Non-Duality, Trinity, Quinternity, Unity

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Abstract

This paper summarizes progress in theoretical physics toward a more unified view of nature, and shows that this progress inexorably is linking to the ancient holistic account of Veda. The Vedic account addresses key dilemmas still widely considered needing to be resolved. The 10 Mandalas of Rk Veda – non-duality, trinity, quinternity, unity (10^{th} to 1^{st}) – integrate force fields in quantum and cosmological theories with the holistic 3-in-1 Vedic model of gross local relativistic spacetime, subtle nonlocal spacetime, and infinite unified field. *

Key words: Locality, Planck scale, nonlocality, unified field, Veda, consciousness, non-duality

Introduction

Modern science rigorously pursues total knowledge of the laws of nature. Its primary methods are *reasoning* and ordinary sensory *experience* from the *objective* third-person perspective. Total knowledge is also pursued in the ancient Vedic knowledge tradition, emphasizing the *subjective* first-person empirical perspective. This paper proposes that the third-person perspective has advanced modern scientific understanding to the stage where first-person direct means to gain knowledge is being recognized as useful to address long-standing dilemmas about matter and mind.

The focus in *objective* science has been on reductive analysis of sensory objects, probing smaller and smaller time and distance scales and higher energy and temperature states to uncover the most fundamental constituents of nature. The range of scales can be summarized as follows:

Ultra-macroscopic levels	~cosmic expanse to Infinity?
Macroscopic levels	~10^{-3} cm to ~cosmic expanse
Microscopic levels	~10^{-4} to ~10^{-8} cm
Ultra-microscopic levels	~10^{-9} to ~10^{-33} cm (Planck length)
Unified field level	~Infinitesimal point to Infinity?

However, the resolving power of our ordinary senses for direct observation is quite limited. The wavelength of visible light, for example, is in the range of 10^{-4} cm, too wide to observe directly anything smaller than a cell. Observation has been extended with the aid of equipment such as electron microscopes to about 10^{-8} cm, still much larger than atomic nuclei. But research now has gone beyond tangible empirical evidence using unaided and aided direct observation. *Indirect* experimental methods are now regularly used, the results of which are macroscopic phenomena observed by the ordinary human senses that are predicted by and dependent upon models of theorized ultra-microscopic, unobservable layers of nature. In physics, one prominent indirect method uses particle accelerators. The most powerful is the Large Hadron Collider (LHC) at CERN near Geneva, Switzerland, with the capability to probe to about 10^{-19} cm. However, energy levels needed in order to probe the theorized tiniest scales are still far greater even than these most powerful instruments available (Boyer, 2008, 2021).

*Content in this paper has been drawn from books by R.W. Boyer: *Pointless: The reality behind quantum theory* (Routledge publication, 2021) and *Bridge to Unity: Unified field-based science and spirituality* (2008).

Another indirect method is to search for remnants that may support predictions of events near the time of the 'big bang.' These cosmological methods address *ultra-macroscopic* research on gravity and the shape of the cosmos, while particle accelerators mainly address *ultra-microscopic* research.

Applying indirect methods such as these, research involving theorized independent external probes has the additional concern that at extremely small scales the objects investigated can be significantly altered by the probing and measuring processes. Analyses of theorized events at smaller scales than are perceivable through the ordinary unaided or aided senses increasingly depend upon conceptions of what the *process of measurement* means. As research progresses from tangible observable objects to more abstract unobservable objects and processes, reasoning and logical consistency are necessarily relied upon more than ordinary macroscopic sensory experience.

One major change from classical to quantum physics is that these issues are now recognized in the *measurement problem* and in trying to understand the *role of the observer* in measurement. Inevitably, assumptions about the nature of the object of investigation, probes and the process of observing, and also the observer now must be considered in investigating these theorized objects. Deeper intuitive presuppositions and assumptions that underpin quantum theory (QT) and that delimit measurement processes now must be given more careful consideration in this research. There is now deeper appreciation that beliefs and assumptions affect how empirical results and 'facts' are interpreted, as well as what experiments are deemed worth conducting.

To protect against unreliable sensory and reasoning processes in the scientific investigators, the *objective* approach relies on *consensual validation* about how experimental results are evaluated. Though given little consideration in the history of modern science, it is slowly but increasingly recognized that it also depends on the level of functioning of contributors to the consensus. Reasoning and ordinary experience are common processes of the ordinary waking state. This state is a representational or reflective mode of knowing, characterized by experience of a fundamental separation or duality of the inner conscious observer and independent outer objects. It is the phenomenological basis for the assumption of the independence of observed and observer that is fundamental to the 'objective' scientific method. Logically, it must eventually give way to a deeper unity in scientific progress toward a single, *completely* unified field (Boyer, 2008, 2021).

Although experiencing nature as separate from the observer is assumed to be 'given by nature,' it is rather that this dualistic view of subject-object independence is imposed upon nature via the observer's ordinary waking state experiences. Given this epistemological framework, it is not surprising that the methodology in modern science is fundamentally fragmented into subject/object *independence*, associated with mind/matter duality. As investigations have gone from macroscopic tangible localized matter to underlying abstract nonlocal fields, however, the *interdependence* of object and observer is now being acknowledged – toward deeper integration and unification.

The Vedic approach emphasizes first-person systematic methods to experience nature that have not been emphasized in 'objective' modern science. In this view, the mind and the universe examined using it share the same source and the same laws of nature. This implies that reliable knowledge can be gained directly in the *inner laboratory of the scientist's mind* by direct empirical means to investigate matter, mind, and consciousness in the systematic pursuit of total knowledge. We first briefly overview major quantum theories to establish the background to extend into Veda.

Standard quantum theory and consciousness

With progress from the classical to the quantum paradigm, critical challenges to the assumption of subject/object independence have confronted 'objective' science. In the *standard (Copenhagen) interpretation* of QT, for example, a conscious observer is said to have a central role in getting from indeterminate quantum possibilities to classical deterministic objects – via quantum wavefunction collapse when an observation is made. QT has to account for the change from the wavefunction (e.g., Schrodinger equation) in mathematical possibility space to sensory actualities as causally interacting objects in ordinary space. The standard interpretation held this occurs *instantaneously with collapse of the quantum wavefunction upon observation by a conscious observer*. But how could a wavefunction equation in imagined, conceptual, mathematical possibility space actually interact with the classical environment and collapse into an observable macroscopic *real* object in conventional physical space? This 'quantum jump' clearly needs to be explained.

Further, the interpretation that a conceptual wavefunction *instantaneously* collapses into a classical object precludes causal explanation for the collapse. It seems not to allow any means for the observed and conscious observer to interact. It places subjective conscious mind as crucial to objective physical reality, while assuming that conscious mind is in the classical physical world and cannot be modeled quantum mechanically. A fundamental inconsistency seems to be that for millions of years classical physical processes preceded evolution of organisms that are complex enough to develop consciousness. If so, then how could such classical physical processes, requiring quantum wavefunction collapse, take place if conscious observers had not yet evolved in nature (Boyer, 2008)? This requires unpacking the concept of the wavefunction and its collapse with respect to the theorized fundamental role of consciousness (Boyer, 2012).

Through the standard QT interpretation, there has been important recognition of the role of conscious mind in scientific observations – in comparison to classical physics which basically ignored the issue. But how the mind works, if and where it exists, and what the world is like – indeed, whether it even exists in-between observations – remain in need of a rational explanation. Key assertions including instantaneous wavefunction collapse involving a conscious observer, *fundamental* randomness at the basis of nature, and the meaninglessness of local causal determinism at the quantum level all contributed to a psychological 'inviolable wall,' within which standard QT was held to be complete and no further explanation of nature was even possible.

Einstein, for one, argued that this view is incomplete (Carmichael, 2007), and that 'hidden variables' eventually will allow a coherent classical deterministic account of nature. But more recent QT interpretations are going underneath the 'inviolable wall' to theorized real levels of nature more fundamental than the ordinary classical physical level. Theoretical and empirical research in QT now concerns subtler, entangled, nonlocal real fields and their causal relationship to conscious mind. Quite importantly, these more recent QT interpretations help bridge the gap between real physical and real mental levels toward addressing the *mind/body problem* and the causal efficacy of mind. Also, the door has opened for possible resolution of other recalcitrant dilemmas that are by-products of fragmentation in the two main theories in modern science: relativity theory and quantum theory. This paper summarizes key steps of progress, and suggests that these most successful theories do not address the *bottom line* of nature. The Vedic model is introduced here because its expanded ontology and epistemology address them in a logically coherent manner.

Beyond the standard QT interpretation toward nonlocal mind and consciousness

In recent decades, QT interpretations have gone beyond the original standard interpretation (Herbert, 1985; Penrose, 2005). Some of these interpretations propose that *ontologically real quantum waves* interact with the real physical environment in a manner that reduces quantum wave coherence into classical physical objects *without* involving conscious observers. Called *objective reduction (OR)*, it is an alternative to *instantaneous* quantum wavefunction collapse when observed.

Objective reduction identifies reduction of the quantum wavefunction to be an objective process occurring spontaneously through time. The quantum wavefunction evolves deterministically, but contains a probabilistic stochastic perturbation insignificant in very small systems. When the small stochastic perturbations add together across large 'quantum systems' or 'objects,' it becomes significant enough to reduce the wavefunction into discrete localized position and other dynamic attributes typical of ordinary macroscopic objects with neither *a conscious observer nor wavefunction collapse involved*. But if imagined 'quantum systems' or 'objects' turn into real physical objects, then they cannot be just concepts in mathematical space. This is a gigantic step to ontologically real *quantum waves* that actually exist at some deeper level of nature (Boyer, 2021).

The principle of *decoherence* posits real causal interactions between abstract 'quantum objects' and the complex ordinary real physical environment. In this theory, small environmental influences don't substantially change the 'quantum object' but do limit its possibilities, spontaneously reducing quantum possibilities toward an allowable set of physical states, independent from a conscious observer. The wave-like nature of objects is exhibited in the pattern of quantum wave interference effects when the wave pattern is coherent and not disrupted by environmental influences. Interactions with the chaotic physical environment suppress or *decohere* the quantum wave interference pattern. Physicist Brian Greene (2004, pp. 210-211) explains:

> Once environmental decoherence blurs a wave function, the exotic nature of quantum probabilities melts into the more familiar probabilities of day-to-day life… If a quantum calculation reveals that a cat, sitting in a closed box…has a 50 percent chance of being alive…decoherence suggests that the cat will *not* be in some absurd mixed state of being dead and alive… [L]ong before you open the box, the environment has already completed billions of observations that, in almost no time at all, turned all mysterious quantum probabilities into their less mysterious classical counterparts… Decoherence forces much of the weirdness of quantum physics to 'leak' from large objects since, bit by bit, the quantum weirdness is carried away by the innumerable impinging particles from the environment.

This QT interpretation reflects a major step toward *quantum reality*. OR proposes that the transition from quantum to the classical level is *not dependent* on a subjective conscious observer. The independence of observed and observer fundamental to classical science is recovered, at least with respect to quantum wave reduction. Soon we will discuss the principle of *consistent histories* added to decoherence, which brings the conscious observer back into the story.

Nonlocality

A huge concern for Einstein was that the standard QT interpretation posits a fundamentally *indeterminate*, irreducible randomness at the very heart of nature. This directly challenges the central pillar of deterministic cause-effect relations in classical science (Herbert, 1985, p. 199). After years of debate, crucial experiments were designed to test whether there is an indeterminate component at

the core of nature, or there are as yet hidden classical variables that will address the indeterminacy, as Einstein and colleagues argued in their well-known *EPR paradox*. Experiments were conducted beginning in the 1980s, based on *Bell's theorem*, which includes assumptions that nature is deterministic, exists objectively independent from the observer, and lightspeed sets an absolute speed limit for anything including any form of information transfer (Boyer, 2021).

When the predictions based on QT and on Bell's theorem were compared in actual experiments, QT was supported. The results supported *quantum entanglement*, the phenomenon of highly correlated behavior of elementary particles after they interact and separate – even when lightspeed would have disallowed them from exchanging any form of information and having causal effects on each other. However, the results are *not* understood as tests whether nature is fundamentally random or deterministic. Rather, they generally are interpreted as showing that the belief objects interact only locally within lightspeed is inaccurate. Greene has pointed out:

> Einstein, Podolsky, and Rosen [EPR] were proven by experiment—not by theory, not by pondering, but by nature – to be wrong… But where could they have gone wrong? Well, remember that the Einstein, Podolsky, and Rosen argument hangs on one central assumption...since nothing goes faster than the speed of light, if your measurement on one object were somehow to cause a change in the other…there would have to be a delay before this could happen, a delay at least as long as the time it would take light to traverse the distance between the two objects… We are forced to conclude that the assumption made by Einstein, Podolsky, and Rosen, no matter how reasonable it seems, cannot by how our quantum universe works (2004, p. 113).

Nonlocality seems not accounted for within the classical mechanics of the known local particle fields (electromagnetic, weak and strong nuclear, gravitational). An adequate model needs to account for relationships more fundamental than the known fields within lightspeed.

Quantum gravity* and real *information space. Important further developments in QT include models that posit an *ontologically real information space* generating ordinary physical spacetime. The notion of causal determinism is extended into this underlying field. This suggests that the 'bottom line' of nature is not *random* quantum fluctuations.

In both relativity theory and quantum theory, particles are treated mathematically as dimensionless points. The concept of a particle is represented as a point with no internal structure, no extension in space, and only the capability of motion through space. Attempts to integrate relativity and quantum theories using the point-particle framework repeatedly resulted in the inconsistency of infinite quantities of energy, suggesting this approach was untenable – or at least incomplete. A major development in recent decades is *string theory*, based in part on the principle of super-symmetry. String theory replaced the mathematical model of the dimensionless point with a filament or string – at about the Planck scale (10^{-33} cm). A string has extension in space, and thus an internal structure with potential for complex higher-order fluctuations, adding explanatory power. The higher-order fluctuations are significant at the ultra-microscopic scale; otherwise, strings have much the same mathematical properties as dimensionless points. There is generally one type of string, although *M-theory* – which integrates some string theories – proposes a range, called branes (short for membranes). Strings and branes are held to fluctuate in patterns that produce particles making up all physical objects. One pattern matches the hypothesized super-symmetric *graviton* to connect strings and gravity, canceling meaningless infinite quantities that prevented a consistent theory of *quantum gravity* (Greene, 1999).

String and M-theories require mathematical *dimensions* in addition to the ordinary three spatial dimensions plus time. The extra dimensions – usually six or seven – are imagined as enfolded or curled up in the string, called spacetime *compactification*. Although extra dimensions are degrees of freedom in imagined mathematical space to model string motion, they also are thought of as *sort of* higher-order spatial dimensions (Greene, 1999, 2004; Randall, 2005). Mathematical geometric strings and branes in compactified higher-dimensional space are posited to be the source of physical objects in conventional space. This again implies causal interactions between physical objects and 'mathematical objects,' further suggesting that 'mathematical objects' are ontologically real and exist somewhere in addition to being concepts in imagined mathematical space. Although attempting to integrate QT and gravity, these theories share with QT the *non-relativistic* framework of background-dependent Newtonian space. A consistent theory of quantum gravity that integrates fully the relativistic spacetime continuum, such that there is no separate background-dependent field, has not yet been achieved. However, a new direction in M-theory posits a more fundamental *nonconventional* space underlying strings and branes that is posited to produce conventional spacetime and all matter in it. It includes the concept of *zero-branes* that may exist:

> [P]ossibly in an era that existed before the big bang or the pre-big bang (if we can use temporal terms, for lack of any other linguistic framework)….[A] *zero-brane*…may give us a glimpse of the spaceless and timeless realm… [W]hereas strings show us that conventional notions of space and time cease to have relevance below the Planck scale, the zero-branes give essentially the same conclusion but also provide a tiny window on the new unconventional framework that takes over. Studies with these zero-branes indicate that ordinary geometry is replaced by something known as non-commutative geometry…. In this geometrical framework, the conventional notions of space and of distance between points melt away, leaving us in a vastly different conceptual landscape… [I]t gives us a hint of what the more complete framework for incorporating space and time may involve… Already, through studies in M-theory, we have seen glimpses of a strange new domain of the universe lurking beneath the Planck length... (Greene, 1999, pp. 379-387).

This glimpse of a potential real field underneath conventional space and the Planck scale reflects an expanded ontology that includes a real background to ordinary, conventional physical spacetime. This next theory takes it further in an attempt to build a *relativistic* theory of quantum gravity.

***Loop quantum gravity*.** This theory, now attempting to be incorporated into string theory, not only emphasizes the context dependence of objects but further their consistency through time from the perspective of an observer. The observer does not cause quantum wavefunction collapse – objective decoherence serves this role. But the change from the quantum state to the classical state needs to be consistent from the perspective of an observer, related to the principle of *consistent histories.*

Decoherence concerns how infinite initial abstract possibilities spontaneously narrow down toward definite tangible actualities. But more is needed to narrow down possibilities and probabilities to logically consistent empirical histories. Decoherence in a *consistent histories* framework concerns consistency of experience of observers. Questions about nature related to observations are identified as decoherent histories if specific answers are not superpositions of answers to other questions. Physicist and quantum gravity theorist Lee Smolin (2001, p. 43) explains:

> This approach lets you specify a series of questions about the history of the universe. Assuming only that the questions are consistent with one another, in the sense that the answer to one will not preclude our asking another, [it] tells us how to compute the possibilities of the different possible answers.

The observer is included in this interpretation of QT – but again, not as causing wavefunction collapse due to conscious observation. There is one world with many different perspectives or minds in it. The world we get depends on the questions we ask about it, such as the measurement choices and historical contexts. Definite answers emerge from questions in a context-dependent manner. This is consistent with the principles of time asymmetry – *arrow of time* – and the 2nd law of thermodynamics (increasing entropy with change across time).

Importantly, the association of initial conditions with initial observational questions also implies initial order (and even an initial role for an observer). The consistency suggests that change in nature is not *fundamentally* random, whether independent from an observer or not; and also, is logically consistent and orderly for the experiencing observer. This theory incorporates the observer, like in the observer-dependent general theory of relativity, attempting to *relativize* quantum theory by emphasizing the relational, observer-dependent nature of consistent decoherent events inside the spacetime continuum. The relativistic frame of reference is a partial consistent history of the universe from a particular observer perspective. In this theory, space is generated from topological relationships in a dynamically evolving network of intersecting loops, referred to as a *spin network*. Smolin (2001) explains further:

> Translated into the loop picture of the gravitational field…the area of any surface comes in discrete multiples of simple units. The smallest of these units is about the Planck area… A spin network is simply a graph…whose edges are labeled by integers. These integers come from the values that the angular momentum of a particle is allowed to have in quantum theory, which are equal to an integer times half of Planck's constant… The volume contained in a spin network, when measured in Planck units, is basically equal to the number of nodes of the network… A very large network can represent a quantum geometry that looks smooth and continuous when viewed on a scale much larger than the Planck length… In the spin network picture, space only seems continuous—it is actually made up of building blocks which are the nodes and edges of the spin network… The spin networks do not live in space; their structure generates space (pp. 130-138).

A spin network is a mathematical theory of a very abstract non-material functional structure, called a *pure geometry*, as the source and generator of conventional four-dimensional spacetime. Adding principles from black hole thermodynamics, the spin network links the concept of bits of quantized pure geometry to bits of non-physical information in a formal mathematical relationship – *Bekenstein's bound*. Accordingly, the smallest possible surface area of space has an inherent mathematical limit to the amount of information it can contain. This represents a further step toward *quantum reality* of a real, non-material quantized *information space* underneath conventional space. Matter is reduced to quantized units of space, then to a pure geometry more abstract than conventional space, and then further to quantized information space. The observer is placed into the complex system of changing causal events by proposing one universe with a multitude of observers in it. It is a complex causal network of interacting light cones built of the smallest possible events or bits of information, with an unlimited number of separate but overlapping consistent observer perspectives. Quantum superposition is at the level of the *mind* in terms of overlapping observer perspectives, drawing on the many-worlds QT interpretation (especially the *mind-worlds* version). Superpositions of histories, independent from each other, associated with different observers, allow agreed-upon outcomes given the same initial conditions and similar histories – a relativistic model. But the concept of an observer remains incomplete. The observer still experiences a unitary state from outside of the system, as in QT. Also, core aspects of the observer, including consciousness, are left out. Smolin (2001) further points out:

> The quantum description is always the description of some part of the universe by an observer who remains outside it…. If you observe a system that includes me, you may see me as a superposition of states. But I do not describe myself in such terms, because in this kind of theory no observer ever describes themselves. Rather than trying to make sense of metaphysical statements about their being many universes—many realities [for example the many worlds interpretation of quantum theory]—within one solution to the theory of quantum cosmology, we are constructing a pluralistic version of different mathematical descriptions, each corresponding to what a different observer can see when they look around them. Each is incomplete, because no observer can see the whole universe. Each observer, for example, excludes themselves from the world they describe. But when two observers ask the same questions, they must agree…. One universe, seen by many observers, rather than many universes, seen by one mythical observer outside the universe (pp. 47-48).

Loop quantum gravity theory attempts to be background independent in the sense that gravity is integrated as the curvature of spacetime and does not function *in* it. But at the same time, it goes beyond relativistic spacetime to a deeper, more abstract substrate of information space to which conventional spacetime is background dependent. However, the only place for an underlying nonconventional information space that could generate conventional space would seem to be a subtler level of nature *underneath* the Planck scale. As physicist Brian Greene (2004) notes:

> [W]hen you get down to the Planck length (the length of a string)…"going smaller" ceases to have meaning once you reach the size of the *smallest* constituent of the cosmos. For zero-sized point particles this introduces no constraint, but since strings have size, it does. If string theory is correct, the usual concepts of space and time, the framework within which all of our daily experiences take place, simply don't apply on scales finer than the Planck scale… As for what concepts take over, there is yet no consensus. One possibility…is that the fabric of space on the Planck scale resembles a lattice or grid [loop quantum gravity], with the 'space' between the grid lines being outside the bounds of physical reality… Another possibility is that space and time do not abruptly cease to have meaning on extremely small scales, but instead morph into other, more fundamental concepts. Shrinking smaller than the Planck scale would be off limits not because you run into a fundamental grid, but because the concepts of space and time segue into notions for which "shrinking smaller" is meaningless…. Many string theorists, including me, strongly suspect that something along these lines actually happens, but to go further we need to figure out the more fundamental concepts into which space and time transform (pp. 350-351).

Mathematician and physicist David Bohm (1980, p. 244) also points to a real level of nature *underneath* the Planck scale:

> [T]he current attempt to understand our 'universe' as if it were self-existent and independent of the sea of cosmic energy can work at best in some limited way… Moreover, it must be remembered that even this vast sea of cosmic energy takes into account only what happens on a scale larger than the critical length of 10^{-33} cm [Planck scale]…. But this length is only a certain kind of limit on the applicability of ordinary notions of space and time. To suppose that there is nothing beyond this limit at all would indeed by quite arbitrary. Rather, it is very possible that beyond it lies a further domain, or set of domains, of the nature of which we have as yet little or no idea.

These quotes exemplify very important and subtle steps of progress toward a real field space of some kind that underlies, is more fundamental than, and permeates our familiar conventional deeply-ingrained notions of space and time. They clearly point in the direction of an expanded ontology of real information space in addition to our familiar physical reality of conventional spacetime (Boyer, 2021).

***Neorealist* interpretation of QT.** This interpretation is outlined in more detail because it explicitly posits an expanded ontology applying the concept of nonlocality. Proposing a *sub-quantum reality*, the theory is primarily from mathematician David Bohm and physicist B.J. Hiley. Bohm had extensive talks with Einstein in the last few months of Einstein's life that might have influenced the ideas (Talbot (1991). It is a deterministic reformulation that does not invoke the subjectivity of the observer in wave function collapse. In this sense, it is a realization of the hidden variables approach favored by Einstein (Talbot, 1991; Bohm & Hiley, 1993). It is sometimes mischaracterized as a return to classical physics because it models elementary particles as classical objects with intrinsic dynamic properties. But it also posits an ontologically real *nonlocal* wave field of nonconventional space that *mediates* particle behavior – the *quantum potential* or *psi wave* – neither in classical relativity theory nor in other QT interpretations. It also goes deeper than the model of real but meaningless information space in loop quantum gravity theory (Boyer, 2008, 2021).

In this interpretation, quantum particles are guided by extremely subtle, real, nonlocal *psi waves*. To match the behavior of objects according to classical and quantum mechanics, the psi wave must be an extended field connected to every particle in the universe, nonlocal, classically invisible, superluminal, and common in nature. The wave behavior of quantized particles is due to the nonlocal psi wave. In contrast to standard interpretations, wave collapse is accounted for objectively, similar to decoherence effects. Also, quantum indeterminism is accounted for deterministically, in terms a particle's path as a combination of the guiding psi wave and the vast myriad of local and nonlocal contextual influences. Together these influences are unfathomable and produce a jittery, complex path of motion that cannot be predicted exactly – thus both deterministic and probabilistic.

Importantly, the psi wave is theorized to be non-random, 'active' *meaningful* information by which it causally influences particle motion, not via the strength of the forces as in the mechanics of the four fundamental fields. However, is it really possible to guide particle behavior by way of this deeper psi wave of *mental intentions*? In other words, does this proposed subtler level of nature include meaningful information associated with causally efficacious intentional minds?

Bohm speculated that the nonlocal psi wave is an ontologically real mental space that functions with extreme subtlety to allow systematic, meaningful information transmission. He proposed this as a general framework for how mind influences matter (Bohm, 1980; Bohm & Hiley, 1993). At this level, nature functions via highly interconnected nonlocal processes in mental space, which brings into the causal chain real causally efficacious mental intentions. In contrast to physical theory, causally efficacious minds are neither epiphenomenal nor a fundamental misperception. And the supposedly closed physical causal chain does not mysteriously unlink to insert conscious mind at some evolutionary stage of physical complexity. Individual minds are nonlocal and causally influence local physical events by an underlying and permeating, *subtler ontologically real field*. This reflects further disembedding of classical physical reality from the notion that it appears due to instantaneous collapse of the quantum wave function via conscious observation (Boyer, 2008, 2021)

Adding an ontological level of nonlocal information or mental space underlying the classical physical world, it thus in some ways might be classified as a type of dualism (rather than classical realism or monistic materialism) – but there is more to it. It is not Cartesian dualism with mind as *not spatially* extended with respect to conventional space. The underlying psi wave field is a fluctuation of *nonconventional*, *nonlocal space* that permeates Einstein's relativistic gravitational spacetime. In this quote, Bohm and Hiley (1993, pp. 347-348) describe it as *sub-relativistic*:

> [W]e say that underlying the level in which relativity is valid there is a subrelativistic level in which it is not valid even though relativity is recovered in a suitable statistical approximation as well as in the large scale manifest world… Although there is no inherent limitation to the speed of transmission of impulses in this subrelativistic level, it is quite possible that the quantum nonlocal connections might be propagated, not at infinite speeds, but at speeds very much greater than the speed of light… As the atomic free path quantum indeterminacy or randomness is the first sign of a 'subcontinuous' domain in which the laws of continuous matter would break down at the quantum level, so the free path in our trajectories would be the first sign of a subquantum domain in which the laws of quantum theory would break down.… The next sign of a breakdown of the quantum theory would be the discovery of some yet smaller dimension whose role might be analogous to the dimension of an atom in the atomic explanation of continuous matter. We do not as yet know what this dimension is, but it seems reasonable to propose that it could be of the order of the Planck length, where, in any case, we can expect that our current ideas of space-time and quantum theory might well break down.

To summarize, this interpretation posits a subtle ontologically real mental space underlying and permeating conventional four-dimensional spacetime. It is characterized as relatively undiminished by distance (compared to how physical forces diminish with increasing distance), deterministic, quantized (in the sense of individual waves, but not Planck-size quanta), relative (in an abstract sense of interconnected and entangled but not Einstein locality), non-physical (not particle matter-like), and a pure geometry of information space (mind-like). It is a background of conventional spacetime underneath the Planck scale. It can be associated variously with terms such as hyperspace, superspace, higher dimensional space, nonconventional space, mental space, and quantum mind (though somewhat a misnomer in that it is not Planck-scale quantized). A difficulty of integrating relativity and QT in quantum gravity is that both don't account for a background of non-Planck scale quantized, nonlocal mental space needed for ontologically real minds (Boyer, 2021)

Classical relativistic spacetime can be characterized as quasi-closed, limited to lightspeed and relativistic gravitational spacetime, Planck-size quantization (per quantum theory), and containing physical particle-wave force fields and classical particle interaction (billiard ball-like) local causality. It is theorized to be underlain by and dependent upon a subtler level – analogous to how earth, water, and air are permeated by conventional space. The subtler level is characterized by nonlocal interactions with more *object interdependence*, individualized but more wave field-like than discrete particle-like, not characterized by particle interactions or thermodynamics, and involving superluminal but not 'instantaneous' motion. In this view, *nonlocal* means *not local* – still finite but not limited to lightspeed. Elaborations of this interpretation identify the subtler field of nonlocal mind as the *implicate order* (Bohm, 1980; Bohm & Hiley, 1993), contrasting it with the ordinary physical level called the *explicate order.* Both are held to be aspects of the ultimate *universal plenum* called the *super-implicate order* – a 3-level ontology, not fundamental duality. Bohm and Hiley (1993) relate the undivided super-implicate order to physical and mental levels:

> One may then ask what is the relationship between the physical and the mental processes? The answer that we propose is that there are not two processes. Rather, it is suggested that both are essentially the same. This means that that which we experience as mind, in its movement through various levels of subtlety, will, in a natural way ultimately move the body by reaching the level of the quantum potential and of the 'dance' of the particles. There is no unbridgeable gap or barrier between any of these levels. Rather, at each stage some kind of information is the bridge. This implies that the quantum potential acting on atomic particles, for example, represents only one stage in the process… It is thus implied that in some sense a rudimentary mind-like quality is present even at the level of particle physics, and that as we go to subtler levels, this mind-like quality becomes stronger and more developed (pp. 385-386).

While this view posits two causally determinate relative levels of space with different degrees of interconnectedness, it also emphasizes their causal seamlessness, and that they are embedded in an even more abstract 'universal flux' (related to infinite Hilbert space). Again, it is thus more fundamentally a monistic account. In the following quotes, the explicate order is described as embedded in the implicate order, both arising from the underlying plenum or universal flux – the super-implicate order (like the unified field as the source of everything). Discussed soon, Bohm (1980, p. 235) links it to non-dual Vedanta in the ancient Vedic account:

> So we are suggesting that it is the implicate order that is autonomously active while…the explicate order flows out of a law of the implicate order, so that it is secondary, derivative, and appropriate only in certain limited contexts…. [T]he relationships constituting the fundamental law are between the enfolded structures that interweave and interpenetrate each other, throughout the whole of space, rather than between the…separated forms that are manifest to the senses (and to our instruments).
>
> [T]here is a universal flux that cannot be defined explicitly but which can be known only implicitly, as indicated by the explicitly definable forms and shapes, some stable and some unstable, that can be abstracted from the universal flux. In this flow, mind and matter are not separate substances. Rather, they are different aspects of one whole and unbroken movement. In this way, we are able to look on all aspects of existence as not divided from each other, and thus we can bring to an end the fragmentation implicit in the current attitude toward the atomic point of view, which leads us to divide everything from everything in a thoroughgoing way (p, 14).

This neorealist interpretation of QT represents a particularly significant further step toward *quantum reality* and an ontological *reality* of levels of nature underlying the physical. Real, local particles are underlain by real, nonlocal waves associated with an even more abstract real information or mental space – ultimately seamless and unified in the super-implicate order. Individual mind is nonlocal, and is not just in the physical brain as a product of neural activity. As a 3-level model, this helps clarify mind/matter duality as a nested structure. The three levels are: 1) the gross relative local field of conventional spacetime; 2) infinite eternal universal plenum, akin to the unified field as the source of everything; and 3) in-between, the subtle relative nonlocal field generally associated with non-material information or mental space

Further progress toward unification

In mainstream physics, the universe is now theorized to be fluctuations of four quantized particle-force fields (electromagnetic, strong and weak nuclear, and gravitational). The 'Standard model' unifies them into three (electroweak, strong nuclear, gravitational), and the hypothesized 'Grand Unification model' into two (strong-electroweak and gravitational). However, the gravitational field has resisted attempts so far to be expressed within the framework of quantum mechanics and to connect it to the other three fields in quantum field theory. Mathematical models attempting to integrate QT theory and relativity theory concern quantum gravity, a major step toward a coherent theory of one single field as the source of everything – unified field theory.

In this view, the universe began via spontaneous symmetry-breaking in three phases as the extremely high levels of energy dispersed and temperature dropped. The first phase transition broke super-symmetry into the gravitational and grand unified forces. About a hundred-thousandth of a second later and at about 10^{-27} cm, the grand unified force broke into the strong nuclear and electroweak forces. In the third phase (about a hundredth of a second later at about 10-16 cm), the

electroweak force differentiated into the weak nuclear and electromagnetic forces. These phases also relate to the theory of an additional field, the *Higgs field*, considered one of the most important concepts in 20th Century physics (Greene, 1999). The Higgs field relates to the quality or principle of viscosity in space, resistance to change in motion, to account for *mass*. It also is sometimes associated with *inflationary* big bang theory, which holds that at the outset of the big bang the force of gravity became a repulsive force that drove the emerging universe into a colossal expansion. This incredible inflationary event involved the Higgs or *inflaton field* contributing a uniform negative pressure to space with a repulsive force so strong it expanded the emerging universe by a factor as much as 10^{90} – associated with dark energy. An elaboration of the theory proposes a *pre-inflationary* period in which gravitational and Higgs fields were chaotic; and eventually a random fluctuation produced values needed for inflationary expansion.

But 'when' the theorized big bang 'began,' an orderly temporal sequence also began. In the natural world according to science, an event emerges in an orderly manner from the previous one. This implies that the source of the universe was a state of *lowest entropy*, not *fundamentally* random. This is crucial in order to understand order in nature. If the universe were *fundamentally* random, how could there be memory and order to connect one moment to the next? There would be no continuity through time, and no orderly laws (Boyer, 2008, 2021). As Greene (2004) points out:

> [I]f the universe started out in a thoroughly disordered, high-entropy state, further cosmic evolution would merely maintain the disorder… Even though particular symmetries have been lost through cosmic phase transitions, the overall entropy of the universe has steadily increased. In the beginning, therefore, the universe must have been highly ordered (p. 271).

The principle of *symmetry* facilitated development of theories that unify quantum fields in the same type of *internal spin*. In this context, spin is a mathematical property of a discrete angular momentum that distinguishes particles. As yet it does not have a physical interpretation, but is sometimes likened to rotational movement analogous to the external spin of a top. Particles are classified into five spin types (0, ½, 1, 3/2, and 2) in half-units of Planck's constant. Generally, whole number or integral types are the force carrier or virtual particles, *bosons*, with the statistical property of unifying or collecting together in the same position and momentum, and cannot be distinguished from each other at all; they relate to coherence phenomena such as laser light. Half-integral spin types are *fermions*, with the property of exclusion and cannot occupy the same energy state (also not distinguishable from each other). Fermions as matter particles create the vast diversity in nature. Generally, particles are either fermions or bosons; fermions as matter particles interact via boson force carrier particles.

The principle of super-symmetry fostered theories such as string theory that attempt to unify bosons and fermions – toward unifying the strong-electroweak force with the gravitational force. It requires super-symmetric partners for all particles and antiparticles. Each particle is thought to have a super-symmetric partner (*sparticle*) with a spin either ½ larger or ½ smaller. To verify this, super-symmetric partners of all particles need to be found (such as the photino as partner for the photon, gluino for gluon, gravitino for graviton). But super-symmetric partners of the known particles have not yet been found. They also relate to *dark matter* and the *hidden sector* because they are not visible. Dark matter was proposed due to applications of super-symmetry, and to help explain how galaxies hold together. *Dark energy* was proposed to help explain empirical findings that the universe is expanding at an increasing rate (Boyer, 2021).

One of the most prominent issues over the past few decades is how to unify the three forces (electromagnetic, weak and strong nuclear) with the force of gravity. Called *super-unification*, it is believed to require an integration of the two major breakthroughs of twentieth-century physics – quantum theory and general relativity. In other terms, it requires connecting the spin 2 gravity field with the other fields. This is the focus of quantum gravity theory.

String theories provide a mathematical model that was believed by many physicists to be the best direction for developing quantum gravity toward unified field theory – but it is now receiving considerable reevaluation. Again, mathematically, string theories require dimensions in addition to the ordinary four dimensions of space and time, sometimes conceptualized as spatial dimensions curled up or compactified in the internal structure of the string. The classical four dimensions are thought to be the non-compactified or unfurled dimensions that make up our ordinary sensory world. But higher-order dimensions are conceptualized as imagined mathematical dimensions that are, as of now, in addition to and not the same as the four *real* spacetime dimensions (Boyer, 2021).

The *Planck scale* and underlying *nonlocality.* In the expanded context emerging in quantum gravity theories, the concepts of strings, branes, or loops – however the smallest entity, process, or event is envisioned – still embody some notion of a membrane or boundary. The Planck length is thought to be the smallest possible division or boundary between objects. But at some point, discontinuous quanta need to merge into indivisible continuity if there is a unified field that is beyond all gaps, boundaries or differences – seamless, unitary, and one with itself. The Planck length is the distance light travels (10^{-33} cm.) in the Planck time (10^{-43} sec.). All the theorized four particle-forces that mediate change in the physical world are said to be subject to this limitation. However, the experimental verification of nonlocality cannot be accounted for within this limitation. Given that the theories and findings about the physical universe are generally correct, it would seem necessary that a subtle underlying, nonlocal field would have to be outside of conventional space and time, as proposed in some of the quantum theories just described. Measurable objects in conventional spacetime are theorized to be made of Planck-size quanta; but perhaps there are underlying non-quantized levels. If so, still there would be no smaller scale than the Planck scale *from the perspective of an independent probe built of physical matter*.

From a holistic rather than reductive perspective, the Planck length could be viewed as the smallest curvature of spacetime from which quantized physical objects are constructed, imposing the *quantum principle at the Planck scale* as the smallest bit of conventional spacetime. In this view, Planck-scale quantization is the limiting of a subtler non-quantized field. Strings, branes, or loops are models of quantization/compactification, an alternative to the dimensionless point. In string theory, the classical macroscopic and microscopic world is where the four dimensions of spacetime are unfolded and unfurled, and spatial dimensions near the ultramicroscopic Planck scale are enfolded or compactified (Boyer, 2008, 2021).

But the *opposite* view may be more appropriate: *quantization at the Planck scale may be the compactification*, limiting a more abstract, underlying, extended, unfurled, nonlocal wave field into discrete, local, enfolded classical quantum/particle structures. In other words, conventional spacetime ends at the Planck scale, but it materializes from a subtler nonconventional, nonlocal field that generates and permeates it. This seems consistent with the contemporary model of space as *flat* – extending in all three directions without being curved. Again, Greene (2004) points out:

> Normally, we imagine the universe began as a dot…in which there is no exterior space or time. Then, from some kind of eruption, space and time unfurled.... But if the universe is spatially infinite, *there was already an infinite spatial expanse at the moment of the big bang...*' In this setting, the big bang did not take place at one point; instead, the big bang eruption took place *everywhere* on the infinite expanse. Comparing this to the conventional single-dot beginning, it is as though there were many big bangs, one at each point on the infinite spatial expanse. After the big bang, space swelled, but its overall size didn't increase since something already infinite can't get any bigger…' [T]his example of infinite flat space is far more than academic... [T]here is mounting evidence that the overall shape of space is not curved…. [T]he flat, infinitely large spatial shape is the front-running contender for the large-scale structure of space-time (pp. 249-50).

The unified field as the lowest (zero) entropy, super-symmetric state of (perfect) order. According to QFT, space is *not* an empty *void* or nothing, if it at least contains vacuum fluctuations. In unified field theory, the universe is more appropriately viewed as emerging from *something* – even from the *source of everything* – certainly not from *literally nothing*. In this theory, the four fundamental force fields emerged through spontaneous sequential symmetry-breaking as temperature dropped and the universe expanded (Greene, 1999). This can be likened to phase transitions of H_2O condensing from steam to water to ice as temperature drops; at each stage, symmetry is reduced. In this more holistic view, the fundamental forces potentially *pre-existed* in the perfectly symmetric super-unified state. But also, as the source of continuously occurring quantum vacuum fluctuations, random jitters, zero-point motion or inherent dynamism, the unified field continues along with and after sequential symmetry-breaking. If it continues after the fundamental force fields differentiated, then it is more than just the unification of these forces. The underlying unity and super-symmetry don't vanish when the diversity of symmetry-breaking manifests from it.

In addition, the principle of the unbounded quantum wave as a coherent state that decoheres through interaction with the classical environment implies that more fundamental quantum fields are associated with increased symmetry, coherence, and order (Greene, 2004). The unified field as the source of everything and origin of orderly, universal laws of nature is also consistent with it as being of the highest order. Moreover, the 'arrow of time' and the second law of thermodynamics further suggest the origin and source of change in nature is a state of lowest entropy (Penrose, 2005; Greene, 2004). Degrees of order from highest to lower come from super- symmetry and lowest entropy, not from *fundamental* randomness (Boyer, 2008, 2021)

Higgs fields and big bang cosmology. Higgs field theory posits that in the third phase of symmetry-breaking into the weak and electromagnetic forces, a Higgs field condensed to a nonzero value when the temperature of the universe dropped to about 10^{15} degrees, creating a Higgs ocean – analogous to steam condensing to water. Another Higgs field – grand unified Higgs – was proposed to explain the earlier second phase of symmetry-breaking of the strong and weak nuclear forces; and a third Higgs field was proposed to explain the first symmetry-breaking when gravity emerged, which relates to *inflationary* big bang theory (Greene, 2004). In this theory, for an extremely brief time period of 10^{-35} seconds of the big bang, gravity became a repulsive force that drove the emerging universe into a colossal expansion (Guth, 1997), much faster than lightspeed. But it is thought not to be inconsistent with it, because lightspeed applies to motion *through* ordinary space whereas inflationary expansion refers to the inflation *of* space (Greene, 2004). It also can be understood to imply a level of nonconventional space involving motion faster than lightspeed but not instantaneous – having a 'not local' quality, but still finite (Boyer, 2021).

According to inflationary big bang theory, the total amount of matter and energy in the universe is more than is accounted for considering the visible objects, which contribute about five percent. Astronomical research suggested that additional matter is needed to hold galaxies together, leading to the theory of *dark matter* said to account for approximately an additional 23 percent (maybe 30%). Observations that the universe is expanding based on measurements of the recession rates of supernova led to revival of Einstein's discarded notion of the *cosmological constant*, this time associated with *dark energy*. It was estimated that the rate of expansion requires a cosmological constant associated with an amount of dark energy that contributes about 72 percent (maybe 65%), which fits the remaining amount for inflationary theory.

But what triggered inflationary expansion? It has been proposed that the big bang emerged from a *pre-inflationary* period when the gravitational and Higgs fields were bumpy and disordered; and eventually, random fluctuations somehow produced values needed for inflationary expansion. But this certainly isn't 'everything coming for *nothing.*' Astronomer David Darling (1996, p. 49) notes:

> What is a big deal is how you got something out of nothing. Don't let the cosmologists try to kid you on this one. They have not got a clue either… "In the beginning," they will say, "there was nothing—no time, space, matter, or energy. Then there was a quantum flutter from which…" Whoa! Stop right there… First there was nothing, then there was something. And the cosmologists try to bridge the two with a quantum flutter, a tremor of uncertainty that sparks it all… and before you know it, they have pulled a hundred billion galaxies out of their quantum hats… You cannot fudge this by appealing to quantum mechanics. Either there is nothing to begin with, no pre-geometric dust, no time in which anything can happen, no physical laws that can effect change from nothingness to somethingness, or there is something, in which case that needs explaining.

Inflationary cosmology needs to be consistent with unified field theory. If the unified field is the state of lowest entropy, then the pre-inflationary period in which low entropy came from inflationary expansion strangely suggests something existed prior to the unified field. Also, how does the pre-inflationary period reconcile with quantum gravity theories that posit information space or higher-dimensional space is the generator of physical space? Information space is not characterized as just a bumpy, chaotic, randomly fluctuating field; but in contrast, suggests order in the sense that it is theorized to produce the orderly structures of physical spacetime and of all matter.

Another way to understand these issues is to consider pre-inflationary theory as another angle in attempts to understand subtle, nonlocal, non-material, nonconventional space (akin to the 'implicate order' permeating the 'explicate order' in neorealism). This would include the order needed to form the gravitational field, Higgs field, dark energy, and inherent dynamism – discussed later in the context of the Vedic model of ontological levels of nature.

Spacetime could not 'blast out' from the infinite eternal unified field. In holistic unified field theory, nature can be said to 'condense' or 'precipitate' via spontaneous sequential symmetry-breaking into increasing localization, discreteness, and mass. In the notion of levels of spacetime introduced above, gross conventional and subtle nonconventional levels are phenomenal limitations of the underlying unified field *that is already present everywhere*. Space would not begin at an infinitesimal point and expand out in all directions from an inert Planck-size quantum or an almost infinitely dense singularity, or from *literally nothing* (Greene, 1999). Rather, infinite space and eternal time 'condense' to many 'points' everywhere. Consistent with this view, there can be bangs from black holes in conventional space. But considering the entire cosmos, it would not explode outward – because everything resulting from it remains *inside* it (Boyer, 2021a, b).

Infinite inside and finite outside

A cutting-edge concept in contemporary cosmology is the *AdS/CFT correspondence*, originally proposed by physicist J. Maldacena (1998). It concerns both the shape of the cosmos and the nature of elementary particles. *AdS* refers to *anti-de Sitter space*, related to quantum gravity formulated in terms of string/M-theory. *CFT* refers to *conformal field theory*, which deals with quantum field theories of elementary particles. To connect to the holistic Vedic account, it is here suggested that the contrasting models of de Sitter and anti-de Sitter space concern different levels of spacetime within infinite eternal spacetime.

The cosmic ultra-macroscopic structure and the ultra-microscopic (infinitesimal) elementary particle structures can be usefully envisioned as linked by applying the concept of levels of spacetime. Phenomenally, creation manifests as not-local finite levels of spacetime open in the inner direction of its infinite eternal basis and closed in the limited outer local finite direction. Going outward is toward the restricted, bounded but vast expanse of the finite world; going inward is toward the unrestricted, unbounded infinite eternal unified field. Outward is finite and bounded; inward is infinite and unbounded. Nature is infinite on the inside and finite on the outside.

According to the completely holistic Vedic model, in the manifestation of levels of nature from the most abstract whole to the most concrete and tangible parts, the parts appear more prominent. In the process of cosmic evolution, the parts on the concrete physical levels as inert randomly-fluctuating quantum particles congeal into stars, galaxies, and planets guided by inherent laws. Through time, living beings evolve that are complex enough to express conscious intelligence, eventually evolving further to direct knowledge of the ultimate wholeness. Parts emerge from the whole, and then via increasing complexity appear to unify – all along naturally guided by the *whole*. Infinity is inside each of us as the unified field of cosmic intelligence, the universal Self, and phenomenally appears in ordinary waking experience to be finite outside us (Boyer, 2021a, b).

Three-level ontological models of nature

Modern physics progressed as an *objectified* reductive investigation, largely avoiding subjectivity. This led to a model with one ontological level: the causally closed *objective* physical universe – sometimes called *materialistic monism* or *physical and scientific realism*. Modern science increasingly recognizes that mind and consciousness are not accounted for in this one-level model. Unified field theories are developing, which can be viewed as adding a second level. But quantum theory required consideration of how to get from quantum wave functions in *imagined* mathematical space to *real* physical space; and this brought mind and consciousness back into the story. It is revealing that a two-level ontology (physical and unified field as now commonly conceptualized in mainstream physics) still doesn't account for mind or for consciousness.

As outlined earlier, the neorealist interpretation of QT is a non-dual or monistic model with three levels: explicate (gross), implicate (subtle), and super-implicate (transcendent) orders (Bohm, 1980; Bohm & Hiley, 1993; Boyer, 2012a) – a major step toward including mind. This interpretation has correspondence with recent three-level models, including the model by mathematician and cosmologist Roger Penrose (2005), which draws from Platonism. Discussing mathematical forms associated with an objective *Platonic realm*, Penrose states:

> I am aware that there will still be many readers who find difficulty with assigning any kind of actual existence to mathematical structures. Let me make the request of such readers that they merely broaden their notion of what the term 'existence' can mean to them. The mathematical forms of Plato's world clearly do not have the same kind of existence as do ordinary physical objects such as tables and chairs... Objective mathematical notions must be thought of as timeless entities and are not to be regarded as being conjured into existence at the moment that they are first humanly perceived... Those designs were already 'in existence' since the beginning of time, in the potential timeless sense that they would necessarily be revealed precisely in the form that we perceive them today, no matter at what time or in what location some perceiving being might have chosen to examine them... Thus, mathematical existence is different from physical existence but also from an existence that is assigned by our mental perceptions. Yet there is a deep and mysterious connection with each of those other two forms of existence: the physical and the mental... I have schematically indicated all of these three forms of existence—the physical, the mental, and the Platonic mathematical—as entities belonging to three separate 'worlds'... There may be a sense in which the three worlds are not separate at all, but merely reflect, individually, aspects of a deeper truth about the world as a whole of which we have little conception at the present time (pp. 17-23).

Another model with three levels has been outlined by physicist Henry Stapp (2000, 2007). In analyzing quantum wave function collapse, three levels are used to explain how *real* objective and *real* subjective experiential levels might interact. Extending orthodox quantum theory, Stapp (2000, p. 213) states that consciousness is needed in wave function collapse because:

> [T]he local-reductionistic laws of physics, regarded as a causal description of nature, are incomplete.... The physical part of reality represents merely the possibilities for an actual experience, not the actually experienced reality itself."

> [F]rom the purely physical standpoint the [wave function] collapse seems to come from nowhere, as an unpredictable and undetermined 'bolt from the blue.' Something is needed to...bring 'classicality' into the dynamics, and it needs a 'cause' for the collapse, and it needs a reality to complement the 'potentia'... It must be something that exists, and the only thing that we know exists, besides the physical part of reality...is the experiential part....

The three levels in this model are physical *reality*, experiential *reality*, and all-possibility Hilbert space. Hilbert space is placed similarly to the super-implicate order in Bohm and Hiley's model, which also has some similarities with Penrose's model of the 'Platonic realm.'

These models also have at least some correspondence with the three-level model by physicist and unified field theorist John Hagelin (1987) – an abstract mathematical *Lagrangian* formulation. In very compact form, the Lagrangian contains two terms. The first term, denoted as Φ, is described as a classical conception of a static space and time translation invariant field – a non-changing field of *existence*. The second term represents *dynamic order* or change, denoted as *II*. This term represents the inherent capability of the field to generate orderly change in it. This formulation also relates the unified field to Hilbert space, a complex vector space of infinite dimensions as an infinite collection of points comprising all quantum mechanical states.

This unified theory includes concepts of the knower or observer and the process of knowing – not just the known. The *knower* quality of the field is interpreted as the property of the Hilbert space of states to be a non-changing, unmanifest background for all possible unitary transformations or states of the field, while itself remaining unchanged. It is likened to the uninvolved *observer* of all transformations that, through its dynamic orderliness associated with the discriminative role in

evolving the quantum mechanical system, determines the physical manifestations of the system. The *process of knowing* quality of the field is related to quantum mechanical *observables* that serve as quantum mechanical operators in Hilbert space, generating changes of one state into another in unitary transformations. The *known* is the stable quantum mechanical *states* themselves. This model can be viewed as a more abstract view of substance and form, as *existence* and *dynamic order*. It is closer to the completely holistic 3-in-1 model described in various ways throughout Vedic literature. In contemporary terms, the Vedic model can be interpreted as including 1) the ordinary finite, local physical level of classical physics; 2) the subtle finite, nonlocal, nonphysical level including mind that is beginning to be identified in some aspects of quantum physics; and 3) the transcendent source of everything in unified field physics (Boyer, 2006, 2007, 2008).

The holistic Vedic account: unity, quinternity, trinity, non-duality (1st to 10th Mandalas)

A helpful strategy in building a more integrated understanding of levels of nature is to disembed from the reductive perspective that brings everything down through smaller and smaller scales to randomness and nothing. In contrast to the universe narrowing down to an infinitesimal point such as a black hole, or even to literally *nothing*, the big bang – or whatever dynamics of nature that result in phenomenal materialization – may be more logically conceptualized as a concretization of infinite into finite. Spacetime is not created from nothing, but rather is a phenomenal limitation of the infinite eternal unified field *that already is existing everywhere*. From this holistic perspective, no new dimensions of space and time are required to account for nonlocality. The difference between subtle nonconventional spacetime (implicate order) and gross conventional spacetime (explicate order) is not new higher-order spatial dimensions (in contrast to string/M-theories), if they are limitations of the infinite eternal unified field (super-implicate order). The reductive approach is challenged to explain how everything comes from nothing, and how the whole is a unification of parts that somehow become more than the sum of the parts. The holistic view has the opposite challenge of how the parts emerge as limitations of the whole – which is exactly what Veda is.

The ancient Vedic tradition (Hensley, 2014) is increasingly recognized to apply this holistic strategy in enumerating levels of nature. Sometimes described as the oldest continuous tradition of knowledge, the word *Veda* generally can be translated as 'knowledge.' The closest concept in modern science seems to be the unified field as the 'source of everything,' which also must be the source of all knowledge (Hagelin, 1987, 1989). Veda begins with ultimate unity or wholeness: the whole creates the parts, which remain within the whole. The ultimate wholeness is simultaneously *smaller than the smallest and bigger than the biggest* (Katha Upanishad 1.2.20, Nader, 2000), beyond reductionism and holism. For many centuries, the Vedic approach remained in obscurity and was largely considered irrelevant to daily life. It was classified as mythological, pre-scientific, and only of historical significance. While its philosophical depth was somewhat acknowledged, its practical developmental technologies were not applied or even understood.

In recent years, Vedic proponent and educator Maharishi Mahesh Yogi has reestablished the holistic value of the ancient Vedic tradition and revived its practical applications, as *Maharishi Vedic Science and Technology*. (Maharishi became well-known beginning in the 1960s as a teacher of Transcendental Meditation and related advanced programs, establishing non-profit educational organizations including a doctoral-level accredited university in the U.S., as well as many schools internationally. Since publication in 1970 of initial research on the TM program in *Science*, over 600

research papers document its beneficial physiological, psychological, and sociological effects (e.g., Orme-Johnson, 2020; Scientific Research on Maharishi's Transcendental Meditation and TM-Sidhi Programme—Collected Papers (1977-90; Dillbeck, 2011.)

In contrast to the reductive physicalist paradigm, the holistic Vedic account unfolds the parts of nature within infinite eternal unity as sequential limitations or localizations into finite forms. In other words, the parts emerge within the whole, rather than the whole emerging from combining the parts. Ancient Vedic science as systematically unfolded in the first section of *Rik Veda* can be understood to account for how phenomenal nature manifests within the unified field of universal Being – from the highest-order holism all the way to phenomenally lower-order, fragmented inert parts. It can be viewed as generally consistent with concepts of sequential symmetry-breaking, quantum decoherence, the 'arrow of time,' and the second law of thermodynamics that imply the universe emerged from the lowest entropy, super-symmetric ground state of the unified field. Major advances in quantum theories outlined earlier are progressing toward the holistic Vedic account in Maharishi Vedic Science, which can be described in terms of three ontological levels 1) the infinite unified field; 2) the subtle finite relative nonlocal field associated with mind; and 3) the gross finite relative local field of physical matter (Boyer, 2008, 2021).

The Totality of nature is expressed in the sequence of 10 Mandalas (chapters) of Rik Veda. It begins with unity. The next eight Mandalas comprise the theorized eight-fold structure of the phenomenal universe (8-fold Prakriti), with five fundamental constituents (associated with earth water, fire, air, space) emerging from three fundamental principles, qualities, or forces (associated with mind, intellect/heart, ego). It ends in the tenth Mandala, non-dual Totality (Brahman). From Mandala 10 to 1, it can be summarized in terms of non-duality (1), trinity (3), quinternity (5), and unity (1) – either direction going from wholeness to wholeness, infinity in each point.

Trinity: three fundamental forces. Conceptual delineations are initial dualities, intimate to functioning of the discriminating intellect. In duality there is an implied trinity, which concerns the relationship between the two. This trinity can be found in both modern scientific and ancient Vedic literature, as well as in many other knowledge traditions. Most ancient knowledge, in India and around the world, share with modern science a common source in simple binary logic from which emerge three-fold models (Bhavasar, Boyer, 2009). In the delineation of observer and observed is the process of observing; in creation and dissolution operators is the maintenance operator; in subject and object is the predicate (and in Father and Son, the Holy Spirit). Also, for example, there are the trinities of knower-process of knowing-known, sat-chit-ananda, rishi-devata-chandas, and Brahma-Vishnu-Siva. In Vedic science, these abstract principles concern the nature of discriminating processes of the intellect and the dynamics of fundamental forces comprising phenomenal objects – observer and observed, and process of observing.

In the aspect of Vedic science called *Sankhya*, three fundamental qualities or 'forces' are delineated and their derivatives enumerated. These three 'forces' (which can be associated with Rk Ved Mandalas 7-9) materialize five fields or constituents (Mandalas 2-6) comprising the entire universe. This framework is helpful for contemporary particle-force theories which posit a multitude of particles emerging from four quantum fields (electromagnetic, weak and strong nuclear, gravitational) that gain mass via the theorized Higgs field. This paper proposes an approach to link the levels in Sankhya with the fundamental force fields in modern physics.

The term Sankhya means to *enumerate* levels/qualities of nature within the Totality, from subtle non-physical levels to the grossest level of physical matter. The three fundamental qualities or forces in Sankhya and Vedic literature generally are *sattva guna, rajas guna*, and *tamas guna*. They are described as inseparable, co-existing and co-functioning in relative degrees to carry out every interaction in phenomenal creation. The *gunas*, or qualities, relate to the fundamental fields that shape infinite potentiality into relative finite phenomena of nonlocal interdependent and local independent objects and processes. They also can be related to the three aspects of time – present, future, past – the three spatial dimensions – x, y, z axes or up/down, forward/backward, and right/left – as well as many other trinities throughout nature, and to the levels of mind (manas), intellect/heart (buddhi/ahamkara), and ego/self (related to mahat). Although their dynamics are interconnected, entangled, and *self-interacting*, in simple terms they can be related to the creative, maintenance, and destructive or dissolution operators conducting all change. As Maharishi (1967) has explained:

> The entire creation is the interplay of the three gunas. When the primal equilibrium of sattva, rajas and tamas is disturbed, they begin to interact and creation begins. All three must be present in every aspect of creation because, with creation, the process of evolution begins and this needs two forces opposed to each other and one that is complementary to both. Sattva and tamas are opposed to each other, while rajas is the force complementary to both. Tamas destroys the created state; Sattva creates a new state while the first is being destroyed. In this way, through the simultaneous processes of creation and destruction the process of evolution is carried on. The force of Rajas plays a necessary but neutral part in creation and destruction; it maintains a bond between the forces of sattva and tamas (pp. 269-270).

On the gross physical level, these fundamental fields can be related to the principles of attraction (gravitation), activity (inherent dynamism), and inertia or resistance to change (mass, Higgs fields). In conventional spacetime, *sattva* can be associated more with the maintenance operator, upholding and fostering balanced change and continuity. It is the unifying principle, or the attraction, balancing, or harmonizing value of nature. In the physical universe, this quality can be associated with gravity, attraction to the center point of an object, and perhaps the gravitational constant. It also can be related to the 3rd law of thermodynamics: decreased activity with decreased temperature in material systems, resulting in decreased entropy, a fundamental *negentropic* process that maintains *inherent order* in nature. *Rajas* can be related to *inherent dynamism*, associated with the creation operator activating the maintenance and dissolution operators. It can be said to provide 'neutral' energy or activation that impels change. In the gross physical universe, it can be associated with energy and expressive or diversifying processes following the law of energy conservation and relating possibly to lightspeed and Planck energy. *Tamas* can be related to inertia or *inherent resistance to change*, more closely associated with the dissolution operator that restrains the creative and maintenance operators. In the gross physical universe, it can be related to the concepts of mass, Higgs field theory, and possibly Planck's constant.

The three values from which the fundamental unit of physical spacetime is derived – the *Planck length* calculated from the gravitational constant, lightspeed, and Planck's constant to be 10^{-33} cm – may correspond to sattva, rajas, and tamas on the gross physical level (Boyer, 2008). Thinking of an abstract field as made of infinity of points, if each point has a certain property then the field also has the property, which gives the field overall textural qualities or defining features, associated with the concept of a medium or field. This may give a sense of how the actual quantitative values of the Planck scale, lightspeed, and relativistic gravity relate to textural qualities and empirical values of sattva, rajas, and tamas of the fabric of gross conventional spacetime at the physical level of nature.

Quinternity: five fundamental constituents. In Sankhya, the three gunas, qualities, or 'forces' condense or precipitate into five abstract fields, constituents, or elements of nature, called *mahabhutas.* The term mahabhuta is from *maha* (great, universal), *bhu* (curving back, giving form, to happen, occur, exist; *bhut* (creation), and *ta* (finished, created). These five mahabhutas can be described as frequencies or vibrations of the unified field in its grossest, most concrete localized expression. The mahabhutas are associated with the classical concepts of space, air, fire, water, and earth – but this terminology had been interpreted in a simplistic and misleading manner. They refer to very abstract processes that structure physical objects with the respective properties of vacuity (space), mobility (air), luminosity (fire), liquidity (water), and solidity (earth). For example, the mahabhuta of *air* not only refers to what we ordinarily think of as air but more fundamentally to the abstract principles that manifest as gaseous processes, and also agglomerations into matter. The nature of the mahabhutas as abstract processes may be more obvious with respect to fire. Including fire as a fundamental constituent clearly suggests the more abstract functional nature of the mahabhutas. The mahabhuta of *fire* refers to the underlying laws of nature involved, for example, in radiation, combustion, oxidation, and illumination (Boyer, 2008, 2021).

In this model, the five mahabhutas make up the gross relative creation – the ultramicroscopic, microscopic, macroscopic, and ultramacroscopic levels investigated in the physical sciences. Each mahabhuta precipitates from the preceding one, with an additional limitation or property along with general properties of the others. The mahabhutas combine in innumerable patterns to create the vast diversity of the physical universe; but no new ontological levels of nature emerge from them. They emerge from five subtler non-physical, nonlocal constituents called *tanmatras.*

As physical, the five mahabhutas must correspond to the quantized particle-forces. The current state of modern scientific knowledge may not be developed enough to establish precise correspondences. But if both describe the physical world, it's reasonable that they would match. The five mahabhutas can be understood to be expressed in sequential enumeration, somewhat akin to sequential symmetry-breaking. The mahabhuta of space contains in potential or latent form the other mahabhutas, but *expresses* most the specific qualities associated with space.

To link this model to the fundamental forces and the concept of sequential symmetry- breaking, one reasonable view is that the mahabhuta of space is most closely associated with the gravitational force. Likewise, the mahabhuta of air would express the gravitational and strong nuclear forces. The mahabhuta of fire would express the gravitational, strong, and weak forces. In this speculative comparison to physical science, the mahabhutas of water and earth express all four forces but most reflect properties of electromagnetism (Boyer, 2008, 2021; Boyer, Hensley, 2009).

Space (Akasha). In the holistic view of the infinite eternal unified field as the source of everything, the universe and spacetime would begin many 'places' or points simultaneously (Greene, 2004). This eliminates paradoxical issues in reductive models of nature as emerging from absolutely nothing or a Planck-size quantum in which space and time expand outward – which impels questions of what existed before it, what it expands into, or what remains when it contracts. Finite levels are phenomenal limitations within the infinite eternal unified field. Noted earlier in this paper, this also is relevant to the contemporary model of space as 'flat' in the sense of extending in all three directions without being curved. Greene (2004) describes this model as the front-running contender for the overall shape of the universe**.**

With respect to finite space in relative creation, however, space can be thought of as curved. The notion of the curvature of space – such as into a torus or sphere, or both if a sphere can be conceived in terms of curving back on itself – relates to finite limitation of infinite self-referral. To explain finite creation, it can be said that infinity curves back onto itself, infinite self-referral *(Bhagavad-Gita, 9.8)* (Maharishi Mahesh Yogi, 1997, p. 37). This curving back onto itself can be associated on the finite manifest level with a *mandala* form – related to the Vedic concept of *Hiranya garbha*,[20] the cosmic egg or manifest form of the unified field curving back to create the finite relative cosmic expanse, Planck-size quanta, atoms, and water droplets.

From the root 'to appear,' *akasha* relates to the principle of *vacuity*, and seems most akin to conventional spacetime. Every physical object is permeated by and shaped from akasha. In modern physics, objects existing in this level have the limitation of lightspeed, and all gross movement of energy and mass in relativistic conventional spacetime reflects this limit. It is directly related to the Planck scale, zero-point energy, the Heisenberg uncertainty principle, Einstein locality and the light cone, Einstein gravity, the particle interaction model of causality, and Planck-size quantization—the defining features or textural fabric of conventional spacetime.

The mahabhutas are sometimes described as dimensionless points, in the same sense as the point particle concept used in calculations of motion in non-relativistic and relativistic classical physics (Bernard, 1947). Physical objects involve the delineation of space into the three spatial dimensions necessary to establish volume and magnitude. The mahabhuta of akasha is not described as having a particulate structure in the sense of quantum theories which posit spacetime as fundamentally discrete Planck-size quanta or as mediated by a particle such as the hypothesized graviton. However, the principle of vacuity of akasha is sometimes described as a textural quality of *porosity* (Bernard, 1947) akin to these conceptions, and also 'spacetime foam.' Although the general theory of relativity describes space as relational, it is nonetheless now not thought of as an empty void but rather associated with specific textural properties. It is in this sense that akasha historically has been associated with *aether* as a very subtle *substance*, *medium* or *field*. In *Vaishesika*, another aspect of Vedic science, there is also a delineation of the five mahabhutas. The four mahabhutas other than akasha are also called *paramanus*, sometimes interpreted as the smallest divisions of matter. The four paramanus (air, fire, water, earth) are characterized as having extension and magnitude in space (akasha), and thus can be associated with quantization and particle properties. The gravitational constant can be related to the force of attraction or sattva. Correspondingly, the influences counteracting the force of gravity would seem to be directly related to lightspeed and Planck's constant. The point particle field is said to be inherently dynamic, quantified in terms of the Planck energy, the amount of energy inherent to each quantum related to lightspeed. It seems reasonable to relate it to rajas or activation. Correspondingly, the property of viscosity or resistance to change associated with Higgs theory would seem to relate to tamas, and also possibly Planck's constant.

The five mahabhutas can be thought of as fields with progressive limitations, each more expressed one embedded in the previous one. They also can be thought of as progressive layers of the medium of gross spacetime, each one taking on an additional specific quality from which is expressed different physical phenomena. One way to think about the paramanus is that they are structured by the spacetime gravitational field being further limited, sharply curving back onto itself and compactified into forms that function as quanta and particles. In this speculative view, the mahabhuta of space would express the gravitational force (Boyer, 2018, 2021).

Air (Vayu). From the root 'to blow,' vayu can be related to the abstract principle of *mobility* or motion, and the related functions of pressure and impact, compression and rarefaction, most akin to the concept of *air*. The mahabhuta of *vayu* (air) precipitates or condenses from the mahabhuta of space. In the increasing limitation of space, it is the nature of the gravitational unifying force to attract points of spacetime together into clumps or regions of more and less compression, which further precipitates into a gaseous state. The mahabhuta of *air* fills the available three-dimensional space – within the constraints of gravity – but has the additional limitation of not being able to permeate objects, properties of a gas. The force that binds or glues particles into nuclei and compounds is the strong nuclear force. In this model, the mahabhuta of air would express the gravitational force along with the strong nuclear force.

Fire (Tejas). From the root 'to be sharp,' tejas relates to abstract principles of *luminosity*, *form*, and *transformation*, associated with the fundamental element of fire. T*ejas* (fire) relates to heat and temperature as well as radiation, combustion, and oxidation. Fundamental to *fire* is oxygen, for example, a core element associated with the principle of air involved in combustion. When there are aggregates of points as volumes in spacetime that cannot penetrate each other, like air, their agitation increases when further limited; pressure and activity rise, measured as temperature or heat. At certain temperatures, particles can be emitted in the form of kinetic energy, resulting in radiation, heat and luminance. The mahabhuta of fire thus might relate to interactions of the gravitational, strong nuclear, and especially weak nuclear forces. As Greene (2004) points out:

> Gravity is a universally attractive force; hence, if you have a large enough mass of gas, every region of gas will pull on every other and this will cause the gas to fragment into clumps.... Even though the clumps appear to be more ordered than the initially diffuse gas—in calculating entropy you need to tally up the contributions from *all* sources.... For the initially diffuse gas cloud, you find that the entropy decrease through the formation of orderly clumps is more than compensated by the heat generated as the gas compresses, and, ultimately, by the enormous amount of heat and light released when nuclear processes begin to take place (p. 172).

Water (Apas). The mahabhuta of *apas* (water) relates to the abstract principle of *liquidity* or *fluidity*. It has freedom of flow or movement to fill the available space within the limitations of its permeability; but because of its lower kinetic energy and higher mass, only sort of 'downward' gravitational pull due to increased thickness or density. The liquid state has additional limitations over fire, air, and space: less motion/heat, more restricted flow compared to gaseous expansion.

> On a molecular scale, for instance, ice has a crystalline form of H_2O molecules arranged in an ordered, hexagonal lattice... The overall pattern of the ice molecules is left unchanged only by certain special manipulations, such as rotations in units of 60 degrees about particular axes of the hexagonal arrangement. By contrast, when we heat ice, the crystalline arrangement melts into a jumbled, uniform clump of molecules—liquid water—that remains unchanged under rotations by any angle, about any axis. So, by heating ice and causing it to go through a solid-to-liquid phase transition, we have made it more symmetric... Similarly, if we heat liquid water and it turns into gaseous steam, the phase transition also results in an increase in symmetry. In a clump of water, the individual H20 molecules are, on average, packed together with the hydrogen side of one molecule next to the oxygen side of its neighbor. If you were to rotate one or another molecule in a clump it would noticeably disrupt the molecular pattern. But when the water boils and turns into steam, the molecules flit here and there freely; there is no longer any pattern to the orientations of the H20 molecule and hence, were you to rotate a molecule or group of

> molecules, the gas would look the same. Thus, just as the ice-to-water transition results in an increase in symmetry, the water-to-steam transition does so as well (Greene, 2004, p. 253).

Liquidity relates to the concept of flow – movement along a path, such as a river current or electrical current. As to particle-forces, it seems most closely associated with electromagnetism. The outer shell of charged atoms allows electrons to flow, such as through copper wire, from negative to positive and positive to negative electric charge. Electric current flows easily when electrons are loosely held; mediums that hold electrons tightly are insulators that restrict flow. The mahabhuta of water involves all four fundamental forces, but most closely electromagnetism with emphasis on electricity. Before their symmetry was recognized, it was modeled as electricity and magnetism,

Earth (Prthivi). From the root 'broad or extended,' the mahabhuta of *prthivi* (earth) relates to the abstract principle of *solidity*, the most inert state. Matter associated with the earth principle has no directional freedom in that it doesn't flow. It involves various degrees of crystalline structures with more rigid and fixed alignment of parts. It represents increased limitation over a liquid form – such as water into ice when temperature and motion associated with heat or fire is reduced into a less dynamic state. The mahabhuta of earth is the endpoint of the process of manifestation.

With respect to correspondence with fundamental physical forces, the mahabhuta of earth seems most associated with magnetism – although tangibly expressing all the fundamental particle-forces and all the other mahabhutas. Are there reasons to associate the mahabhuta of earth more with magnetism and the mahabhuta of water more with electricity? Electric current flows across objects between charge sources. Attraction and repulsion between two charges occurs in a straight line between the two sources. Electric currents generate magnetic fields. In contrast to the electric force, the magnetic force is a dipole system in which the opposites of attraction and repulsion (north and south poles) are contained in one source and travel in a defined circular path that curves back onto itself in a closed loop around an electric current, in a perpendicular direction to the current flow. This restriction in a magnetic field can be thought of as a further limitation compared to flow of the electric force. All matter exhibits magnetic properties in the presence of a magnetic field, and can be classified in terms of degrees to which it is attracted or repulsed by it, depending on the alignment of atoms. In some cases, attractive and repulsive forces cancel each other, resulting in net neutral magnetic properties. The association of the earth mahabhuta with magnetism doesn't mean all materials made of earth are magnets – though they all interact to some degree with magnetic fields. Rather, the abstract principle associated with earth can be related to underlying laws of nature expressed as magnetism a bit more closely than with water. The mahabhuta of earth expresses all five fundamental qualities. In this delineation, the magnetic force is based in the electric charge – which is consistent with the theory of electromagnetism.

Again, Sankhya (and ancient Vedic science generally) identifies three fundamental levels – gross relative, subtle relative, and transcendent completely unified field. Recognizing these three levels of nature provides the needed bridge to account for many recalcitrant paradoxes in the reductive physicalist paradigm. The fundamental particle-forces and spin states appear to match with the three fundamental 'forces' and five 'elements' in Veda. Hopefully, this encourages more integrated understanding of particle mechanics and wave dynamics toward seamless unity (Boyer, 2008, 2021).

Direct empirical validation of non-duality

In holistic Vedic science, the completely unified field is inherently conscious, orderly, and dynamic – from the Totality of universal Being to the phenomenal appearance of no consciousness, no intelligence, and no life at the level of inert physical matter. 'Absolute' reality is the essence of relative realities. Infinity is the essence of space, eternity is the essence of time, immortality is the essence of mortality; and consciousness itself, universal Being, is the essence of individual consciousness and individual being. This top-down *consciousness-mind-matter ontology* has the task of explaining how some parts of nature appear not to be conscious, even if everything is ultimately the unified field of consciousness. This is addressed in the structure of the Veda itself. It is opposite of the impossible task in physicalism to explain how inert randomly fluctuating fields coming from nothing create conscious beings with causal control over their parts in an unbroken deterministic causal chain. In Maharishi Vedic Science and Technology, holistic and reductive views are ultimately reconciled and validated through, as Maharishi Mahesh Yogi emphasizes, development of higher states of consciousness as the natural birthright of human beings (Boyer, 2008).

The epistemology of Yoga describes natural, systematic means to develop higher states. This ancient tradition emphasizes the inner direct first-person perspective that has been missing in modern science. Again, it holds that the human mind and the universe examined using it share the same source and the same laws of nature. This correspondence allows knowledge to be gained directly – in the *inner laboratory of the mind*. The direct first-person subjective approach in Yoga complements the third-person objective approach in that it goes beyond the subject-object duality characteristic of experience in the ordinary waking state to a non-dual unified state of consciousness. The scientist naturally transcends the subject-object duality for direct verification of the underlying seamless Totality. This paper suggests that for the first time in modern science a logically coherent framework is emerging from which to address the mind-body problem, the causal efficacy of mind, and the place and role of consciousness. This framework can be understood to be consistent with the ancient Vedic ontology in Sankhya. Incorporating systematic first-person methods in the epistemology of Yoga address quite subtle, long-standing quandaries in modern science and allows for their resolution to be validated directly in higher states of human consciousness.

Summary and Conclusion

The ancient Vedic tradition as articulated in Maharishi Vedic Science and Technology is held to be based on direct empirical experience of the structure of Veda. Rik Veda has 10 Mandalas that can be summarized in terms of unity, quinternity, trinity, and non-duality (1^{st} to 10^{th} mandalas). This paper outlined how it links to the most successful theories in modern science. It provides a framework for progress on the total structure of nature in the model of three ontological levels: the gross relative, the subtle relative, and the transcendent unified field. Further, the model of the gross relative level in Vedic science, composed of five fundamental constituents emerging from three fundamental abstract qualities, helps to integrate the fundamental particle-forces and Higgs field toward quantum gravity and unified field theory. The systematic means to gain reliable knowledge in Yoga complements the dualistic objective means in modern science for deeper understanding and validation of the all-encompassing unified field. In this account, the entire universe including each of us is infinite on the inside and appears finite on the outside. As Maharishi (2003) profoundly states:

"The individual is cosmic."

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