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# Darwinian Evolution and Quantum Evolution are Complementary: A Perspective

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## Abstract

Evolutionary biology has fascinated scientists since Charles Darwin who cornered the concept of natural selection in the 19th century. Accordingly, organisms better adapted to their environment tend to survive and produce more offspring; in other terms, randomly occurring mutations that render the organism more fit to survival will be carried on and be transmitted to the offspring. Nearly a century later, science has seen the discovery of quantum mechanics, the branch of mechanics that deals with subatomic particles. Along with it, came the theory of quantum evolution whereby quantum effects can bias the process of mutation towards providing an advantage for organism survival. This is consistent with looking at the biological system as being a product of chemical-physical reactions, such that chemical structures arrange according to physical laws to form a replicative material referred to as the DNA. In this report, we attempt to reconcile both theories, trying to demonstrate that they complement each other, hoping to fill the gaps in our understandings of the versatility of the mutational status of the DNA as an essential mechanism of life compatibility.

**Keywords**: Darwinian evolution; Quantum evolution; Mutations

## Introduction

In recent years, it has been suggested that quantum mechanics/physics/entanglement "with all its weirdness" not only belongs to the sub-atomical world that explains the physical universe; but is also involved in the persistence and the evolution of the biological system.

The smallest units that form everything in our universe are referred to as "strings of energy". These strings vibrate in 10 or 11 dimensions, and it is the combination of the different vibrations of these units that is responsible for the differential appearance of existing entities. Whether the latter are biological or non-biological systems, living or non-living systems, their essence would be the same, and they would thus follow and obey similar physical regularities/laws.

This is consistent with looking at the biological systems as being products of chemical-physical reactions. In such a context, the chemical structures arrange according to physical laws to form a replicative material referred to as the DNA (a specific form of vibrating strings of energy), making up what we refer to as biological systems. The latter can eventually arrange in different ways, and at times, end up forming living organisms, which range all the way from bacteria to human beings.

## Darwinian theory of evolution

The Darwinian theory of evolution, one of the best and consistent theories that humans discovered, suggests that DNA mutations occur randomly, and that those that provide an advantage "status" to the living organism subsequently prevail in the successive generations; this is referred to as natural selection. On the other hand, harmful DNA mutations are lost because organisms acquiring them cannot form a suitable equilibrium with their environment. Therefore, their chemical material cannot persist in the intricate living form, and will thus transform back into a simpler chemical form that will return back to nature, and get integrated again into other living or non-living beings. This is how the strings of energy vibrating together in what resulted in a given living being, will break to form a new stable form and become part of it across other structures in our universe. Recently, few biologists and physicists challenged the theory of evolution claiming that the quantum theory better describes evolution than the Darwinian one. We will try hereby to explain that both Darwinian and quantum theories are simply addressing the same concept yet in slightly different languages. This apparent schism in apprehending evolution is not surprising since scientists at times differentiate between biological and physical systems, and forget that both are simply strings of energies vibrating and the differentiation between them is semantics.

## Quantum theory of evolution

At the subatomic level, Newtonian/classical physics breaks or at least "apparently breaks" and "reality as agreed on" follows quantum physics. At that level, quantum particles can be anywhere in space until they are "observed" or measured. Quantum particles exhibit wave-particle duality that could be affected by whether there is a conscious observer or not [1-4], such that there is no independent observer because the presence of the observer can exert an effect on the experiment, "or at least apparently so". Thus, it seems that absolute reality is "merely an illusion albeit a persistent one", as described by Einstein himself, and could only exist if there is an observer, and thus we refer to the term common reality "as observed by humans" when describing reality. This was clearly demonstrated in the double slit experiment whereby light was shown to exist as both a wave and a particle, assuming either property depending on whether it is measured. As such, when observed, light will unfold as a particle and when not observed it will act as a wave function [1,5,6]. This was the basis of one the most famous debates between two of the greatest minds in the history, Einstein and Bohr [7]. Einstein could not settle to the fact that reality cannot be determined until measured, and accordingly reality should exist even if not observed. On the other hand, Bohr considered the probabilistic nature of certain values to be the basis of reality, meaning that one could not determine the exact position of a particle, yet one could predict

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the probability of finding a particle at a given point. It is important to remember that human beings are also strings of energy vibrating in particular ways leading to human beings, and with it the development of consciousness which allowed us to be aware of our existence, and the subsequent quest to understand ourselves and the universe. In other words, we are forms of a vibrating energy trying to understand itself, and other forms of vibrating energy, and therefore we are part of the system itself and cannot be absolutely independent observers.

### Quantum entanglement

The debate between Einstein and Bohr led to the more intriguing enigma: quantum entanglement [8,9]. Quantum entanglement suggests that two particles that have come in contact with each other for some time become connected to each other, no matter how far they are separated by distance and time. Using the principle of Heisenberg uncertainty, Bohr suggested that two entangled particles act as follows: the moment you measure particle 1, a message in some way is sent to particle 2 immediately. For instance, if the sum of particles 1 and 2 is blue and green, then as soon as you measure particle 1 and it exhibits one color, particle 2 will immediately get the message and exhibit the other color [10,11]. This phenomenon was very disturbing to Einstein because it suggested that a message could be sent at a speed faster than light and he described this phenomenon as "spooky action at a distance". Later, Einstein in collaboration with two other scientists, Podolsky and Rosen, arrived at a conclusion, suggesting that particles 1 and 2 are pre-determined, that measurement of particle 1 has no effect on particle 2 and that the nature of the particles is determined at the point they become connected. For instance, one could imagine that particles 1 and 2 are like a pair of shoes, such that if particle 1 turns out to be the left pair, automatically particle 2 will turn out to be the right pair; and therefore, in such a case, there is nothing "spooky" about the phenomenon. The Einstein-Bohr debate could not be settled at that time because there were no means to perform decisive experiments. In 1964, Bell a theoretical physicist, wrote a formula that carried with it the hope to settle the Einstein-Bohr debate [3,12-14]. Experimental physicist Clauser and later Aspect designed experiments that showed that Bohr's hypothesis was the valid one [2,15]. Physicists cannot explain why things are that way, yet they recently are trying to reconcile both the quantum mechanics and relativity theories in one equation as both, each separately describes the world accurately but the problem happens when trying to combine them "apparently because of our gaps in fully understanding the picture". A potential equation that may reconcile both is ER (Einstein-Rosen bridges also known as wormholes) =EPR (E=Einstein, P=Podolski, R=Rosen). This equation suggests the existence of wormhole (short cuts in space) that link distant entangled particles in space through short cuts and thus what seems to be traveling faster than speed of light is our inability to see the shortcuts taken by the particles [16].

## Reconciling the Darwinian and Quantum theories of evolution

Biological systems are the living counterparts of the physical universe and are also made up of molecules, atoms and subatomic structures, and strings of energy and therefore should obey the same laws/regularities of quantum physics and relativity. A couple of decades ago, it was suggested by some biologists and physicists that quantum mechanics may play a substantial role in the biological systems, and in sustaining life [16]. We believe that people that way, would be splitting hairs, as both points of views represent a continuum in the evolutionary process and it all is consistent with the current Darwinian evolution point of reference.

As apparently opposed to classical Darwinian evolution, which states that mutations occur randomly and that those that provide advantage to an organism persist while the harmful ones perish with the death of the organism, quantum evolution suggests that mutations can occur in a somehow skewed fashion as to provide advantage for organism survival. Proponents of the quantum evolutionary theory suggest that at the quantum level, similarly to the wave-particle superposition concept, the DNA (made up of atoms and subatomic particles) is also held in a superposition of states, which eventually unfolds in a mutation that is "helpful" to the organism [16,17]. McFadden showed that mutations in mycobacteria were happening more than what would be attributed simply to chance. Yet this is consistent with the Darwin's theory of evolution because when looking at organisms that persisted throughout evolution, it would be natural that these organisms are best fit to the physical laws of the universe and thus are better able to adjust (DNA physical change/mutation) with the environmental changes as opposed to the ones that went extinct. Therefore, any form of existence that carries the ability to conform to new situations will continue to exist, while those that cannot will be lost. Thus, helpful mutations implicate the ability of living organisms to adjust and persist in harmony with the physical existence. We can therefore imagine mutations as being a change in form of an existing organism, occurring at the level of the DNA, to maintain the equilibrium of existence between itself and the surrounding physical world.

A subset of the classical Darwinian evolutionary biologists, find the quantum evolution somewhat disturbing. Yet, we believe that classical evolution and quantum evolution are complementary and the differences are mainly due to semantics. Examples of how quantum physics helped explain some basic biological mechanisms of adaptation and species survival are numerous and include, but are not limited to, the world of enzymes and immune reactions in multicellular organisms, not to forget the world of antibiotic resistance in small organisms like bacteria. For instance, enzymes, proteins essential for survival, can facilitate chemical reactions to occur in seconds or fraction of seconds, instead of what would otherwise take up to years should they occur spontaneously. It was recently shown that enzymes can catalyze such reactions at great speeds, in a teleportation like phenomenon termed quantum tunneling, whereby electrons and protons vanish from one place only to suddenly reappear at a second place where it is needed, and by skipping all other places in between [18,19]. This same phenomenon also occurs in the most important chemical reaction that made life possible on earth, photosynthesis. Chlorophyll will absorb the sunlight and convert it to chemical energy with tunneling of the electrons and protons leading to nearly 100% efficiency in converting sunlight to other energy [20,21].

Evolution and survival implicate, however, persistence of the stable and existence in harmony with the changing situations. It follows that the current existing mechanisms such as the enzymatic activity and photosynthesis reactions along with their underlying quantum phenomena, represent the default status of a balanced existence in a universe with apparently defined physical properties and constants. Wormholes and the recent equation ER=EPR can clearly explain the current unfolding of the superposition phenomenon and is consistent with the Darwinian theory of evolution.

A simple example to clarify the concept is to consider the following: you are performing an experiment whereby you get several hundreds of different kinds of ants, each of which performs specific functions which are slightly different from each other. The second step in your experiment consists in creating a huge chamber with a set of specific physical laws governing its environment (resembling a small universe).

At that point, by probability, most of the different ants will die and only a small number, those that conform to the physical laws of that chamber, will persist and these will subsequently reproduce and populate the chamber. Thus, this specific universe, by definition, favors the existence of the specific living organisms that have the ability to adapt and stay in equilibrium with the surrounding environment.

Thus, during the process of evolution, atoms were bond together forming longer chains, leading to molecules, and subsequently to "living forms or systems" starting from bacteria and progressing to more complex forms. The different groupings of atoms that ultimately provided a better equilibrium with the universe persisted, and this in turn led to more complex forms of atom groupings with similar characteristics, such as enzymes for instance, and at the end of the spectrum, life forms which carry within them the basic structures providing harmony between the environment and such kind of existence.

McFadden studied the less complex form of existence (bacteria), which generally have the better chances for survival as it will need less adjustments (helpful mutations) as compared with more complex forms, when the surroundings change. Therefore, it is not surprising that the oldest form of existence, bacteria, still persists while 99% of species that existed earlier in time could not adjust to sudden and dramatic external changes. This phenomenon supposedly occurs less frequently with more complex life forms as the DNA system becomes more complex (infinite number of strings of energy vibrating together to form a stable organism). Yet this phenomenon is not unusual: the simpler an organism, the less systems it contains, and thus when environments change it is easier for this atomic complex (we call life) to adjust (we call mutations) to the changing physical states as to remain in harmony with the changing environment. As such, the ability of simpler organisms to readily adjust (via mutations) to changes in the environment has favored their persistence in the world as compared to more complex forms. This ability to rapidly adjust via frequent mutations provides by itself an advantage to the organism, and it is no surprise that the capacity for high frequency of mutations has persisted in the simpler forms throughout the infinite number of changes in the environment. The probability of helpful mutations happening will thus surely be higher than chance alone as it is the very reason why simpler systems have persisted so far, as we are talking about the organisms that have persisted millions or even billions of years. This ability for frequent mutations has rendered simpler systems more dynamic in the face of a constantly changing universe. To simplify the issue, here is the following example: imagine you initially have a class with 10,000 students with a class average X on the physics exam. You subsequently choose the top 50 students among the class and the new average of this class will be higher than X. Additionally, this new class will be able to better adjust to the higher difficulties of subsequent exams as these members were the more distinguished "built to survive the present environment". Therefore, when we look at one point in time and observe mutations occurring higher than just by chance in certain organisms, we need to remember that these kinds of organisms have survived millions of years and were selected for, as compared to others, by the physical laws of the universe and thus, are better able to adjust (beneficial mutations) for new changes in the environment. All this is consistent with Darwin's theory of evolution.

The probability with more complex organisms is understandably lower since these forms are made of more complex atomic states and thus the probability of all these systems within the same organism to harmonize with the new state becomes less and therefore such organism may go extinct if sudden dramatic environmental changes occur.

## Results and Discussion

To simplifying things again, let's consider the ants that survived in the chamber. The kind of ants that persisted had in fact, at the beginning features consistent with the quantum theory, which allowed them in a default status to be in equilibrium with the surrounding physical world. Later, and according to Darwin's theory of evolution, mutations in such organisms will occur randomly and those that are beneficial will persist. Over a long period of time, all these beneficial random mutations accumulated and persisted leading to a system, which in its whole, also exhibit features of quantum evolution. Going back to the example of photosynthesis, whereby the rapidity of the reaction has been attributed to quantum tunneling; this successful reaction most likely arose through the accumulation of random beneficial mutations following Darwin's theory leading ultimately to a system that obeys the laws of quantum entanglement/evolution theory. Thus, photosynthesis is not a mechanism that started the way we observe it currently; on the contrary it was a progressive phenomenon.

Another example would be that of the flagellum. This highly complex molecular machine is similar to that of photosynthesis. The flagellum appears to be so intelligently designed that it would be difficult to believe that such a structure could have developed progressively via random mutation and selection. However, this structure developed progressively and has had different functions throughout evolution, and it has been suggested that the flagellum was originally a protein export system. With time, this latter might have been modified (via random beneficial mutations) as to allow bacteria to attach to a surface by extruding an adhesive filament. This same structure is also believed to have been altered (via random beneficial mutations) to form an ion-powered pump for expelling substances from the cell might, setting the ground for a rotary motor. To summarize the flagellum history encompasses millions of years through which the structure had different functions with the function progressively changing based on beneficial mutations that render the organism more fit to survival, with the most beneficial structure at the current stage of evolution being the motility provided by the flagellum [22,23]. Hence, accumulation of a huge number of random beneficial mutations following Darwin's theory provided the bacterium progressively throughout evolution different advantages that all culminated into providing motility to the bacterium which further gave it a greater advantage over non-motile bacteria. So, what might seem to have been solely the product of quantum evolution is also the product of Darwinian evolution slowly occurring throughout a long stretch of time.

Abdurakhimov et al. have recently shown an overlap between the quantum and the classical world when studying the interactions of light (electromagnetic fields) and matter (electrons) [1]. Rabi splitting of eigenfrequencies of the coupled motion is observed both in the cavity reflection spectrum and ac current of the electrons, the latter probed by measuring their bolometric photoresponse. Even though similar observations of Rabi splitting in many-particle systems have been described as a quantum-mechanical effect, they show that the observed splitting can be explained completely by a model based on classical electrodynamics. This finding further confirms that "most likely" all the present systems in our universe represent a continuum of a similar process and discrepancies we face are due to the lack of our complete understanding of the full picture.

## Conclusion

In this review, we have depicted a new angle on the persistence and the evolution of the biological system. To sum up, our biological system, which is merely the product of chemical-physical reactions,

whereby its chemical structures arrange according to physical laws to form a replicative material, referred to as the DNA. We have attempted to demonstrate, that the Darwinian theory of evolution; which suggests that DNA mutations occur randomly and that those that provide advantage to the living organism subsequently propagate in the successive generations; and the Quantum evolutionary theory; whereby quantum effects can bias the process of mutation towards providing an advantage for organism survival; are along a continuum. Future experiments will determine whether Darwinian and Quantum evolutionary theories could be combined and complement each other to fill the gaps in our understandings of the versatility of the mutational status of the DNA as an essential mechanism of life compatibility. Finally, it is of utmost importance to remember when talking about evolution that we live in a universe with specific physical laws and that we cannot separate the biological system from the physical one, as they are all part and parcel of a same entity.

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