In Search of Reality

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Abstract

In this paper, I will discuss the underlying philosophy of physics. A new definition of observer is presented, then the meaning of two words, i.e., existence and reality, will be examined. With the changes made for these three items, a new philosophy emerges that allows an examination of the concepts of cause and effect, time, space, and the role of mathematics in physics. The new philosophy suggests a structure of the universe that indicates both an understanding of the double-slit experiment and a new approach to the quantization and root cause of gravitation.

Keywords

philosophy of physics, observers, existence, reality, space, time, causality, gravitation, quantum theory

1 Introduction

There are many outstanding problems in modern physics. Quantum theory provides a very accurate means of studying the micro-scale universe, but we have no idea why it works: *The two slit experiment contains the only mystery. We cannot make the mystery go away by explaining how it works.* Feynman[Rosenblum, 2011].

Gravitation theory provides a very accurate means of studying the macro-scale universe, but what is its root cause and how does it fit with the other three fundamental forces? Many attempts have been made to quantize gravity, but none has succeeded yet.

In this paper, I will take a close look at two words, i.e., existence and reality, and the human creature that invented and defined them to show how these three items impact physics. In doing so, I will attempt to follow Einstein's advice, i.e.,: *Look beyond the multitude of trees and examine the forest*. [Einstein,1916]

I will not discuss the history of the philosophy of physics or add to the common pool of theoretical knowledge. When we speak of reality, it generally means the state of the universe as it actually exists. Thus, reality and existence are intimately entwined. In many ways, the meanings of words set the direction of philosophy, physics and science, as well as all other human interactions. Often words are derived from the past, so they have their roots in antiquity. Human beings invent words and use them, in part, to build models and theories of the universe.

The concept of 'observer' permeates modern theoretical physics, but it is never fully defined.
How is it defined and how does it fit into reality? In theoretical physics the precise meaning of an observer varies with the application. In classical physics, a hypothetical non-accelerating observer exists in an inertial system. In Newton's laws of motion and the Special Theory of Relativity apply to measurements made by such observers. The term observer refers most commonly to the 'inertial reference frame.' This

use differs from the common meaning of 'observer', so it is not necessary to speak further of an observer; the reference frame is sufficient.

In the General Theory of Relativity the term 'observer' refers more commonly to a person (or apparatus) making passive local measurements, a usage that is closer to the common meaning of the word, i.e., a person who watches or notices something.

In Quantum Mechanics, 'observation' means a quantum measurement. An 'observer' creates a measurement apparatus and selects observables that can be measured. It is recognized that an observer making measurements fixes the outcome from the many possible outcomes presented by the quantum world. There is much discussion about the connection of quantum measurements and consciousness.

Many of the physicists who contributed to the development of modern physics have had much to say in this regard. Some of them are quoted below [Rosenblum, 2011]

Martin Rees

> *In the beginning there were only probabilities. The universe could only come into existence if someone observed it. It does not matter that the observers turned up several billion years later. The universe exists because we are aware of it.*

Albert Einstein

> *I think that a particle must have a separate reality independent of the measurements. That is, an electron has spin, location and so forth even when it is not being measured. I like to think the moon is there even if I am not looking at it.*

John Bell

> *Is it not good to know what follows from what, even if it is not necessary "for all practical purposes". Suppose for example that quantum mechanics were found to resist precise formulation. Suppose that when formulation beyond " for all practical purposes" is attempted, we find an unmovable finger obstinately pointing outside the subject, to the mind of the observer, to the Hindu scriptures, to God, or even only Gravitation? Would that not be very, very interesting?*

Eugene Wigner

> *When the province of physical theory was extended to encompass microscopic phenomena through the creation of quantum mechanics, the concept of consciousness came to the fore again. It was not possible to formulate the laws of quantum mechanics in a fully consistent way without reference to the consciousness.*

Werner Heisenberg

> *The atoms or elementary particles themselves are not real; they form a world of potentialities or possibilities rather than one of things or facts.*

Sir James Jeans

> *The universe begins to look more like a great thought than a great machine.?*

Roger Penrose

> *It is a striking fact that almost all the interpretations of quantum mechanics…depend to some degree on the presence of consciousness for providing the "observer" that is required for…the emergence of a classical-like world.*

Bernard d'Espagnat

> *The doctrine that the world is made up of objects whose existence is independent of human consciousness turns out to be in conflict with quantum mechanics and with facts established by experiment.*

David Chalmers

> *Consciousness poses the most baffling problems in the science of the mind. There is nothing that we know more intimately than conscious experience, but there is nothing that is harder to explain.*

J. M. Jauch

> *The interpretation of quantum mechanics has remained a source of conflict from its inception. For many thoughtful physicists, it has remained a kind of "skeleton in the closet."*

From the foregoing quotes, I sense confusion among the creators of modern physics as to the true meaning of the observer and the reality of the universe.
There are three things that are to be explored, i.e., a modified definition of the human observer and two words this creature has created. We will change the definitions of both existence and reality, and, in doing so, modify the underlying philosophy of physics.

2 Part I: The Basics

2.1 The Observer

First, and most important, all observers are made of matter and energy, the entities of the physical universe, and all live totally within the universe. For clarity, consider the human being. Imagine the birth of a human infant. At the instant of birth, the infant's brain is void of information about what we call the physical world into which he or she has emerged. There are parts of the brain that are genetically present, but those parts do not provide much information about the world into which the infant has been thrust. There may be some weak information acquired from within the womb, but, for the most part, the brain knows nothing of the physical world. From the moment of birth, the brain is flooded with electrical impulses from the external physical world through the five senses. At first, the information contained in these impulses has no meaning, but, as they continue to stream in, patterns begin to form. Memories of these patterns in the brain and central nervous system begin to build an'internal model' of the external world. The interpretation of this internal model begins with the elders responsible for the infant's care. As the individual grows, all forms of physical and social interactions strengthen the model. This process of building an internal model continues throughout life and becomes a better and better representation of the external world in which the individual lives, ultimately representing the sum total of the person's interactions with the environment. Every individual has a unique, 'subjective' internal model.

The brain has the ability to record events and experiences into memory, and it can recall and analyze those memories with respect to the already existing internal model. I call this *dynamic memory*. All life forms that possess a nervous system are expected to have dynamic memory. Dynamic memory might be thought of as consciousness, however we don't need to define consciousness.

David Chalmers

> *Consciousness poses the most baffling problems in the science of the mind. There is nothing that we know more intimately than conscious experience, but there is nothing that is harder to explain.*

Other things that exist have memory, such as geological features, fossils, books and computers, but these are static memories and they have no ability to recall and analyze. The internal model acts as the ultimate interpreter of all incoming information from the senses.

From this, we can begin to define an observer as any entity that exists and has dynamic memory. To speculate in a meaningful way about the structure of the universe, two other properties are needed, i.e.,1) the ability to communicate, which results in 'entangling' the internal models of individuals, thereby converting subjective internal models to collective internal models and 2) the ability to manipulate the environment. Lower animals might have dynamic memory, but they lack the communication skills necessary to transfer abstract analysis between individuals; only humans have this skill to any extent[1]

Thus a complete definition of an observer is:

> *Any entity constructed entirely of matter and energy, (the attributes of the universe) with dynamic memory and advanced communication skills, as well as the ability to manipulate its environment.*[2]

John Bell noted

> *Is it not good to know what follows from what, even if it is not necessary " for all practical purposes". Suppose for example that quantum mechanics were found to resist precise formulation. Suppose that when formulation beyond " for all practical purposes" is attempted, we find an unmovable finger obstinately pointing outside the subject, to the mind of the observer, to the Hindu scriptures, to God, or even only Gravitation? Would that not be very, very interesting?*

2.2 Existence and Reality

With the human observer defined, the two words, existence and reality, created by this human can be re-examined.

The standard dictionary definitions are :

Existence

> *The fact or state of living or having objective reality*[3]

Reality

> *The world or the state of things as they actually exist.*

A thesaurus may suggests in some ways, that the terms 'existence' and 'reality' can be used interchangeably. The definitions of these two words are circular, i.e., the definition of one depends on the definition of the other. Their use by individuals in their daily activities does not usually cause problems, but care must be exercised when they are applied to the understanding of the universe. Thus, I have redefined the meaning of these two words to eliminate the apparent circular definition, and then explored the impact on physics that these relatively simple changes produce. Why would one undertake such a trivial pursuit in the first place? Two statements made by Einstein provide motivation.

In his memorial notice for Ernst Mach wrote:

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[1]Dolphins may have dynamic memory and the ability to communicate but they lack the ability to manipulate their environment.

[2] It seems quite reasonable that, with a powerful enough computer, left to run continuously and programmed to search for patterns within its memory that are fed by external sensors, dynamic memory might be developed. Such a computer system that runs perpetually already exists, and we call it 'the internet.' If this system were structured to recognize patterns within its memories and with the aid of robots take actions upon those patterns, an 'artificial observer' might be built.

[3] 'Objective' means not influenced by personal feelings of opinions in considering and representing facts.

> *Concepts that have proven useful in ordering things easily achieve such an authority over us that we forget their earthly origins and accept them as unalterable givens. Thus they come to be stamped as necessities of thought, a priori givens, etc. The path of scientific advance is often made impassable for a long time through such errors. For that reason, it is by no means an idle game if we become practiced in analyzing the long-commonplace concepts and exhibiting those circumstances upon which their justification and usefulness depend, how they have grown up, individually, out of the givens of experience. By this means, their all-too-great authority will be broken.* Einstein[Einstein, 1916]

Then in a letter to Robert A. Thornton, Einstein wrote;

> *I fully agree with you about the significance and educational value of methodology as well as history and philosophy of science. So many people today - and even professional scientists - seem to me like somebody who has seen thousands of trees but has never seen a forest. A knowledge of the historic and philosophical background gives that kind of independence from prejudices of his generation from which most scientists are suffering. This independence created by philosophical insight is - in my opinion - the mark of distinction between a mere artisan or specialist and a real seeker after truth.* Einstein[Einstein, 1944]

It is not necessary to redefine the entire definitions of existence and reality; we shall only add definitions for use in connection with physics and leave the colloquial definitions for other applications.

The new definitions I wish to explore are:

Existence

> *As applied to the universe, 'existence' means the universe in its entirety, known parts and unknown parts. Multiverses, if such exist, are but subsets. The processes of the universe are independent of observers. Physical observers are made entirely of matter and energy, and they are part of existence but cannot extract themselves to examine the attributes of existence from the outside.*

Reality

> *'Reality' is an internal mental model, a belief or theory developed by physical observers, concerning how the universe exists. The physical observer, as well as his internal model, are attributes of existence.*

This supports Einstein's remark, "the Moon exists even if it's not being observed." However, this means that imbedded observers can never know the true nature of existence. Since non-imbedded observers do not exist, existence can never be viewed from outside and, thus, can never be known, but the attributes of existence are observable and can be theorized by imbedded observers.

Throughout the remainder of this work, the word; 'reality' always means the internal model of observers; it never means how the universe actually exists. The word 'existence' means the entire universe, including observers and their internal models. The words, 'existence' and 'universe', are occasionally used interchangeably, but as defined, they always mean 'existence.'

There are some parallels to the philosophy of Berkeley[Stanford Encyclopedia of Philosophy, 2004] and others that hold that all that exists is in the mind. However, existence is not denied here. The universe exists independent of observers but has no inherent reality. The universe creates creatures that can impose upon it a reality. These creatures and their collective internal models exist as attributes of the universe.

Thus reality is how we believe the world to be as defined by all known observations and givens of experience. This is labeled science. Science describes observed attributes of the universe that can be repeated and verified by any observer. Reality also can be created by our imagination; this is often called pseudoscience or, sometimes, religion. These are realities that cannot be verified by independent observers but are held as beliefs. New ideas that do not fit with existing ideas and theories are often labeled as pseudoscience.

All knowledge of the universe is intimately dependent on our internal model. Electrical impulses that race through our brain and nervous systems exist but add no information about the universe until they are interpreted by our internal model. It can be said:

"The attributes of the universe become 'real' by virtue of dynamic memory that is itself an attribute of the universe."

As Sir James Jeans observed

> *The universe begins to look more like a great thought than a great machine.*

With these changes we can begin to question some of the basic foundations of physics.

2.3 Cause and Effect

What is meant by cause and effect? In all cases, effect follows cause by definition as interpreted by our internal model. Cause and effect started as a local idea. We manipulate something that is said to be the cause and something happens as a result, i.e., there is an effect. Cause and effect are always interpreted by the memories that exist when other memories arrive. The internal model, through collective reasoning, abstracts these local series of memories into broader attributes of the universe, e.g., an apple falls to the ground (an effect), and universal gravity is deemed to be the cause; thus, causality is invented. The notion of cause and effect begins at the earliest age; for an infant, the memory of crying is already present when the memory of eating arrives. Cause and effect begin to develop in the internal model of creatures with dynamic memory from their earliest moments. Thus, cause and effect are created by our internal model based on its interpretation of connected memories. Cause and effect often form chains, i.e., a house is destroyed (an effect) is chained with a storm (the cause). When the storm is an effect, weather is the cause. When weather is an effect, the sun is the cause. When the sun is the effect, gravity and nuclear energy are the causes. All are interpreted by our collective internal model.

2.4 Time

Time is a series of events recognized and interpreted by existing memories in our internal model. To see this in another way, consider the following thought experiment. Imagine ancient cognitive beings whose only notion of time was based on watching the motion of the sun and stars. Now, imagine all inhabitants are put to sleep for an arbitrary period so that no dynamic memory measures the duration of their sleep. Now, let all be awakened and asked how long they were asleep. They cannot answer this question. They can look at the position of the sun or stars and guess, but this requires a memory of the position of the sun or stars. Even if they remembered the positions, they would have to guess how long they slept, and they could guess a day or many days. They might look around to see if other things have changed, such as the growth of a tree, but this also requires memory of the tree before they went to sleep. There is no way to know without invoking memory. Therefore, we must conclude that time is judged by memory and the internal model. Memories arrive in sequence, and the arrival of a memory is always evaluated by the events already in memory.

Related to this, the brain operates over some range of frequencies. Brains must work through their memories before they can arrive at an interpretation. This manifests itself in the general, but subtle, notion that the young reckon time as slow, whereas the elderly reckon time as fast. The more memories that fill the brain the longer it takes, as reckoned by external clocks, for the brain to process information. During that process, the brain is unaware of the movement of the clock or of the sun. We understand the world by the electrical currents that continually flow through our brains, evaluating sensory inputs by the continuous interaction with our internal model. With the ability to manipulate attributes of existence, we can construct mechanisms that record events. Thus, we invent clocks and believe time to be a fundamental attribute of the universe, whereas time is an invention of our internal model.

2.5 Space

A similar argument can be made about space. Let us think further about the observer. Her or his perception of the world is through five senses; to be more explicit, it includes the entire nervous system. We have already discussed the observer's ability to analyze incoming events and place them in some order based on memories, thus the notion of time is formed.

How does an observer's internal model distinguish space? As the internal model develops from infancy, it comes to model our extremities not just through our eyes but also through tactile senses. One comes to know that an arm can only stretch a limited distance based upon the feeling of muscle tension. Then, this feeds the internal model with a sense of length, although as an infant, length has no meaning. With the help of our communications with our older caregivers, our internal model comes to understand the concept of length.

We learn to manipulate our muscles, thus we learn to walk. Then, we can reach objects that we could only see earlier. This further supports the impression of space in that the collection of electrical signals that move through our brains and nervous systems add to the internal model of the external world. In our youth, we see a ball, and our internal model recognizes the object; signals pass through our nervous systems manipulating our muscles so that we are propelled toward the ball. The feedback through our eyes and the continual analysis by our internal model form the conception of space. We build upon our internal model by constructing rigid rods to measure space and clocks to measure time, but both of these measures are part of reality, although the constructed objects exist. How is this different from a dream? In a dream, all of these effects can occur. How does our internal model distinguish a dream from a non-dream? A dream is an effect, and, upon analysis, our internal model comes to realize that there was a cause, i.e., the act of going to sleep. Thus, our dynamic memory sorts out what we believe to be a dream from a non-dream.

The existence of all attributes, i.e., space, time, momentum, and energy as well as the forces, are not measurable quantities[4] without observers. Thus, all measures of these things are, by definition, reality. It cannot be said that existence does not possess space and time; it can only be said that existence of space and time have no measure. Our reality superimposes on existence a measure that is valid only so far as our instruments allow us to see processes taking place. Extrapolations of our theories beyond actually observed processes transform science into pseudoscience by assuming that we can extract ourselves from the universe to view it from the outside.

Einstein stated in an address at Leiden:

> *There can be no space nor any part of space without gravitational potentials; for these confer upon space its metrical qualities, without which it cannot be imagined at all.* [Einstein, 1920]

And, again, he insisted:

> *A pure gravitational field might have been described in terms of the metric tensor (as functions of the co-ordinates), by solution of the gravitational equations. If we imagine the gravitational field, i.e. the metric tensor functions, to be removed, there does not remain a space of the type Minkowski spacetime, but absolutely nothing, and also no topological space.* [Einstein, 1952]

These are correct statements about the reality of the General Theory of Relativity but not about existence, as is implied. Clearly, these statements imply our internal model cannot imagine space without a measure. What is imagined, according to Einstein, is the attribute of gravitation and not space. The fact that space and time are only properties of reality and do not exist independent of dynamic memory does not imply that they are not useful in the description of existence. Imbedded observers are at a loss to imagine how the

[4] Measurable quantities means by any language, natural or mathematical.

dynamical world exists without resorting to our constructs. Therefore, theories invented with the aid of those constructs are useful, but they limit our understanding of existence.

2.6 Mathematics and the Universe

The physical world is defined in our collective reality by providing a means of measurement, thus anchoring abstract, dynamic memories to quantities that can be analyzed and communicated. This is most effectively done by mathematics, the most fundamental property of which is a system for counting. The logical structure of mathematics is a tool that quantitatively defines the world that our internal model has constructed. Mathematics facilitates the conversion of subjective internal models to collective internal models. It is a communication tool, as are all natural languages.

Existence has no measure. Measureable quantities mean quantities that are measurable by any language, irrespective of whether that language is natural or mathematical. The most that can be said is that existence has attributes that can be observed. The speed of light is thought of as a constant, but that attribute implies a measure that does not exist. The same applies to Planck's constant, the gravitational constant, and all others. All mathematical theories are properties of our internal collective model and are realities. Newton's mathematical laws define force, mass, and acceleration. Maxwell's mathematical laws define charge and electromagnetic fields. Einstein's special and general relativity theories define space, time, and gravitation in the large scale. Quantum mechanics defines the world on the small scale. All these are mathematical realities that attempt to model the attributes of existence.

3 Part II Consequences of this Philosophy

Various aspects of the fundamentals of physics were discussed in Part I. In this part, several theoretical sketches are discussed.

3.1 Structure of the Universe

Suppose all attributes of the universe exist for all '*space and time'* and are defined as commonly done in quantum theory. That is to say that an infinite collection of states, $\{|U >\}$, exist that constitutes the universe. Even though this describes the workings of existence, it is only a model of our reality. It is worth stating again that existence is not knowable, and writing down the total collection of states, $\{|U >\}$, or even imagining those states is our subjective reality and has nothing to do with existence. We cannot make any statement concerning the nature of the collection of states, $\{|U >\}$. The individual states, $|U >$, could be elementary particles or stars; we have no idea. How do dynamics exist in the universe without space or time? It is imagined that dynamics take place in existence by instantaneous jumps from one state to another. Energy and momentum change when jumps occur, thus dynamics without space and time can be imagined.

Heisenberg's notion seems to fit,

> *The atoms or elementary particles themselves are not real; they form a world of potentialities or possibilities rather than one of things or facts.*

3.2 The double Slit Experiment

An experiment was constructed in a laboratory to study an attribute of existence. A barrier that contained two small slits was placed between a light source and screen that was to record the results. The source has a control to adjust the intensity, thus allowing only one source entity at a time to be emitted. The entity travels from the emission point to the screen, and its arrival is registered there. With this simple setup, all that can be known is that an entity left the source and arrived at the screen. How it got there cannot be known because the experiment was not designed to determine that. What the observer sees is a point on the screen, and when many points arrive, an interference pattern is observed. Here, the point must be made that the screen that registers the arrival of entities is not the observer since it is only static memory. The observer must have dynamic memory and is the designer of the equipment and the interpreter of the pattern that appears on the static memory. From past observations, interference patterns are associated with waves.

Furthermore, the experience provided by Compton [Compton, 1926] showed that photons behave like particles when they interact with matter. The experimenter asks how a particle could go through both slits at the same time to produce the interference pattern. That leads the observer to ask how the entity got to the screen. The observer's internal model questions which slit the particle went through; if it went through one slit, where did the interference pattern come from? This imagined scenario is a perfectly natural question based upon the content of the observer's collective internal model. A redesign of the experiment by placing a detector at one of the slits to determine the path of the entity, selects a different subset from the states of the universe, and, when the experiment is run again, a different result is obtained. The point to be drawn here is that the observer selects the subset from the states of the universe when the experiment is designed, the results only can be determined by the selected subset. There is no need to introduce a wave function collapse [Bohr, 1928] when the event is recorded on the static memory or to envision Everett's alternate universe [Everett, 1957] or Cramer's transactional backward-in-time absorber theory [Cramer, 1986].

3.3 Gravitation

Gravitation was the first "fundamental" force to be defined. In the present epoch, our collective reality envisions four fundamental forces from observed attributes of the universe, i.e., electromagnetism, the strong nuclear force, the weak nuclear force, and gravitation. The first three forces appear to have somewhat similar strengths, but the fourth, gravitation, is weaker by many orders of magnitude. Its vastly different strength has no explanation. The weakness of gravitation is a mystery. The three quantized forces, of similar strength, are built on background-dependent space and time, whereas Einstein's gravitation is built on background-independent space and time[5].

Many attempts have been made to quantize gravity, but it has never been accomplished. At present, quantizing the theory of General Relativity is one of the most outstanding problems in theoretical physics. It is possible to show that the structure of General Relativity follows from the quantum mechanics of interacting, theoretical spin-2, massless particles [Feynman, 1995] called gravitons; however, there is no concrete evidence that the attribute of gravitons exist. String theory, superstring theory, M-theory, and loop quantum gravity all depend on the existence of gravitons, and that attribute is vital to the validation of various lines of research to unify quantum mechanics and relativity theory.

I will now sketch a subjective reality model of gravitation. Let us imagine that gravitation is not a fundamental force. This will provide a way to build the attribute of gravity from micro-scale components of the universe. It also will remove the weakness issue. To explain this, imagine that all states, as discussed in section 3.1, are distributed uniformly, i.e., there is maximum disorder. This would be void of any structure, and so the observed attributes of the universe, including observers, would not exist. I will postulate that the root cause of gravitation is the maintenance of a balance of order and disorder of the universe. Assume that

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[5] Background-independent space time means that space and time are dynamical and determined by the theory. Background dependence indicates that space and time are fixed and not determined by the theory.

there are two new operators, an order operator G and a disorder operator $\bar{G}$. As discussed in section 3.1, these operators operate on states of the universe. Further, we postulate that these operators operate continually on random collections of states throughout the universe. For example, a local group of single particle states can be represented as a sum, i.e.,:

$$|\psi> = \sum |\phi_i> \quad (1)$$

A multi-particle state constructed from this collection is

$$|\Psi> = \prod |\phi_i> \quad (2)$$

Then when G operates on the collection of single particle states

$$G|\psi> = |\Psi> \quad (3)$$

it generates a multiple particle state. The order operator G produces more order and higher local energy. If this were the only property, the universe would end up as a large multi-particle state of total order, a condition that is not an observed attribute[6]. The disorder operator, $\bar{G}$, breaks up multi-particles into single particles, increasing disorder and thus decreasing local energy. When $\bar{G}$ operates on multi-particle states it reverses the process:

$$\bar{G}\,|\Psi> = |\psi> \quad (4)$$

I envision that both ordered states and disordered states appear continually and randomly throughout the universe. The random nature of this process will create local density fluctuations that can grow into classical-sized objects.

Before discussing this growth, let us return to the question of energy. It is argued that the Hamiltonian operator that determines the energy does not commute with G or $\bar{G}$; rather, the commutators are:

$$[H, G] = -\Gamma\, G \quad (5)$$

and

$$[H, \bar{G}] = \Gamma\, \bar{G} \quad (6)$$

where Γ is the binding energy that holds particles together and is part of the order-disorder process. The Hamiltonian operator has two parts, i.e., $H = H_\psi + H_\Psi$, such that:

$$H_\psi|\Psi> = H_\Psi|\psi> = 0 \quad (7)$$

To demonstrate this calculation, consider the case in which two isolated protons[7]

$$|\psi> = |\psi_{p1}> + |\psi_{p2}> \quad (8)$$

are bonded together

$$G|\psi> = |\Psi> \quad (9)$$

where

[6] The two conditions, complete disorder and complete order, are not physical, and the universe never reaches either condition.
[7] For simplicity, electric charge and neutrons were ignored.

$$|\Psi> = |\psi_{p1}> |\psi_{p2}> \tag{10}$$

To determine the energy, eq. (9) is operated on by the Hamiltonian operator,

$$HG|\psi> = H|\Psi> \tag{11}$$

Using the commutator, eq. (5) yields:

$$G\,H|\psi> -\Gamma\,\mathrm{G}\,|\psi> = H|\Psi> \tag{12}$$

where

$$H|\psi> = (M_{p1} + M_{p2})c^2|\psi>$$

(13)

Then eq. (12) becomes:

$$G\,(M_{p1} + M_{p2})c^2|\psi> \; -\Gamma\,\mathrm{G}\,|\psi> = H|\Psi> \tag{14}$$

The Hamiltonian operating on the multi-particle state gives:

$$H\,|\Psi> = \mathrm{E}\,|\Psi> \tag{15}$$

where E is the total energy of the combined system. Now, G operate on the single particle states, we get:

$$(M_{p1} + M_{p2})c^2|\Psi> \; -\Gamma\,|\Psi> = \mathrm{E}\,|\Psi> \tag{16}$$

The total energy of the combined system is the sum of the masses of the two protons minus the binding energy. The mass of helium $M_{He} = (M_{p1} + M_{p2}) - \Gamma/c^2$ is less than the combined mass of the two protons, so an energy of Γ is released. This process also can proceed in reverse by applying the Hamiltonian operator to eq. (4):

$$H\bar{G}|\Psi> = H|\psi> \tag{17}$$

This time

$$H|\psi> = E|\psi> \tag{18}$$

and E is now the total energy of the two isolated protons. Now, apply the commutator rule, eq. (6), and get:

$$\bar{G}H|\Psi> \; +\Gamma\,\bar{\mathrm{G}}|\Psi> = E|\psi> \tag{19}$$

Since E of the assembled system is M_{He}c^2, we have:

$$H|\Psi> = M_{He}c^2|\Psi> \tag{20}$$

and eq. (19) becomes:

$$\bar{G}(M_{He}c^2)|\Psi> \; +\Gamma\bar{G}|\Psi> = E|\psi> \tag{21}$$

Now, $\bar{G}$ can operate on the multi-particle state, we get:

$$(M_{He}c^2)|\psi> \; + \Gamma|\psi> = E|\psi> \tag{22}$$

Therefore, the energy reverts to the energy of the two isolated protons, i.e., $E = (M_{p1} + M_{p2})c^2$.
In this sketch, it is imagined that quantum assembly is not a high energy collision process but is analogous to the accretion [Tytell, 2004] of small entities into classical-sized objects. High-energy collisions, we assume, take place when the collection becomes classical in size, i.e., within stars. Further, imagine that order and disorder occur at some steady state rate, and statistical variations in the density of space form the nucleus around which classical-sized objects are built.

Even though it has been argued that there is no space or time in existence, we can continue to use space and time in our reality. This allows us to use the higher local energy to build up increasing order...and accretion...in Einstein's gravitational equation, and, thus, General Relativity continues without alteration. As the multi-states build, the increased energy creates and distorts space-time, which, in turn, increases the incorporation of multiple- and single-state objects further.

To use Einstein's gravitational equation, the energy developed above must be represented as an energy density. To see how this connects with General Relativity, consider a single proton[8] with energy $E_p = M_p c^2$, this needs to be cast in terms of an energy density. Unit analysis can be used as a guide. The mass density can be written as $\rho_M = f^2/G_N$, where G_N is the Newtonian gravitational constant and f is a characteristic frequency. It follows then that the energy density is

$$\rho_E = \frac{{E_p}^2 c^2}{h^2 G_N}. \tag{23}$$

Starting with the metric

$$ds^2 = -Bdt^2 + Adr^2 + r^2 d\theta^2 + r^2 Sin^2\theta d\phi^2 \tag{24}$$

where both A and B are functions of r, and all the off-diagonal terms are zero.
The Einstein's gravitational equation[Weinberg, 1972] can be written as

$$R_{\mu\nu} = -8\pi \frac{G_N}{c^4}\left(T_{\mu\nu} - \tfrac{1}{2} g_{\mu\nu} T^{\lambda}_{\lambda}\right). \tag{25}$$

Then, for a perfect fluid at rest, the gravitational field equations become

$$R_{rr} = -4\pi \frac{G_N}{c^4}(\rho_E - P)A \tag{26}$$

$$R_{\theta\theta} = -4\pi \frac{G_N}{c^4}(\rho_E - P)r^2 \tag{27}$$

$$R_{tt} = -4\pi \frac{G_N}{c^4}(\rho_E + 3P)B \tag{28}$$

For this theoretical sketch, it was assumed that there were no internal velocities or pressure. Combining eq(23) and eqs 26, 27, 28, it is noted that G_N does not appear. Define, $\gamma = \frac{8}{3}\pi(E_p/hc)^2$ and write down the expanded components of the Ricci tensor to get

$$R_{rr} = \frac{B''}{2B} - \frac{B'}{4B}\left(\frac{A'}{A} + \frac{B'}{B}\right) - \frac{A'}{rA} = -\frac{3}{2}\gamma\, A \tag{29}$$

$$R_{\theta\theta} = -1 + \frac{r}{2A}\left(-\frac{A'}{A} + \frac{B'}{B}\right) + \frac{1}{A} = -\frac{3}{2}\gamma\, r^2 \tag{30}$$

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[8] It is assumed that quarks and gluons contribute to the mass of the proton, but their internal motion is ignored at present.

$$R_{tt} = -\frac{B''}{2A} + \frac{B'}{4A}\left(\frac{A'}{A} + \frac{B'}{B}\right) - \frac{B\prime}{rA} = -\frac{3}{2}\gamma\, B \tag{31}$$

To solve for A, write

$$\frac{R_{rr}}{2A} + \frac{R_{\theta\theta}}{r^2} + \frac{R_{tt}}{2B} = -3\gamma \tag{32}$$

This yields a solution for A, i.e.,:

$$A = \frac{1}{1-\gamma\, r^2 + \frac{\kappa}{r}} \tag{33}$$

where κ is a constant of integration. Before we can solve for B we must decide what to do with κ, if we set $\kappa = 0$, we find that the space is divided into two regions about a singularity. The position of the singularity occurs at $r_S = 4.56 \times 10^{-16}$ m, this is interpreted to be the radius of the confinement space occupied by quarks and gluons in the proton. For $r < r_S$, the metric $g_{rr} = A_{in} = 1/(1-\gamma\, r^2)$ does not have a singularity at $r = 0$[9]. For $r > r_S$, the proton has no mass outside r_S, so $\gamma = 0$ and $\kappa = -2G_N M_p/c^2\, r$, therefore $g_{rr} = A_{out} = 1/(1 - 2G_N M_p/c^2\, r)$, as we might expect.[10]

With this configuration, a solution for B is obtained. For $r < r_S$, by writing

$$BR_{rr} + AR_{tt} = -3\gamma\, AB \tag{34}$$

Given A from eq(33) the solution of eq(34) is

$$B_{in} = \sqrt{A_{in}} \tag{35}$$

and for $r > r_S$ we get

$$B_{out} = 1 - \frac{2\, G_N\, M_p}{c^2 r} \tag{36}$$

For the space $r < r_S$. The metric becomes

$$ds^2 = \frac{1}{1-\gamma\, r^2}\left(dr^2 - \sqrt{1-\gamma\, r^2}\; c^2 dt^2\right) + r^2 d\Omega^2 \tag{37}$$

This space approaches flatness, or free space, as $\gamma\, r^2$ decreases. and at $\gamma\, r^2 = 0$ the space is flat. Particles such as quarks in the confinement space $r < r_S$ will "see" an infinite space since the metric $ds^2 \to \infty$, thus quarks will be confined to the inner space. This is consistent with observed attributes, since there are no free quarks. Outside $r > r_S$, the space is the Schwarzschild space.

As order increases and the macro-scale size of the universe increases, the disorder operator appears unable to maintain a balance of order and disorder. Other effects enter to assist in establishing balance, for one, supernovas. Another is the expansion of the universe, consistent with Einstein's gravitational equations, since there are no steady state solutions. As the mass density decreases, due to expansion there is more

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[9] If the quarks have mass, then from eq(23) the mean radius of the quarks can be estimated by using the mean quark rest energy in place of the proton energy, then $\rho_E\, V = Mq\, c^2$. Then from the volume, V the radius can be determined. This works out to be 3.8×10^{-28} meter, for a quark mass of 1.57×10^{-29} kilogram. This suggests that quarks are very small but not point particles.

[10] The outer region has a singularity, usually associated with the event horizon of a black hole, but here it has no physical significance since it is very deep inside the inner region.

space for particle states to occupy, thus disorder increases. Furthermore, as the mass density, given by $\rho_M = f^2/G_N$, decreases, frequency decreases, so distant attributes appear redder. It is not necessary to introduce the Doppler effect. The balance of order and disorder must be maintained, thus more macro-scale objects may have to appear to balance the expansion. The Hubble ultra-deep field images [Beckwith, 2006] are suggestive of this balancing.

The Cosmic microwave background [Penzias, 1965; Smoot Group, 1996], thought to support the big bang, can be understood as a continual interaction of particle states with electromagnetic quanta in the disordered regions distant from classical-sized objects. This suggests that this attribute is not at the fringes of the universe but occurs throughout all of space. In this subjective reality model, the big bang is not needed. Furthermore, accepting the big bang model as an attribute of existence is equivalent to assuming we can extract ourselves from the universe to view it from the outside, contradicting the premise set forth in this paper. Further, in interstellar and intergalactic space, random particle states are more likely to assemble and disassemble at some rate producing a steady state concentration of helium without nucleosynthesis.
This larger concentration of helium was one of the arguments against the steady state universe and was thought to support the big bang.

When discussing processes on the micro-scale, we introduced a characteristic frequency related to mass density as a means of determining energy density. Is the characteristic frequency scale dependent or does it apply to all scales? This can be tested by considering the solar system in which we will assume the characteristic frequency is related to the observed attribute of the planitary orbital period. Table 1 [Fowles, 1962] provides the planetary data that were used in the calculations. The main problem is to determine the mass density. The mass determination is straightforward, and it is the total mass enclosed by the orbit of each planet. For example, the orbit of the Earth encloses four masses, including itself, i.e., $M_{Sun} + M_{Mercury} + M_{Venus} + M_{Earth}$. The volume that encloses this mass is more difficult. Let us assume that Figure 1 shows the volume associated with the mass. The volume is given by:

$$V = \frac{4\pi}{3} a^3(1 - e^2) \tag{38}$$

where a is the semi-major axis, and e is the eccentricity (Table 1). The mass density, $\rho_M = \sum M / V$, is the sum of the masses enclosed by the orbit of each planet divided by the volume created by that orbit. Even though the planetary orbits are in a plane, the total mass enclosed by a particular planet orbit is associated with a volume. This clearly does not fit with our collective internal model; in fact, the entire gravitation theory presented here does not fit, since we have argued that space and time are only parts of our reality and have no measure in existence. Continuing with the calculation, the characteristic frequency for each planet is $f = \sqrt{\rho_M G_N}$. If the characteristic frequency and the orbital period are related, the product will be constant. This is clearly demonstrated in Figure 2 for each planet. Thus, the characteristic frequency is valid on the macro-scale as well as the micro-scale[11]. The perihelion precession of the orbit of Mercury is different from that of the other planets, and this suggests that the volume defined by the orbit of Mercury is equivalent to a zero eccentricity, since the semi-major axis slowly sweeps around the sun, the volume is taken to be $\frac{4\pi}{3}a^3$. This perturbation is included in Figure 2. On the micro-scale, the gravitational constant, G_N, does not appear in the result and is only introduced to satisfy the boundary condition at infinity, which is implicit in the Schwarzschild solution. On the macro-scale, the gravitation constant is clearly a part of the solution.

[11] The Sun does not appear in Figure 2; it has no well-defined orbit in the solar system, but it is included in the mass calculation for each planet.

The force we call gravitation is due to the distortion of space-time as described by Einstein. This distortion, in fact space-time itself, is created by energy. The usual view of Einstein's gravity is that energy tells space and time how to curve and the curvature of space and time tells energy how to move. In this view, energy creates space and time and endows it with a metric, a useful reality.

To repeat Einstein[Einstein, 1920]:

> *There can be no space nor any part of space without gravitational potentials; for these confer upon space its metrical qualities, without which it cannot be imagined at all.*

Most important, in this new underlying philosophy, it is not the true nature of the universe; it is only our collective reality. Our theory is a new way to look at the root cause of gravity. I have added only a brief amount to this gravitation model to indicate that a number of unique attributes of the Universe are contained within it. I will not take the order-disorder concept of what we collectively call gravitation any further at this time, but I believe it has some potential for future study.

4 Conclusions

It has been observed that words carry forth connotations from the past and enter into our thinking in ways that are not easily deciphered. When we attempt to theorize beyond what we can actually observe, we run the risk of carrying forward ancient ideas. Many times, key elements of our theories are passed over and set aside as perhaps belonging to other disciplines. I believe that one such key element is the observer, and others are words that can carry thoughts of our predecessors. In the work presented here, a new definition of physical observer was given. In doing so, changes were found to occur. Our arguments show that memory plays a profound part in how physical observers observe and interpret the world. We drew a distinction between static memory and dynamic memory that can recall and analyze mental content. We concluded that the definitions of existence and reality were circular, with each dependent on the other. We wondered what the consequences of redefining those two words to remove the circular connection would be. It is worth repeating that observers are responsible for all words and languages, including mathematics. The meanings of words weave the thoughts of antiquity in unexpected ways into our modern science and technology. Our evolving internal model is influenced by our language; the meaning of words affect how we, as observers, see the world.

Changing the definitions of existence and reality had a startling impact on the concepts we hold dear. One wonders in what other ways the threads of ancient thoughts are impacting our modern world through the evolution of words and languages. We added a new definition of existence, i.e., *The physical universe exists independent of observers, but entities that exist in the universe that have dynamic memory build a mental model of existence, and that model, as defined, is reality*. We concluded that we will never know how the universe actually exists; we can only observe its attributes and create models and theories as to how it exists. Once the physical observer, existence, and reality were redefined, we found that cause and effect, as well as time and space, were only part of our mental model. Further, we found that mathematics is not an inherent part of existence but is no more than a communication tool that helps us convert our subjective internal model to our collective internal model supported by all those, living or dead, who have contributed to our efforts to understand the Universe.

Finally, we constructed a model of existence, wherein all of the attributes of existence are states analogous to states as defined by quantum theory, and we found a simple explanation for the mysterious double-slit experiment. We also introduced some thoughts on how gravitation might be connected to elementary constituents of the universe, as we presently understand existence. There are many other attributes of existence that we did not addressed. They will be left for future work.

Existence is unknowable and contains aspects of all things that affect the lives of physical observers in ways we have not yet conceived. The internal model of observers is their belief system, be it science or pseudoscience, and it all comes down to a belief system that we construct. In both cases, the subjective internal model can become collective, but only with science is our collective model supported by observable attributes of the universe.

As J. M. Jauch quipped

> *The interpretation of quantum mechanics has remained a source of conflict from its inception. For many thoughtful physicists, it has remained a kind of "skeleton in the closet."*

I hope that this work will crack open the closet door just a bit to let a few photons illuminate the skeleton.

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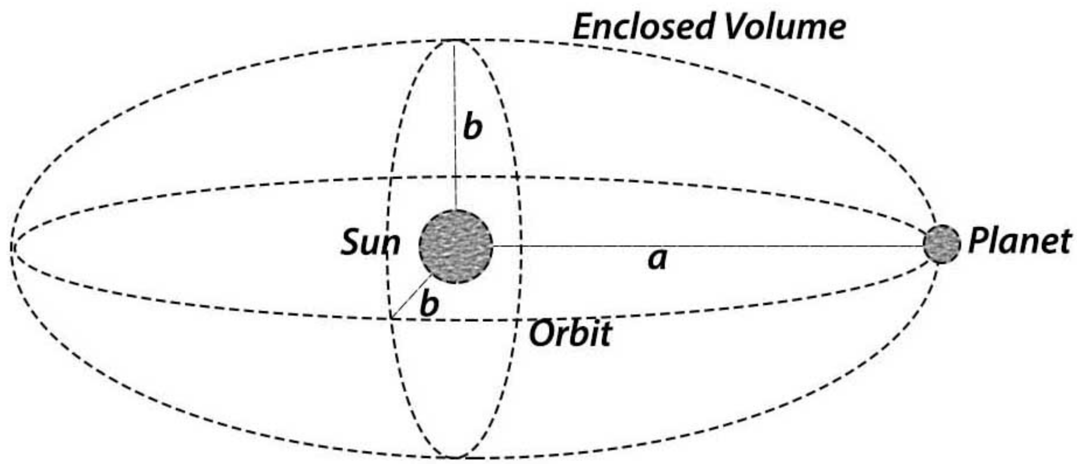

Figure 1 Volume geometry for determining the mass density

Planet	emimajor Axi (A.U.)	Period (Years)	Eccentricity	Mass (Mass of earth)
Mercury	0.387	0.241	0.206	0.05528
Venus	0.723	0.615	0.007	0.81575
Earth	1.000	1.000	0.017	1.00000
Mars	1.524	1.881	0.093	0.10749
Astroid Belt	2.750	4.502	0.000	0.00050
Jupiter	5.203	11.860	0.048	317.92300
Saturn	9.539	29.460	0.056	95.19260
Uranus	19.190	84.020	0.047	14.54100
Neptune	30.070	164.800	0.009	17.15240

Table 1 The orbital parameters of the planets in the solar system, including the asteroid belt, are given relative to the earth. The parameters of the earth are: mass = 5.97×10^{24} kgm, period = 3.1536×10^{7} s and semi-major axis = 1.49669×10^{11} m

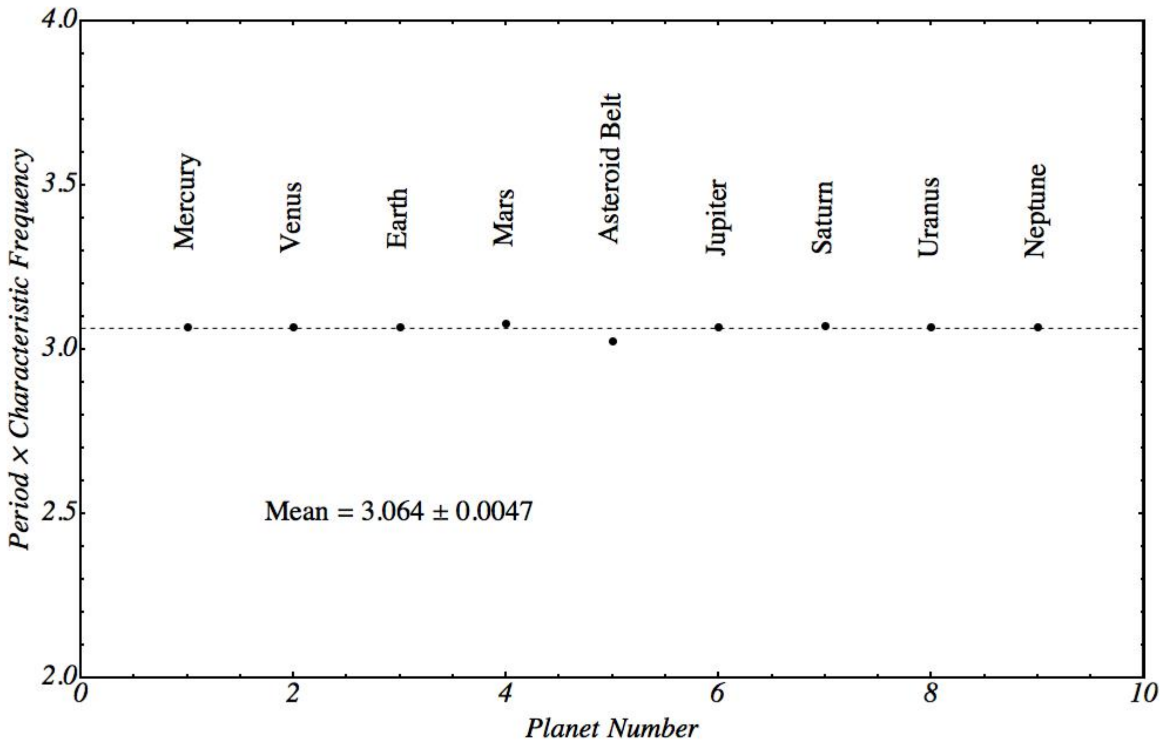

Figure 2 Relation between the characteristic frequency and the period of the planets