The Observer Effect

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Abstract

This paper discusses how an observer, when properly defined, can lead to a different interpretation of the universe by providing a way to connect General Relativity and Quantum Mechanics. First, this was used to investigate the mass of the Milky Way Galaxy, and the result suggests that dark matter does not exist. Then, Hubble's Law was examined, and we were led to the same conclusion, i.e., dark energy does not exist. Finally, the linkage of quantum mechanics and relativity provides another explanation of the cosmic microwave background (CMB) and casts doubt on the Big Bang theory. All of these observations and conclusions were made possible by examining the philosophical foundation provided by a better understanding of how intelligent life forms make sense of the physical world. First, we discuss the intelligent life forms that are responsible for all observations and theories related to the universe. With this new understanding of ourselves, from a physics perspective, a philosophy emerges that alters our understanding of space and time. A theory is developed on this philosophical foundation that provides a way to connect the background dependence of quantum mechanics and the background independence of general relativity.

Keywords: observers, philosophy, space, time, gravitation, Quantum Theory, Milky Way, dark matter, Hubble's Law, dark energy, CMB

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1 Introduction

In ancient Greece, philosophy was the primary discipline for understanding the universe (Graham), and physics was subservient to philosophy. Around the time of Galileo, observations and experiments became primary. Philosophy and physics exchanged places in importance, and this state of our thinking has been predominant until the present time. More recently, consideration has been given to philosophy due primarily to the oddness of quantum mechanics, which began through observational physics. Although physics remains primary, philosophy of the physical universe is developed to complement the physics we have invented from observations and experiments.

The proverbial pendulum has swung to both extremes. We understand that, in all aspects of human existence, a philosophy underlies everything that we do, but, unlike the perception of the ancient Greeks, philosophy is not primary. Instead, it sets the foundation upon which physics and all other human endeavors are built. We cannot understand the universe by either philosophy or observation alone. Our most advanced physics, when pushed far beyond the domain where it can be validated, loses its predictive ability, and we are left effectively with a religion.

In our present understanding of the universe, we have left out the most important ingredient, ourselves. We set the foundation of all our activities and observations, we invent the theories and measure all of the relevant constants, and, then, we validate the theories by experiments and observations. We are the most important factor in our understanding of the universe, and we are left out of our physics. Thus, the purpose of this paper is to bring us into the theories of physics.

The two main theories of the physical world are Quantum Mechanics and General Relativity. Quantum Mechanics provides a very accurate means of studying the micro-scale universe, and General Relativity provides a very accurate means of studying the macro-scale universe. Many attempts have been made to bring them together, most by trying to quantize gravity, but none have succeeded yet. There are many fundamental differences between these two theories. The fundamental difference that I will concentrate on is the structure of space and time. Quantum Mechanics is built on an existing background-dependent scaffolding of space and time, i.e., space and time must exist before quantum mechanics, as we know it, can be developed. In General Relativity, gravity is a result of the linkage of geometry to the physical properties of matter and energy, and, from that, space-time emerges and thus background independence, i.e., gravity does not require the pre-existence of space and time. A linkage of these two different philosophical concepts can be made, once a real observer is fully understood.

The concept of an observer permeates physics, but it is never fully defined. In theoretical physics, the precise meaning of an observer is loosely defined. In classical physics, a hypothetical, non-accelerating observer exists in an inertial system, and the observer usually is characterized by introducing some frame of reference. Once the frame of reference has been constructed, the real observer is extracted or removed. Both Newton's laws of motion and his Special Theory of Relativity, as ?well as Electrodynamics, apply to measurements made by such abstract observers. In Quantum Mechanics, an observer creates a measurement apparatus and selects observables that can be measured. Quantum theory has many possible results, but only one is made real by an observation. There is much discussion about the connection between quantum measurements and consciousness, but this is an erroneous interpretation, that came from the Copenhagen complementarity interpretation of quantum theory (Heisenberg, 1958). Even in error, Quantum theory begins to recognize the necessity of life forms. In the Theory of Relativity the concepts of space and time are altered, both these point to a difficulty with the underlying, or foundational, philosophy. The abstract observer used throughout physics leaves an important ingredient out of our basic understanding of the physical world[1]. I will argue that a full understanding of the physical world must fully recognize the life forms that observe and theorize about the universe. This will put constraints on what can, and cannot, be claimed as observations and how and when theories can be used and interpreted.

2 Intelligent Life Forms as Physical Observers

In this section, first, I will develop the underlying philosophy upon which the theory was developed. This starts with an understanding of the life form that observes and develops these theories. In Longo (2014), the first attempt

[1]The study of human consciousness and the study of the human brain usually are dismissed as belonging to another discipline. A simple generalization is all that is needed to make contact with physics.

was made to develop and apply an expanded version of this section. It is not my intent to undertake a philosophical discourse on the nature of consciousness. However, what I disclose about the nature of physical observers may be related to what we understand as consciousness, but it is not necessary to enter into that conversation. The philosophical writings on space, time, and consciousness are much too voluminous, making them outside the scope of this paper. Interested readers might start with Heisenberg (1958) and Smythies (2003). We are interested in the nature of space and time and how the physical observer influences the understanding of physics.

To discuss my view and definition of the physical observer and how this knowledge might take us to the next level of physical understanding, I will start by considering, for clarity, the birth of a human being. 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. Genetically, parts of the brain may have limited information, and some information may be acquired from within the womb, but those parts do not provide much information the physical world. From the moment of birth, the five senses flood the brain with electrical impulses from the external physical world. 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. As the individual grows, all forms of physical and social interactions strengthen the model. This process of building an internal model continues throughout life, gradually becoming a better representation of the external world in which the individual lives. Ultimately, the model represents the composite of all of the person's interactions with her or his environment. Thus, every person has an internal model that is unique and subjective.

The brain has the ability to record events as memories, and it can recall and analyze those memories with respect to the already existing internal model. I call this dynamic memory. Other existing things also have memory, such as geological features, fossils, and books, but these are static memories, and these things have no ability to recall and analyze. The internal model acts as the ultimate interpreter of all incoming information from the senses.

To speculate in a meaningful way about the structure of the universe, two other properties are needed. One of the properties is the ability to communicate, and this causes people's internal models to become entangled, converting subjective models to collective models. The second property required to advance knowledge is the ability of people to manipulate their environment.

Thus, the following complete definition of an observer is presented:

> *An observer is any entity constructed entirely of matter and energy (the attributes of the universe) with dynamic memory, advanced communication skills, and the ability to manipulate its environment.*

3 Existence and Reality

Language and the meaning of words influence how we think, thus, it is important to have well-defined words (Jaynes, 1976). Having defined the human observer, we must re-examine two other poorly-defined words, i.e., existence and reality, created by this human. The standard dictionary definitions are:

> Existence;
> *The fact or state of living or having objective reality, i.e., being objective; means not influenced by personal feelings or opinions in considering and representing facts.*
>
> Reality;
> *Reality refers to the world or the state of things as they actually exist.*

The definitions of these two words are circular, i.e., the definition of each depends on the definition of the other. Languages fundamentally impact our thoughts, thereby influencing how our internal model interprets observations. The circular definitions of these two words leave both words ill-defined. To make progress, we must have clear and well-defined words that leave no ambiguity in our interpretation of our senses. I will redefine the meaning of these two words to eliminate the circular definition, thus rendering each well-defined[2]. Then, I will explore the impact on physics that these changes produce. The new definitions I will explore are:

[2]There are possibly many ways to define these words, my choice is nothing more then how I see the world.

Existence;
As applied to the universe, existence means the universe in its entirety, i.e., known parts and unknown parts. Multiverses, if they exist, are just subsets. The processes of the universe are independent of observers. Physical observers are made entirely of matter and energy; they are part of existence, but they cannot extract themselves to examine the attributes of existence from the outside, nor can they project themselves to distant locations in the universe to observe properties there.

Reality;
Reality is an internal mental model, a belief or theory developed by physical observers concerning how the universe exists. The physical observer and her or his internal model are attributes of existence.

Physical observers can never know the true nature of existence, since physical observers cannot view the universe from the outside, but the attributes of existence are observable and can be theorized. Logic can bring us closer to a full understanding of existence. All knowledge of the universe is intimately dependent on our internal model. Electrical impulses may race through our brains and nervous systems, but they add no information about the universe until they are interpreted by our internal model. With these changes, we can begin to question some of the basic foundations of physics.

4 Time, Space and Mathematics

4.1 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 an ancient cognitive being whose only notion of time was through watching the motion of the sun and stars. Imagine that everyone was put to sleep for an arbitrary period so that no dynamic memory can measure the duration of their sleep. Now, let everyone be awakened and asked how long they were asleep. This question cannot be answered. They may look at the positions of the sun and stars and guess, but this requires a memory of the previous positions of the sun and stars. They might look around to see if other things had changed while they were asleep, 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. Events arrive in sequence and the arrival of an event is always evaluated by memories that are already present. 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, even though time is an invention of our internal model.

4.2 Space

A similar argument can be made concerning space. Let us think further about the observer. Her or his perception of the world is through five senses; to be more explicit, we must include the entire nervous system. 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 our tactile senses. One comes to know that an arm can only stretch a limited amount based on the feeling of muscle tension. We learn to manipulate our muscles, and we learn to walk. Then, we can reach objects that earlier we could only see. When an athlete sees a ball, the internal model recognizes the object causing signals to pass through the nervous system, which manipulates the muscles, propelling the athlete 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 measurement devices only support our collective reality.

4.3 Mathematics and the Universe

Even if the attributes of space, time, momentum, and energy exist, they cannot be measured without observers. Thus, all measures of these attributes are, by definition, reality. It cannot be said that existence does not possess space and time or momentum and energy; it can only be said that existence has no measure of these. Our reality superimposes on existence a measure that is valid only so far as our instruments allow us to observe processes when they occur. Extrapolations of our theories beyond processes that we actually have observed transform science into non-science by assuming that we can extract ourselves from the universe to view it from the outside or from a distant location. 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 models to collective, internal models. It is a communication tool, as are all natural languages. The most that can be said is that existence has attributes that can be observed.

5 A Physical Description of the Theory

This theory is focused on astrophysics, and it is divided into two parts. The first part is the general nature of the theory, and it is applied to a relatively close astronomical structure, the Milky Way. The second part deals with distant objects, e.g., distant galaxies, as well as Hubble's law and the cosmic microwave background. These are well beyond the domain for which our basic theories have been validated.

To the extent possible, I will attempt to ensure that the theory adheres to this philosophy. Space and time are only part of our minds, and they have no measure in the universe since all that is measured is of our making. In a philosophy that eliminates space and time, everything that physics has developed would have to be discarded. Given our present understanding of the universe, it would stifle any further development. In the theory presented here, all existing physical theories are taken as givens, and they were not modified in any way. We handle these existing theories philosophically by downgrading space and time to invented parameters that then are calibrated by invented tools. This is considered to be the only speculation that is necessary as a starting point. Most importantly, since all theories must be observationally dependent, these theories are constrained, which means that using them to construct models of the cosmos must be limited to the domain in which they have been validated.

However, any further compounding speculations that violate the base philosophy will be questioned. I assumed that any models developed from existing theories are not compound speculations so long as they are not pushed to far beyond where the theory was tested. This definition of observer puts constraints on what can be referred to as observations, it also allows reinterpretation of existing ideas. First, let us ask what can or cannot be considered to be observations. 1) For example, we can know, the types of entities we are observing in distant stars by the structure of spectral lines, and no further assumptions are required since the atomic spectral structure can be determined in our laboratory. 2) We can assume that the distance to observed objects can be measured by some independent means, such as, parallax, variations in Cepheids and luminosity distance. 3) We cannot know that distant radiating objects are the same in all aspects to the equivalent entity in our laboratory, because this assumes that we can project ourselves to the distant location to validate these spectra; therefore, this would be an added speculation. Instead, the observer must be content with observations that are made directly.

As a first step, we will connect background dependence and background independence space and time. This is made easier by appealing to the base philosophy. Since space and time are only artifacts of our mind, they are interpreted by our collective reality, and, further, they have no measures in existence; thus, we are free to reinterpret space and time. All solutions to Einstein's field equations can be constructed mathematically as a manifold embedded into some higher-dimensional Euclidian or Lorentzian, real space and time (Misner et al., 1970), (Paston & Sheykin, 2012). When constructing the manifold, our present collective reality informs us that only on the embedded surface is physics valid, and all points that are not on the surface are not physical. This is where our current collective reality can be reinterpreted. Since space and time are only artifacts of our mind, we propose that all points in the embedded space can have physical meanings.

To make this clear, we used the Schwarzschild manifold and assumed that it is a valid description of galaxies that are not too distant from its confirmed domain. In the Appendix, I will discuss the validity of this assumption. The origin of the embedding space in this case is placed at the center of the galaxy. Now, the embedding Euclidian space will be interpreted as a tangent space. Next, we interpret the tangent space as physically real, i.e., a space and time scaffolding that is background-dependent within which quantum objects reside. Quantum objects are not confined to the point where the tangent space is built; rather they can encompass the entire tangent space. Tangent spaces can be built at any point on the space-time manifold, so, as different objects are observed, they reside in different tangent spaces, and they can be transformed among themselves so that the entire tangent space is background-dependent. Macroscopic collections of matter, stars, collections of stars, large collections of gas, and photons that travel cosmic distances all reside in the background-independent space-time on the manifold[3]. Thus, the entire space is filled with both background-dependent and background-independent spaces. Atoms observed at different points of the manifold will be influenced by the galactic gravitational fields at those points.

This is a very general prescription, and first, we will apply the theory to the mass of the Milky Way to connect it to observations. The concept of dark matter, first speculated by Zwicky (1937) was cemented into our collective reality by Rubin (1980) in the study of the rotation of galaxies. To explain the luminosity of nebula, it seems that more matter is needed than can be obtained from the theory of gravitation. Similarly, the rotation of galaxies need more matter than obtained by gravitation. Furthermore, it is not possible to simulate the formation of galaxies by gravitation with the amount of luminous matter determined by gravitation. Thus, more matter would have to be provided to explain these observations, thus we invent dark matter, or the theory of gravitation must be modified. Altered gravitation is being studied by the modified Newtonian dynamics (MOND) theory (Milgrom, 1983). In the theory presented here, we make the usual simplifications of the model of the Milky Way galaxy by ignoring its spiral arms, assuming that all orbits in the disk are circular, and ignoring the thickness of the disk. We will assume the Schwarzschild spacetime solution models the Milky Way[4] with its primary embedding space at the center of the galaxy.

A reference is needed that must be obtained by constructing a tangent space at the location of the sun, and, for this work, the small difference in the galactic gravitational field between the sun and our laboratories on Earth

[3]Photons that travel cosmic distances do so on the manifold. This is a pragmatic necessity to preserve local validation of general relativity, e.g., that light bends near the sun.

[4]The Schwarzschid solution was used even though it has not been validated at the distance of our galaxy; this issue is addressed in the Appendix.

is ignored. The sun's tangent space is unique in the sense that the galactic gravitational field at the sun is where we live, where we have built all of our physical theories, and where we have measured all of the relevant constants. So to us, it is a unique place in the universe. At any other point on the manifold, quantum properties are modified by a scale factor that depends on where the atom is located, and this modifies the observational measurements. Then, the first question that must be answered is; does a scale factor affect the properties of quantum systems?

6 The Effect of a Scale Factor on Quantum and Classical Properties

The application of the theory to the rotation curve of the Milky Way is assumed to be circular orbits in the disk of the galaxy, therefore the coordinate $\theta = \pi/2$ and because of the symmetry, no scale change in ϕ is expected. Only the radial coordinate is affected by the scale factor.

6.1 Dirac's relativistic Hydrogen Atom

The probability amplitude for the radial coordinate (Bjorken, Drell, 1964), (Messiah, 1962), are given by

$$\frac{\partial F(r)}{\partial r} - \frac{\kappa F(r)}{r} = (\frac{mc^2 - E}{\hbar c} - \frac{\alpha}{r})G(r), \tag{1}$$

and

$$\frac{\partial G(r)}{\partial r} + \frac{\kappa G(r)}{r} = (\frac{mc^2 + E}{\hbar c} + \frac{\alpha}{r})F(r). \tag{2}$$

Where $\kappa = \pm(j+1/2)$, and α is the fine structure constants. If σ is the scale factor that depends on the galactic radial, then, in the tangent space, the quantum radial r is replaced everywhere by σr, including the arguments of the probability amplitude functions, F and G. After some algebra, this gives:

$$\sigma\frac{\partial F(r)}{\partial r} - \frac{\kappa F(r)}{r} = (\sigma\frac{mc^2 - E}{\hbar c} - \frac{\alpha}{r})G(r), \tag{3}$$

$$\sigma\frac{\partial G(r)}{\partial r} + \frac{\kappa G(r)}{r} = (\sigma\frac{mc^2 + E}{\hbar c} + \frac{\alpha}{r})F(r). \tag{4}$$

Following the usual calculations, let $k_1 = \frac{mc^2+E}{\hbar c}$, $k_2 = \frac{mc^2-E}{\hbar c}$ and $\rho = \sqrt{k_1 k_2} r$. Substituting these into equations 3 and 4, we get:

$$\sigma \frac{\partial F(\rho)}{\partial \rho} - \frac{\kappa F(\rho)}{\rho} = (\sigma \sqrt{\frac{k_2}{k_1}} - \frac{\alpha}{\rho}) G(\rho), \tag{5}$$

$$\sigma \frac{\partial G(\rho)}{\partial \rho} + \frac{\kappa G(\rho)}{\rho} = (\sigma \sqrt{\frac{k_1}{k_2}} + \frac{\alpha}{\rho}) F(\rho). \tag{6}$$

The solution is obtained in the usual way by assuming series in ρ, $F(\rho) = e^{-\rho} \Sigma a_m \rho^{s+m}$ and $G(\rho) = e^{-\rho} \Sigma b_m \rho^{s+m}$. After considerable algebraic manipulation, the eigenvalues of energy are obtained:

$$E_{n,j} = \frac{mc^2}{\sqrt{1 + \frac{(\alpha/\sigma)^2}{(n + \sqrt{\kappa^2 - (\alpha/\sigma)^2})^2}}}. \tag{7}$$

The atomic energy states are dependent on the scale factor, σ, at the gravitational point where the tangent space is constructed. Thus, a spectral shift can occur even if the relative velocity is zero. Furthermore, the fine structure constant is the only constant that is affected. In this theory, it seems that gravity couples to the electric charge. The eigenvalues of the non-relativistic energy can be obtained by an expansion of equation (7),

$$E_n = -\frac{mc^2 \alpha^2}{2n^2 \sigma^2}. \tag{8}$$

6.2 The Hyperfine 21-cm Radiation from Hydrogen

In astronomy, 21-cm radiation is used often. The hyperfine interaction (Bjorken, Drell, 1964) between the proton and the electron is given by:

$$H_{int} = -\mu_{\mathbf{e}} \cdot \mathbf{B}(\mathbf{r}). \tag{9}$$

Where $\mu_{\mathbf{e}}$ is the intrinsic magnetic moment of the electron. Since the electron is a point particle with no internal parts it is given by

$$\mu_{\mathbf{e}} = -\frac{e}{2m_e c} \mathbf{S}_{\mathbf{e}}. \tag{10}$$

The proton is not a point particle; it has internal parts, i.e., quarks and gluons, so it is reasonable to assume that orbital motion is involved. To get the magnetic moment of a proton, we start from the classical definition of the magnetic moment (Jackson, 1963).

$$\mathbf{m}(r) = \frac{e}{2c}\mathbf{r}\times\mathbf{v}, \tag{11}$$

where $\mathbf{v}$ is the orbital velocity and $\mathbf{r}$ is the radius of the orbit. With the replacement of $\mathbf{r}$ with $\sigma\mathbf{r}$ and $\sigma\mathbf{r}\times\mathbf{v} = \sigma g_p \mathbf{I_p}/m_p$, we get

$$\mu_{\mathbf{p}}(r) = \sigma\frac{|e|}{2m_pc}g_p\mathbf{I_p}. \tag{12}$$

Where $\mathbf{I}$ is the proton spin and g_p is the proton gyromagnetic ratio. The magnetic field generated by the proton is

$$\mathbf{B}(r) = \frac{2}{3}\sigma\frac{|e|}{2m_pc}g_p\mathbf{I_p}\delta(\sigma r). \tag{13}$$

The shift in the energy level is given by $\Delta E_n = \langle\Psi_n^*(\mathbf{r})|H_{int}|\Psi_n(\mathbf{r})\rangle$, to first order is

$$\Delta E_n = \sigma\frac{1}{6}\frac{e^2 g_p}{m_e m_p c^2}\mathbf{S_e}\cdot\mathbf{I_p}4\pi\int(\sigma r^2)d(\sigma r)\Psi_n^*(\sigma r)\delta^3(\sigma r)\Psi_n(\sigma r). \tag{14}$$

In spherical coordinates the delta function becomes $\delta^3(r) = \delta(r)/r^2$ and $\delta(\sigma r) = \delta(r)/\sigma$. The integral become $|\Psi_n(0)|^2$ and appears to be independent of σ but there is a σ dependence[5] and $|\Psi_n(0)|^2$ becomes

$$|\Psi_n(0)|^2 = \frac{1}{\pi}\frac{1}{(\sigma a_B)^3}. \tag{15}$$

Replacing the integral in equation (14) with equation (15) the energy level shift is then:

$$\Delta E_n = \frac{m_e c^2}{\sigma^2}\frac{2}{6}\alpha^4 g_p(\frac{m_e}{m_p})\mathbf{S_e}\cdot\mathbf{I_p}. \tag{16}$$

With transitions between the singlet state $\mathbf{S_e}\cdot\mathbf{I_p} = +(1/2)\hbar$ and the triplet state $\mathbf{S_e}\cdot\mathbf{I_p} = -(3/2)\hbar$ the splitting of the two states becomes

[5] The σ dependence can be seen from the Bohr model; using the centripetal force balance between electrons and protons and the quantized angular momentum yields $r = n^2(a_B)$. It follows that, when we replace r with σr, we get σa_B.

$$\delta_n = \frac{4}{3}\frac{m_e c^2}{\sigma^2}\frac{g_p \alpha^4}{n^2}(\frac{m_e}{m_p}). \tag{17}$$

For $n = 1$ and setting $\sigma = 1$ for our laboratory measurement, this yields 21-cm radiation. At a distant location, the emitted radiation is different by σ^{-2}, the same factor as for neutral hydrogen.

6.3 Maxwell's ElectroMagnetic Equations

Photons originate from atomic transitions or microscopic exchange of photons that produces the force between particles. Exchange photons are considered here as short-range phenomena, and they remain in the tangent space. Photons that escape the radiating atomic system and travel cosmic distances obey space-time rules, as mentioned above. We shall only consider the photons that travel cosmic distances from their origins to our telescopes. These photons originate in the tangent space of the observed object, so they are affected by the gravitational field at the origin point. To determine the effect, we proceed along the same lines as for the Dirac equation. The radial, coordinate r of the electromagnetic field at the point of origin is replaced by σr, including the arguments in the E and B fields. The curl components of the electric fields, $\bigtriangledown \times \mathbf{E}$, are in spherical coordinates, and we find that there remains a dependence on the scale factor σ. The components are given by:

$$(\bigtriangledown \times \mathbf{E})_r = \frac{1}{\sigma}(\frac{1}{r\sin\theta}\frac{\partial}{\partial\theta}(\mathbf{E}_\phi \sin\theta) - \frac{1}{r\sin\theta}\frac{\partial \mathbf{E}_\phi}{\partial\phi}), \tag{18}$$

$$(\bigtriangledown \times \mathbf{E})_\theta = \frac{1}{\sigma}(\frac{1}{r\sin\theta}\frac{\partial \mathbf{E}_r}{\partial\phi} - \frac{1}{r}\frac{\partial}{\partial r}(r\mathbf{E}_\phi), \tag{19}$$

$$(\bigtriangledown \times \mathbf{E})_\phi = \frac{1}{\sigma}(\frac{1}{r}\frac{\partial}{\partial r}(r\mathbf{E}_\theta) - \frac{1}{r}\frac{\partial \mathbf{E}_r}{\partial\theta}). \tag{20}$$

These three equations are repeated exactly with $\mathbf{E}$ replaced by $\mathbf{B}$. Then, we can determine the Maxwell equations at the distant location

$$\bigtriangledown \times \mathbf{E} = -\frac{\sigma}{c}\frac{\partial \mathbf{B}}{\partial t}, \tag{21}$$

$$\bigtriangledown \times \mathbf{B} = \frac{\sigma}{c}\frac{\partial \mathbf{E}}{\partial t}. \tag{22}$$

The divergent equations, i.e., $\bigtriangledown \cdot \mathbf{E} = 0$ and $\bigtriangledown \cdot \mathbf{B} = 0$, are unaltered since no charge density or current density is present. This suggests that the speed of light is altered by the gravitational field at the launching point. Once the electromagnetic fields are launched, they travel cosmic distances on the space-time manifold, and remain unchanged, as expected from General Relativity, until they are intercepted by our instruments. Exchanged photons remain locally in the tangent space and are not affected by σ.

6.4 Spectral Shift

The spectral shift is a measurable quantity, and it is related to the scale factor that modifies quantum mechanics by their location in space-time., i.e., the tangent space on the manifold folds gravity into quantum mechanics. The spectral shift is defined as:

$$Z = \frac{f_{emitted} - f_{received}}{f_{received}}. \tag{23}$$

In our current collective reality, it is assumed that $f_{emitted}$ is the same as the frequency measured in our laboratory. In this theory, the emitting frequency is dependent on the local gravitational field. The basic premise of this theory is that we cannot transport ourselves to the point of emission to check this assumption; we can only know what we can see or measure, so we must have:

$$Z = \frac{f_{lab} - f_{received}}{f_{received}} = -1 + \frac{f_{lab}}{f_{received}}. \tag{24}$$

This is, in fact, what we currently do by assuming that the emitting atoms are the same as in our laboratory. The difference is in the received frequency, which is the lab frequency modified by the scale factor of the local gravitational field at the point of emission. Assuming we are observing hydrogen, then:

$$f_{received} = \frac{mc^2\alpha^2}{2h\sigma^2}(\frac{1}{n^2} - \frac{1}{m^2}) = \frac{f_{lab}}{\sigma^2}. \tag{25}$$

Therefore, the spectral shift Z is a simple function of the scale factor σ:

$$Z = -1 + \sigma^2. \tag{26}$$

Then, the scale factor is a measurable quantity in terms of Z:

$$\sigma = (Z + 1)^{1/2}. \tag{27}$$

This theory produces a spectral shift independent of any motion. It does not eliminate a contribution due to motion, i.e., the Doppler effect, but we consider the Doppler shift to be smaller, since the Doppler effect is not a part of the theory but an add-on speculation. The Doppler effect for galactic rotation, for example, is appropriate since orbital motion can be inferred from other observations.

7 The Scale Factors for the Determination of Mass

The determination of the mass of the Milky Way is the primary concern. To determine the mass of the Milky Way, we follow the lead of the Einstein field equations, where geometry is determined by physical properties. This suggests there is a scale factor determined by geometry $\sigma = \sigma_{geometry}$, and a scale factor determined by physical properties $\sigma = \sigma_{physical}$, and that the geometric scale factor and the physical scale factor are be equated. The geometric part is straightforward, since the metric tensor scales the proper length to the coordinate length. Since our interest is only the radial metric tensor component of the Schwarzschild metric, the σ_{geo} is taken to be

$$\sigma_{geo} \equiv \frac{ds}{dR} = (1 - \frac{g}{R})^{-1/2}, \tag{28}$$

where we have taken $g = \frac{2GM}{c^2}$.

The structure of σ_{phy} is not as clear. If we consider the potential energy as the appropriate physical quantity, in our present collective reality, we know that the gravitational potential energy of an atom is about 40 orders of magnitude smaller than the electric potential energy for the atom. However, this is not the correct comparison.

The electric potential energy is obtained by taking a charge from infinity to the electron orbital of interest and comparing that to the gravitational potential energy obtained by taking an electron from infinity to the proton that is held in a galactic orbit by the total mass inside that orbit. This is more appropriate, and the ratio of these two potential energies is on the order of one.

The electric potential energy is obtained by integrating the force on the charge brought in from infinity to the orbital in question:

$$V_e = -\alpha\hbar c \int_{\infty}^{r_{n,l}} \frac{d(\sigma r)}{(\sigma r)^2}, \tag{29}$$

where $r_{n,l}$ is the atomic radius of the orbital, given by

$$r_{n,l} = \langle \psi_{n,l} | r | \psi_{n,l} \rangle = n^2 a_B (1 + \frac{1}{2}(1 - \frac{l(l+1)}{n^2})). \quad (30)$$

The Bohr radius a_B is given by $a_B = \sigma \frac{\hbar}{\alpha m c}$, see footnote 5. If we take $l = 0$, the electric potential is

$$V_e = \frac{2\alpha^2 m c^2}{3n^2 \sigma^2}. \quad (31)$$

The gravitational potential energy of an electron brought in from infinity to the galactic orbit that the observed atom follows gives:

$$V_G = -GMm \int_{\infty}^{R} \frac{d(\sigma r)}{(\sigma r)^2}, \quad (32)$$

or

$$V_G = -\frac{GMm}{\sigma R}. \quad (33)$$

where M is the total mass of the galaxy inside the orbit that the observed atom follows, and m is the mass of the electron. Viewed in this way, it is meaningful to take the ratio of the electric potential to the gravitational potential. From the ratio of equation (31) and equation (33), we get the physical scale factor:

$$\sigma_{phy} = \frac{4\alpha^2}{3n^2 \sigma} \frac{R}{g}. \quad (34)$$

Equating with the geometric scale factor, $\sigma_{geo}(R)$, equation (28) with equation (34), gives

$$(1 - \frac{g}{R})^{-1/2} = \frac{4\alpha^2 R}{3n^2 g \sigma}. \quad (35)$$

Solving equation (35) for g gives

$$g^{\pm} = 2(\frac{2\alpha^2}{3n^2})^2 \frac{R}{Z+1}(-1 \pm \sqrt{1 + (Z+1)(\frac{3n^2}{2\alpha^2})^2}). \quad (36)$$

Take the positive root, and, using the Balmer series, $n = 2$, the fine structure constant $\alpha = 7.297 \times 10^{-3}$ and in the Milky Way $Z \ll 1$. We find that g is a linear function of R. The galaxy's mass increases linearly with the galactic radius, and this means that the rotation curve is flat, as observed.

8 Mass Calculation of the Milky Way

The mass of the luminous disk of the Milky Way is thought to be 4.6×10^{10} to 6.4×10^{10} plus gas that adds between 10% and 15% of the star mass (Phelps et al., 2013, Kafle et al., 2014; Licquia & Newman, 2013). Our present collective reality fixes the total mass of the galaxy, including dark matter, between 0.5×10^{12} to 1.5×10^{12} solar masses (Xue, 2008) and between $8. \times 10^{11}$ to 4.5×10^{12} solar masses (McMillan, 2011). The lower limit necessary for galaxy formation by gravitation is $3. \times 10^{11}$ solar masses (Amblard et al., 2011). The mass of the disk, at a radius of 15 kpc, calculated using equation (36), is 2.75×10^{12} solar masses, which is within the range of masses quoted in the literature that includes dark matter and also above the lower limit for galaxy formation. This suggests, at least due to the unusual rotation curves, that the introduction of dark matter is not only added speculation but also may not be needed. If our calculation defines the extent of the galaxy proper, then, beyond 15 Kpc the mass will remain constant and the gravitational energy will decrease as $1/\sqrt{R}$.

8.1 Super Massive Black Hole

If we push this result back toward the center of the galaxy, what will we find for the super massive black hole? Our present collective reality gives a galactic radius for the black hole of 1.54×10^{-5} Kpc and a black hole mass of 2.61×10^{6} solar masses (Genzel, 2004; Ghez, 2004). With the theory developed here and using the same galactic radius for the black hole, we get a mass of 2.83×10^{6} solar masses.

9 Hubble's Law

Attempts to understand Hubble's observations theoretically have extended general relativity well beyond its tested domain. Add to this space and time that are artifacts of our mind based on our philosophical underpinning, the use of general relativity to interpret Hubble data is questionable. Therefore, there is no way to provide a fundamental theoretical understanding of his law. At this time, all we can do is use Hubble's observed data to build an empirical theory in this cosmic domain. Starting with Hubble's observation, we have the measured spectral shift Z, when plotted against the expected distance R_0, measured in some independent way, to the object under observation gives a straight line given by:

$$Z = \frac{H}{c} R_0. \tag{37}$$

This is known as Hubble's law, where H is the Hubble constant, and c is the speed of light. In the theory developed here, the spectral shift Z is given by equation (26), and, from section 6.3, the galactic gravitational field modifies the speed of light by the scale factor at the point of origin[6]. This modifies the expected distance by:

$$R_1 = R_0 \sigma, \tag{38}$$

where c is now our Earth measured value. Using equation (27) for σ we get:

$$R_1 = R_0 (Z + 1)^{1/2}. \tag{39}$$

The distance to the object appears greater, i.e., the object is further away than expected from equation (37). Consequently, when we plot (R_1, Z), we find that, for a given Z, the curve bends away from Hubble's law. In our current collective reality, this suggests the acceleration of what is thought to be an expanding universe, and, thus, we had to invent the mysterious dark energy.

10 Cosmic Microwave Background

The cosmic microwave background, in our present collective reality, is thought to be evidence for the big bang theory, which describes the creation of the universe. It is said to definitively support the expansion of space, consistent with general relativity, from a primordial singularity. It eliminates the competing steady state theory that held that the universe is eternal and has no beginning and no end. The greatest difficulty with the steady state universe is related to the fact that general relativity does not support a solution that is independent of time, meaning that matter had to be created continuously to fill in the void left by the expansion of space. A difficulty brought to light by the underlying philosophy is the validity of the domain of all our created theories. Thus, building models of the entire universe and its creation or

[6]The speed of light is used in many equations, but it is modified by the scale factor only when information is transmitted over cosmic distances.

end is fun, but it is a meaningless exercise. Theories are only valid in or near the domain in which they have been tested.

As discussed earlier, a general relativity solution that describes the space-time of a galaxy can be built as a manifold embedded in a higher-dimensional Euclidian space and a tangent space can be built at every observed object in space-time. In these tangent spaces, which are background dependent, quantum objects reside. Since all tangent spaces overlap, the entire space can be thought of as consisting of both background-dependent and background-independent spaces with each having its own rules. This interpretation follows from the underlying philosophy, since, as was stated above, both space and time are just artifacts of our minds, space and time can be reinterpreted.

Quantum objects behave in unusual ways; free quantum entities cannot be localized but can be anywhere in space, and, in this case, they are in the tangent space. This is due to superposition and the uncertainty principle (Heisenberg, 1958). as well as the (de Broglie,1924) principle. It is not valid to ask how a free object got to where it might be observed or how long it took to get there[7]. Thus, if we focus our instruments onto some distant, seemingly-void space between galaxies, we will observe microwave radiation. So, this radiation is found everywhere in the visible universe. Both massed, Baryons and leptons, and massless photons will be present. Massed quantum objects in any observed local volume are always in thermal equilibrium with the massless background radiation. The entire universe is in thermal equilibrium. With the acceptance of thermal equilibrium, we can follow the alternative derivation of the black body spectrum (Einstein, 1916); also, see Powell and Crasemann (1961). The equation of thermal equilibrium between electromagnetic radiation and the massed intergalactic quantum objects is given by:

$$(A_{12} + B_{12}u_f)e^{-E_2/kT} = B_{21}u_f e^{-E_1/kT}. \tag{40}$$

Where A_{12} is a spontaneous transition probability from state 2 to state 1, the absorption probability from state 2 to state 1 is $B_{21}u_f$ and the induced emission probability from state 1 to state 2 is $B_{12}u_f$. Setting $E_2 - E_1 = hf$ and applying detail balance, $B_{12} = B_{21}$ then solving for the radiation density

[7]To be consistent with the Copenhagen interpretation, an initial observation fixes the position of the object, whereas subsequent observations only can be determined by probability. We assume that the nearest macro object fixes the initial position, and, by providing photons that scatter from the dispersed matter, also fixes their final location.

u_f that bathes the massed quantum objects in the observed volume we get

$$u_f = \frac{A_{12}/B_{12}}{e^{hf/kT} - 1}. \tag{41}$$

Setting $A_{12}/B_{12} = 2hf^3/c^2$ gives the planck black body radiation curve

$$u_f = \frac{2hf^3}{c^2}(e^{hf/kT} - 1)^{-1}. \tag{42}$$

In particular, if we set our receiving instruments to the microwave frequencies, we will observe a black body spectrum that is indistinguishable from what is called the Cosmic microwave background. Since the Cosmic Microwave Background data are valid observations, the temperature of 2.727 K remains valid. In this theory the entire universe is a perfect black body, with heat sources distributed randomly throughout. Actually, we are not viewing a spherical volume; we are viewing along the axis of a long cone determined by the aperture of our instrument. The quantity of both massed particles and photons are so rare it takes many Mpc of accumulation to observe the effect.

11 Conclusions

The conclusions in this paper are directly dependent on how the human brain understands the world. This in turn modifies observations and theories of the universe from existing concepts. It was not necessary to have a detailed understanding of the human brain; just a simplified abstraction of consciousness got us started along this path. Recognizing that when mental activities are dealing with abstract subjects, they lean heavily on the meaning of words, and this resulted in forcing a change in the meanings of two poorly-defined words, i.e., existence and reality. As a result, it has followed that time and space are only artifacts of the human mind, and this gave us freedom to reinterpret time and space in the theories of the universe. This freedom modifies the concepts of what we believe to be the physics of the universe. In our current collective reality, we believe space and time to be real, so we invent theories using these concepts. These theories have brought us a long way in understanding the universe, but it is the hope that a full understanding of ourselves will take us to the next level.

To initiate the theory discussed herein, some compromises were necessary, because a philosophy that eliminates space and time would require that everything developed previously in physics would have to be discarded. Given our present understanding of the universe, it would stifle any further development. The theory that was developed included one major exception, i.e., that all of the present theories of physics are valid as of this epoch, and none of them were modified. This was considered to be the only speculation that was necessary as a starting point. The quantities of space and time in these theories are thought of as useful variables. Accepting the philosophical concepts that space and time are only in our collective reality, a reinterpretation of what we think of as space and time is then allowed, that in turn allows a connection between gravitation and quantum mechanics in a way not heretofore considered. When applied to the Milky Way the mass of the rotating disk has a mass equivalent to the expected mass of the entire galaxy, including dark matter, and is above the minimum mass needed for galactic formation by gravitation. That means that beyond the luminous disk the mass will be constant and the gravitational energy will falloff as $R^{-1/2}$.

Further out in the cosmos, the Hubble Law, for example, is far removed from the tested domain of existing theories. Using them to interpret these laws is unreliable and, from a philosophical perspective, converts science into non-science. The only thing we can do is to use the observed data directly to develop simple, pragmatic models with the hope that they will point the way to more advanced theories. The creation of the universe from a primordial singularity is so far removed from the tested domain of general relativity that it cannot be considered reliable from either philosophical or scientific perspectives.

As with all good theories, a means must be available for testing them against valid observations. There are two possible tests for this theory, i.e., 1) if different hydrogen series can be observed for a given object, this may provide an experimental test and 2) the absolute value of the speed of light has not been measured as originating from distant stars, to my knowledge. Once an electromagnetic field is launched and travels cosmic distances, we expect it to remain unchanged until it is intercepted by our instrumentation; thus, we should obtain a measure of the scale factor, which will aid in the development of new theories. Since tangent spaces define a manifold, it is reasonable to assume that a manifold can be constructed from an experimental set of a large number of scale factors.
We believe that another interesting result In our present collective reality is that the macroscopic universe is built from microscopic matter. This theory suggests that microscopic matter is altered by the macroscopic universe.

Could matter even be created? I look upon this theory as an intermediate step in the development of the basic theory of the universe; in some sense, it is analogous to the intermediate theory of the Bohr atom between the classical and quantum theories.

12 Appendix

12.1 The Validity of the Schwarzschild space

It was assumed that Einstein's theory with the Schwarzschild solution is a valid description of the Milky Way galaxy, even though it is somewhat outside the tested domain. The use of the Schwarzschild space and the scale factors produced a galactic mass that increases linearly with distance from the center of the galaxy. Thus, the rotation curve was found to be flat, as noted in section 7. The question remains concerning the validity of the Einstein field equation as a description of the galaxy. This possibly can be tested by using of the Robertson expansion (Weinberg, 1972). By expanding the metric coefficients g_{rr} and g_{tt} in the small parameter g/r, and introducing constant factors. Thus we obtain

$$g_{rr} = A(r) = 1 + 2\gamma \frac{g}{r} + ..., \tag{43}$$

and

$$g_{tt} = B(r) = 1 - \frac{g}{r} + 2(\beta - \gamma)\frac{g^2}{r^2} + ... \tag{44}$$

For a particle that is moving slowly in the weak field approximation. The free fall equations give the rate of rotation:

$$\frac{d\phi}{dt} = (\frac{1}{2r}\frac{dB(r)}{dr})^{1/2}. \tag{45}$$

To test the rotation we assume a fixed orbit at $r = r_0$ so that the total mass inside the orbit is fixed. Differentiating equation (44), keeping the mass constant and multiplying by r, then using equation (36), we obtain the rotational velocity:

$$V_{rot} = c(\frac{1}{2}\frac{g(r_0)}{r}(1 - \Delta(\frac{1}{2}\frac{g(r_0)}{r}))^{1/2}, \tag{46}$$

where $\Delta = (\beta - \gamma)$ and c is the speed of light. If $\beta = \gamma = 1$, then the Einstein field equations are correct for this application; if any of the dimensionless parameters have values other than 1, the field equation will be different from Einstein's field equations[8]. If $\beta = \gamma$, equation (46) becomes:

$$V_{rot} = c(\frac{1}{2}\frac{g(r_0)}{r})^{1/2}. \tag{47}$$

Using equation (36) for $g(r_0)$ and selecting the position of the sun at $r_0 = 8.0$ Kpc from the galactic center for the test, equation (47) gives 595.4 kms^{-1} for the velocity of the sun. Assuming the velocity of the sun is 216 kms^{-1} given by independent measurements (Schmidt, 1965), then equation (46) gives a value for Δ of 2.45×10^{-6}. This small value for Δ means that both β and γ are close to each other, but they are not necessarily 1. If this argument is correct, the field equation from Einstein's theory may not be valid if $\beta \approx \gamma$ but much different from 1, since equation (43) will not be a solution. If $\beta \approx \gamma \approx 1$, then Einstein's theory may not be strictly valid, but it may be a good approximation. However, at this time, we cannot make a definitive judgment as to the validity of Einstein's theory when used to study the Milky Way.

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[8] There is also a parameter, α, that is not shown here because it cannot be tested using gravitation to determine mass.

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