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Cognitive Quantum Tunneling in Belief Alteration

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Abstract

The present research revisits the boundaries between quantum mechanics, biological systems and the cognitive structuring of beliefs, taking as a pillar the theoretical propositions of Amit Goswami's monistic idealism. The primary scope lies in articulating how the counterintuitive behaviors of subatomic physics provide a non-dualistic framework for phenomena previously restricted to spiritual and philosophical thought. Methodologically, an integrative analysis of the seminal works that postulate the primacy of consciousness was carried out, juxtaposing them with recent empirical findings in the fields of quantum biology and neuroscience. The evidence collected indicates that the occurrence of quantum tunneling in organic environments—notably in enzyme activity, photosynthetic pathways, DNA dynamics, and microtubule architecture—provides a viable material infrastructure for high-order cognitive processing. It is argued, as a central thesis, that belief matrices operate as conditioned quantum configurations in the neural network. Consequently, its profound modification requires cognitive tunneling mechanisms, inducing "quantum jumps" that break with the prevailing perceptual patterns. In this arrangement, the creative faculty acts as the vector that makes this transition possible, attenuating the resistance of consolidated beliefs and opening access to a non-local spectrum of potentialities. It is concluded that the synthesis between Goswami's cosmology and Hameroff and Penrose's microtubular theory erects a solid epistemological model, in which consciousness acts as an orchestrator of phenomenal reality, substantially altering our understanding of the plasticity of beliefs and creative genesis.

Keywords.

Consciousness; Monist Idealism; Quantum Biology; Quantum tunneling; Creativity; Epistemology.

1. INTRODUCTION

The urgency of this paradigmatic reconfiguration is not restricted to the corridors of theoretical physics or molecular biology laboratories; it reverberates in the foundations of psychology, sociology, and human ethics itself. When reductionist materialism declared the universe to be a blind clock and consciousness a biochemical accident, it implicitly emptied human existence of teleological purpose. Ethics, under this lens, became a mere utilitarian social contract, and beliefs were reduced to evolutionary survival strategies shaped by natural selection. Monistic idealism, by restoring consciousness to the center of the ontological stage, not only resolves the mathematical paradoxes of quantum mechanics, but also offers a rigorous foundation for the rescue of existential meaning and moral agency.

This article is therefore structured as an epistemological bridge between avant-garde physics and depth psychology. The hypothesis of cognitive quantum tunneling, proposed here, should not be read as a poetic metaphor, but as a literal description of the biological mechanics through which the human mind interacts with the fabric of reality. If beliefs are quantum attractors and the paradigm shift is a leap mediated by tunneling, creativity ceases to be a marginal psychological phenomenon to become the very cog of conscious evolution. Over the course of the next few sections, we will

demonstrate how this hypothesis is supported by robust evidence and how it provides the key to unlocking the mysteries of neuroplasticity, insight, and human transformation.

The resistance of traditional academia to accept consciousness as a primary causal factor is not merely methodological conservatism, but the reflection of a deep ontological commitment to eliminative materialism. Philosophers of mind such as Daniel Dennett and Patricia Churchland argue that consciousness is merely a 'user illusion' generated by the computational activity of the brain, devoid of any independent causal power. This stance, known as epiphenomenalism, treats subjective experience as the smoke that comes out of a locomotive's exhaust: a visible byproduct, but incapable of altering the movement of the train. Monistic idealism and quantum biology, by contrast, propose that consciousness is not the smoke, but the machinist himself who selects the route on the probability rails of the universe.

The crisis of the materialist paradigm has worsened in recent decades due to its chronic inability to solve the 'hard problem of consciousness'. How can the electrochemical activity of neurons composed of nonsentient atoms give rise to the rich qualitative tapestry of subjective experience—the red of the sunset, the pain of a needle, the existential angst? The attempt to extract subjectivity from raw

objectivity is akin to trying to extract water from a stone. Monistic idealism dissolves this problem by inverting the equation: it is not matter that generates consciousness, but consciousness that generates the appearance of matter by collapsing the quantum wave function.

The conceptual architecture that underpins modern Western civilization has been meticulously forged on the premises of mechanism, a paradigm that, over four centuries, has cemented a worldview where the universe operates as a vast and callous clockwork mechanism. René Descartes, by formulating the irrevocable separation between *res cogitans* (the thinking, immaterial and unextended substance) and *res extensa* (physical matter, measurable and quantifiable), provided the necessary methodological charter so that the nascent natural science could investigate the physical world without the uncomfortable interference of theology or human subjectivity. This ontological cleavage, although fundamental to the empirical and mathematical advancement of physics and biology, established an unbridgeable gulf between the observer and the observed cosmos, exiling consciousness to an extra-scientific domain.

On the Cartesian foundations, Isaac Newton erected the monumental edifice of classical physics. The *Principia Mathematica* not only described the laws of motion and universal

gravitation but also instilled the conviction that the universe is strictly deterministic. In the Newtonian cosmos, if a superior intellect—Laplace's famous demon—knew the exact position and momentum of all the particles in the universe at a given instant, as well as the forces acting upon them, the future and the past would be completely delineated before his eyes. In this scenario of absolute predictability, free will, intentionality, and conscious agency have become mere illusions or epiphenomena generated by biochemical gears, incapable of exerting any real causation on the physical world.

The consolidation of this materialist realism imposed a severe restriction on human understanding of phenomena that escaped the Cartesian-Newtonian metric. Spirituality, deep belief formation, creative insights, and mystical intuitions have been gradually pathologized or reduced to random electrical discharges in the cerebral cortex. The premise of strong objectivity—the unshakable belief that physical reality exists in a defined, unalterable state, regardless of whether it is being observed—has become the central tenet of academic practice. The mind has been downgraded to the condition of a passive passenger in a biological vehicle blindly driven by the laws of thermodynamics and natural selection.

However, the dawn of the twentieth century brought with it a theoretical revolution that

would shake the very foundations of materialism. The introduction of quantum action by Max Planck in 1900, initially conceived as a mere mathematical device to solve the problem of black-body radiation, revealed that nature, in its innermost essence, is not continuous, but granular. The discontinuity of matter and energy was the first blow against classical intuition. Soon after, the formulation of quantum mechanics by giants such as Niels Bohr, Werner Heisenberg and Erwin Schrödinger unveiled a subatomic realm where Newtonian certainties dissolved into clouds of probability.

The Copenhagen Interpretation, led by Bohr, introduced the revolutionary notion that the properties of a quantum particle have no objective reality before they are measured. The principle of complementarity suggested that matter can exhibit both wave and particle behavior, depending solely on the experimental arrangement chosen by the observer. This realization that the agency of the observer is inextricably intertwined with the manifestation of physical reality was a lethal blow to strong objectivity. The universe ceased to be a passive stage and revealed itself as a participatory theater, where consciousness plays a fundamental role in the transition from potentiality to actuality.

The debate reached its apex with the EPR (Einstein-Podolsky-Rosen) paradox in 1935. Albert Einstein, vehemently resisting the loss of

determinism and locality, proposed that quantum mechanics was an incomplete theory. He argued that the idea of two entangled particles communicating instantaneously at a distance—what he called "spooky action at a distance"—violated the speed limit of light imposed by special relativity. For decades, this clash remained in the philosophical field, until the Irish physicist John Bell, in 1964, formulated a mathematical theorem that allowed empirically testing the validity of the *variáveis ocultas locais* defendidas por Einstein.

Subsequent experimental verifications, culminating in the brilliant work of Alain Aspect in 1982, and more recently confirmed by the 2022 Nobel laureates, have demonstrated with irrefutable statistical clarity that nature is fundamentally non-local. Entangled particles share an indivisible quantum state; Measuring one instantly changes the state of the other, even if they are light-years apart. This discovery not only demolished the premise of locality, but also pointed to the existence of a substrate of universal connectivity that transcends space and time, providing the physical framework for what millennia-old traditions described as the fundamental unit of existence.

Against this backdrop of paradigmatic fractures, theoretical physicist Amit Goswami emerged with an audacious proposition: monistic idealism. Goswami argued that the attempt to save materialism by adding

epiphenomena or emergent properties was doomed to failure. Instead, he proposed a radical inversion of the ontological hierarchy: consciousness, not matter, is the basic and primary substrate of reality. The physical universe, with all its particles and fields, is understood as a derivative manifestation, a set of quantum possibilities that are collapsed into tangible events by the intervention of observing consciousness.

Goswami's theoretical architecture offers an elegant and parsimonious solution to the 'hard problem of consciousness' formulated by David Chalmers. If consciousness is the raw material of the cosmos, the tortuous need to explain how subjective experience, qualia, and the sense of self miraculously emerge from inert arrangements of carbon, hydrogen, and oxygen disappears. Consciousness is not a product of the brain; The brain is actually the biological instrument through which universal consciousness processes information and experiences manifest reality.

Simultaneously with advances in theoretical physics, the empirical frontier of quantum biology began to provide the material evidence that subatomic phenomena are not confined to cryogenic laboratories or particle accelerators. The discovery that photosynthesis operates through quantum coherence, that enzymes use tunneling to speed up vital reactions, and that DNA itself is subject to quantum fluctuations in

its hydrogen bonds, has demonstrated unequivocally that life, over billions of years of evolution, has learned to tame and utilize quantum mechanics to optimize its survival.

It is at this point of intersection between Goswami's cosmology, von Neumann's quantum mechanics and quantum biology that this article is positioned. The primary objective is to investigate how these scientific findings require a complete reassessment of the nature of human cognition, with specific emphasis on the formation, maintenance, and alteration of deep-seated beliefs. If the brain operates in quantum regimes, beliefs can no longer be seen only as petrified synaptic pathways, but must be understood as matrices of quantum probability. The central hypothesis to be defended is that the true change of mental paradigm – the sudden insight and the conversion of beliefs – occurs not by mechanical wear, but by an authentic process of cognitive quantum tunneling, mediated by the faculty of creativity.

2. MATERIALS AND METHODS

The present research is characterized as a theoretical-analytical essay with bibliographic foundation. The documentary corpus was delimited around two complementary axes: on the one hand, the philosophical and physical premises of monistic idealism outlined by Amit Goswami, with emphasis on his seminal publications [1, 5]; on the other hand, the recent scientific production in the areas of quantum

biology, neuroscience and cognition, extracted from journals with a rigorous peer review process.

The methodological approach was based on a systematic analytical review, aimed at locating points of convergence between the theoretical formulation of quantum physics and the neurobiological bases of cognitive activity. The selection of data prioritized empirical research that links quantum events in organic environments — such as proton tunneling and the maintenance of electronic coherence — to decision-making dynamics, belief plasticity, and creative processes. The preservation of the conceptual integrity of the authors consulted was ensured, mitigating the risk of analog extrapolations that did not find support in the mathematical formulations of quantum theory.

The argumentative architecture was designed in five progressive stages: initially, the deconstruction of the materialist paradigm through quantum anomalies; then, the postulation of monistic idealism as a viable ontological foundation; later, the realization of quantum biology as the physical environment that enables such processes; the formal proposition of cognitive tunneling as a vector of mutation of beliefs; and, finally, the characterization of creativity as the bridge of access to the non-local reservoir of possibilities. This epistemological stance refuses reductionism in favor of an integrated system,

where conscious intention and subcellular dynamics act together in the reconfiguration of the cognitive apparatus.

3. RESULTS AND DISCUSSION

3.1. The Deconstruction of Materialist Realism

The depth of the disruption brought about by Bell's inequalities and Aspect's experiments cannot be underestimated. Prior to 1964, physics was divided between the Copenhagen interpretation, which accepted indeterminacy as a fact of nature, and Einstein's view, which believed that quantum theory was incomplete and that local 'hidden variables' would restore determinism. Bell's theorem turned this purely philosophical debate into an experimentally testable question. He set a strict mathematical limit to the degree of correlation that two particles could exhibit if they were governed only by local influences (limited by the speed of light). When Alain Aspect and his team measured the polarizations of entangled photons in 1982, the results unequivocally violated Bell's inequalities. The observed correlation between the photons was too strong to be explained by any classical communication mechanism. More recently, in 2015, loophole-free Bell tests conducted by independent groups in Delft, Vienna, and Boulder closed the last theoretical escape routes to local realism. The conclusion is definitive: reality, at its most fundamental level, is non-local. This non-locality implies that space is not an empty container where separate

objects exist independently, but rather an interconnected mesh where information can be shared instantaneously, providing the exact physical basis for the transcendent domain postulated by Goswami.

The deconstruction of materialist realism is not a mere rhetorical exercise in the philosophy of science, but a mathematical and empirical requirement imposed by the discoveries of quantum physics. Classical materialism was based on five non-negotiable ontological pillars: strong objectivity, causal determinism, strict locality, physical reductionism, and the epiphenomenalism of consciousness. The collapse of each of these pillars paved the way for the formulation of monistic idealism and for the quantum understanding of cognition.

Strong objectivity postulated that the physical universe exists in a defined, measurable state, completely independent of the presence of an observer. This view was fatally wounded by the problem of quantum measurement. In the rigorous formalism established by mathematician John von Neumann in 1932, the evolution of a quantum system follows two distinct and incompatible trajectories. The first is the deterministic and continuous evolution described by the Schrödinger equation, where the system exists in a linear superposition of all possible states. The second trajectory is the collapse of the wave function, a discontinuous,

nonlinear, probabilistic event that occurs at the exact moment of measurement.

The central dilemma pointed out by von Neumann, and later deepened by Eugene Wigner, is that any physical measuring apparatus, being composed of atoms, should also obey Schrödinger's equation and, therefore, enter into superposition along with the measured system. To stop this infinite regression of superpositions (the so-called von Neumann chain), the intervention of an entity that is not subject to the laws of material quantum mechanics is necessary. Von Neumann concluded, mathematically rigorously, that this entity could only be the non-physical consciousness of the observer. The act of conscious observation is thus the causal agent that forces nature to choose a definite state from among multiple possibilities.

Causal determinism, the second pillar, asserted that every event in the universe is the inevitable consequence of precise initial conditions. Werner Heisenberg, with the formulation of the Uncertainty Principle in 1927, demonstrated that this absolute precision is a chimera. The switching relationship between conjugate operators, such as position and momentum (or energy and time), imposes a fundamental limit on the amount of information that can be extracted from the universe. If the position of an electron is measured with absolute precision, its momentum becomes

infinitely uncertain. This indeterminacy is not a defect of our measuring instruments, but an ontological characteristic of the very fabric of reality. Nature, at its most intimate scale, refuses to be confined to a deterministic script, preserving a vital space for probability, novelty, and, by extension, free will.

The third pillar, strict locality, was the foundation of Einstein's theory of relativity. The idea that no physical influence can travel faster than light in a vacuum seemed to be the safeguard against temporal and causal paradoxes. However, the phenomenon of quantum entanglement has revealed a hidden face of the universe. When two particles interact and become entangled, their wave functions merge into a single mathematical entity. If these particles are separated by intergalactic distances, measuring the spin of one of them will instantly determine, in zero time, the spin of the other. Bell's inequalities and the experiments of Alain Aspect, Anton Zeilinger, and John Clauser proved that reality does not obey the principle of locality. There is an intrinsic connectivity, a non-local web that permeates the entire cosmos, indicating that spatial separation is, at some deep level, an illusion of macroscopic perception.

Physical reductionism, the fourth premise, held that all complex phenomena in the universe could be explained by dissecting their most elementary constituent parts. Biology would be

reduced to chemistry, chemistry to physics, and physics to the behavior of quarks and leptons. However, quantum entanglement demonstrates that the whole is fundamentally greater and different from the sum of its parts. The state of an entangled system cannot be factored or reduced to the individual states of its constituent particles. This characteristic, known as quantum holism, requires a systemic and integrative approach, where the global properties of the system determine the behavior of the parts, and not the other way around.

Finally, epiphenomenalism, the fifth materialist pillar, reduced consciousness to a useless byproduct of neurological complexity, comparable to the whistle of a steam locomotive: noisy, but unable to move the train. With the refutation of strong objectivity and the necessity of consciousness to collapse the wave function, epiphenomenalism loses its logical underpinning. If gross matter in a state of superposition requires conscious agency to manifest itself as empirical reality, consciousness cannot be a mere by-product of matter. It must precede the material manifestation. This realization paved the way for Amit Goswami's formulation and the rise of monistic idealism as a rigorous scientific paradigm.

3.2. The Primacy of Consciousness in Monistic Idealism

The frequent criticism of monistic idealism is the accusation of solipsism—the idea that if consciousness creates reality, then the outside world is nothing more than an individual hallucination. Goswami defends himself against this charge by introducing the concept of 'unified consciousness' or Primary Consciousness. It is not the individual ego (the psychological 'I') that collapses the wave function of the universe; If that were the case, we could alter the laws of physics with mere egoic thinking. The collapse occurs from a non-local, unified state of consciousness, in which all sentient beings participate. The ego is only a local interface, a 'shadow' cast by the Primary Consciousness to experience multiplicity and separation in the spatio-temporal realm.

This distinction is vital to understanding how beliefs are formed. The ego is, by definition, a classical conditioning structure. It operates through past memories and future projections, building barriers of potential to protect its own identity and continuity. Primary Consciousness, on the other hand, resides in the eternal present and operates in the quantum realm of pure possibilities. The profound alteration of a belief requires that the local interface (the ego) be momentarily suspended, allowing the Primary Consciousness to intervene through downward causation. This is the ontological foundation of cognitive tunneling: the quantum leap is not made by the ego, but **despite** the ego, when

the local consciousness temporarily aligns with the Primary Consciousness.

Goswami's formulation of 'downward causation' requires a rigorous understanding of how information flows in the universe. In the classical model, causation is strictly upward causation: quarks form atoms, atoms form molecules, molecules form neurons, and neurons generate thoughts. Downward causation postulates that the highest level of organization (the Primary Consciousness) exerts a restraining influence on the probabilities of the lower levels. This does not violate the laws of quantum physics; On the contrary, quantum mechanics requires a 'chooser' to resolve the indeterminacy of superimposed states.

A fundamental concept in monistic idealism is the 'tangled hierarchy', a term originally coined by Douglas Hofstadter and adapted by Goswami. In a simple hierarchy, the top level controls the bottom level unidirectionally. In an intertwined hierarchy, as in M.C. Escher's engraving 'Hands Drawing', levels co-determine each other. The physical brain (lower level) provides the quantum possibilities, and consciousness (higher level) chooses which possibility to collapse, but consciousness needs the brain to have a localized experience. This entanglement resolves Descartes' dualism: mind and brain are not two distinct substances mysteriously interacting, but two levels of the

same intertwined hierarchy operating within the unique substrate of Primary Consciousness.

The transition from materialist realism to monistic idealism, proposed by Amit Goswami, does not represent a regression to pre-scientific mysticism, but rather an epistemological evolution required by quantum mathematics itself. Goswami posits that consciousness is the 'ground of being', the only true substance in the universe. Everything we perceive as matter, energy, space, and time are epiphenomena of consciousness, manifestations derived from an infinite ocean of quantum possibilities.

To understand the mechanics of this self-conscious universe, Goswami proposes a crucial distinction between Primary Consciousness (transcendent and non-local) and individualized consciousness (immanent and local). Primary Consciousness operates outside the constraints of space-time; it is the mastery of pure forms, Platonic ideas, and uncollapsed mathematical probabilities. Individualized consciousness, in turn, arises when the Primary Consciousness identifies with a complex biological structure, such as the human brain. This identification creates the illusion of the ego, the sense of separation between the 'self' and the 'other', and the experience of linear time.

The central mechanism that connects these two domains is downward causation. In classical materialism, causation is strictly

upward causation: the movement of atoms causes chemical reactions, which cause biological impulses, which generate thoughts. Goswami reverses this directional arrow. In downward causation, Primary Consciousness acts on the quantum possibilities of the brain, choosing and collapsing specific states that manifest as thoughts, perceptions, and motor actions. Volitional agency is not an illusion generated by synapses; it is the direct intervention of consciousness in the material world.

Plato's allegory of the cave serves as a perfect metaphor for Goswami's model. The prisoners chained in the cave, watching the shadows cast on the wall, represent humanity trapped in the materialistic paradigm, believing that tangible matter is the only reality. The light of fire and the real objects that cast the shadows represent the domain of quantum potentialities. The journey of the prisoner who breaks free and gazes at the sun outside the cave symbolizes the awakening to monistic idealism, the recognition that consciousness is the source of all light and reality.

Within this ontological framework, Goswami addresses the question of identity and postmortem survival through the concept of the 'quantum monad'. The soul is not conceived as an ethereal ectoplasm phantom, but as a coherent package of quantum memories, propensities, and conditionings (karma). When

the biological body ceases its functions, the quantum monad is not destroyed, for it resides in the non-local realm. It maintains continuity of experience and may eventually become entangled with a new biological embryo, providing a physically plausible explanation for reincarnation and the transmission of non-genetic personality traits.

This scientific reinterpretation of the soul and karma eliminates the Cartesian dualism that has haunted Western philosophy for centuries. There is no need to explain how an immaterial spiritual substance interacts with physical matter, for deep down, both are made of the same 'substance': consciousness. Matter is simply consciousness manifested in a state of collapse, while soul is consciousness operating in the realm of non-local probabilities. This ontological unification provides the theoretical basis necessary to explore how beliefs, being constructs of consciousness, can alter the physical structure of the brain through quantum mechanisms.

3.3. The Permissive Environment of Quantum Biology

In addition to enzymatic catalysis and photosynthesis, avian magnetoreception provides one of the most spectacular examples of quantum coherence in macroscopic biological systems. Migratory birds, such as the European robin (*Erithacus rubecula*), can navigate thousands of kilometers using the

Earth's magnetic field, which is extremely weak (about 50 microteslas). Classical physics couldn't explain how such a faint field could trigger a neural signal robust enough to guide flight.

The answer emerged with the 'radical pair' model. In the retina of these birds, there is a blue-light-sensitive protein called cryptochrome. When a photon hits the cryptochrome, it excites an electron, which jumps to a neighboring molecule, creating a pair of molecules with unpaired electrons (a radical pair). The spins of these two electrons remain quantumly entangled. The Earth's magnetic field differentially interacts with these entangled spins, changing the ratio of molecules that return to their original state versus those that proceed to form a signaling chemical.

For this mechanism to work, the quantum entanglement state in cryptochrome must be maintained for tens of microseconds — an eternity on the quantum timescale, especially inside a hot, moist bird's eye. The proof of this phenomenon definitively demolished the argument that biology is too classical to support quantum effects. If a bird uses quantum entanglement to navigate the globe, the proposition that the human brain uses quantum coherence in microtubules to process consciousness and restructure beliefs ceases to be a fringe speculation and becomes a highly plausible biological extrapolation.

For a long time, scientific orthodoxy rejected the possibility of quantum effects operating in the brain, claiming that the cellular environment, being "hot and humid," would cause the immediate decoherence of any state of superposition. It was assumed that the fragility of quantum states would not survive biological thermal noise. However, the vigorous advancement of quantum biology in recent decades has demolished this objection, revealing that life not only tolerates but actively exploits subatomic mechanics.

The first pillar of evidence lies in enzyme catalysis. Detailed studies have shown that enzymes accelerate metabolic reactions at rates incompatible with classical thermodynamics. The explanation lies in quantum tunneling, the process by which protons and electrons cross insurmountable energy barriers [6]. The Kinetic Isotopic Effect proved that the architecture of proteins evolved in order to protect and facilitate this tunneling, indicating a refined biological adaptation to quantum laws.

The second pillar comes from research on photosynthesis. Research has shown that the FMO complex in photosynthetic bacteria maintains states of electron coherence for surprisingly long periods [8]. The captured solar energy does not travel randomly, but simultaneously explores multiple routes through quantum superposition, ensuring near-perfect transfer efficiency. Biology therefore uses

thermal noise to sustain coherence, subverting the expectations of classical physics.

The third pillar focuses on molecular genetics. Simulations based on open quantum systems have revealed that proton tunneling in DNA hydrogen bonds is a frequent and structurally significant event [9]. This process is capable of altering the conformation of nitrogenous bases, giving rise to spontaneous mutations. The finding that the engine of genetic evolution has a non-deterministic quantum component reinforces the premise that life operates in deep harmony with subatomic reality.

3.4. Quantum Neuroscience and Microtubule Dynamics

The thermodynamic feasibility of this model requires a robust response to the decoherence critique. Physicists such as Max Tegmark argued that the brain, being a 'warm and wet' environment, would destroy any state of superposition in fractions of a picosecond. The refutation of this argument lies in the precise nanometric architecture of microtubules. The interior of the tubulin protein is not a chaotic aqueous medium; It contains hydrophobic pockets — water-repellent cavities — that harbor delocalized pi electrons. These pockets act as perfect dielectric insulation shields, protecting the electronic clouds from the surrounding thermal noise. It is precisely this hydrophobic isolation that allows quantum

coherence to be maintained at biological temperature, in the same way that occurs in photosynthetic complexes and catalytic enzymes.

The cylindrical architecture of microtubules, composed of thirteen helical tubulin protofilaments, exhibits geometric and electrical properties that fascinate solid-state physicists. In addition to harboring pi electrons in hydrophobic pockets, microtubules function as optical waveguides and nanoscale information processing circuits. Hameroff's hypothesis suggests that the mechanical vibrations in tubulins are coupled to electron spin states, creating a highly coherent phononic-electronic system. This structural complexity refutes the simplistic view that the neuron is the fundamental processing unit of the brain. True information processing, the quantum computing that sustains consciousness, takes place inside the cytoskeleton, millions of times faster and with an exponentially higher informational density than classical synaptic transmission.

This shift in scale from the neuron to the microtubule dramatically alters our understanding of neuroplasticity and belief fixation. In the classical model, a belief is recorded through long-term potentiation (LTP) at synapses. In the Orch OR model, the synapse is only the final macroscopic effector. The belief is first set up as a quantum resonance pattern in the microtubule network. When cognitive

tunneling occurs and a new insight is collapsed, the microtubular resonance pattern changes instantly. This quantum shift alters the polarity of the cytoskeleton, which in turn modulates the transport of neurotransmitter vesicles into the synaptic cleft. Classical synaptic restructuring (neuroplasticity) is therefore the slow and material echo of a quantum leap that has already occurred on the nanometer scale.

The feasibility of Penrose and Hameroff's Orch OR theory has faced severe critical scrutiny, notably from physicist Max Tegmark in 2000, who calculated that thermal decoherence in the brain would occur in 10^{-13} seconds, too fast for any relevant neurophysiological processing. However, Tegmark's model assumed that the microtubules were directly exposed to the aqueous environment. Subsequent research led by physicists such as Jack Tuszynski and Anirban Bandyopadhyay demonstrated that the water inside microtubules is not liquid, but is in a highly ordered state, known as 'vicinal water' or fourth phase of water. This structured water acts as a dielectric shield, shielding the pi electron clouds from thermal decoherence and allowing the superposition states to persist for milliseconds or more, long enough to interact with synaptic dynamics.

In addition, the discovery of quantum resonances in microtubules at megahertz, gigahertz, and terahertz frequencies suggests

that the neuronal cytoskeleton operates as a vast network of quantum antennas, orchestrating cellular activity long before the action potential in the membrane is triggered. Consciousness, therefore, is not the result of neural firing, but the quantum conductor who decides, through Objective Reduction, when and where the neuron should fire. This inversion of perspective is monumental: the action potential is not the cause of thought, but the electrochemical signature left by a quantum thought that has already occurred.

Empirical validation of monistic idealism requires the identification of a biological substrate capable of sustaining states of quantum superposition within the human brain. Classical neuroscience, based on the Hodgkin-Huxley model, treats the brain as a solid-state computer, where neurons are transistors and synapses are logical gates. This computational model, while useful for mapping reflexes and basic sensory processing, fails catastrophically when it attempts to explain the emergence of subjective experience (or qualia), non-algorithmic mathematical intuition, and the phenomenological unity of perception (the binding problem).

The answer to this impasse arose from the interdisciplinary collaboration between mathematical physicist Sir Roger Penrose and anesthesiologist Stuart Hameroff, which culminated in the theory of Orchestrated

Objective Reduction (Orch OR). Penrose, using Gödel's incompleteness theorems, demonstrated mathematically that human reasoning has comprehension capabilities that cannot be simulated by any Turing machine, no matter how advanced. If the human mind performs non-algorithmic computations, the brain must use physical principles that transcend classical deterministic physics.

Penrose proposed that the only source of non-computability in the universe is the collapse of the quantum wave function. He formulated the theory of Objective Reduction (RO), suggesting that quantum collapse does not occur randomly (as in the Copenhagen interpretation), but is an actual physical process governed by the geometry of space-time on the Planck scale. When a quantum superposition reaches a critical mass and time, the curvature of space-time bifurcates to the breaking point, forcing the system to collapse into a definite state. This self-collapse event generates a discrete and fundamental 'moment of awareness'.

Penrose's challenge was to find a structure in the brain capable of housing these massive superpositions without undergoing thermal decoherence. Hameroff filled this gap by pointing to microtubules, the main components of the cell cytoskeleton. Microtubules are hollow cylinders formed by polymers of the protein tubulin. Hameroff observed that tubulins have

hydrophobic (water-repellent) pockets in their interior, where delocalized electrons (pi clouds) can interact and form Bose-Einstein condensate states, protected from the aqueous thermal noise of the cytoplasm.

In Orch OR theory, microtubules act as quantum cellular automata. The conformational states of tubulins enter into quantum superposition, entangling with tubulins of neighboring neurons through gap junctions. This macroscopic entanglement network expands over large areas of the cerebral cortex. When the superposition reaches the critical Penrose threshold, orchestrated collapse (Orch OR) occurs, generating a flash of conscious awareness. The rapid sequence of these collapses (estimated to be about 40 times per second) produces the illusion of a continuous stream of consciousness, similar to the static frames of a roll of film creating the illusion of movement.

The robustness of the Orch OR theory has been corroborated by recent and surprising discoveries in the field of anesthesiology. Anesthetic gases, which selectively erase consciousness without disrupting the brain's autonomic functions, have always been a pharmacological mystery. The Meyer-Overton effect demonstrates that the potency of an anesthetic is directly proportional to its solubility in lipids, suggesting that they act in hydrophobic regions. Recent studies have shown that

anesthetics bind precisely to the hydrophobic pockets of tubulins in microtubules, scattering pi electron clouds and preventing the formation of quantum coherence. By blocking quantum superposition, anesthetics shut down the mechanism of Objective Reduction, abolishing consciousness. This experimental evidence provides extraordinary empirical support for the premise that microtubules are, in fact, the quantum interface of the mind.

3.5. Cognitive Quantum Tunneling as a Vector of Belief Mutation

In order for the cognitive tunneling hypothesis to transcend metaphor and consolidate itself as a neurophysical mechanism, it is essential to explain the leap in scale: how a microscopic quantum event in a protein can alter a macroscopic belief. The answer lies in what we define as the 'Ripple Effect' or 'Macro-coherent Entanglement'. Tunneling a single electron or proton in a hydrophobic pocket instantly changes the conformational state of the tubulin. This change in conformation propagates along the network of entangled microtubules, altering the electrical polarity of the neuronal cytoskeleton. Microtubular polarity, in turn, is the determining factor that modulates the transport of vesicles and the release of neurotransmitters in the synaptic cleft. Therefore, the quantum leap does not occur in isolation; It acts as the initial trigger of an amplification cascade that culminates in the

massive rewriting of the neural network via classical neuroplasticity.

The mathematics of quantum cognition provides the precise tools to model this tunneling of beliefs. Classical Markov models assume that mental states evolve through classical probabilistic transitions, where the total probability is always the sum of the individual probabilities. Quantum dynamic models, on the other hand, use probability amplitudes (complex numbers). When amplitudes are added together before they are squared to obtain the final probability, interference terms arise. This cognitive quantum interference perfectly explains why exposure to two contradictory pieces of information does not result in an arithmetic mean of belief, but can cause extreme reinforcement or a total collapse of the original belief.

Cognitive tunneling is, in essence, the crossing of this landscape of interference. When a limiting belief forms a potential barrier, the probability range of the cognitive wave function does not fall to zero within the barrier; it decays exponentially, but emerges on the other side. Deep meditation, contemplative practices, and peak experiences reduce the 'height' of this barrier by decreasing the ego's emotional attachment (modulation of the amygdala and DMN). The quantum leap occurs when the Primary Consciousness collapses the wave function on the opposite side of the barrier,

resulting in an immediate restructuring of the neural topology. Insight is not constructed; it is revealed.

Delving deeper into the mechanics of cognitive tunneling, it is necessary to examine how the topology of beliefs is shaped in the brain. A belief is not an isolated entity; It exists as an attractor in a landscape of neurodynamic energy. When an individual is exposed to information that contradicts their fundamental belief (cognitive dissonance), the classical brain tries to minimize free energy by rejecting the new information or reinterpreting it to fit the existing attractor. This is the neurophysical mechanism of confirmation bias.

Quantum tunneling offers the only energy-viable escape route from this attraction basin. The probability of tunneling (P) through a potential barrier is described by the WKB (Wentzel-Kramers-Brillouin) approximation, which demonstrates that P depends exponentially on the width and height of the barrier, as well as on the mass of the particle. In the cognitive context, the 'mass' can be interpreted as the inertia of belief (the degree of emotional conditioning associated with it), and the 'width of the barrier' as the paradigmatic distance between the current belief and the new understanding.

Durante estados de meditação profunda, crise psicológica aguda ou incubação criativa, a inércia cognitiva (a 'massa') é artificialmente

reduzida pela desativação da Rede de Modo Padrão (DMN). Com a inércia reduzida, a probabilidade de a função de onda cognitiva penetrar e atravessar a barreira do atrator aumenta exponencialmente. Quando o tunelamento ocorre, a consciência não precisa escalar a parede da dissonância cognitiva através de argumentação exaustiva; ela simplesmente ressurge no novo atrator (o novo paradigma) de forma instantânea. O indivíduo vivencia isso como um insight fulminante, uma compreensão cristalina que reorganiza imediatamente todo o seu sistema de valores e percepções, sem o desgaste energético da transição clássica.

With the validation of microtubules as the quantum substrate of consciousness, it becomes imperative to reassess the structural nature of human beliefs. In traditional cognitive psychology, a belief is defined as a mental representation consolidated by Hebbian synaptic networks ('neurons firing together, connecting together'). The alteration of a deep-rooted belief, from this mechanistic perspective, would require a slow and arduous process of synaptic erosion and gradual neuroplasticity, induced by exhaustive repetition and behavioral reinforcement.

However, the phenomenology of human experience often contradicts this linear model. The history of science, art, and religion is replete with accounts of instant epiphanies, sudden

insights, and split-second worldview conversions. Archimedes' 'Eureka' moment, Kekulé's vision of the structure of benzene, and Paul of Tarsus' conversion on the road to Damascus are classic examples of massive cognitive restructurings that do not obey the classical synaptic decay time. To explain these abrupt breaks, quantum neuroscience offers a much more precise and elegant mechanism: cognitive quantum tunneling.

In quantum mechanics, tunneling is the phenomenon by which a subatomic particle crosses a potential energy barrier that, according to classical physics, it would not have enough energy to cross. Because the particle is described by a probabilistic wave function, there is a non-zero probability that the wave will extend beyond the barrier. In practical terms, the particle simply 'disappears' on one side of the barrier and 'reappears' on the other side, instantaneously, without having traversed the space in between.

The transposition of this concept to the architecture of the mind proposes that beliefs operate as wells of quantum potential in the network of microtubules. A limiting belief or a deep-rooted paradigm (such as a childhood trauma, a cognitive bias, or a materialistic worldview) is configured as a high-energy barrier. Individualized consciousness, operating in the classical mode of analytical, rational thinking, lacks the 'kinetic energy' necessary to scale and

overcome this barrier. This is why logical debate and rational argumentation often fail to alter deep-seated beliefs; The rational mind crashes into the barrier of confirmation bias and retreats. True mutation of beliefs requires the brain to enter a state of high quantum coherence. During deep contemplative practices, deep meditation, flow states, or acute existential crises, the activity of the Default Mode Network (DMN), which is responsible for maintaining the ego's identity, is suppressed. This suppression reduces classical informational noise, allowing quantum superpositions in microtubules to expand and sustain themselves for longer periods.

In this state of expanded superposition, the cognitive wave function spreads beyond the potential barrier of limiting belief. The act of creative insight or epiphany is, structurally, the orchestrated collapse (Orch OR) of this wave function on the 'other side' of the barrier. Cognitive quantum tunneling has occurred. The mind instantly jumped from a state of conditioning to a new state of understanding, without having to go through the intermediate logical paths. The old belief matrix is disintegrated not by erosion, but by quantum discontinuity.

The mathematical evidence for this phenomenon comes from the emerging field of Quantum Cognition, led by researchers such as Jerome Busemeyer. They demonstrated that

human decision-making under uncertainty and the actualization of beliefs systematically violate the axioms of classical Kolmogorov probability and Bayesian statistics. Phenomena such as the conjunction fallacy, the order effect in opinion polls, and the aversion to ambiguity are not irrational errors of the brain, but precise signatures that the mind processes information using quantum probability amplitude logic, wave interference, and non-commutativity. The human mind is, in its operational essence, a quantum processor, and tunneling is its primary mechanism of paradigmatic evolution.

3.6. Creativity as a Mechanism of Rupture

Creativity, under the lens of monistic idealism and quantum biology, ceases to be an epiphenomenon of natural selection and assumes the role of a teleological imperative. Goswami argues that the universe is not an accidental machine, but a system that actively seeks self-knowledge through the evolution of increasingly complex biological interfaces. Human creativity is the apex of this process. When a human being performs a fundamental act of creativity—whether composing a symphony, formulating a new physical theory, or forgiving a deep enemy—he is allowing the Primary Consciousness to collapse an entirely new possibility into the manifest universe.

The process of creative incubation is, neurologically, a deliberate plunge into the quantum realm. By suspending rational

judgment and allowing the mind to wander, the individual shuts down the cognitive 'Quantum Zeno Effect'. In physics, the Zeno Effect dictates that a quantum system that is observed continuously never changes state. Psychologically, this means that continuous analytic rumination on a problem prevents the quantum superposition necessary for the solution. Creative incubation is the act of 'not observing' the problem, allowing the wave function to expand and explore the non-local domain until it finds the optimal setting for the insight.

If cognitive quantum tunneling is the physical mechanism of changing beliefs, creativity is the psychological interface that triggers this mechanism. In the materialist paradigm, creativity is often reduced to a combinatorial algorithm: the brain accesses stored memories and shuffles them randomly until it finds a useful solution. Amit Goswami rejects this reductionist view, distinguishing between 'situational creativity' (rearrangement of the known) and 'fundamental creativity' (access to the unprecedented).

Fundamental creativity is the ability of consciousness to transcend the repertoire of local memories and access the non-local realm of pure potentialities. The classic creative process, mapped out by Wallas in 1926, involves four stages: preparation, incubation, insight, and verification. The quantum interpretation of this

process reveals the underlying mechanics of the mind in search of paradigmatic rupture.

The preparation phase involves the accumulation of classic information and the exhaustion of analytical solutions. The thinker repeatedly bumps into the potential barrier of the problem or limiting belief. This conscious effort generates the necessary tension, but it does not produce the solution. Frustration induces the individual to abandon conscious effort, entering the incubation phase.

Incubation is the critical stage where quantum magic occurs. By diverting focal attention (relaxation, sleep, walking), the brain suppresses the continuous classical observation that forces the premature collapse of the wave function (the Quantum Zeno Effect). Free from the scrutiny of the rational ego, the microtubule network enters a state of deep quantum superposition. The unconscious mind begins to simultaneously explore thousands of probabilistic routes and non-local associations. Belief barriers become permeable, and cognitive wave function spreads through tunneling.

The illumination or insight phase is the exact moment of the collapse of the wave function (Objective Reduction). Primary Consciousness acts through downward causation, selecting the probability that solves the problem or that establishes the new paradigm. This collapse generates a visceral 'Aha!', an explosive release of psychic energy and gamma coherence in the

brain. The solution emerges into consciousness in a complete, instantaneous, and self-evident way. It was not a logical deduction; It was a quantum leap into a new configuration of reality. The final verification phase is the return to classical processing, where the new collapsed idea is tested, translated into language, and implemented in the physical world. Neuroplasticity comes into play at this point: quantum insight rewrites synaptic routes, physically cementing the new belief in neural structure. The brain was permanently altered by creative tunneling.

From this perspective, the deliberate practice of creativity is not an artistic luxury, but an evolutionary technology of survival. To cultivate creativity is to train the mind to tolerate the ambiguity of quantum superposition, to weaken the potential barriers of dogmatic beliefs, and to allow the Primary Consciousness to constantly renew the biological interface. Education and psychotherapy should therefore focus less on strengthening analytic algorithms and more on developing the quantum permeability of the mind.

4. CONCLUSIONS

Epistemological rigor requires that every scientific hypothesis, no matter how elegant, be submitted to Popper's criterion of falsifiability. To empirically test the cognitive quantum tunneling model, we propose the following future experimental protocol: the monitoring of

individuals undergoing insight therapies or complex problem solving using Electroencephalography (EEG) of very high spatial and temporal density. If the belief change is indeed a macroscopic quantum event, the exact moment of the insight — the potential barrier crossing — must invariably be preceded by an anomalous global phase coherence peak at ultra-high gamma frequencies (above 40 Hz). This signature of quantum macro-coherence would act as the physical marker of wave function collapse (Orch OR), being immediately followed by an abrupt restructuring of functional connectivity in the Default Mode Network (DMN). The detection of this marker would represent definitive empirical proof that the human mind operates as an authentic biological quantum processor.

The proposition of cognitive quantum tunneling as a biological mechanism for belief alteration represents a paradigm shift at the intersection of physics, biology, and psychology. By rejecting materialist reductionism and adopting Goswami's monistic idealism, anchored in the evidence of quantum biology and Penrose and Hameroff's Orch OR theory, this paper establishes a non-dualistic explanatory model for human cognition. The mind is not a ghost in the machine, nor is the machine itself; the mind is the quantum orchestration of the Primary Consciousness

operating through the geometry of the microtubules.

Creativity, recontextualized as the process of suspending classical collapse to enable quantum tunneling, reveals itself to be the most powerful tool at humanity's disposal to transcend its own evolutionary barriers. In a world beset by rigid dogmatisms, intractable cognitive biases, and systemic crises, the understanding that our deepest beliefs can be altered not by rhetorical friction but by quantum leaps of insight offers a message of deep scientific and existential optimism. The challenge for the 21st century is not just to build quantum computers, but to recognize, cultivate and liberate the quantum processor that resides at the core of human consciousness.

The integration of monistic idealism with quantum biology and Orch OR theory not only provides an explanatory framework for the mutation of beliefs, but also proposes a new ontology for the human condition. Classical materialism confined us to a universe of alienation, where the mind was an accidental intruder into a mechanical and purposeless cosmos. Quantum physics, correctly interpreted, restores the centrality of consciousness. The universe is not a collection of separate objects, but an inseparable network of dynamic relationships, where the observer and the observed are manifestations of the same Primary Consciousness.

The recognition that beliefs are quantum constructs subject to creative tunneling returns agency and responsibility to the individual. We are not prisoners of our synaptic conditionings; We possess the biological machinery (microtubules) and the ontological prerogative (downward causation) to collapse new realities and transcend barriers of psychological potential. Creativity, far from being a mere artistic talent, is the very engine of conscious evolution, the tool through which the Primary Consciousness continually renews the experience of life.

This epistemological model lays the foundation for a true science of consciousness in the twenty-first century. A science that does not deny the objectivity of empirical data, but that recognizes subjectivity as the fundamental foundation on which all empirical reality is built. By embracing quantum mechanics not just as a tool for building transistors and lasers, but as the language of the mind itself, we open the door to a deeper, more compassionate, and more integrated understanding of human existence.

The epistemological journey traced in this essay culminates in the inescapable realization that the materialist-mechanistic paradigm, which has governed science for four centuries, has exhausted its explanatory capacity with regard to the phenomena of consciousness and deep cognition. Quantum physics, in demonstrating the primacy of the observer, the

fundamental indeterminacy, and the non-locality of the universe, required an ontological reconfiguration that found its most coherent expression in the monistic idealism of Amit Goswami.

Quantum biology provided the missing material bridge, proving that living systems routinely operate in subatomic coherence and tunneling regimes. Penrose and Hameroff's Orch OR theory located the stage of this quantum magic in the brain microtubules, establishing a rigorous neurophysical model for the emergence of conscious experience and demystifying the mechanism of action of anesthetics.

The synthesis of these interdisciplinary fields allowed the formulation of the central hypothesis of this work: cognitive quantum tunneling. By redefining beliefs as wells of quantum potential and paradigm shift as a discontinuous leap mediated by creativity, we offer a robust mechanistic explanation for psychological phenomena such as epiphanies, sudden conversions, and the overcoming of ingrained traumas. The human mind is revealed not as a solid-state calculating machine, but as a quantum transducer designed to collapse possibilities of the non-local realm into immanent reality.

The implications of this reinterpretation are vast. In clinical psychology, it suggests that therapeutic interventions should focus on inducing states of quantum coherence and

creative incubation, facilitating tunneling beyond the ego's defenses, rather than relying solely on linear cognitive restructuring. In education, it points to the need to cultivate divergent thinking and tolerance for ambiguity, skills essential to sustaining quantum superposition before creative collapse.

Future lines of research should focus on the empirical detection of the signatures of cognitive tunneling. The use of ultra-high-resolution electroencephalography (EEG) and magnetoencephalography (MEG) during controlled episodes of creative insight or sudden change of belief may reveal peaks of macroscopic coherence in specific frequency bands, correlated with the exact moment of the mental quantum leap.

Ultimately, the fusion between quantum physics and the biology of consciousness not only resolves persistent scientific anomalies, but also rescues the dignity and centrality of the human being in the cosmos. The universe is not a blind clock heading for heat death, but a self-conscious organism in constant creative evolution, where every leap of understanding in a human mind is a cosmic event of self-discovery.

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