Breaking the Illusion (破相) of Local Realism: Bridging Classical and Quantum Physics Through the Lens of Buddhist Doctrine

This paper examines the concept of 破相 (*pòxiàng*), which in Buddhist philosophy refers to the deconstruction of appearances or forms, and this paper uses it as a theoretical framework to bridge the gap between classical and quantum physics. Classical physics presents a deterministic, well-defined reality where objects exist with fixed properties independent of observation. However, quantum mechanics challenges this view, revealing a probabilistic, fluid, and deeply interconnected reality with the observer's perspective. The Buddhist doctrine of *pòxiàng*, which involves recognizing the illusory nature of fixed forms and appearances, provides a powerful philosophical lens through which the principles of quantum physics—such as superposition, entanglement, and the observer effect—can be interpreted.

By examining the groundbreaking work of physicists John Clauser, Alain Aspect, and Anton Zeilinger, who shared the 2022 Nobel Prize in Physics, this analysis demonstrates how their experimental confirmations of quantum entanglement and violations of Bell inequalities not only challenge classical notions of locality and determinism but also resonate deeply with Buddhist metaphysical insights. This interdisciplinary study argues that Buddhist ideas about illusions and the impermanence of forms correspond to the quantum state's inherent uncertainty and non-fixed nature. This paper suggests a deeper, more integrated understanding of reality by exploring how classical physics' rigid view of reality is 'deconstructed' at the quantum level, similar to the Buddhist recognition of form as an illusion. The research contributes to scientific and philosophical discourses by highlighting how the impermanence and illusion of fixed forms in Buddhist doctrine can be seen as metaphors for the collapse of the quantum wave function into a definite state upon observation.

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Introduction

> To be a Buddha is metaphorically rendered as the state of having undergone a long deep sleep wherein myriad delusional experiences unfolded, the dreams of ***samsara***, and by recognizing ***samsara*** to be like a dream, the dreamer is said to awaken[1].

The concept of 破相 (*pòxiàng*) in Buddhist philosophy, emphasizing the deconstruction of appearances or forms, provides a compelling philosophical framework for interpreting some of the more counterintuitive aspects of quantum physics, especially in light of the contributions made by John Clauser, Alain Aspect, and Anton Zeilinger. These physicists, recognized with the 2022 Nobel Prize in Physics, were instrumental in experimental demonstrations that challenged classical assumptions about locality and determinism in physics through their work with entangled photons[2]. Their experimental efforts have shifted the concept of quantum entanglement, demonstrating and manipulating it—a phenomenon where two particles remain interconnected despite being separated by large distances. Clauser and Aspect conducted pioneering 'Bell tests' using entangled photons, experiments that corroborated the predictions of quantum mechanics and refuted competing classical theories[3]. Zeilinger extended these techniques to control entanglement, enabling practical applications in quantum computing, cryptography, and other fields of quantum information science[4].

Quantum mechanics has consistently provided accurate predictions for experimental outcomes, yet its inherent uncertainty in particle properties has long been a contention among physicists[5], including Albert Einstein. In 1935, Einstein and his collaborators articulated their concerns through the famous EPR paradox, which posed a thought experiment involving two entangled particles distributed between two observers, Alice and Bob[6]. According to quantum mechanics, a measurement by Alice would instantaneously affect the uncertainty about Bob's particle, suggesting what Einstein famously called 'spooky action at a distance'. To address this, Einstein hypothesized the existence of hidden variables, underlying classical parameters that would deterministically govern the behaviour of particles, contrasting with the probabilistic nature of quantum theory.

The concept of hidden variables remained largely philosophical until 1964, when John Bell, then at the University of Wisconsin-Madison, devised an ingenious theoretical framework to test this hypothesis experimentally. Bell's theorem established that if hidden variables governed the system, the results of measurements conducted by Alice and Bob would conform to a specific mathematical inequality[7]. Conversely, this inequality would be violated if quantum mechanics accurately described reality. Subsequent experiments by Clauser, Aspect, and Zeilinger provided empirical support for the quantum mechanical description, conclusively demonstrating the non-local nature of entanglement and laying the groundwork for modern quantum technologies[8].

The convergence of Eastern philosophical traditions, mainly Buddhist metaphysics, and modern scientific frameworks such as quantum mechanics has attracted significant scholarly interest. This interdisciplinary dialogue becomes especially pertinent when examining concepts such as the Buddhist *pòxiàng*, which refers to the deconstruction of appearances and the realization of inherent emptiness. The *Avataṃsaka Sūtra* 《大方廣佛華嚴經》states:

> 若見諸相非相，即見如來 (If one sees that all appearances are non-appearances, one sees the *Tathāgata*[1])

The deconstruction of appearances entails looking beyond the superficial solidity of perceived objects or bodies and recognizing that, at a fundamental level, they are composed of subatomic particles, all in a state of constant vibration and not at rest, indicating that recognizing the illusory nature of all forms leads to a deeper understanding of reality. This perspective aligns with the principles of quantum mechanics, where particles such as quarks, leptons, and bosons are understood not as static entities but as dynamic excitations within quantum fields[9]. This paper argues that the apparent stability and solidity of objects are revealed to be illusions arising from the complex interactions of these subatomic particles governed by fundamental forces—gravity, electromagnetism, and the strong and weak nuclear forces. These particles are in perpetual motion, fluctuating and interacting in ways that defy the classical notion of a fixed, solid object[10]. The concept of *pòxiàng*, therefore, encourages a deeper inquiry into the nature of reality, moving beyond appearances to understand the underlying vibratory nature of existence, which is constantly in flux. One can appreciate all phenomena's transient and interdependent nature by deconstructing the illusion of solidity, as articulated in Buddhist philosophy. This understanding resonates with the insights provided by quantum mechanics, which challenges our classical perceptions and reveals a fundamentally dynamic and interconnected universe. Thus, Buddhist metaphysics and quantum theory converge in their portrayal of reality as a complex web of interdependent processes, continually evolving and never static, in Buddhistic reference, known as dependent origination[2][11]. This philosophical perspective provides a valuable lens for interpreting the non-intuitive aspects of quantum mechanics, such as the breakdown of local realism (from the dependent origination perspective) and the inherent indeterminism of reality.

In Buddhist teachings, particularly those related to the concept of emptiness (空, *śūnyatā*), all phenomena are understood to be devoid of intrinsic nature and to arise dependent on causes and conditions (*Nāgārjuna, Mūlamadhyamakakārikā*). This viewpoint deconstructs attachment to superficial appearances and fosters a deeper comprehension of the interconnectedness and interdependence of all entities. Similarly, quantum mechanics posits that particles lack definite properties until they are measured, and these properties are intricately connected across large distances through entanglement[12].

This paper seeks to contribute to the ongoing interdisciplinary discourse by exploring the convergence between Buddhist metaphysics and quantum mechanics, focusing on how the concept of *pòxiàng* can provide a novel interpretative framework for understanding quantum phenomena. The paper begins by clarifying the Buddhist notion of *pòxiàng* and its relevance in deconstructing the illusory solidity of perceived objects, emphasizing its philosophical underpinnings in the teachings of emptiness and dependent origination as articulated by *Nāgārjuna*. This will be juxtaposed with the principles of quantum mechanics, mainly by examining the groundbreaking work of physicists John Clauser, Alain Aspect, and Anton Zeilinger, recipients of the 2022 Nobel Prize in Physics. Their experimental confirmations of quantum entanglement and violations of Bell inequalities challenge classical notions of locality and determinism and resonate deeply with Buddhist metaphysical insights. The analysis will demonstrate how these findings reflect reality's interdependent and non-intrinsic nature, concepts central to Buddhist thought. By comparing these perspectives, this paper offers a more nuanced understanding of reality that transcends classical physics and surface-level perceptions, highlighting the shared vision of a dynamic, interconnected universe. The analysis proceeds by drawing parallels between the Buddhist deconstruction of appearances and the non-local behaviour observed in quantum entanglement, illustrating how both frameworks challenge classical notions of separateness and independent existence. Furthermore, this paper explores the implications of these ideas for contemporary

understandings of reality, suggesting that the apparent contradictions between classical and quantum physics can be reconciled through the lens of dependent origination.

By synthesizing insights from Buddhist philosophy and quantum theory, this paper aims to deepen our understanding of both disciplines and demonstrate their mutual relevance. It proposes that Buddhist metaphysical concepts, when applied to quantum mechanics, offer a valuable perspective for interpreting complex quantum behaviours that defy classical intuition. This integrative approach enhances the philosophical interpretation of quantum mechanics and enriches Buddhist scholarship by contextualizing its teachings within the framework of modern scientific inquiry.

Finally, this paper contributes to the growing interdisciplinary research that bridges Eastern philosophical thought and Western scientific paradigms, providing a nuanced understanding of reality as an interconnected, dynamic, and ever-evolving process. It invites further exploration into how traditional metaphysical concepts can inform contemporary scientific theories, paving the way for a more holistic approach to the nature of existence.

Quantum World through the Lens of Human Sensory Limitations

Quantum mechanics operates at a vastly different scale from human sensory experience. Our perceptual faculties evolved to navigate the macroscopic world and are ill-equipped to directly observe the nuances of quantum behaviour. The constraints imposed by the speed of light on quantum observations fundamentally limit our ability to access the true nature of reality. According to special relativity, the speed of light (approximately 299,792,458 meters per second) represents the ultimate speed limit in the universe, and no information or material object can travel faster than this limit[13]. This constraint governs macroscopic interactions and dictates the limitations of our observational capabilities at the quantum level. As a result, our measurements and observations are always influenced by this universal constant, which inherently restricts our ability to perceive the instantaneous nature of quantum phenomena[12].

Quantum mechanics, with its probabilistic nature, reveals a world vastly different from the deterministic reality postulated by classical physics. At the quantum scale, particles such as electrons and photons do not have definite properties or positions until measured[14]. Instead, they exist in a superposition of states, represented mathematically by a wave function that encodes the probabilities of various outcomes[15]. This indeterminacy and non-locality are not directly observable because photons mediate our interactions with the quantum world, the quanta of light, which travel at the speed of light and form the basis of all observational processes[16].

The human body, composed of cells comprising molecules, atoms, and subatomic particles, operates as a complex and finely tuned system[17]. At the atomic level, atoms are formed from protons, neutrons, and electrons, while protons and neutrons are composed of quarks[18]. These fundamental particles—including quarks, leptons, and bosons—are subject to constant motion and vibration (illustrated in Figure 1), governed by the fundamental forces of nature: gravity, electromagnetism, the strong nuclear force, and the weak nuclear force. Quarks, the building blocks of protons and neutrons, are bound together by the strong nuclear force, mediated by particles called gluons. Leptons, including the electron, are another class of elementary particles, and they, too, are governed by interactions at the quantum level. These particles are so small and energetic that they cannot be localized with precision, embodying the principle of quantum uncertainty[19]. This uncertainty challenges the classical

understanding of locality, as particles such as electrons do not exist in fixed positions but in probability distributions called wavefunctions[20]. If we could observe these particles at or beyond the speed of light—hypothetically freeing us from the observational limits imposed by relativity—the macroscopic stability of the world would dissolve. Instead of perceiving objects as solid and stable, we would witness a constantly fluctuating field of particles in continuous motion, vibrating and interacting according to the laws of quantum mechanics[21]. The Lotus Sutra 《法華經》) suggests

> 是法住法位，世間相常住 (These dharmas abide in their dharma positions, and the phenomena of the world are always abiding)

The line from the Lotus Sutra suggests that all phenomena in the observable world follow a certain order or law, known as 'dharma positions' (法位). This indicates a stability and regularity in the classical, macroscopic world, where natural laws such as gravity, thermodynamics, and classical mechanics dictate the behaviour of objects and events in a predictable manner. This stability and consistency provide a framework through which we understand and interact with the physical world. However, this predictable order breaks down at the quantum level, where phenomena do not abide by the same deterministic principles that govern the classical world. In quantum mechanics, particles like electrons and photons exhibit behaviours that are probabilistic rather than deterministic. They do not have fixed positions or momenta until they are measured, existing instead in a superposition of states[20]. This indeterminacy contrasts with the notion of 'dharmas abiding in their positions', as the properties of quantum particles are not fixed and do not always follow classical trajectories or locations. Moreover, the phenomenon of quantum entanglement further defies classical expectations of locality and causality. Entangled particles remain correlated regardless of the distance between them, which violates the classical view that interactions between objects diminish with distance. This non-local behaviour suggests that the fundamental nature of reality, as described by quantum mechanics, does not conform to the orderly, abiding principles that are evident in the macroscopic world described by the Lotus Sutra. In this way, the Lotus Sutra reflects the stability and continuity of classical phenomena, while quantum mechanics reveals a deeper, more intricate level of reality where the apparent order of the macroscopic world is underpinned by probabilistic and interconnected quantum processes that defy classical intuition. Thus, at the quantum scale, particles are never at rest; they are in a perpetual state of vibration and interaction, even in what we perceive as stable matter, which implies a constant presence of dharma nature, yet devoid of intrinsic solidity. This movement manifests the quantum fields that underlie all particles, from quarks to leptons.

The apparent solidity we experience in the everyday world is thus an illusion produced by the limits of our observational capabilities. The *Vimalakirti Nirdesa Sutra* 《維摩詰所說經》 uses metaphorical language to depict the illusory nature of phenomena, stating:

> 是故知一切法，如幻如化，如夢如影，如響如焰 (Thus, one should understand that all dharmas are like illusions, transformations, dreams, shadows, echoes, and mirages), encouraging practitioners to see beyond superficial forms to the underlying emptiness.

Figure 1. It illustrates the Illusion of Bodily Solidity Revealed as Subatomic Particles in Constant, Jittering Motion

Our sensory faculties, operating far below the speed of light, cannot detect the constant motion at the subatomic level, so we perceive objects as static and solid. However, at the quantum scale, particles are continuously exchanging energy and transforming through interactions mediated by fundamental forces such as the electromagnetic force (for electrons and photons) and the strong force (for quarks and gluons)[22].

This hypothetical perspective—observing at or beyond the speed of light—would fundamentally challenge our classical intuitions, revealing that what we perceive as stable objects are transient phenomena, which all are “like illusions, transformation, dreams shadows, echoes and mirages”, maintained through the dynamic interactions of countless particles. In quantum field theory, these particles are excitations of underlying fields, and constant fluctuations in energy define their existence. Even the vacuum of space is not empty but filled with quantum fluctuations, where virtual particles constantly appear and disappear[22]. The distinction between solid matter and energy would blur at a higher observational capacity, revealing a dynamic quantum world where particles are in constant motion and interaction. This challenges classical mechanics, which perceives matter as fixed

and solid. Observing the underlying quantum field would show a continuously evolving web of energy and particles. The speed of light imposes limitations that shape our understanding of space-time and causality. In quantum field theory, particles are excitations of underlying fields, their interactions governed by virtual particle exchanges constrained by the light cone structure of space-time. In《楞嚴經》 (*Śūraṅgama Sūtra*)

> 佛告阿難：汝所見者，光明遍照，照所照者，不移無礙，是則汝心，與彼明色，亦復如是，不同凡夫，妄識分別。(The Buddha told Ananda: What you see is the light that illuminates everywhere. The illuminated does not move and is unobstructed. Thus, your mind, along with the bright light you see, is not different from the delusional distinctions made by ordinary beings).

The *Śūraṅgama Sūtra* passage highlights the illusory nature of perceived distinctions. This teaching aligns with the insights of quantum mechanics, which challenges the classical view of matter as fixed and solid. While classical mechanics is perceived by ordinary beings as a world composed of discrete objects governed by predictable laws, quantum mechanics reveals a deeper reality where particles exist as probabilistic excitations of underlying fields, interacting through non-local connections constrained by the speed of light. The notion of 'unobstructed light' in the *Śūraṅgama Sūtra* can be interpreted metaphorically as representing an observational perspective that transcends the constraints imposed by the speed of light, thereby enabling a view of reality that is unbounded and free from obstruction. This perspective allows for the perception of the interconnected, continuously evolving nature of reality, which goes beyond ordinary conceptions of separateness and solidity. Such an understanding resonates with quantum mechanics, where particles are not confined by classical limitations but instead exist in a probabilistic and relational state that defies conventional spatial and temporal constraints. By suggesting an unobstructed view, the sutra implies a mode of awareness that perceives the fundamental unity and dynamism of all phenomena, unmediated by the usual limitations of sensory perception and classical physics. This broader, more inclusive understanding of reality invites a rethinking of the nature of observation itself, aligning with the non-local and indeterminate nature of quantum phenomena.

Furthermore, the notion of locality—wherein objects can only be influenced by their immediate surroundings—breaks down at the quantum level due to phenomena like entanglement[23]. Entangled particles remain correlated over arbitrary distances, such that the measurement of one particle instantaneously affects the state of the other, seemingly in defiance of the speed of light constraint. This non-local behaviour, demonstrated experimentally through violations of Bell's inequalities, highlights the limits of our classical understanding and suggests a more intricate, interconnected reality[24]. The concept of non-local entanglement, where entangled particles remain interconnected regardless of distance, defies the constraints imposed by the speed of light, suggesting a deeper level of reality that classical physics cannot fully explain. While relativity establishes the speed of light as the upper bound for information transfer, quantum entanglement appears to operate outside these conventional limits, indicating that spacetime constraints do not bind the underlying nature of reality but are integrally related through dependent origination. From a Buddhist philosophical perspective, entanglement can be interpreted through the lens of dependent origination (*pratītyasamutpāda*), which posits that all phenomena arise in interdependence and lack inherent, independent existence. In this view, the apparent separateness of entangled particles is an illusion, much like the perceived stability of macroscopic objects. Dependent

origination suggests that the existence and behaviour of one particle are fundamentally tied to the conditions and state of the other, regardless of spatial separation[25].

The discussion thus far underscores the profound limitations of human sensory perception and classical observation in grasping the true nature of reality at the quantum level. The apparent solidity and stability of the macroscopic world are illusions produced by the constraints of our perceptual faculties and the fundamental limits imposed by the speed of light. When viewed through the lens of quantum mechanics, matter is a dynamic interplay of energy and particles, continuously fluctuating and interacting within a framework governed by fundamental forces. This perspective challenges the deterministic assumptions of classical physics. It aligns with Buddhist metaphysics, suggesting that the inherent nature of reality is not fixed and independent but interdependent and constantly in flux.

This paper contributes to the interdisciplinary discourse by drawing parallels between quantum mechanics' probabilistic and interconnected nature and the Buddhist concept of dependent origination (*pratītyasamutpāda*). It suggests that objects' apparent stability and separateness are illusions similar to the delusions generated by ordinary sensory perception in Buddhist teachings. By integrating these insights, the paper offers a novel interpretative framework that bridges the gap between modern scientific understanding and ancient philosophical wisdom, encouraging a re-examination of how we conceptualize reality at its most fundamental level. This exploration not only advances our comprehension of quantum phenomena but also enriches our understanding of the metaphysical implications of interdependence and emptiness, providing a holistic perspective that transcends the boundaries of both science and spirituality.

Beyond Physical Perception: Transcending Sensory Limits to Understand the Interconnected Nature of Reality in Buddhism and Quantum Physics

The inability to observe the true nature of the quantum world beyond the speed of light perpetuates the illusion of separateness and stability in the macroscopic world. The constraints on human observation, particularly within quantum mechanics, mirror Buddhist teachings on the illusory nature of sensory experiences. Both perspectives suggest that what is perceived through ordinary senses can be misleading, as it conceals existence's deeper, interconnected reality. Quantum mechanics has demonstrated that the universe does not adhere to the classical concept of local realism; particles can be entangled and exhibit correlations that defy the limitations of space and time[26], thereby challenging our conventional understanding of reality. The Nobel Prize in Physics awarded to John Clauser, Alain Aspect, and Anton Zeilinger for their work on quantum entanglement underscores this paradigm shift[27]. Their experiments confirmed that the universe is fundamentally non-local, aligning with the Buddhist view that sensory perception often misrepresents the true, interdependent nature of phenomena, suggesting that the reality we experience is a construct of the mind rather than an independent, self-sustaining existence[25].

In Buddhism, our ordinary perceptions, termed 肉眼[3] (physical or flesh eyes), are understood to be inadequate for grasping the true nature of reality. Sensory observation through the physical eyes is seen as a superficial engagement with the world, constrained by the illusion of separateness and solidity. This is similar to how classical physics provides a limited view of reality by relying on deterministic and localized observations that fail to account for particles' deeper, quantum interconnectedness. Buddhist teachings posit that elevated states of awareness, symbolized by the metaphorical lenses of 天眼[4] (divine eye), 慧眼[5] (wisdom

eye), 法眼[6] (Dharma eye), and 佛眼[7] (Buddha eye), enable one to transcend ordinary perception and discern the true nature of reality as interdependent and empty (*śūnyatā*). These higher modes of perception are not to be understood literally but as metaphors for profound spiritual insights that reveal the contingent and non-intrinsic nature of all phenomena. Such insights align with the principles of dependent origination (*pratītyasamutpāda*), which asserts that everything arises in dependence on a network of causes and conditions, lacking independent, inherent existence[25].

The progression from 肉眼 (flesh eye) to 佛眼 (Buddha eye) illustrates an ascent from ordinary sensory perception to profound spiritual insight. While the flesh eye is limited to the physical and apparent world, each successive eye expands the scope of perception and understanding, ultimately culminating in the Buddha eye, which perceives the true nature of all phenomena in their entirety. This hierarchical structure reflects the Buddhist path from ignorance and delusion to full awakening, demonstrating the transformative potential of spiritual practice.

This view parallels the findings of quantum mechanics, which challenges the classical notion of discrete, independent objects by revealing the non-local and probabilistic behaviour of subatomic particles[24]. Quantum entanglement, for instance, shows that particles can remain interconnected across vast distances in ways that defy classical expectations of separateness and locality. As Buddhist philosophy urges a move beyond conventional sensory perceptions to understand the emptiness and interconnectedness of all things, quantum mechanics encourages us to reconsider the nature of reality itself, revealing a fundamentally dynamic and relational universe rather than one composed of isolated, static entities.

Though distinct in their methodologies and purposes, both frameworks converge in their portrayal of reality as a complex, interdependent web, constantly in flux. This understanding challenges the solidity and independence perceived in everyday experience and calls for a more nuanced, holistic perspective that transcends both the limitations of classical physics and superficial sensory experiences. Consequently, the insights of Buddhism and quantum mechanics together invite a re-examination of the nature of existence, highlighting the illusory nature of separateness and encouraging an appreciation of the deeper, interconnected fabric of reality.

The resonance between quantum mechanics and Buddhist epistemology lies in the realization that both frameworks call for a shift from surface-level observation to a deeper understanding of reality perceived through different lenses (天眼, 慧眼, 法眼, and 佛眼). In quantum theory, the inability to observe at or beyond the speed of light keeps the quantum world hidden, creating the illusion of stability and solidity in the macroscopic world. Similarly, Buddhist thought teaches that sensory perception masks the true nature of reality, which is empty of intrinsic form and inherently interconnected *(Shurangama Sutra*).

In both quantum and Buddhist perspectives, deeper layers of reality are accessible only through transformative modes of observation—whether through advanced scientific instruments or heightened states of consciousness. This alignment between the limitations of sensory perception and the quantum world emphasizes the need to move beyond immediate appearances and explore the underlying dynamics that govern material and quantum existence.

This challenges the classical notion of locality and separateness, much like dependent origination challenges the idea of inherent self-existence. The implications of non-local entanglement are profound, bridging the conceptual gaps between classical physics, quantum mechanics, and metaphysical interpretations of the universe. By understanding entanglement through the dependent origination framework, we can see reality not as a collection of isolated, independent objects but as a deeply interconnected web of interdependent relationships. This view aligns with the quantum mechanical understanding of the universe as an evolving and interconnected whole, challenging our conventional notions of space, time, and causality.

In this way, both quantum mechanics and Buddhist metaphysics reveal that the true nature of reality transcends the limitations of classical observation (through 肉眼), suggesting a fundamentally relational, dynamic, and interdependent universe.

Transcending Appearances: 破相(*pòxiàng)* as a Framework for Understanding Quantum Phenomena

This limitation is reminiscent of the Buddhist insight that our ordinary perceptions are deceptive and fail to capture the true nature of reality, as illustrated in the Diamond Sutra 《金剛經》:

> 一切有為法，如夢幻泡影，如露亦如電，應作如是觀。(All conditioned phenomena are like a dream, an illusion, a bubble, a shadow, like dew or a flash of lightning; thus, one should observe them).

The Buddhist concept of *pòxiàng* involves dismantling illusions and challenging the reality of perceived forms by emphasizing their emptiness. This notion finds a parallel in quantum mechanics, particularly in breaking local realism, where particles can be entangled and exhibit correlations that classical physics cannot explain. Bell's theorem, which provides a method to test the hidden variable hypothesis empirically, demonstrates that no local hidden variable theory can replicate the predictions of quantum mechanics[28]. This finding challenges the classical view of independent, separate objects, aligning with the Buddhist understanding that all distinctions and separations are ultimately empty and illusory. Here are three excerpts from Buddhist sutras in Chinese that convey the understanding that all distinctions and separations are ultimately empty and illusory:

> 《金剛經》 (Diamond Sutra): 凡所有相，皆是虛妄。若見諸相非相，即見如來。(All appearances are deceptive. If one sees that all appearances are not appearances, one considers the ***Tathāgata***).

> 《心經》 (Heart Sutra): 色不異空，空不異色；色即是空，空即是色。(Form does not differ from emptiness; emptiness does not differ from form. The form itself is emptiness, and emptiness itself is form).

> 《大智度論》 (***Mahāprajñāpāramitā-śāstra***): 一切法無自性，無生無滅，無來無去，故說為空。(All phenomena are devoid of intrinsic nature; they are neither born nor destroyed, neither come nor go, and therefore are said to be empty).

In summary, the selected passages from essential Buddhist sutras illustrate that all perceived forms, distinctions, and separations are fundamentally illusory, pointing to the concept of emptiness (*śūnyatā*) as the ultimate nature of all phenomena. The Diamond Sutra teaches that appearances are deceptive, and true wisdom arises when one perceives the formlessness behind these appearances. Similarly, the Heart Sutra emphasizes the inseparability of form and emptiness, rejecting the dualistic distinction between them. Furthermore, the *Mahāprajñāpāramitā-śāstra* reinforces the view that all phenomena lack inherent existence and that the distinctions we make between different objects and experiences are merely constructs born out of ignorance. Together, these texts reflect the Buddhist understanding that the reality we perceive manifests our limited sensory and conceptual frameworks, and true insight involves transcending these illusions to grasp the interconnected, empty nature of reality. This perspective challenges our conventional views and calls for a deeper recognition of the inherent interdependence and impermanence that underlie all phenomena.

Another pertinent passage from the *Mūlamadhyamakakārikā* by *Nāgārjuna* asserts:

> 一切法無自性，生亦不可得。(All phenomena lack intrinsic nature, and their arising cannot be grasped).

This view aligns with the quantum mechanical understanding that the properties of particles are not predetermined but arise probabilistically and, therefore, cannot be grasped, only becoming definite upon observation. The framework of *pòxiàng* offers a compelling interpretive tool for bridging the conceptual gap between classical and quantum physics. Classical physics, emphasizing locality and determinism, mirrors the attachment to forms and appearances. In contrast, quantum physics, revealing a non-local and probabilistic reality, resonates with the Buddhist insight into the emptiness and interconnectedness of all phenomena. By applying *pòxiàng* as a theoretical framework, we can gain a more profound appreciation for the non-intuitive truths unveiled by quantum mechanics, seeing them as part of a broader metaphysical understanding that transcends the boundaries of science and spirituality.

From Local Realism to Quantum Non-Locality: A New Perspective on Interconnectedness

Classical physics has long maintained locality as a core principle, asserting that objects can only be influenced by their immediate surroundings and that any interactions are limited by the speed of light, a notion foundational to our understanding of causality and physical reality[29]. However, experiments conducted by Clauser, Aspect, and Zeilinger on quantum entanglement challenge this classical assumption[2]. Their findings demonstrate that two particles, once entangled, remain instantaneously correlated regardless of the distance separating them, thereby violating the principle of locality and suggesting that quantum mechanics operates under entirely different laws.

This phenomenon can be metaphorically aligned with the Buddhist *pòxiàng*, which entails the deconstruction of appearances and the recognition that the reality perceived through sensory experience is illusory. In the quantum realm, this is akin to the realization that particles do not possess definite properties until they are observed, thus challenging the classical view of fixed, independent entities[12]. Quantum mechanics, particularly through Bell's theorem and entanglement experiments, reveals that the characteristics of particles are contingent upon their interaction with observers, reflecting the Buddhist view that all forms are empty of

inherent existence and arise through dependent conditions (*Nāgārjuna*, *Mūlamadhyamakakārikā*).

Moreover, the Buddhist doctrine of dependent origination (*pratītyasamutpāda*), which posits that all phenomena arise in interdependence, resonates with quantum entanglement, where the state of one particle is inseparable from another, even across vast distances. In the *Mahāparinirvāṇa Sūtra* 《大般涅槃經》, it is explicitly stated:

> 諸法實相者，謂於世間一切法中，空無所有 (The true nature of all dharmas is that they are empty of any inherent existence)

This interconnectedness, echoing the deep interdependence and uncertainty highlighted by quantum entanglement, which reveals the interconnectedness of particles beyond classical spatial constraints, undermines classical notions of isolated, independent entities, suggesting a universe far more interdependent and relational than previously understood[23]. Both *pòxiàng* and the quantum violations of Bell inequalities offer a radical shift from deterministic, localized models of reality, pointing to a fluid, interconnected, and probabilistic universe. Viewing quantum experiments through the lens of *pòxiàng* enriches the philosophical discourse on quantum mechanics, fostering a dialogue between Buddhist metaphysics and modern physics that expands our understanding of the nature of reality. This synthesis enhances interpretations of quantum phenomena and deepens the dialogue between science and philosophy, bridging classical and quantum views in new and profound ways, mainly when congruences are found in Buddhist scriptures.

In various Buddhist scriptures, the ephemeral nature of phenomena and the absence of inherent existence are emphasized, reflecting a profound alignment with the principles of uncertainty and non-locality found in modern quantum mechanics. In the Diamond Sutra《金剛經》:

> 須菩提！若善男子、善女人，以三千大千世界碎為微塵；於意云何？是微塵眾，寧為多不？須菩提言：甚多。世尊！何以故？若是微塵眾實有者，佛則不說是微塵眾。所以者何？佛說微塵眾，即非微塵眾，是名微塵眾。世尊！如來所說三千大千世界，則非世界，是名世界。何以故？若世界實有者，即是一合相；如來說一合相，則非一合相，是名一合相。須菩提！一合相者，則是不可說，但凡夫之人，貪著其事。
>
> ***Subhuti***, if a virtuous man or woman were to grind the great trichiliocosm (三千大千世界) into particles of dust, do you think that these particles would be many?"
> ***Subhuti*** replied, "Yes, World Honored One, they would be many."
> The Buddha continued, "If these particles had an inherent existence, the ***Tathagata*** would not call them 'dust particles.' Why? Because what the ***Tathagata*** refers to as 'dust particles' are not actually 'dust particles'; they are merely named 'dust particles.' Likewise, the world is not truly the world; it is merely named 'the world.' Why is this so? Because if the world had inherent existence, it would be a singular unity. The ***Tathagata*** teaches that a singular unity is not true; it is only named as such by convention. ***Subhuti***, what is called a 'singular unity' is beyond description, yet ordinary people become attached to it.

須菩提！若人言：佛說我見、人見、眾生見、壽者見。須菩提！於意云何？是人解我所說義不？不也，世尊！是人不解如來所說義。何以故？世尊說我見、人見、眾生見、壽者見，即非我見、人見、眾生見、壽者見，是名我見、人見、眾生見、壽者見。須菩提！發阿耨多羅三藐三菩提心者，於一切法，應如是知、如是見、如是信解，不生法相。須菩提！所言法相者，如來說即非法相，是名法相。

Subhuti, if someone were to say that the ***Tathagata*** holds views about a self, a person, a being, or a life span, would that person understand the meaning of my teachings?"
Subhuti replied, "No, World Honored One, such a person would not understand the meaning of the ***Tathagata*'s** teachings. Why? Because when the ***Tathagata*** speaks of a self, a person, a being, or a life span, they are not truly such; they are merely named as such."

The Buddha continues by explaining that to achieve supreme enlightenment, one must not be attached to any phenomenon. Even what we call the nature of phenomena (法相) is not the true nature; thus, one should not become attached to it.

須菩提！若有人以滿無量阿僧祇世界七寶，持用布施。若有善男子、善女人，發菩提心者，持於此經，乃至四句偈等，受持、讀誦，為人演說，其福勝彼。云何為人演說？不取於相，如如不動。何以故？一切有為法，如夢、幻、泡、影；如露，亦如電，應作如是觀。

佛說是經已，長老須菩提，及諸比丘、比丘尼、優婆塞、優婆夷，一切世間天、人、阿修羅，聞佛所說，皆大歡喜，信受奉行。

Subhuti, if someone were to fill immeasurable worlds with the seven treasures and give them away as an act of charity, and if another person, whether man or woman, having awakened the aspiration for enlightenment (***bodhicitta***), was to uphold, recite, and explain even as much as a four-line verse from this sutra, the merit of the latter would surpass that of the former. Why? Because when explaining this sutra, one should not cling to appearances, remaining unmoved like the reality itself. Why is this so? All conditioned phenomena are like a dream, an illusion, a bubble, a shadow, like dew or a flash of lightning. Thus should one observe them.

After the Buddha had spoken this sutra, Elder ***Subhuti***, along with all the monks, nuns, laymen, and laywomen, as well as all the ***devas***, humans, and *asuras* in the world, rejoiced at the Buddha's words, accepted them with faith, and practiced accordingly.

In this passage from the Diamond Sutra, the Buddha uses the metaphor of dust particles (which can also be metaphorically referred to as quantum particles) and the trichiliocosm (a vast world system) to deconstruct the apparent solidity and independent reality of all phenomena. In Buddhist philosophy and quantum mechanics, the metaphor of dust particles serves as a powerful analogy for understanding reality's transient and elusive nature. In the Diamond Sutra, dust particles symbolize the lack of inherent existence and the emptiness

(*śūnyatā*) of all phenomena. The Heart Sutra 《心經》 further elaborates on the concept of non-duality, stating:

> 色不異空，空不異色；色即是空，空即是色」(Form does not differ from emptiness; emptiness does not differ from form. Form itself is emptiness, and emptiness itself is form).

This highlights the interdependence of form and emptiness, paralleling the wave-particle duality in quantum mechanics, where particles exhibit wave-like and particle-like properties depending on the observation context. This notion resonates with the quantum mechanical concept of subatomic particles, which do not possess fixed, inherent properties until observed[20].

In *Nāgārjuna*, in his *Mūlamadhyamakakārikā* 《中論》, elucidates:

> 眾因緣生法，我說即是無；亦為是假名，亦是中道義 (All phenomena arise from conditions, and I declare they are empty; they are merely names and also reflect the middle path).

This passage emphasizes that all phenomena lack intrinsic existence and are contingent on a web of interdependent causes and conditions, which mirrors the quantum view that particles do not possess definite properties until measured. Quantum particles, such as electrons and photons, exist in a superposition state, representing multiple potential outcomes, until a measurement collapses the wave function into a definite state[12].

In the quantum realm, particles can appear and disappear from existence, exhibiting behaviours that challenge classical notions of stable, localized entities. For instance, virtual particles in quantum field theory constantly emerge and vanish in the vacuum, contributing to the Casimir effect[30]. The Śūraṅgama Sūtra 《楞嚴經》 describes a similar phenomenon, and it states:

> 當處出生，隨處滅盡 (Arising at this place, ceasing at this place), underscoring the transient and impermanent nature of phenomena.

These particles, much like the dust particles in the Diamond Sutra, lack inherent properties and are defined by their interactions with other particles and fields. In quantum field theory, particles are not static entities but temporary excitations of underlying fields, appearing (or arising) and disappearing (or ceasing) due to the inherent fluctuations of the quantum vacuum. These virtual particles, although unobservable directly, have measurable effects, such as the Casimir effect and the Lamb shift, which provide indirect evidence of their existence[31]. This phenomenon is enabled by Heisenberg's uncertainty principle, which permits short-lived violations of energy conservation, allowing particle-antiparticle pairs to spontaneously emerge and annihilate in a process that challenges classical concepts of a stable, unchanging reality[32]. These findings underscore a view of the universe as a dynamic, interconnected web of interactions, where the apparent solidity of matter is a result of underlying quantum processes. This transient nature challenges our conventional understanding of reality, suggesting that what we perceive as solid and continuous is, in fact, a dynamic interplay of fleeting, interdependent elements. Moreover, the principle of non-locality in quantum mechanics, demonstrated through entanglement, shows that particles can

be instantaneously correlated across vast distances without being physically connected[33]. The *Avataṃsaka Sūtra* 《華嚴經》 states:

> 一切眾生及諸世界，皆如影像，無有自性 (All sentient beings and all worlds are like reflections and have no intrinsic nature).

This defies the classical idea of separateness and locality, much like the Buddhist view that all distinctions and separations are illusory and that phenomena are interconnected and contingent upon causes and conditions (*Nāgārjuna, Mūlamadhyamakakārikā*). The metaphor of dust particles thus aligns with the quantum understanding of reality as a web of interdependent processes, lacking any intrinsic, unchanging essence, further emphasizing the illusory nature of phenomena, much like the quantum concept of non-locality and entanglement.

The appearance and disappearance of quantum particles[34] can also be linked to the concept of dependent origination (*pratītyasamutpāda*) in Buddhism, which posits that all phenomena arise in dependence on other phenomena and lack independent existence. This philosophical framework, which deconstructs the notion of self-contained entities, parallels the quantum view that particles exist as excitations of underlying fields and that their properties are not intrinsic but arise through interactions. The metaphor of dust particles in the Diamond Sutra and the behaviour of quantum particles in modern physics point to a fluid, interdependent reality devoid of inherent solidity. By challenging the classical and common-sense notions of stable, objective reality, both frameworks invite us to reconsider the nature of existence itself, suggesting that what we perceive as solid and distinct is merely an illusion born of our limited perspective, formed by particles that emerge and disappear in uncertain ways[35].

Quantum mechanics, mainly through uncertainty, reveals that particles exist in superpositions, lacking definitive states until measurement collapses the wave function into a specific outcome. This idea aligns with the Buddha's assertion that dust particles and the world do not have inherent existence but are dependent on observation and interaction. The *Mahāprajñāpāramitā-śāstra* 《大智度論》 explains the concept of dependent origination, describing how

> 無明因緣行，行因緣識，識因緣名色……是名緣起法 Ignorance conditions volitional formations, which condition consciousness, and so on)

Furthermore, the concept of quantum entanglement, demonstrating that all phenomena arise from interdependent conditions and have no separate, independent existence, deconstructs the classical notion of isolated, independent entities, which demonstrates that particles remain interconnected regardless of distance, echoes the Buddhist understanding of interdependence and the illusory nature of distinctions and separations.

The Diamond Sutra encourages practitioners to transcend superficial appearances, recognizing that forms are merely transient and interconnected phenomena, much like quantum particles that defy classical notions of locality and determinism. The instruction to perceive all conditioned phenomena as fleeting—like a dream, an illusion, a bubble, or a flash of lightning—can be compared to the quantum superposition of particles, where potential outcomes exist until an observation collapses them into a defined state.

Furthermore, the *Bodhisattvacharyāvatāra* 《入菩薩行論》 observes:

> 若此夢境非真實，則一切法非真實 (If this dream-like state is not real, then all dharmas are not real)

This collapse can be seen as analogous to becoming attached to appearances, pointing to the dream-like, illusory quality of the phenomenal world, solidifying what is inherently fluid and interdependent.

Finally, the Buddha's teaching in this passage, which emphasizes the superiority of understanding and conveying the wisdom of the sutra over material acts of generosity, also reflects the transformative potential of such realizations. By grasping the interconnectedness and emptiness of all forms, one gains deeper insight into the nature of reality. Like quantum mechanics, this view challenges classical assumptions of an independent, deterministic universe. It suggests that reality is far more fluid and interconnected than our senses and classical physics suggest.

These texts collectively demonstrate Buddhism's deep insight into the nature of reality, suggesting that all phenomena are empty of inherent existence and arise dependently. This understanding closely resonates with modern scientific perspectives on the non-local and probabilistic nature of the material world, bridging the insights of ancient wisdom and contemporary science.

Conclusion

In conclusion, the intersection between quantum mechanics and Buddhist metaphysics offers a profound framework for understanding reality's fluid and interconnected nature. Classical physics, rooted in the principle of locality, posits that objects are only influenced by their immediate surroundings. However, the pioneering experiments on quantum entanglement conducted by Clauser, Aspect, and Zeilinger revealed the limitations of this framework, showing that particles can be instantaneously correlated over vast distances, thus defying locality. This discovery resonates with the Buddhist concept of *pòxiàng*, which challenges the belief in the inherent solidity of forms and emphasizes the emptiness and interdependence of all phenomena[25]. Moreover, the *Mahāprajñāpāramitā Sūtra* 《大般若經》asserts:

> 「諸法無自性，無生無滅，無來無去」(All dharmas are without intrinsic nature, neither born nor destroyed, neither coming nor going)

Both quantum mechanics and Buddhist thought emphasize the impermanence and emptiness of phenomena, much like the continuous fluctuations of the quantum field, which deconstruct the classical notion of independent, fixed entities. Through Bell's theorem and violating Bell inequalities, quantum physics demonstrates that particles lack definite properties until observed, reflecting the Buddhist understanding that all phenomena are contingent and lack intrinsic existence. The Buddhist principle of dependent origination, which suggests that all phenomena arise through interdependence, parallels the non-local behaviour of entangled particles, further bridging these two domains of thought.

Ultimately, integrating *pòxiàng* with quantum mechanics enriches the philosophical interpretation of quantum phenomena and fosters a deeper dialogue between science and

philosophy. This convergence highlights the need for a more nuanced understanding of reality that transcends both the limitations of classical physics and ordinary sensory perception. By expanding the scope of inquiry, this interdisciplinary dialogue offers new insights into the nature of existence, demonstrating the potential for both fields to inform and complement one another in the ongoing exploration of reality.

Statements and Declarations

About the Author

David Leong, Ph.D., is an entrepreneurship theorist with more than two and a half decades of experience as an entrepreneur. He started his entrepreneurial ventures early after graduating from the National University of Singapore in 1994 with a Bachelor of Business Administration degree. He has two PhDs – one from Charisma University and the other from the University of Canberra. He has founded at least fifteen ventures spanning corporate finance, business and marketing consultancy, technology solutions, asset management, and human resources (HR). He is widely regarded as an expert resource and a leader in the business field. In addition, local media, such as The Straits Times, Business Times, Lianhe Zaobao, and Channel News Asia, often seek his views on economics, politics, and HR issues. His research is in entrepreneurship. His other research interest is the Chinese Yijing (Book of Changes). He draws the relatedness of Yijing with modern science, particularly quantum physics. He is the author of several scientific and professional articles, as well as chapters in books. He also published a book "Uncertainty, Timing and Luck on Quantum Terms in Entrepreneurship."

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Footnotes

[1] The term '*Tathāgata*' (Sanskrit: तथागत; Pali: Tathāgata) is a significant epithet used to describe a Buddha, and it is one of the most frequently used self-referential terms by

Siddhartha Gautama, the historical Buddha, in canonical texts. This title, often translated as ‘Thus-Gone’ or ‘Thus-Come’, reflects the Buddha's transcendence beyond ordinary existence and his attainment of enlightenment. It conveys a state of being that has transcended the dualities of coming and going, being and non-being, and all conditioned phenomena[36]. The term suggests a profound realization of the ultimate truth, beyond conventional definitions of existence, marking the Buddha’s unique status as one who has perfectly realized and embodies the *Dharma*. This title highlights the Buddha's identity as one who has reached the ultimate state of enlightenment and has fully comprehended the nature of all phenomena as they truly are, beyond the illusions of the mundane world.

[2] Dependent origination (Sanskrit: *pratītyasamutpāda*; Pali: *paṭicca-samuppāda*), also referred to as conditioned co-arising, is a foundational concept in Buddhist philosophy that posits that all phenomena arise in dependence on a complex web of conditions. This principle asserts that nothing exists independently; rather, every thought, object, and being, as well as the universe itself, is interdependent and conditioned by a multitude of factors. This interconnectedness applies universally, demonstrating that every aspect of existence is contingent on the presence and interaction of other elements (Nagarjuna, *Mūlamadhyamakakārikā*).

[3] The 肉眼, or flesh eye, refers to ordinary physical vision by ordinary beings, the basic sensory perception through which beings perceive the external world. This type of vision is limited to material forms and is constrained by physical and cognitive limitations. It is subject to delusion, as it perceives the world in terms of separateness and solidity, unable to see the true nature of phenomena as empty (*śūnyatā*) and interconnected[37].

[4] The 天眼, or divine eye, is a form of supernormal vision that allows one to see beyond the limitations of space and time. In Buddhist cosmology, this eye enables one to perceive the birth, death, and rebirth of beings in various realms of existence. It transcends the constraints of the flesh eye by providing insight into the continuous cycle of samsara (birth and death), thus revealing the impermanence of all conditioned things. It is often described in the context of meditative attainments and is considered a preliminary stage of advanced spiritual practice [37].

[5] The 慧眼, or wisdom eye, represents the capacity to discern the ultimate truth of emptiness (*śūnyatā*). Unlike the divine eye, which perceives the form and process of existence, the wisdom eye penetrates the true nature of phenomena, seeing beyond their illusory appearances. It allows one to understand the principle of dependent origination (*pratītyasamutpāda*), recognizing that all phenomena are interdependent and devoid of inherent self. This level of insight is crucial for attaining the path of liberation[37].

[6] The 法眼, or *Dharma* eye, signifies the ability to perceive the *Dharma* (the ultimate law or truth) as it truly is. It entails the understanding of the workings of all dharmas (phenomena) and their alignment with the teachings of the Buddha. The *Dharma* eye allows one to see the path leading to the cessation of suffering, discern the differences in capacities and dispositions of beings, and apply the teachings accordingly. It is an essential attribute of a bodhisattva who guides others towards enlightenment[37].

[7] The 佛眼, or Buddha eye, is the highest and most comprehensive form of vision. It encompasses all the previous eyes and is the all-seeing, all-knowing eye of a fully

enlightened Buddha. It represents perfect wisdom and omniscience, perceiving the ultimate nature of all things simultaneously. The Buddha eye sees the true nature of all beings and phenomena without obstruction or distortion, perfectly embodying compassion and wisdom. It is the culmination of spiritual development and the attainment of ultimate enlightenment[37].

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