

Re-Creation: A possible interpretation of quantum indeterminism

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Abstract

I discuss some of the main interpretations given to explain the indeterministic nature of quantum measurements and show that all has some loopholes in one corner or another. I propose an alternative interpretation based on the notion of continued re-creation of the physical properties. The rate at which the system is re-created is a measure of the determinism of the measurements. The existence of uncertainties is better explained through this view, the meaning of incompatible observables becomes clearer, and with the notion of re-creation and the origin of the Heisenberg uncertainty principle becomes more vivid.

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I. INTRODUCTION

It is a common understanding among physicists that the concept of quantum measurement is still a problem which is in need for a solution in order to clarify the deep implications of quantum theory. There is no consensus among physicists; instead we have different views

and interpretations on how quantum measurements can be interpreted. Quantum measurements are the backbone of applied quantum mechanics and, therefore it will be necessary to resolve this problem for further development of quantum theory. Since the early years of quantum mechanics this problem was the subject of fierce discussions and controversy, all connected to one basic question and that is: how do we interpret quantum mechanics?

In this paper I will present a new interpretation of quantum measurement based on the notion of continued re-creation of the physical properties of systems. This notion may have its early realization in opinions of some Greek philosophers, but surely had its most sophisticated conceptualization in Islamic thought through the works of Mutakallimun [1]. Using this notion I will try to explain some of the basic principles of quantum mechanics, at least on the conceptual level at this stage, avoiding much mathematical details. Then I will try to foresee some of the physical implications of such an interpretation and will glimpse upon the philosophical and theological implications.

II. EARLY DEVELOPMENT OF QUANTUM THEORY

The discovery of the wave properties of particles, the particle properties of waves, and the discreteness of many Observables in the atomic realm has established the need for a new description of entities of the microscopic world. At the beginning of the twentieth century many basic problems in atomic physics were addressed leading to the establishment of quantum mechanics as a paradigm to explain the observed properties of the atomic realm. The most fundamental notions of early quantum mechanics were based on the assumption that particles behave like waves. The main difficulty in realizing a wave-like description for the particles lays in the fact that particles are localized whereas waves are extended. This problem was overcome by the Louis de Broglie suggestion that a particle can be represented by a wave which has a wavelength inversely proportional to its momentum. This notion was soon utilized to obtain a description of particles in terms of a de Broglie wave-packet with the wavelength being that of a group of waves representing the particle. This description opened the way to formulate the classical localized particle mechanics in terms of the wave mechanics. Accordingly, Erwin Schrödinger formulated a wave equation in 1926 to describe the time development of atomic particles under field of force [2]. The need to consider high speeds required introducing the special relativistic formulation of the problem and led to

the well-known Dirac equation of the electron which was discovered few years later [3].

In essence the wave-like description of atomic particles benefited from all the properties of wave phenomena and it was soon realized that the microscopic world enjoys some basic properties that makes it different from the macroscopic world. Particles, like atoms and electrons, are now being identified as “quantum states” symbolized by the wave function $\psi(x, y, z, t)$. This is a mathematical expression summarizing the physical content of a physical system in terms of spacetime coordinates and other parameters of the system like energy and momentum. The mathematical nature of $\psi(x, y, z, t)$ was already recognized since the early days of formulating the Schrödinger equation, and it was realized that the wave function has no direct physical meaning in itself. Soon Max Born [4] was able to identify

$$|\psi^*(x)\psi(x)| = |\psi(x)|^2, \quad (1)$$

to stand for the probability density of finding the particle in the position x .

The wave-mechanical description of particles set by Schrödinger was best realized by saying that a particle is a wave-packet that is composed by super-posing many basic (plain) waves. This description soon faced many difficulties. The slightest dispersion in the medium will pull the wave-packet apart in the direction of propagation, and even without such dispersion it will always spread more and more in the transverse direction. Because of this blurring a wave-packet does not seem to be very suitable to represent a particle. Shortly before Schrödinger had formulated his wave equation, during the early summer of 1925, Werner Heisenberg [5] conceived the idea of representing physical quantities by sets of complex numbers. This was soon elaborated by Born, Jordan and Heisenberg [6] himself into what has become known as *matrix mechanics*, the earliest consistent theory of quantum phenomena. Both views, the wave mechanics of Schrödinger and the matrix mechanics of Heisenberg are said to be equivalent despite differences in some basic concepts and formulation.

Few years later Jon von Neumann [7] formulated as a calculus of Hermitian operators in Hilbert space. The wavefunction was represented by complex function in an infinite-dimensional space covered by basis vectors. According to the formalism set by von Neumann a physical system is completely described by a wave function $|\psi\rangle$, which is now to be taken as a vector in an infinite-dimensional Hilbert space. A measurement of any observable a belonging to the system is the result of the action of a mathematical operator

\hat{A} , corresponding to that observable, on the state vector (wave function) representing the system. The result of such an operation is to produce a value (a number called the eigenvalue) that stands for the value of the observable at the moment of measurement. With this new comprehension natural objects, which objectively were identified as ontologically existing things, became known in terms of new epistemological entities that are represented by abstract mathematical forms. It should be emphasized that this is a very important turning-point in the history of scientific thought. The fact that $|\psi\rangle$ which represent the physical system is a mathematical expression that has no direct physical meaning as noted earlier and the fact that physical observables became obtainable in the theory only as a result of operating certain mathematical operators on $|\psi\rangle$ is surely a clear indication of the fundamental turn that was implied by quantum mechanics.

The quantity a (the observable) cannot be taken as such to stand for the physical value of the observable; it has to be averaged within the state of the system and it is then called the *expectation value* of the operator \hat{A} at the state $|\psi\rangle$. This is the average value of all possible measurements that can be carried in the system in the state $|\psi\rangle$. However we have to remember that theoretically the number of all possible measurements is infinite, for this reason the expectation value may not be obtained in any single measurement.

III. THE HEISENBERG UNCERTAINTY PRINCIPLE

Much to the curiosity of the physicists, some aspects of the wave-like description of particles led to some uncertainties in determining simultaneously pairs of observables like position and momentum, energy and time and other observables. This was expressed by the Heisenberg uncertainty principle which, in one of its forms states that the position of a particle and its momentum can never be determined simultaneously with infinite accuracy. This principle contributed to the indeterminacy of the quantum world and had taken much attention and interest from physicist. The uncertainty principle is deeply rooted in the wave-mechanical description of particles; once we represent a particle by a wave then it is inevitable that we should allow for some kind of a distribution of the values of its position and momentum. The Fourier analysis of such a description shows that the wave description requires some inevitable non-locality in position which leads to the inherent uncertainty in these variables. Similar situation applies to measurement of time where it would lead to mutual uncertainty

between time intervals and the corresponding energies. The uncertainty relations are related to the non-commutativity of the respective operators. In matrix mechanics operators are matrices and in such case

$$a \times b \neq b \times a, \tag{2}$$

for this reason the operators of position and momentum do not commute. Likewise are the operator for time and the Hamiltonian, which is the operator for energy. This in turn will eliminate the possibility of finding a simultaneous eigenvectors for the position and momentum. Instead we relate the two separate eigenvectors by a Fourier transform. It is important to note that indeterminacy of position and momentum caused tremendous shock to classical physicists. The classical equation of motion of a particle requires knowing both the initial position and the initial momentum. Having been denied such a knowledge physicists were puzzled with the solutions of the equation of motion. This caused the downfall of classical mechanics in the microscopic world. The glory of classical mechanics, especially in its most sophisticated form devised mainly by Lagrange and Hamilton still provoke some physicists to re-establish the reign of classical physics.

IV. DISCRETENESS AND CONTINUITY

The quantum indeterminacy problem is deeply rooted in the long-lasting question of discreteness and continuity. This is an issue which has been under persistent debate since the early days of the Greek, throughout the Islamic period which witnessed fierce debates between the philosophers and Mutakallimun [1].

The indeterminacy of quantum states described by the Heisenberg uncertainty principle brought to the attention of physicists the fact that quantum mechanics is a mechanics of the undetermined nature. As noted above, this soon posed what came to be known as the *measurement problem* in quantum mechanics. This today, more than three quarter of a century after the advent of the theory, is still an issue of unprecedented dissension. In fact it is by far the most controversial problem of current research in the foundation of physics and divides the community of physicists and philosophers of science into numerous opposing schools of thought.

The main issues in this division seem to be centered on two things: the quantum jumps,

and the measurement indeterminacy. Quantum jumping is an indication of the discrete nature of the atomic world. If this is to be a fundamental characteristic of the microscopic world then continuity of the macroscopic world would seem to be only fictitious. It was reported that Schrödinger once said “if all this damned quantum jumping were really to stay I shall be sorry I ever got involved with quantum theory” [9]. The main difficulty will arise when we find that our differential calculus, which is the backbone of the mathematical formulation of classical physics that was based on continuity and infinite divisibility, will be in need of serious revision. Consequently, the canonical formulations of physical laws will not be valid and the basic concepts of field theory will be challenged. The Schrödinger equation is a deterministic equation that adopts the principle of continuity and the concept of infinite divisibility. However, a wave equation has helped to provide an approximated picture of the quantum world. The discrete features of the quantum world are now being presented as product of the wave mechanical nature which allows for superposition of waves producing interference pattern. Consequently, one can avoid thinking of the abrupt quantum jumps in favor of some more lenient thinking in terms of the probability distribution, such that some kind of continuity between discrete states is maintained. Therefore, instead of having the macroscopic continuity becoming an apparent feature that hides the underlying discreteness, we now have discreteness appearing as an emergent product of some phenomena of the continuum. Beside this, it would be important to note that precise analysis of the quantum phenomena of the two slit interference shows some fundamental characteristic departure from the standard wave-interference phenomena [10]. In these experiments, a particle remains to be non-divisible. However, such a departure awaits an explanation, which can precisely identify those features in both phenomena that makes them different.

V. THE APPLICABILITY QUANTUM MECHANICS

In this context comes the question whether quantum mechanics is a theory that can be applied to a single particle or is it a theory of ensembles. Physicists have different opinions on this issue. Some of them, like Bohr and Heisenberg, believe that quantum mechanics is suitable to describe single particles as well as many particle systems. This is generally the view held by the Copenhagen school. Others physicists, like Einstein and Born, believe that quantum mechanics is only applicable to ensembles rather than individual particles,

and accordingly it can only be interpreted statistically. Others, like Everett and Wheeler, believe that quantum mechanics is essentially an interaction theory that can be realized only through the interaction between the observer and the system. In one way or another, this will allow for a subjective interference in determining quantum states. In fact, the basic formulation of the equation of motion in quantum mechanics, Schrödinger's equation, suggests that it can be applied to single particles, on the other hand having the values of observables coming out as an average only may suggest that we are talking about an ensemble of particles in which each particle enjoys different value for that observable. The general behavior of the system of these particles then is represented by the behavior of the average. However, this restriction becomes unnecessary if we would interpret the existence of an average as being happening as a result of many measurements being performed on the same particle. In this case the implicit fact will be that the value of the observable assigned to the system (the single particle in this case) is not fixed but is ever changing. But then the question arises as to whether this change in the value of the observable is due to the changing state of the system, or is it due to the process of the measurement itself. If we assume that it is due to the changing state of the system then the process of measurement can be taken to be completely passive. On the other hand, if it will be considered to be a result of the measurement itself then we are assuming primarily that the measurement itself has a disturbing effect on the system. This amounts to assume the existence of an interaction between the system and the measuring device. Having the microscopic systems being so small and delicate, no one can deny that such possible interactions may cause subsequent disturbances. Therefore, such interactions will lead to *de-cohere* the quantum system. The disturbances caused by the measuring devices are generally non-systematic and so complicated that it would be unpredictable. On the other hand one might expect that in some cases the disturbances caused by the macroscopic measuring device can be so large that it will overwhelm the basic value of the observable under measurement. The third point to make here is that such disturbances, if known, can be accounted for in the equation of motion through the potential term in the equation of motion. Accordingly, the case will always be that of an interacting system for which the equation of motion may be solved exactly or through numerical techniques. Virtually anything environmental can be included in the potential of the system, which controls the behavior of the system through the equation of motion. Considering these notes, it would be odd to assume that quantum

indeterminacy is a sheer result of the incision of measurement.

VI. INTERPRETATIONS OF QUANTUM MEASUREMENTS

In a given individual experiment, the result of the measurement is one of several alternatives. A repetition of the experiment under identical initial conditions may lead to another of these possible alternatives. This is incompatible with the unitary evolution of Schrödinger. Several solutions have been proposed for this apparent inconsistency. The main ones are:

A. The von Neumann Interpretation: wavefunction collapse

To explain the process of measurement von Neumann suggested that the state function changes according to two different ways (see for example [7]):

Process 1: a discontinuous change brought about by observations by which the quantity with eigenstate $|\psi\rangle$ is projected onto the state

$$|\phi\rangle = \hat{A}|\psi\rangle \tag{3}$$

instantly with probability

$$|\langle\psi|\phi\rangle|^2, \tag{4}$$

This amounts to determine the overlap between the state $|\psi\rangle$ and the state

$$|\phi\rangle = \hat{A}|\psi\rangle. \tag{5}$$

Process 2: a change in the course of time development according to the deterministic Schrödinger equation.

The description in process 1 is called *the wavefunction collapse*, which means that the state $|\psi\rangle$ after measuring the observable A will be converted into the state $|\phi\rangle$ given in Eqn. (5).

In this formulation of von Neumann a fundamental problem was recognize long ago, this is the embodied apparent inconsistency between the indeterministic nature of process 1 and the

deterministic nature of process 2. This apparent inconsistency has been presented in different forms, and it is in fact deeply rooted in the formulation of quantum mechanics from its very beginning. Joseph Jauch [11] presented the problem as follows: the problem of measurement in quantum mechanics concerns the question whether the laws of quantum mechanics are consistent with the acquisition of data concerning the properties of quantum systems. This consistency problem arises because the system to be measured and the apparatus which is used for the measurement are themselves systems which are presumed to obey the laws of quantum mechanics. Therefore the evolution of the state of such system is governed by the Schrödinger equation. However, the measuring process exhibits features, which are apparently inconsistent with the Schrödinger-type evolutions. The typical process ends with the establishment of a permanent and irreversible record. This contradicts the time-reversible Schrödinger equation. So, despite the fact that the von Neumann interpretation of quantum measurement was adopted by the Copenhagen school, nevertheless it suffers from some fundamental problems.

B. The statistical interpretation

For this we have two views

Viewpoint I: by which quantum mechanics is understood to apply to ensembles and not to single particles. Albert Einstein was an advocate of this interpretation. Einstein says: "The function ψ does not in any way describe a condition which could be that of a single system: it relates rather to many systems, to 'an ensemble of systems' in the sense of statistical mechanics." [12]. Einstein hoped that a future more complete theory may describe quantum mechanics as an approximation of a more general one.

Viewpoint II: which was proposed by Born, and supported by Bohr, according to which the wavefunction ψ was understood to be symbolic of representation of the system and that

$$|\psi(x)|^2 = \psi^*(x)\psi(x), \quad (6)$$

is taken to describe the probability density for the system is in the position x . But probability can only be understood to have a meaning through a population. In this case the population is that of many repeated measurements. This may be asserted by the fact that Born was of the opinion that his suggestion is of the same content as that of Einstein and

that "the difference [in their views] is not essential, but merely a matter of language." [13]. One can say that the Einstein interpretation is covered by the fact that in any measurement on a quantum system we measure macroscopic quantities, a fact which was originally emphasized by Bohr. If, however, we come to measure by any means a microscopic quantity then the Einstein interpretation will not be valid. On the other hand, by requiring that many measurements are to be done on the same system, Born's interpretation implicitly assumes that the system is to remain within the same state over the duration of all those measurements. Obviously this cannot be generally guaranteed.

C. The hidden variables interpretation

This interpretation was championed by David Bohm [14] who assumed that quantum mechanics is incomplete, and that there are some hidden variables that should complement the physical description in order to get the full picture of the physical world, which is assumed to be deterministic. There are several kinds of hidden variable theories, some are local and some are non-local. Belinfante [15] has given a very detailed account of these theories both in their scientific content and in their historical development. By Bell's theorem [16] the local hidden variable theories were shown to be inconsistent with quantum mechanics. There remains to say that none of the existing non-local theories is found to conclude any prediction that is new to the standard formulation of quantum mechanics.

D. The multi-world interpretation

This was originally proposed by Hugh Everett [17] in 1957. Everett reformulated the process of measurement abandoning the concept of wavefunction collapse set by process 1 of the von Neumann formalism, while keeping the assumption of the deterministic evolution of the system under Schrödinger equation. Everett criticized the need for "external observers" to obtain measurements by the von Neumann scheme and instead went to consider the system as being composed of two main subsystems: the object and the measuring device (or observer). This formulation established the concept of "relative state". The treatment lead Everett to conclude that: "throughout all of a sequence of observation processes there is only one physical system representing the observer, yet there is no single unique state of the

observer (which follows from the representations of interacting systems). Nevertheless, there is a representation in terms of a superposition, each element of which contains a definite observer state and a corresponding system state. Thus, with each succeeding observation (or interaction), the observer state "branches" into a number of different states. Each branch represents a different outcome of the measurement and the corresponding eigenstate for the object-system state. All branches exist simultaneously in the superposition after any given sequence of observations". Everett went further to suggest that: "the trajectory of the memory configuration of an observer performing a sequence of measurements is thus not a linear sequence of memory configurations, but a branching tree, with all possible outcomes existing simultaneously in a final superposition with various coefficients in the mathematical model. In any familiar memory device the branching does not continue indefinitely, but must stop at a point limited by the capacity of the memory". John Wheeler supported the Everett theory emphasizing its self-consistency [18]. An elaboration of the Everett interpretation was also the subject of a study by Graham [19] working under the supervision of Bryce DeWitt. It was assumed that the eigenvalues associated with the observer subsystem form a continuous spectrum, whereas the eigenvalues associated with the object form discrete set. In order to reconcile the assumption that the superposition never collapses with ordinary experience which ascribes to the object system after the measurement only one definite value of the observable, it was proposed that the world will be splitting into many-worlds existing simultaneously where in each separate world a measurement yield only one result, though this result differs in general from one world to another.

VII. THE RE-CREATION POSTULATE

In order to interpret quantum measurement I propose the following two postulates:

Postulate P (1): All physical properties of a system are subject to continued re-creation.

Postulate P (2): The frequency of re-creation is proportional to the total energy of the system.

It will be shown below that the re-created observables assumes a new value every time it is re-created. This will cause the observable to have a distribution of values over certain range (width) that is always controlled by the re-creation frequency. The higher the total energy of the system the narrower is the range of values over which the dispersion is expected and

vice versa. For this reason macroscopic systems are expected to behave classically, whereas microscopic systems exhibit mostly quantum behavior. Clearly, the narrower the dispersion of values, the more determinable is the value of the observable and vice versa.

VIII. RE-CREATION AND THE UNCERTAINTY PRINCIPLE

Once created an observable assumes a given basic value defined by the state of the system at that moment. According to the re-creation postulate physical parameters are permanently in a natural process of continued re-creation, irrespective of the measurement operation. However, values of those parameters can only be known at the time of measurement. Re-creation is a process of change. Once a given parameter is re-created other parameters of the system will be affected; thus changing their values in accordance with the related physical laws. Any change is best described, in the most general form by the generator corresponding to that parameter. For example if x is re-created then the system will change infinitesimally by $\partial/\partial x$ but this is just proportional to the momentum operator. This will duly cause the value of the position x to change every time it is re-created, thus presenting a distribution of values for x instead of acquiring one single value. Conversely if p is re-created then the whole system will change by $\partial/\partial p$, but this will cause an infinitesimal shift in the value of p and consequently a shift in the value of the position parameter x . Therefore every time an x is re-created a change in the momentum of the system will occur and conversely every time the momentum is re-created a change in the value of the position will occur. This means that re-creating the position will result in creating momentum and vice versa. If the system itself is to stay invariant under the process of re-creation then we must have

$$\left(\frac{\partial}{\partial x} x - x \frac{\partial}{\partial x} \right) |\psi \rangle = |\psi \rangle . \quad (7)$$

Using the explicit forms for the position and momentum operators this would imply that

$$\hat{p}\hat{x} - \hat{x}\hat{p} = [\hat{p}, \hat{x}] = -i\hbar, \quad (8)$$

In other words, the effect of change is logically being seen as a commutation of the parameter and its generator (which were also called complementary observables). This is the well-known commutation relation that led to the Heisenberg uncertainty relations. In

this scheme however measurements could be passive action that does not necessarily affect the system itself.

This proposal of re-creation preserves the statistical nature of the possible values of the observables and resolves the question whether of quantum mechanics is applicable to single particle or to an ensemble of particles. Here we see that the single particle state is being under continued re-creation, thus forming an ensemble of values on its own if a memory is to be available to keep records of all values assumed under re-creation. Nevertheless, a measurement of an observable taken over duration of time exceeding the re-creation period will always yield an average of the values assumed by the system during that period of measurement. So, practically we almost measure average values every time we perform a measurement. This explains how the probabilistic behavior arises in the case of single particle quantum system. According to the above scheme we always measure average values with very low dispersion for macroscopic objects; the re-creation frequency is very high and consequently the measurement time cannot coup with the re-creation period. This gives the macroscopic world its classical, apparently deterministic, characteristics. This is why we have the measured values of the observables of a macroscopic system always being very close, even identical, to the theoretical expectation values of the observables. On the other hand in microscopic systems the re-creation frequency is relatively low and, therefore, we would expect the dispersion of values to be high enough exposing the indeterministic character of the world.

The proposal also provides us with better understanding of the origin of the uncertainty relations. Here we see that the appearance of uncertainty in the values of complementary observables is a direct result of re-creation and the entanglement of such variables. This means that indeterminism is a direct consequence of the continued re-creation.

IX. PHYSICAL IMPLICATIONS OF RE-CREATION

There are several implications of the proposed re-creation scheme described above. Some of these implications may be used to test the theory. However, because of the mostly technical nature of these implications, I will only provide an overview of those implications at this stage. The full technical treatment of these implications might be presented elsewhere.

A. Macroscopic quantum states

The re-creation frequency can be affected by external field of force. Since it is known from the theory of general relativity that any time duration for an event occurring near a gravitational field of force is dilated by a factor proportional to the strength of the field then one should expect that re-creation periods are to be dilated once being in the vicinity of a strong source of gravity, e.g., a compact astronomical object like white dwarfs and neutron stars (see for example, [20]). Consequently, re-creation frequencies should be red-shifted once being in the vicinity of a strong gravitational source. This means that macroscopic classical processes would turn to exhibit quantum features once being in a strong gravitational field. This will cause the appearance of macroscopic quantum states in such regions, e.g. near the event horizon of black holes.

B. Quantum coherence

Coherence is one basic feature, which is realized in quantum systems, and it is customary known that coherent systems are quantum systems. Such systems are always featured with high efficiency e.g. lasers. The availability of macroscopic quantum state may make it plausible to expect the occurrence of macroscopic coherent states too, thus opening the way to understand some very obscure phenomenon like the gamma-ray bursts which are known to occur at the far rim of the universe. Beside this the re-creation postulate allows for a new definition of coherence by which two systems can be considered coherent if their re-creation frequencies are identical and their re-creation occurs in the same phase.

C. Quantum Zeno effect

This is a very interesting proposal, which was suggested by Misra and Sundarshan [21] in 1977. The proposal is based on the notion of wave function collapse and was considered to be a prediction of the collapse interpretation. The idea is that if continuous measurements are carried on a given state, then the system is expected to stay in that state because of the continuous collapse of the wave function onto the same state. As they say, a watched pot never boils. There was a claim that this prediction was verified [22], but such claims were soon refuted [23]. Recently some more rigorous calculations have been done trying to

present the quantum Zeno effect (QZE) quantitatively in more accurate form taking into consideration the effect of the measurement duration [24]. The re-creation interpretation presented in this paper sets an upper limit for the measurement time for the QZE to be possibly verified. The measurement time of observable (say transition energy) should be less than the re-creation period for the QZE to occur. Measurements performed within time durations, which are more than the re-creation time will result in averaging the values of the observable over several re-created states and consequently cannot hold the system at a specific state, consequently QZE will not be verifiable in such cases.

X. DISCUSSION AND CONCLUSIONS

The scheme proposed in this paper for the interpretation of quantum indeterminism offers a scope that allows for an objective ontology of the physical world besides the possibility of being undetermined. Such a scheme is more realistic and more consistent than the observer-dependent interpretation that is implied by the von Neumann and the Everett-Wheeler interpretations. The re-creation scheme is free of the known paradoxes of quantum measurements like Schrödinger's cat and the EPR since it does not consider a subjective role for measurements or a wave function collapse. The scheme presented exhibit a natural presence of entanglement of states belonging to the same system. This is the direct effect of the re-creation. Moreover, this scheme resolves the statistical nature of quantum mechanics by allowing the statistical distribution of the possible values that an observable might take to fall within the natural process of continued re-creation of that observable.

It is important to note that the above scheme will not affect the standard calculations of quantum mechanics, except that it might motivates new investigations into regions which are until now have not been excavated by mainstream research works. Examples of these are the existence of macroscopic quantum states and the possibility of understanding the gamma ray burst being a result of some macroscopic quantum processes taking place under very specific conditions deep in the universe. However, the proposed scheme here is by no means complete and is open for further development.

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