

A Non Dimensional Model of Reality

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Abstract: A model of reality is discussed in which the universe is finite but unbounded, and which lacks the special state of an initial singularity. In this scenario, a primordial void or zero dimension would exist eternally - providing a dimensionless basis for cosmogenesis. Such an underlying zero dimension would establish a holographic relationship between all points in space-time - which would provide a basis for many of the non local behaviors of quantum mechanics. A zero dimension would also provide a place for consciousness to reside as a necessary part of science - that of the observer - thus providing a basis for the observer effect, and resolving the problem of mind-body duality. In addition, a zero dimension would provide a conceptual basis for the use of renormalization and imaginary time in physics equations involving space and time - and would likewise provide a basis for equations of physics being time-reversal invariant.

Keywords: Cosmology, zero dimension, consciousness, observer effect, holographic, non locality, duality

1. Introduction

Events of quantum mechanics such as quantum entanglement appear to occur as some kind of non local action or knowledge at a distance. The quantum entities involved in entanglement, such as photons, have indeterminate attributes until they are observed or measured. And when measured, they exhibit 'coordinated attributes' such as complimentary polarization. This was shown definitively by Aspect, Dalibard, and Roger [1]. And more recently, the effects of quantum entanglement have been shown by Yin et. al. to occur over a distance of over 1,200 kilometers [2]. Moreover in this same study, the coordinated states of entangled particles have been shown to occur at least 10,000 times faster than the speed of light. These results support a common belief that — because there is but a single state vector for an entangled system, the phenomena should therefore occur instantly over any distance in space [3].

It is unclear whether these kinds of phenomena are truly instantaneous — or whether they simply occur faster than the speed of light. However, for most practical purposes, non local events that are momentary, faster-than-light, or instantaneous will be considered to all be in the same category — as being untenable under the current principles of science. This is because, when Einstein developed his theory of special relativity, he established the speed of light to be the upper limit of speed through space-time [4]. So nothing should happen instantly or faster than light speed — even for the simple sharing of information or coordination of quantum states.

The principle of locality states that an object can only be directly influenced by its local surroundings. However, quantum events such as entanglement have been shown to occur non locally, even when entangled particles are very far apart. Einstein, Podolsky, and Rosen, among others, believed that this kind of non local action showed that quantum theory was incomplete [5]. They proposed that something was missing to account for the non local action of entanglement and other quantum events. And if this 'missing something' could be found they maintained, the several puzzling behaviors of quantum mechanics — such things as quantum entanglement — would then be explained. If their proposition is correct, a new theory or an extension of quantum mechanics is needed to explain the various non classical attributes of quantum mechanics.

Such a theory is the subject of this article. Or rather, a model is presented in the article — which proposes that the space-time universe is emergent from a more fundamental zero dimension or non dimensional expanse. Such an underlying zero dimension would have observable consequences in the space-time world — including many of the non classical behaviors of quantum mechanics. So the article will first discuss the origin and properties of the space-time dimensions — will show how these properties can be developed into a dimensionless formula and model of the universe — and will then discuss the consequences of such a model in the real world.

2. The origins of dimensions

There are many theories about the origin of the universe. But it is generally agreed that the physical universe started in a highly dense state, followed by a rapid expansion known as the 'big bang.' At this initial starting point, everything in the universe — including dimensions — suddenly came into being. Stephen Hawking has shown that based on the properties of light, space-time itself must have begun about 13.75 billion years ago at the time of the big bang [6]. And from this point of origin, the space-time universe has expanded into the world as it now exists. So when we look around today, we perceive the universe as a vast expanse, apparently consisting of four physical dimensions — three dimensions of space, and one dimension of time.

If the dimensions of our universe came into being at this original point of the big bang — it is possible that there were no dimensions in existence before the big bang. This would have been a 'primordial void,' or a state of zero dimensions. And from this zero dimensional expanse, the physical dimensions of space-time would have come into existence at the big bang. The dimensions of space-time may be invisible and intangible, but they are not completely nothing. They are known

to have their own energy — a zero-point field. So space and time are an integral part of the physical world that came into existence at the big bang — and they have acted as the basic structure of the physical universe ever since.

However — as Vlatko Vedral has argued, “we must explain space and time as somehow emerging from a fundamentally spaceless and timeless physics [7].” After all, the physical universe had to have come from something — even if that origin was from a spaceless and timeless 'void,' or zero dimension. But — like space-time, a zero dimension would not be nothing. There must have been some sort of potential within such a void for the physical universe to form. So in the scenario under consideration, the universe of space and time is considered to have emerged from some innate potential within a 'preexisting' spaceless and timeless expanse of zero dimensions. The big bang occurred, and the universe then expanded into what we see today as the material realm of dimensions. But just because material space-time came into being, does not mean that the non material zero dimension would have gone away. We may perceive a universe that consists of only four dimensions — but a zero dimension could still be present as an invisible part of the world. We would simply have overlooked it until now.

3. The properties of dimensions

There are seven properties of dimensions pertinent to the model discussed in this article. The first of these properties is that dimensions are the structural foundation of reality. They influence how the universe operates by affecting the behaviors of everything within them. So the many properties of a universe are determined by the number and type of dimensions they contain — where different dimensional environments could allow for different behaviors. So objects in a universe that contains a zero dimension could therefore display different behaviors than they would in a universe with only physical dimensions.

The second property is that dimensions are an ordering principle which is a necessary condition for the separation of objects. The presence of space results in the separation of spatial distance — while the presence of time results in the separation of temporal duration. However, a zero dimension that lacks both space and time, would also lack both spatial and temporal separation. So a zero dimension would provide a non separating or unifying environment. Also, because there would be no distance or places — and no duration or times in a zero dimension — it would take no time to 'travel' any 'distance' there. So whatever may exist in a zero dimension could be in any place at any time — basically existing everywhere at once. And as a result of these properties, anything that exists in a zero dimensional expanse would exist everywhere at once, and would exist together non separately throughout its expanse.

A third property of dimensions is that an expanse of space-time could be finite and temporary. But without space and its distance — or time and its duration — a zero dimension would be infinite and eternal. Because the physical universe came into being at the big bang, the universe had a beginning. And a universe that has a beginning could also have an end. But a zero dimension

being eternal, could exist before, during, and after the physical universe. And that means a zero dimension would always have an independent existence. It could exist by itself, before and after the physical universe. And even when the physical universe is present, a zero dimension would remain independent of space-time — because it would still remain if space-time ceased to exist. So a zero dimension would be infinite and eternal, while the physical universe may be finite and temporary. And as a result, the fourth property would be that a zero dimension would be fundamental and independent, while space-time would be emergent and dependent.

The fifth property pertinent to the model under discussion is that all dimensions exist at every point in the universe. So every point in the universe would have the general coordinates of $\{x,y,z,t\}$ — representing the three dimensions of space and one dimension of time. However, in a universe that contains a zero dimension, the zero dimension would also exist at every point of space-time. So a complete description of any location would have to include the zero dimension — which can be designated by the symbol of the empty set \emptyset . The notation for a zero dimensional set $\{\emptyset\}$ should therefore be combined with the notation for the four dimensional set of space-time $\{x,y,z,t\}$, as follows'

$$\{\emptyset\} \cup \{x,y,z,t\} \tag{1}$$

Formula 1 shows the zero dimensional set with no coordinates, and the space-time set with four coordinates. In their union, the two sets would interpenetrate and interact with each other at all points in space-time. But the two sets are shown as being separate in this way, because a zero dimension would remain independent, whether or not the space-time set is present.

The sixth property of dimensions discussed here is that anything existing in one dimension will exist in all dimensions. So an object at some point in space-time will occupy all four physical dimensions. And in a universe with a zero dimension, it will occupy the zero dimension as well. However — there can be no coordinates in a zero dimension because there is no space or time to provide them. So something could be present at a specific location in space-time, but it could not exist at a specific location in a zero dimension. An object could therefore exist only as a non localized presence throughout a zero dimension.

The seventh property of dimensions discussed here, is that nothing physical can exist in a zero dimension. So physical objects can exist in the physical dimensions of space and time, but they cannot exist as such in the zero dimension. However, there is a non physical part of physical entities that *could* exist in a zero dimension — and that is an object's wave function. A wave function is a non physical entity that encodes all of the information that can be known about an object. This information includes the object's spin, position, momentum, and polarization, etc. — as well as encoding the probability of how these properties may change over time.

It has been debated whether wave functions are a real entity or mere information. But Pusey, Barret, and Rudolf have recently shown that “any model in which a quantum represents mere information ... must make predictions that contradict those of quantum theory [8].” And this means that wave functions are not just a convenience of mathematical thought. Wave functions must be

real entities for the world to work the way it does. So, as real but non physical entities — wave functions could exist in a zero dimension.

Any object that occurs in space-time would then have an associated essence, being its wave function. So in this model that contains a zero dimension, a material object would exist in physical space-time — while its associated wave function would exist in the non physical zero dimension. But there are no coordinates or specific locations in a zero dimension. So the wave function of any quantum entity would necessarily exist as a non localized presence spread throughout the non zero dimensional realm.

In our quantum world, it is considered that only quantum states exist independently of observation. Such wave functions are considered to be the fundamental part of objects — determining the probability of how and where objects would be manifested — and how their manifestation can change over time. And in the scenario under consideration, wave functions as the fundamental basis of objects would exist in the zero dimension. So this scenario is shown in formula 2 — where wave functions Ψ would exist in the zero dimension.

$$\{\emptyset \Psi\} \cup \{x,y,z,t\} \quad (2)$$

Here, the wave functions of all things would be spread throughout the zero dimension. And the zero dimensional set would co-exist with and interpenetrate space-time set. But within a zero dimension that lacks time, wave functions would exist there in timelessness. So a wave function in timelessness would be free to manifest its associated physical object from one place in space to another — with little or no time passing. The faster than light coordination of attributes for entangled particles would therefore be made possible by a shared wave function spread throughout a timeless zero dimension — which interpenetrates all points of space-time. So the coordinated behaviors of entangled particles could therefore occur across any amount of space — even across the entire universe — with little or no time passing.

This would allow entanglement to operate on a local basis no matter where the entangled particles may be. And for the same reason, there should be no 'signal degradation' for the seemingly non local events of entanglement and other non classical behaviors of quantum mechanics — because there is nothing that could block a sharing of information between dimensional realms. As a result of these properties, quantum events that are mediated by a zero dimension should have the potential to occur without time passing — and without interference — no matter how far apart they may be.

The assumption that quantum events such as entanglement happen only in space-time has given them the appearance of being non local. But the presence of a zero dimension would allow quantum events to occur as completely local events. So it can be seen that without a zero dimension, quantum mechanics *has* been incomplete — just as Einstein et. al. insisted it was [5] — because it has lacked a basis for such apparently 'non local' events. However, the presence of a zero dimension would extend quantum mechanics beyond space-time, allowing it to operate on a strictly local basis.

When in motion, quantum entities display intermittent / non continuous behaviors. In quantum tunneling for example, a particle can move across an energy barrier, such as an n/p junction of a tunneling diode — which it would not normally have sufficient energy to traverse. But its change of position is not achieved in a continuous flowing motion. It simply disappears from one side of the barrier, and reappears on the other side.

Even for a change of position that we would normally call 'travel in a straight line' — a quantum entity moves non continuously from position to position — without occupying the intervening spaces. However, such intermittent behavior is not puzzling in a world that contains a zero dimension. An object's wave function would exist continuously everywhere in the zero dimension — while the wave function's associated material entity such as an electron could be manifested intermittently from position to position in space-time.

David Bohm wrote about such behaviors, saying that quantum mechanics does not work if it operates only in space-time — that reality must instead consist of two parts — an en-folded or implicate level, and an un-folded or explicate level [9]. Particles such as electrons are not things that exist continuously, but as something that can come into existence and then go back out again many times during its 'travels.' And the electron is the same when it comes back into existence in space-time, only in the sense that it is manifested from the same unfolding wave function and that one electron is much the same as all others. Such particles are en-folded entities that can un-fold in a series of manifestations, which together may then approximate a track or trajectory in space-time

Wave functions existing in a zero dimension that interpenetrates every point of space-time, can be seen as the en-folded part of reality. While their associated material entities being serially manifested in space-time can be seen as the un-folding part of reality. And Bohm would be right that quantum mechanics required more than just space-time to operate the way it does. This then can provide a basis for the behaviors of quantum entities such as being intermittent, non continuous, 'non local,' and in some instances being faster than light. And wave functions existing in a zero dimension that interpenetrates all points of space-time could likewise provide a basis for quantum entities having indeterminate positions and states that would be en-folded in a timeless zero dimension — until they are observed or measured. And they would then be manifested or un-folded in a particular position or series of positions in space-time.

4. Where consciousness may reside

We usually experience consciousness as if it exists as a part of our brain. Or at least, it often feels like our consciousness exists within our heads. And this may be due to the fact that the major sensory inputs of vision and hearing are located in our heads. But no one really knows how a non material consciousness can arise from a material source — whether it is a side-effect of our brain activities, or otherwise.

If consciousness is an epiphenomenon or side-effect of brain activity, then it should be tied to the body. For example, consciousness could be a side-effect of electromagnetic impulses or brain

waves occurring within the brain. And in this case, consciousness would be based on the wave functions of electromagnetic waves. On the other hand, if consciousness is not materially based — then it seems that consciousness would not be bound to our material bodies or brains. But in either case, consciousness would be present at least where our brains exist in space-time. And also in either case, there would be a non physical part of consciousness — as a separate consciousness, or as the wave functions of whatever brain processes may give rise to consciousness.

So our consciousness or the wave functions of its basis would exist at some specific place in the physical dimensions associated with our bodies or brains. But as per the sixth property of dimensions — anything that exists in one dimension will exist in all available dimensions. So in a world that contains a zero dimension, our non physical consciousness would exist in space-time. But it would also exist in the set of non dimensionality. Then — because there are no specific locations in a zero dimension — consciousness or the wave functions on which consciousness is based would be spread throughout the zero dimension. And since a zero dimension would interpenetrate every point of space-time, consciousness would then exist at all points in space-time as well. So in a universe with a zero dimension, consciousness would end up existing everywhere in both sets of dimensions. And all wave functions would similarly be present at all points in space-time as well. So no matter what distance in space that events may occur, any and all events would become local events to such omnipresent wave functions and/or omnipresent consciousness.

In addition — because a zero dimension would provide a non separating or unifying environment — consciousness would exist in a unified state with all wave functions in the zero dimension. So consciousness would be in a non separate position to affect wave function probabilities — which could then affect the expression of the wave function's associated objects in the physical dimensions. In this way, consciousness affecting material systems should be expected to occur in a universe that contains a zero dimension. And such a situation of consciousness affecting material events has been shown to occur. In meta analysis studies, it was found that conscious attention can produce a non random outcome from random number generators and double slit interferometer patterns — in small but statistically significant numbers, both forward and backward in time [10].

In a zero dimension, there is no preferred direction of time. So consciousness affecting wave function probabilities — being mediated in timelessness — could be manifested both forward and backward in time. Such a retro-causation has been shown by Tan et.al. to occur for quantum particles — where simply having knowledge of a particle's state in the present can cause the state of that particle to change in the past — with a 90 percent probability [11]. This then, is a probability that in 9 out of 10 instances, that the state of a quantum entity can be 'predicted' successfully — backward in time. The presence of a zero dimension would provide a timeless medium from within which wave functions could manifest their associated material system both forward and backward in time — thus allowing both causation, and retro-causation. And consciousness residing non

separately with wave functions in a zero dimension would be in place to affect such causal behaviors backward and forward in time.

Henry Stapp has argued that classical physics cannot determine how the mind works [12]. For that he maintains, a quantum basis is needed where consciousness interacting with wave functions could affect the wave function's associated material system. However, this idea of consciousness affecting material systems has been criticized by Danko Georgiev and others, on the basis that 1) the mind or consciousness would not have its own wave functions to allow such an interaction to occur, and that 2) the Zeno effect called upon by Stapp would not cause a sufficient delay in collapse of the wave function to promote a long-term state of consciousness [13].

The non separate or unifying environment of a zero dimension would cause consciousness and wave functions residing there to exist as a non separate or unified part of each other. So this would give consciousness a way to interact with wave functions within a zero dimension — even though consciousness may not have its own wave functions. Consciousness could therefore interact intimately with wave functions, thus affecting the probabilities of wave functions. And since a zero dimensions would co-exist with and interpenetrate space-time at all points in space-time, this would provide a way for consciousness to affect the expression of wave functions' associated material systems anywhere in the material world. Also, since consciousness and wave functions would basically co-exist outside of time, their interaction could occur for an indeterminate amount of time. So a quantum basis for consciousness need not be contingent on whether there is sufficient time for it to occur. So while the arguments against Stapp's quantum basis for mind may apply when mediated by space-time, they would not apply when mediated by non-space-time.

The interactions of consciousness and wave functions — taking place outside of time — could then be manifested either forward or backward in time. Thus providing a basis for both causation and retro-causation. And in addition, this could provide a basis for the observation or measurement of a quantum entity affecting a collapse of the wave function. Observation, measurement, or any such interaction with consciousness, could affect wave functions in the zero dimension, resulting in the observed entity in space-time having a single state and position. This could also answer the question of how something non material like the mind, could affect material systems like the body.

Because consciousness and wave functions would exist together non separately in a zero dimension — and because a zero dimension would interpenetrate all points of space-time — consciousness affecting wave functions in non space-time could thus affect the material systems of our bodies in space-time. And this would occur right where we are — because consciousness and wave functions in the zero dimension would always exist wherever any part of our bodies may be. And such an influence could be effected instantly in all parts of the body — thus resolving the problem of mind-body duality, and the nearly instantaneous aligning of cell activities in the body.

5. Developing a space-less and time-less model

The model under discussion has so far been developed to the point of formula 2 above, which includes the coordinates $\{x,y,z,t\}$. However, Einstein has shown with his special relativity, that the three dimensions of space and the one dimension of time interact with each other as if they are two parts of one entity [4]. So for the purposes of this model, the usual notation of coordinates $\{x,y,z,t\}$ can be shortened to the integrated entity of space-time $\{st\}$.

In addition, the material entities of the space-time realm must also be represented in the formula. If we designate the standard model of physics as \mathbf{m} , the components of the material world would reside in the space-time set as m — while the basis of these material entities would reside in the non space-time set as Ψ .

$$\{\emptyset \Psi\} \cup \{st m\} \quad (3)$$

While consciousness is a part of nature, it is not usually included in models or formulas of physics — because its place in nature is not well understood, and because it is widely considered to be an epiphenomenon of material brain activities. However, a model that purports to provide a fundamental basis for reality, must include all things. To be a true theory of everything — such a theory of everything *must* include consciousness. It is arguably the most important part of reality, because without conscious awareness — without observation — there could be no science in the first place. And there could certainly be no quantum physics, where experimental setup and observation are an integral party of reality. Furthermore, conscious interacting with wave functions in a zero dimension is an integral part of the model. But in opposition to this, our personal consciousness appears to be dependent on our material bodies and brains, and to exist separately in space-time. So formula 4 shows our individual consciousness residing within space-time, with an extended consciousness residing in a zero dimension.

$$\{\emptyset \Psi C\} \cup \{st m c\} \quad (4)$$

Here, wave functions and extended consciousness would exist non separately throughout the zero dimensional set. While individual consciousness and the material entities would exist separately in the space-time set. And the two sets would coexist with and interpenetrate each other. So each set would contain representatives of dimensionality, materiality, and consciousness. And the two sets of dimensions and their components could then interact with each other.

A particle has a dual nature, where it can be a particle at a single location, having a particular set of attributes or states — but it also has a wave nature with multiple potential states for each of its attributes, and being spread out in multiple locations. Consciousness can be seen as having a similar dual nature — having an individual or personal consciousness at a single place where our bodies may exist — while also having an extended consciousness that would exist concurrently throughout the zero dimensional set.

The individual or 'particle' nature of consciousness would be due to its being associated with the material body and brain at particular coordinates in space-time. And the universal or 'wave' nature of consciousness would be due to its being spread infinitely throughout a zero dimension that

has no coordinates. So a universe with a zero dimension can provide a basis for a 'particulate' or individual consciousness — existing along with a 'wave nature' or extended consciousness being present unto infinity — similar to an individual particle existing at a single point along with its wave nature being present unto infinity. Each is really a combination of its expanded wave nature and a contracted 'particle' nature. And the dual nature of both particles and consciousness would be based on having a non local manifestation everywhere within a zero dimension — while having a localized manifestation within the space-time dimensions. This scenario of the dual-nature of consciousness will be further addressed in the discussion section.

The existence of a zero dimension being present in the world today would provide a basis for wave / particle duality. It would provide a basis for individual / extended consciousness. It would provide a basis for mind-body duality. And it could provide a basis for the equations of physics to act in both directions of time, because the fundamental basis of action in a quantum world — which is wave functions — would have their basis in a zero dimension that has no direction of time. And as such, equations of physics should be expected to have no preferred direction of time. An explanation and basis for all of these dualistic phenomena, can therefore be provided by the environments of dual sets of dimension — that being, a non material dimensionless environment co-existing with a material space-time environment.

Before the big bang, the immaterial zero dimensional set would necessarily have included a potential for the physical world to come into existence. And this potential would have been realized at the advent of the big bang. Formula 5 shows this progression — where a potential in the non physical realm generates (\rightarrow) a union of physical and non physical realms. These two realms would then co-exist with and interpenetrate each other. And this intersection would occur everywhere in space-time.

$$\{\emptyset \Psi(u) C\} \rightarrow \{\emptyset \Psi C\} \cup \{st m c\} \quad (5)$$

However, a universe that can come into existence, could at some point cease to exist. So the formula must be reversible, where the combined physical and non physical realms can — as with other reversible equations of physics — reverse back to its fundamental existence of a zero dimension. This is shown in formula 6, where the sets can move back and forth between a singular and dual state — and a space-time universe can then occur any number of times, n .

$$\{\emptyset \Psi(u) C\} \leftrightarrow \{\emptyset \Psi C\} \cup \{st m c\}^n \quad (6)$$

Here, the fundamental set of non space-time, containing a wave function for the universe $\Psi(u)$ and extended consciousness C — would give rise to the set of space-time, containing the standard model of all material things m and individual / personal consciousness c . The two sets would then coexist with and interpenetrate each other. And all wave functions would interact with time — manifesting their associated material objects — until a completely contracted or completely expanded space-time set goes on to produce a new space-time set, or devolves back to the singular state of only a zero dimensional set being present.

So formula 4 above, shows the present day state of the universe — with a union of the zero dimensional set containing wave functions and extended consciousness — and the space-time set containing individual consciousness and material entities. Formula 5 shows the primordial void or zero dimension proceeding to a dual state universe via the big bang. And formula 6 shows a zero dimension providing a basis for any number of space-time universes. But no matter how many space-time universes may exist, the zero dimension would exist independently and eternally, as the fundamental basis of the universe.

In a world that contains both a space-time and a zero dimensional set, the space-time realm would contain all of the entities of the standard model of physics — that is, all of the dimensions, the matter, and the energy, etc. While the zero dimensional realm would contain nothing physical — no dimensions, no matter, and no energy. So a zero dimensional realm would exist as the lowest possible energy state — or least energy ground state of the universe. But as discussed above, the zero dimension would contain non physical wave functions and extended consciousness. So a zero dimension would exist as a ground state for dimensions, which is non dimensionality — it would exist as a ground state for all material things, which is wave functions — and it would exist as a ground state for all consciousness, which is being-ness. A dimensionless zero dimension would therefore exist as the basis of all things.

6. Discussion

6.1 Locality

The principle of locality states that events should be independent of influences located in distant regions of space-time — that there should only be direct influences from an object or event's immediate surroundings. However contrary to this principle, quantum entities exhibit several kinds of behaviors which utilize information non locally — such as quantum entanglement. But these behaviors appear to act non locally, only if we presume that they occur in space-time.

If wave functions exist in a zero dimension — and a zero dimension co-exists with and interpenetrates all points in space-time — then wave functions would be present throughout a timeless zero dimension, while also being present at all points in space-time. So entanglement mediated by wave functions in a zero dimension would have a non space-time basis allowing it to occur at any distance in space — at any distance in time — both forward and backward in time — and at faster than the speed of light. And as a result, these apparently 'non local' events would occur on a strictly local basis.

This would also be true for collapse of the wave function. The wave function of a quantum entity could exist everywhere in a zero dimension in an indeterminate state and position. And when observed or measured, it would be found to exist only in a particular state and at a particular point in space-time, with no time passing. But the wave function would still exist everywhere in the zero dimension, and would still be present to manifest subsequent events — across any distance in space-time — again, with no time passing.

Such a physical manifestation being 'condensed' from across any distance of space with no time passing, would appear to violate the principles of special relativity — because the speed limit of the universe is supposed to be the speed of light. But special relativity only precludes exceeding the speed of light through a space-time medium. It does not preclude exceeding the speed of light through a *non* space-time medium. So it is perfectly 'legal' for information of wave functions to be transferred between various locations in space-time at faster than the speed of light — as long as it does so outside of space-time — which would be the case with a transfer or sharing of information through a zero dimension. And beside — if wave functions are present throughout a zero dimension that interpenetrates space-time, and are therefore present at all points in space and time — then neither transfer, travel, nor translocation are taking place. Any sharing, coordination, or acquisition of information, would always occur through direct and local means.

The equation for gravity originally developed by Newton described gravity as being an apparently non local event, which violates the principle of locality [14]. But as shown by Einstein's general relativity — the events of gravity can now be seen as local events mediated by curvatures that are spread throughout the space-time dimensions [4]. Quantum events have similarly been seen as apparently being non local events, but can now be seen as local events mediated by wave functions that are spread throughout a zero dimension. And the fact that gravity propagates at the speed of light while quantum events can occur at faster than the speed of light, would simply be due to the separating nature of space-time versus the unifying nature of non space-time. Each domain would follow the same laws of nature, but entities within them would behave differently due to the different characteristics of their dimensional environment.

6.2 Consciousness

The model portrayed in formula 6 above shows our personal consciousness being in the material space-time realm — existing at a single position along with our bodies — but it also shows an extended consciousness being spread throughout a zero dimensional realm along with wave functions. If this is a true picture of reality, it seems that we should have some sort of extended awareness beyond the singular position of our individual consciousness in space-time — which we normally do not have. But this lack of extended awareness could occur because our presence in the zero dimension is not under our conscious control. And this would be the case if our connection with the zero dimension is through our sub-conscious minds. Our not being aware of a more extended awareness or perception would then be caused by not being aware of our sub-conscious mind's existence in the zero dimension.

If consciousness resides in both space-time and a zero dimension — it could be that our conscious mind resides in space-time while our sub-conscious mind resides in the zero dimension. Our personal conscious mind residing in space-time would be aware of local information and events. While our subconscious mind — being spread throughout a zero dimension that interpenetrates space-time — could be aware of events throughout the cosmos. But we would not be

consciously aware of any information or events available to our sub-conscious minds. Our sub-consciousness residing non separately with wave functions in a zero dimension could inadvertently affect wave functions there — which could then affect their associated material systems. And as mentioned previously, this could resolve the observer or measurement problem — because our sub-consciousness could unknowingly affect wave functions in a zero dimension when we measure or observe a quantum object or event in space-time.

So if we have a conscious knowledge of a quantum event, we could subconsciously — and therefore non purposefully — affect the outcome of that event by affecting the event's wave function. And this could similarly explain how our immaterial mind or consciousness could interact with and affect our material bodies — thus resolving the problem of mind-body duality. In both cases, our sub-conscious mind could unknowingly affect wave functions in a zero dimension, thus affecting the outcome or manifestation of the associated material systems. The fact that we are not aware of these processes involving our subconscious minds residing in a zero dimensional realm, would be because it is very difficult for us to perceive a realm of zero dimensions. After all, if a zero dimension is present in the world today, we have not noticed it as such before now.

6.3 Cosmogenesis

Because a zero dimension would have an independent existence separate from space-time — and because the wave functions of all objects or events in the universe would be contained in the zero dimension — information about the universe in the form of wave functions could have existed in the 'primordial void.' So the information of wave functions could have been present when the physical universe came into being at the big bang. Without time being present, such wave functions would have existed simply as a potential. And besides there being wave functions for particular objects and events within the zero dimension, there can also be a wave function for the universe itself. So without time, a wave function for the universe $\Psi(u)$ could have existed in the zero dimension as a potential for the universe to form, as shown in formula 6. And this omnipresent potential could then have provided a basis for the universe to have its current attributes. This basic information would then be available for any number of space-time realms that could form with all possible sets of attributes.

This kind of serial cosmogenesis was proposed by Ervin Laszlo, that our universe is a culmination of a series of universes — so that when one universe ends, the next universe would begin [15]. In this way, the wave functions from previous universes would have been present in Lazlo's term of 'pre-space,' to inform the next universe. So an untold number of universes could evolve serially — one after the other. And this process of evolution could then result in the the current universe having the particular set of attributes it has today.

Another scenario for cyclic cosmogenesis is Stephen Hawking's no boundary proposal — that space-time is finite but has no boundaries [6]. Hawking's proposal is based on imaginary time, where time itself would be cyclical. In Hawking's proposal, the universe would start out similarly

with a big bang and expand to its present expanse. But at some point, it would reverse direction, contract, and end up where it started in an infinitely dense state at the 'end of time.' The universe would then exist as a series of cyclical space-time realms — with each cycle having a beginning of time, and an end of time for that cycle. And as with Laszlo's proposal, there would be a point where space-time did not exist between cycles. So with both proposals, there would be a point where space-time would not be present to carry forward information into the next space-time cycle.

However — in a universe that contains a zero dimension, a dimensionless environment would exist continuously and independently from space-time. So it would be present when space-time is not. A zero dimension could therefore provide a place to carry forward information between space-time cycles. In this way, a wave function for the universe $\Psi(u)$ could have been present in a zero dimension that would have provided the universe with a set of attributes at the beginning of time. This wave function potential would have been present within the space-less and time-less realm of a zero dimension, and would be realized at the beginning of each cycle. And the continued presence of the zero dimension interpenetrating every point in space-time, would contain all wave functions that would be the basis for the ever-changing events of our space-time universe. Also, as pointed out by Hawking — if the universe is envisioned as a single universe particle, then the wave function of the universe $\Psi(u)$ would exist in a state of all possible universes — while one of the possible universes would be manifested as the present universe. And all of these possible states would eventually be manifested — but would be manifested intermittently or non continuously, just like other quantum particles. Between universes there would be no space-time, with only a universal wave function being present in the dimensionless realm or 'primordial void.'

The resulting system would be an oscillating wave of physicality, resonating within an infinite and eternal zero dimension. Each cycle would expand and contract in a similar way — but each cycle would unfold physically in different ways. And the attributes of the space-time realms would be the result of this resonance within an environment of zero dimensions. In short, a wave function of the universe would be the basis for a wave of physical realms — that would continue to expand and contract in repeated cycles — forever — although each cycle of time would be separate from all of the others, with time of that universe stopping before the time of the next universe begins. And each cycle would be different, based on the variability of quantum probabilities — even if they have the same laws of nature. And of course, the life forms of each one would evolve into completely different forms to fit the various / different environments. So all possible space-time universes would eventually be manifested, and all possible life forms would come into being, based simply on a fundamentally dimensionless realm.

In a world with a zero-dimension, the information of all wave functions would exist everywhere — including the wave function of the universe. They would be spread throughout the zero dimension — and would interpenetrate all points of space-time. So every point in the universe would hold the information of the entire universe. In this case, any point could therefore re-produce the entirety of a universe — which is the nature of a hologram. Where a lesser (\emptyset) dimensional part

of reality would contain all of the information for an emergent / greater (4) dimensional part of reality. Any part of the lesser (\emptyset) dimensional part could then reproduce all of the greater (4) dimensional part. And it is this holographic property that would provide a basis for many of the non local events of quantum mechanics.

The current cycle of the universe has been expanding ever since the big bang occurred. And it had been widely expected that gravity would slow down and perhaps stop this cosmic expansion. So it came as a surprise, when Perlmutter et. al. discovered the expansion of the universe had actually accelerated in the 'recent' past' [16]. This increased rate of expansion has been attributed to 'dark energy,' whose basis has not yet been determined. But whatever its cause, this accelerating expansion would appear to rule out a cyclical universe, where the universe could reverse its current expansion, and end up in a condensed state again. On the other hand, expansion of the universe has changed in the past, so it could change again in the future. Expansion could reverse course, and contract, and then end up in a condensed state similar to its condition at the big bang — which would be consistent with the cyclical Laszlo and Hawking proposals.

However, if expansion due to dark energy continues unabated, the universe could keep expanding until it reaches a completely expanded condition. Caldwell, Kamionkowski, and Weinberg proposed that dark energy could continue to increase the rate of cosmic expansion — with the universe eventually becoming a 'singularity of empty space' [17]. So depending on which scenario comes to pass, the universe may end up in a completely expanded or a completely contracted state. But whatever 'end state' the current space-time realm may attain, a holographic universe based on a zero dimension could begin a new cycle of expansion — from a completely expanded state — or from a completely contracted state. Either way, the information needed to begin a new cycle of space-time would always be present outside of space-time, in an eternal zero dimensional realm. Each cycle could be different in its attributes, physical forms, and life forms. But the cycles would not actually be serial in nature — because each cycle would have its own separate time. Time would cease between cycles, with only the wave function of the universe and independent consciousness being carried forward in the zero dimension.

6.4 Imaginary time

Imaginary time is based on the imaginary number “i,” which is usually seen as a mathematical convenience used in various physics equations. The sum of paths or path integral formulation of quantum mechanics developed by Richard Feynman, can be used to determine the probable outcomes of quantum events. This is accomplished by integrating or summing all possible paths that a quantum entity might take — which includes all possible paths in the past and the future. And to do this, imaginary time is needed, which utilizes a Euclidean or flat space-time, where the dimension of time is indistinguishable from the dimensions of space. As a result, there is no asymmetry or 'arrow' of time. This helps to avoid otherwise problematic infinities. But it has yet to be established why the utilization of non asymmetrical imaginary time is necessary — because

we only ever experience time as being asymmetrical, having one direction into the future. As George Jaroszewicz has said:

“It is not clear why going to imaginary time, doing Euclidean spacetime integrals, and then returning to real time should be necessary. It amounts to a black box recipe for dealing with singularities for which there is also a game played in the renormalization programme in general, and it hides the (problem) under a mathematical carpet. No theorist should be satisfied with this. It is not clear for one thing whether the problem is that real time really is an illusion and the mathematics is telling us this, or whether the problems with real time Feynman integrals are telling us that our theories are inadequate. It is clearly of the utmost importance to settle this issue properly.” [18]

If a quantum entity were actually to rely on a sum of paths determination — it would need to do so with little or no passing of time, as it changes its position / state from moment to moment. A basically 'instantaneous' behavior like this would not be possible in normal space-time — especially since it would involve a virtually infinite number of paths 'to be considered.' But if wave functions exist throughout a timeless zero dimension, the information of all possible paths could be accessed with no time passing — because such information would be instantly available through wave functions existing in timelessness that interpenetrates every point of space-time.

If the information gathered by a quantum entity to make a sum of paths determination happened instantly, it might be construed that such information was gathered at an infinite rate of speed. This would be because information would seemingly have moved from one place to another without time passing. However, this would be an invalid or inappropriately derived infinity, because it would be inappropriate to allocate such an occurrence to the realm of space-time. The resulting infinity can be ignored as far as space-time is concerned, because it would be happening outside of space-time in a zero dimension. The same may also be true when zero space is involved, such as with singularities — which involve a zero spatial volume, resulting in a similar invalid or inappropriately derived infinities. If infinities are actually involved, they would be properly associated with the infinite realm of a zero dimension rather than improperly with space-time. So they can be 'taken from space-time,' and allocated to the non space-time realm. And this removal of infinities from space-time would be equivalent to renormalization or removal of infinities from equations that involve space and time.

When Einstein's general relativity equation for gravity is used to evaluate a black hole, a singularity is found to exist — which involves infinities such as infinitely curved space-time. And this is generally taken to mean that the laws of physics as we know them have broken down — or at least that general relativity is not meant to address such a situation. In the case of a singularity at the position of a black hole, the proportions of real and imaginary time involved are respectively zero real time and 100 percent imaginary time. But saying that there is 100 percent imaginary time, is basically the same as saying there is 100 percent zero time. Because when there is 100 percent

imaginary time — there is zero real time present — which is equivalent to only the underlying zero time realm being present.

If there is a zero dimension underlying the universe today, the infinities of a black hole basically exposes its presence. Because at the point of a singularity — space-time would be completely absent, while a zero dimension would be all that is present. So the need to use both real time and imaginary time in equations, could simply be a function of the time of space-time and the timelessness of a zero dimension both being present in the world — giving them the ability to interact with each other. In the presence of gravity, the times of the two realms — asymmetrical real or normal time, and symmetrical imaginary or zero time — would interact with each other to form hybrid or complex time. And in the presence of sufficiently intense gravity, there would only be zero time left at that point.

The existence of a zero dimension coexisting with space-time could therefore clarify the physical meaning of imaginary time and complex time — and thus provide a conceptual basis for their applicability in the real world. Imaginary time — with its lack of asymmetrical time — would be needed because it is a function of an underlying zero dimension with this same lack of asymmetrical time. Just as imaginary time is graphically envisioned as being 'at right-angles' to real time — where a Wick rotation through complex time can provide all permutations of merged real time and imaginary time, or complex time — so could a zero dimension be envisioned in this same way — as interacting with real time to produce all degrees of such interacting complex time.. The computational exercise of 'going to imaginary time, doing Euclidean space-time intervals, and then returning to real time' — would be comparable to the environment that quantum entities would experience in the real world, if an underlying zero dimension is present in the world today.

In a world with a zero dimension, the solution of general relativity for black holes could be seen as revealing the presence of an underlying zero dimension — which becomes readily apparent only at the extremes of gravity — and which could be revealing an underlying truth about the cosmos. It would then be necessary to utilize imaginary time that lacks asymmetrical time in physics equations relating to space-time — because this lack of asymmetrical time is a fundamental property of an underlying zero dimension, which then interacts with with the asymmetrical time we normally experience within dimensionality. The presence of infinities and the process of removing them through renormalization, would then have a conceptual basis in reality. And the possible range of space-time curvature that is the possible range of gravity, would be a continuum of complex time — which would consist of increasing degrees of imaginary time representing increasing amounts of a zero dimension — with an end point of 100 percent imaginary time representing 100 percent of a zero dimension.

So a complete range of gravity would encompass an increasing inclusion of zero space-time, with an end point of completely realized zero space-time. And problematic singularities would be safely allocated outside of space-time proper. Exactly as it would occur in Hawking's proposal of a cyclical universe that is finite but has no boundaries — a singularity would never be reached in the

presence of black holes, nor at the state between universal cycles — because a state of non space-time would be reached instead. In both cases of intense gravity, at the moment when a singularity would be formed, the underlying zero dimension would be revealed, which exists eternally in a natural state of infinity. This state of non space-time or zero dimension, would be the ground state of reality from which all universes emerge — in an eternal cycle or wave of physicality, which is manifested from a wave function of the universe $\Psi(u)$ that exists eternally in a fundamentally non dimensional reality.

7. Conclusion

We may perceive the world as being filled with objects that are separated by the dimensions of space and time. But it could still contain a zero dimension that would holographically connect all things. This inter-connection would supply each point in space-time with wave function information from all other points in space-time. So it is this information-bearing holographic nature that would allow many of the apparently non classical events of quantum mechanics to occur:

- 1) At any distance in space
- 2) Both forward and backward in time
- 3) Instantly, or at faster than the speed of light
- 4) Without any blocking or degradation of 'signal' integrity for the information being utilized
- 5) And with consciousness and wave functions interacting to produce phenomena such as 'collapse of the wave function'

As discussed, the above characteristics have preliminary verification, or at least do not contradict experimental results. So it is predicted that these items will be verified, or will be verified to a greater degree of precision, toward occurring at an infinite distance in space, and at an instantaneous moment in time — as many physicists believe that they should. It is also predicted that research in transpersonal psychology should progressively show that consciousness can exist independently of any material basis.

In addition, the presence of a zero dimension would similarly provide a basis for phenomena, such as:

- 6) Entanglement
- 7) Collapse of the wave function
- 8) The measurement or observer effect
- 9) Conscious-subconscious mind duality
- 10) Mind-body duality
- 11) Wave-particle duality
- 12) Retro-causality
- 13) Time reversible equations of physics
- 14) The holographic nature of the universe
- 15) Intermittent / non continuous 'motion' — including quantum tunneling

- 16) Events having an indeterminate state and position — being spread potentially throughout the universe
- 17) Universal information being instantly available everywhere, for such things as quantum entanglement, and path integral determinations, etc.
- 18) Utilizing imaginary time lacking in asymmetrical time, in physics equations involving space-time — because an underlying zero dimension is likewise lacking in asymmetrical time
- 19) A conceptual basis for performing renormalization — by avoiding singularities, and allocating infinities to a realm outside of space-time
- 20) A space-less and time-less basis for an eternal cycle of physical universes — where each cycle has its own separate time, and a singularity is never reached, within the space-time realm — because an infinite 'singularity' would reside outside of and independently from the space-time realm, as a zero dimension. The zero dimension would in effect *be* the infinite-eternal 'singularity' of non space-time that is the beginning and end of all universes and black holes, but would be independent of and be the basis for the space-time realm.

The model and formula developed in this article show how the current world of space-time could have come into being from a more fundamental realm that is dimensionless in nature. It shows how the standard model of physics can operate within the space-time dimensions, and yet be based on non dimensionality. It shows that imaginary and complex time could be a result of two interacting realms, a set of non dimensions and a set of multiple dimensions. And it shows how consciousness can be included as an intrinsic part of science — where the interaction of sub-consciousness with wave functions is a logical part of nature. And consciousness can in turn be seen as existing both dependently and independently of materiality — because the personal / conscious mind would be dependent on the dimensional part of the world, while the unconscious /extended mind would be independent of materiality in the non dimensional part of the world.

Because a zero dimension is not physical, it would have nothing physical within it — no dimensions — no matter — and no energy. And as such, a zero dimension would exist as the least energy ground state of the universe. It would be the ground state for dimensions, which is non dimensionality — the ground state for material things, which is wave functions — and the ground state for consciousness, which is being-ness. But in harboring consciousness and the wave function of the universe, it would exist as an eternal realm of universal potentiality — for all consciousness, all materiality, and all universes. So a zero dimension would therefore exist as the basis for all things. And this underlying framework of dimensionality, can hopefully then help us to better understand the world we live in — explaining many of the things that have been puzzling us for years.

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