed ultimately from the source up to the supermassif black hole of the host galaxies and clusters, *Sec. 5(7)8*; please refer also to *Simulation 8(7)2, E5a,* item 15 in this regards. Therefore, any expandon emission by particle in spatial medium is along with contracton releasing by particle via H hall package tunnel towards the source and ultimately to the supermassif black hole through common H hall package tunnels of source-black hole, *Sec. 5(9)3d, part c, Fig. 5(5)2*. Please refer also to *Sec. 5(16)3b, part B, item VII*.

Remark 8(9)2a – Supposing, the correlated photon's beam is moving near a massif mass-body. If the massif mass-body is situated in the approaching section of the path (or light trajectory), i.e. *MT*, the gravitational time delay is reduced respect to the static case, i.e. point *M*. Conversely, the time delay is increased in the receding section of the path, i.e. *MO*. A similar example can be considered in case of gravitational time delay for light beam emitted from a quasar passing by a moving massive object, e.g., Jupiter; please refer to [441] *part II, the* v_J/c *corrections.*

Remark 8(9)2b – According to *Sec. 5(16)3b, part B*, a particle track texture, i.e. *OT* line in this section, has expanding behavior. Therefore, it is consisting of a main track and related subtracks. In other words, a particle, e.g. photon, at quantum scale chooses mainly the main track, and randomly the subtracks based on a probable fashion. Noteworthy, the *OT* line shown in *Fig. 8(2),* is related to the more probable main track for the reason of simplicity. By the way, to each of these *OT* lines irrespective of their geometry is related an H hall package tunnel. Evidently, at macro scale, as in case of Sun-photon-target system, the main track is the path-track of emitted photon at a good approximation.

8(9)3 – Discussion

A) Isolated H systems, e.g., photon, electron, moving in vacuum texture undergo an equilibrium, *Sec. 1(15),* known as indistinguishability before measurement (i.e. interaction with a massif detecting device). Through measurement a part of the H system is captured or detected with measuring device*, Remark 8(9)3a*, and its conjugate counterpart (e.g., its reversed handedness) is remained intact. Factually, any interaction (or measurement) with a massif mass-body as detector is accompanied by Mirror

Image effect, *Sec. 6(2)3*. Noteworthy, the scenario of e.g., reversed handedness conjugate is related merely to single direction H particle-paths of measured H system.
According to *Sec. 8(9)1*, the measurement of one of the aspects of electron up or down spin as in *Example 8(9)1b,* or, *H* or *V* polarized photons as is given in *Example 8(9)1a* is related to the equal existence of two counter-current matter and antimatter Universes, *Sec. 5(16)9*. However, it is along with the slight preference of the former, i.e. an equilibrium phenomenon between two Universes. Thus, by measuring of one particle*, Sec. 8(7)1a, Example 8(7)1,* of an entangled pair system, this equilibrium is broken and leading to second particle configuration. Please refer also to *Consequence 7(4)2c1*, and *Note 8(9)3a*. According to *Sec. 8(7)2, Example 8(7)2, B1*, from viewpoint of H particle-paths the non detected twin preserves its correlation with its emitter.
As results obtained from sections dealing with entanglement, we have:
1) The detected particle dissipates in measuring device H system; thus, there are no wave function collapse of the entangled pair.
2) The non-detected particle due to equilibrium breakage takes its configuration, and preserves its correlation with the emitter up to second measuring device. Therefore, it is extended from the emitter until second detector with its new configuration. Noteworthy, during the second measurement it dissipate in the same manner as the first particle in this measuring device. By the way, there are a two steps measurement in this case.
3) The instantaneity scenario is related to measured particle and equilibrium breakage within the abstract vacuum, *Sec. 5(16)3h*, of the related H hall package, *Sec. 5(16)3a*. Please refer to *Sec. 8(9)1, paragraph 3*.
4) The particle constitutes a common H hall package of path-length value h, *Sec. 5(16)3g*, with the measuring device that ended to uncertainty principle, *Sec. 7*.
B) During a measurement, the photon that traveled its path at an aberrative finite speed reversed back the effect of its interaction spontaneously through this path from target, i.e. lab to the main source, i.e. the Sun, *Note 5(16)7, g2*, as stated in *paragraph III*, irrespective of the motion of measuring device (detector). Factually, according to H particle-paths hypothesis, the *CMPRF's* observer *A* located at the origin of the Sun-photon-target system that due to huge inertia of the Sun is coinciding on the center of mass of the latter can be regarded as naturally reliable observer, *Sec. 5(9)3d*. Noteworthy, the aberration phenomenon is restricted to the relative motion of detector observer (or an observer *B* at an inertial reference frame) respect to the Sun, e.g. the Earth lab, *Remark 8(9)3b*. Please refer also to *Sec. 5(2)1d, part B*, and *Sec. 8(9)2, item IV*. In addition, in a system that the inertia of the source and target are at the same order, e.g. of two equal masses, the target inertia affects on the location of *CMPRF'* origin of the system. Therefore, the target mass will affect also on the photon path respect to observer *B*.
C) The path-length in the vacuum media of light track is expanding of type R_e, and that of related source, i.e. the mass medium is contracting of type L_c characteristics of equal magnitude and opposite signs, *Sec. 5(16)11*. Factually, according to *Sec. 5(9)3d, part c*, the path-lengths are taken form during an interaction (or measurement, *Sec. 8(7)2*). In other words, the common H hall packages tunneling between the two mass-bodies, i.e. source, and measuring device. As a result, there are a propagation of the light by the source through vacuum texture, *Sec. 5(16)3b*, *part A*, at finite speed, i.e. *c*, up to a measurement through common H hall package instantaneously*, Sec. 7(4)2f, part c*. Please refer also to *Simulation 8(7)2, E5a*.

Note 8(9)3a – "Let us suppose an external system with coordinate *Y* is allowed to interact with spin or particle *A*. If it did then this would not constitutes sending a signal *A* to *B*, but would just be a direct disturbance of *B* by its interaction with *Y* "[345], *Bohm's proof of Eberhard's theorem, Vigierp 80*. Please refer also to *paragraph 4(B).*

Remark 8(9)3a – "The quantum mechanical description of the object differs from the classical description of the measuring apparatus, and this require that the object and measuring device should be separated in the description but the line of separation is not the one between macroscopic instruments and microscopic objects. It has been argued in detail (Howard *1994*) that Bohr pointed out that parts of the measuring device may sometimes be treated as part of the object in the quantum mechanical description."[349], *Complementarity, item 11*; please refers also to *Sec. 7(4).*

Remark 8(9)3b - The Earth moving around the Sun at appropriate time intervals, and conditions can be regarded with some approximation as an inertial reference frame *B* moving on a straight-line trajectory.

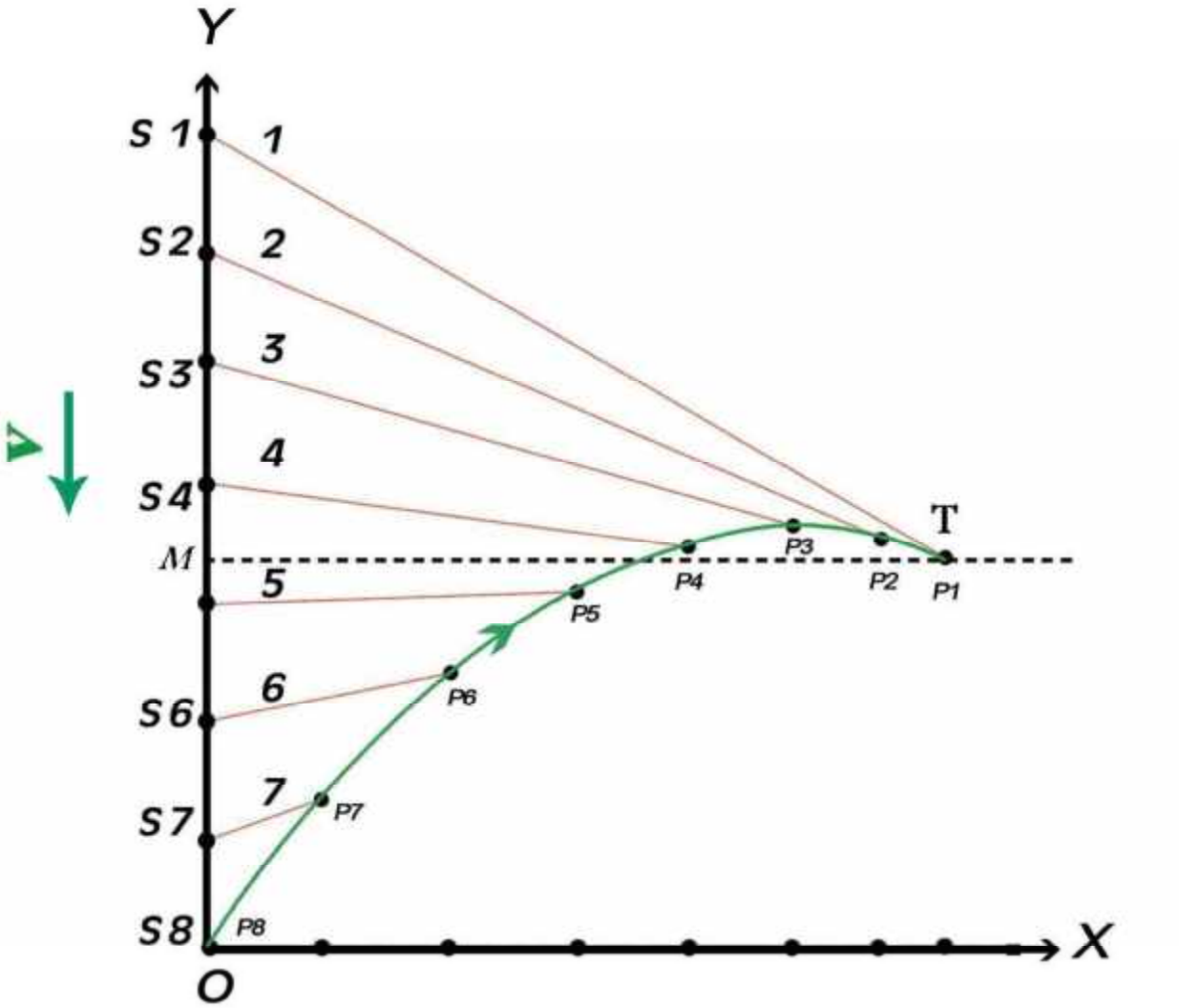


Fig. 8(2) – The correlation between a moving source S and a fixed target F during photon emission of the former