Quantum Weirdness Revisited—Maybe It's Not So Weird After All

By Bob Eige

Abstract

In this article, the author presents a group of relational principles that are based on the Buddhist notion of *relationality*. He calls these principles *Zen-based Relational Principles* (*ZBRP*). The author claims that concepts inherent in the notion of *relationality* can be applied to the relational view of quantum cosmology to create a comprehensive set of relational principles. To demonstrate the value of ZBRP he provides examples intended to show how this group of principles makes *quantum weirdness* more comprehensible, and how ZBRP may elucidate several central questions in quantum physics and cosmology.

About This Article and the Author

This article is written in an abbreviated manner. It is addressed to individuals who are knowledgeable in quantum cosmology and who have some background in Buddhism (particularly Zen Buddhism). The purpose of this article is to introduce the reader to a perspective that can make certain quantum phenomena more comprehensible and that can reveal new insights into these phenomena. This article is not about parallels between quantum theory and Buddhism. Nor is its purpose to support a metaphysical worldview. The domain that is discussed in this article is the physical domain and the methods and approaches physicists and Zen Buddhists use to understand it. This of course does not imply that the physical domain is the central focus of Zen Buddhism.

The structure of this article is as follows: the first section is a review of the debate between the relationists and the absolutists. The next two sections contain an introduction to relationality and a presentation of ZBRP. Following these sections, I show how relationality can be applied to the relational view. To clarify the Buddhist concept of *Sunyata* (emptiness/relationality) I then present "A Quick Study of Emptiness". The subject of quantum weirdness is then introduced and characterized. The section entitled "ZBRP Used as a Lens" provides six examples of how ZBRP can be used to clarify problems related to quantum phenomena. One of the examples pertains to quantum measurement and this example demonstrates how ZBRP can provide the long sought explanation of the basis for uncertainty.

If you make it through the article to the remaining sections, you'll find the reading a bit easier. "ZBRP and Oneness" reviews some common misconceptions regarding the Buddhist concept of Oneness. In the conclusion I describe my hopes for this article. The conclusion includes some thoughts regarding experimental tests of ZBRP. It is followed it with an addendum whose focus is a brief discussion on the issue of parallels between Buddhism and quantum physics. In the addendum I also respond to the key issues presented in Ken Wilber's book *Quantum Questions*. "Bumper Stickers, Tee Shirt Slogans and Asides" provide some levity at the conclusion of the article. The final sections of the article are the acknowledgements and references.

Quantum Weirdness Revisited—Maybe It's Not So Weird After All

Relativity, quantum physics, and Buddhism have captured my interest for many decades. I am not, however, a physicist or an academic. My primary objective is to introduce a complete set of relational principles borrowed from Zen Buddhist concepts and to demonstrate the value of these principles in clarify some of the central concepts in quantum physics and cosmology. I suspect that in my application of ZBRP I may have a few "hits" and some big "misses." This is to be expected since I am not a quantum physicist. My hope is that I can demonstrate the value of ZBRP in at least a few significant examples. By so doing I will encourage others to attempt a more rigorous application of this group of principles.

The Debate Between the Relationists and the Absolutists

In the philosophy of physics, the debate between the relationists and the absolutists has been going on for decades. The position that I favor is that of the relationists. The relationists and the absolutists both have their highly respected advocates among physicists. In order to put this debate in historical perspective, I refer to a quote and two explanations offered by Brian Greene. Greene is the author of *The Elegant Universe* and the current bestseller *The Fabric of the Cosmos*. This respected physicist was also the host of the *Nova* series, *The Elegant Universe*.

> In the relational concept of space favored by Leibniz and Mach, space is not a something—it's the language for expressing the relationship between one object's position and another's (Greene 2004, 37).

Greene describes Newton's (absolutist) position by saying that he declared space and time eternal and immutable—without relation to anything external. At another point Greene states that the relational view of spacetime is still being debated and that it has principles that are consistent with Einstein's theory of relativity and principles that are not. (Greene 2004, 75).

In recent years Julian Barbour (author of *The End of Time*) and Lee Smolin (author of *Three Roads To Quantum Gravity* and *The Life of the Cosmos*) have gained respect for their work on relational-based models of quantum cosmology. One of Smolin's central ideas is that the world is nothing but an evolving network of relationships (Smolin 2001, 20). Smolin also points out that Einstein's general theory of relativity is "a direct descendent of Leibniz's and Mach's views on the relational view of space" (Smolin 2001, 20).

Introduction to Relationality and The Zen-based Relational Principles

I came to the perspective described in this article by studying a "realm" that, at first, was almost as weird to me as the quantum realm. The realm that I am referring to is *Sunyata*—translated variously as emptiness, relationality, and relational origination. Dependent origination and dependent co-origination (*Pratitya-samupada*) are other terms that are considered synonymous with Sunyata. In this article, I frequently use the term *relationality* when referring to Sunyata and its English translation and synonyms. These concepts are either explicit or at least implicit in

all forms of Buddhism. My focus on Zen reflects my belief that it is the most succinct form of Buddhism and that it encapsulates core beliefs that underlie most forms of Buddhism.

Fully grasping relationality is difficult and runs counter to our ordinary way of understanding our world. Only when it is well understood and carefully applied does it have any value in physics. Masao Abe has written one of the very best books on the subject, *Zen and Comparative Studies.* I highly recommend it as a companion to this article.

The leading exponent of Zen Buddhism in the West since the death of D. T. Suzuki, Abe is the award-winning author of *Zen and Western Thought* (1985). He is one of the major contemporary representatives of the Kyoto school of Japanese philosophy. This article relies heavily Abe's book *Zen and Comparative Studies.* I chose it because it presents a comprehensive, precise, and coherent presentation of relationality.

The following quotes serve as an introduction to Abe's book and lay the foundation for this article:

> The ultimate reality in Buddhism is not God, or Being, or Substance; it is Sunyata, which is often translated as "Emptiness" (Abe 1997, 42).
>
> Pratitya-samupada ("dependent origination", or better, "co-dependent origination") is the most basic perception of Buddhist teachings (Abe 1997, 93).

Abe then goes on to present the key principles of relationality. For the sake of clarity and ease of reference I have re-cast this group of principles as *Zen-based Relational Principles* (*ZBRP).* The following extended quote from Abe includes these principles:

> When we examine this statement of co-dependent origination in terms of "the logical structure of co-dependent origination" we may indicate at least the following three points:
>
> > 1. Everything in and out of the universe without exception is interdependently related to every other thing; nothing whatsoever is independently self-existing without relying upon something else. And any relationship is reciprocal and reversible; there can be no unreciprocal and irreversible relationship whatsoever.
> >
> > 2. Each items [sic] which is mutually related with all other items must have a uniqueness or particularity. This is because, among entities which have no uniqueness or particularity, there can be no mutual dependence.
> >
> > 3. How is it possible that these two apparently contradictory aspects, i.e., first the complete interdependence, and second the uniqueness of each item, are both implied in the structure of co-dependent origination? This is possible precisely

> because there is no particular principle, no special reality, such as God, Brahman, Being, which, being beyond, behind, or beneath the co-dependent originational relationship among all things, gives a foundation to it. In other words the above-mentioned two apparently contradictory aspects are working together without contradiction because the relationship of the co-dependent origination takes place in the locus of emptiness (Abe 1997, 98).

The Zen-based Relational Principles

ZBRP breaks out Abe's three statements into the seven principles they contain. I have used the term "thing/item" to maintain consistency among the seven principles of ZBRP. When ZBRP is used to elucidate an issue in quantum cosmology all seven principles are necessary to provide the highest level of clarity.

> Principle 1: All things/items are interdependently related.
>
> Principle 2: No things/items whatsoever are independently self-existing without relying on something else.
>
> Principle 3: Any relationship is reciprocal and reversible.
>
> Principle 4: There can be no unreciprocal and irreversible relationship whatsoever.
>
> Principle 5: Each thing/item that is mutually related with all other things/items must have a uniqueness or particularity.
>
> Principle 6: There is no particular principle, no special reality, such as God, Brahman, Being, which, being beyond, behind, or beneath the co-dependent originational relationship among all things/items, gives a foundation to it.
>
> Principle 7: The relationship of the co-dependent origination takes place in the locus of emptiness. (Therefore Principles 1 and 5 work together without contradiction.)

Relationality and Its Application to the Relational View

When we carefully examine how Abe constructs his presentation of relationality, we can see why it can be applied to the relational concept of physical reality. For a start, we notice that Abe's presentation makes no reference to metaphysics (Incidentally, metaphysical speculation is rejected in most forms of Zen.) except to explicitly exclude the need for a "special reality, such as God, Brahman, Being ... to provide a foundation" (Abe 1997, 98). Abe's group of principles is not about what does or does not exist. It is about how all things exist. Simply put—all things exist interdependently and are devoid of self-existence. Understanding the concept of *self-*

existence is essential to a full understanding of this article. This concept will be explained in the next section.

Physicists sometimes say that relativity did not replace Newton's theory; it only encompassed it in a more comprehensive theory. The same is true of the Zen perspective. This is because the Zen perspective acknowledges the conventional way of knowing things and then embeds it in a more comprehensive view. Abe states, "Buddhists ... speak of two levels of truth: conventional and ultimate. Conventionally, objects exist; really, they are empty" (Abe 1997, 51). In physics, perceiving separate things is the conventional way of understanding them. The more comprehensive way (i.e. ZBRP perspective) is to understand that the only way things in their uniqueness or particularity can exist is relationally.

Einstein applied Riemann's four-dimensional geometry to the cosmos with great success. I am hopeful that the concepts that I have "borrowed" from Zen Buddhism can be applied to the quantum realm with some measure of that success.

A Quick Study of Emptiness

Before moving on to the application of Zen-based principles to quantum cosmology, I want to spend a bit of time further clarifying the concept of Sunyata (emptiness). Whole books have been devoted to this subject. In this brief section I'll do my best to communicate its essence. The first step is to understand that emptiness pertains to how things exist. It is not about *if* they exist. Understanding emptiness requires a shift in perception. This shift may be compared to a Gestalt figure-ground perceptual shift. Perhaps you've seen drawings used for this purpose. If you focus on one aspect of the image you see one thing. Shift your perspective from the figure to the ground (or vice-versa) and you see something else. The shift required in understanding emptiness is to take one's attention away from things and objects that appear to stand alone and to begin to notice that they exist as part of a larger environment or context. The Buddhists say all things arise and cease to exist co-dependently. In this sense they have no self-existence and are thus empty or empty of self-existence.

When the concept of emptiness is applied in quantum cosmology the results are profound. The implication is that all things including time, space, fields, matter and energy are all empty in the sense that they all exist co-dependently. From the ZBRP perspective none of the elements listed can be said to have self-existence. In the classical world (conventional view) we are used to building our models from component pieces. The quantum world forces us to re-examine each of the individual components. Unless we understand that the components themselves cannot fully stand alone, we lack the perspective necessary to develop a completely consistent and comprehensive model. It is difficult to grasp the true nature of the components that we are so used to working with, once we take the ZBRP-imposed view. Somehow they seem less substantial and dependable. This is unavoidable. As the Buddhists say, Sunyata (emptiness) is the true ground. The value of understanding our world in this way is that it leads to a more comprehensive and consistent model than the absolutist view.

Quantum Weirdness Revisited—Maybe It's Not So Weird After All

Quantum Weirdness—A Very Brief Introduction

In the chapter titled "Quantum Weirdness" in *The Whole Shebang* Timothy Ferris writes:

> Whatever we elect to call it—nonlocality, 'quantum observership,' or the 'quantum measurement problem'—weirdness is as knotty a conundrum as the physical world has ever presented to the human mind" (Ferris 1998, 270).

The *Nova* special "The Elegant Universe" uses a lot of special effects and digital animation in its eager attempt to show how weird quantum phenomena is. The approach introduced here is intended to help make the quantum realm a bit less weird.

Double-slit experiments are at the heart of all discussions of quantum weirdness. Ferris describes how when these experiments are conducted, in all their various forms:

> The system denies us the forbidden information on path B, instantly, as soon as we make a measurement on path A. It does so even if a signal would have to travel a velocity faster than light in order to convey news of our fiddling from A to B (Ferris 1998, 266).

The "faster-than-light" aspect implies nonlocality. The implication of nonlocality, rocked the world of physics when it was announced. Since then scientists and philosophers have been hard at work trying to come up with suitable explanations. The most commonly applied explanations of nonlocality are the Copenhagen interpretation, the many worlds explanation, and the hidden-variables interpretation. I'll discuss the ZBRP perspective on each of these interpretations later in the following section.

ZBRP Used as a Lens

In this section I have provided six examples of how ZBRP can be applied to quantum phenomena in order to make them more comprehensible and thus less weird. If there is a value to having a complete set of relational principles, such as ZBRP offers, it will be revealed through its application. Each phenomenon is carefully examined using ZBRP as a type of "relational lens" in order to see what it might uncover. As a non-physicist, I expect there to be significant flaws in my examples. I hope that others will others will join me in exploring diverse applications of ZBRP and will share their findings.

Quantum Observership, Quantum Measurement, and Objects with No Hair

Quantum weirdness reveals itself in the quantum realm and ZBRP provides a new understanding of why this is. The "no hair" quality of objects in this realm is the key. Let me explain; in this realm the attributes of an object, such as an electron, is limited to a few properties; in the case of an electron—mass, charge, and momentum. Sometimes, physicists say that these objects have

"no hair" because every one is identical. Because we can completely describe an electron by its three attributes, providing the values for these qualities is equivalent to observing/measuring it in its entirety. In Buddhist terms this is equivalent to observing/measuring a self-existing thing. Since, according to Buddhism, there are no self-existing things we now have the basis for explanations of quantum weirdness from the Buddhist perspective. From the Buddhist perspective the problem reflects the general problem inherent in all observation and measurement. That is the problem of perceiving or differentiating things as self-existing. To re-state Abe, "Buddhists … speak of two levels of truth: conventional and ultimate. Conventionally, objects exist; really, they are empty" [i.e. they only exist relationally] (Abe 1997, 51).

Following ZBRP logic we can now see that the so-called problem of quantum observership may be nothing more than a very clear mirror that reflects how things really exist. That is—they exist relationally. Although observation on the macroscopic realm does not reveal this truth, observations in the quantum realm do. The act of quantum observation necessarily draws the observer into the deep connections that all things have with all other things.

Experiments demonstrate that the more we know about an electron's position, the less we know about its momentum. Conversely, the more we know about its momentum, the less we know about its position. Sometime this type of result is characterized as the "fuzziness" of quantum phenomena. Both Greene and Ferris point out the source of the "fuzziness" of quantum phenomena:

> Indeterminacy mandates that quantum calculations incorporate probabilities. The probabilities, in turn, produce the characteristic fuzziness of the quantum phenomena (Ferris 1998, 250).
>
> Heisenberg's principle does not just declare uncertainty, it also specifies, with complete certainty, the minimum amount of uncertainty in any situation. (Greene 2004, 97).

From a ZBRP perspective the degree of "fuzziness" can be seen as a mirror that reflects the degree in which a particular type of effort to measure a "self-existing" thing draws the observer into the interconnections of all things. Once this is clearly understood, it is apparent that ZBRP provides the long sought explanation of the basis for uncertainty! This explanation is at once simple and very subtle. It is so easy to miss. I've tried to explain this as clearly as I can and I don't want to be repetitious in my presentation. Therefore I urge you to re-read this section several times.

Three Interpretations of Double Slit Experiment Phenomena

The three most commonly given interpretations of quantum phenomena observed/measured in double slit experiments are the *Copenhagen interpretation*, the *many worlds (many histories)*

explanation, and the *hidden variables* explanation. Let's examine all three from the ZBRP perspective, starting with the Copenhagen interpretation.

> The Copenhagen claim is that electrons and other quantum-scale objects exist in a superposed state, until an act of observation "collapses the wave function," resolving the system into one or the other of its potential, and mutually contradictory, aspects (Ferris 1998, 255).

Most of the grunts and groans of displeasure associated with the Copenhagen interpretation relate to the following belief: the idea of an objective physical reality is undermined if we can only know of the existence of a phenomenon when it is observed/measured. ZBRP does imply its own strong view on what an objective physical reality accounts for. There are no "self-existing observers" who can observe/measure "self-existing things." Thus there is no objective physical reality "out there." According to ZBRP the objective reality is that all things exist by mutual relationship. To some extent our sense of self includes the notion that we live in a world that is "out there", that is "solid" and that is objective. Letting go of these notions requires some personal re-orientation. This effort is required if we want to attain a greater degree of clarity.

ZBRP can also provide some clarity as to how the superposed state comes about. A particle, being "hairless" always stands as a reflection of the "no self-existing" nature of things whenever we try to get in into our grasp. The hardest thing about understanding this concept is our stubborn insistence on believing that if we try hard enough we can grasp anything. Holding onto the image of "a thing that can be grasped", is literally the source of the problem. This approach to clarifying the paradox of superposition differs from one offered by Smolin (Smolin 2001, 47). He bases his interpretation on theories that include many quantum descriptions of the same universe. These theories depend on a way of splitting the universe into two parts such that one part contains the observer and the other part contain what the observer wished to describe. The descriptions are different, but they have to be consistent with one another. Smolin states, "this resolves the paradox of superposition by making it a consequence of one's point of view". The essential difference represented by the ZBRP approach is that the superposed state is a consequence of merely *having* a point of view! This is because a point of view implies separateness. There is just no way to get around that fact. We are so used to seeing our selves as being *in the universe* rather that being *of the universe*. Making this subtle change of perspective just takes time to get used to.

Briefly stated, in the *many worlds* explanation each observation/measurement results in the entire universe splitting. In one universe the particle has the qualities we measure, in the other its complementary quality. Related concepts include *sum over worlds*; *many histories*; *sum over histories*; *and multiverse.* From the ZBRP perspective, when we attempt to observe/measure an electron and view it in its totality—as a self-existing thing—the entire universe gets implicated because all things exist relationally. I believe the *many worlds* approach acts as a type of "work around." It splits the universe instead of mapping the connections of particulars to other

particulars and the whole. As others have pointed out, the many worlds approach is definitely not economical!

In the *hidden variables* explanation a "guiding wave" communicates the necessary information between particles on either side of the beam-splitter so that an action taken on one part of the quantum system can be linked to the other part. It is more likely that the necessary "communication" takes place instantaneously because time itself is not a "self-exiting" thing. This idea is discussed in the following section.

The End of Time and Nonlocality

Julian Barbour's well-received book, *The End of Time*, is one of many books and articles that discuss the "end of time," space, or spacetime. The authors of books and articles of this type usually come to their conclusions by creating a higher dimensional model and/or some version of the relational view. From the ZBRP perspective time, space, spacetime, fields and other things/ items do not end! Instead they are understood to be not self-existing. This is a very important distinction. Recall ZBRP Principle 5: Each thing/item that is mutually related with all other things/items must have a uniqueness or particularity. Thus the ZBRP view of time is that its existence is mutually related to all other things and that it *does* maintain its particularity.

Abe states, "In our lived reality time is recognized in and through the transition of things. In short, it is not that there is a time a priori in which the transition of things take place. Time and things are inseparably connected with one another" (Abe 1997, 164). Since time and things are inseparable, time is understood in Buddhism to be non-substantial and empty because things are understood to be non-substantial and empty. It is noteworthy that Abe's statement makes it clear that the concept of non-substantiality applies to dimensions (i.e. time) as well as things. It is also interesting to compare Abe's statement about time with that of Mach (as quoted by Barbour 2001, 67) "It is utterly beyond our power to measure the changes of things by time. Quite the contrary, time is an abstraction, at which we arrive by means of changes of things." (Smolin makes the same claim, "There is no time apart from change". (Smolin 2000, 20)

I have been struggling to effectively apply ZBRP to the problem of nonlocality and am not yet satisfied with my progress. However, I do have a few thoughts that I would like to share because I believe that the Buddhist view of time may shed some light on this difficult problem. Their view of time makes clear the depth of connection of all things including time (explicitly stated by Abe) and space (implied). I have created an image to help communicate the idea of "the deep interconnection of all things." Imagine a three-dimensional sphere to represent four-dimensional spacetime. Time, space, matter, energy and fields are all "particulars" that exist relationally within this sphere*. The sphere does not exist *in time*, rather time is one of the particulars that comprise the sphere. When I view things this way, I can begin to sense that there may be "room" for nonlocality in this model.

* For sake of completeness dark matter and dark energy should be included in this list.

Quantum level experiments that, in a manner, force the issue of self-existing things may key into the way time itself exists and thus yield the apparent proof of nonlocality.

In *The Fabric of the Cosmos*, Greene—discussing entanglement and nonlocality—writes, "the quantum connection between two particles can persist even if they are on opposite sides of the universe…. It's as if they are right on top of each other" (Greene 2004, 80). In this description, Greene focuses the spatial component in describing entanglement. From the ZBRP perspective the apparent existence of all separate things is due to the mutual "entanglement" of all things. There never are any truly separate subatomic particles in spacetime.

The Implicate Order and The Holographic View

David Bohm's implicate order has much in common with the approach taken by ZBRP. In his book, *The Undivided Universe*, he summarizes his perspective as follows:

> The essential features of the implicate order are … that the whole universe is in some way enfolded in everything and that each thing is enfolded in the whole (Bohm 2002, 382).

Bohm uses the hologram as an example of a structure in which all parts contain reflections of the whole. He makes for some difficult reading, but from what I can gather his approach includes (explicitly or implicitly) all principles of ZBRP except for 5 and 7. These principles are restated here:

> Principle 5: Each thing/item that is mutually related with all other things/items must have a uniqueness or particularity.
>
> Principle 7: The relationship of the co-dependent origination takes place in the locus of emptiness.

If my read of Bohm is correct, then in relation to his work, the value of ZBRP is that it provides a somewhat more complete and explicit set of principles for relational theory. (My debt to Bohm is that he has "done the math.")

Reflections on Greene's Summary in The Fabric of the Cosmos

At the end of *The Fabric of the Cosmos*, Greene speculates on where cosmology and quantum mechanics are headed:

> …the distinction between spacetime and more material entities would largely evaporate, as they would emerge from appropriate aggregates of more basic ingredients in a theory that's fundamentally relational, space-less, and timeless. (Greene 2004, 491).

Applying Abe's view regarding the co-dependence between time and things is particularly helpful to Greene's statement. As previously quoted, Abe states:

> Since time and things are inseparable, time is understood in Buddhism to be non-substantial and empty because things are understood to be non-substantial and empty. (Abe 1997, 164)

From this perspective, the distinction between spacetime and material entities has not evaporated. Both emerge and cease to exist in a relational manner. Looking forward, if "more basic ingredients" are found their emergence and ceasing will also be co-dependent.

ZBRP Pill for Quantum Jitters

Quantum jitters is a colloquial term that describes the wild frenzy of space that arises from applying the uncertainty principle to the gravitational field on smaller and smaller scales (Greene 2004, 349). Physicists say that string theory calms the quantum jitters by replacing point particles with vibrating strings. This is because unlike point-particles, which have no extension in space, strings reach their minimal extension at the Planck scale. ZBRP interprets the calming effect of string theory as being due to its not forcing the issue of self-existing entities on a very small scale.

Discussions of quantum jitters frequently include the concepts of "space-time foam" and the idea that "everything is made of space". Both of these concepts do not stand up to ZBRP. Space-time foam, if it exists, cannot exclude its mutually co-dependent relationship with all things. The "all-is-space" concept attempts to reduce everything to one thing that somehow is self-existing. From the ZBRP perspective, any theory that states that all is "X"; "Y"; "Z"; or whatever, cannot be true. This includes the theory that "All is one." (see below)

<u>ZBRP and Oneness</u>

The belief that "all is one" can be found in some religions and in the field of metaphysics. Some theorists have tried to adapt versions of this concept to the field of physics. I believe that in *all* cases such attempts are doomed to failure. This is because the statement "all is one" does not reflect a complete relationist or relational set of principles. It fails to include the reciprocal nature of all relationships and does not imply emptiness. A well conceived relationist or relational perspective does not attempt to minimize "the many." Listen carefully to how Masao Abe formulates a complete relational concept that
includes the "one" and the "many".

> The many *are* one: one *is* the many ... for in dependent co-origination, it is not only that one and the many are dependent on each other in their arising and ceasing, but also that both one and many are completely without substance and *empty.* One is the many

> precisely because one *is* not one: the many *are* one precisely because the many are not the many (Abe 1997, 91-92).

There is an age-old question: is the universe made of one thing or many things? Perhaps the reason this issue remains unresolved in common perception is that it has been posed as an either-or question. According to ZBRP, it's neither. Only by understanding the subtle relationship between *the many* and *the one* can we finally reach a greater level of clarity.

Conclusion

Physicists now say that are living in a quantum universe of which the classical universe is a subset. This shift in perspective has taken us one big step in the right direction. The next step is to recognize that all the things in our universe are themselves empty and have no self-existence. From this perspective, things perceived as separate or self-existing are non-fundamental. This includes macroscopic objects, subatomic particles, energy, fields, and the dimensions of time and space (or spacetime) plus dark energy and matter.

In ZBRP the only thing that is fundamental is emptiness or relationality. Relationality can be considered a "grand unified theory" for it demonstrates how all things are connected. Physicists who accept this perspective share the perspective of the Zen Buddhists that Sunyata/Emptiness is the true ground of reality. The substantiality of self-existing things, be they physical things or dimensions is thus refuted. ZBRP does not perceive emptiness as a metaphysical concept but as simply a way to refer to the fact that all things exist relationally. To fully appreciate ZBRP one has to undergo a profound change in how things are perceived. Emptiness is difficult to fully embrace but once appreciated it makes quantum weirdness a lot less baffling.

I have searched for a published source that includes a comprehensive set of principles of relational theory and have come up empty handed. Perhaps my search was incomplete and someone has developed such a set of principles. I believe that Lee Smolin and Julian Barbour come the closest to encompassing the seven principles of ZBRP. In relation to their work there are two ways that ZBRP stands out. The first is that it explicitly defines the most complete set of relational principles. The second is that it makes use of the concept of emptiness to help explain how time and space can be maintained as essential attributes of a complete model of our universe.

There may be opportunities to experimentally test a variety of hypothesis that can be generated from ZBRP. At this point I can make three suggestions about how these tests could be conducted: focus on phenomena that involve objects with no-hair; focus experiments on very small-scale spaces, and; expect the type of weirdness that will be generated to be field specific. I'll dip my toe in some risky water and present an example. Probing an electromagnetic field will generate quantum weirdness focused most strongly in a three-dimensional space, while probing a gravitational field will generate a quantum weirdness focused most strongly in four-

dimensional spacetime. For now, I leave it up to those more qualified than myself, to come up with other opportunities to test the implications of ZBRP.

My hope for this article is that it generates discussion leading to an accepted group of relational principles. This achievement would go far in helping to make quantum cosmology more readily comprehensible. I am eager to receive comments on this article. Except for having a couple of knowledgeable friends review this article, I have not discussed these ideas with others in the field. If you have comments on this article that you would like to share, please email me at: bobeige@ Comcast.net.

Addendum

Parallels between Buddhism and Quantum Theory

In developing this article, I took care to take into account the observations Ken Wilber has made on the so-called parallels between Buddhism and quantum theory. In his book *Quantum Questions*, Wilber has done a skillful job in revealing the lack of clarity in most of the books and articles on this subject. To summarize a few of his key points I have included several quotes taken from his book.

> Physics deals with form, and mysticism deals with the formless. Both are important, but they cannot be equated (Wilber 2001, preface ix).
>
> Mystics speak of contacting reality in its "suchness," its "isness," its "thatness," without intermediaries; beyond words, symbols, names, thoughts, images…. Physics is looking at *nothing but a set of highly abstract differential equations* not at "reality" itself, but at mathematical symbols of reality (Wilber 2001,6).
>
> The nature, aim, and results of the approaches are profoundly different: the one dealing with abstract and mediate symbols and forms of reality, the other dealing with a direct and non-mediated approach to reality itself (Wilber 2001,6).

My aim in writing this article has not been to show parallels between Buddhism and theories of quantum physicists. The primary value of my work is to show how a complete and precise set of relational principles can further the relational view. I borrowed from Zen Buddhism and the work of Masao Abe to do this. Having said that, I believe that it is apparent that the relational approach developed by quantum physicists does include concepts that are common to Zen Buddhism.

Beyond this simple answer I'd like to address some of Wilber's concerns. How can the Buddhist concepts of emptiness, relationality and relational origination be applied to the physical domain of form when they are intended to deal with the formless? The answer is that in Buddhist

philosophy all things are empty of self-existence. They arise and cease to be co-dependent. All things include physical things.

ZBRP can probably be reduced to a set of mathematical symbols. Except for Principle 7, the principles merely define relationships. Principle 7—pertaining to emptiness—is a bit different. It presents an image that can only be grasped when Principles 1-6 are understood. Emptiness need not be grasped as a metaphysical concept; it is a way of representing the lack of substantiality of separate things.

The concept of Sunyata/Emptiness represents a concise group of principles that defines the limits of how any apparently self-existing thing can be understood. It can be applied equally to all domains. In the physical domain it will not help to "look at reality itself" as Wilber states. Interestingly the same is true of any other domain including the metaphysical one! Buddhists don't use the concept of Sunyata to "look at reality itself." My understanding is that the concept is used to help "close the door" on efforts to contact reality using "abstract and mediate symbols and forms of reality." Once this door is closed, the door to the formless can begin to open. The Zen approach includes a non-mediated approach, but all formulations pertaining to Sunyata represent a mediated approach. The mediated aspect of the Zen approach is encapsulated in ZBRP.

<u>Bumper Stickers, Tee Shirt Slogans and Asides</u>

Here are a few slogans suggested by ZBRP - suitable for bumper stickers and tee shirts.

You can never know everything about anything

It Takes A Universe

It's The Relationships, Stupid!

It's Not All Happening At The (Particle) Zoo

It's a Zero Sum Universe After All*

*I haven't included a discussion of the "zero sum universe" into this article. It is however, an important concept in relational theory. Smolin discusses it in *Three Roads to Quantum Gravity* and I highly recommend this book.

In ZBRP the long sought "Theory of Everything" (TOE) is replaced with a Theory of No-Thing (TON)! Correctly stated, but less amusing, this should read as "Theory of No Self-Existing Thing" (TONST).

Acknowledgements

I'd like to thank my wife, Peggy Carlan, for her loving encouragement and support for and during this project. Thanks to my friend Larry Borok for his insightful review of this article, editing suggestions, and for his comments pertaining to Zen Buddhism. Larry has studied and been a practitioner of Zen for many decades and his insightful comments were very helpful. Thanks also to my friend Jay Lord for his review of this article and his comments pertaining to quantum physics and editing suggestions. Jay is a world-class programmer and has an extensive background in math and physics. And finally, thanks to Jill Roberts for providing excellent editing services. Her careful review of the article, corrections and suggestions are greatly appreciated. After her review my first draft I made some additions and changes to the article. Any errors that have crept in are most certainly mine.

References

Abe, M. 1997. *Zen and Comparative Studies*. Honolulu: University of Hawai'i Press.

Greene, B. 2000. *The Elegant Universe*. New York: First Vintage Books.

Greene, B. 2004. *The Fabric of the Cosmos*. New York: Alfred A. Knoff

Ferris, T. 1998. *The Whole Shebang*. New York: Touchstone.

Smolin, L. 2001. *Three Roads To Quantum Gravity*. New York: Basic Books

Barbour, J. 2001. *The End of Time*. New York: Oxford University Press.

Bohm, D. 2002. *The Undivided Universe*. London: Routledge

Wilber, K. 2001. *Quantum Questions.* Boston: Shambala Publications, Inc.