Did the Universe Emerge from *Nothing*? Reductive vs. Holistic Cosmology

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ABSTRACT

'Consensus' big bang theory is frequently associated with a reductive view of the universe as emerging from an infinitely dense, infinitesimally small singularity or even nothing (*ex nihilo*). But wouldn't nothing mean no potential, energy, temperature, information, or random quantum fields to bang out when the 'right values' of 'unstable nothing' arose? Let us instead consider a coherent alternative, in which the universe emerged within an infinite eternal unified field that cannot be 'banged out of.' It can be called a singularity in the sense that it is the singular totality, and 'nothingness' in that it transcends all 'things'—but not literally nothing. This paper summarizes progress in cosmological models toward a holistic account in which the entire universe phenomenally emerges within infinite eternal 'space-time.' The shift from reductionism to holism has immense implications for the origin and structure of nature—as well as our phenomenal relation to it as conscious beings with real minds and free will—consistent with ancient Vedic cosmology.

Key Words: inflationary cosmology, reductivism, nothingness, unified field, Vedic cosmology

DOI Number: 10.14704/nq.2014.12.4.777 **NeuroQuantology 2014; 4:424-454**

Introduction

Reductive investigation of smaller time and distance scales and higher temperatures led to theories of the universe emerging in phases of a *hot big bang* about 13.7 billion years ago. The need to account for the extremely uniform distribution of energy/matter and the geometric flatness of space led to the *inflationary* model. Further elaboration posited a *pre-inflationary* phase in which initial quantum fields were highly disordered or entropic. Random fluctuations are theorized to have resulted in a brief inflationary phase that created a low entropy state, followed by a 'hot' big bang from which emerged other fundamental forces in sequential symmetry-breaking and nucleosynthesis as the universe cooled (e.g., Guth, 1998; 2007). This technically impressive 'consensus' reductive inflationary model with pre-inflationary high entropy needs to be reconciled with a lowest entropy unified field as the ultimate bottom-line 'source of everything.'

The 'inflaton' field, dark matter, and dark energy

In Einstein's formulation of general relativity, the universe could stretch or shrink. Because of his belief in a stable universe, he added another term: the *cosmological constant*. This allowed his formula to contain a negative value representing a force of outward pressure or 'repulsive gravity' that if carefully chosen would balance attractive forces in stasis. With evidence the universe is expanding, however, Einstein dropped the cosmological constant, reportedly calling it his greatest blunder (Lincoln, 2004).

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.
Received: 3 September 2014; **Revised:** 17 September 2014;
Accepted: 5 November 2014
***e*ISSN** 1303-5150

But the cosmological constant was revived in *inflaton* field (inflationary) theory. In this theory, for an extremely brief time period of about 10^{-35} seconds at the outset of creation a repulsive force contributed a uniform negative pressure counteracting attractive gravity. This repulsive force caused a hyper-accelerated expansion of the universe by an incredible factor—possibly as much as 10^{100} more than in standard big bang theory—smoothing and flattening the universe. This brief inflationary phase was proposed in part because the standard big bang model did not account for the current size of the universe.

Inflation is theorized to be much faster than light-speed, but not inconsistent with it. Whereas expansion within light-speed applies to motion *through* space, inflation is held to be the expansion *of* space itself. Positing an inflationary force not subject to light-speed, unlike attractive gravity and apparently everything else in the physical universe, is at least curious. It might be understood to imply deeper underlying levels of nature not subject to the limits of classical relativistic physical space-time. As discussed later, this turns out to be a key issue in cutting edge quantum theories increasingly consistent with ancient Vedic cosmology. This paper reviews progress toward the holistic Vedic account, in which there is no need for an inflationary big bang to begin the universe *in the manner* envisioned in reductive cosmology.

Although the inflationary model does not attempt to explain the 'beginning' of the universe, it is fundamentally a reductive conception associated with the view that something like an infinitesimally small, infinitely dense singularity produced the beginning of space, which then inflated and continues an accelerating expansion even today. In the following quote, physicist Hawking (2001, p. 79) expresses this view:

> [T]he universe began in a big bang, a point where the whole universe, and everything in it, was scrunched up into a single point of infinite density. At this point, Einstein's general theory of relativity would have broken down, so it cannot be used to predict in what manner the universe began….

Reductive inflationary big bang theory requires a total amount of matter and energy that is considerably more than the tally of 'visible' objects, which contribute about 5%. Astronomical research suggested that additional matter is needed to hold rotating galaxies together, which led to the theory of *dark matter* based on mathematical symmetry that accounts for about an additional 25%. Observations of the accelerating expansion of the universe based on measurements of recession rates of supernovae helped revive the cosmological constant, associated with *dark energy* and super-symmetry. It was estimated that inflation requires a cosmological constant related to an amount of dark energy contributing about 70% more, which fits the total required for the inflationary model. But dark matter, an amorphous uniform repulsive force such as 'dark energy,' and super-symmetric particles have yet to be found in the natural world.

Inflation also provides a possible explanation for how the early universe came to be in a state of low rather than high entropy, somewhat consistent with the 2nd Law of Thermodynamics which states that entropy always increases. After inflation due to 'repulsive gravity,' the entropy resulting from attractive gravity producing non-uniform clumps of matter increased the overall entropy. But there is no time asymmetry in this theory, or in the known physical laws generally, which means that the origin of this statistical '2nd Law'—and also the related *arrow of time,* its unidirectional nature—is not yet addressed.

Support and challenges for the inflationary model

Physicist/cosmologist Paul Steinhardt (2011) summarizes three core points consistent with inflationary cosmology: 1) theoretically, the pre-inflationary universe contained randomly fluctuating quantum fields that inevitably resulted in values needed to trigger inflation; 2) it provides a model of the uniformity, smoothness, and flatness of our current universe; and 3) it has had good predictive power. For example, satellite telescopes have yielded remarkable evidence consistent with it, from small variations in cosmic microwave background radiation (CMB) in galaxies spread across the universe.

While this evidence is strong, there are concerns that its initial conception and predications don't match today's version of it (Steinhardt, 2011). One concern is that the energy values for inflation are in an extremely narrow range; and the current flat and smooth

universe is much more likely without inflation—possibly 10^{100} more likely (Steinhardt, 2011). Another concern is that the remarkable match between the CMB findings and the initial 1983 predictions of inflationary theory were based on the initial model of how it works, which since has been shown to be incorrect (Steinhardt, 2011). A third concern is that combining inflationary cosmology with quantum theory predicts continuous (eternal) inflation (Linde, 1994). This suggests that there are no specific predictions of the theory other than that all things will happen; and thus there may be no way to test its claims (Steinhardt, 2011).

The issue of special initial conditions is said to be addressed because inflation predicts infinity of universes, which makes the 'special conditions' in our universe mathematically inevitable. The theory further predicts that quantum fluctuations affect when inflation ends. This means that some regions of space continue to inflate, which would mean inflation is not just 10^{-35} seconds long but rather continuous in some regions. 'Island' regions are created where inflation ends, such as in the narrow range needed for the properties of our observed universe. In the theory, these processes go on continuously, producing an unlimited number of island regions or self-contained universes surrounded by regions of inflating space.

Eternal inflation would seem to predict not only infinity of universes with the properties needed for our universe, but also infinity of universes without them. To get out of this 'infinite' problem, a model of finite inflation seems needed; but this brings back the problem of 'special conditions.' One strategy is to find a principle to *measure* the likelihood of universes like ours that allows them to be more likely. But then principles will be needed to justify this *measure* principle, and so on (Steinhardt, 2011). Some cosmologists contend that the logical conclusion of infinity of universes predicted by eternal inflation is the most likely (e.g., Guth, 2007; Tegmark, 2014), and that concerns eventually will be resolved. Still others contend that the model needs to be replaced; and alternatives fitting at least most of the evidence are being proposed (Steinhardt, 2011).

Open vs. Closed Universe

Continuous (eternal) inflation suggests an *open* universe, and perhaps eventually a huge dark cold emptiness sometimes called the 'Big Chill.' Whereas the theory seems to suggest the origin of space is closed and finite, infinity of universes would be an open cosmology (which also might seem backward). But if the repulsive force dissipates and massive objects slow down, attractive gravity could pull things back together in a *closed* universe. Some closed universe models propose that as galaxies are compressed, increasing density and temperature would disintegrate all objects into a thick hot soup of elementary particle-forces. Everything could be crunched to the size of a basketball, soccer ball, baseball, golf ball, and an ultramicroscopic singularity, like the core of a black (or slightly grey) hole sometimes called the 'Big Crunch.' At this point a 'black' hole and the origin of the big bang may seem similar (see Hawking quote), and some suggest they are the same: ultramicroscopic curvatures of space such as particles, strings, or an almost infinitely dense or infinitely dense singularity.

Other models suggest that stellar masses might not shrink to the ultramicroscopic scale or an infinitely dense singularity. Rather, they might stabilize at some sort of inert equilibrium on a microscopic or even macroscopic scale, such as an undifferentiated mass of plasma called a *gravistar*. This avoids the difficulties of ultramicroscopic 'black' holes as singularities with mathematically challenging 'infinite quantities.' But whether it all comes down to *something* or *nothing*, how it came to be needs coherent explanation. Key issues include how order and information got into quantum randomness to begin with, and whether the source of the universe is infinite in every way, or possibly just in density and energy but not spatial expanse.

White holes and the multiverse

It has been speculated that positive and negative charges of elementary particles suggest an opposite to the 'black' hole: a 'white' hole that radiates rather than contracts matter/energy/information (e.g., Wheeler, 1990). If a black hole connected to a white hole, matter/energy/information pulled into the black hole might be expelled through the white hole into another part or even another universe, as in the concept of a *wormhole*. Such opposite pairs could be the weave of a local-nonlocal fabric of space-time. Wormholes might also exist whether or not they are associated with black holes. For example, the concept of a white

hole is now being applied to explain *quantum entanglement*, the phenomenon that pairs of elementary particles have highly correlated behavior even after separated and unable to be causally connected in terms of local causality within light-speed and the light cone (e.g., Tegmark, 2014). This also is suggestive of dynamical processes not limited to, and that underlie, relativistic physical space-time. Recent ideas that all particles may be entangled (universal or cosmic entanglement) are further suggestive of an underlying and more interdependent, interconnected field.

It has been speculated that a wormhole could be a portal for human travel. It would seem that a non-thermal transformation of matter/energy into some form of pure information beyond the matter composing our physical bodies (and then back) would be required to survive wormhole 'travel' (and also teleportation if it involves decomposing /recomposing our physical bodies). Such wormhole 'travel' also requires preserving individual memories for example, as well as means for intentionally directing us to places even outside our light cones—beyond classical and quantum views of causality. These ideas also portend some level of nature or medium deeper than ordinary space-time, such as a quantum information field underlying physical space-time, discussed later.

Again, inflationary cosmology proposes that our universe may be just one of infinity of universes, very brief 'virtual' ones and others lasting a long time from our ordinary perspective, some even with different laws of nature. Distinct self-contained parallel universes are predicted, with no ordinary means to interact, which may go through private bangs and crunches somewhat like virtual particles in the theorized effervescent soup of space-time foam.

The collection of all possible universes is sometimes called the *multiverse* (Greene, 1998; Smolin, 2001; Hawking, 2001; Penrose, 2004; Tegmark, 2014). Many universes such as our own presumed 'special' universe might be created and destroyed continuously in various stages and regions of the multiverse. In this model, there would be infinity of copies of our universe, apparently as well as us—so we and our universe would not be at all special. On the other hand, this may be another example of growing concern about mathematical speculations disassociated from empirical physics (e.g., Smolin, 2006; Woit, 2006). As we go deeper into nature, it is harder to maintain the connection between empirical 'real' physics and conceptual 'imaginary' mathematics—which also suggests levels of structure and function subtler than the physical level.

It is generally recognized that classical theories of gravity and space-time are inadequate, and that quantum theory is needed to account for black holes and related cosmological mechanics (again see Hawking quote). Some further suggest quantum theory needs to be modified to include entropy/information beyond matter/energy in a theory of *quantum gravity* (e.g., Penrose, 2012).

Alternatives to the inflationary model

Models with other forces have been proposed as alternatives to the *inflaton field*, such as a 'technicolour' force mediated by 'techniquarks' (Smith, 2003). Another model proposes that accelerating expansion has occurred in a steadier manner over billions of years, with no cosmological constant. In this and other models, the current expansion will end at some time, moving into other phases such as a *cyclic* pattern. Some of these views relate to *quintessence* theory, an early Greek term for a fifth element (*aether)* in addition to air, fire, water, and earth (Caldwell, Dave and Steinhardt, 1998; Zlatev, Wang and Steinhardt, 1999). Discussed later, the ancient Vedic account has this fifth 'space element' (*akasha*), but it is a much subtler concept.

Models are now also being proposed that don't include dark matter and dark energy. One example emphasizes antimatter as a repulsive gravitational force that may have collected in theorized *voids*, vast areas in ordinary space absent of galaxies or other visible astrophysical objects (Zyga, 2012a). In this model, matter and antimatter in general relativity are repulsive with respect to each other but self-attractive. Antimatter collected in large voids might drive accelerating expansion in a cyclic pattern without dark energy and without a big bang in the manner now posited in 'consensus' inflationary big bang theory. Another example proposes that accelerating expansion comes from virtual fluctuations of matter and antimatter in the quantum vacuum, producing real repulsive gravitational dipoles of matter and antimatter. The energy density in the

gravitational dipoles has been calculated to be close to the needed cosmological constant value for accelerating expansion (Zyga, 2012b).

Such views concern bangs and crunches as pulsations of the relativistic space-time gravitational field, through which galaxies repeatedly form and collapse. Though it is recognized that quantum mechanics is needed to explain bangs and crunches, these events mainly would be local events within the fabric of ordinary, conventional relativistic physical space-time to account for the observed evidence for accelerating expansion. They would not necessarily be a big bang in the sense of the origin of the entire multiverse—local, nonlocal, and infinite.

Accelerating expansion would seem to mean that every point, so to speak, in ordinary space is expanding. One perspective is that at the smallest time and distance scales in relativistic physical space-time the expansion would be miniscule with respect to a particular individual observer; but at the most distant regions for that observer the expansion would approach light-speed. This suggests that the finite local field of relativistic physical space-time is better conceived as a *medium* that curves back on itself within the limits of light-speed and general relativity, an important concept to resolve some fundamental issues about relativistic physical space-time, discussed again later.

Models of local mechanics of conventional relativistic physical space-time represent alternatives to account for evidence now interpreted as support for the inflationary model that posits what would appear to be the unique phenomenon of superluminal motion outside of classical physics. Importantly, these models further imply underlying real fields of existence beyond relativistic physical space-time, based on more inclusive theoretical and empirical findings, especially the empirical evidence for entanglement. Discussed next are recent models that are alternatives to the entire theory of the universe blasting out in a big bang (e.g., Steinhardt, 2003, 2011; Steinhardt and Turok, 2007; Penrose, 2012).

Cyclic models

The major alternatives to continuous (eternal) expansion are cyclic models. In these models, a closed universe could cycle between expansion and contraction—bangs and crunches. Steinhardt (2003, pp. 299-308) contrasts the continuous expansion and cyclic models:

> The standard model, or consensus model, assumes that time has a beginning, which we normally refer to as the Big Bang. According to this model, for reasons we don't quite understand, the universe sprang from nothingness into somethingness, full of matter and energy, and has been expanding and cooling for the past 13.7 billion years. In the alternative model, the universe…is endless in the sense that it goes on forever in the past and forever in the future. And in some sense, space is endless…. More specifically, this model proposes…the evolution of the universe is cyclic… People have considered this idea as far back as the beginning of recorded history. The ancient Hindus, for example, had a very elaborate and detailed cosmology based on a cyclic universe…
>
> What one can say is that data have confirmed predictions of the naïve inflationary theory…that inflation leads to a predictable outcome governed by the laws of classical physics. The truth is that quantum physics rules inflation, and anything that can happen will happen. And if inflationary theory makes no firm predictions, what is its point? Rogue regions that delay ending inflation continue to grow at an accelerating pace, so they invariably take over. In an ideal situation, any rogue regions would expand more slowly—or, better still, shrink. The overwhelming bulk of the universe would consist of well-behaved regions that end the smoothing phase on time, and our observed universe would be comfortably normal…. [C]yclic theory…has just this property (p. 43).

Physicist/cosmologist Max Tegmark (2014, pp. 151) further explains:

> Inflation aside, there might be other mechanisms that create universes. An idea proposed by Richard Tolman and John Wheeler and recently elaborated by Paul Steinhardt and Neil Turok is that our cosmic history is cyclic, going through an infinite series of Big Bangs…such incarnations would also form a multiverse….
>
> Another universe-creation mechanism, proposed by Lee Smolin, involves mutating and sprouting new universes through black holes rather than through inflation…with natural selection favoring universes with maximal black-hole production.

As an example of cosmological models that do not incorporate inflation, Steinhardt and Turok's (2007) recent book proposes a cyclic model that draws from superstring

theory, and is said to avoid challenges to the inflationary model. In this model our universe is a *D-brane*, a type of mathematical object on which open strings can end. Our *D-brane* is near another *D-brane*, which through vast time periods crash into and bounce off each other to create another expansion similar to the 'hot big bang' phase. After about a trillion years there is a contraction, followed by a new expansion. The smoothing of space occurs in the low-density contraction phase.

Both this cyclic model and the inflationary model predict 'gravity waves' due to random quantum fluctuations that would leave an imprint on the CMB, proportional to the energy density. The CMB imprints would differ because in the inflationary model gravity waves were created when the universe was very dense, whereas in this alternative cyclic model they were created when the universe was practically empty and the imprint would be negligible (Steinhardt, 2011). Research now underway is testing for the imprint, and recent findings are discussed shortly.

Mathematician/cosmologist Sir Roger Penrose (2004) also has expressed concern about the inflationary model, focusing on the 2nd Law of Thermodynamics:

> There are certainly some elements fundamental to the inflationary picture whose aesthetic status is somewhat questionable, such as the introduction of a scalar field [inflaton field]...unrelated to other known fields and with very specific properties designed only for the purpose of making inflation work.... Let us consider the horizon problem.... There is...something fundamentally misconceived about trying to explain the uniformity of the early universe as resulting from a thermalization process...whether this is a uniformity in the background temperature, the matter density, or in the space-time geometry generally.... For, if the thermalization is actually doing anything (such as making the temperatures in different regions more equal than they were before) then it represents a definite increasing of the entropy.... There are certainly deep puzzles relating to the peculiarly constrained state of the early universe. But these constraints are fundamental to the very existence of the Second Law of Thermodynamics.... All thermalization processes *depend upon* the Second Law.... Moreover, all spontaneous symmetry-breaking processes and all phase transitions (these being needed for inflation) take place only by the good grace of the Second Law. These processes do not explain the Second Law; they *use* it.... If we want to know why the universe was initially so very special, in its extraordinary uniformity, we must appeal to completely different arguments from those upon which inflationary cosmology depends (pp. 754-757).

In Penrose's (2012) new book, *Cycles of time: An extraordinary new view of the universe,* he proposes another cyclic model, Conformal Cyclic Cosmology (CCC). It describes a pulsating pattern of very long time periods, which Penrose refers to as 'aeons.' This model focuses on consistency with the 2nd Law of Thermodynamics. It considers not only initial states of low entropy that evolve to high entropy within an aeon, but also how it might involve fundamental changes to quantum theory in order to account for them, as well as to account for increasing entropy across aeons which would seem necessarily to change successive ones.

The 2nd Law of Thermodynamics that posits increasing entropy is a key issue. It concerns information and order, which also can be related to intelligence. As discussed later, objective science has had great difficulty addressing the concept of order and its source in nature—and even more so the concept of intelligence. This is especially the case with respect to the origin of the orderly laws of nature that science attempts to know and apply, but that are frequently viewed as a spontaneous product of fundamental randomness rather than order.

Recent evidence interpreted as against cyclic models and for inflation

If classical relativistic space is more fundamentally a quantized field, then it would have inherent dynamism in the form of quantum jitters or fluctuations at the Planck scale range, as with other quantum fields. Inflationary theory predicts that such fluctuations produce ripples or 'gravity waves' that get 'stretched' during inflation into patterns that might be detectable in the CMB. The BICEP2 research team recently reported such patterns in CMB radiation (The BICEP2 Collaboration, 2014). The results are interpreted as support for both the illusive gravity waves and for inflationary theory. If these findings are confirmed, they would appear to be inconsistent with other models, including

Steinhardt and Turok's (2011) cyclic model. However, some cosmologists suggest additional research is needed to rule out alternative explanations, such as that the pattern is due to nucleosynthesis, or even to artifacts, with no contribution from theorized gravity waves (e.g., Dent, Krauss, and Mathur, 2014; Steinhardt, 2014).

In the following composite quote of physicist Matt Strassler (2014), phases of the inflationary big bang model are summarized from reasonably well-established evidence to this recent new evidence, from the nucleosynthesis of fundamental force fields to an earlier extremely brief inflation. It further notes speculations about pre-inflationary phases possibly emerging from an infinitely dense singularity:

> Much of the history of the observable patch [our universe] is imprinted in the details of the CMB.... The fact that the COBE satellite's data agrees closely with the prediction of a black-body spectrum...is overwhelming evidence that there was a Hot Big Bang going on at the time that atoms first formed, when the observable patch...became transparent to light—a time now believed to be about 380,000 years after the Hot Big Bang began [nucleosynthesis]....
>
> However, for times before nucleosynthesis, the arguments are weaker.... It is a remarkable fact that the CMB is incredibly uniform...and explaining why...is one of the arguments in favor of cosmic inflation. Detailed measurements of the CMB have increasingly given us insight...where we don't have any particle physics data.... [T]hese calculations begin with very simple assumptions about the patterns of non-uniformities that were present at the start of the Hot Big Bang, and then we check if these assumptions give predictions for non-uniformities in the CMB that agree with data. They do!.... This lends support to the hypothesis of cosmic inflation.... But...one can imagine simple non-uniformities arising in some other way.... This may have changed with BICEP2s new measurement, which gives powerful new evidence for cosmic inflation through inflation's generation of gravitational waves...assuming the measurement itself, and the interpretation of the measurement, both hold up over time. Since a measurable amount of gravitational waves can only be produced, as far as we know, if a period of inflation occurred and was driven by a **very** large amount of "dark 'energy," BICEP2's result may rule out all known alternatives to inflation.... But BICEP2 can really only tell us about *the late stage and exit from inflation*...not further. We cannot infer much yet from CMB measurements about the "inflation" field (and its particle) that is supposed to play the dominant particle-physics role during inflation, and we have no idea what other types of fields it may interact with, so it is hard to be sure what types of processes got inflation started.... But anything before inflation is not in the least reliable...in particular the notion that the universe's heat and density increased to the extent that Einstein's equations have a singularity...is an *assumption*.... Moreover, it is quite possible that the start of the universe, which people often refer to as the ultimate Big Bang, may not have had anything "Bangish" or even Big about it.... The scientific community won't have any problem with this, because many of us have never taken that idea very seriously in the first place.

Physicist Max Tegmark (2014/04/12) makes similar points within this reductive framework:

> It is inappropriate to define our Hot Big Bang as the beginning of time, because we don't know whether time actually had a beginning, and because the early stages of inflation were neither strikingly hot nor big nor much of a bang. Inflation is better thought of as a cold Little Swoosh, because at that time our universe was not that hot (getting a thousand times hotter once inflation ended), not that big (less massive than an apple and less than a billionth of the size of a proton) and not much of a bang (expanding a trillion trillion times slower than after inflation).

Does *nothing* really mean reductive nothing, or holistic *nothingness*?

According to the 'consensus' view, a high entropy (inflaton) field came to exist in some unknown way that due to random fluctuations attained the 'right values' for inflation of the universe to a low entropy state. The universe became very hot after inflation, perhaps in nucleosynthesis. The accelerating expansion within ordinary space cooled down the universe, eventually arriving at its current size with attractive gravity forming astrophysical objects such as galaxies, stars, planets, Earth—and 'me' and apparently 'you.' Deeper challenges come with speculations that randomly fluctuating gravity/inflaton fields somehow came into existence in a *pre-inflationary* period from a singularity, or even

from *nothing*. As physicist/string theorist Brian Greene (2004) points out:

> The big bang is a theory…that delineates cosmic evolution from a split second after whatever happened to bring the universe into existence, but it says nothing at all about time zero itself… [T]he big bang leaves out the bang. It tells us nothing about what banged, why it banged, how it banged, or, frankly whether it ever really banged at all (p. 272).

Astronomer David Darling asks the quite reasonable and still relevant question of how nothing could blast out in the first place:

> 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 (1996, p. 49).

The reductive view of everything emerging from nothing is exemplified here by the work of physicist Lawrence Krauss, summarized from his 2012 book, *A Universe From Nothing: Why There Is Something Rather Than Nothing*. In this book, he describes different meanings of 'nothing,' starting with the Newtonian classical notion of space as empty 'nothing,' then to vacuum energy in quantum theory as a 'deeper nothing,' and finally hints at everything coming from 'really nothing.'

> …[W]e have discovered that we live in a universe in which empty space—what formerly could have passed for nothing—has a new dynamic that dominates the current evolution of the cosmos. We have discovered that all signs suggest a universe that could and plausibly did arise from a deeper nothing—involving the absence of space itself—and which may one day return to nothing via processes that may not only be comprehensible but also processes that do not require any external control or direction (p. 183).

Krauss' view of the universe 'arising from beyond ordinary space itself, to which it may return, and arising in a manner that does not require external control or direction,' is consistent with ancient Vedic cosmology. Even if we think of time as *beginning*, however, it would seem to make no sense that all conceptions of it could end in literally 'nothing' again. This subtly implies eternal 'time' and infinite 'space.' Krauss' arguments for 'something coming from nothing' seem far from *literally* nothing. But Krauss (2012) argues:

> It certainly seems sensible to imagine that a priori, matter cannot spontaneously arise from empty space, so that *something,* in this sense, cannot arise from *nothing*. But when we allow for the dynamics of gravity and quantum mechanics, we find that this commonsense notion is no longer true. This is the *beauty* of science, and it should not be threatening. Science simply forces us to revise what is sensible to accommodate the universe, rather than vice versa (p. 151).

Krauss' point about the difference between reason and empirical experience is a key issue, discussed at the end of this paper. The issue here is that in 'nothing' we now have 'the dynamics of gravity and quantum mechanics;' and Krauss (2012) finds more in 'nothing:'

> While inflation demonstrates how empty space endowed with energy can effectively create everything we see, along with an unbelievably large and flat universe, it would be disingenuous to suggest that empty space endowed with energy, which drives inflation, is really *nothing*. In this picture one must assume that space exists and can store energy, and one uses the laws of physics like general relativity to calculate the consequences. So if we stopped here, one might be justified in claiming that modern science is a long way from really addressing how to get something from nothing. This is just the first step, however. As we expand our understanding, we will next see that inflation can represent simply the tip of the cosmic iceberg of nothingness (p. 152).

Now, 'nothing' also includes space, time, energy, a system to 'store energy,' and 'the laws of physics like general relativity.' But Krauss is beginning to replace 'nothing' with 'nothingness,' a step toward holism. In this

direction, Krauss' 'nothing' is getting more complicated, with even more things in it.

> Empty space is complicated. It is a boiling brew of virtual particles that pop in and out of existence in a time so short we cannot see them directly… These "quantum fluctuations' imply something essential about the quantum world: nothing always produces something, if only for an instant (p. 153).

In Krauss' (2012, pp. 158-159) 'nothing'—fortunately becoming 'nothingness'—there are several required ingredients. These include "a boiling brew of virtual particles," "unstable," that "always produces something;" symmetry and asymmetry, a small amount of matter to remain after almost equal amounts of matter and antimatter annihilate each other, the inequality driven by some random initial condition; underlying laws to allow quantum processes to drive the universe away from a featureless state; space, time, energy and its storage, general relativity, all possibilities allowed by the laws of nature as occurring, and inflationary dynamics.

From a more integrating perspective, rather than Krauss' complicated 'nothing' as 'unstable,' it seems reasonable to say that *something* has the inherent tendency to change. This relates to *inherent dynamism* (e.g., associated with the 'heat bath,' virtual particles, space-time foam, quantum fluctuations, the repulsive force of the inflaton field). It also includes symmetry, and at least an initial potential balance of matter and antimatter, which somehow became an asymmetry. In 'nothing' we now have processes that comprise initial conditions, which drive 'nothing' into the physical asymmetry of our somewhat known orderly universe.

Another way of saying this is that inherent dynamism inevitably is expressed, and importantly maintained, through natural laws in a universe stable enough to exist at least for a while. These laws can be associated with a second ingredient or principle, identified as *inherent order*. And 'nothing' further requires matter/antimatter, energy storage, as well as some sort of opposition to gravitational attraction and to all change, described in inflaton field theory, and also Higgs field theory as a viscosity to space which gives mass to objects. These can be related to a third ingredient, which can be identified as *inherent resistance to change* (viscosity). We thus can identify three ingredients through which the universe emerges: inherent dynamism, inherent order, and inherent resistance to change. These can be related to the three fundamental creative, maintenance, and annihilation/dissolution operators. Later we discuss how they also relate to three fundamental principles, qualities, or 'forces' in the Vedic account.

To summarize, in the reductive view everything came from no point at all, nothing. In the holistic view, everything emerged within the super-symmetric, lowest entropy unified totality of nature. These views need to be reconciled.

The unified field and *fundamental* order

Of course the origin of the big bang could not have occurred at some point in ordinary space-time, because ordinary space-time would not have existed 'before then.' On the other hand, it seems fundamentally inconsistent—at least for some of us—to assert that the universe came from *literally* nothing. In the theorized pre-inflationary period of the initial high entropy state, fluctuations of highly disordered gravitational and inflaton fields are said to have existed. This implies some form of pre-space and time in which the random fluctuations occurred—not nothing. Again, the concept of inflation much faster than light-speed also is suggestive of some less restricted force field or medium in nature that drives inflation.

In the contrasting holistic view of the unified field as the bottom-line source and container of everything, the fundamental 'forces' can be said to pre-exist in the super-symmetric unified field. But also, the unified field must continue to exist as the source of *continuously* occurring quantum vacuum fluctuations, zero point motion, or inherent dynamism. This means that the unified field is more than the unification of the fundamental fields, if it remains as an underlying basis even after symmetry-breaking. The underlying super-symmetry or unity doesn't go away with symmetry-breaking. It at least is said to contain continuous quantum fluctuations, which certainly suggests it is *something*. In the following quote of mathematician/physicist Bohm (1980, pp. 241-243) it is described as the 'ground of everything:

> As we keep on adding excitations corresponding to shorter and shorter wavelengths to the gravitational effects, we come to a certain length at which the measurement of space and time becomes totally undefinable… When this length is

> estimated it turns out to be about 10^{-33} cm [Planck length]. If one computes the amount of energy that would be in one cubic centimeter of space, with this shortest possible wavelength, it turns out to be very far beyond the total energy of all the matter in the known universe... In this connection it may be said that space, which has so much energy, is full rather than empty. The two opposing notions of space as empty and space as full have indeed continually alternated with each other... Thus, in Ancient Greece, the School of Parmenides and Zeno held that space is a plenum. This view was opposed by Democritus, who was perhaps the first seriously to propose a world view that conceived of space as emptiness (i.e., the void)... Modern science has generally favored this latter atomistic view, and yet, during the nineteenth century, the former view was also seriously entertained, through the hypothesis of ether that fills all space... It is being suggested... that what we perceive through the senses as empty space is actually the plenum, which is the ground for the existence of everything...

Super-symmetry implies *fundamental* order

Initial symmetry-breaking can occur only if the unified field is highly symmetric, even 'super-symmetric,' with the lowest entropy and highest order. The unified field as the origin of the orderly laws of nature suggests zero or no entropy. Further, the *arrow of time* and related 2nd Law of Thermodynamics are consistent with the source of change as a state of least or zero entropy. These points support the view that relative degrees of order emerge from the highest order, not from *fundamental* randomness or 'nothing' with no order and no inherent potential at all.

Indeed, if the universe were fundamentally random, *any* outcome would have equal probability. There would be no basis for continuity: no *memory* to maintain consistency to and through the next 'moment' if a real event happened to occur once. This is key for understanding the origin and continued existence of the entire multiverse. As Greene (2004, p. 271) notes:

> [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.

Moreover, how could *nothing* be *fundamentally* random? Randomness usually means that each event is independent of other events. Wouldn't this require distinguishable events, which presume some form of time sequence and space independence in order to distinguish them? When time and space exist with things in them, a sequence of identifiable events can be tested for orderly or random patterns; but already the fundamental orderly structure of 'events' in some form of time and space has been assumed. The concept of randomness does not seem applicable to literally 'nothing,' which would be 'before' there are discrete, countable events that could be orderly or random.

Randomness also would seem to be meaningless if we have only one real event—our universe. In the unique case of the origin of the universe (a one-trial sample), the concept of randomness seems misapplied as an alternative to order. As Penrose (2012.p. 36) notes in a related context, we would be in the "...curious situation of making statistical arguments based on only one data point (the conditions in our universe)."

The counter to these points about randomness seems to be the concept of the *multiverse*, and the related view that all possible universes which can exist do exist. Beyond the concept of randomness is the notion that all possibilities actually occur (at least in some sense). In this view, there is nothing special about our anthropomorphically 'special' universe that allows us to exist because infinity of such universes is inevitable (see earlier Steinhardt quote).

Krauss (2012, p. 170) moves closer toward *literally* 'nothing' by referring to a 'nothing' with *"...no space, no time, no anything!"* in which *"...even the laws of physics may not be necessary or required."* In a multiverse where all possible universes which can exist do exist, our laws of physics just happen to be one of the possibilities that are inevitably actualized, and there is infinity of them. The issue here might seem to be testability. But if all possible universes that can exist do exist, then there would be infinity of testable universes, as well as perhaps infinity of universes that know about all the other universes, and in which everything

happens, ad infinitum. Though we still may want to explain the origin of the multiverse, the explanation would be inevitable also, so testability is a moot point. But also then, wouldn't there be infinity of universes in which the origin is inexplicable and untestable?

Given this mathematically-based cosmology of infinity of universes, one might wonder whatever happened to 'Occam's Razor.' If science really means *something* and answers *real* questions—as is its precious tradition—we cannot just consider mathematical possibilities with infinite variety and infinite repetition of each event as the explanation for anything and everything; we need to explain phenomenally real empirical realities and a coherent orderly structure of nature, as in physics.

A core irony in modern science—held to be a rational systematic pursuit of orderly laws of nature—is again the difficulty of accounting for how order arises. At this point, the mathematical view of infinity of universes appears to obviate the need for explaining order by assuming all is random, spontaneous, and meaningless but appears to be orderly because we are in one of infinity of inevitable universes that appears orderly. This isn't particularly satisfying science.

To be discussed at the end of the paper, the completely holistic Vedic account purports to include systematic means of validation of ultimate unity as the source, origin, and container of all levels of the multiverse. These subtler empirical means have been overlooked in modern science. This is in part due to reductive physicalism and its corresponding unarticulated view of the nature of subjective mind and consciousness in the assumed to be pragmatic but deeply fragmenting reductive attempt at 'objectivity.'

Theories about subjectivity and consciousness in modern science are shaped by the objectified reductive approach and physicalist worldview. In these theories, consciousness is attributed a functional role in attention, intentionality, and the sense of self. It is described as fading out during sleep and coma, restricted by brain damage or malfunctioning, and ceasing when the physical body no longer sustains life.

For the most part, in these theories consciousness is an emergent property of complex functional organization in and around cellular processes of the physical brain. At more fundamental elemental, atomic, subatomic, and quantum levels, physical systems follow invariant laws of nature that are thought essentially to be a product of random disorder. Signifiers of sentient life—intelligence, intentionality, selective attention, survival instinct—have not been identified at more fundamental levels, and neither have the source of order, meaning in nature, nor mind and consciousness. This should be a valuable clue in pursuing the source of order in modern science (Boyer, 2008).

In the physicalist worldview, the inner subjective domain of conscious mind is at best epiphenomenal, and nature is frequently attributed to be fundamentally random and meaningless. There is no actual place in this view for real conscious intentions that influence what happens (which means no free will). While modern science has strengthened belief in the universal orderliness of nature, curiously now this belief extends neither to the most fundamental levels identified in modern science (quantum randomness), nor to the subjective domain (unreliable subjectivity).

On the other hand, a holistic view of inherent order allows for sentience, meaning, and real minds; and it is the direction of contemporary and ancient theories we will soon discuss (Boyer, 2014). These views include perspectives and experiences of nature not limited to the ordinary waking state of consciousness and its corresponding concept of space and time in which modern science has been conducted. This *state-dependent* limitation of how modern science has been practiced has been almost completely unrecognized in modern science.

Space-time would not 'bang out' from the all-encompassing unified field

If the unified field is a lowest or no-entropy state, then the theory of a pre-inflationary period prior to low entropy would suggest the inconsistency that something exists *prior* to the unified field—namely pre-inflationary randomly fluctuating gravity and inflaton fields from which the low-entropy state is created with inflation. In a completely unified field theory, no 'thing' or process exists prior to, outside of, or creates the unified field—neither attractive gravity and repulsive inflaton fields nor an '*unstable nothing*.'

A key difference between reductive speculations about the origin of the universe as emerging from a singularity or from 'nothing' and holistic views is how space is conceived. In reductive views, space-time refers to only ordinary relativistic space-time characterized by classical gravity, light-speed, and now Planck-scale quantization. But then it jumps into an abstract conceptual notion of mathematical 'imaginary' space that is not thought of as ontologically real. A holistic view includes both the physical and the mental meanings of space-time as ontologically real, and also as emerging ultimately from the infinite eternal 'space-time' of the unified field.

In a holistic unified field-based view, there might be individual explosive bangs in the ordinary space-time gravitational field, for which the evidence is strong. With respect to the entirety of existence, however, the origin of the multiverse would not be an explosive 'hot big bang' to something outside it. Rather, it would be some sort of implosion, condensation, or precipitation because everything resulting from the ultimate unified field remains inside it (Boyer, 2007). Ordinary space-time would be a phenomenal limitation of the infinite (space) and eternal (time) that is the unified field. Space-time would not start from a point or space-less singularity and expand out, but condense to finite levels remaining within the all-encompassing unified field.

Physicist Brian Greene (2004) summarizes fundamental differences between reductive big bang cosmology and the holistic view of space as infinite and time as eternal. In addition, he points out that the holistic view appears to be consistent with the contemporary view that space is *flat*:

> 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.249-250).

The contemporary models described so far, including inflationary big bang theory, are based largely on the reductive physicalist paradigm of ordinary, conventional space-time and relativistic gravity. There is little consideration of nonlocal, non-physical levels of nature underlying classical space-time, such as the concept of pre-space, quantum information field theory, loop quantum gravity, and the 'implicate' and 'super-implicate' orders in the neorealist interpretation of quantum theory, discussed soon. These additional levels—that is, the quantum information field and the ultimate underlying unified field—are theorized to *permeate* and *generate* physical space-time and relativistic gravity. The inflationary model suggests that low entropy was produced at the end of the inflationary period, but unified field theories suggest that the ultimate unified field itself is the lowest entropy field.

Quite different, and much more integrated, cosmological models are needed if conventional space-time is underlain by a real nonlocal information field and a lowest entropy unified field. These issues now will be considered in holistic three-level models, in contrast to the current 'consensus' models of reductive one-level physical realism and materialistic or emergent monism.

Progress toward a three-level ontological model

Recognition that the fragmented one-level (physical) and the two-level (physical and unified field) models don't yet account for real mind is leading to three-level models. The additional level is placed in-between the physical and the unified field, and is where real subjective minds could exist. Recent quantum theory interpretations reflect progress toward this expanded ontology.

The subtle level underlying and permeating the gross physical level is determinate (not indeterminate and random); nonlocal (not just local); wave-like (not just particle-like); includes mind as *real* (not epiphenomenal); includes mind as subtler than matter (not emerging as a product of the brain); includes mind as causally efficacious (we are

not robots); and includes nature as both subjective and objective (not subjectivity independent of objectivity in irreconcilable dualism with no causal links for mind over matter). A three-level ontology is exemplified in the contemporary models now briefly outlined. Fortunately it reflects increasing theoretical understanding that scientists have real minds; but *experiential* appreciation of additional phenomenally real levels of nature beyond the physical still appears to be quite rare.

Tegmark's multiverse levels

Physicist Max Tegmark (2014, p. 120) describes physical reality as "Everything that exists," which would seem to be a one-level ontology of physical realism or materialistic monism. But he summarizes contemporary speculations about the eternal inflationary model with its logically deduced prediction of infinity of universes in terms of four levels. This extends beyond our ordinary associations of what physical means—importantly into a *nested* model that can be shown to fit the three-level ontology toward which we have been progressing. While emphasizing a more abstract mathematical view of nature compared to our ordinary understanding of physicalism, however, it can be said to severely conflate physical and mental.

Level I. Tegmark (2014) states that, "The Level I parallel universes are simply universe-sized parts of our space that are so far away that light from them hasn't yet had time to reach us (p. 129)." This level has infinity of galaxies including ours, and infinity of copies of each of us and our universe, as well as infinity of universes apparently with infinite gradations of like-to-unlike copies of us and our universe. Level I parallel universes share the same laws of nature, but differ in some details because of starting out slightly different due to being generated from random quantum fluctuations. As Tegmark (2014) notes, "[S]tudents in Level I parallel universes would learn the same thing in physics class but different things in history class (p.122)."

However, the parallel universes overlap, with no special boundaries distinguishing them other than the current light cones of observers. But Tegmark also asserts that of the infinity of 'look-alikes' of you in the infinity of universes, "there's only one who speaks English, lives on a planet identical to Earth, and has experienced a life completely indistinguishable from yours in all ways." He further notes that this undermines classical determinism because "there's no way for you to determine which of these copies is 'you' (p.13)." How come there is only one (not infinity of them) is unclear. But he states further that if there are exact copies of 'you, then':

> [T]here's no guarantee that you'd even find an exactly identical one…there's only a finite number of universe possibilities that our collective human civilization can ever distinguish between in practice, since our brains and computers can store only a finite amount of information. Moreover, we can only measure things with finite accuracy (p. 130).

Level II. Tegmark (2014) points out that typically eternal inflation predicts "an infinite set of distinct ones [parallel universes], some perhaps with apparently different laws of physics (p. 132)." What defines Level II is that eternal inflation creates space between universes more rapidly than can be traveled within them even at light-speed, so the universes are forever isolated from each other and there is no possibility of crossing from one to another within the limitation of light-speed and classical local causality. In some areas of space the inflation ends, forming a Level I region with infinity of universes in it that eventually create clusters of atoms, then stars, then galaxies and then us in our universe. But the specific laws of physics characterizing these isolated, Level I 'pocket' universes in the Level II multiverse may be somewhat different due to their varying histories. Tegmark (2014) then takes it further in Level II:

> Many of the regularities that we used to view as *fundamental laws,* which by definition hold anywhere and anytime, have turned out to be merely *effective laws*, local bylaws that can vary from place to place, corresponding to different knob settings defining space in different phases (p. 138)…. Many physical laws and constants that are unchanged across a Level I multiverse may vary across the Level II multiverse, so students in Level I parallel universes learn the same thing in physics class but different things in history class, while students in Level II parallel universes could learn different things in physics class as well (p. 153).

Tegmark explains that 'effective laws' refer to the "Particular solution to the mathematical equations that describe physics;

[which] can be mistaken for fundamental laws if the same solution is implemented throughout the universe (p. 139)." In this view, dark matter is said to be an attractive force pulling things together, and dark energy is repulsive. Avoiding too much of either is needed for the fine-tuned balance necessary for our hospitable universe. Though local details may differ, both Levels I and II seem to be subject to the concepts of relativistic space-time gravity and light-speed—again apparently with the unique exception of inflation.

At the Planck scale that is held to be the smallest possible unit of conventional space and time, our ordinary notions of distance and duration break down. But as we will discuss, a breakdown of ordinary notions of space-time doesn't invalidate all notions of it. And correspondingly, a breakdown of classical notions of local causality due to probabilism in quantum field theory doesn't invalidate all notions of causality, also discussed later.

Level III. Tegmark (2014, p. 151) states that "…[A]ll possible Level I multiverses are realized within each of these Level II multiverses." Because this would seem to include it all, what is the need for additional levels, what is their nature, and where could they possibly exist?

Tegmark (2014) identifies a Level III multiverse based on ideas originating from the many-worlds interpretation of quantum theory by Hugh Everett (1957), sometimes described as a 'many mind-worlds' interpretation. According to this interpretation, each observation or measurement results in a parallel mind-world or conceptual universe, but unfortunately with no means for continuity across them. This is an irreparably fragmenting view, and it would seem to undermine empirical physics that requires continuity of experience across times, places, and events.

This interpretation describes an abstract infinite mathematical space, Hilbert space, in which 'exist' mathematical objects. Tegmark (2014) asserts that 'quantum wavefunctions' (Schrödinger equation) are purely mathematical 'objects' that may constitute the most fundamental 'physical' reality. They are no longer characterized as substantive material objects but rather superposed probabilities in mathematical space of appearing in a particular place and time in three-dimensional space-time when measured.

At Level III, we are shifting away from ontologically real physics to a more abstract mathematical multiverse that identifies a conceptual mathematical level of nature as more fundamental, but also strangely as still physical. This reflects the leap now underway from *classical reality* to *quantum reality* that is bigger than any transition in the history of physics. It reflects important progress toward levels of existence in addition to our familiar physical universe.

But the ontological reality of Level III universes or mind-worlds is not adequately addressed. Identifying purely mathematical 'objects' in the Level III multiverse as 'physical' can be viewed as a basic reluctance to acknowledge *mental* reality and a subtler ontologically real medium of nature where minds could actually exist that underlies our ordinary physical world.

Level IV. Tegmark (2014) proposes a Level IV multiverse that seems to be an attempt to give more credence to the abstract mathematical conception of nature as 'real.' It is described by the 'Mathematical Universe Hypothesis (MUH) that attributes the entire collection of universes in the ultimate multiverse to the mathematical 'reality' of Hilbert space. To reinterpret this four-level model, the three ontologically real levels seem to be Levels I and II associated with classical reality, Level III quantum reality, and Level IV as an abstract but real mathematical Hilbert space.

> The Mathematical Universe Hypothesis implies that mathematical existence equals physical existence….This means that all structures that exist mathematically exist physically as well, forming the Level IV multiverse. The parallel universes we've explored form a nested four-level hierarchy of increasing diversity, Level I (unobservably distant regions of space), Level II (other post-inflationary regions), Level III (elsewhere in quantum Hilbert space) and Level IV (other mathematical structures)…. Exploring the Level IV multiverse doesn't require rockets or telescopes, merely computers and ideas…. Mathematical structures, formal systems and computations are closely related, suggesting that they're all aspects of the same transcendent structure whose nature we still haven't fully understood (p. 357).

Tegmark places Levels I, II, and III in the transcendent field of Hilbert space (Level IV), in which are quantum 'objects' (associated with

the Schrödinger equation), the bases of ordinary phenomenal physical/material objects. These purely mathematical structures are orderly relationships, and they are said to exist as real parts of nature; but they don't quite seem to be attributed ontologically real existence beyond our familiar physical world and are not attributed the quality of extension in some more abstract notion of space-time beyond the relativistic space-time gravitational field.

However, perhaps the most significant aspect of this model is that it is clearly transitioning from reductivism to holism, as evidenced by the notion of all the levels of nature nested within Hilbert space. Three fundamental levels of nature seem to be identified: the concrete local physical relativistic space or medium of Levels I and II, the abstract nonlocal quantum reality of Level III, and the most abstract *transcendent* level identified in terms of mathematical Hilbert space of Level IV, in which reside abstract but real and purely mathematical structures.

Another quite significant aspect of this model is that in conceiving of the levels as nested and within infinite Hilbert space, it also can be understood to be toward bridging the conceptual gaps between matter, mind, and the integrated totality (unified field). In starting to do this, however, it does not address the relationship between mathematical space or quantum reality, information field space, and real mind. Tegmark (2014) attributes features to the Level IV multiverse beyond orthodox interpretations of quantum theory, and that further relate to the many-worlds interpretation associated with Level III. In the following quote, these attributes are described by his phrases the 'Computable Universe Hypothesis' and the 'Finite Universe Hypothesis':

> The Computable Universe (CUH) [hypothesis is] that the mathematical structure that is our external physical reality is defined by computable functions.... The Finite Universe Hypothesis (FUH) that our external physical reality is a finite mathematical structure implies the CUH and eliminates all concerns about reality being undefined.... The MUH implies that there are no undefined initial conditions: initial conditions tell us nothing about physical reality, merely about our address in the multiverse [where we happen to exist in the Level I and II parallel universes, which relates to the specific conditions that formed our habitable part].... The MUH implies that there's no fundamental randomness: randomness is simply the way cloning feels subjectively [that is, the inability to experience processes that created our particular habitable universe with us in it].... The MUH implies that most of the complexity we observe is an illusion about our address in the multiverse.... Our multiverse is simpler than our Universe, in the sense that it can be described with less information, and the Level IV multiverse is simplest of all, requiring essentially no information to describe.

These points reflect additional steps in the direction of the holistic Vedic account. They are also consistent with the unified field as the source of order in nature, rather than *fundamental* randomness as quantum theory is frequently interpreted to mean. However, what is not yet explained is how computational ability, typically associated with sentience and intelligence (as well as subjectivity and mind), enters into the Computable Universe. The source of orderly computation is not addressed.

Penrose's three realm model

Mathematician/cosmologist Sir Roger Penrose outlines a model with three realms that is a little more explicit in trying to incorporate mental reality. In a discussion of mathematical structures associated with objectively real *Platonic Forms*, Penrose (2004, p. 17-19) outlines a model with three realms or worlds:

> 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. They do not have spatial locations; nor do they exist in time. 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 conceived .... Thus, mathematical existence is different not only 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, the mental, and the Platonic mathematical...as entities belonging to three separate 'worlds.... 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'...
>
> [T]he entire physical world is...governed according to mathematical laws.... If this is right, then even our own physical actions would be entirely subject to such ultimate

> mathematical control, where 'control' might still allow for some random behavior governed by strict probabilistic principles.

Penrose suggests that unchanging mathematical laws, existing separately from our individual minds, control physical actions in nature while still allowing statistically random behavior. But relationships between the three realms are unresolved. Curiously, Penrose (2004, p. 14) expresses his preferred belief that all physical processes are governed by mathematical laws and all mental processes are based in the physical; but then he describes "…the entire Platonic world to be within the compass of mentality. This is intended to indicate that—at least in principle—there are no mathematical truths that are beyond the scope of reason." If the truths govern the mental and physical realms, wouldn't they need to be a more fundamental and encompassing reality? Also, Penrose seems to be undecided about whether the three realms have a nested and hierarchical relationship. This seems to be due to attributing space-time only to ordinary physical space-time. However, in expressing his preference for the relationship between the three realms in his quote above, Penrose (2004) also recognizes the *possibility* of "…physical action beyond the scope of mathematical control…mentality not rooted in physical structures…the existence of true mathematical assertions whose truth is in principle inaccessible to reason and insight (p. 20)."

Penrose (2004, pp. 22-23) takes it another step by stating that

> 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. We have a long way to go before such matters can be properly illuminated.

Then taking a step backward, Penrose (2004) envisages the phenomenon of consciousness "…to be a *real* physical process, arising 'out there' in the physical world… (p. 1032)." Although the conscious mind seems to be considered real here, again a reductive view is evident in which higher-order conscious mind comes from lower-order physical brain processes. In this view, Platonic Forms would seem to be in the physical brain, while also having their own objective reality 'out there' separate from individual subjectivity. In his 1994 book, Penrose asserts strongly that Platonic Forms are primary, and that "…the world of conscious perceptions and the world of physical reality are its shadows (p.417)," but it is not so strongly asserted in this more recent work. In noting the ambiguities about how the three worlds may be related, Penrose (2004) states

> I believe that major revolutions are required in our physical understanding. Until these revolutions have come to pass, it is, in my view, greatly optimistic to expect that much real progress can be made in understanding the actual nature of mental processes (p, 21).

Stapp's three aspect model

Another recent model with three real forms of existence, or 'realities,' is outlined by physicist Henry Stapp (2000, 2007). This model explicitly recognizes subjectivity as an essential aspect. In the following quotes about the orthodox interpretation of quantum wave function collapse, three real forms of existence are used to explain how objective and subjective aspects of nature might interact. Stapp (2000, p. 213) states that consciousness is needed in the orthodox quantum theory that includes wave function collapse because

> …the 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… (p. 212).

This model includes physical reality, experiential reality, and also all-possibility Hilbert space as in Tegmark's Level IV. It further has similarity with Penrose's use of the 'Platonic realm' in his statement just quoted. (However, it is not clear how Penrose's three realms and Tegmark's four levels reconcile with physicalism, which is usually identified as a one-level ontology).

These models have some correspondence with the unified field as the source and

container of everything, local and nonlocal. All-possibility Hilbert space also has some similarity with the universal plenum in Bohm's neorealist interpretation of quantum theory to be discussed now, which explicitly identifies three levels of nature and associates mind with the nonlocal, non-physical level in-between ordinary local relativistic space-time and an ultimate universal plenum.

Bohm's three-level hierarchical model (neorealism)

Mathematician/physicist David Bohm's three-level hierarchical model (Bohm, 1980; Bohm & Hiley, 1993) posits *quantum reality* in addition to physical reality as a real nonlocal field that underlies and causally affects physical matter. Sometimes called *neorealism*, it recovers both the principles of objectivity independent of the observer and of nature as determinate, basic to classical views of realism but not to quantum theory.

In further contrast to some quantum interpretations, particles are real whether measured or not (a tree falling in the woods creates a sound whether anyone is there to hear it). Their dynamic attributes are guided in part by a nonlocal guiding pilot wave or *psi wave*. To match quantum probability predictions, the psi wave must be connected to every particle in the universe, classically invisible, and common—a subtler, highly interdependent field of 'universal entanglement.' The path of a particle is influenced by local physical forces in their environmental contexts, and also by the 'active' influence of the nonlocal psi wave. The observer is brought back into the picture as an intentional influence (psi wave), related to the concept of *quantum mind*. This nonlocal field is both smaller than (permeating) and bigger than (encompassing) the entire physical universe. This means that it permeates the physical brain, and can influence it directly.

In other words, gross real *matterstuff* is embedded in a subtler real *mindstuff* that does have some form of extension in a subtler field of space-time. For the first time in modern science, this allows a logically coherent model of how your brain and arm, for example, is guided by your mind.

In this model, the classical physical level, *explicate* order, is underlain and permeated by the subtler *implicate* order, a highly interconnected, entangled, enfolded nonlocal field of wave impulses with meaning and 'signal' value as real mental intentions. Mental intentions of individual minds in this subtler field can cause motion in physical matter. Further, the *explicate* order and subtler *implicate* order both are nested in the infinite universal plenum or *super-implicate* order. (Bohm, 1981; Bohm & Hiley, 1993). Thus the neorealist interpretation is a non-dual or monistic account with three concentric, nested, hierarchical levels: physical reality (explicate order), quantum reality (part of the implicate order including quantum mind), and their source in the unified field (super-implicate order). This clearly reflects an expanded cosmology.

Hagelin's three-level Lagrangian model

Another model with three levels, by physicist/unified field theorist John Hagelin (1987, 1989), applies the abstract mathematical *Lagrangian* formulation. It also associates the unified quantum field with Hilbert space, a complex vector space of infinite dimensions that comprises all states of a quantum mechanical system. Hagelin uses this formulation to present a unified field theory that more explicitly includes principles identifiable with the subjective concepts of the knower or observer and the process of knowing—not just the objective known as in the physical realism of classical physics.

The *knower* or observer 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 completely unchanged. 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 interpreted as the stable quantum mechanical *states* themselves. Importantly, this model goes beyond classical and quantum theories in the sense that it more explicitly incorporates in mathematical terms the knower or observer and process of knowing or observing along with the known or observed. It leads to the completely holistic 3-in-1 model in Maharishi Mahesh Yogi's re-clarification of the completely holistic Vedic account of nature.

The ancient Vedic account

The quote earlier from Steinhardt (2003) referred to the ancient Hindus as having a 'very elaborate and detailed cosmology based on a cyclic universe.' That cyclic model is drawn from the ancient Vedic knowledge tradition, which predates Hinduism. The Vedic tradition is held to be not a faith-based religion, but rather an *ancient science* emphasizing both theoretical consistency and empirical validation—from which numerous religions and philosophies have drawn.

Veda, which can be translated as 'total knowledge,' concerns total knowledge of the laws of nature, like the pursuit in modern science. A pivotal contribution to its reemergence is the work of Maharishi Mahesh Yogi, who has focused on re-clarifying and testing it in a scientific context as *Maharishi Vedic Science and Technology*.

In the ancient Vedic tradition, as well as other traditions albeit with various cultural and language differences, a transcendent universal essence of nature is described. This has obvious correspondence with the unified field (Hagelin, 1987, 1989). The great accomplishment of modern science in beginning to formulate mathematical models of ultimate unification has established the basis to link to the ancient Vedic tradition and other traditions that emphasize ultimate unity. Ancient holistic accounts can be viewed as corroborating contemporary emerging views. The most parsimonious explanation is that ancient and modern views converge on the same unified field (Hagelin, 1987). Logically there can be only one completely unified field. It can be likened to mathematical concepts of empty set, or zero, or one (Oneness); and to both the philosophical terms of eternal *Void* (reductive emptiness) and eternal *Being* (holistic fullness).

The ultimate unified field of nature can be thought of as a singularity, but not just infinitely dense. Rather, it is an infinitely expanded and eternal field of space-time; it is infinite in every way. It is that which can be said to be infinitesimal point value and infinite value *simultaneously*. Each single point (one) is also the totality (One), and in that unique sense it is the Singularity—the singular all-encompassing totality of existence at every single point, wholeness in each point. It is Oneness in every single point, transcending all dualities or contrasts that can be conceived by the discriminating intellect.

In the completely holistic Vedic account, the unified field of universal *Being* is an abstract, infinite eternal field of pure existence and pure intelligence, the unmanifest basis of all substance and all orderly structure or form. Within that infinite eternal field, finite levels of nature are phenomenally expressed in increasing limitations from subtlest to grossest—somewhat akin to sequential symmetry-breaking. However, the completely holistic Vedic account addresses both objective and subjective aspects of nature. Individual subjective minds and objects of sense (the subject-object duality) are both described as phenomenally emerging in a sequence of increasing limitations within the transcendent infinite eternal totality or ultimate Singularity.

The completely holistic 3-in-1 Vedic model

The *interdependence* of mind and matter is a major implication of quantum theory. In the progress toward a more integrated view of nature, quantum theory is a prime example of growing recognition of the necessity to account for subjectivity and mind. This progress is exemplified in models discussed above that posit levels of nature beyond the still widely-believed-to-be only real physical level in mainstream modern science. These cutting edge models are attempting to address a subtler, more abstract field underlying ordinary conventional space-time, in addition to both the physical level and an all-encompassing unified field of infinite eternal space-time. Scientific speculations about this in-between level relate to quantum information field, dark energy, hidden sector, inflation, wormhole, loop quantum gravity, and string field theories. But these mathematical glimpses are still quite foggy due to lack of direct empirical validation.

The Vedic 3-in-1 model holds that there is a bottom-line infinitely self-interacting unified field of universal *Being* or ultimate Singularity, within which phenomenally exists a subtle nonlocal, entangled, object-interdependent level, which in turn permeates the gross local, object-independent physical world. Conventional, local, gross space-time is a limitation of nonconventional, nonlocal, subtle space-time, both of which are limitations of the infinite eternal space-time that is always present everywhere. Again, this can be interpreted to mean that space doesn't begin from an infinitely dense singularity or 'nothing'

banging outward, but condenses into subtle nonlocal and gross local levels as nested, concentric, hierarchical mediums with different textural properties. The following quote of Strassler (2014) hints at this holistic view, while still assuming only conventional space-time—another plank on the bridge to ancient Vedic cosmology:

> Even if you had an initial singularity, it's not a point in space, but a moment in time. If you run the Big Bang naively backwards you don't get a *location* of infinite density; you get a *time* where the whole universe is infinite density. But even then—once the density reaches the Planck density, we know that quantum gravity will be important, and that Einstein's equations can't be used without modification. So we don't trust the singularity in Einstein's equations; that's just probably an indication that you're trying to use the equations when they don't' apply.... No one knows how "large" the initial region of space may have been...it could have been very small or very large...or even if the notion of an "initial' region makes any sense. It's not clear that space has any meaning at the early stages of the universe; we have examples of theories in which space emerges only later. It's not even clear that time makes any sense back then either.... So I'm afraid you're going to have to open your mind and let the possibilities grow larger, rather than grasp for an answer. We don't have one, and the possibilities are probably larger than we currently realize.

Reductive inflationary theory and emerging cyclic theories, as well as alternative theories of local bangs and crunches, are for the most part within one-level physicalism. These theories not only need to be reconciled with holistic unified field theory, but also with theories of a nonlocal information field subtler than the physical level of nature. Models that include an information field and real nonlocal minds are beyond notions of thermalization, entropy, and quantum processes *in the manner* of physical bangs and crunches. The concepts of information, mind, and consciousness are not associated with friction and heat. They are more abstract than any physical mechanics limited by light-speed, classical relativistic gravity, Planck-scale quantization, the 2nd Law of Thermodynamics, and particle-interaction causality.

The completely holistic Vedic account can be interpreted in terms of three mediums, levels, or fields of space-time: 1) our familiar gross relativistic local space-time gravitational field associated with big bang theories and classical physics; 2) a subtler relativistic nonlocal space-time field now glimpsed in theories of a *pure geometry, pre-space*, or *information field* in quantum physics; and 3) the infinite eternal field of space-time in unified field-based physics. Maharishi Mahesh Yogi (1963, pp. 32-33) describes modern scientific progress toward this 3-in-1 Vedic model:

> The discovery of the field of this one basis of material existence will mark the ultimate achievement in the history of development of physical science. This will serve to turn the world of physical science to the science of mental phenomena. Theories of mind, intellect, and ego will supersede the findings of physical science. At the ultimate or the extreme limit of investigation into the nature of reality in the field of the mind will eventually be located the state of pure consciousness, the field of the transcendental nature lying beyond all relative existence of material and mental values of life. The ultimate field of *Being* lies beyond the field of mental phenomena and is the truth of life in all its phases, relative and absolute. The Science of Being is the transcendental science of mind. The Science of Being transcends the science of mind which in its turn transcends the science of matter which, again, in turn, transcends the diversity of material existence.

Infinitely self-interacting dynamics in cyclic Vedic cosmology

The unified field as universal *Being* is inherently orderly and dynamic. To explain manifestation, that ultimate field is described as the simultaneity of wholeness/part, infinity/point. In each point is infinity, and the Singularity contains infinity of points. Again, the Singularity is not just the reductive notion of an infinitesimal point, as for example in the concept of a black hole singularity. It is *at the same time* the holistic notion of infinite expanse: simultaneously infinity/point, wholeness/part, and universal/individual. For purposes of explaining creation, the Singularity or Totality (frequently called *Atma* in Vedic literature) is attributed two coexisting opposite qualities: infinite silence and infinite dynamism. To explain how these opposites coexist, it is described as infinitely self-interacting, instantaneously referring or curving back upon itself. *Infinitely self-interacting* dynamism means eternal silence. As Maharishi

(2004) has described it: "Silence and dynamism—they are one thing, not two things."

The 'curving back' is a way of intellectually describing self-interaction as the basis for explaining phenomenal nature. It also is associated in Vedic cosmology on the finite manifest level of nature with a *mandala* form, and with the related concept of *Hiranya garbha* (Radhakrishnan, 1978) sometimes called the cosmic egg or manifest form of the unified field curving back upon itself in finite space-time. On the gross level of conventional relativistic space-time, the dynamic of 'curving back' can be associated with a mathematical point, quantum, atom, particle-like object, or black hole singularity, often expressed in the form of a sphere or circle (or egg, or atom) which curves backup on itself. It is expressed in various degrees of self-interaction: an infinitely self-interacting field (infinity in each point), then a nonlocal self-interacting field with high interdependence or 'entanglement,' and then the gross local relativistic gravitational field with discrete phenomena in it that appear to interact as independent, inert objects such as particles.

The self-interaction or 'curving back' also implies a third inherent quality in addition to subject (knower or observer) and object (known), namely the relation or connecting link between them (process of knowing or observing). Their unified state is described as the *Samhita* of *Rishi, Devata,* and *Chhandas*, the completely holistic 3-in-1 structure. The unified field as infinitely referring back to itself also means *self-referral*, wakefulness of itself, held to be the 'nature' of consciousness itself. This cyclic reverberation or 'curving back' is described in the Vedic text *Bhagavad-Gita* (Maharishi, 1997, p.37):

> *Prakritim swam avashtabhya visrijami punah punah (Bhagavad Gita 9.8)*
>
> *Curving back upon My own Nature, I create again and again.*

The *Sankhya* system in Vedic literature (as well as other aspects including *Ayur-veda,* natural medicine) enumerates the completely holistic 3-in-1 ontological model. As the Sankhya levels of nature are interpreted in this paper, only at the gross physical level is nature expressed in terms of space localizing in Planck-scale quanta into classical, independent objects in ordinary gross perception where particle-interaction mechanics and their corresponding thermodynamics apply (Boyer, 2008, 2012). (In other words, the subtle level of 'mind is not physically 'hot').

To summarize levels of space-time in the 3-in-1 Vedic model as it is presented here, from the gross classical perspective finite space is smooth and continuous, like an ocean with waves of water built of molecules/particles (the *mahabhuta* level of *akasha* or space). At this gross level, the appearance of continuous smoothness is due to the gestalt nature of ordinary sensory experience. At its finest-grained layers, gross finite space can be viewed as characterized by Planck-size quantization, relativistic gravity and the limitation of light-speed that define this familiar gross medium of space.

Deeper to the underlying and permeating subtle level, Planck-size quantum graininess ends and space can be described as smooth, continuous, and wave-like. The subtle level of space (*shabda tanmatra*) can be described as infinitesimally small quantization, almost perfectly smooth, with an almost infinite degree of point/infinite interdependence or self-interaction. In this interpretation, the subtle medium of nonlocal space is more wave-like, not grainy as quantized particle-atom-like or space-time foam, and not having the textural limitations of classical relativistic gravity and light-speed.

At the infinite level (transcendental *akasha*), space can be described as *infinite* graininess— which can also mean no graininess at all. That level would be infinitely smooth and whole: infinity in each point, infinite interdependence and infinite independence at the same time, *infinitely self-interacting* point/infinity. In other words, there is a perfectly smooth underlying continuity of infinitely self-interacting infinity/point simultaneity which is the infinite eternal ground of space-time, within which there is finite subtle space-time (*tanmatra* level) and then finite gross space-time (*mahabhuta* level). The gross level is granular (Planck-sized quanta) and particle-like, permeated by subtle finite and ultimately transcendent infinite eternal space-time that fill in the gaps between concrete real particles and quantum waves.

The infinite self-interacting level is instantiated in the finite subtle level of 'curving back on itself' (such as *Hiranya garbha*) held to be much vaster than gross space; and then in

the more restricted 'curving back' as in concepts of point-particle, strings and branes, atomic structures, stars and planets on the finite gross relativistic level of conventional space-time. At the infinitely self-interacting level, individuality and the point value are not lost: it can be said to be infinite individual point and universal, infinite wholeness *simultaneously*.

Classical space appears smooth and continuous at the macroscopic level of gross sensory experience. This was modeled in classical physics using the abstract mathematical notion of a dimensionless point. But this mathematical idealization did not take into consideration space as an ontologically real substrate with specific defining properties; that is, it was believed to be completely 'empty.' The reason that it appeared to be empty is that the level of analysis was too crude, such that the tiniest features were not detected. Then relativity theory added that space is relativistic space-time, more like an abstract substrate, medium, or ether with defining properties rather than just empty nothing. Then quantum field theory identified space as not 'empty,' not smooth, and not continuous but rather Planck-size graininess. This is basically as far as classical and quantum physics had gone, until recent years with attempts to characterize quantum gravity. In this subtler view, space is not characterized in terms of idealistic abstract mathematical dimensionless points (with no consideration of ontology). Space is believed to be quantized, and has specific finite properties such as quantized space-time foam at the level of the Planck scale as the tiniest possible unit of conventional space-time.

In the effort toward more integrated explanations, models have emerged based on mathematics with little consideration of ontology and empirical physics. A prime example is the concept of higher mathematical dimensions that on the one hand don't deal with space as a real substance or medium but on the other hand may have real dimensions (such as string theories that require some notion of a substrate to vibrate in if they are real). These contemporary models are now going beyond classical and quantum models of space, such as information field space said to generate conventional space-time, and also dark energy and the hidden sector (depending on speculations of their relation to classical relativistic gravity). However, these epistemological views of imaginary mathematical space have not been reconciled with ontologically real levels of space in empirical physics. They can be viewed as attempts to envisage the subtle *(tanmatra)* level of nature described in Sankhya and Vedic science generally; but they are not well-articulated because the thinking is still locked into the one-level physical ontology and the gross physical notion of space-time which severely conflates physical and mental levels.

Also, at this stage causality is interpreted only in terms of local processes in gross relativistic space-time (within the light cone and light-speed). The empirical validation of entanglement, however, suggests connections between objects and events that are nonlocal and outside conventional notions of local causality limited by light-speed. In this view, there are correlations outside of local processes, but not yet an understanding of means to communicate information or determinate causal influences nonlocally, necessary for nonlocal causality.

Importantly, some cutting edge models do posit a nonlocal information field space that underlies local space-time geometry and allows for nonlocal causality (e.g., Bohm & Hiley, 1994, Boyer, 2008). These deeper views of ontologically real levels of nature beyond the conventional physical space-time gravitational field need to inform cosmological theories such as those described earlier.

They further can be viewed as progressing toward the completely holistic Vedic 3-in-1 model, such as Tegmark's (2014), Stapp's (2007), and Hagelin's (1989) models associated with all-possibilities mathematical Hilbert space. But how, for example, the hidden sector, dark energy, and underlying information field relate to real nonlocal mind is only starting to be considered (e.g., Hagelin, 1989, 2014). In addition, how the fundamentally fragmenting reductive model of an eternally inflating random multiverse, in which everything that can happen does happen ad infinitum, needs to be integrated with a holistic, fundamentally orderly, finite multiverse.

Three fundamental ingredients within the 3-in-1 Vedic model

In quantum field theory the universe at its basis continuously exhibits zero point motion or 'quantum jitter' whether in its particle, force,

vacuum or ground state. This activation is theorized to be an *inherent dynamism* throughout nature. Also, Higgs field theory relates to a viscosity or *resistance to change* throughout nature to explain mass. Further, while quantum theory interpretations commonly attribute fundamental randomness to the universe, unified field theory is a contrasting view of fundamental super-symmetry and lowest entropy, or *inherent order*.

As noted earlier, these three principles can be associated with three fundamental qualities or 'forces' that are extensively described in ancient Vedic literature. In Vedic terms, they are frequently referred to as *rajas*, *tamas*, and *sattva*—collectively called *gunas*. They are held to be inseparable and continuously interact to create all phenomenal diversity at all levels of nature. They comprise a gradient from the eternal infinite unified field to the phenomenally finite interdependent subtle level and then the object-independent gross level—all within the ultimate Singularity. The gross level is associated with ordinary inert, relatively disorderly matter/energy (more tamas); and the more abstract subtle level is associated with increasing orderly intelligence (more sattva). The principle of activation or energy (rajas) extends across the levels.

In the opposite direction, from gross to subtle, progress in physics toward this holistic view is reflected in increasing abstraction, from mass to energy and now to information and even mathematical abstractions as the essence of nature. Recall that in Krauss' arguments for 'something from nothing' three fundamental ingredients or principles were identified. In a scientific perspective, considering the core abstract structural principles of nature apart from religious connotations and cultural attributions which can cloud the issues, this trinity also can be viewed as corresponding to major religious traditions. For just one example, the fundamental trinity of 'Father, Son, and Holy Spirit' can be taken very abstractly in terms of their structural relations and dynamics as a three-level model. It is useful to recognize similarities of fundamental principles across worldviews for a more universal and less divisive understanding. Maharishi (1967, p. 206) describes the emergence of these principles in a type of symmetry-breaking in the Veda as the dynamic sequential process of phenomenal manifestation:

> The first manifestation of creation is the self-illuminant effulgence of life…called the Veda. The second step in the process of manifestation is the rise of what we call vibration, which brings out the attributes of prakriti, or Nature—the three gunas…. Here experience begins in a very subtle form: the trinity of the experiencer, the experienced, and the process of experience comes into existence. This is the beginning of action in the process of creation.

Although the Vedic account requires careful examination to draw correspondences with modern physics, one speculative view proposed here is that *sattva* can be related to *inherent order*, the maintenance operator, and on the gross physical level to the attractive force of gravity. *Tamas* can be related to *inherent resistance to change*, the dissolution or annihilation operator, and to the viscosity of space and mass associated with Higgs field theory. However, the concept of the Higgs field as a viscosity seems to be conflated somewhat with 'repulsive gravity.' In the Vedic account, a 'repulsive' or energetic force is perhaps better associated with *rajas* and *inherent dynamism*. This is expressed in terms of energy and an activation principle, not yet having a distinct correspondence in fundamental physics. The crucial point here is that, although from a different context and language, the Vedic description has a direct (and unrecognized) correspondence to fundamental dynamics that modern physics is attempting to describe about the process of creation. Maharishi (1967, p. 128) elaborates on the nature of the three gunas in terms of extremely subtle dynamics of fundamental forces at the basis of nature's functioning that can be directly related to principles in modern physics:

> The entire creation consists of the interplay of the three gunas—sattva, rajas and tamas—born of prakriti or Nature. The process of evolution is carried on by these three gunas. Evolution means creation and its progressive development, and at its basis lies activity. Activity needs rajo-guna to create a spur, and it needs sato-guna and tamo-guna to uphold the direction of the movement.
>
> The nature of tamo-guna is to check or retard, but it should not be thought that when the movement is upwards tamo-guna is absent. For any process to continue, there have to be stages in that process, and each stage, however small in time and space, needs a

> force to maintain it and another force to develop it into a new stage. The force that develops it into a new stage is sato-guna, while tamo-guna is that which checks or retards the process in order to maintain the state already produced so that it may form the basis for the next stage.

Other correspondences might be made with various emphases, such as the creative principle with inherent order and maintenance principle with inherent dynamism—similar to physics ideas associating the creative operator with propagation and maintenance operator with activation. Approaching ultimate unity, distinctions may seem less distinct, toward all parts in every part.

In the Vedic account as summarized briefly here, the three fundamental qualities, constituents, ingredients, or forces (gunas) further differentiate into five subtle constituents (tanmatras) and their five grosser constituents (mahabhutas). Speculating further on these correspondences, there seems to be direct relationships between the five gross constituents (mahabhutas) on the familiar physical level of nature and particle-force fields as currently identified in modern physics (e.g., Hagelin, 1989; Boyer, 2008. 2012).

The five fundamental constituents in the Vedic account are space (akasha), air (vayu), fire (tejas), water (apas), and earth (prthivi). In the Vedic account, there is a natural and profound design relationship between the observed and the process of observing, related to objectivity and subjectivity. In this holistic view, these constituents are associated with the five senses of hearing, touch, sight, taste, and smell. However, these five constituents are by no means to be interpreted as primitive notions associated with pre-scientific beliefs sometimes attributed to ancient mythologies. They relate to abstract dynamical structures in physical nature quite relevant to contemporary physics. For example, the concept of 'fire' concerns principles of transformation including radiation, luminosity, oxidation, and combustion among others—and also to sight.

The qualities of the five fundamental constituents are expressed in sequential enumeration, akin to symmetry-breaking. Space contains the properties of the others (air, fire, water, earth) in latent form, but *expresses* the qualities associated with space. To link this system to the fundamental physical particle-forces identified in physics, one reasonable speculative correspondence (Boyer, 2008, 2012) is that 'space' is most closely associated with gravity (but also would encompass the other fundamental strong nuclear, weak, and electromagnetic forces in latent form). Likewise 'air' might express the gravitational and strong nuclear forces (with the weak and electromagnetic forces latent). In the same sequence, 'fire' might express the gravitational, strong, and weak forces (with the electromagnetic force latent). In this comparison, 'water' and 'earth' express all four forces but are most associated with the electromagnetic force.

Further, in this view 'water' may relate more with electricity and 'earth' with magnetism, which then aligns the physical forces with the five ingredients or 'forces in the Vedic model as enumerated in Sankhya. The magnetic force would represent the most tangible and restricted form of 'curving back on itself,' a dipole in which attraction and repulsion are in a circular path of the same magnetically charged object. These speculations potentially provide much more depth in connecting modern scientific and ancient Vedic views.

In 'consensus' inflationary big bang theory there did not seem to be enough *inherent dynamism* to account for inflation, which led to theories of dark matter, dark energy, and an inflaton field. To account for *inherent resistance to change*, Higgs field theory has been proposed; and to account for inherent order, hyper-inflation to a low entropy state has been proposed, as possibly emerging from no order in a bottom-line of 'nothing.' There is now some evidence for the Higgs particle-field, but there is as yet little or no evidence for dark matter and dark energy as well as the corresponding mathematical model of super-symmetry at finite levels of nature characterized as various types of super-symmetric particles with particle-interaction causality.

These theories in physics have some mathematical consistency, but their speculative nature needs to be recognized. In the spirit of speculation, the Vedic model of three fundamental ingredients and five constituents (called the *eight-fold Prakriti*) phenomenally emergent within the unified field or ultimate Singularity is quite significant. It may serve as a framework for simplifying and integrating particle theories and the natural processes of

phenomenal manifestation of what is now called the early universe or multiverse.

Cycles of time in Vedic cosmology

To get a sense of the eternal perspective in Veda, Maharishi's (1967) commentary on the *Bhagavad Gita* includes a description of the cycles of time drawn from Vedic literature. However, the Vedic terms initially might be somewhat distracting. To understand Vedic cosmology in relation to modern science, it is helpful to draw correspondences of Vedic and modern scientific terms, which requires understanding both. Maharishi has re-clarified the completely holistic nature of ancient Vedic science and its systematic connections to modern scientific language, theories, and empirical findings.

In this light, concepts in the quote below relate to the three fundamental principles of nature (gunas) introduced earlier (the term *Vyasa* is associated with the historical sage who gave us the *Bhagavad Gita*). The term *Brahma* can be related to the quality of *inherent dynamism*; the term *Shiva* to *inherent resistance to change* (and ultimately eternal silence); and the name *Vishna* to *inherent order* (but also incorporating *inherent dynamism* from the perspective of the duality of silence vs. dynamism); and combining all three in the term *Prakriti* (Nature or Divine, Universal Mother) as the 3-in-1 self-interacting dynamics of the unified field. These also can be associated with the trinity of knower, known, and process of knowing as well as other fundamental trinities mentioned earlier including from various religious views. Using these terms, in this quote Maharishi (1967) gives a sense of the eternal cyclic model in Vedic cosmology:

> Time is a conception to measure eternity. Indian historians base their conception of time on eternal Being; for them eternity is the basic field of time.
>
> To arrive at some conception of the eternal, the best measure will be the life-span of something that has the greatest longevity in the relative field of creation. This, according to the enlightened vision of Vyasa, is the Divine Mother, the Universal Mother [Prakriti, Nature, self-interacting dynamics of the unified field], who is ultimately responsible for all that is, was and will be in the entire cosmos.
>
> The eternity of the eternal life of absolute *Being* is conceived in terms of innumerable lives of the Divine Mother, a single one of whose lives encompasses a thousand life-spans of Lord Shiva. One life of Lord Shiva covers the time of a thousand life-spans of Lord Vishnu. One life of Lord Vishnu equals the duration of a thousand life-spans of Brahma, the Creator. A single life-span of Brahma is conceived in terms of one hundred years of Brahma; each year of Brahma comprises 12 months of Brahma, and each month comprises thirty days of Brahma. One day of Brahma is called a Kalpa. One Kalpa is equal to the time of fourteen Manus. The time of one Manu is called a Manvantara. One Manvantara equals seventy-one Chaturyugis. One Chaturyuga comprises the total span of four Yugas i.e. Sat-yuga, Treta-yuga, Dvapara-yuga and Kali-yuga. The span of the Yugas is conceived in terms of the duration of Sat-yuga. Thus the span of Treta-yuga is equal to three quarters of that of Sat-yuga; the span of Dvapara-yuga is half that of Sat-yuga, and the span of Kali-yuga one quarter that of Sat-yuga. The span of Kali-yuga equals 432,000 years of man's life (pp. 253-254).

Pralaya as an alternative to inflationary big bang and bang/crunch theories

The concept of *pralaya* in Vedic cosmology is sometimes translated as dissolution or reabsorption. It refers to the ending of an active phase of creation into a latency phase in which phenomenal creation is unexpressed, or 'sleeps.' Vedic texts describe cycles of time in which pralayas occur. In this delineation, a pralaya of the entire manifest creation (multiverse both gross and subtle) occurs after an active manifest phase of the duration of a life-time of Brahma (which can be calculated to be about 311 trillion and 40 billion Earth years). (Note that the estimated time of the origin of the universe in inflationary big bang theory is about 14 billion years, and its duration about 1 trillion years in Steinhardt's alternative cyclic model).

According to this cyclic cosmology, currently we are in a *Kali-yuga* phase, one of several levels of sub-phases (sort of like seasonal fluctuations) described in the quote of Maharishi above, which started about 5000 years ago. This phase is characterized as the most challenging phase in terms of quality of daily life, in which there is generally less coherence and harmony.

But within Kali-yuga there can be sub-periods similar to the most coherent of the four phases (*Sat-yuga*). A sub-period of this type is

described as beginning 5000 years after the start of the current Kali-yuga, which means that it would just now be developing. This sub-period is further described as extending for the next 10,000 years (Brahma-Vaivarta Purana, verses 49-60)—certainly encouraging given the incoherence in our contemporary society. Recent progress from matter to energy to information, and the emergence of consciousness as a major theme in modern science, indicates constructive trends toward a more coherent and integrating understanding of nature, and also could reflect this developing more positive sub-period in the Vedic time-line.

Phases of active manifestation begin when the three fundamental qualities or forces (*gunas* of *sattva, rajas, tamas*) differentiate from their unmanifest or perfectly balanced, super-symmetric state (*Prakriti* or Nature) into the phenomenally manifest finite multiverse. The first level of expression is the nonlocal, non-physical subtle level now beginning to be recognized in quantum physics, and then the ordinary gross local physical level which has been the focus of classical physics. This process is described as manifesting within infinite eternal space-time to subtle, interdependent nonlocal space-time, and then ordinary gross physical local space-time, suggestive that it occurs everywhere (recall Greene's quote, in contrast to Hawking's quote).

Quite importantly, a new phase is said to begin 'where' the previous phase left off. This means there is continuity across phenomenal phases: information is not lost in the pralaya phase, the unmanifest dormant phase, or the new manifestation phase. Discussing the commentary of Vyasa about the dissolution process in the Brahma Sutras, Maharishi has stated (Katz, 2011, p.139):

> …Vyasa said that that which is all-pervading, that which is transcendental, is Brahman. And then he added that that which is obvious is also Brahman. So the question may arise: 'What will happen when this obvious [aspect] disappears at the time of the dissolution? So he says [2.1.8-9]: 'The situation does not change when the manifested world dissolves. Brahman remains Brahman, whether the obvious is there or is melted into oblivion.' So, there are these two aspects of Brahman, the omnipresent and the obvious. When one aspect gets dissolved, even then the status of Brahman is not jeopardized, even though the dissolution of the manifest reality is the dissolution of one's own status.

An obvious analogy is waves on the surface of the ocean settling down to a smooth, perfectly still surface with no longer any manifest activity on the surface. The dissolution is said to proceed from the gross physical level through the non-physical subtle level to the unmanifest transcendent level (Srimad Bhagavata Mahapurana, 1995)—again the completely holistic 3-in-1 ontology.

In the next manifestation phase, however, nature is *as it was before*. The energy/impulse to begin activity is a memory in the transcendent ocean of the unified field; information about the state of manifest creation at dissolution is retained for re-creation—called *Smriti* or memory. This is indicated in Rk Veda 10.190.3, the first mandal or section of Veda (Maharishi, 2003):

Yatha purvam akalpayat

Creation based on what was before.

The model of pralaya is relevant to a debate among leading theorists whether objects lost in a 'black' hole would also mean that the information about them also is lost. Hawking and Thorne (e.g., Hawking, 1998) asserted that the information would be lost, while t'Hooft and Susskind (e.g., Susskind, 2008)) asserted that information loss would violate fundamental principles of physics. The debate seems to have been concluded in favor of the latter view. However, if in a 'hot' big crunch all physical objects are destroyed, wouldn't information about them also be destroyed? If not, how and where would the information be stored, maintained, and retrieved in the next hot big bang in a cyclic model in which information is not lost?

This is again suggestive of non-physical information that does not get destroyed but rather is stored and retrievable. It is in the direction of the Vedic model of pralaya or dissolution, in which there is continuity across cycle phases. This requires a more expanded and integrated model of ontologically real levels of nature and their dynamics beyond the physical, as this paper outlines.

The Vedic model needs to account for the important CMB evidence interpreted as strong support for the inflationary model. Alternative explanations for CMB involving local bangs and crunches with longer time-frames, rather than the inflationary model frequently associated with the reductive perspective of the entire

universe banging out from nothing, might be viewed as in this direction. However, alternatives will be needed that go beyond physicalism to more abstract underlying information and unified fields to be consistent with the 3-in-1 Vedic account.

In the Vedic literature there are numerous descriptions of the processes of creation and dissolution, some taking different angles. An important principle, emphasized in Maharishi Vedic Science and Technology, is that 'knowledge is different in different states of consciousness' (Maharishi, 1972). The point here is that various accounts may each have their validity from the perspective of a particular stage of understanding, context, and corresponding experience. Maharishi emphasizes how different views of *reality* fit stages of experiential development, as well as different vantage points within the same stage, each with their own significance and *reality* (Morris, 2004). In the Vedic account, our familiar physical level of nature can be considered *relatively real*, the nonlocal non-physical level of nature *relatively more real* (even *hyper-real*), and universal Being as the total infinite eternal *Reality* (Boyer, 2013).

Unifying reductivism/holism: Top-down diversification and bottom-up unification

Consistent with the completely holistic Vedic account, it is not that the value of survival, intentional top-down causation, self-awareness, and consciousness are *created* as emergent properties in biological evolution. And it is not that these higher-order processes did not exist in latent form before their emergence, or that there is no inherent direction or purpose to them. Rather, they are inherent in the orderly laws of nature within the unified field, and over long periods of time become expressed in higher stages of evolutionary development. In the human species, they are increasingly prominent in natural evolution and reflect free will. Evolution is impelled all along by causal dynamics of subtler, holistically guided 'evolutionary pathways' (Davies, 1991) that direct the flow of nature via fundamental laws. In this view, emergence refers to higher-order expressions of latent functions, not emergent epiphenomena with no substrate.

Experiential reports of higher evolutionary development appear throughout religious and spiritual traditions—although the descriptions can be quite obscure (e.g., Pearson, 2014). With advances in modern science, hopefully these subtle relationships, historically believed in by many but quite difficult to explain, can be validated in a more inclusive rational scientific framework.

Phenomenal nature is said to be an eternal cycle of the evolution of parts from ultimate wholeness, and then evolving to reveal the wholeness in each part. This is a never-ending self-referral process across vast eons of time. The theory of evolutionary biological emergence can be viewed as consistent with one phase of this holistic self-referral cycle. In other words, higher-order, top-down mental processes emerge in the physical associated with increasingly complex physical structures, as in reductive physicalism. But these complex physical structures are shaped by subtle non-physical, more holistic processes all along the way (in Vedic science, *Dharma*).

As the field of all possibilities, the unified field of universal *Being* is its own self-referral physiology, and contained within its fine fabric is the intelligence and energy that manifest all beings and objects. Its grossest levels appear to be inert particles or atoms such as in rocks and earth. On the gross level, the inherent intelligence and energy of nature appear to be the least integrated, and mind and matter appear to be the most separate (mind/matter duality).

On the subtle level, energy and intelligence are more integrated, with more the character of mind and thought forms than gross physical material forms. It is the subtle mind that initiates and directs the gross body to move, carried out through subtle field dynamics automatically (robotically) expressed in the gross local domain in classical biophysical mechanics. Mind and body interact with each other and reciprocally influence each other. As mind and body develop, top-down control of mind over matter is increasingly evident. Objects and processes in the subtle relative level reflect locality and independence while at the same time are nonlocal and interdependent, exhibiting more the coexistence of point/infinite value, personal/impersonal, individual/cosmic than at the gross level. At the infinitely self-referral level, unity predominates: oneness *is* Oneness.

To summarize, modern science attempts to account for subjectivity and consciousness in terms of inert energy/matter as quantum force-particle fields. These fields eventually synthesize into complex biological organisms that can sense, think, and appear conscious of surroundings for survival value through entirely blind, meaningless random mutations and natural selection. Biological survival is considered basic to natural selection, but there is no coherent account of how the *value* of survival gets into the closed physical causal chain said to have begun long before living biological organisms existed. Complex biological organisms with minds and consciousness are due to (supervene on) lower-order inert processes—called *epistemological* emergence. As increasingly complex physical structures spontaneously happened, empirically some were both more stable and more adaptable, and thus able to last longer. In this view, the difference between living and non-living is a matter of systems that are complex and flexible enough to maintain 'themselves' over time. Also just by chance they developed the ability to behave as functional units, and also to make copies of themselves, which anthropomorphically can be said to allow individual and group 'survival.'

Then it was recognized that these unitary-behaving systems must have some means to guide lower-order processes into holistic units that are more than the sum of the parts—so-called *ontological emergence*. But all these processes are held to be in the closed causal chain, with no room for real top-down causal guidance or a real 'biological self.'

Then arguments were made for 'self-organizing systems' to emerge, again without any planned precedents. But these unitary systems are now becoming recognized to require at least some intelligent orderliness. The major current speculations include that the order is added from the outside as in artificially intelligent systems, or from outer space such as via meteors, or from random fluctuations of nothing. The 'right values' of nothing led to a non-random information processing system, which since has managed to maintain and build on the first instance of non-random order, eventually shaping biological organisms that can know themselves and their world.

This part of the story, which largely can be viewed as consistent with the Vedic account, focuses on synthesizing parts into wholeness. What is missing, and needed for a coherent account, is the other part of the self-referral cycle: the unified field as fundamentally orderly and whole that phenomenally diversifies into parts while not losing the wholeness—detailed in the Veda.

In the analysis or diversification, nature phenomenally manifests from wholeness to parts, from unity to diversity. The transcendent infinite eternal unified field, the 'home of all the laws of nature,' the simplest state of nature, phenomenally diversifies within itself. Cosmic evolution involves condensing from wholeness to parts in phenomenal diversification, and then back through synthesizing parts into wholeness in unification—an eternal self-referral cycle.

As enumerated in the *Sankhya* model of ontological levels of nature in Vedic literature (Maharishi, 1967), the sequence is from the unmanifest unified field of consciousness (*Purusha/Prakriti*) to the subtlest level of manifest nature (sometimes called *Mahat* or cosmic ego), to Ahamkara (cosmic intellect, also called *Buddhi*), to Manas (cosmic mind), to the *Indriyas* (organs of sense) and *Karmendriyas* (organs of action), to the *Tanmatras* (subtle objects of sense, the five essences of space, air, fire, water, and earth), and finally to the *Mahabhutas* (gross objects of sense, the five gross elements). As discussed earlier, gross objects can be related to particle fields in modern physics emerging via spontaneous sequential symmetry-breaking.

This means that all levels of phenomenal nature exist as relatively *real*, whether or not any particular individual observer is observing or measuring them (no quantum 'wave function collapse' upon observation in the manner posited in orthodox quantum theory). However, what is phenomenally experienced when observed depends on the level of nature being observed, and the methods used in the observing process.

With the phenomenal structure of levels of nature in place to be observed, we human observers initially observed the grossest surface level (coarse-graining), which appeared to be objective and inert, independent of subjectivity, devoid of sentience, and the most *real* from the limited object/subject duality of the ordinary waking state. With top-down subtle guidance as a predisposition for 'evolutionary pathways' (Dharma)—seemingly spontaneous but applying the laws of nature including principles

of random order—the parts had long ago naturally congealed into more complex wholes as biological organisms, with increasing causal power to direct their own unitary behavior in free will (Boyer, 2014). As we humans develop more refined experiences and higher states of consciousness, the subtler, interdependent, non-physical level of nature associated more with sentience and subjectivity appears even more *real*. In the highest development, all phenomenal levels are experienced as *Maya,* ever-changing 'measurable' existence, and their essence as infinite, eternal, never-changing, self-referral universal Being is the *total reality*.

Means of validation

To start this final section we refer back to points noted earlier in Krauss' (2012) view of the universe as arising from 'beyond space itself, to which it may return, in a manner that does not require external control or direction.' These points also can be viewed as generally consistent with ancient Vedic cosmology. As just described, however, in the Vedic 3-in-1 account are levels of space-time beyond the ordinary classical level that Kraus identifies as the only level of 'space' (again, the additional levels include the subtle nonlocal interdependent level and the transcendent eternal infinite level of the unified field). The Vedic account is an eternal cyclic cosmology of creation and dissolution. As infinitely self-interacting, the unified field would not require external control or direction at all—indeed, there is no 'external' to it.

Krauss (2012) also made the point, quoted earlier, that the "*beauty* of science" (p. 151) is that it makes us correct our commonsense reasoning to match the real world. He explains:

> If we wish to draw philosophical conclusions about our own existence, our significance, and the significance of the universe itself, our conclusions should be based on empirical knowledge. A truly open mind means forcing our imaginations to conform to the evidence of reality, and not vice versa, whether or not we like the implications (p. 139).
>
> This is why philosophy and theology are ultimately incapable of addressing by themselves the truly fundamental questions that perplex us about our existence. Until we open our eyes and let nature call the shots, we are bound to wallow in myopia (p. 178).

Krauss' point about commonsense reasoning without confirmation by empirical experience relates to an essential contribution of ancient Vedic science. Ancient Vedic science also emphasizes empirical experience to validate theoretical understanding. But importantly, in the Vedic account re-clarified by Maharishi Mahesh Yogi, worldviews relate to developmental stages. There are levels of experience and abilities to understand different levels of phenomenal nature. Again as Maharishi (1972) states, "Knowledge is different in different states of consciousness."

The object-subject duality of the ordinary waking state of consciousness—within which modern science has been conducted—is neither a reliable nor sufficient basis to understand and experience the unity of total knowledge. Empirical experiences based only on ordinary sensory abilities don't cover the full range of gross, subtle, and transcendent levels of nature needed to address the 'fundamental questions that perplex us about our existence.' The ordinary waking state commonly is limited to the surface physical sensory level. Subtle and transcendent levels—now starting to be considered in quantum and unified field theories toward three-level models—had been overlooked throughout the history of modern science, related to overlooking the subjective process of knowing and knower, and focusing only on the objective known. Modern science has been for the most part restricted to a reductive physicalist view in which the gross physical level is believed to be the only real level. This applies not only to commonsense reasoning, but also *commonsense experiencing*. It has not had access to systematic *subjective* means of gaining knowledge. In re-clarifying the completely holistic 3-in-1 Vedic account, Maharishi (1997) describes systematic means in Vedic Yoga to experience directly subtler levels and the ultimate unity. This is through the natural process of transcending mental activity to its ground state in the purported fourth state of pure consciousness in addition to ordinary waking, dreaming, and sleep. This natural transcending process is said to develop more refined experiences to support deeper, more integrated understanding of oneself in relation to the cosmos.

> Being objective in its approach, modern science brings only intellectual understanding about the functioning of the laws of nature. It does not penetrate into the life of the scientist (Maharishi Mahesh Yogi, 1997, pp. 122-123).

> Being is not appreciated by the mind, although It is its very basis and essential constituent… The great dignity, the great splendor and grandeur of Its… omnipresent nature is present in man as the basis of ego, intellect, mind, senses, body, and surrounding. But it is not obvious… It is the omnipresence of *Being* that is responsible for hiding Being behind the scenes… It lies out of the realm of time, space, and causation, and out of the boundaries of the ever-changing phenomenal field of creation (Maharishi Mahesh Yogi, 1986, p. 25).

> Those whose hearts and minds are not cultured, whose vision concentrates on the gross, only see the surface value of life. They only find qualities of matter and energy… They do not enjoy almighty *Being* in Its innocent, never changing status of fullness and abundance of everything that lies beyond the obvious phase of forms and phenomena of matter and energy, and of mind and individual… Pure Being is of transcendental nature because of Its status as the essential constituent of the universe. It is finer than the finest in creation; because of Its nature, It is not exposed to the senses which primarily are formed to give only the experience of the perception of the mind, because the mind is connected for the most part with the senses (Maharishi Mahesh Yogi, 1963, pp. 24-25).

> As long as we are experiencing through the senses, we are in the relative field. Therefore, *Being* certainly cannot be experienced by means of any of the senses. This shows that through whatever sense of experience we proceed, we must come to the ultimate limit of experience through that sense. Transcending that, we will reach a state of consciousness where the experiencer no longer experiences… When the subject is left without an object of experience, having transcended the subtlest state of the object, the experiencer steps out of the process of experiencing and arrives at the state of *Being*… The transcendental state of Being lies beyond all seeing, hearing, touching, smelling, and tasting—beyond all thinking and beyond all feeling (Maharishi Mahesh Yogi, 1997, pp. 45-46).

In this Vedic approach, a 'truly open mind' experiences phenomenally real levels in addition to the gross outer surface level. Such experiences go beyond the ordinary level of refinement of the senses, to 'let nature call the shots' by *effortlessly* transcending the subtlest mental activity to the unified level of consciousness itself. That natural 'direct experience' includes not only that we 'open our eyes' to look outward but also that we close our eyes to go inward and experience the underlying silent inner ground state of the mind.

Maharishi (1967, p. 129) summarizes key points discussed in this paper by referring to the dialogue in the *Bhagavad-gita* between '*Lord Krishna*' and his friend and student, '*Arjuna*.' Again, although the language may not seem 'scientific,' the core principles are held to be crucial for empirical validation of the origin and structure of the cosmos held to be the scientific objective.

> There are gross planes of nature, and there are subtle planes. When the Lord says: 'Be without the three gunas', He means that Arjuna should bring his attention from the gross planes of experience, though the subtle planes and thus to the subtlest plane of experience; transcending even that subtlest plane, he will be completely out of the relative field of life, out of the three gunas. So the Lord's words: 'Be without the three gunas', reveal the secret of arriving at the state of pure consciousness.

This quote describes profound systematic means for direct validation of the total structure of the cosmos according to ancient Vedic science. Direct validation is possible because consciousness is primary to nature and individual conscious experience is at its ultimate core the unified field of consciousness itself. Until we 'experience' directly the subtle and transcendent levels through the natural process of transcending, to give deeper meaning to Krauss' (2012, p. 178) comment, "we are bound to wallow in myopia"—fixated on the 'flatland' gross one-level view of nature and its corresponding objective third-person approach to knowledge. Maharishi has re-established the *effortless* and *natural* means of transcending in Vedic Yoga for direct 'experience' of the transcendent unity of nature. We are no longer constrained to do science only in the ordinary waking state of consciousness and "left on the dry plains of reason (Maharishi, 1967, p. 477)."

Summary and Conclusion

Integrating reductive and holistic perspectives

A completely unified field would be infinite and eternal; but these descriptors also might seem to apply to 'nothing.' The unified field as 'nothing,' 'emptiness,' or 'Void' is from a reductive perspective, and as 'everything,' 'fullness,' or 'totality' is from a holistic perspective.

But 'everything' is different from 'nothing.' The source of everything would be perfect order, *not* random disorder. It can be called 'nothing' in the sense of being beyond all relative finite things; and *nothingness* in the sense that it transcends objects and processes from the phenomenal perspective of finite existence. In this completely holistic view, it can be said that infinity is the basis of space, eternity is the basis of time, immortality is the basis of mortality, and universal consciousness is the essence of individual consciousness.

Further, in this view the 'hot big bang' that led to the cosmic expanse of the gross physical universe, and 'hot' crunches to 'black' holes can be related to thermalization processes specific to the relativistic space-time gravitational field. These processes take place in cyclic creations and dissolutions of the totality of manifest existence, gross *and* subtle, within the unified field through vast eons of time far beyond 13.7 billion years—in which information is not lost. In the Vedic 3-in-1 account, reductive and holistic views are integrated in a coherent unified field-based cosmology in which nature does not ultimately dissipate into a huge dark cold emptiness but rather phenomenally renews itself in one eternal continuum of self-referral cycles.

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