The theory of disappearance and appearance

Khoder Mazen*
Lebanese University, Faculty of Engineering
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It is known that quantum mechanics is one of the most successful theories in physics across the entire history of physics, nevertheless, many believe that its foundations are still not really understood like: wave-particle duality, interference, entanglement, quantum tunneling, uncertainty principle, vacuum catastrophe, wave collapse, relation between classical mechanics and quantum mechanics, classical limit, quantum chaos etc., and the continuous failures in the unify between relativity theory and quantum theory may be an indication about a problem in the foundations, this paper aims at discovering the first small step in the path of solving and understanding these quantum puzzles, in fact, the key to solving quantum puzzles is by understanding the reality of the motion and how it occurs. This paper proposes a model of motion with a new action principle like the principle of least action called "alike action principle". Actually, we have been able to deduce the principles of quantum mechanics so that the oddity of the quantum becomes easier to understand and interpret, for example, this paper proposes a solution to vacuum catastrophe and gives us the origin of dark energy, and shows that the basic law of motion must be broader than both quantum mechanics and classical mechanics.

1. INTRODUCTION

It is known that the foundations of quantum mechanics are still not really understood, In the fifties of the last century began serious attempts to find an alternative theory of quantum mechanics or at least to understand its obsolescence and still this attempts continue until today, for example: David Bohm "Bohmian mechanics" [1], Hugh Everett "The Many-Worlds Interpretation of Quantum Mechanics" [2], Nelson "Stochastic Theory" [3], Gerhard Grossing "Nonequilibrium Thermodynamics" [4], Laurent Nottale "principles of scale relativity" [11], A. Bouda and Toufik Djama [5, 6], Faraggi and Matone [7], Antony Valentini "Dynamical origin of quantum probabilities" [8] and many others.

It is known that the correspondence principle states that the behavior of systems described by quantum mechanics reproduces in a statistical way the classical mechanics in the limit of large quantum numbers, so because we have only a statistical matching in the classical limit between quantum mechanics and classical mechanics, **Bohr said that quantum mechanics does not produce classical mechanics in a similar way as classical mechanics arises as an approximation of special relativity at velocities very slow than light speed. He argued that classical mechanics exists independently of quantum mechanics and cannot be derived from it**.

Max Jammer has said: "quantum mechanics and classical dynamics are built on fundamentally different foundations"! [13] Many modern research [14, 16] confirms that quantum mechanics can not reproduce classical mechanics.

Based on this fact it seems that the general equation of movement must be broader than both quantum mechanics and classical mechanics!

One important example is the particle in a box model (the infinite potential well) if we have the potential V given by :

$$V = \begin{cases} 0\ , & 0 < x < a \\ \infty\ , & x \leq 0, x \geq a \end{cases}$$

then the wave function for the stationary state is :

$$\psi_n(x,t) = \sqrt{\frac{2}{a}} \sin\left(\frac{n\pi x}{a}\right) \exp\left(\frac{-iE_n t}{\hbar}\right)$$

so the probability density for finding the particle is :

$$P_n(x) = \frac{2}{a} \left| \sin\left(\frac{n\pi x}{a}\right) \right|^2$$

and if $k = \frac{p}{\hbar}$ the probability density of momentum p of the particle is :

$$P_n(p) = \frac{a}{\pi\hbar} \left(\frac{n\pi}{n\pi + ka}\right)^2 \operatorname{sinc}^2\left(\frac{1}{2}(n\pi - ka)\right)$$

We know that for large number n we have:

$$\lim_{n\to\infty} P_n(p) = \frac{1}{2}\left(\delta\big(p + \frac{n\pi\hbar}{a}\big) + \delta\big(p - \frac{n\pi\hbar}{a}\big)\right)$$

so we arrived at the classical limit when the velocity is $\frac{n\pi\hbar}{a}$ for the same energy level, in this case, Einstein says [15] that the quantum mechanic is satisfactory complete for the momentum but it is not for the position! because (based on the probability density for finding the particle) we have always some points that the particle can never exist.

If we examine the probability density for finding the particle when $n \to \infty$ we found a sequence of peaks separated by a distance equal :

$$\frac{a}{n} = \frac{\lambda}{2}$$

* mazen.khoder@gmail.com

that λ is de Broglie wavelength:

$$\lambda = \frac{h}{mv}$$

and v is the classical velocity, so if the correspondence principle describes exactly the reality we need to oppose the objection of Einstein and affirm that in fact, the motion does not continue!
So we need to start from the concept of the motion itself, the motion as we know is related to space and time, it is a continuous change in position of a particle over time, but the existence of the particle in our world during its movement causes a real logical problem, It's about the continuity thus the infinity of a particle's positions, it corresponds to Zeno's paradoxes which were issued by the philosopher Zeno of Elea (ca. 490-430 BC) who has claimed that **"the reality is in plurality and change is mistaken, and in particular that motion is nothing but an illusion"**! [9]
This being said, we must resolve this problem by either assuming that space is not continuous or the movement itself is not continuous!
In fact, both assumptions must be taken into consideration.
This paper presents a theory of discontinuous motion of particles in continuous space-time.
So we start from the concept of the motion itself and assume that the motion (in the quantum world and classical world) is a sequence of appearances and disappearances events in space and time.
This is not the first time to assume such idea, some other scientists take this idea as a really serious one, such as:
Gao Shan presents a theory of discontinuous motion of particles [10], Laurent Nottale, Scale relativity [11] which is a geometrical and fractal space-time theory, Boisvert, Wilfrid, who has self-published his first book "Theory of Instantaneous Motion" [12]
In general, the earlier suppositions are good attempts which take the idea of discontinuity of motion as a real fact.
But based on this paper, it appears that exists certain criticisms in their works which briefly come as follows:
- Gao Shan and Boisvert, Wilfrid assume that the motion is spontaneous.
- Laurent Nottale declares that the motion is non-differentiable but it is continuous!

2. THE MOTION

Let's assume (FIG. 1.) that ε is the duration during which a moving particle exists before disappearing and that μ is the duration of the particle's disappearance from our world before it reappears later.
So what about the trajectory of particle?
Since the particle's motion is a sequence of appearances and disappearances events, the continuous trajectory of the particle cannot exist, but we can suppose that for each disappearance and appearance events we have an imaginary path (FIG.1.) that only reflect the properties of space and time on the values of ε and μ.
If the particle at time t_1 appears in location m_1 and at time t_2 appear in location m_2 affected by an imaginary path with velocity v so we can suppose:

$$L = \int_{t_1}^{t_2} v dt \tag{1}$$

L is the length of the imaginary path, and we have:

$$t_2 - t_1 = \varepsilon + \mu \tag{2}$$

We can suppose that the duration of existence of the particle ε is the same for the observer and for the reference of particle itself because the relative velocity between the two objects is zero during the phase of existence of the particle.
However, we can suppose that the particle didn't measure the duration of its disappearance μ from our world simply because it wasn't in our world during this phase !
Therefore, we can suppose based on relativity restraint that:

$$\tau = \int_{t_1}^{t_2} \sqrt{1 - \frac{v^2}{c^2}} dt \tag{3}$$

That τ is the proper time, we mean the time which the particle measured in its related reference during its movement from (m_1,t_1) to (m_2,t_2) using (or affecting by) an imaginary path. Note that this integral is a line integral where the function to be integrated is evaluated along a curve.
so we suppose that $\varepsilon = \tau$ then:

$$\varepsilon = \int_{t_1}^{t_2} \sqrt{1 - \frac{v^2}{c^2}} dt \Rightarrow \text{If v} \to c \Rightarrow \varepsilon = 0 \text{ and } \mu = t_2 - t_1$$

or if we have $v \ll c \Rightarrow \varepsilon = \int_{t_1}^{t_2} (1 - \frac{1}{2}\frac{v^2}{c^2}) dt \Rightarrow$

$$\varepsilon = t_2 - t_1 - \int_{t_1}^{t_2} \frac{1}{2}\frac{v^2}{c^2} dt \Rightarrow \varepsilon = \varepsilon + \mu - \int_{t_1}^{t_2} \frac{1}{2}\frac{v^2}{c^2} dt \Rightarrow$$

$$\mu = \int_{t_1}^{t_2} \frac{1}{2}\frac{mv^2}{mc^2} dt \Rightarrow \text{ if } K = \int_{t_1}^{t_2} \frac{1}{2} mv^2 dt \Rightarrow$$

$$\mu = \frac{K}{mc^2} \tag{4}$$

so for this imaginary path we have:

$$L = \int_{t_1}^{t_2} v dt,\ \mu = \frac{K}{mc^2},\ \varepsilon = (t_2 - t_1) - \mu \tag{5}$$

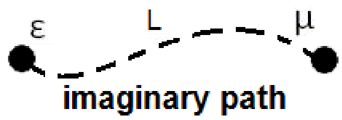

FIG. 1. One quantum jump

3. QUANTUM JUMP

First, we mean specifically by "quantum jump" one period of movement between two appearances of a particle. As we know, based on Newton's First law of motion:
"In an inertial reference frame, an object either remains at rest or continues to move at a constant velocity, unless acted upon by a force".
But this law is not compatible with the disappearance and appearance idea!, this law is not always true since the particle might easily appear (if the quantum jump is enough) in a forbidden (have a variation to very large potential field like for example particle in box) place after some quantum jumps in the direction of the movement of the particle!, so for a huge number of particles that jump in the subatomic level the newton law may put our universe in unstable situation!, and this might happen specifically when the length of the jump is close (or greater) to the length of the field's fluctuations.
But in the case where the length of the quantum jump is very small compared to the length of the field's fluctuations then the first law of Newton will be applicable because in this case, we can be sure that the particle will feel the force before that the force gets altered so all initial velocities are acceptable.
In this case (classical world) if the initial velocity is $\vec{v}$ so this velocity must be constant during one quantum jump (because no significant change in the potential field), in this case, we assume that the quantum jump J should be the de Broglie wavelength divided by two:

$$J = \frac{\lambda}{2} = \frac{1}{2}\frac{h}{mv}$$

then from equation (3) and $\varepsilon = \tau \quad \Rightarrow$

$$L = \frac{\lambda}{2} = \frac{h}{2mv},\ \varepsilon = \frac{h}{2mv^2}\sqrt{1-\frac{v^2}{c^2}},\ \mu = \frac{h}{2mv^2}(1-\sqrt{1-\frac{v^2}{c^2}}) \quad (6)$$

when $v \ll c \Rightarrow$

$$L = \frac{h}{2mv},\ \varepsilon = \frac{h}{2mv^2},\ \mu = \frac{h}{4mc^2} \quad (7)$$

when $v \to c$ like photon

$$L = \frac{h}{2mc},\ \varepsilon = 0,\ \mu = \frac{h}{2mc^2} \quad (8)$$

We know that $\vec{F} = m\vec{\gamma}$ but in our point of view of appearance and disappearance theory the real Newton equation must not contain the derivative of velocity (unless as an approximation) because the motion always must be a sequence of quantum jumps, so in the classical word the Newton equation become (when $v \ll c$):

$$\vec{F}\varepsilon_2 = m\vec{v}_2 - m\vec{v}_1 \quad (9)$$

$$\varepsilon_2 = \frac{h}{2mv_2^2} \quad (10)$$

So in classical world when $\vec{v}_1$ is the initial velocity we can calculate $\vec{v}_2$ that is the new velocity and ε_2 that is the duration of existence of the particle in our world before disappearing.
But when we come out from classical phase and enter to the quantum phase we need to modify Newton's first law as follows:
In any reference, an object either remains at rest or continues to move using a quantum jump based on a new action principle called "alike action principle" that takes in consideration all forces existent in the universe (not only the applicable forces on the particle itself).

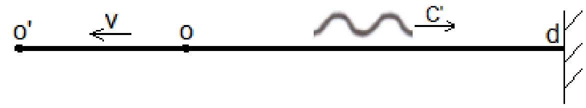

FIG. 2. Derive relativity restraint

3.1. Derive relativity restraint

As added result we can also derive the relativity restraint based on our new assumption as (FIG. 2.):
at time t_0 the particles O and O' have the same position, then at time t_0, O' moves with speed v respect to O and in the same time one photon moves with speed C respect to O as we see in figure, and let's assume that ε is the duration during which O' exists before disappearing and that μ is the duration of the particle's disappearance from our world before it reappears later.
In general we assume for the reference related to O if one object has the length L then the same object must have length αL with respect to O' and vice versa because we have symmetry between the two references related to O and O', but we not know the value of α as function of velocity V, and also we not know if the velocity of the photon is the same for O' as for O.
We assume that the velocity of the photon with respect to O' is C' and for the reference related to O we have: $|od| = x$, and

$$|oo'| = v(\varepsilon + \mu)$$

$$(but for\ O')\ \ v = \frac{\alpha|oo'|}{\varepsilon} \Rightarrow \alpha = \frac{\varepsilon v}{|oo'|} \Rightarrow$$
$$-\varepsilon v + \varepsilon c' = \alpha x \quad (for\ O')$$
$$\frac{-xv}{c} + \alpha\varepsilon c' = x \quad (for\ O) \Rightarrow$$
$$\alpha^2 = (1 - \frac{v}{c'})(1 + \frac{v}{c})$$

Our new assumption to derive relativity restraint is for $v = c$ we have $\varepsilon = 0 \Rightarrow \alpha = 0 \Rightarrow$

$$0 = 1 - \frac{c}{c'} \Rightarrow c' = c \Rightarrow \alpha = \sqrt{1 - \frac{v^2}{c^2}}$$

so for one event (x, t) in reference O and (x', t') in reference O' we can deduce the lorentz transformation as follow:

$$x - vt = \alpha x' \quad (for\ O)$$
$$x' - vt' = \alpha x \quad (for\ O') \Rightarrow$$

$$x' = \frac{1}{\alpha}(x - vt) \ \ and \ \ t' = \frac{1}{\alpha}(t - \frac{v}{c^2}x)$$

4. ALIKE ACTION PRINCIPLE

When the particle is in location m_1 at time t_1 and we are investigating where would it be in time t_2?
We use this equation to distinguish all space paths:

$$L = \int_{t_1}^{t_2} v dt$$

for each path, we can define the ordinary action S which is verified by:

$$S = \int_{t_1}^{t_2} (\frac{1}{2}mv^2 - U)dt \tag{11}$$

Now we have a lot of choices for the location in time t_2, we suppose that we are in quantum phase or in other words we ignore the classical mechanic effect which permits us to ignore the initial velocity (for the imaginary path of a particle used to come to the initial position m_1).
In our case (quantum phase) the initial velocity didn't have a real significant effect on the movement of the particle as if the particle always forgets how it came to its initial position and starts again without any initial velocity.
In the quantum phase the particle has some preferred destinations based on a new quantum action principle named **"alike action principle"** that ensures the existence of physical harmony within our universe, like for example preventing the particle from easily reaching to forbidden locations (guarded by fields of great forces).
Therefore, in general, this new constraint in movement could be valid at multiple positions at the same time, so in general, we have multiple acceptable positions in time t_2.
Thus the probability of existence came up in our description of the movement in quantum world!

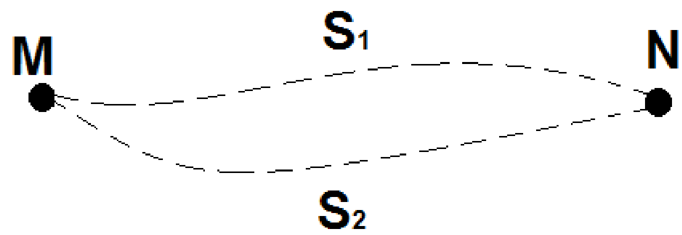

FIG. 3. Two imaginary paths

We suppose that we have a preferred value of action that we call h (plank constant), the new action principle called "alike action principle" states:
The preferred appearance destination took by the particle at time t is the one for which all the remainders due to $\frac{S}{h}$ (for all paths which lead to this destination) are stationary.
In other words, having the same (or close to each other) remainder after dividing them by h.
for example, if we have two actions (for two paths) to one destination location (FIG. 3.):

$$S_1 \text{ and } S_2 \Rightarrow S_1 = n_1 h + r_1 h,\ 0 < r_1 < 1$$
$$\text{and } S_2 = n_2 h + r_2 h,\ 0 < r_2 < 1 \Rightarrow$$
$$S_2 - S_1 = (n_2 - n_1)h + (r_2 - r_1)h \Rightarrow$$

if we have $r_2 - r_1 = 0$ then S_2 and S_1 have the same remainder after dividing by h then we have a preferred location (point N) at time t_2, but if we have $\left|r_2 - r_1\right| = \frac{1}{2} \Rightarrow$ the difference between the remainders reach its maximum so we have a forbidden location (point N) at time t_2.
so we can say that the action value h is the action preferred in nature and it is the preferred unit of quantum jump and in reverse, it becomes not preferable as it goes far from h.
so we need to find a function which verifies the following requirements:
$f(nh) = 0$ and $f(nh + \frac{h}{2}) = 1$ (using as maximum)
It obvious that this function is a periodic function and the most simple one that verifies these requirements is:

$$\sin^2(x)$$

Thus by having two actions S_1 and S_2 we can define the **"difference quantum actions"** as:

$$\delta_{S_1,S_2} = \sin^2(\frac{\pi}{h}(S_1 - S_2)) \tag{12}$$

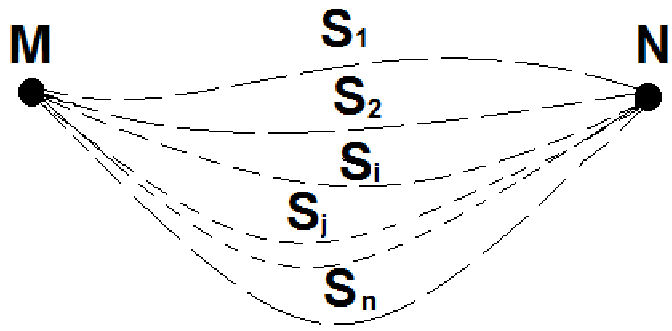

FIG. 4. many imaginary paths

So when the difference quantum actions are minimum it yields a maximum preferred destination of particle and when we have a maximum difference quantum actions it yields to a minimum preferred destination of particle and down to forbidden destination.

If we have n paths (In real case we have infinities of paths) to the potential destination of the particle (FIG. 4.) then we can simply suppose that the difference quantum actions for all n paths are the sum of all the differences between each pair of paths:

$$\delta_{S_1,S_2,\ldots S_n} = \sum_{(i,j)} \sin^2(\frac{\pi}{h}(S_i - S_j)) \tag{13}$$

We have some important mathematical properties for the equation (13) which we introduce here without demonstrations:

$$\text{max of } \{\delta_{S_1,S_2,\ldots S_n}\} = \frac{n^2}{4} \tag{14}$$

$$\lim_{(S_i - S_j \bmod h) \text{ is equiprobable in [0,h]}} \delta_{S_1,S_2,\ldots S_n} = \frac{n(n-1)}{4} \tag{15}$$

5. DERIVE PATH INTEGRAL FORMULATION

We now want to specify the equation which can be used to calculate the quantity Q that is proportional to the probability of existence of any potential destinations at time t_2, so for each potential destination the input of this function is $\delta_{S_1,S_2,\ldots S_n}$ and the output is proportional to the probability of appearance of the particle in this destination.
Accordingly this probability is maximum when $\delta_{S_1,S_2,\ldots S_n} = 0$ and it is minimum (zero) when $\delta_{S_1,S_2,\ldots S_n}$ is maximum $\Rightarrow$ when $\delta_{S_1,S_2,\ldots S_n} = \frac{n^2}{4}$, and we can also assume in the case of equation (15) that the distribution of the quantum difference actions is allocated evenly across the range between 0 and h.
There isn't any tendency to forbid reaching to the destination and nor to maximize the probability of appearance of the particle at this destination, therefore, in this case, we can suppose that the probability of appearance is proportional to the number of n paths (like classical case).
we can simply suppose that the function is linear to the $\delta_{S_1,S_2,\ldots S_n}$ so:

$$Q = a\delta_{S_1,S_2,\ldots S_n} + b, \text{ a and b is constants} \Rightarrow \text{we have:}$$
$$0 = a\frac{n^2}{4} + b, \text{ and } n = a\frac{n(n-1)}{4} + b \Rightarrow$$
$$Q = n^2 - 4\delta_{S_1,S_2,\ldots S_n} \tag{16}$$

ultimately we have three main results:
one which could be assimilated to the classical mechanic (in this case all n paths are acceptable), and the two others are pure quantum results in which one of them increases the probability of appearance to become proportional to n^2 and the other prevents any appearance in the selected destination.
It becomes clear to us that the hidden variable in quantum phase is the quantum jump itself which will be taken by the particle during the next movement based on a new action principle called "alike action principle".
Now we want to verify that this quantum "alike action principle" yields to the path integral formulation of quantum mechanics which is equivalent to Schrodinger equation, so from equation (16) we have that:

$$Q = n^2 - 4\delta_{S_1,S_2,\ldots S_n} \Rightarrow \text{ if we take } n = 2 \Rightarrow$$
$$\begin{aligned}
Q &= 4 - 4\delta_{S_1,S_2} \\
&= 4 - 4\sin^2(\frac{\pi}{h}(S_1 - S_2)) \\
&= 4(1 - \sin^2(\frac{\pi}{h}(S_1 - S_2))) \\
&= 4\cos^2(\frac{\pi}{h}(S_1 - S_2)) \\
&= 2(1 + \cos(\frac{2\pi}{h}(S_1 - S_2))) \\
&= 2(1 + \cos(\frac{2\pi}{h}S_1)\cos(\frac{2\pi}{h}S_2) + \sin(\frac{2\pi}{h}S_1)\sin(\frac{2\pi}{h}S_2)) \\
&= 2 + 2\cos(\frac{2\pi}{h}S_1)\cos(\frac{2\pi}{h}S_2) + 2\sin(\frac{2\pi}{h}S_1)\sin(\frac{2\pi}{h}S_2) \\
&= \cos^2(\frac{2\pi}{h}S_1) + \sin^2(\frac{2\pi}{h}S_1) + \cos^2(\frac{2\pi}{h}S_2) + \sin^2(\frac{2\pi}{h}S_2) \\
&+ 2\cos(\frac{2\pi}{h}S_1)\cos(\frac{2\pi}{h}S_2) + 2\sin(\frac{2\pi}{h}S_1)\sin(\frac{2\pi}{h}S_2) \\
&= \left(\cos(\frac{2\pi}{h}S_1) + \cos(\frac{2\pi}{h}S_2)\right)^2 + \\
&\left(\sin(\frac{2\pi}{h}S_1) + \sin(\frac{2\pi}{h}S_2)\right)^2 \\
&= \left|\exp(i\frac{2\pi}{h}S_1) + \exp(i\frac{2\pi}{h}S_2)\right|^2 \Rightarrow
\end{aligned}$$

in general we can prove:

$$Q_{S_1,S_2,\ldots S_n} = \left| \sum_{i=1}^{n} \exp\left(i\frac{2\pi}{h}S_i\right) \right|^2 \tag{17}$$

so we derive the "path integral formulation" of quantum mechanics discovered by Feynman (for infinity paths the sum become an integral).
Thus when the particle exists in a location M in time t1 we need to apply the quantum "alike action principle" in all locations to find the probability of appearance at time t_2 which is proportional to the quantity $Q_{S_1,S_2,\ldots S_n}$ in each location.
So any modification in these locations, for example by modifying the fields through which the imaginary paths go through will affect the calculation of $Q_{S_1,S_2,\ldots S_n}$!
This being said, the appearance of a particle in any new location will lead once again to the calculation of quantum alike action which clarifies what is called wave collapse.
Furthermore, it also clarifies the "decoherence" concept which illustrates the effect of the environment on the wave function when the particle chooses one location (which is very close to some particles exist in the environment) to appear at! unexpectedly, Einstein's supposition that the observation is not related to the observer, as well as Bohr's supposition that the observer causes the observation is not true, so based on our vision, the observed particle itself causes the observation by choosing one location to appear at based on the quantum "alike action principle".
For photon we can do similar to the particle, so when $\lambda \ll$ scale of slits etc. then the photon follows a direct line with the quantum jump in equation (8), but when λ is comparable or greater then the scale of slits etc. then the photon follow its "alike action principle".
So for $S = \int_{t_1}^{t_2} (\frac{1}{2}mv^2 - U)dt$, the similar quantity of $\frac{1}{2}mv^2$ is the kinitic energy $E_k = mc^2 - m_0c^2$ so for photon we can said:

$$m_0c^2 = 0 \Rightarrow E_k = mc^2 \Rightarrow$$
$$\frac{S}{h} = \frac{mc^2(t_2 - t_1)}{h} \Rightarrow \frac{S}{h} = \frac{L}{\lambda}, \text{ L is the path length} \Rightarrow$$
$$Q_{L_1,L_2,\ldots L_n} = \left| \sum_{i=1}^{n} \exp\left(i\frac{2\pi}{\lambda}L_i\right) \right|^2 \tag{18}$$

6. SOME CONCLUSION

So the observer didn't decide where the particle will appear but the particle itself has decided its next location among all possible destinations based on a new action principle called "alike action principle".
This clarifies to us and makes more understandable all strange behaviors of matter in quantum mechanics such as interference, wave collapse, entanglement, quantum tunneling, uncertainty principle etc. For instance, regarding the entanglement:
In fact, two entangled particles took those related physical values in coordination while being adjacent! and we observed this physical values right after their quantum jump which has occurred at a jump velocity:

$$\frac{L}{\mu}$$

which may exceed the speed of light so we do not have any spooky action at a distance, for example of equations (5) if $v \simeq constant \Rightarrow$

$$L = v(t_2 - t_1), \quad \mu = \frac{v^2(t_2 - t_1)}{2c^2} \Rightarrow$$
$$v_a = \frac{L}{\mu} = \frac{2c^2}{v}$$

6.1. Basic law of motion

Based on the idea of disappearance and appearance it seems that the general equation of motion is a combination of the quantum "alike action principle" (equation (17)) and the quantified newton law of motion (equations (9, 10)) so when the quantum jump $J = \frac{\lambda}{2} = \frac{h}{2mv}$ is very small compared to the length of the potential field's fluctuations then the particle takes into consideration the initial velocity v and follows the quantified Newton law of motion (equations (9, 10)).
In the contrary, when the length of the jump is close (or greater) to the length of the potential field's fluctuations then the particle ignores the initial velocity v or becomes with minimal effect and only uses the quantum "alike action principle" to know where it will go!
So in classical limit, I mean when the particle enters in the classical regime, the initial velocity takes its role to specify the future movement, in this case we may witness a chaotic behavior (big sensitivity to initial values) when we put for example the particle in a special shape such as a stadium billiard.
In parallel, when we refer back to the quantum regime the particle always ignores the initial velocities. Thus, the chaos will disappear from the quantum world (we verified Berry [17]) as we know in quantum chaos because the Schrodinger equation is a linear equation which didn't consider a chaotic behavior as newton law did.

6.2. Relativist case

It is clear that our model of the movement is not symmetrical between the observer and the observed particle, so to have a full symmetry (to be compatible with the relativity restraint) we need to suppose that all particles in the universe have also a special appearance and disappearance motion in the particle's unique related reference, in this case we can describe the movement in all references similarly, and we can assume that this is what we call in quantum mechanics Zitterbewegung ("trembling motion" in German) which is a hypothetical rapid motion of elementary particles, the period of this movement is equal to $\frac{h}{2mc^2}$ [18].

6.3. Cosmological constant problems

In cosmology, we have two cosmological constant problems, the first is the old one what we called the vacuum catastrophe is the big disagreement between the observed small value of the cosmological constant that is the value of vacuum energy density (that is the dark energy) and the theoretical large value of zero-point energy expected by quantum field theory.
The second (or new) cosmological problem is the coincidence problem that is:
The vacuum energy density is in the same order of magnitude as the matter density!
This theory may give us a solution for this two problems, since the particle's motion is a sequence of appearances and disappearances events, the law of conservation of energy can states that the total energy of the Universe remains constant over time, so this paper assume that when the particle disappears, it back to the universe as an energy distributed randomly throughout it, then after some time it returns as a normal particle etc., according to the previous paragraph, the particle is always in trembling motion between disappearance and appearance modes so it always spends half its time $\frac{h}{4mc^2}$ in the existence and the other half in the disappearance, so if we assume that N is the total number of particles in our universe and we want to calulate the probability to have n particle in disappearence mode we have:

$$P(n) = \frac{N!}{n!(N-n)!}\left(\frac{1}{2}\right)^n\left(\frac{1}{2}\right)^{N-n}$$

so it is clear that we multiply the probability of finding n particles in disappearance mode with $N-n$ particles in appearance mode by the number of all combinations of n particles from the total N, so the equation becomes:

$$P(n) = \frac{N!}{n!(N-n)!}\left(\frac{1}{2}\right)^N \tag{19}$$

it is clear that the expected value of n is $\frac{N}{2}$ that have the maximum probability and we can calculate also the standard deviation SD is:

$$SD = \frac{1}{2}\sqrt{N}$$

so if we comapre the SD in n with the expected value $\frac{N}{2}$ we have:

$$\frac{SD}{\frac{N}{2}} = \frac{1}{\sqrt{N}}$$

it is clear that this number is almost zero so the fluctuation around the expected value is very small, always we have $\frac{N}{2}$ random particles in disappearance mode, therefore we have $\frac{N}{2}$ random particles back to the universe as an energy distributed randomly throughout it, so as result we found that the vacuum energy density is almost equal to the half of matter density!
For verification with the observed values, we can see [19], therefore the origin of dark energy is the ordinary matter itself!

Finally, this theory is just a beginning step of another way to see the physical world and to open a new deep view of our universe.

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