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Brain's classicality conception of the universe

Abstract

The article discusses the challenges posed by the revelations in physics, particularly in the realm of quantum mechanics, and the questions they raise about our perception of the world reality. It highlights the incongruity between the diffusive, indefinite nature of the quantum reality at the foundation of existence and our experience of a single classical reality. The need for a universal transition or reduction from quantum to classical reality is emphasized, with the mention of challenges related to observer interference and the complications introduced by the objective collapse theories. The interpretation difficulty of quantum-to-physical reduction, along with the reliance on ad hoc collapse theories, is acknowledged. The work introduces the theory of decoherence as a valuable tool for interpreting quantum states during measurement collapses. It proposes a novel approach using the concept of decoherence in the context of universal wave function density matrices. The focus is on entanglement between three major quantum subsystems: mass particles, massless particles, and the human body-nervous system. This entanglement forms a "Von Neumann chain" of correlated systems, where ignoring one system renders the other two entangled in mixed states. The proposed scheme suggests that, through statistical selection based on survival patterns of the brain, one alternative state is chosen, influencing the state of the massless (environment) subsystem. The entanglement between the two systems results in the classical appearance of the chosen alternative in the stream of consciousness. Importantly, this approach removes the role of the autonomous mind (consciousness) from the process while addressing some of the earlier mentioned requirements. In conclusion, the scheme affirms that the universe, despite our conception, remains fundamentally quantum and has never transitioned to classicality. It posits that the universe evolves according to the deterministic dictates of a presumptive relativistic universal wave function.

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Introduction

It is scientifically theorized that the very early events of the universe, regardless of the nature of the related processes of the Big Bang,[1,2] rendered the development of its quantum fields, and a soup of plasma of quantum particles (comingled disturbances in these interacting fields), consisting of only photons and quarks.[3] From this beginning, so far as it is established, the fundamentally (microscopically) quantum mechanical universe, with the physical (classical) appearance we perceive, has emerged. It is noteworthy that the question of reality of the world we perceive has always haunted our predecessors throughout history, this is reflected best in Plato's "other world"[4] and the "cave allegory";[5] and in philosopher Kant's statement of about the reality of "things in themselves";[6] as well in the suggestion of some contemporary philosophers that the universe altogether is a computer simulation;[7,8] a virtual reality. It is somewhat bewildering that the very nature of the quantum universe also imparts such doubts. This is because of the strangeness of its constituent particles. The quantum particles have multimodal indefinite existence (different characteristics and difference locations); all with a certain chance,[9] the states of which represented by a wave (packet) function,[10] which evolves according to the Schrodinger's (diffusive) wave equation. Despite the fascinating revelations of these mind-boggling secrets of nature and the numerous grounds on which quantum mechanics theory has been proven, and having served as the engine of modernity, it has failed in revealing the "quantum to-physicality process," which is responsible for the physicality (classicality) experienced at all levels, from the very laboratory proofs of its theoretical robustness, to that of the universe. There are also a few other misgivings in this filed, essentially the problem of non-locality (violation of special relativity) and integration with the theory of relativity. Physicist Paul Davies, in a recent presentation,[11] categorizes all concerns of the field under the topic of "open question (minutely rephrased) of quantum mechanics" as follows:

1) Is everything quantum?
2) Does quantum mechanics have a restricted range?
3) Is quantum mechanics an effective theory to be replaced?

However, considering the validity of the quantum theory, proven in many quantum physics experimental observations and applications, it is very likely to be complemented by future discoveries. Regarding the puzzle of the quantum to-physical transition (reduction) process," the first major idea has been the Copenhagen interpretation.[12] This theory mainly addresses the interpretation of measurement of microscopic quantum systems, by an agent, which in quantum lingo is expressed as the collapse of the quantum particle wave function, from its objective indefinite state into a definite objective state. This approach suggests that the boundary between quantum and physical reality is extended to the experimenters mind, enabling him to probe quantum reality for its perceived classicality. The interpretation, aimed at resolving what was referred to as the "measurement problem," faced apprehension in the physics community, reflected in the aphorism of "shut up and calculate."The Copenhagen interpretation was mathematically formalized by the well know physicist Von Neumann,[13] where a procedure called" process 1" accounts for the reduction. And the theorized process purports a link between two realms; the mind (consciousness) and physicality, which is behind the reduction process. The role of the consciousness in the quantum to-physical reduction was also alluded to by the Nobel laureate Physicist Wigner[14] in the following statement:

"that the consciousness of an observer is the demarcation line that precipitates collapse of the wave function, independent of any realist interpretation."

Physicist Stapp[15] in reviewing earlier works, while emphasizing the role of the consciousness, point to its elusive nature in the following statement, which nonetheless imparts a hint of doubt

about the autonomous mind (an agency that even its denier have an impression of having):

"At the pragmatic level it is a "free choice," because it is controlled, at least in practice, by the conscious intentions of the experimenter/participant, and neither the Copenhagen nor von Neumann formulations provide any description of the causal origins of this choice, apart from the mental intentions of the human agent."

In a further description of Von Neumann's formulation, Stapp explains process 1 dynamics in the realm of ontology akin to Descartes' psycho-physical dualism. A further modified version of the orthodox quantum mechanics is called Von Neumann/Stapp approach,[16] in which supplemental processes are added; a "process 3," where Nature accommodates the choice considered in the process 1. Nonetheless, "the choice" as a consciousness event still plays critical role; the role of the autonomous mind. However, the existing consensus in contemporary (if not contingent) philosophy, and modern neurological and hard sciences, regarding the (absence of) free will, sees consciousness in different light: It is pointedly reflected in a statement by Zurek,[17] in the context of the realization (transition) of classicality from the quantum reality, in the following statement:

"Moreover, while the ultimate evidence for the choice of one alternative resides in our elusive 'consciousness,' there is every indication that the choice occurs much before consciousness ever gets involved and that once made, once made, is irrevocable."

As may be noticed, the statement suggests that consciousness is seemingly at the receiving end of the choice made by the brain, meaning that the choice is rather a physical (neural) phenomenon that happens in the brain and later is mapped into the stream of consciousness. Works of Libet,[18] and similar studies, are the likely basis of the above understanding. Libet's work suggests the "choice" to be a "physical work of the brain." However, this work also addressed by Stapp.[16] in the context of the quantum mechanics formalism, suggesting that the quantum state of the brain is modified by sustained (rapid) "intention of the agent" and the "neural correlates of the brain;" still keeping the two processes that define consciousness. Stapp's work is an elegant, and possibly a tactful, effort to not leave the role of the "willful agent" out of the process of measurements of the quantum states by the developing link between two domains of mind and brain, as intension is sustained. The collapse theories were put in different light by the work of Peter Zeh.[19] who introduced the theory of "Decoherence." This theory attributes quantum wave function collapse to the loss of coherence as a result of entanglement with the measurement environment. Physicist Zurek in his elegant paper regarding the subject.[17] demonstrated the process very clearly in an example. These works[17,19] have provided a basis for the understanding of some of the fundamental aspects of the "quantum-to physical transitions," and possibly even the second law of thermodynamics. However, important role of this agency of the mind appears also in the advance reduction theory of "Decoherence" authored the physicist Peter Zeh[19] as pointed out follows:

"*Accordingly, it is the observer who "splits" indeterministically—not the (quantum) world."*

Given the mystical aspects of collapse theories, a critical appraisal is warranted. If "the physical world is real," claiming that life had anything to do with it is out of bound of science. Therefore the only course for its emergence needs to be sought either in the "Everetian approach" or the "objective collapse theories," hoping that future work can provide them with what science requires for their validity; However, in case science is unable to account for a real world, the recourse is to make it a construct of the human brain in which wave function collapses, one way or other.

So far, this work of the brain is attributed to its abstract agency of the mind, "the consciousness" which is understood to be what defines (at least) humans who can intend and make choices. Perhaps this possibility can be extended to life in the earliest form, as it appeared in our planet, since almost all creatures most likely have a measure of it? However, from the perspective of the scientific consensus for the computational brain, the transition (reduction) of quantum to-physical has to be considered as an event of the brain and, for that matter, a computational output. This is in the face of the fact that regardless of its genesis, the classical universe we perceive is a brain simulation based on that our encounter with all that is external to our system, is through the electrochemical signals the brain receives, and what the computational brain makes of it. This connotes a materialistic view[20–22] in which causality is behind all dynamical processes of the brain and there is no room for choice; thus the perceived classicality of the universe is the result of computations in our autonomous nervous system (a matter entity).

The belief in the Psycho-Physical duality, of whatever extent, points to the possibility that the "impressions of the mind's autonomy" have their survival correlate in the brain, allowing (animate) beings to feel the ability to "will" despite the irony of inability to "will to will".[23] Regardless, the collapse of the wave function (however it happens), and consequent brain computations are needed to create our classical world. In all anthropocentric theories of collapse (involving autonomous mind or autonomous brain), the "prompting of the choice," like other life secrets, has its roots in predicates of survival. The "problem of measurement," becomes even more challenging when considering quantum to-physical reduction at the universal scale. It can be approached more suitably in the context of an evolving wave function for the universe, allowed because of the early quantum beginning of the universe. The idea of the "universal wave function" was suggested by DeWitt[24] and thoroughly pursued by Everett.[25] As in the case of simple quantum systems, this function would stand for many indefinite alternatives, in this case universes, which is hard to reconcile with our classic universe, given that universe is a closed system with no external observer. The insufficiency of the collapse theories has served as motivation for seeking another approach to the realization of classicality. The work I present here is a hypothesis of reduction that leaves the universe all together in quantum state and yet accounts for the classicality we perceive, without resorting to consciousness or autonomous mind. This approach of "quantum-physical dualism replaces the "Psycho-Physical" dualism, allowing the evolution of our universal quantum existence despite humans' experience of its classicality. Additionally, it would put to rest the possibility raised by Stapp[15] that the human personality may survive bodily death.

Finally is important note that collapse theories serving no critical purpose in quantum mechanical computations; they are in realm of philosophy of science.[26] What ails them, to repeat, is the ad hoc nature of the quantum to-physical reduction process they embed, for which "there is no law or rule as to how it happens".[17]

The Theory

I begin this work with the common presumptions that the universe, of which we are a part, is physical (classical) and that it has originated from a very early quantum plasma entity. Also this classic world nonetheless has remained, at least fundamentally (microscopically),

quantum, defined by the Standard model of elementary particles. This theoretical perspective of the quantum universe is defined by Von Neumann accordingly as:[13]

"...quantum theory is a formulation in which the entire physical universe, including the bodies and brains of the conscious human participant/observers, is represented in the basic quantum state, which is called the state of the universe."

The quantum state of universe can be formulated in the context of a hypothetical relativistic universal wave function, justified based on the quantum beginning of the universe which governs the evolution of the quantum state of the universe. This function, the beholder of many objective indefinite alternatives--the hypothetical solution to the fundamental law of quantum mechanics, the Schrodinger's equation--would describe the (wave Packets) density distributions of every particle in the universe. Approaching the problem of the genesis of the classical world from the perspective of a universal quantum wave function offers possibilities for resolving the underlying puzzle of reduction, unburdened with the problems of involving consciousness in the collapse process. Of course, we cannot disregard the possibility of an autonomous collapse as was suggested by one of fathers of the quantum mechanics, quoted by Stapp,[15] in the following:

"---- Heisenberg introduced the Aristotelian concept of "potentia", and regarded the quantum mechanical state of a system to be not only a compendium of knowledge about what has happened in the past, but also a "potentia"---an objective tendency- --for this evolving quantum state to abruptly collapse to a reduced part of itself. These reductions are needed to keep cutting back the otherwise expanding continuum of possibilities created by the Schrodinger-equation-based temporal evolution of the quantum state to the part of itself that is compatible with our collective human experience."

This philosophical statement considers autonomous reduction to be inherent in the nature of the quantum state of the universe, but of course, work is needed to develop quantum formalism for it; such efforts are progressing as indicated in the introduction. One important aspect of the formalism of the universal wave function is to note that the quantum system of the universe is likely to have been configured into an infinitude of clusters early on due to interactions among the particles, rendering the distribution of the masses (inanimate and otherwise) we perceive in the universe. This may imply that the universal wave function would entail infinitude of indefinite objective alternatives in the mass clusters, while holding equally likely distribution for the non-interactive massless particles in their domain. This condition is best represented in the formulation of density matrix-- an alternative way of representation of the probabilistic states of quantum systems-- for the whole system or different segments of it. On such conceptual basis, I explain the classicality of the universe we experience in the context of the density matrices of the tri-segment (subsystems) partition of the "pure quantum system of universe," forming a "Von Neumann chain" of correlated systems. Ignoring (tracing over, in mathematical lingo) the density of one very complex segment "leaves "mixed states" for the other two, each in "statistical correlation," -- similar to results of applying "Von Neumann's non-unitary process 1" between two subsystems-- to be selected by the impetus of survival, "a nature's choice".

In this layout the "two mixed quantum subsystems" under consideration, subjects of our perceptions, are the together cohered "massless (mainly photonic) system", and the "beings' nervous system," essentially the beings themselves. And from statistical correlation thus created among the many indefinite states of the body system, we perceive the one state that optimizes survival, which is selected per dictates of the reptilian part of our brains, which in turn selects between the statistical correlated indefinite states of the massless system.

Such selections render the states referred to by Zurek as pointer states.[17] This process may be regarded as collapse of universal wave function of the universe in our brains, while the universe, external to nervous systems of beings, remains quantum and the classicality is only brain's selection-creation process; a neuronal net computation driven by survival. The "brain's enforced selection of the photonic-phonon entangled system" we register provides the "corresponding information (via this subsystem) about the universal quantum reality (after all photons and phonons connect us to the rest)," upon which our brain creates the take of physicality (classicality) "reflected" in our consciousness (no role play for it). Consciousness, wherein the results of our conception of the decohered (collapsed) universal wave function of which we are a part, appears, is generally understood to be the mysterious facet of our nervous system; it's the mental domain. Philosophers of the past millennia and neuroscientist of the recent decades have been struggling to gain some insights into its nature, all to no avail, since it has remained for them mainly a "hard problem".[27] A review of new theories of consciousness can be found in.[21] A disruptive theory by Roger Penrose and Stuart Hameroff[28] suggests that consciousness arises from quantum effect in brain microtubules. However, the relationship of the quantum wave function collapse-- even if it happens in the brain-- to consciousness, has not been, by no means, been established. Nonetheless this theory, called Orchestrated Objective Reduction (Orch-OR) theory, which points to autonomous reduction in the brain, indirectly and partially, supports my work. However, in some circles of thinkers it is "res de nihilo;" and in my opinion, is easily explainable in the context of the system theory,[21] which regards "consciousness as nervous system (intelligent computing machinery) output in response to the sensory stimuli," through the activation of the motor neurons in certain ways; bodily movements or silent uttering of thought or simpler version of it, which is vocalization; they have always been taken as evidence of consciousness. This line of reasoning, though sounding strange, is in accord with the idea that all occurring event in a system can be regarded as the result computations of its governing physical laws, the system specifications, and the nature of stimulation by physical processes.

In essence, it is mainly our nervous system entanglement with (mainly) photons and phonons, which through their coherent engagement with the massive subsystem of the quantum universe, stimulate our brains and contribute to the rendering of classicality. Heuristically, it can be suggested that our universe is fundamentally the quantum photonic segment that fills the empty appearing space; the domain of our senses. Decoherence of photon waves in our body's nervous system, where entanglement with quantum reality occurs, leads to the "appearance" of our consciousness agency "splitting the quantum universe" to create the classicality necessary for survival. The coherent state of our measuring quantum systems, essentially those of our brains, and the photons and phonon, is what remains after ignoring the mass environment.

Conclusion

The provided passage explores the challenge in physics to understand the transition from the early post-inflationary universe, characterized by plasma of quantum particles, to the classical macroscopic world we perceive. This transition remains an unresolved issue in physics, presenting two potential avenues for resolution: meeting the sound requirement for an observer, absent in the initial

closed quantum systems of the universe, or finding an autonomous process to facilitate the transition. Both approaches face major hurdles that need to be overcome.

This work, inspired by the concept of decoherence, suggests a hypothesis that leaves the quantum reality of the world intact, which may also help resolving some of quantum mechanics shortcomings. The hypothesis involves considering three coherent quantum subsystems that collectively form the entire pure quantum system of the universe. These subsystems include the animate quantum medium (beings' nervous system), the massless quantum medium (mainly photons and phonons), and the external quantum mass particle system of the universe. This division, forming a "Von Neumann's chain,"[17] allows the density matrices of the first two subsystems can be obtained by ignoring (tracing over) that of the third one. This operation results in the body-nervous system and the photonic-photon systems becoming statistically correlated (mixed quantum) subsystems, subject to selection forces driven by survival instincts, the work of the "autonomous brain;" not the "autonomous mind". This process, in turn, creates the illusion of a classical world.

Acknowledgments

This work is inspired by a publication of Zurek,[17] which addresses the eventuality of triply entangled system, where the density formalism of the quantum states of these systems allows for the development of mixed state for two, by ignoring the third, without resort to Von Neumann's process 1.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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