A Toy Gravity Universe and The Quantum Graviton

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Abstract

Beginning with a gravity gedanken experiment; this paper predicts a null result for CERN [31]'s upcoming antimatter free-fall gravity experiment. That prediction that antihydrogen will neither fall up nor down in Earth's gravitational field; builds out into a Toy Gravity Universe which has subtle repulsive gravitational force and leads to the definition of the quantum graviton.

After 100 years, there is no agreed upon merger of gravity and the quanta. Something obvious has been missed. There is no such thing as an obvious gravity experiment. Yet views such Dragan Slavkov Hajdukovic[32] are common, "An amusing (while non-scientific) question is why so many great experimentalists waste significant time on experiments whose outcomes are known in advance (according to the nearly unanimous prediction of theorists, antimatter must fall in the same way as matter)." That certainty needs to be loosened.

A minority of theorists believe that antimatter falls up. Virtually none support my view that antimatter falls neither up nor down in Earth's gravitational field. In my mind a null result holds the key to defining the quantum graviton as this Toy Gravity Universe will do.

This Toy Gravity Universe is built without changing standard equations physics, the constants of nature, or disagreeing with the physical evidence. With these constraints, building a Toy Gravity Universe is achieved by reinterpreting concepts, theories and equations with reason applied to physical evidence and insight.

This Toy Gravity Universe is composed of subUniverseR (i.e. our visible universe) and subUniverseI, which has imaginary number dimensions and is CPT symmetric to subUniverseR. These two subUniverses are large enough, finite, non-inflating 3-spheres related mathematically by T-duality and physically connected by gravity. Quantum mechanics and the gravity of Newton and Einstein give essential clues in the development of this Toy Gravity Universe.

New CPT particles and CPT antiparticles will necessarily be added to the Standard Model of Elementary Particles; these are not supersymmetry particles. The Concordance Model of Cosmology's interpretations of cosmic redshift evidence and CMB evidence will be replaced with Toy Gravity Universe interpretations that don't require inflation.

Finally, if CERN [31]'s upcoming antimatter free fall gravity experiment shows that antihydrogen falls up or down in Earth's gravitational field (rather than give a null result); then the predictions and interpretations of this Toy Gravity Universe collapse like a house of cards.

Prologue: Since 1980, the CERN LEAR, ATHENA, ATRAP, ALPHA, AEGIS, and GBAR experiments have progressed in developing the experimental skills to determine whether matter and antimatter attract or repel. The consensus hypothesis is that matter and antimatter gravitationally attract; the minority hypothesis that they repel; I expect a null experiment. On Feb 11, 2021 CERN discussed this upcoming experiment.

> "no direct measurement for antimatter has yet been performed due to the difficulty in producing and containing large quantities of it… Following a proof-of-principle measurement by the ALPHA collaboration in 2013, ALPHA, AEgIS and a third AD experiment called GBAR are all planning to measure the free fall of antiatoms at the 1% level in the coming years. Each uses different techniques, and all three have recently been hooked up to the new ELENA synchrotron, which enables the production of very low-energy antiprotons." CERN[31]

This upcoming CERN antimatter gravity experiment is very important. In my opinion, a null result is most probable and holds the key to merging gravity and quantum mechanics; as I will show in building this Toy Gravity Universe. But if in the CERN antimatter gravity experiment; antihydrogen falls either up or down (rather than giving a null or inconclusive result); then the key hypothesis of this paper is incorrect; and the insights and predictions of this Toy Gravity Universe collapse like a house of cards.

Gravity Gedanken Experiment: predicts null result for CERN free fall antimatter gravity test Max Jammer[1] explains, "In order to obtain, therefore a kinematic definition of force, Mach considers two particles A and B interacting with each other but otherwise unaffected by all the other particles in the universe. This assumption, he claims, is a legitimate extrapolation from experience."

Richard Feynman asserted, "Every particle in Nature has an amplitude to move backward in time and therefore has an anti-particle."

Thus my starting assumptions for this gravity gedanken experiment:

- In our time forward matter universe, anti-particles move backward in time.

Consider two non-relativistic matter particles a and b of equal mass in an inertial frame of reference. Hence I further assume for this gravity gedanken experiment that:

- The only force is Newton's gravity, no other force is involved.

In this time forward matter universe, these two matter particles attract according to Newton's gravity. In our time forward matter universe, as the clock tics forward in time, the distance between matter particles a and b decreases. Thus F_g is attractive:

For 2 matter particles $F_g(m_a, m_b) = G\, m_a m_b/(x_{ab})^2 =$ + real number, attractive force

Next, I stop this thought experiment, replace the two matter particles with two antimatter particles. And because of our assumptions (based on Feynman), that antiparticles go backward in time (in our time forward universe); the distance x_{ab} between antiparticles a and b increases (i.e in the video of the gravity gedanken experiment run backward).

Now the increase in distance x_{ab} between antiparticles a and b means that F_g = - real number, is a repulsive gravitational force. This result comes from literally applying Feynman's insight to Newton's gravity. This is the first core result of this gravity gedanken experiment; upon which this Toy Gravity Universe builds out.

If I stopped here; but then you would soon casually dismiss this idea; by quoting Feynman again (which I will do in a moment). So I must continue describing the consequence of this gravity gedanken experiment and build out those consequences in many steps into a Toy Gravity Universe. As I built out this Toy Gravity Universe, I conceptually have tried to break my hypothesis through contradiction with physical evidence. But I can't; instead, I am led step by step physical concept by physical insight to the quantum graviton.

So now these two antiparticles a and b move farther apart as the time forward clock tics. That is, the two antiparticles a and b will repel (i.e. will go backward in time, in our time forward universe). Thus visualizing, we see that these two antimatter particles must gravitationally repel one another. Paraphrasing, as our clocks tic forward in our time forward universe; the distance between antimatter particles a and b increases. Considering Newton's gravity's action on these two antiparticles in this gedanken experiment, we see the force of gravity must be:

For 2 antimatter particles, $F_g(m_a, m_b)$ = - real number, repulsive force

Looking at Newton's gravity $F_g(m_a, m_b) = G\, m_a m_b/(x_{ab})^2$, (and keeping the constants of nature constant) we realize that F_g can only be a negative real number if m_a and m_b (i.e. the two antiparticles' gravitational masses) are imaginary number masses.

i.e. $m_{ga}i$, $m_{gb}i \in I$ in our time forward matter universe

Now every antiparticles' inertial mass (by bubble chamber and other experiments) equals that particles' gravitational mass. It is only an antiparticle's gravitational mass that is "undecided". Thus, this gedanken experiment breaks the symmetry of the equivalence principle; because an antiparticle's real number inertial mass is not equal to that antiparticle's imaginary number gravitational masses, in our time forward matter universe.

Next, I replace the two matter particles a and b with one matter particle (i.e. $m_{ga} \in R$) and one antimatter particle (i.e. $m_{gb}i \in I$) and apply Newton's gravity to determine the force.

$F_g(m_a, m_b i) = G\, m_a m_b i/(x_{ab})^2$ = +i imaginary number force, whose real part = 0 exactly

Richard Feynman[2] explains, "actual forces have no imaginary part, only a real part. We shall, however, speak of the "force" $F_o e^{iwt}$, but of course the actual force is the real part of that expression." Thus, according to Feynman, only the real number part of a calculated force contributes to action in our time forward matter universe (for the moment, I will agree) thus:

$F_g(m_a, m_bi) = G\ m_a m_bi/(x_{ab})^2 = 0$ exactly (i.e. ignoring the imaginary number force component, according to Feynman, for now)

Summarizing the results of this gravity gedanken experiment thus far.

The gravitational force between 2 antimatter particles in our time forward matter universe is;

$F_g(m_ai, m_bi) =$ - real number force, repulsive force

(this requires that antimatter particles mass $m_{ga}i, m_{gb}i \in I$ are imaginary number mass units since I choose not to change constants of nature).

The gravitational force between a matter particle and an antimatter particle in our time forward matter universe is

$F_g(m_a, m_bi) = +i$ imaginary number force, whose real part = 0 exactly

These two gravitational forces (i.e. $F_g = +i$ and $F_g = -1$) need explaining, in the sense of physical observables. Thus, I build out this Toy Gravity Universe either to a point of physical and logical absurdity; or to a point of understanding right down to physically explaining imaginary number forces and physically describing the quantum graviton, including its quantum interactions.

Step 0) Approach and Guiding Principles: This Toy Gravity Universe is composed of two parts. The first part is like our visible universe, I call it subUniverseR ("R" as in Real numbers). The second part is CPT symmetric to our visible universe, I call it subUniverseI ("I" as in Imaginary numbers). In defining these two subUniverses, I am careful that subUniverseR (which represents our visible time forward matter universe) agrees with all accepted physics and astronomical evidence. There is no point in disagreeing with evidence. However, I may reinterpret evidence. Also, as with Newton gravity in the gravity gedanken experiment above, I will not change any standard physics equations or any constants of nature; but interpretations, domains of relevance, and concepts may vary.

I've already changed the domains of mass, space and force to include imaginary numbers; and I'll also add an imaginary number CPT symmetric subUniverseI. These changes will not done gratuitously, I will apply physical and mathematical reasoning. These two subUniverses are not among the 10^{500} universes "predicted" by string theory. Rather, I define these two specific Toy Gravity subUniverses in a way that agree with current evidence, abide by standard equations, accept the particles of the standard model and so on. However, these particles, equations, and evidence will be interpreted logically to help explain unsolved physics and astronomy problems, to make new predictions, and to suggest new experiments/observation by reinterpreting evidence and predicting additional states of Standard Model elementary particles.

Specifically, I define subUniverseR to be indistinguishable in a gravitational observational and experimental evidence sense from our current visible universe (from an insider's point of view). In this paper, I focus on gravity and mostly ignore EM, weak and strong forces. Let me also note that subUniverseI is defined to be indistinguishable (from an insider's point of view) from our

subUniverseR; because of its CPT symmetry. And finally, from an insider's point of view, inside of either of these two subUniverses; there will be evidence that can only consistently be explained by invoking a CPT symmetric antimatter time backward subUniverseI (an insider in either subUniverse assumes they are in subUniverseR.

There are an infinite number of gratuitous mathematical ways to define two such subUniverses. My aim is toward conceptual and logical simplicity; which most likely means mathematical complexity, with difficult equations to solve. Assuming the predictions of this Toy Gravity Universe are confirmed by upcoming experiments; mathematicians and physicists will find ways to explain this Toy Gravity Universe better than I can; and also to expand its physical logic to include not only general relativity, QED, QCD, etc. But focusing just upon gravity and the quantum graviton has been enough for this paper. As well without confirmation from the upcoming CERN antimatter gravity experiments, I am unwilling to proceed to the next more speculative consequence of this Toy Gravity Universe.

My Toy Gravity Universe gets rid of gravitational spatial infinities; it is finite and non-expanding. But this Toy Gravity Universe is sufficiently large to accommodate all physical evidence. In building this Toy Gravity Universe, I choose to ignore all predictions beyond the event horizon of our visible universe (at 13.8 billion lightyears) and everything beyond the event horizons of black holes. Also, neither subUniverseR nor subUniverseI are among the gratuitous infinite number of Tegmark's four levels of multiverses or Greene's 9 types of multiverses.

Godel's Incompleteness Theorems are always top of mind guiding the build out of such a Toy Gravity Universe. Physics and astronomy are the first sciences confronting the consequences of the Incompleteness Theorems. In my opinion, some of the unsolvable problems in physics and astronomy come from inherently contradictory assumptions that lead to incompleteness (in a Godel sense) that such and such questions are inherently unsolvable problems in a particular logical system (aka model universe). In my mind, cosmic redshift evidence, CMB evidence, and cosmic inflation evidence can not be physically and logically solved in the Concordance Model of Cosmology; because the Concordance Model of Cosmology is incomplete (in a Godel sense).

The list of "unsolved physics and astronomy problems" and "incorrectly solved physics and astronomy problems" grows with each compromise by accepting unphysical assumptions and unphysical mathematical extrapolations. It is one thing to truncate an infinite series to reach agreement with physical evidence (as in renormalization). It is totally different to extrapolate to infinity to "predict" a "physically" theoretically unverifiable state of matter.

Our equations are shadows of reality. Like inquisitive 13 year-olds, we need to understands enough. We need to ask question that blows right through useless illusions. We need to consider answers, that are contrary to the "nearly unanimous prediction of theorists". In a field such as quantum gravity, where literally nothing is clearly understood; the "nearly unanimous prediction of theorists" calls for careful investigation.

Step 1) The CPT Symmetry between subUniverseR and subUniverseI

I redefine our visible universe as the subUniverseR, but I will get rid of its infinite extent. Matter and space are real numbers quantities (i.e. m, x_1, x_2, $x_3 \in R$) and as well the usual physics applies to subUniverseR. As I make changes, I will use visual crutches to better explain subUniverseR.

I also define an invisible universe as the subUniverseI in which gravitational mass and space are represented by imaginary numbers quantities (i.e. mi, y_1i, y_2i, $y_3i \in I$). That this subUniverseI is CPT symmetric, with our visible subUniverseR, assures that the familiar physics also applies in the subUniverseI. I will build and layer up details and concepts as I go.

Let's take a moment to assure ourselves that in subUniverseI as well as subUniverseR that we obtain identical results for one law of physics, Newton gravity, $F= G m_a m_b/(x_{ab})^2$. In subUniverseI, CPT symmetric matter (aka CPT matter) has gravitational mass of -mi, and CPT antimatter has gravitational mass of -m. So in subUniverseI. First CPT matter, -mi.

$F= G(- m_a i)(-m_b i)/(r_{ab} i)^2$, multiplying imaginary numbers, we get

$F= G (-1)m_a m_b/[(-1)(r_{ab})^2]$ and simplifying, we get

$F= G m_a m_b/(r_{ab})^2 = +$, i.e. CPT matter attracts

Now, CPT antimatter, -m.

$F= G(- m_a)(-m_b)/(r_{ab} i)^2$, multiplying imaginary numbers, we get

$F= G m_a m_b/[(-1)(r_{ab})^2]$ and simplifying, we get

$F= G m_a m_b/(r_{ab})^2 = -$, i.e. CPT antimatter repells

Hence, Newton's gravity in subUniverseI is an identical law of physics as in subUniverseR.

$F= G m_a m_b/(x_{ab})^2$

In other words, an Observer in either subUniverse couldn't tell whether they were in subUniverseI or subUniverseR. Similar demonstrations for other laws of physics apply.

At this point, these two subUniverses are not explicitly linked together. In order to gravitationally link these two subUniverse, I must transform them further.

I define the shape and size of our subUniverseR as a finite 3-sphere of radius 13.8 billion lightyears. This is large enough that no observed gravitational phenomenon differs either locally or astronomically from our actual observed visible universe.

Now a 3-sphere subUniverseR is mathematically more complicated than the mathematically familiar flat Euclidean description of our actual universe. But I can't visualize connecting two flat Euclidean universes in the robust way that I can see two 3-spheres subUniverses connect. Also, a 3-sphere subUniverseR description preemptively gets rid of the spatial infinity of our flat Euclidean visible universe; and this avoids a number of avoidable problems, like the possibility of an infinite number of unverifiable Tegmark Level I multiverses.

Occam's razor and Godel's Incompleteness Theorems warn us of dangerous unintended consequences/collateral problems of carrying our reasoning to infinities. For these reasons, I have chosen to avoid mathematical infinities of extent and build out this Toy Gravity Universe composed of two 3-sphere subUniverse. But there are other advantages. I can visualize two 3-sphere subUniverses gravitationally interacting more easily than two flat Euclidean subUniverse; and I can quantum gravitationally connect them in a physically more robust way.

Later, I will quantum gravitationally connect these two subUniverses. But first I need to work on the visualization and description. At this point, you probably cannot visualize these two subUniverses. Let's begin. A 1-sphere is the 1-dimensional curved line of a circle (but not the interior area of the circle); a 2-sphere is the 2-dimensional curved surface of a ball (but not the interior volume of the ball). Similarly, a 3-sphere is the 3-dimensional curved. Just as 1-sphere can be visualized as a circle place on a 2-dimensional Euclidean plan; so too a 3-sphere can be visualized as a 3-sphere curved volume placed in 4-flat-dimensions; but that extra dimension is a crutch concept to help us visualize.

From the inside, a 3-sphere appears like the 3-dimensional volume of a 3-dimensional ball with a 2-sphere surface horizon. Yep, it feels like it is a part of Euclidean space. So our 3-sphere subUniverseR appears from the inside to have an event horizon at 13.8 billion light years radius. But there is more to a 3-sphere subUniverseR than a ball. From the surface of the Earth (i.e. within a 2-sphere); the surface of the Earth appears to be a flat disc with a 1-sphere (i.e. a circle) boundary horizon. But we know that the surface of the Earth is not a flat disc. Just so, our 3-sphere subUniverseR is not a ball universe, or even an inflating ball universe like the Concordance Model of Cosmology.

Now for sure, our subUniverseR has only the slightest curvature; because a radius of 13.8 billion light years makes a very slight curve. But having this slight curve means; we will avoid problems of infinity, we will more easily visualize two interacting suUniverses, and we will more easily be able to connect these two subUniverses quantum gravitationally. And it is very important to physically connect these subUniverseR and subUniverseI; otherwise, what's the point? In this Step1, you've seen the toes of this pink elephant (Toy Gravity Universe) that I am building. Hopefully, this Toy Gravity Universe will be a useful pink elephant. All models of our visible universe are toys, pink elephants. Our visible universe is so much richer than any model.

Step 2 The T-duality Connection Between subUniverseR and subUniverseI

Now I begin connecting these two 3-sphere subUniverses in a quantum gravity way. For visualization purposes in linking these two subUniverse gravitationally, I will pretend that these two subUniverse are not the same size. I will relate these two subUniverses by T-Duality.

T-duality was first applied in string theory. In T-duality, a string (i.e. particle) propagating in a circular spacetime of radius R is equivalent, from a physics theories point of view, to a string propagating in a circular spacetime of radius 1/R. I use this T-duality crutch to more easily visualize a very large 3-sphere in real number space interacting with a very small 3-sphere in imaginary number space (at every point of these two subUniverses). Let's begin.

Imagining the complex number plane. We put real numbers on the x-axis and imaginary numbers on the yi-axis. Of course, both axes are infinite. So I curve the number lines into circles to make a finite situation. But the first way, that I can successfully visualize the real and imaginary numbers so that x- axis and the yi-axis they are orthogonal at every point is to use a torus. So with a torus (i.e. a donut shaped surface), I can visualize the surface as being covered by two orthogonal circles at every surface point of the donut. We can assign real numbers R to the larger radius circles that goes around the outside of the donut; and we can assign imaginary numbers to the smaller radius circles that goes through the hole of the donut (or vice versa). It doesn't matter which circle is marked with real numbers, x-coordinates, and which circle is marked with imaginary number, yi-coordinates. In making a torus, I got rid of the infinite extent of a flat plane; but we still have an infinite number of points on circular number line of finite extent. Well I am not going down the rabbit hole of the continuum hypothesis. But physical quantum thinking visually avoids Zeno infinite continuities of series of fractions.

This torus is the beginning in our visualization. As well, it gives us a glimpse of a lurking mapping problem. Now I replace the torus by applying T-duality to two 1-spheres. A 1-sphere is a circle. I first envision real numbers x marked on a large finite circle of radius R, and I envision imaginary numbers yi on a small finite circle of radius 1/Ri. So now the real number circle is very large, while the imaginary number circle is very tiny. But this very large, very tiny point of view can be thought of as a kind of perspective shifting. Whether R is large and 1/R is small or vice versa is equivalent logically. Thus, observersR moves in a large 1-dimensional real number subUniverseR of x_1 points on a line, unaware of a tiny (from observerR POV) 1-dimensional imaginary number subUniverseI of y_1i points on a line. And vice versa for observerI. And just like the torus, these two subUniverseR and subUniverseI intersect in a mathematical orthogonal way at every point of these two subUniverses. So mathematically subUniverseR and subUniverseI are connected.

That does not mean they are physically connected at every point. We will get to those physical quantum gravity connections. We will physically connect these two subUniverses in several ways. For now, notice that I have not yet physically explained, why this Toy Gravity Universe is

bifurcated into two subUniverses. I have not physically explained why an observersR can not communicate with an observerI. I have not physically explained why; even if an observerR can infer based on physical evidence that the other subUniverseI exists, he can never determine which subUniverse he inhabits. I will explain these things.

With this success in the visualization of two 1-sphere subUniverses, we next visualize two 3-sphere subUniverses. In subUniverseR x_1, x_2, x_3 are the 3 real-number-dimension; and in subUniverseI y_1i, y_2i, y_3i are the 3 imaginary-number-dimensions. This gives us two 3-dimensional manifolds for a total of 6-dimensions at each point. With the help of T-duality, we can almost visualize ourselves in the real number 3-sphere subUniverseR, with a bifurcated tiny imaginary number 3-sphere subUniverseI ever present and curled up right at the tip of our nose and everywhere. Now this T-duality is a mathematical trick, that allows us to visualize this 6-dimensional complex number object (composed of these two yet to be physically connected subUniverses) right on the tip of our mind. But T-duality has to be more than a mathematical trick. There has to be physical reasons why an observerR can never see or touch objects in subUniverseI. I will explain those physical reasons.

Also, from a physics point of view, this subUniverseR is too static. We will need to build out the physics story, the gravitational actions of this whole Toy Gravity Universe, paying particular attention to gravitational actions in and effecting subUniverseR from an observerR's POV.

For now, we have a CPT symmetric Toy Gravity Universe with a T-duality mathematical framework; because we can visualize it and work with it physically. Within these two subUniverses, the laws of classical and modern physics apply and the physical evidence is identical in both subUniverses. But as we will see, the interactions between these two subUniverse will produce physical evidence that can best be explained by the existence of a CPT symmetric T-duality subUniverse.

Now these two subUniverses must gravitationally connect or else I've gone to a great deal of trouble without a physical conceptual payoff. Summarizing, we have two 3-sphere subUniverses. The subUniverseR (a.k.a. our visible universe) is 13.8 billion lightyears in radius; while the subUniverseI is microscopically small from any point in our subUniverseR (a.k.a. our visible universe). And we understand that whichever subUniverse we are in, we visualize ourselves in the larger subUniverseR, and we visualize the other as subUniverseI which microscopically small. We view T-duality as a kind of perspective, like geometric perspective that makes a distant person appear as small as an ant; but we realize there needs to be a physical explanation why T-duality blinds us to the direct actions in subUniverseI. Always keep in mind that subUniverseR (a.k.a. our visible universe) has real number masses, distances, and forces; while subUniverseI has imaginary number masses, distances, and forces.

We are conceptually holding two mathematically complex subUniverses in our mind. One subUniverseR is a real number 3-dimensiona 3-sphere, the other subUniverseI is an imaginary

number 3-dimensional 3-sphere; and these two subUniverses are physically related by CPT symmetry and mathematically related by T-duality. Though the T-duality mathematical bifurcation (or separation) will have to be explained in terms of physical separation. And despite all the implied mathematical complexity, we are holding a simple conceptual idea in our mind.

By the way, CPT-Symmetric Universe[3] by Latham Boyle, Kieran Finn and Neil Turok is an excellent paper. It builds a CPT-Symmetric Universe as an addition to our present visible universe. It offers new interpretations to cosmological baryon asymmetry and cosmological dark matter. It requires only the standard three generations of the standard model of particles (including the right handed neutrino, not yet observed). And finally it offers testable predictions regarding neutrinos and gravitational waves. Very nice and then there is their second excellent paper, The Big Bang, CPT, and neutrino dark matter[4] by Latham Boyle, Kieran Finn and Neil Turok. It goes into all the necessary ugly/beautiful mathematics but also includes readable Introduction and Discussion sections. These two papers drive some important wedges into the underlying cracks in the Concordance Model of Cosmology (aka standard model of cosmology). Very well done, these two excellent papers deserve more attention.

Step 3 The Meaning of Imaginary Number Gravitational Force

Now, we begin to connect these two subUniverses gravitationally with the imaginary number force of gravity of the gedanken experiment. In applying Newton's gravity, the second result of our gedanken experiment gave us an imaginary number force; which we ignored at the time due to Feynman suggestion that imaginary number forces aren't physical. i.e. when Richard Feynman explained that, "actual forces have no imaginary part, only a real part. We shall, however, speak of the "force" $F_o e^{iwt}$, but of course the actual force is the real part of that expression." Thus according to Feynman, only the real number part of a calculated force contributes to the action in our time forward matter universe. Well now is time to disagree with Richard Feynman; and to begin physically interpreting this imaginary number force.

2)The gravitational force between a matter particle and an antimatter particle is

$$F_g(m_a, m_b i) = +i \text{ imaginary number force, whose real part} = 0$$

This imaginary force of gravity resulted from applying Newton's gravity to a particle and an antiparticle in the subUniverseR (from subUniverseR's point of view)

$$F_g(m_a, m_b i) = G\, m_a m_b i/(x_{ab})^2 = +i$$

Now applying Newton's gravity to a CPT particle $-m_b i$ and a CPTantiparticle $-m_a$ in subUniverseI an imaginary number distance r_{ab} apart; we get a negative imaginary number gravity force.

$$F_g(-m_a, -m_b i) = G\,(-m_a)(-m_b i)/(r_{ab} i)^2 = -i$$

These two imaginary number forces, from our subUniverseR point of view, are the pull and push interaction between subUniverseR and subUniverseI. The net of this push pull is an orthogonal attraction and rotation between these two subUniverses, like two children in a playground holding onto a rope as they run in circles away from each other. But the children in the

playground are in the same Euclidean plane of action. It gets harder to visualize two orthogonally connected T-duality 3-spheres (or even 1-spheres) spinning in opposite directions to one another at every point. And of course, one of these 3-sphere is the mathematically real number subUniverseR (our visible universe) and the other is the imaginary number subUniverseI.

So, this intrinsic rotation is of the real number subUniverseR relative to the imaginary number subUniverseI from subUniverseR's POV, and vice versa. Our subUniverseR is held together from solar systems to galaxies to subUnverseR with force of gravity equal to a positive real number. This intrinsic rotation is caused by the push/pull of imaginary number forces between the two subUniverses. (similar results from subUniverseI POV). This is merely the beginning of our exploration of imaginary number gravitational forces and of more complex quantum gravity interactions, that build these two subUniverses into a complicit Toy Gravity Universe.

Step 4. The Collective Gravitational Phenomenon in Each subUniverse

From subUniverseR time forward point of view, subUniverseR is held together from solar systems to galaxies to subUnverseR itself by the force of Newton's gravity (equal to a real number). Matter in subUniverseR is held together by

$$F_g(m_a, m_b) = G\, m_a m_b/(x_{ab})^2 = \ + \text{real number, attractive force}$$

And this attractive force of gravity, in the 1-dimensional subUniverse case; attracts the matter of subUniverseR into a circle, or 1-sphere (a 3-sphere in the 3-D case). Of course without a repulsive force of gravity, the attractive force of gravity would reduced subUniverseR to a singularity. Similar statements for CPT symmetric subUniverseI.

Einstein remarks in Ciufolini[27] and Wheeler's book, ".. the theory of relativity makes it appear probable that Mach was on the right road in his thoughts that inertia depends upon a mutual action of matter."

Carl Friedrich von Weizsacker[5] explains the paradox of a single electron, "It turns out to be meaningless to talk, for example, of an isolated ("naked") electron, i.e., of an electron as it might exist without any interaction with the radiation field… What we refer to empirically as an isolated particle is in reality already the result of its interaction with the permanently co-present environment."

Paraphrasing von Weizsacker, it is meaningless to talk of an isolated particle as it might exist without any interaction with the graviton field. What we refer to empirically as the gravitational mass of an isolated particle is in reality already the result of its interactions with the permanently co-present attractive gravitation environment of subUniverseR. Matter's gravitational interaction with other matter leads to the collective gravitational phenomenon of subUniverseR. Ditto subUniverseI. And these two collective cosmic subUniverses are held together individually by Newton's gravity. For the moment, we accept Newton's gravity equations totally, thinking of Newton's action at a distance as a kind of collective Newtonian entanglement. Later, I will talk about the repulsive gravitational force, of the gedanken experiment above, that balances the attractive Newtonian gravity. And of course, CPT symmetry means that what we say about subUniverseR applies exactly to subUniverseI.

Next let us note the relationship with other collective phenomenon as Robert B. Laughlin explained in his Nobel Lecture, Fractional Quantization[6], "I myself have come to suspect that all the important outstanding problems in physics are emergent in nature, including particularly quantum gravity." And then in A Different Universe[7], Laughlin further explains, "I am increasingly persuaded that all physical law we know about has collective origins, not just some of it. In other words, the distinction between fundamental laws and the laws descending from them is a myth, as is the idea of mastery of the universe through mathematics alone."

Here we will reason a bit more about the two imaginary number gravitational forces that come from applying Newton's gravity (in the previous step)

$F_g = +i$ and $Fg = -i$ from subUniverseR's POV

These imaginary number gravitational forces create a push pull between subUniverseR and subUniverseI that hold them together (in gravitational Cassimir kind of way) and sets the two subUniverses rotating relative to one another in an intrinsic quantum sense. I will describe more carefully what is physically quantumly going on, when I define the quantum graviton.

Also, at this time I mostly drop the terms "time forward" and "time backward"; because these concepts are non sequitur in this Toy Gravity Universe (as I will explain later); and by now you are probably comfortable with these two subUniverses by themselves without mention of "time forward" or "time backward". As I will discuss later, these concepts ('time forward", "time backward") have specific meanings, both classically and quantumly, that are generally useful illusions or crutches in understanding local physical action.

Also, what is going on physically regarding antiparticles annihilation? In subUniverseR antiparticles are mildly stable; whereas particles are very stable gravitationally. So antiparticles quantum mechanically change state to particles. There is no annihilation. Later, I will explain this idea more specifically and quantum mechanically. But first I must layer additional ideas to build up this Toy Gravity Universe.

Step 5 Newtonian Inflationary Gravitation in Each subUniverse

With the first result, of the gravity gedanken experiment, we showed that the gravitational force between 2 antimatter particles in our time forward matter universe is repulsive.

$F_g(m_a i, m_b i) =$ - real number force, repulsive force

This repulsive Newtonian gravitational force in our subUniverseR acts between all the various various antiparticles in our time forward subUniverseR. Positrons are found above thunderstorm clouds, in Van Allen Belts, produced in neutron stars or black holes. Essentially no antimatter nuclei have been found in cosmic rays; but virtual pairs of particles and antiparticles are fleetingly produced due to quantum mechanics uncertainty principle everywhere (quibble). And the Unruh effect produces antiparticles and particles along with Hawking radiation in certain high gravitational situation (quibble and to be discussed later).

However these antiparticles are produced; they do not interact gravitationally with the matter in subUniverseR. Antimatter, in our subUniverseR, only gravitationally interact with other antimatter in our subUniverseR. Thus, gravitationally within our subUniverseR, antimatter repels

other antimatter. The quantum gravity effects will be explained later. However, we will not explore any secondary effects involving the EM, weak, or strong force interactions between antimatter and matter our subUniverseR. Unless necessary to explain gravity.

The primary effect of this gravitational repulsive force in subUniverseR is simply to keep subUniverseR in balance gravitationally; meaning that without antimatter continually entering subUniverseR there would be no repulsive force to keep subUniverseR from collapsing into the 200 billion supermassive black holes at the center of each galaxy in subUniverseR. In a later step, I will give an explanation of the cosmic redshift in this non-inflationary subUniverseR.

Frank Wilczcek[8] described this gravitational problem in the concordance model of our visible universe, "Gravity is the dominant force in astronomy, but only by default. Other interactions are far stronger, but they feature both attraction and repulsion. Normally matter reaches an accurate equilibrium, with forces cancelled." Let me continue where Wilczek's thought falls silent.

In the concordance model of our visible universe, no repulsive gravity force is in equilibrium with the attractive gravity force; so we are stuck with inventing an eternally inflating universe which is not very pretty (i.e. Einstein's "biggest blunder"). But there is a repulsive gravitational force between antimatter in our Toy Gravity Universe. This repulsive gravitational force is small; thus subUniverseR has reached the large gravity equilibrium size of 13.8 billion lightyears.

But if our Toy Gravity Universe is NOT expanding; then I must reinterpret the cosmic redshifts evidence. The evidence is clear; there is no point in arguing against the cosmic redshift evidence. But because we changed the domains of relevance of Newton's gravity equation to include imaginary numbers (based on physical reasoning); we will be able to reinterpret the cosmic redshift evidence and the CMB evidence in a non-inflationary way. So yes, there is a nuanced repulsive gravitational force; but no, it is not interpreted cosmic inflation.

Step 6 Imaginary Number and Real Number Gravitational Mass
Working with Newton gravity in our gedanken experiment, we saw that in Newton's equation

$$F_g(m_a, m_b, r_{ab}) = G\, m_a m_b/(r_{ab})^2$$

All variables m_a, m_b, r_{ab}, as well as the result F_g, can be plus or minus real numbers units or plus or minus imaginary number units.

Therefore, there are 4 distinct gravity mass numbers (+1, +i, -1, -i) for each particle in this Toy Gravity Universe, versus one mass numbers for each particle in the Concordance Model of Cosmology (aka the Standard Model of Cosmology) and the Standard Model of Particle Physics. Though there are particles and antiparticles in the Standard Model universe, they are not differentiated by a quantum gravity mass number; thus most physicist assume that antimatter is gravitationally attracted to matter (i.e. antimatter falls down in free fall on Earth).

But in our Toy Gravity Universe, we do not accept majority working hypothesis that antimatter falls down. Many theorists may agree with Hajdukovic that "An amusing (while non-scientific) question is why so many great experimentalists waste significant time on experiments whose outcomes are known in advance (according to the nearly unanimous prediction of theorists, antimatter must fall in the same way as matter)." But that important antimatter gravity

experiment has not been done. And nearly 400 years ago, Galileo understood that “In questions of science, the authority of a thousand is not worth the humble of a single individual.” So let me emphasize, this Toy Gravity Universe does not disagree with physical evidence ever. CERNs difficult antimatter gravity experiment has not been done yet. And without understanding quantum gravity; any “nearly unanimous predictions” is an exercise in group think, not science.

In this Toy Gravity Universe based on physical reasoning about antimatter and gravity, we have changed the domain of relevance, of Newton’s gravity equation, to include imaginary numbers. Thus, in this Toy Gravity Universe, instead of just particles and antiparticles; there are particles of 4 distinct quantum gravity mass charges (+1, +i, -1, -i). So, this Toy Gravity Universe offer opportunity for significant new quantum gravity interpretations. And these interpretations lead inevitably to the definition and description of the quantum graviton.

In the Standard Model of Elementary Particles, the mass charge of particles and antiparticles is implicitly the positive real +1. Thus

electron $mass_g$ = +1 x electron $mass_i$ (note: matter dominates $subU_R$)

positron $mass_g$ = +1 x electron $mass_i$

In the Standard Models, the inertial mass equals the gravitational mass and is identical for particles and antiparticles. e.g.

electron m_g = electron m_i = positron m_g = positron m_i = +1 x real number electron mass

In the Standard Models, bosons are their own antiparticle.

In the Standard Model many of these quantities are theoretical; because the extraordinarily difficult experiments have not been done yet.

But in this Toy Gravity Universe there are 4 distinct types of mass numbers for each particle.

In subUniverseR (our visible universe)

electron $mass_g$ = +1 x electron $mass_i$ (note: matter dominates $subU_R$)

positron $mass_g$ = +1i x electron $mass_i$ (i.e. positrons have +imaginary number mass)

In subUniverseR, inertial mass equals the absolute value of the gravitational mass.

In subUniverseR, bosons are quantumly composed of particle and antiparticle (or aspects); thus, bosons are usually not their own antiparticle. Yes, this is an implicit prediction.

For example, the B_s^0 meson should have a slightly different in gravitational mass than its antiparticle. In our subUniverseR, B_s^0 meson-particle has a real number gravitational mass component for its bottom quark but an imaginary number gravitational mass component for its strange quark. However in our subUniverseR, the B_s^0 meson-antiparticle has an imaginary number gravitational mass component for its bottom quark but a real number gravitational mass component for its strange quark. So in subUniverseR (and our visible universe) the B_s^0 meson

particle and antiparticle should have different gravitational masses; but the B_s^0 meson particle and antiparticle have identical inertial masses in subUniverseR.

Meson experimental research is excellent and highly respected, so I am not deliberately suggesting a very difficult experiment to test. But it is an example to show that this Toy Gravity Universe does make predictions that in principle can be tested.

In subUniverseI (CPT symmetric to subUniverseR)

CPT electron mass = -1i x electron mass (note: CPT negative-imaginary-number-matter, is the stuff out of which atoms and stars are made in the subUniverseI)

CPT positron mass = -1 x electron mass (note: CPT negative-real- number- matter, is the stuff out of which antimatter is made in the subUniverseI)

Now, I am focused primarily on gravitational interactions. But I do discuss the other 3 fundamental forces and their particles as they relate to gravity. That being said, let's consider the energy of photons. Energy gravitates, i.e. $E = mc^2$; so in this Toy Gravity Universe and specifically in subUniverseR which I am primarily focused, energy can have imaginary number values, as well as real number values. And specifically, Eddington and others have shown that photons (i.e. EM energy) from stars have gravitational mass, thus $E_g = m_g c^2$. Now in subUniverseR, photons are not quite their own antiparticle; because a photon is composed of particle aspect (i.e. +1 real number energy aspect) and an antiparticle aspect (i.e. +i imaginary number energies aspect). Those imaginary number energies have real physical consequences in our subUniverseR. In particular, those imaginary number energies of photons must be considered with the other antimatter to determine the cosmic repulsive force of Newton's gravity (see Step 5 above and step 12 below) in this Toy Gravity Universe.

As it turns out, you don't need a lot of energy to account for much of the various dark energy. Frank Wilzcek[8] quantifies, "the dark energy exerts negative pressure. It tries to pull you apart! Fortunately, although dark energy supplies about 70% of the mass of the universe as a whole, its density is only about 7×10^{-30} times the density of water, and its negative pressure cancels only about 7×10^{-14} of normal atmospheric pressure-less than a part in a trillion. I don't know when we'll have clearer ideas about what the dark energy is. I'd guess not very soon." I agree with most of what Wilzcek says; but in subUnverseR, cosmic inflation (if it exists) is caused by the repulsive force of Newton's gravity which acts upon antiparticles (i.e. antimatter) and the antiparticle aspect of photons. In subUniverseR, antiparticles have +mi (imaginary number mass) and photons have energy of E +Ei, (where i is the imaginary number component of energy in subUniverseR). The mathematics works, when the Toy Gravity Universe assumptions and consequences are correctly applied to Newton's gravity equation and summed over the subUniverseR. But it is important to note that in this Toy Gravity Universe though particles of the Standard Model all carry energy in the form of mass or radiation; there is one exception. The quantum graviton is a hypothetical particle that is not part of the Standard Model of Elementary Particles. And there is much debate as to whether the graviton carries energy or not.

Later, I will think further about these 4 distinct types of gravity mass numbers, i.e. quantum gravity charges. How do particles and energy transition from one type of quantum gravity charge

to another? Do particles and antiparticles annihilate each other or do particles oscillate from one quantum gravity charge type particle to another? What is the preferred quantum environment or state of matter, i.e. where are each of the 4 quantum gravity charge types of matter most stable? These questions seem important, some can be partially answered in this Toy Gravity Universe with hints from current theory, experiment and observation. We have to grasp firmly and yet critically upon the available slippery physical evidence and insights. Slippery because physical evidence must always be interpreted within the context of one theory or model or another.

I've already suggested a beginning of an answer by asserting that the electron and positron are stable in the subUniverseR, whereas the CPT electron and CPT positron are stable in the subUniverseI. I suppose some would quibble that the positron is not very stable in our time forward subUniverseR (aka our visible universe). But a stable environment for antimatter has been constructed at CERN, "When the energy is low enough, physicists at the ALPHA experiment use the electric potential to nudge the antiprotons into a cloud of positrons suspended within the vacuum. The two types of charged antiparticles combine into low-energy antihydrogen atoms. Since antihydrogen atoms don't have an electric charge, the electric field can no longer hold them in place. So instead, two superconducting magnets generate a strong magnetic field that takes advantage of the antihydrogen's magnetic properties. If the antihydrogen atoms have a low enough energy, they can stay in this magnetic "bottle" for a long time."[9] Very nice, stable specialized environment in our visible and Toy Gravity Universe.

So, the experimental, observational, and theoretical question is "What is the preferred quantum environment of the 4 quantum gravity charge states (+1, +i, -1, -i) of the various particles of the standard model and compositions made there of? Where in subUniverseR, subUniverseI or other manifolds of this Toy Gravity Universe might the 4 quantum gravity charge states of matter and energy be stable? And how do matter and energy quantum gravitationally change from one quantum gravity charge state to another?

Step 7 Neutrino and Other Matter Oscillation in Our Visible Universe

Photon oscillation is the electromagnetic field; and electrons oscillate in and move in the electromagnetic field. But in what field do neutrinos and mesons oscillate? My suggestion is neutrinos and mesons oscillate in the quantum gravity field. Normally the oscillation of fermions in the quantum gravity field is not observed; because the electromagnetic field dominates and prevents the observation of gravitational action. In this section, we explore matter oscillations.

Let's consider a quote from Paul A. M. Dirac[10], "It is found that an electron which seems to us to be moving slowly, must actually have a very high frequency oscillation motion of small amplitude superposed on the regular motion which appears to us. As a result of the oscillation motion, the velocity of the electron at any time equals the velocity of light." Well of course, our measurements of the speed of an electron beam of an electron microscope are 40% to 80% of c; but a particle accelerator can accelerate an electron to 99.999…% of the speed of light. But this 40%, 80%, or even 99.999…% of c are not (I assume) what Dirac was discussing. These experimental measure of the speed of an electron beam calculate the velocity of an electron between point a and point b by the shortest path. Whereas Dirac's description of the velocity of an electron implies following the more convoluted fractal path of an electron; and thus metaphorically (not experimentally), Dirac measures the distance in infinitesimal increments and

thus mentally imagines the velocity of an electron as instantaneously c, e.g. in its atomic orbits. If not a convincing thought experiment (my apologies to Dirac); but let's play out this idea a bit.

Dirac's statement is not based on 6 sigma calculations of experimental data. No. Dirac's statement is based on logic and physical insight. So yes, we are logically going where the uncertainty principle can not mathematically or experimentally take us. But also consider that the 6 sigma way of thinking may contribute to some collateral problems; that are among the top 100 unsolved systemic problems in physics and astronomy. Yes systemic, for example problems arising from infinities and singularities are often systemic; think Ptolemaic epicycles which lead to more epicycles, or infinities to more infinities, i.e. infinite series without renormalization. What breaks the mathematics that leads to more infinities is not 6 sigma, but physical insight.

Astronomy has beaten to death the Steady State Universe (mostly because of its inability to convincingly explain physical evidence); but meanwhile astronomy accepts an inflationary (thermodynamically open) universe, that leads to a casual discussion of an infinite number of various multiverses, and puts up hurdles to explanations of unintended consequences called "unsolved problems", and a Concordance Model of Cosmology that may or may not predict conservation of energy with general relativity in our visible universe.

But let's not forget, that the Concordance Model of Cosmology (despite an unexplainable accelerating cosmic inflation that achieve matter velocities greater than the speed of light c) is mathematically the best model for fine tuning all of the conflicting cosmological evidence. Hmm, but that doesn't make it correct; it merely makes it useful. A more correct model of the universe must have a real understanding of quantum gravity; because gravity is the primary force of all astronomy from the white hole phenomenon (i.e. big bang/inflation) to supermassive black holes, and all astronomy between. Without the physical insights, reasoning, and understanding of a credible quantum gravity; our best theories cannot usefully select or guide the most useful experiments and observations. We can still get lucky; but betting on luck is expensive experimentally (though not theoretically).

Hot neutrinos can't pass through the Concordance Model of Cosmology analysis of what is most likely to be dark matter. But now that all the dark matter supersymmetry candidates have not been found; neutrinos are still a dark horse candidate for dark matter. Despite the supersymmetry mathematical juggernaut having led astronomy and physics astray. The mathematical ideas of supersymmetry are resilient and will find uses. But deciding whether neutrinos are viable candidates for dark matter, I leave that to neutrino physicists.

As to whether dark matter is even needed to explain galactic rotation, I refer you to General Relativistic Velocity: the Alternative to Dark Matter[14], by F I. Cooperstock and S. Tieu. Excellent work, nearly unanimously ignored; needs to be seriously considered.

Rambling on, in the analysis of coastlines, e.g. from point A-Miami to point B-New York City, the distance measured depends on the size of your ruler and on your measurement method. Yes, I am thinking classically and know very well that whether measuring distant right down to the tiniest increments or measuring velocity between such tiny increments; we either have to deal with quantum mechanic's uncertainty principle or be a Maxwell demon.

When Dirac said, “the velocity of the electron at any time equals the velocity of light”; Dirac was thinking like a Maxwell demon. So being a Maxwell demon for the moment, let’s accept Dirac proposition to mean that an electron’s velocity in its quantum orbital state around an atom is c. Quantum atomic orbitals are among electron’s stable “natural” environments. Whereas a neutrino’s “natural” environment is not the quantum atomic orbitals.

Of course, the neutrinos “natural” stable quantum states are gravitational, not electromagnetic. And let me assert that the neutrinos “natural” stable states are galactic or even intergalactic. And just as Dirac proposed that “the velocity of the electron at any time equals the velocity of light”; let me propose that the velocity of neutrinos in their stable states is the velocity of light, c. Of course experimentally, the velocity of neutrinos is indistinguishable from the speed of light. Some measurements have even clocked neutrinos as moving faster than the speed of light. But that’s not my point. Nor am I disputing that neutrinos have mass. I accept the evidence of neutrinos velocity being equal to c; and the reasoning that suggest neurtrinos have mass. Hmm?

My point is that neutrino physicists are kind of like Maxwell demons. By that I mean, neutrino experimental physicists sit right inside the neutrino’s quantum galactic orbit. Thus, neutrino physicists measure the neutrino’s speed, in its “natural” galactic orbital environment as it travels at speed indistinguishable from c. Neutrino experiments are incredibly difficult; because neutrinos do not interact electromagnetically. Neutrinos ride the quantum gravity field that is exactly space; while electrons ride electromagnetic waves.

A last matter oscillation that I mention is the B_S^0 meson. It is well known that the B_S^0 meson spontaneously transforms to its antiparticle and back, i.e. oscillates. This is flavor oscillation. Thus oscillation, i.e. phase transformations from one quantum state of matter to another, occurs in the correct quantum environment for all particles in the current Standard Model of Elementary Particles. These oscillations involve the electromagnetic, the weak, and the strong forces.

I haven’t even skimmed the surface of the research; but hopefully I have not misspoken. My intent is only to prepare for the coming descriptions of quantum gravity oscillations.

Step 8 Annihilation vs. Quantum Gravity Change of State

“Currently the only way to know whether antimatter was actually trapped is to let it annihilate with regular matter. When the magnets are switched off, the antihydrogen atoms escape their trap and quickly annihilate with the sides of the trap. Silicon detectors pick up the energetic flare to pinpoint the antiatom’s position. Only then can the physicists be sure that they had trapped antihydrogen.” CERN[9]

We know there was an electromagnetic energy flash, but we really don’t know if matter and antimatter annihilated each other. The stability of mesons suggests that matter and antimatter don’t annihilate; rather they are part of a stable dynamic quantum vacuum. Frank Wilzcek[8] suggests that “quark-antiquark pairs form because perfectly empty space is unstable.” That is a good antidote to the idea of the empty vacuum. Wilzcek[8] elsewhere says, “One could say that (the ethers) condense spontaneously our of empty space”. Thus, it seems that in our visible universe as well in my Toy Gravity Universe; that both space (as a quantum condensate) and matter (as a classical subset of quantum states) are quite stable in a quantum mechanical sense. Then Wilzcek[8] further clarifies that, “The primary ingredient of reality is alive with quantum

activity… The primary ingredient of reality also contains enduring material consequences. These make the cosmos a multilayer, multicolored superconductor." But Wilzcek and others mostly seems to apply quantum ideas to the EM, weak and strong forces. Because there still is not an accepted way to apply quantum ideas to gravity. A goal of this paper is to define and apply quantum gravity concepts in my Toy Gravity Universe all the way to a definition of the quantum graviton and a description of quantum gravity field and gravitational waves.

In this Toy Gravity Universe, and in its two subUniverses, there are quantum gravity changes of state between the states of matter, antimatter, CPT matter, and CPT antimatter. Some changes of state have a high quantum probability, others have a low quantum probability.

In this Toy Gravity Universe, I will give examples of elementary particles oscillating between the distinct quantum gravity states, i.e. +1, +i, -1, -i (where +1 and -1 have real number mass units and +i and -i have imaginary number mass units). These quantum gravity changes of state can sometimes be thought of as quantum rotation, for example when a +i antielectron rotates to become a +1 electron. This rotation concept comes easy when we think of rotating from +i to +1 in the complex plane. But mostly it is best to think of quantum gravity change of state as oscillations; because the oscillation involves quantum reasoning, e.g. a boson is the quantum superposition of states (i.e. rapid oscillation between states) of a particle and antiparticle.

Finally, these 4-quantum gravity states of mass/energy represent a new quantum symmetry that is very different than supersymmetry. Thus, the new quantum particles are not supersymmetry particles; they are merely Standard Model of Elementary Particles with additional quantum gravity mass numbers (+1, +i, -1,-i), i.e. quantum gravity charges. Previously, the Standard Model had only particles and antiparticles; which had the same quantum gravity mass number. So the antiparticles in this Toy Gravity Universe are slightly different than the antiparticles in the Standard Model of Elementary Particles.

Step 9 Infinities, Mathematics and Measurements

This Toy Gravity Universe and its two subUniverses and other two manifolds are not any of supersymmetry's landscape of 10^{500} universes. Physicist use infinities when they are useful; yet we have known for a long time that infinities can create problems and difficult paradoxes. We certainly do not want to get rid of the useful infinities including irrational or transcendental numbers. The difficulty is knowing when an infinity is useful and when an infinity is creating systematic errors. Renormalization for example is a group of techniques to deal with troublesome infinities. The renormalization can be a simple truncation of an infinite series; just throwing away the troublesome part. This is done because it works in giving a correct answer (i.e. one that agrees with experiment). This practice appears logically irresponsible; until mathematicians and physicists work out a consistent mathematical way of thinking about the physical situation.

A Euclidean universe brings with it the problems of infinite extent. And then classical theories (e.g. Newton's gravity and general relativity) bring with them problems of infinitesimal extent (i.e. singularities). Physicists are on the alert for the potential problems of these infinities. As well, sometimes nature, mathematics and a successful theory conspire to systematically misdirect scientific hypotheses toward misinterpretations of nature.

The Concordance Model of Cosmology essentially assumes a flat infinite expanding Euclidean universe, with little concern for the implicit problems of infinite extent. Whereas if we start with a very big locally flat circle, we have avoided infinite extent of a line. We use the Euclidean line, rather than the geodesics to measure distance on Earth; because the Euclidean line is easier to deal with mathematically than a circle. We have been trained to the bias of straight lines. Hence the different ways to map the 2-sphere curved surface of our Earth onto a flat Euclidean map. Maps of cities and small states have small distortion. But Euclidean world maps all have significant systemic distortions in terms of relative distance, size, shapes and relationship of countries and continents. Similarly, at great cosmic distances of our visible universe, a Euclidean flat model of the visible universe systemically distorts .

General Relativity uses non-Euclidean geometry. However Einstein's field equations are difficult to solve even approximately; so we have ended up with a flat expanding universe (essentially Newtonian/Euclidean) Concordance Model of Cosmology with pockets of non-Euclidean curvature (i.e. black holes using general relativity). And the Concordance Model just uses a flat Euclidean timeline from the white hole/big bang singularity phenomenon so long ago to 13.8 billion lightyears and beyond. It's easier to use flat space and time in the Concordance Model; but it is introduces systemic error and encourages unphysical gravitational thinking.

And whether you agree with me or not about systemic problems; I think you'll agree that astronomy and physics has several infuriating longstanding unsolved problems. In this Toy Gravity Universe, some of those unsolved problems will be solved; and some other "solved" problems will be reinterpreted.

Darwin's evolution[14] followed the observational evidence in a most logical way. Darwin had nothing but observation and logic; but that had enough foresight to agree with Mendel's quantitative experiments and modern mechanisms of RNA and DNA. Yes Darwin/Wallace's concepts have been adjusted a bit; but most biologists agree with Theodosius Dobzhansky that "Nothing in biology makes sense except in the light of evolution".

Physics and astronomy don't have a foundation idea like evolution. Neither the Concordance Model of Cosmology nor Supersymmetry are such foundation ideas. Supersymmetry wasn't driven by the needs of elementary particle physics; but by the needs of unsolved problems of cosmology. Supersymmetry offered the Concordance Model hope; which inspired much theoretical, observational, and experimental work. But 5 decades of null results, seriously strained the optimism which supersymmetry gave to the Concordance Model. As well, steps to merge general relativity with quantum mechanics have failed for decades. We are no closer to rapprochement between these two great theories. So somewhere we are harboring a systemic problem, a blind spot that is so insignificant or so apparently absurd that it is invisible.

All of the theoretical, experimental and observational knowledge of the last five decades is not wasted. It will be reapplied somewhere. Sabine Hossenfelder[10] suggests, "of all the scientific disciplines, physics deals with the simplest of systems, making it ideally suited for mathematical modeling." Well yes and no. As physics matures it is becoming more complex in the sense of biology. Thus, the mathematical modeling, which is a strength of physics; has become its Achilles heel. If you start with flawed physical assumptions, then mathematics and computers allows you very quickly and logically to reach superflawed conclusions.

Sabine Hossenfelder's excellent book, Lost in Math (how beauty leads physics astray), discusses the problems of physics. Hossenfelder says, "A census in 2014 counted 193 inflation potentials, and that was only with a single field. But theoreticians' ability to mind models that predict any possible future observations has just shown they can't predict anything… I don't have a miracle cure for the problems theoretical physicists are trying to solve, and if I told you I did, you'd be well advised to laugh me off… How long is too long to wait for a theory to be backed up by evidence? I don't know. I don't think this question even makes sense. Maybe the particles we are looking for are just around the corner and it's really only a matter of technological sophistication to find them." Well, maybe you, Hossenfelder and others should pause for a good laugh before continuing; because this paper offers some absurd answers. Yes haha, but please continue.

Physics and astronomy's foundation bias is expressed by almost all physicists and astronomers in those moments. Garrett Drapes[12] says, "All our successful theories are mathematical." Sabine Hossenfelder[13] also stands by math a bit too idealistically, "You can be wrong with math, but you can't lie." Well, these are significant biases honestly acquired by physicists. And despite this humble moment of soul searching at the beginning of the 21st century; when a new founding model of physics is needed once again; many theoretical physicists remain expert mathematical physicists; because they need do mathematics. But we do not need mathematics until some core physical idea with evidence, insight, hypotheses and logic is well enough understood as toy to begin building a mathematical model of precise predictions to test against our nuanced ephemeral paradoxical quantum visible world.

Lee Smolin[33] notes that, "Mara Beller, a historian who studied Niels Bohr's work in detail, points out that there was not a single calculation in his research notebooks, which were all verbal arguments and pictures." Robert B. Laughlin[7] further explains, "Good theoretical physics is actually more like art than engineering and is similarly difficult to summon up on demand, the physical idea precedes the mathematics, and the act of writing it down as a simple equation is like capturing a song or a poem." Carl Friedrick von Weizsacker[5] continues, "A scientific truth is almost always first surmised, then asserted, then fought over, and then proven."

Many modern physicists bristle at the idea that they are as biased and locked into group think as Max Planck suggested, "A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die and a new generation grows up that is familiar with it. . . An important scientific innovation rarely makes its way by gradually winning over and converting its opponents: it rarely happens that Saul becomes Paul. What does happen is that its opponents gradually die out, and that the growing generation is familiarized with the ideas from the beginning: another instance of the fact that the future lies with the youth."

Working on General Relativity from 1907 – 1912, Einstein had strong physical intuitive, rational concepts; but he did not have the mathematics to apply to his core physical ideas. Einstein needed the mathematical concepts and equations to build general relativity. Marcel Grossman, a friend and mathematician, helped Einstein find, learn and build the mathematics of General Relativity. Then from 1913 – 1915, Einstein built, worked through errors and published his theory. Hence, Einstein spent several intuitive years doing difficult conceptual physics; before he was ready to look for the right mathematical tool.

My point is that the physical concepts lead the mathematics. Supersymmetry was thought to be the necessary ingredient and the only candidate to merge general relativity and quantum mechanics. But with hindsight, it was a mathematically idea with hope, not with a gedanken experiment insight. So, when supersymmetry failed again and again, there was no protest that it had to be right; because of this or that physical insight.

I say that if an antimatter gravity experiment shows that antihydrogen falls either up or down; then the hypotheses of this paper fall like a house of cards. It is important for a scientist to think through the possibility of being incorrect. Nature's clues sometimes misdirect; and it is easy to misunderstand. I have thrown several ideas out in the writing of this paper; because they were incorrect. When I wake from a morning dream which shows that my idea of the night before is totally incorrect; I say, "Damn it." But then I say, "No need to hold onto a bogus idea." Scientific honesty requires me not only to accept evidence that destroys my best scientific ideas; it requires me to actively search for such contrary evidence.

And as we search for contrary evidence, we must take heed Darwin[14]'s words, "I had, also, during many years, followed a golden rule, namely, whenever a published fact, a new observation or thought came across me, which was opposed to my general results, to make a memorandum of it without fail and at once, for I had found by experience that such facts and thoughts were far more apt to escape from memory than favorable ones. Owing to this habit, very few objections were raised against my views which I had not at least noticed and attempted to answer." So yes, even Darwin had to fight his scientific biases.

Step 10 Cyclic Toy Gravity Universe

Let's begin to discuss the cyclic nature of this Toy Gravity Universe. Particles must continuously change state from subUniverse I to subUniverseR and vice versa. But how? Have patience as I layer concepts and build up an understanding of quantum gravity changes of state in this Toy Gravity Universe. Remember that one of these subUniverses is time forward and the other is time backward. But from within either subUniverse, it is fundamentally undecidable which subUniverse is time forward and which is time backwards; because it is a false choice. Time fundamentally being an illusion.

Both subUniverses are open systems; but it is fundamentally undecidable (in a Godel sense) whether the whole Toy Gravity Universe is an open or closed system. But of course, a closed or open approximation can be usefully applied to any subset of this Toy Gravity Universe. Such is only an approximation; because from one point of view that part (e.g. an electron) is closed; but from another point of view that part (e.g. an electron) is open. And which way we think of the part versus the whole (e.g. whether electron or Toy Gravity Universe) depends on what we are trying to understand, what problem we are trying to solve. To successfully navigate physics, we must think emergently. One set of "laws" apply best here but not there, another there but not here. Yes, we also think as reductionists, we try to reduce physics to just one law, a theory of everything. And we claim success, when two laws become one. But then again, we must be emergentists, expecting to find evidence which implies another new law of physics, a new way of thinking and understanding, where before there was not even a correct question.

We focus on evidence for a reversible universe or an irreversible one. But the evidence is conflicted as Ilya Prigogine[15] suggests when he asks, “Can Carnot and Darwin both be right?” In my Toy Gravity Universe the answer is yes.

The weak, electro-magnetic, and strong forces have attractive and repulsive forces; which are part of the equations, understanding and interpretation of those forces. And that understanding has been further expanded by merging those theories with quantum mechanics. Thus QED and QCD are working predicting testable growing areas of physics.

But neither Newton’s nor Einstein’s gravity has a repulsive force, as currently understood. Therefore, the Concordance Model of Cosmology enshrined Einstein’s “biggest blunder” as the only option and beefed up the cosmic fudge factor to mathematically fits the next unexplainable evidence that “appears as an accelerated inflating cosmos.” But the incorporation of a good mathematical fit into the Concordance Model of Cosmology does not mean that we understand the unexplainable evidence that “appears as an accelerated inflating cosmos.” We don’t understand “cosmic inflation”. So why do we write that lack of understanding into precise mathematical language? The term “cosmic inflation” is not an explanation based on physical understanding. The term “cosmic inflation” is the name given to the unexplainable evidence that we don’t understand. Naming does not solve, even when that naming is done in precise mathematical language. Mathematical arguments, like legal arguments, cut both ways; and victory does not mean correct.

This Toy Gravity Universe must agree with the “cosmic inflation evidence”, the “dark matter evidence”, and the “antimatter gravity evidence.” But it may disagree the obvious “cosmic inflation”, “dark matter” and “antimatter gravity” interpretations. The continued failure of the Concordance Model to explain the “cosmic inflation evidence”, the “dark matter evidence”, and the “antimatter gravity evidence”; suggests that the logic and reasoning is fundamentally incorrect. As well our inability to merge gravity and quantum mechanics suggests systemic misunderstanding of some fundamental concepts. Without understanding, difficult math can still be done; but it will not point to physically important predictions and experiments.

Feynman describes the problem of the Concordance Model very well, “Somebody makes up a theory: The proton is unstable. They make a calculation and find that there would be no protons in the universe anymore! So they fiddle around with the numbers, putting a higher mass into the new particle, and after much effort they predict that the proton will decay at a rate slightly less than the last measured rate the proton has been shown not to decay at. When a new experiment comes along and measures the proton more carefully, the theories adjust themselves to squeeze out from the pressure.” Ah hoc theories lead to ad hoc adjustments that continue and continue.

Now, in this Toy Gravity Universe, each subUniverse has a repulsive gravitational force that is much more subtle than the crude mathematical inflationary fudge factor fit (of the Concordance Model). In subUniverseR, there is a repulsive force of gravity that is very weak cosmically, when compared to the attractive gravitational force. The weakness of the repulsive gravitational forces is only because antimatter continually quantum transitions into matter. Nevertheless, a gravitational balance has been reached that fixes the size of subUniverseR at a radius of 13.8 billion lightyears. I will reinterpret the cosmic redshifts evidence, CMB evidence, and reinterpret a recent LIGO result.

The Concordance Model's description of attractive gravitational interaction is local, it applies from apples to galaxies. However, the Concordance Model's description of repulsive gravitational interaction is non-local, it seems to apply only between galaxies and beyond. These are both fair observations, which will need to be maintained while reinterpreted.

This Toy Gravity Universe' repulsive gravitational force is a result of the gravity gedanken experiment. Properly understood, that result is a very nuanced repulsive gravity force. Further analysis revealed also two nuanced orthogonal imaginary number forces that need further interpretation. These orthogonal imaginary number forces will be used explain the cosmic redshift evidence and the CMB evidence. These nuanced results unfold as logical consequences of the gravity gedanken experiment, as step by step.

The gravitational repulsive force in subUniverseR acts mostly in a non-local sense. However, In CERN's upcoming antimatter gravity free fall experiment; the annihilation location of antihydrogen atoms will be precisely recorded. This will be done to determine if antimatter falls down or up. These antihydrogen atoms will be contained for a long time after they are captured. This is done so that the antihydrogen atoms slow down and reach a low kinetic energy state. Gravity is 10^{-40} times weaker than the electromagnetic force; so, as much noise as possible needs to be eliminated from the experiment. This means, that if, as I predict, the CERN antimatter gravity result is null; that the CERN measurements, if precise enough, could separate the repulsive gravitational effect from the Brownian dispersion. Such a very difficult experiment may eventually be done with the necessary precision to measure the antihydrogen atoms repulsive gravitational force directly and thus G directly. That's a dream not a prediction.

The bias that matter is solid, indestructible, "real number" thing has survived from Democritus to Galileo to Newton to Einstein to perhaps even Heisenberg. Wilzcek says, "The mass of ordinary matter is the embodied energy of more basic building blocks, themselves lacking mass." But the possibilities of such an insight, only slowly emerges. The assertion that gravitational mass has 4 distinct quantum gravity charges +1, +i, -1, -i (where +1 and -1 have real number mass units and +i and -i have imaginary number mass units) would profoundly effect physics.

In subUniverseR, the repulsive gravitation forces is scattered pretty much randomly wherever virtual particles and antiparticles pairs are popping in and out of existence, which is anywhere. (this idea of virtual pairs be modified). But also our understanding of boson interactions will be reinterpreted in subUniverseR; because for example photons (with +E real number energy particle aspect and with +Ei imaginary number energy antiparticle aspect) are not their own antiparticle.

Step 11 The Black Holes / While Holes Gravitational Cycle Between subUniverses

There is a lot of nonsense about black holes and very little sense or nonsense about white holes (i.e. the "big bang"). To clarify black holes, I disregard general relativity inside the event horizon except to say that there is a singularity. However, I change the black hole general relativity singularity into a quantum gravity singularity. As for white holes, I only keep a quantum mechanical singularity and our visible universe. I throw away the entire timeline of the Concordance Model of Cosmology; but I keep most of the various explanations. But in this step, I will simply proceed with my description of a Toy Gravity Universe by connecting subUniverseR and subUniverseI via two singularities visually not physically yet.

The first quantum gravity singularity is a common singularity to all 200,000,000,000 supermassive black holes singularities in subUniverseR and to the one white hole singularity of subUniverseI. The second quantum gravity singularity is a common to all 200,000,000,000 supermassive black holes singularities in subUniverseI and to the one white hole singularity of subUniverseR.

Any verbal/visual description can of course be translated into a mathematical description. What I describe, perhaps wouldn't translate elegantly into a mathematically description. But, however crude mathematically, what I describe needs to make quantum gravity physical sense by the end of this paper.

Much excellent work has been done upon black holes, so before I get critical with my modest insights, let me humbly dedicate this section of my paper to Subrahmanyan Chandraeskhar, who showed us the meaning of persistence in the face of authority. Twice.

In subUniverseR, the event horizon of a black hole, is a mathematical 2-sphere. A squashed 2-sphere to be sure, because all black holes (like all atoms, all planets, all stars, all galaxies) in this Toy Gravity Universe are rotating. Now in subUniverseR, I ignore the black hole science fiction about astronauts happily drifting across the event horizon of a supermassive black hole and barely noticing anything until spaghettification begins. I accept everything outside of black holes including the event horizon; but inside the event horizon of a black hole, I only accept a quantum gravity singularity.

In subUniverseR, when matter or light crosses the event horizon of a black hole; it undergoes a quantum gravity change of state. Or, when a neutron star reaches the critical mass of a black hole, it undergoes a quantum gravity change of state. This phase transition is like water to ice or non-superconducting to superconducting. Specifically, the only type of matter that can exist at a quantum gravity singularity is bosonic. So every electron (and other fermions) that cross the event horizon of a black hole must quantum gravitationally transition into a boson.

In our Toy Gravity Universe, a particle (fermion or boson) has one or more of 4 quantum gravity states (i.e. +1, +i, -1, -i). With these 4 quantum gravity states (or charges), we begin to think quantum gravitationally about matter and energy in our Toy Gravity Universe.

Now at a black hole singularity, matter of gravitational charge +1, needs to become a boson; otherwise, all that mass and energy being gravitationally attracted across the event horizon of a black hole will not fit at the black-hole-quantum-gravity-singularity. In our Toy Gravity Universe, an electron becomes a quantum gravity boson when its superposed quantum gravity charge equals zero. In this Toy Gravity Universe, a quantum gravity boson is defined as a boson with superposed quantum gravity number = 0, superposed quantum mass value = 0, superposed quantum energy value = 0, integer spin number, and electric charge = 0.

In our Toy Gravity Universe, annihilation doesn't happen. What happens quantum mechanically at the singularity is that an electron (for example) quantum mechanically oscillates between the electron state (quantum gravity charge +1) and the CPT antielectron state (quantum gravity charge -1); and this oscillation (i.e. superposition) is a quantum gravity boson state of an electron +1/-1 at the singularity. Not an annihilation.

So at the singularity of the black holes of subUniverseR which is also the singularity of the white hole which is subUniverseI (details later); the electron from subUniverseR changes state to a quantum gravity +1 electron/-1CPT antielectron boson at black-holeR singularity/white-holeI singularity. We ignore the electromagnetic force here; because it is very easy to get confused. Just focusing on the quantum gravity description of action is enough.

This quantum gravity boson is a superposition of an electron of quantum gravity charge +1 and a CPT antielectron of quantum gravity charge -1. This superposition could be of a very high energy electron and a very high energy CPT antielectron. (see boson section below for more discussion), but the superposed quantum state has zero superimposed energy. We don't have two distinct particles; we don't have annihilation; we have a superposition of two particles; which is a quantum gravity boson with a superposed quantum gravity charge = 0, a superposed gravity mass = 0, a superposed gravity energy = 0, an integer spin, and an electric charge = 0. Thus, the +1 electron has undergone a phase change from a fermion to a quantum gravity boson.

Now, let's discuss the black holes and the big bang (i.e. white hole phenomenon) of our visible universe. In our visible universe there are many supermassive black holes at the center of every galaxy. But in our visible universe, there is only one big bang (i.e. white hole phenomenon). The Concordance Model of Cosmology has built up a whole story of our universe from the detailed "first 20 minutes after the big bang" until now, 13.8 billion years later.

For example, in December 2021, it was reported that galaxy GN-z11 was discovered at 13.4 billion light years from Earth; which means that the time necessary for a galaxy to evolve keeps dwindling, problem. The Mar 22, 2021 article How do supermassive black holes grow so large? They got too big, too fast, problem. These are only problems in the Concordance Model where our visible universe is only 13.8 billion years old. Maybe future observations and experiments will support theories that explain these problems. But for now, the Lambda-Cold Dark Matter (ΛCDM) universe, the current version of the Concordance Model of Cosmology, has no answer to these problems of not enough time for galaxies and supermassive black holes to develop.

Also, the Concordance Model has a credibility problem similar to Supersymmetry's. Just as the Supersymmetry theories increase the predicted mass of particles, when experiments do not find those predicted particles; so too, the Concordance Model decreases the time required development time to form galaxies or supermassive black holes, when observations find older galaxies and bigger supermassive black holes. In my mind, the collateral problems of Concordance Model will only increase as experiments and observations improve.

Importantly, subUniverseR has no problem accounting for the development time necessary for galaxies and supermassive black hole. Such problems are systemic problems invented not by physical evidence but by unphysical assumptions of the Concordance Model. But subUniverseR was not built with unphysical infinities; so in subUniverseR, we ignore the Concordance Model's metaphysical discussion of 10^{-43} seconds and 10^{32} kelvin. We keep to physically measureable predictions of processes. Quantum gravity progress is not possible through such mathematical extrapolation to the infinitesimal to the infinite. We have measured 10^{-21} seconds so measuring a process involving 10^{-25} seconds would be a difficult goal. The goal of my Toy Gravity Universe is understanding, describing and defining the quantum graviton and the quantum gravity field; while making qualitative predictions. Quantitative is too soon.

In a diplomatic way, Antonino Del Popolo[16] and Morgan Le Delliou in their review of ΛCDM problems suggest that, "At this stage, it is of fundamental importance to understand whether the problems encountered by the ΛDCM model are a sign of its limits or a sign of our failures in getting the finer details right."

In subUniverseR, each of the many supermassive black holes at the center of galaxies have a 2-spheres event horizon. And the entire subUniverseR 3-sphere is exactly the 3-sphere event horizon of the big bang singularity. This unsymmetric mathematical image (of a 2-sphere black hole event horizons and 3-sphere white hole event horizon is necessitated by the physical evidence that there is only one big bang/white hole phenomenon in our visible universe and that phenomenon is our visible universe. Yes, I assert that our 3-sphere subUniverseR is exactly the white-hole-event-horizon. The physical evidence suggests 2-sphere event horizon for black holes and a 3-sphere event horizon for our visible universe. Now from the inside, our 3-sphere subUniverseR appears to have a 2-sphere event horizon at 13.8 billion lightyears; which is exactly what 3-sphere appears exactly as a 3-dimensional ball with a 2-sphere event horizon.

So our Toy Gravity Universe has two singularities. The first quantum gravity singularity is the singularity which all of the supermassive black-holes of subUniverseR shares with the one singularity of subUniverseI. We notate as follows

- first QG singularity of Toy Gravity Universe is $\mathbf{\Sigma}BH_R/WH_I$-singularity.
- second QG singularity of Toy Gravity Universe is $\mathbf{\Sigma}BH_I/WH_R$-singularity

On the black hole side of these quantum gravity (QG) singularities, we have many 2-sphere event horizons in the appropriate subUniverse. On the white hole side of these singularities, we have a 3-sphere event horizon, which is identical to the appropriate subUniverse. That's how I visualize it. Given the physical clues, this is the simplest way I can visualize this Toy Gravity Universe. These QG **Σ**BH/WH-singularities are the major quantum cycle of material between subUniverseR and subUniverseI.

So in our subUniverseR, the big bang evidence is interpreted as being a 3-sphere that is exactly the subUniverseR. Now a 3-sphere is all volume without an area boundary; just as a 2-sphere is all area without a distance boundary. This is analogous to our 2-sphere surface of Earth which appears to have a circular (i.e. 1-sphere) horizon from any point on Earth; but really there is no such boundary edge. Just so for galaxies in our 3-sphere subUniverseR, there is no boundary area for a galaxy to be nearer to or farther from.

The Concordance Model of Cosmology (which is Euclidean infinitely flat) has this boundary problem, meaning that there is a kind of "absolute" location problem of galaxies relative to that boundary surface. Thus the Concordance Model of our visible universe is required to invent mathematical unphysical work arounds (i.e. the rest of our visible universe for millions of billions of lightyears is completely empty, so there is no chance of our inflating visible universe ever inflating into another Tegmark Level I universe sharing our infinite flat Euclidean universe, that by the way in principle could include an infinite number of such Tegmark Level I multiverses). In the Concordance Model, our visible universe is an ever expanding 3-d ball enclosed in a 2-sphere surface in a Euclidean flat, infinitely expanding space of nothing for a long distance. Thus, there are inherent infinite extent problems/contradictions in the

Concordance Model. A galaxy can be at the boundary of the visible universe, either the 13.8 billion lightyear event horizon of our visible universe, or the hypothetical much larger “invisible” 46 billion lightyears away boundary edge (due to the limiting velocity of c in carrying information to us) while this whole “finite” “observable” universe is expanding at a velocity greater than c. Much double-think and gratuitous mathematically sophisticated unphysical calculations are required to support these Concordance Model interpretation.

But in this Toy Gravity Universe, subUniverseR is simply a 3-sphere; which is an unbounded finite volume with no boundary condition to generate unphysical problems and their mathematical work arounds. Any galaxy placed randomly in subUniverseR can never be closer or farther away from a boundary area; because a 3-sphere volume has no boundary area; just as a 2-sphere area has no boundary line. The illogical thinking that requires a boundary line for the 2-sphere Earth’s surface; accepts the ideological compromise of a flat Earth. The illogical thinking that requires a boundary area for the 3-sphere universe; accepts the ideological compromise of a flat expanding visible universe.

When I assert that infinity of extent of the Concordance Model leads to a large number of unintended physical consequence; we must not pretend that Max Tegmark’s 4 levels of multiverses or Brian Greene’s 9 types of multiverses are not related to the Concordance Model. These multiverses are not even possible in this Toy Gravity Universe; they are direct systemic consequences of the Concordance Model. Since this Toy Gravity Universe does not allow infinities of extent, does permit changing of physical constants (i.e. constants are not variables), does not arbitrarily allow changing of physics equations, and requires physical evidence to test hypotheses; thus multiverses are not gratuitously allowed in this Toy Gravity Universe.

Let’s visualize in 2-dimensions. The Concordance Model in 2-dimensional space is like a circle with enclosed area on a flat expanding Euclidean plane. Now, if I place a galaxy randomly in that circle; there are boundary conditions. Of course, there is the speed of light, and the universe inflating faster than the speed of light, and the universe all starting at a gravitational singularity, and there is an event horizon beyond which an observer can never observe because of the speed of light. And these and other complication are all trying to accomplish one thing; to make the Concordance Model appear to be isotropic; which means the universe appears the same in every direction from every point. So the Concordance Model unlike the Flat Earth model has made itself isotropic by defining away the boundary problem.

That’s how math works; you can define anything with enough equations, even if those equations represent epicycles. Epicycles start with the observational evidence that planets appear to wander back and forth as they make their way around the night sky. But at some point the compounding with more epicycles, becomes impossible to deal with; Galileo’s observation of Jupiter’s moons was that impossible point for epicycles. But only because in Galileo’s time; there were no computers to handle an infinite series of epicycles.

Now let’s visualize subUniverseR in 2-dimensional space as a 2-sphere. It is curved like the surface of a ball. And though it is easier to visualize the 2-sphere subUniverseR as imbedded in 3-dimensional Euclidean space; that is not mathematically necessary, it is a mental crutch. The space of our 2-sphere subUniverseR (in our 2 dimensional visualization) need not be imbedded in any higher dimensional Euclidean space. The 2-sphere subUniverseR is the space, specifically

the space is the quantum gravity field. All these visualization crutches are for our puny human mind that is trying to understand the quantum gravity field that is composed of quantum graviton. We try and need to understand the quantum graviton interactions that compose the symphony of our visible universe. But the quantum graviton has no need for such self understanding, except in the sense that interaction is understanding; and being the quantum graviton, is being the quantum gravity field interacting with every particle, antiparticle, CPT particle, and CPT antiparticle. From one point of view we have an isolated quantum graviton; from another point of view we have the quantum gravity field, which is the entire curving space of our visible universe. But the quantum graviton "knows" its interactions and being beyond our puny explanations of physics and astronomy; which is why we keep measuring space and interpreting this or that distance measurement as a gravitational wave or noise.

We do thousands of experiments on electrons every day. We do those experiments; because we don't know what the electrons next interactions might be. Despite our significant scientific understanding of electrons; we just can't predict what an electron will do in this or that new situation. But the mind-boggling thing is that every electron; implicitly "knows" interactionally the ways of being an electron. Similarly quantum gravitons, which are space, "know" the interactions call the quantum gravity field which includes all of the visible unverses dynamic ever changing curvatures include gravitational waves. So we measure carefully interactions from LIGO experiments to crash test dummy test.

We can't predict the damage, injuries or survival in a 5 mph automobile crash into a brick wall; so we crash thousands of cars with crash test dummy to determine how a new automobile design performs in terms of damage, injuries and survival. Our universe is more complicated than automobiles and crash test dummies. A theory of everything must include a theory of 5 mph crashes of automobiles with crash test dummies into brick walls.

Back to our 3-sphere subUniverseR; the gravitons "know" exactly what being a graviton, being a quantum gravity field, being space is. The nothing of space is the elusive quantum graviton, quantum gravity field. The quantum gravity field arranges itself into the mathematical size and shape described as our 3-sphere subUniverseR of matter. As I describe the parts of this Toy Gravity Universe (i.e. CPT symmetric subUniverses, quantum singularities); try to think like a quantum graviton or a crash test dummy.

In thinking of subUniverseR as a 3-sphere; we also think of each galaxy as not being in a preferred position because 3-sphere space (like a 2-sphere space) has no boundary and no preferred position. This is part of what special and general relativity are about. And if we make a Concordance Model of Cosmology that implicitly has a boundary and thus preferred galaxy position; then we have already disagreed with the relativity of space and we have designed in all the systemic problems of an absolute space; regardless that our mathematical epicycles shout plausible deniability.

Galaxies do not occupy a preferred position in our 3-sphere subUniverseR; and supermassive black holes' event horizons are 2-sphere intersections with our 3-sphere subUniverseR. Yes, just as a 1-spheres (i.e. circles) intersect a 2-sphere (e.g. the surface of the Earth); so 2-spheres (i.e. black hole event horizons) intersect a 3-spheres (i.e. the white hole event horizon which is our subUniverses). From the quantum gravity $\mathbf{\Sigma}BH_I/WH_R$-singularity our 3-sphere subUniverseR,

which is the event-horizon-white-hole-R, emerges. GalaxiesR are within our 3-sphere subUniverseR. The 2-sphere black-hole-event-horizonsR are "within" galaxies and intersects our 3-sphere subUniverse.

Now we continue building this Toy Gravity Universe by connecting the 4 manifolds; subUniverseR and the subUniverseI, and the **Σ**BH_R/WH_I-singularity and the **Σ**BH_I/WH_R-singularity. In subUniverseR (our visible universe), supermassive black-hole-event-horizons at the center of galaxies attract +1 matter towards their BH-event-horizon. The +1 matter, that accretes around the BH-event-horizon at relativistic speeds, is reduced to +1 elementary particles. At the BH-event-horizon, +1 particles (still in subUniverseR) begin to oscillate toward a lower mass; but there is no lower mass except the -1 CPT antiparticle of subUniverseI. Thus the +1 particles begins to oscillate to the -1 CPT antiparticle. The quantum gravity oscillation frequency increases until the +1 particle and -1 CPT antiparticle are superposed, becoming one quantum gravity boson, +1 particle/-1 CPT antiparticle, at the of QG **Σ**BH_R/WH_I-singularity.

Now we will skip through the subUniverseI (which uses the same logic) all the way to the quantum gravity **Σ**BH_I/WH_R-singularity. At QG **Σ**BH_I/WH_R-singularity the QG bosons oscillate between -i CPT particles and +i antiparticles. There is a Hawking's radiation low probability of QG boson, radiating as a -CPT particle, back out of a black-holeI and back into subUniverseI. But there is a modest probability of the QG boson, radiating as a +i antiparticle, via the white-holeR phenomenon into subUniverseR, which is exactly the white-holeR event horizon. Now in subUniverseR, a -i antiparticle is only modestly stable; so with haste the -i antiparticle quantum gravitationally transforms into a +1 particle.

Now, some of you may be wondering where exactly are the two quantum gravity singularities? Well they are two 0-spheres at the centers of the two 3-sphere subUniverses. A 0-sphere is the point at the center of a 1-sphere, 2-sphere, 3-sphere or higher dimensional n-sphere. But why aren't the two 0-sphere at exactly the same point? My visualization suggests that one quantum gravity singularity is unstable; whereas two produce a stable Toy Gravity Universe. Also, when I talk about the quantum graviton, I will give additional physical reasoning.

Summarizing a bit differently, in Toy Gravity Universe, the sum of all black hole event horizons in the subUniverseR all share a common quantum gravity singularity with the one white hole event horizon that is subUniverseI. Thus for example, the superposed electron/CPT antielectron quantum gravity boson is sort of stable at the **Σ**BH_R/WH_I-singularity, its home environment. Like Hawking radiation, the electron has very low probability of radiating back out of the black hole into subUniverseR by the Unruh effect. It just does not want to quantum gravity transition back to being in the +1 matter electron state in the subUniverseR (the odds are totally against such a quantum events). However, the CPT antielectron aspect of this quantum gravity boson has a modest probability of quantum gravity transitioning out of that persistent **Σ**BH_R/WH_I-singularity manifold into 3-sphere white-hole-event-horizon manifold otherwise known as subUniverseI. It transitions to anyplace in 3-sphere subUniverseI; because no position is preferred, all positions are equally probable. i.e. continuous little bangs.

Now these CPT antielectrons are only modestly quantum gravitationally stable in subUniverseI, so they quickly quantumly transform to CPT electrons. CPT antielectrons do not annihilate CPT electrons, in subUniverseI; just as antielectrons do not annihilate electrons in subUniverseR.

CPT antielectrons repel all antimatter in subUniverseI (from subUniverseI POV). The stable quantum gravity charge in subUniverseI is -i. So, matter and energy of charge number -i gravitationally attracts (from subUniverseI POV) until it crosses the event horizon of a black-holeI in subUniverseI. Now, when the CPT electron crosses the event horizon of a black-holeI in subUniverseI; it undergoes a quantum gravity change into a quantum gravity boson. But this quantum gravity electron boson in the **Σ**BH_I/WH_R-singularity is different from the previous quantum gravity electron boson in the **Σ**BH_R/WH_I-singularity; it oscillates between -i CPT electron and +i antielectron.

Now the -i CPT electron / +i antielectron boson superposition at the **Σ**BH_I/WH_R-singularity has no quantum probability to quantum gravitationally changing back into a -i CPT electron and radiate back out of a black-holeI in subUniverseI. But the -i CPT electron / +i antielectron quantum gravity boson superposition at the **Σ**BH_I/WH_R-singularity has a modest probability to quantum gravitationally change into an +i antielectron and radiate into white-hole-event-horizonR which is our 3-sphere subUniverseR (our visible universe). In subUniverseR, this +i antielectron will for a very short time gravitationally repel other antimatter in our subUniverseR; before this +i antilectron quantum transitions into a +1 electron.

In this Toy Gravity Universe, the quantum annihilation of an antielectron does not occur, rather the antielectron spontaneously oscillates until it is gravitationally caught in the collective gravitation of subUniverseR and remains as a +1 electron. This explanation may seem gratuitous; it is not. It fits the physical evidence and suggests experiments to verify.

This Toy Gravity Universe is finite in extent, 6-dimensional of which 3 are real number dimensions and 3 are imaginary number dimensions. It is logically indeterminant in the Godel sense; that an observer in either subUniverse can't determine whether this Toy Gravity Universe is open or closed mathematically. Each subUniverse and each singularity manifold is mathematically open; although the thermodynamically closed approximation is often useful.

Traveling from one manifold to another (without quantum change of state) is not possible unless you are a graviton. Any molecule, object, being, planet approaching a black hole event horizon in either subUniverse will decomposed to bosons or fermions due to the matter and radiation swarming around the black hole event horizon. From the event horizon of the black hole of a subUniverse, fermions and bosons will phase transition into quantum gravity bosons at the persistent **Σ**BH/WH-singularities. Then from each **Σ**BH/WH-singularity, there will be quantum phase transition from that singularities quantum gravity bosons into antiparticles and bosons in the respective subUniverse. This persistent process is the white hole phenomena.

I don't pretend that this Toy Gravity Universe is an easy mathematical object to build from the verbal physical mathematical description of these two persistent subUniverses and these two persistent **Σ**BH/WH-singularities. But mathematicians and mathematical physicists are capable. If they understand the physical concepts and insights here, or elsewhere, as much as possible; they will build amazing Calabi-Yau 3-sphere fractal 6-dimensional complex number things of significant predictive use to experimentalist. But for us it is enough to visualize and physically understand with the help of physical insights, logic and visual/mathematical crutches.

Just because I am using mostly words to draw mental pictures, does not mean that logic is weak or flawed. It means that it is easier to visualize a man rotating in a Cyr wheel, than to write the equations of the biogeometric interaction. But visualization done carefully will guide the development of equations that represent the observed or hypothesized physical situation.

From the grand Toy Gravity Universe point of view, which sees the full black holes / white holes gravitational cycle between subUniverses; each subUniverse and **Σ**BH/WH-singularity is reversible at the elementary particle level, and sustainable at the manifold level. Although the probability of reversing the full black holes / white holes gravitational cycle between subUniverses is Hawkings radiation very improbable. Thus, practically each subUniverse and each **Σ**BH/WH-singularity is quantumly irreversible. At this point, subUniverseR and subUniverseI seem neither to be expanding nor contracting; they seem in a kind of cyclic interactive quantum gravity equilibrium. In each subUniverse there is a continual growth in order and complexity as new matter and energy enters each subUniverse; and there is a continual decay from macroscopic EM friction and gravitational attraction into oblivion as matter and energy leave each subUniverse.

Whether this Toy Gravity Universe is logically and mathematically perpetually sustainable or not; I leave to the logicians and mathematicians. Personally, I think it is mathematically undecideable, in a Godel sense, whether this Toy Gravity Universe is open or closed, perpetual sustainable or not.

Step 12 Cosmic Redshift Evidence and CMB Radiation Evidence

We still have the cosmic redshift data to reinterpret. But do we have the motivation? I mean if the Concordance Model "works" why fix it? But does it work? In our visible universe, there is no disputing the cosmic redshift data; it is credible. But the interpretation of the cosmic redshift evidence is not "rock solid" indisputable; because the Concordance Model of Cosmology rest upon several unphysical assumptions:

- A flat Euclidean universe of mathematically infinite extent
- A non-rotating universe, in a universe where everything is gravitationally rotating
- Cosmic inflation, which is mathematical fudge without physical understanding
- No rapprochement between quantum mechanics and gravity, in a cosmos ruled by gravity

We need to acknowledge that these create a systemic desert landscape ripe for burying our heads in the mathematical speculations of quantum gravity without a credible physical insight. Our fundamental misunderstanding of quantum gravity means that the Concordance Model of Cosmology is a systemic iceberg of misunderstanding, from cosmic redshift evidence to CMB radiation evidence and beyond. This Toy Gravity Universe will now clarify these issues. And continuing, we will see the quantum graviton; and also glimpses of the quantum gravity relationship to time, intrinsic spin, and quantum gravity conservation of energy.

Gustav Ichheiser[17] asserts, "Men of genius, endowed with exceptional insight concerning some aspects of reality which they are trying to explore, frequently develop equally striking blind spots concerning some other highly significant aspects of the very same reality." I quibble and would replace the phrase, "Men of genius" with "Women and men of intelligence".

Max Planck famously said, “A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it.” So it seems that Planck and Ichheiser agree. I’m a bit more optimistic.

How, in logic of this Toy Gravity Universe, do I reinterpret the cosmic redshift evidence and the CMB radiation evidence within a physically consistent, finite, nonexpanding subUniverseR? Let’s begin.

A photon travels in a “straight line” in the infinitely flat expanding universe that is the Concordance Model of Cosmology (aka whichever version you choose). Now if that photon travels towards us from near the event horizon of the visible universe (13.8 billion lightyears away); then that photon is very much redshifted. But we don’t understand why it has redshifted. Also, that star of origin so far away is right on the edge of visibility; approximately half of its light heads back into the visible universe towards us; and the other half of its light heads outside of the 13.8 billion lightyear radius of our visible universe, where no one in our visible universe will ever see it. Yes I know, the Concordance Model “explains” that the cosmic redshift evidence is caused by “cosmic inflation” which we don’t understand. Nice epicycle.

Case 1 Concordance Model. When the light from that distant star heads back into the visible universe, it come to us cosmicly redshifted; meaning that the photon lost energy in transit or upon arrival at Earth. Where did that missing cosmic redshift electromagnetic energy go?

Case 2 Concordance Model. When the light from that distant star heads out of our visible universe, it doesn’t matter whether it is cosmically redshifted or not. The question is then, where is all the photon’s electromagnetic energy going? In this case, the photons from that most distant star have left our visible universe and taken all of their energy with them. Whether that light is cosmically redshifted or not, is not important; because that light is leaving our visible universe with all of its energy. Wherever that energy is; it is not in our visible universe.

Different explanations used in the two cases in the Concordance Model of Cosmology; but all of these explanations are difficult to understand and in dispute among physicists. Some general relativists believe in the physicality of pseudo tensors; other physicist don’t believe in the physicality of pseudo tensors. Basically, the interpretations range from the energy is lost from our visible universe forever (hence no conservation of energy) to somehow the energy is conserved. There is no consensus on how or if energy is conserved in general relativity.

This problem is the tip of the gravitational iceberg problem; the larger part of the gravitational iceberg is lies under the ocean of cosmology. Whether Newton’s gravity, Einstein’s gravity, or a quantum gravity is used; if the spacetime used is of infinite extent a clear understanding of energy, time and gravity is not possible. The flat spacetime assumptions adds systemic noise that interferes with understanding quantum gravity; and the additional assumption of cosmic inflation adds even more systemic noise which creates additional systemic problems. My simple logic, my mathematical naivete, my Newtonian approach will achieve a much better understanding of quantum gravity; because it is built upon physical insight, in a finite 3-sphere Toy Gravity Universe without cosmic inflation.

The problem with “biggest blunders”, whether of Ptolemy’s epicycles or Einstein’s cosmological constant, is that the “biggest blunders” multiply in terms of unintended consequences; that pose as “reasonable” “physical” explanation. With this noise of unintended consequences, it is difficult to even verbally ask a right question to frame a predictive possible experiment. To derive a mathematically sophisticated answer without real physical understanding is hubris. Our physical world gives us the clues about how to logically explain our world in words and in mathematics. But the more we incorrectly mathematically explain our visible universe; the thicker that mathematical carpet of “biggest blunders” gets. Thread by thread the mathematical carpet is “repaired” to account for next unexplainable problem. And with every additional thread, it gets more likely that we will never replace that thick mathematical carpet and never “physically” explain “correctly” various physical evidence.

This is the point at which the mathematical junkies suggest that in the future artificial intelligence computers might create mathematical programs of the physical world that are “correct” but that we mere humans cannot understand. As if that is a justification for inventing mathematically sophisticated theories that can’t be communicated logically verbally. The more physical reality disagrees with the thick mathematical carpet (as it inevitably will); the more unlikely we are to even consider questioning our beautiful intricate mathematical carpet. We question the experiment, the precision, unrelated areas of physics; and we recheck our model and then we add a few more gratuitous mathematics threads to “fix” the problem. Because the mathematical carpet has gotten so very thick; it is “too big to move”; “too thick to even look under”; it is “too big to be incorrect”.

Emmy Noether showed the symmetry connection between time translation and conservation of energy. Very simply, if there is time translation; then there is conservation of energy. But if there is no time translation (i.e. no time); there is no conservation of energy.

Let’s play Maxell’s demon. Let’s sit upon a photon as it travels in subUniverseR. Well, we no longer have the infinity problem of where did the energy go, even if it is beyond the event horizon 13.8 billion lightyears of our 3-sphere subUniverseR. Because just as the perceptual event horizon of a 2-sphere (i.e. the surface of the Earth) looks like a distant circle (i.e. a 1-sphere) from anywhere upon a 2-sphere (i.e. the surface of Earth); the perceptual event horizon from inside of a 3-sphere (i.e. subUniverseR) always looks like a 2-sphere from anywhere within subUniverseR. Thus the energy of the photon must always be in subUniverseR even if it is beyond the perceptual event horizon. And that photon will follow a geodesic in subUniverseR until it is absorbed somewhere in subUniverseR. Right? Notice I am using the term perceptual event horizon (which is a 2-sphere) to distinguish it from the gravitational event horizons which is the the entire 3-sphere that is subUniverseR.

So the question of where the energy goes when the photon leaves the visible subUniverseR (which is bound by a perceptual event horizon) is that it stays in subUniverseR; because gravity holds it to geodesics of subUniverseR’s 3-sphere curvature. And as well since subUniverseR is not expanding (at speeds greater than c), there is no energy problem of photons from hypothetical stars outside the perceptual event horizon of our visible subUnivereR entering the visible portion of subUniverseR. Such photons are all within subUniverseR gravitationally. Some photons leave the perceptual event horizon, some photons enter the perceptual event horizon. OK that was easy.

But what about the cosmic redshift evidence? Even in this curved, finite, non-inflating 3-sphere subUniverseR; we still have the cosmic redshift evidence to explain. Specifically, when a photon is “cosmically” redshifted (and hence loses energy); where does that energy go?.

The Concordance Model of Cosmology answers the question of what causes the cosmic redshift evidence by inventing “cosmic inflation” that “causes” space to expand and thus causes the photon wavelength to expand as space expands; thus the photons “cosmically redshifted”. This epicycle argument though rich in mathematics is devoid of physical insight and understanding. Cosmic inflation is a mathematical fudge. Nobody knows why the cosmos inflated (or not).

Now I will again become a Maxwell demon; this time I will sit upon a photon travelling around our 3-sphere subUniverseR. Of course, this is not really a reference frame in special relativity, but a Maxwell demon may observe something useful anyway (without violating special relativity). I am ready; a photon is emitted from a distant star; as I jump on, I note the photon’s energy (uncertainty prinicples don’t apply to Maxwell demons); the ride is uneventful as the photon follows the curvature of subUniverseR; then my photon crashes into an observerR’s spectrometer; I noticed that my photon transfers less energy than the photon had gained when it was emitted long ago from a distant star. That is the cosmic redshift. What is going on? Where did that energy go? I, Maxwell’s demon, have been sitting upon this photon wavicle the entire trip without so much as a quantum hiccup. Did I miss something unusual during my trip?

Yes, but what? I reflect. As I traveled around that 1-sphere subUniverseR (a 1-sphere is easier to visualize than a 3-sphere); I did not notice any persistent attractive gravitational force that was attracting my photon more strongly from in front or from behind. There were on average as many galaxies and stars in front as from behind; so the overall attractive gravitational force from the entire subUniverseR of all +1 matter (e.g. dust, star, planets, galaxies) and the +1 E energy basically all cancelled out. (nice place to think discussion about inertial mass)

So the cosmic redshift was not due to the attractive gravitational force as I traveled around subUniverseR from point of emission to point of absorption. Hmm? What kind of Maxell Demon am I? I must think; I must observe.

Again I ride the photon. Hmm? This time I felt a slight persistent attractive orthogonal force in the direction +i of subUniverseI. This was surely due to +i attractive gravitational force between the +1 matter (e.g. dust, star, planets, galaxies) and the +i Energy of the antiparticle aspect of the photon upon which I, Maxwell’s demon, was riding. Ahha. Of course, this +i attractive gravitational force produced a barely notices +i acceleration of my photon toward subUniverseI. And now that I think about it. And so what?

Ahha, I look in the -i direction of subUniverseI; and I barely notice an Unruh effect. It was ever so slight; but as I (a Maxwell demon) circled subUniverseR, I was simultaneously attracted (i.e. accelerated) towards +i subUniverseI and simultaneously I saw an Unruh effect emitting radiation (so to speak) into -i subUniverseI direction; which was the opposite orthogonal direction of subUniverseI to which the photon was being attracted (i.e. accelerated).

This Unruh radiation is very strange. But in that accelerated state, I (a Maxwell demon) could see Unruh effect radiation specifically -1/-i CPT photons being emitted into the -i direction of

subUniverseI by a +1/+i photon in subUniverseR traveled in the +1 direction in subUniverseR. Yes I, a Maxwell Demon, (but not an observerR) can see an -1/-i CPT photons being emitted in the -i direction of subUniverseI. Ahha. So the missing energy inferred from the "cosmic redshift evidence" of the +1/+i photon (upon which I riding) was quantum gravitationally emitted out of our subUniverseR as a -1/-i CPT photon being emitted non-locally in the -i direction of subUniverseI. So a travelling photon in subUniverseR locally lost +1/+i energy by emitting a CPT photon into subUniverseI which non-locally gains -1/-i energy. Thus at the Toy Gravity Universe level energy seems conserved. Both real and imaginary number values of photon energy are conserved at the Toy Gravity Universe level.

But wait a minute. The same process is going on with a travelling CPT photon in subUniverseI losing -i/-1 energy by emitting a photon into subUniverseR which non-locally gains +1/+i energy. Ahha, when subUniverseR loses photon +1/+i energy as the local cosmic redshift phenomenon; subUniverseR gains (on average) photon +1/+i energy as the non-locally CMB evidence. Meaning these two phenomenon cannot be causally connected in subUniverseR by an observer. They can only be causally connected by considering the cosmic redshift/CMB radiation phenomenon as a inter-subUniverse quantum phenomenon. Meanwhile same interpretation is discovered by my CPT symmetric twin in subUniverseI. Joking.

Nice, we now have a balance of photon exchanges across subUniverses that on average results in the apparent conservation of energy within each subUniverses.

Prediction: the sum of cosmic redshift radiation energy loss from subUniverseR (to subUniverseI) equals the sum of CMB radiation energy gained to subUniverseR (from subUniverseI). So energy is only "apparently" conserved in subUniverseR..

$$-\Sigma_{Energy} \text{ cosmic redshift evidence} + \Sigma_{Energy} \text{ CMB radiation evidence} \approx \text{zero}$$

Nevertheless to an observerR, it appears that conservation of energy is violated; because there is not a local causal connection between local "cosmic redshift evidence" (i.e. loss of energy) and non-local "CMB radiation evidence" (gain of energy) in subUniverseR. However, I, a Maxwell demon, can attest that the energy lost from subUniverseR (to subUniverseI), that was observed as the "cosmic redshift evidence", is approximately equal (on average) to the energy gained to subUniverseR (from subUniverseI), that was observed as "CMB radiation evidence" in subUniverseR. Thus on average subUniverseR maintains constant energy; which is not the same as conservation of energy.

So summarizing again: As a +1/+i photon travels across subUniverseR; its +i antiparticle aspect gravitationally interacts with all + matter in subUniverseR. This gravitational interactions results in a +i orthogonal gravitational force; which accelerates the photon gravitationally toward subUniverseI. However, this acceleration of the subUniverseR photon in the +i direction toward subUniverseI; results in an equal and opposite Unruh effect in which a -i/-1 CPT photon (or equivalent) is emitted in the -i direction into subUniverseI. This loss of +1/+i photon energy results in an observerR noticing the "cosmic redshift evidence" in which a photon travelling across subUniverseR loses energy. It is unknown where and how this energy is lost in subUniverseR. Also, in subUniverseI a -i/-1CPT photon similarly emits a +1/+i photon in the +1 direction into subUniverseR. An observerR notices these non-local +1/+i photons in

subUniverseR as “CMB radiation evidence” (cosmic microwave background radiation) of unknown origin. Eventually multiple explanations are given for the “unrelated” cosmic phenomena of “cosmic redshift evidence” and “CMB evidence”. The cosmic “identity” between these apparently unrelated cosmic phenomena is not realized until inter-subUniverse quantum gravity interactions between subUniverseR and subUniverseI are understood

Further as a Maxwell demon, let me assert the following without proof. Time in both subUniverseR and subUniverseI is a local phenomenon; thus, the cosmic redshift is a local phenomenon in both subUniverses and the CMB is a non-local phenomenon in both subUniverses. A clear sense of time is only observed in the local closed system approximation in subUniverseR and subUniverseI. In those thermodynamic closed system approximations of subUniverseR, time exist and can be measured by various clocks; and when time exists, conservation of energy is present. So why does conservation of energy apply in subUniverseR regarding the cosmic redshift and the CMB? It doesn’t. In subUniverseR without the subUniverseI assumption, the prediction

$$-\Sigma_{Energy} \text{ cosmic redshift radiation} + \Sigma_{Energy} \text{ CMB radiation} \approx \text{zero}$$

is a mathematical coincidence, if it was even noticed. And physical causal reasoning within subUniverseR, to explain the loss of energy due to the cosmic redshift and to explain the gain of energy from CMB radiation, would be incorrect in our visible subUniverseR without the understanding of a subUniverseI. Thus, the mathematical equations, logic and “physical reasoning” supporting the local incorrect explanation for “cosmic redshift evidence” and supporting the non-local “CMB radiation evidence” would simply be threads of the increasingly thick mathematical unphysical carpet known as the Concordance Model of Cosmology.

If allowed to continue to grow, the Concordance Model of Cosmology will not only become thicker, more deeply rutted, and impossible to move; in time the Concordance Model of Cosmology would become a mathematical magic carpet with no connection to reality. It would have explanatory power without predictive power. Each new physical observation would need to be individually threaded (i.e. updated) by the “scientists” or better yet the artificial intelligence computer without physical understanding. Physical understanding of the physical evidence would no longer be possible or necessary; mathematical data fitting would be all there is. As in the Hitchhiker’s Guide to the Galaxy, the supercomputer’s ultimate answer is 42.

Some would say that it is hubris to expect or believe that we can understand the world in any significant way; that even our best reasoning and understanding is only an illusion that is useful. And those who believe such; might argue that a useful mathematical carpet that delivered results without a shred of physical insight or understanding would be quite wonderful. I disagree.

The paradox of the “cosmic redshift evidence” and “CMB radiation evidence” in our subUniverseR is only resolved by understanding clearly the physical situations in which our subUniverseR may usefully be thought of as open and interacting with subUniverseI. Assuming that CERN’s upcoming antimatter gravity experiment achieves a null result; then this Toy Gravity Universe explanation of the cosmic redshift and the CMB radiation is correct. If not, well then, this Toy Gravity Universe is a very interesting pink elephant. Read on anyway.

The non-local physical understanding and logic that I used to interpret the cosmic redshift evidence and the CMB evidence in a 1-sphere, noninflating subUniverseR; is exactly the same non-local physical understanding and logic needed to interpret the cosmic redshift evidence and CMB evidence in a 3-sphere, noninflating subUniverseR.

The Concordance Models of Cosmology is a dead end; it has no new hypotheses to test. It no longer is a useful catalyst to experiment or observation. It is a mathematical magic carpet that clutters and obscures correct physical interpretation of observational and experimental evidence. Yet there is a larger momentum of support among physicists and astrophysicists for the Concordance Model of Cosmology; than for supersymmetry. That will change as experiments and observations improve and as results predicted by quantum gravity of this Toy Gravity Universe are confirmed.

Could I be wrong? Of course, even if this Toy Gravity Universe is somewhat correct, e.g. correctly predicts the CERN null antimatter gravity result, we know that this Toy Gravity Universe, like every model, has a domain of relevance, limits to its usefulness; beyond which it is incorrect. Nature is more surprising than any toy, as is the mind at play.

By the way, the missing 95% of the mass and energy of our visible universe is not a problem; considering our complete lack of understanding of quantum gravity, it is a rounding error. Also, the problem of the cosmological constant disappears in this Toy Gravity Universe because no cosmological constant is necessary. So back to zero, which makes sense as we shall see. When we have a more correct understanding of quantum gravity; new interpretations will arise from the enrichment of concepts such as quantum gravity charge.

The biggest lesson, from the failure of Supersymmetry; is that elegant mathematical models with weak physical insight lead to collateral systemic unsolvable physics problems. In my mind, the Concordance Model of Cosmology shares in the disrepute of supersymmetry; because it firmly hitched the problems of cosmology to the possibilities of supersymmetry. But the Concordance Model failure is bigger that the failure of supersymmetry; because the Concordance Model accepted the unphysical mathematical infinity of spatial extent and the unphysical explanation of cosmic inflation to "explain" the physical cosmic redshift evidence. Whereas Supersymmetry at least hitched its ideas upon the success of physical evidence. In effect Supersymmetry said, "We predict particles, and if you don't find them; then supersymmetry is incorrect." But the Concordance Model of Cosmology had no if/then implicit scientific failsafe statement. Instead of "if this prediction is incorrect; then this theory is incorrect", the Concordance Model of Cosmology has been very comfortable wearing its unphysical assumptions; and thus destined itself to become a thick rutted mathematical magic carpet unrooted from physical evidence and insight. In other words, the Concordance Models of Cosmology has no clothes.

Step 13 Bosons Versus Quantum Gravity Bosons

What form of matter/energy could possibly be stable at a point of quantum gravity **Σ**BH/WH-singularities? Bosons. Thus, all matter and energy must quantum transition to bosons at the event horizon of black holes and all bosons must transition to fermions and appropriate bosons at the event horizon of white holes.

"Matter is not what it appears to be. Its most obvious property -variously called resistance to motion, inertia, or mass- can be understood more deeply in completely different terms. The mass of ordinary matter is the embodied energy of more basic building blocks, themselves lacking mass. Nor is space what it appears to be. What appears to our eyes as empty space is revealed to our minds as a complex medium full of spontaneous activity." Frank Wilczek[8]

In physics quasiparticles are emergent particles based on collective phenomenon of real particles. Thus, electron holes are the absence of an electron in a collective atomic grid of electrons. And when an electron hole moves and is measured, actual electrons move in the opposite direction. Similarly, a bubble of air floating upward in the water, can be thought of a quasi-water-droplet. As the quasi-water-droplet (i.e.bubble) rises, the actual water moves down and around the quasi-water-droplet. So, a mathematics of quasi-gravity could be defined empirically for bubbles moving upward in water, oil, honey and so on. So, in physics a quasiboson, is a quasi-particle that behaves like a boson. A phonon is a quasi-boson, just as a photon is an actual boson.

In subUniverseR the intrinsic spins of particles and antiparticles are the same as in the visible universes' Standard Models for elementary particles. However, the mass and energy is different. In the Standard Model of Elementary Particles, the gravitational mass of a photon is exactly zero and the energy of the photon is a positive real number +E. But in our subUniverseR, the gravitational mass of a photon is zero, i.e. 0 + 0i, but the energy of the photon is +E +Ei, where E is a real number and Ei is an imaginary number. So a photon's quantum gravity charge is a superposition of 1 + 1i which is not equal to zero. But the imaginary number energy +Ei part would not effect Eddington's 1919 gravitational eclipse observation.

So, the definition for a boson is the same in my Toy Gravity Universe as in our visible universe, in that a boson is composed of a particle and an antiparticle aspects; however, the boson of this subUniverseR is a different object than that of our Standard Model's of Elementary Paricles. So, there are subtle predictions and careful experiments that could test whether Toy Gravity Universe's bosons are more correct than Standard Model of Elementary Particles' bosons.

Also, in my Toy Gravity Universe, there is another type of boson, which I call a quantum gravity boson. A quantum gravity boson has zero charge, zero superimposed quantum gravity mass, integer spin, and zero superimposed quantum gravity energy value.

In this Toy Gravity Universe, there are 2 subUniverses, subUniverseR (our visible universe) and subUniverseI; there are also two quantum gravity singularities, the BH_R/WH_I singularity is shared by all black holes in subUniverseR and the one white hole that is subUniverseI; and the BH_I/WH_R singularity is shared by all black holes in subUniverseI and the one white hole that is subUniverseR. And these four spaces or manifolds of our Toy Gravity Universe form a persistent irreversible quantum gravitational cycle:

→ subUniverseR → BH_R/WH_I singularity → subUniverseI → BH_I/WH_R singularity →

And the matter and energy of our subUniverseR moves through this entire quantum cosmic cycle repeatedly. With all of the various quantum changes of state of gravity that we'ver discussed and of the other forces which we will not discuss here. And each stage in this cycle in a sense is dominated by one of the four quantum gravity charges.

+1, subUniverseR → -1, BH_R/WH_I singularity → -i, subUniverseI → +i, BH_I/WH_R singularity

And at each stage in this quantum gravity cycle, the overall quantum probability favors transitioning forward. For example, Hawking radiation probability of quantum transitioning a singularity back out the black hole event horizon to a subUniverse is miniscule because of the extreme gravitational attractive force keeping matter (or CPT matter) at the singularity. On the other hand, the probability of quantum transitioning from a singularity by the repulsive gravitational force on antimatter (or CPT antimatter) is a high probability event

Matter of subUniverseR is decomposed to bosons or elementary particles in the accretion disc of radiation and matter swarming around the event horizons of black holes in subUniverseR. Nor is crossing the event horizon of a supermassive black hole a calm event.

The event horizon of a black hole is of physical interest as a quantum phenomenon, not as a general relativity phenomenon. At the event horizon of a black hole all matter and energy has already been decomposed to bosons or elementary particles. The next step is a quantum phase transition to the quantum gravity singularity of the black hole. And the only kind of "particle states" that can exist at a quantum gravity singularity are quantum gravity bosons; which have zero charge, zero mass, integer spin, and zero superimposed quantum gravity energy value.

Let's be specific. In our visible universe of the standard models, a photon is its own antiparticle. However, in our Toy Gravity Universe, the definition of an antiparticle is slightly different. In subUniverseR, a photon has zero mass, integer spin, zero charge but it has two quantum gravity numbers +1 and +i; thus a photon has an energy value of +1E +iE. In our Toy Gravity Universe, a photon's imaginary number energy antiparticle aspect is not locally observed in subUniverseR.

So, to create a quantum gravity boson out of a photon at the singularity (of a subUniverseR Black Holes and the subUniverseI White Hole) we need the subUniverseR photon to transition to a photon/CPT photon superposition; where a photon has quantum gravity charge of +1/+i (i.e. particle/antiparticle aspects) and a CPT photon has quantum gravity charge of -i/-1 (i.e. CPT particle/CPTantiparticle aspects). Thus this quantum gravity boson, superimposed of a photon and an CPT antiphoton, has zero mass, integer spin, zero charge, zero superimposed quantum gravity charge number (i.e. superimposed of +1, +i, -i, -1), and zero superimposed quantum energy (i.e. +E, +iE, -iE, -E). And this quantum gravity boson is the spin 2 quantum graviton in our Toy Gravity subUniverse.

Before dismissing, please consider what the late Fred I. Cooperstock[18] said in his 2008 book General Relativistic Dynamics. "We have carefully avoided the use of the word "radiation" in connection with gravity waves. This is because the word "radiation" connotes an energy flow and we have assembled reasons to question whether these waves, whose existence we do not doubt, actually convey energy… *The hypothesis is that energy, including the contribution from gravity, resides in the regions where the energy-momentum tensor in non-zero*… The implication of the localization hypothesis is striking: since the energy-momentum tensor vanishes in vacuum, gravity waves cannot convey energy through the vacuum… a very profound thinker in the person of Synge suggested to us that consideration should be given to the possibility that the very concept of energy simply does not belong within general relativity."

So my Newtonian analysis, that has been carried out to the logical interpretation/definition of a quantum graviton (and hence a gravity wave) that has zero superimposed quantum energy, agrees with Cooperstock's general relativistic analysis that a gravity wave carries zero energy.

Of course, Professor Fred I Cooperstock, late emeritus professor at the University of Victoria, Canada was ignored in regard to his hypotheses that "gravity waves cannot convey energy through the vacuum" and his papers, showing that general relativity does not require dark matter to explain galaxy rotation, were actively dismissed. Cooperstock[18] explains, "We see that when our premier theory of gravity, general relativity, is brought into the analysis, the observed flat galactic rotation curves linked to essentially flattened disks can be realized with no evident need for exotic dark matter." I recommend a reread of Cooperstock's papers and book.

Interlude: Gravitation "~~Energy~~" Waves Detected?

February 2016, Nature[19] reported, "This is the first black-hole merger that scientists have observed. The violent event temporarily radiated more energy — in the form of gravitational waves — than all the stars in the observable Universe emitted as light in the same amount of time… But direct detection of the waves had to await the sensitivity achieved by Advanced LIGO, which can detect stretches and compressions of space-time that are as small as one part in 10^{22} — comparable to a hair's-width change in the distance from the Sun to Alpha Centauri, the nearest star to the Solar System."

Well this LIGO concept of gravitational wave energy disagrees with Fred I. Cooperstock's[183] understanding "We have carefully avoided the use of the word "radiation" in connection with gravity waves. This is because the word "radiation" connotes an energy flow and we have assembled reasons to question whether these waves, whose existence we do not doubt, actually convey energy… *The hypothesis is that energy, including the contribution from gravity, resides in the regions where the energy-momentum tensor in non-zero*… The implication of the localization hypothesis is striking: since the energy-momentum tensor vanishes in vacuum, gravity waves cannot convey energy through the vacuum… a very profound thinker in the person of Synge suggested to us that consideration should be given to the possibility that the very concept of energy simply does not belong within general relativity."

I need to focus upon these difference concepts of gravitation "energy" waves. Either I misunderstand gravitational "energy" waves; or the LIGO gravitational wave detection team misunderstands gravitational "energy".

Of course, Rainer Weiss, Barry C. Barish, and Kip S. Thorne were awarded the 2017 Nobel Prize in Physics for "for decisive contributions to the LIGO detector and the observation of gravitational waves". So let me see what is being said about that.

I had not planned on discussing LIGO and Gravitational Wave Detection. But gravitational waves have gained prominence and I need to understand how they fit in the framework of gravitational understanding that is this Toy Gravity Universe. My default bias is that with great difficulty the LIGO team determined places to look for gravitational waves (e.g. binary black holes), designed and built a gravitational antennae, detected much noise and learned how to rule it out; and finally detected gravitational waves. But I don't know where team LIGO stands in

terms of whether gravitational waves carry energy or NOT. If their reasoned understanding is that gravitational waves carry energy; then I respectfully disagree. So here I begin to understand LIGO's views on gravitational wave energy.

In the 2016 LIGO announcement and paper B. P. Abbott et al.*, Observation of Gravitational Waves from a Binary Black Hole Merger[17], the word "energy" was only tangentially written. So, I decided to read the Weiss, Barish, and Thorne's Nobel lectures; because I expect these to be clearly written without technical jargon.

In Nobel Lecture, Rainer Weiss[21] says the word "energy" in one sentence, *"The gravitational waves carry energy as well as linear and angular momentum."* This sentence occurs in a historic discussion paraphrasing Einstein's thinking.

In Nobel Lecture, Barry C. Barish[22] explains the experiment, "THE BLACK HOLE MERGER EVENT (GW150914) The observation of the first Black Hole merger by Advanced LIGO was made on September 14, 2015… The two black holes inspiral and merge together due to the emission of gravitational radiation coming from the accelerations… the two objects were moving at about three-tenths the speed of light and that increases to over half the speed of light by the time of the final merges!... Using numerical simulations to fit for the black hole merger parameters, *we determine that the total energy radiated into gravitational waves is 3.0 ± 0.5* M_o c^2 … MORE BLACK HOLE MERGERS The first Advanced LIGO data run continued for four months, from September 2015 to January 2016… Assuming that gravitons are dispersed in vacuum like massive particles, then the bound on graviton mass is $M_g < 7.7 \times 10^{-23}$ eV/c^2… SCIENCE IMPLICATIONS OF THE OBSERVED BLACK HOLE MERGERS… We have every reason to expect that we will discover new phenomena and learn 'new' astrophysics from gravitational waves… Our other major scientific goal is to test general relativity in the important regime of strong field gravity…" LIGO "*Using numerical simulations to fit for the black hole merger parameters, we determine that the total energy radiated into gravitational waves is 3.0 ± 0.5* M_o c^2." So they don't measure the energy carried by the gravitation wave. "The Initial and Advanced LIGO gravitational wave detectors are Michelson interferometers with 4 km long arms. Both use Fabry-Perot cavities to increase the interaction time with a gravitational wave, and power recycling to increase the effective laser power."

So Barish mentions the word gravity in two sentences (*italics mine in quotes from all 3 Nobel Lectures*). My read of Barish is that LIGO measures the tiniest wobble wobble wobble of the fabric of space due to a gravitation wave from a binary star. But LIGO used information from photon telescopes to determine the size of the binary black hole merger; and from that LIGO calculated the energy of collision, and team LIGO assumed that the energy of collision was transferred to the gravitational wave. I disagree with that interpretation. I guess team LIGO believe gravitational waves carry energy.

Continuing in Nobel Lecture, Kip S. Thorne[23] says, "Gravitational waves, by contrast, are oscillations of the "fabric" or shape of spacetime itself… Astrophysical gravitational waves, by contrast, are emitted coherently by the bulk motion of mass or energy… Gravitational waves are never significantly absorbed or scattered by matter, even when emitted in the earliest moments of the Universe's life… *The waves here depicted are from: • Supernovae (SN), that is, the implosion of the core of a normal star to form a neutron star, releasing enormous gravitational*

energy that blows off the normal star's outer layers. • Compact-binary destruction (CBD), that is, the inspiral and merger of binaries consisting of two black holes, two neutron stars, or a black hole and a neutron star… ***It is remarkable that gravitational astronomy gives us the binary's distance r but not its redshift z (fractional change in wavelengths due to motion away from Earth), whereas electromagnetic astronomy, looking at the same binary, can directly measure its redshift but not its distance***… The waveforms from BBH (binary black holes) collision and merger carry detailed information about geometrodynamics: the nonlinear dynamics of curved spacetime… John Wheeler identifed geometrodyamics as tremendously important. It is the arena where Einstein's general relativity should be most rich, and deviations from Newton's laws of gravity should be the greatest. Black hole collisions, Wheeler argued, would be an ideal venue for studying geometrodynamics… In these simulations the two holes collided head on and merged to form a single, highly distorted black hole that vibrated a few times (rang like a damped bell), emitting a burst of gravitational waves, and then settled down into a quiescent state. Here we had, at last, our first example of geometrodynamics… The primary target of these collaborations is gravitational waves from gigantic black hole binaries, weighing ~10^8 to ~10^{10} suns… In the low-frequency band, LISA should see mergers of very massive black holes (~ 10^3 to ~10^8 solar masses)… Exploring the First One Second of our Universe's Life… Among the predictions that such observations might test is the origin of the electromagnetic force —one of the four fundamental forces of Nature. Theory predicts that, when the universe was very young and very hot, the electromagnetic force did not exist. In its place there was an electroweak force. As the universe expanded and cooled through an age of ~10-11 seconds and a temperature of ~1015 K, there was, according to theory, a phase transition in which the electroweak force came apart, giving rise to two new forces: the electromagnetic force, and the weak nuclear force… As the universe expanded, the wavelengths of these waves also expanded, until today, 13.8 billion years later, the wavelengths are expected to be in LISA's frequency band. One of LISA's goals is to search for these stochastic gravitational waves produced by the birth of the electromagnetic force. LIGO could see gravitational waves produced by a similar frst-order phase transition when the universe was far younger, ~10^{-22} seconds, and far hotter, ~10^{21} K."

These three Nobel Lectures, on the successful detection of gravitational waves from "THE BLACK HOLE MERGER EVENT (GW150914)", mention the word "energy" only four times.

Weiss explains, "gravitational waves carry energy". Barish explains, "Using numerical simulations to fit for the black hole merger parameters, we determine that the total energy radiated into gravitational waves is $3.0 \pm 0.5\ M_o\ c^2$ ". Thorne explains, "the implosion of the core of a normal star to form a neutron star, releasing enormous gravitational energy that blows off the normal star's outer layers… Astrophysical gravitational waves, by contrast, are emitted coherently by the bulk motion of mass or energy."

It seems that LIGO team is confidence in their detection of gravitation waves; and they are confident that gravitational waves are emitted by "the bulk motion of mass or energy". However, in my opinion the LIGO experiment has added nothing to the discussion of whether gravitational waves carry energy or not. they have no idea of whether their detected gravitational waves carried energy. So, the LIGO team cautiously and correctly only speaks hypothetically "gravitational energy"; because their excellent experiments/observations shed no light upon the unresolved issue of whether gravitation waves carry "gravitational energy" or not.

"Energy localization has been an enduring controversy in general relativity. We will bring forward our hypothesis that energy, including the contribution from gravity, is most logically localized in the regions of the energy-momentum tensor. This has the unsettling implication that gravitational waves, assuming the reality of their existence to which we certainly subscribe, are not carriers of energy in vacuum." Cooperstock[18]

Ignazio Ciufolini and John Archibald Wheeler on the other hand suggest, "We know that, in general relativity, gravitational waves carry energy and momentum; this has been experimentally indirectly confirmed with the observations of …. Binary pulsar PSR 1913+1916."

Cooperstock[18],counters page 90, "(re) binary pulsar PSR1913+16... evidence for energy loss by emission of gravitational waves. This would be attractive… were it not for the unique aspects concerning energy and its localization in general relativity." So the discussion continues regarding energy of gravity waves. I'm biased towards no energy.

Step 14: The Quantum Graviton

Now, I am ready to discuss the quantum graviton in this Toy Gravity Universe. To begin we must think like a quantum graviton, aware of the "laws" of gravity, aware of the various gravitational evidence from experiment and observations, and aware of gravity like a crash test dummy. In our Toy Gravity Universe, quantum gravitons are forged in the quantum gravity **Σ**BH/WH-singularities. Thus quantum gravitons are emergent particles. (see discussion of bosons and quantum gravity bosons above.) And quantum gravitons exist in all 4 manifolds of this Toy Gravity Universe; but their crossing of those manifold boundaries only occurs as specific quantum interaction events.

Gravitons are "elementary particles"; and they are also "emergent particles"; and they are the quantum grids in the quantum gravity field; and they are the space of real and imaginary number dimensions (formerly known as spacetime). These are not inconsistencies or paradoxes to a quantum graviton; we on the other hand must choose our points of view. But quantum grids (or links) are not fixed grid units as on graph paper that might stretch or change shape. No, in this Toy Gravity Universe the graph paper is replaced by an active grid of quantum gravitons; which increase in number or decrease in number depending upon the gravitational interaction. Remember these quantum gravitons are space; and the increase or decrease in space is in either the real or imaginary number spatial dimensions; and depends upon the specific quantum gravity interaction we are discussing.

To visualize how the gravitons are the same as space, follow my reasoning. But do not accept it. Understand it, visualize it yourself until it makes sense to you or not. Because in a real sense, I barely understand my own reasoning. And yes, I will appreciate your help to understand better my own reasoning. Like all quantum mechanics, understanding quantum gravity will always seem absurd and never be fully understood. And yet, understanding the quantum graviton, the quantum gravity field, and the quantum gravitational wave is of interest because it helps better understand, explain, and predict our visible universe.

Gravitons have zero mass, integer 2 spin, zero charge, zero superimposed quantum gravity charge (i.e. superimposed +1, +i, -i, -1), and zero superimposed quantum energy (i.e. +E, +iE, -iE, -E). There is redundancy in what I say; to say zero quantum gravity charge is enough,

everything else is implied by that one statement. And these quantum gravitons are the only particles, whose quantum gravity charge is the same in all 4 manifolds of this Toy Gravity Universe.

In the attractive and repulsive quantum gravity interactions, the increase and decrease in the number of gravitons is inferred from the detectable physical evidence. But neither the quantum graviton, nor the quantum gravitational field can or have been directly detected. All gravitational interactions are understood from analysis of observed evidence that implies quantum gravity interaction (e.g. the apple falling, the moon orbiting, the cosmic redshift, the wobble wobble of the LIGO machinery) according to this or that theory of gravity.

When apples fall to Earth, when binary pulsars merge; I don't assume that the attractive gravitation field is emitting gravitons. It isn't. Matter objects of +1 quantum gravity charge absorb gravitons; antimatter objects of +i quantum gravity charge emit gravitons. Thus when an apple and the Earth are gravitationally attracted; both apple and Earth absorb quantum gravitons in numbers proportional to their mass. Also, when antimatterA and antimatterB are gravitationally repulsed; both antimatterA and antimatterB emit quantum gravitons in numbers proportional to their mass.

When quantum gravitons are absorbed; space (which is the quantum gravity field) is decreasing, deflating. When quantum gravitons are emitted; space (which is in the quantum gravity field) is increasing, inflating. The quantum gravity field is not a classical object like a rope, or spring, or sticks, of webs of all of the above. No the quantum gravity field is a quantum object that is composed of quantum gravitons that are perpetually quantumly interacting with other quantum gravitons absorbing on another and emitting one another. This means that quantum gravitons in their self interactions are continually creating and annihilating the real number and imaginary number space. Now if that's all that quantum gravitons did; the universe would be boring.

Now a word about gravitational waves. Gravitation attraction is evidence of the absorption of space. The apple geometrodynamically moves toward Earth; because apple absorbs little bits of space and Earth absorbs enormous amounts of space; thus both apple and Earth follow the geodynamic curves towards each other (at velocities inversely proportional to their masses).

So Barish is incorrect when he describes the black hole merger event (GW150914) as "The two black holes inspiral and merge together due to the emission of gravitational radiation coming from the accelerations… we determine that the total energy radiated into gravitational waves is $3.0 \pm 0.5\ M_o\ c^2$." No gravitons were emitted; enormous numbers of gravitons were absorbed. So many that space itself (i.e the gravitational field) imploded. Barish continues, "the total energy radiated into gravitational waves is $3.0 \pm 0.5\ M_o\ c^2$"; no this is incorrect. The implosion of space means that the enormous space occupied by 3 suns has disappeared in that binary black hole merger. Exactly that enormous volume of space (assuming LIGO's calculation is correct) has disappeared; and that disappearance of space has cause a displacement gravitational wave of space (not energy) to move at the speed of light, like a gravitational tsunami wave across the universe. But unlike an ocean tsunami, this gravitational tsunami carries no energy; so rather than doing damage; it travels barely detectable right through stars and galaxies (as neutrinos also do) until its absorption by matter or by a LIGO detector. That is, so many gravitons were absorbed that an enormous local displacement of space occurred; and that displacement moved at

the speed of light through the essentially stationary quantum gravity field of quantum gravitons. And because this enormous displacement carries no energy; it is barely detectable (at least neutrinos carry energy). Mostly space is empty, matter things are essentially ephemeral (barely here); and so called vacuum of space even less so.

Thorne is more correct when he avoids the concept of gravitational energy and says, "The waveforms from BBH (binary black holes) collision and merger carry detailed information about geometrodynamics: the nonlinear dynamics of curved spacetime… John Wheeler identified geometrodyamics as tremendously important." But then he also incorrectly says, "The waves here depicted are from Supernovae (SN), that is, the implosion of the core of a normal star to form a neutron star, releasing enormous gravitational energy that blows off the normal star's outer layers." No! Gravitational energy does not blow off the outer layes of a star, anymore than gravitational energy raises the tides of the ocean. Yes the tides rise on one side of the planet and fall on the other side of the planet. And from a Newtonian gravity perspective, we can calculate the change in gravitational energy. But from a general relativistic perspective; we understand that the geometrodynamics changed, i.e. the shape and curvature of the quantum gravity field changed. And that sharp change in curvature of the quantum gravity field, is the quantum gravitational wave that rolls across the geometrodynamics curvature of the universe like a silent tsunami.

If LIGO has "detect stretches and compressions of space-time that are as small as one part in 10^{22} — comparable to a hair's-width change in the distance from the Sun to Alpha Centauri, the nearest star to the Solar System."[19] We are all properly amazed.

In subUniverseR, all massive objects absorb quantum gravitons; until that massive object is eventually accreted beyond the black hole event horizon; after which all fermions and bosonic matter and energy transforms to quantum gravity bosons at the quantum gravity singularity.

The quantum graviton carries all 4 quantum gravity charges (+i, +1, -1, -i); thus, how the graviton interacts with an object depends on which quantum gravity charge (or charges) that object carries. In subUniverseR, +i antimatter continuously emits quantum gravitons; and +1 matter continuously absorbs gravitons. On the other hand, in subUniverseI, -1 CPT antimatter continuously emits gravitons; and -i CPT matter continuously absorbs gravitons. That is the extent of the quantum gravitons interaction with objects, absorption or/and emission of quantum gravitons by objects.

The entire subUniverseR is connected physically by the quantum graviton field, which is the space composed of quantum gravitons. In fact, the entire Toy Gravity Universe is connected physically by the quantum graviton field. In subUniverseR, matter attracts and absorbs quantum gravitons, while antimatter repels and emits quantum gravitons. In subUniverseI, CPT matter attracts and absorbs quantum gravitons, while CPT antimatter repels and emits quantum gravitons.

Newton[25] when discussing the two body attractions in our solar system said, "Two bodies can be drawn to each other by the contraction of rope between them." That is almost correct; except that the gravitational field is not a classical connection like a rope; but a rather a very strange quantum gravity field (web, grid) made of a quantum gravitons which kind of two-headed two-

tailed ouroboros that are not only is continuously eating themselves but continuously excreting themselves. And this crazy double-duo-ouroboros, double because it is two snakes and duo because it both eats and excretes itself, is continuosly interlocking and unlocking gravitationally with other gravitons; thus forming the quantum gravity field.

The photon also is not self-interacting electromagnetically in either the Standard Model of Elementary Particles in our visible universe or in subUniverseR. And various experiments show that electromagnetic waves go right through each other without scattering. But in our visible universe and in subUniverseR photons gravitationally attract. We need to understand this gravitational attraction in subUniverseR versus our visible universe Standard Model; before we can fully understand the gravitational field's self-interactions and what exactly that means for gravitational waves in subUniverseR.

In our visible universe, a photon is its own antiparticle; where an antiparticle has the same mass as a particle. In subUniverseR a photon is also its own antiparticle; but an antiparticle has a +i quantum gravity charge mass, while a particle has a +1 quantum gravity charge mass. In our visible universe (according to the Standard Model), both the particle aspect and the antiparticle aspect of a photon carry + energy; thus, the total energy of a photon is +2E energy. However, in subUniverseR, the antiparticle aspect of a photon carries +i E energy while the particle aspect of the photon carries +1 E energy. Thus, in subUniverseR, the total energy of a photon is +E +iE. Where of course i is an imaginary number.

So how do we interpret the +E +iE energy of a photon in subUniverseR, in terms of gravitational interactions? Like our visible universe, the mass of matter is overwhelming in subUniverseR when compared to the antimatter in subUniverseR. Thus, the collective +1 matter of subUniverseR gravitationally orients photons with the +1 energy aspect of each photon in our subUniverseR; but with the +i energy aspect of each photon is oriented towards subUniverseI; which we know from T-duality is right next to every quantum particle of subUniverseR.

OK that's a bit of absurdity to swallow. But just remember that all of quantum mechanics is a bit of absurdity to swallow; and the only reason that we swallow it is that the theory predicts experimental results in the qualitative sense and in the quantitative sense. And I've just described photon differences that can be tested and compared to results predicted in Standard Model versu Toy Gravity Universe.

That +E energy aspect of a photon, which is the $E = h\nu$, means that an electromagnetic wave; is gravitationally self-attracting in subUniverseR. (When references suggest that photons do not self-interact; they mean electromagnetically.) Yes, a little differently in subUniverseR than in our visible universe. But the net result is that an electromagnetic wave gravitationally coheres in subUniverseR; in part, because the photons +1 quantum gravity charge aspect is absorbing quantum gravitons (i.e. space) in subUniverse R; while the photons +i quantum gravity charge aspect emitting quantum gravitons (i.e. space) in subUniverseI.

But you might suggest that the photon could also emit a graviton from it's +i E energy aspect in our subUniverseR. And I say, yes it could if it was electromagnetically oriented correctly. An antihydrogen atom that is electromagnetically held in a vacuum bottle; is gravitationally aligned to our +1 matter subUniverseR. The electromagnetic force easily overpowers the repulsive

gravitational force between antihydrogen atoms in a containment bottle. The photon's antimatter aspect is forced electromagnetically to align with the +1 matter quantum gravity charge of our subUniverseR.

Without the electromagnetic force of a containment bottle, the +1 matter of our subUniverseR gravitationally forces photons to align gravitationally with the +1 matter quantum charge aspect of our subUniverseR. What that means is that the +i Energy aspect of the photon is aligned with the curled subUniverseI that is rotating relative to our subUniverseR. Thus, the graviton emitted by a photon appears in subUniverseI. This is the same explanation as that given above for cosmic redshift and CMB.

Quantum gravity bosons can occupy the same "space" at the two quantum gravity **Σ**BH/WH-singularities. But on the other hand, due to the collective gravitational attraction of +1 matter in subUniverseR; the quantum gravitons are all oriented with their + quantum gravity charge aspect aligned with the + matter of subUniverseR. And in that state (and quantum gravitons do have states) the quantum graviton act geometrodyamically to shape and curve subUniverseR. Or perhaps, we should think of a quantum graviton in subUniverseR as an oscillation between the two quantum gravity state of being in subUniverseR and the state of being in quantum gravity **Σ**BH_I/WH_R-singularities.

Thus, the quantum gravitons in subUniverseR are gravitationally aligned with the +1 quantum gravity charge; and thus also the quantum gravity field in subUniverseR. Thus, also in subUniverseR the gravitational field is a vast 3-dimensional quantum geometrodyamic web of aligned quantum gravitons. And geometrodyamic gravitational waves travel across that geometrodyamic web of quantum gravitons that are aligned by the +1 quantum gravity charge of the +1 matter of subUniverseR,

Now a binary black hole merger creates quantum gravitational waves; these implosive gravitational waves are ripples through the geometrodyamic web of quantum of gravitons (i.e. the quantum gravity field) which embraces our subUniverseR. Now this geometrodyamic web of quantum gravitons is not a classical web such as grid paper or a crystal structure. No, this quantum web is more like a superfluid that is jostling in all directions; appropriately double duo ouroborosly attracting or repelling across the 3-real-number-dimensions and the 3-imaginary-number-dimensions and the two quantum gravity **Σ**BH/WH-singularities.

In subUniverseR, the +i antimatter repulsion between all +i antimatter is a very minority (because antimatter is so fleeting) but important gravitational interaction. +i antimatter is continually entering subUniverseR from the quantum gravity **Σ**BH_I/WH_R-singularities. But that +i antimatter unlike the +i antimatter aspect of photons, has no quantum gravity charge to align with in our dominant +1 matter charge subUniverseR. Thus, when that +i antimatter in subUniverseR emits a quantum graviton; that quantum graviton enters our subUniverseR. And that emitted quantum graviton aligns with the pervasive +1 geometrodyamic web of quantum gravitons in subUniverseR. When this isolated +i antimatter particle, emits its last quantum graviton; this +i antimatter particle has entered its lowest gravitational state (a numerical state not an energy state). The +i antimatter particle; then quantum gravitationally rotates becoming +1 matter as it aligns with the geometrodyamic web of +1 oriented quantum gravitons in subUniverseR.

In quantum gravity repulsion, a cloud of antihydrogen atoms for example, has a very short half-life in our subUniverseR; before an antihydrogen atom quantum mechanically transitions into a hydrogen atom. (yes this happen in steps). But in those 10's of microseconds as antihydrogen atoms; each antihydrogen atom continuously emits an appropriate number of quantum gravitons in the direction of the gravitational interaction with other antihydrogen atoms in our visible universe. And these emitted gravitons are the increasing space of subUniverseR. The quantum gravity field (the space of subUniverseR), which is continually increase and decreasing due to various quantum graviton absorptions and emissions, has achieved a force balance similar but more complicated than the other 3 forces. Thus, the inflationary aspect of subUniverseR is not 1 enormous "big bang"; rather it is the persistent summation of mindboggling large finite number of the "tiniest little bangs" imaginable in subUniverseR.

So when the electromagnetic field is turned off; quantum gravitons continue to be emitted from the antihydrogen atom; until the antihydrogen atom of +i quantum gravity charge reach their ground states for a +i quantum gravity charged particle. At that point, there are no more gravitons for the antihydrogen atom to emit from its various parts. Then the only high probability quantum interaction, for the antihydrogen atoms parts, is to rotate from a quantum gravity charge +i antiparticle particle to a quantum gravity charge +1 particle of subUniverseR. This quantum transitions occurs in steps impossible to guess beyond handwaving suggestions like, surely mesons are one of the possible steps; all of the antiparticle elements don't disappear from our subUniverseR. Right, a lot of possible paths to our +1 matter dominated particles.

Rethinking the big bang steps for this Toy Gravity Universe's black holes / while holes gravitational cycle between subUniverses; the various Toy Gravity Universe persistent quantum processes are similar if not identical to various timeline processes of the Concordance Model of cosmology timeline. However, the Concordance Model's events of long ago, whether in the first 20 minutes or 2 million years of the universe, have a physical reality in this Toy Gravity Universe that is expressed in persistent continuous interactions in this Toy Gravity Universe.

Also, though quantum gravitons, quantum gravity fields, quantum gravity waves do not carry gravitations energy in this Toy Gravity Universe; energy conservation is preserved (on average) in subUniverseR because it is open. Thus, the cosmic redshift of +1/+i photons in subUniverseR radiates Unruh effect radiation in the form of CPT photons of -1/-i quantum gravity charge into subUniverseI. The reciprocal nature of these interaction means that the cosmic redshift in subUniverseR is causally linked with CMB radiation in subUniverseI (and vice versa). Thus, conservation of energy is "apparently preserved" by these local / non local interactions across subUniverses through these quantum gravity reciprocalities.

Antimatter is continually entering into subUniverseR via the white hole phenomenon; in which quantum gravity bosons of the **Σ**BH_I/WH_R-singularity quantum gravity transform into antifermions and bosons (e.g. photons and mesons) in subUniverseR; because that is the only high probability quantum gravity transition available at the the **Σ**BH_I/WH_R-singularity.

The quantum graviton web mediates all quantum gravity interactions in our 3-sphere subUniverseR. This gives rise to the 3-sphere shape of space and size of subUniverseR. Of note the galaxies in subUniverseR are an approximately gaussian distribution of velocities relative to one another. An equilibrium of motion has been achieved at the particle level and at the galaxy

level; primarily due to the gravitational balance between the attractive and repulsive forces of gravity. Of course, a geometrodyamic quantum graviton web is like a superconducting fluid of gravitons mediating all of the interactions of this Toy Gravity Universe.

In our Toy Gravity Universe, a graviton emerges when a photon transitions to the quantum singularity of a black hole. A photon is not a quantum gravity boson; it has +1E +iE energy from its particle and antiparticle aspects. The photon from our subUniverseR must quantumly transition to a quantum gravity boson in order to abide at the BH_R/WH_I singularity to which it is draw by Newton's gravity, general relativity, and quantum gravity. At the event horizon of a black hole, a photon begins to oscillate between a photon and a CPT photon. When the oscillation between photon and CPT photon is strong enough that photon has become a quantum graviton. Of course, a black hole event horizon is only about attracting; hence the newly emerging quantum graviton tunnels right to the BH_R/WH_I singularity. As a quantum graviton boson, the emerging quantum gravitons can abide at the singularities.

Thus quantum gravitons emerge from photon/CPT photon oscillation and are stable at either of the two quantum gravity singularity and also in each of the subUniverse of this Toy Gravity Universe. So the quantum superposition of a photon and its CPT antiphoton yields a quantum graviton with zero mass, spin number 2, zero charge, zero superimposed quantum gravity charge number (i.e. superimposed of +1, +i, -i, -1), and zero superimposed quantum energy (i.e. +E, +iE, -iE, -E) in the BH_R/WH_I singularity. Also, equivalently, a graviton may be formed as the quantum superposition of a CPT photon and an antiphoton in the BH_I/WH_R singularity.

Since gravitons, from an observer POV, only slightly attract or repel other gravitons in the real number spaces x_1, x_2, x_3 (i.e. subUniverseR) and the imaginary number spaces y_1i, y_2i, y_3i (i.e. subUniverseI); it might appear that gravitons could get stuck in the BH/WH singularities. This doesn't happen; because quantum gravitons are superfluid of quantum gravity bosons that will not climb from a BH/WH singularities back out of the black hole event horizon from which they have to quantum mechanically entered or oscillate back to a photon to get out that black hole. No, as we know Hawking radiation from a black hole is an extremely improbable action. However, a quantum graviton superfluid is not forbidden from climbing out of a white hole. And so the quantum graviton superfluid flows quantumly randomly everywhere from the BH_I/WH_R singularity into our subUniverseR, which is the 3-sphere white-hole-R-event-horizon. Well then in this phase of the cosmic cycle, matter has its job of attracting and absorbing all of those gravitons and orienting those quantum gravitons to our subUniverseR.

Also, there is a intrinsic spin direction that gravitons carry. In subUniverseR gravitons spin is left handed; in subUniverseI gravitons spin is right handed. Thus, at the BH/WH singularities, the quantum graviton's intrinsic spin is oscillating. Nevertheless, as a graviton quantumly transitions through the quantum gravitational cycle between subUniverses and BH/WH singularities; the quantum gravitons intrinsic spin handedness changes like the handedness travelling along a Mobius strip. And therefore, just as there is a hawking radiation improbability of a photon emerging from a black hole event horizon; there a handedness improbability for a graviton emerging from a black hole event horizon; and a probability of a graviton emerging into the white hole event horizon. Enough said.

Visualizing all of these gravitational processes isn't easy or scientific (unless it is predictive). But if we think clearly, we partially understand that in this Toy Gravity Universe and its subUniverseR and subUniverseI and its BH_I/WH_R singularity and BH_R/WH_I singularity; that there is room to physically catalogue and logically balance all of the possible quantum comings and goings of gravitons. But it will be tricky.

Now let's visualize a bit more, the graviton field (i.e. superfluid graviton grid) in action. In subUniverseR, matter +1 quantum gravity charge absorbs gravitons proportional to its mass; thus two matter objects (i.e. F_g = +) are each swallowing gravitons. Envision the graviton between the sun and the Earth as continually being swallowed by the sun and the Earth. Thus the gravitational change of state between sun and Earth is a quantum decreases in number of gravitons in the gravitons field; thus the space contracts or deflates as gravity attracts. That could mean that the number of gravitons gets smaller; but quantum gravitons keep entering the subUniverseR at a modest rate. My assumption is that rate at which gravitons enter and leave subUniverseR is in balance cosmically but not locally.

So in a sense, there are checks and balances in our subUniverseR and Toy Gravity Universe. And we haven't even gone into the checks and balances between gravity and the other forces; which are significant and complex. But mostly make only a subtle difference in our subUniverseR. Though you have seen suggestions here and there; this paper has focused primarily upon gravity.

But remember subuniverseR is not a closed system. And most antimatter in subUniverseR comes from the BH_I/WH_R singularity which is a manifold outside of the subUniverseR manifold in our Toy Gravity Universe. Antimatter is continually and widely dispersed into subUniverseR, where it rapidly changes state from gravity mass number +i to gravity mass number +1.

In subUniverseR changes of state are mostly called oscillations or rotations, not called annihilation; because antiparticles in subUniverseR are defined differently than the antiparticles in the Standard Model of Elementary Particles in our visible universe. This antiparticle definition difference between this Toy Gravity Universe and the Standard Model Particles of our visible universe makes for different interpretations in the interactions of EM, weak, and strong forces. Thus, the various detailed interactions whether of mesons or protons should give slightly different prediction for QED and QCD as well as quantum gravity. But I do not pursue these differences; my focus is only quantum gravity. But there are experiments that can measure the difference between the predictions of our Standard Model of Elementary Particles in our visible universe versus the prediction of the modified Standard Model of Elementary Particles in this Toy Gravity Universes. In my mind the concept of annihilation mostly misrepresents the quantum changes of state that occurs in our real visible universe.

Now meanwhile antimatter particles (despite their very short lifespan) are also emitting quantum gravitons into the space, thus antimatter particles are mutually repelling each other. And since the space of subUniverseR is continuously receiving antimatter particles which emit gravitons and the superfluid quantum gravitons from the white hole phenomena; the space of subUniverseR is continuousy inflating which keeps subUniverseR geometrically in balance with the attractive gravitational force. Hence the shape and size of subUniverseR remains constant. Then when an antiparticle runs out of gravitons to emit, their highest probability quantum change of state is from an antiparticle +i quantum gravity charge to a particle +1 quantum gravity

charge. And of course, the particle +1 quantum gravity charge absorbs quantum gravitons in subUniverseR.

This visualization explains how space (i.e. the quantum graviton field) inflates and deflates; and how the superfluid graviton grid (i.e. gravitons) increases and decreases. So, the space of subUniverseR is continuously deflating right into black holes event horizons of subUniverseR; and it is also inflating due to the persistent white hole phenomenon that is subUniverseR. A gravitational balance is achieved.

Our Toy Gravity Universe, achieves a quantum equilibrium, a quantum steady state which is very different than the historic classical steady state models of our visible universe. But our Toy Gravity Universe has reached this quantum gravity steady state equilibrium in each subUniverse and each singularity. Of course, this gravity equilibrium is not enough; other physics needed to be merged with this Toy Gravity Universe.

Between particles and antiparticles in subUniverseR and CPT particles and CPT antiparticles in subUniverseI (from subUniverseR point of view) the gravitational forces (i.e.$F_g = \pm i$) produces both attraction and rotation of subUniverseR relative to subUniverseI (in a quantum mechanical sense). In a quantum mechanical sense, means that these two bifurcated subUniverses of our Toy Gravity Universe are kept together and rotating in a cosmic dance at every interaction in which imaginary number gravitational forces (i.e.$F_g = \pm i$) are produced.

Now that is the quantum graviton, quantum gravity field, the quantum gravity wave, the quantum gravity superfluid that is the real number space and the imaginary number space in this Toy Gravity Universe. Yes, the quantum gravity field is exactly the real number space of subUniverseR and the imaginary number space of subUniverseI.

And since gravitons are "self-interacting" gravitationally; I have explained how the gravitational field carries gravitational waves. An important thought occurs regarding gravitational waves. Thorne[23] remarks "It is remarkable that gravitational astronomy gives us the binary's distance r but not its redshift z (fractional change in wavelengths due to motion away from Earth), whereas electromagnetic astronomy, looking at the same binary, can directly measure its redshift but not its distance. In this sense, gravitational and electromagnetic observations are complementary, not duplicative." This interpretation, of the evidence of binary black holes merger event GW150914, is in agreement with the Concordance Model of Cosmology; however, it is a misinterpretation of the evidence according to Toy Gravity Universe model.

Let me change Thorne's statement to correctly interpret the evidence of binary black holes merger event GW150914 in subUniverseR. "Gravitational astronomy gives us the distance r to the merger of binary black holes. But gravitational astronomy does not give a cosmic redshifted gravitational wavelength as the Concordance Model of Cosmology predicts. Thus, the correct interpretation of black hole merger event (GW150914); is that not only have gravitational waves been detected; but they have determined that the visible universe is not expanding; because the geometrodyamic quantum graviton wave information, specifically the gravitational waves wavelength has not redshifted." This is in agreement with the Toy Gravity Universe model in which subUniverseR does not expand due to a cosmic redshift. Thus, gravitational astronomy

gravitational wave observations are a corrective to electromagnetic astronomy's misinterpretations of the cosmic redshift of electromagnetic waves.

Step 15: A Gravitational Disambiguity of Time

This Toy Gravity Universe, in building a CPT symmetric subUniverseI composed of imaginary number spatial variables $-y_1i$, $-y_2i$, $-y_3i$; has inadvertently invented a 3-dimensional gravitational time (in the Minkowski sense of special relativity's spatial variable $-yi = -ict$). This suggest that these 3-imaginary-number-dimensions, curled by T-duality, that are inferred by us in our subUniverseR to be the one temporal dimension of special relativity. But as you see in describing this Toy Gravity Universe and its subUniverse, there was little or no gravitational need for temporal descriptions. All significant actions can be thought of as quantum gravity changes of state; are as counterintuitive as quantum mechanics changes of state in general.

We see that the real number and imaginary number subUniverse are CPT symmetric and thus interchangeable spaces (with or without a temporal interpretation). If we wish we can think of spatial actions as occurring in the real number quantum dimensions of subUniverseR and temporal quantum actions as occurring in the imaginary number quantum dimensions of subUniverseI. But it is impossible, from inside either subUniverse, to distingiush whether we are in the real number spatial universe or the imaginary number spatial universe.

Earlier I raised the question, why are there two QG **Σ**BH/WH-singularities? The first answer is that in my visualization two singularities build a stable Toy Gravity Universe; but one singularity is unstable. There are two other reasons.

Consider the QG **Σ**BH_R/WH_I-singularity; the QG Boson for an electron oscillates between +1 electron and -1 CPT antielectron, and similarly for other QG Boson pairs of oscillating fermions. Notice that the gravity charges of the two oscillating fermions both have real number quantum gravity charges, +1 and -1. In the Minkowski interpretation above; this suggests that the QG **Σ**BH_R/WH_I-singularity is a spatial singularity from a subUniverseR POV. Meaning that from a subUniverseR POV, the singularity associated with black holes is a spatial singularity, in which time effectively doesn't exist, i.e. imaginary number space doesn't exist.

On the other hand, the QG **Σ**BH_I/WH_R-singularity oscillates between -i CPT electron and +i antielectron, and similarly for other QG Boson pairs of oscillating fermions. Notice that the gravity charges of the two oscillating fermions both have imaginary number quantum gravity charges, +i and -i. In the Minkowski interpretation above; this suggests that the QG **Σ**BH_I/WH_R-singularity is a temporal singularity from a subUniverseR POV. Meaning that from a subUniverseR POV, the singularity associated with the white-hole-phenomenon that is subUniverseR is a temporal singularity from, in which real number space effectively doesn't exist, i.e. real number space doesn't exist.

This interpretation of spatial black holes singularities and temporal white hole phenomenon echoes the Concordance Model description. But in this Toy Gravity Universe we clearly see that such temporal versus spatial interpretations are an illusion.

So from subUniverseR POV, there are two QG **Σ**BH/WH-singularities because one is temporal and on is spatial. But of course, the same is also true for subUniverseI POV also. However, from

subUniverseI POV, the temporal and spatial singularities are switched. And asking whether observerR or observerI is correct is an undecidable question; because from either QG **Σ**BH/WH-singularity's POV, the singularity is neither spatial nor temporal; neither has momentum not energy. So once again, I ask myself, why are these two QG **Σ**BH/WH-singularities necessary; in what way are these two singularities different? What is their physical difference? Not just what is physically different for the QG Boson pairs of oscillating fermions; but also for the QG Boson pairs of oscillating bosons (e.g. photons, W).

There seems to be only one candidate property that can be different between these two QG **Σ**BH/WH-singularities. Now of course, even before I suggest this property; I have to say that an observerR and an observerI would not agree on which singularity had which property. So some things seem always to be indeterminate in a Godel incompleteness sense and a quantum sense.

So now in each of the two QG **Σ**BH/WH-singularities, let us imagine only 1 particle, the quantum graviton. What property is the only property that could be different in these two singularities? Intrinsic spin. In the two QG **Σ**BH/WH-singularities, the intrinsic spin of the quantum graviton is different. So one graviton could have right handed intrinsic spin and the other left handed, or something else. I will talk a bit more about intrinsic spin in the problems discussion at the end of this paper.

Finally, regarding this gravitational disambiguity of time; I must note that the equation $\lambda = c/\nu$ is not primarily about the relationship between the wavelength of light and the frequency of light in our visible universe, where c is the speed of light. In our visible universe, there is no increase in information or knowledge by knowing that a photon has wavelength λ and also a frequency ν; both statements carry exactly the same information in all physical situations. Basically time (i.e. 1/frequency) is just an agreed upon transformation of space. The store is 2 miles down the road, the store is 5 minutes down the road. The translation between the two measure needs always needs an additional piece of information (which is assumed), how fast you walk, drive, or ride a horse. So in a practical sense, the equation $\lambda = c/\nu$ just tells me how to accomplish the space to time translation on Earth, i.e. subUniverseR.

But in a more philosophical physical sense, the equation $\lambda = c/\nu$ could be written $\lambda = c/(-\nu i)$; where $-\nu i$ is not an imaginary number frequency, but the T-duality imaginary number spatial dimension in subUniverseI. And the equation, $\lambda = c/(-\nu i)$, is the T-duality relationship between the spatial dimensions of subUniverseR and subUniverseI.

Two other gravitational time disambiguities entered into this toy Gravity Universe. We discussed the intrinsic rotation of subUniverseR relative to subUniverseI and vice versa. That intrinsic gravitational spin is related to the intrinsic spin of the elementary particle in the Standard Model of Elementary Particles. In this paper, I have chosen not to discuss the differences in interpreting intrinsic spin in subUniverseR versus the Standard Models of our visible universe; because it would complicate and muddle our discussion towards the quantum graviton.

And also discussed the black holes/white holes quantum gravitational cycle between subUniverseR and subUniverseI. Within each subUniverse and each BH/WH singularity manifold, there is an irreversible quantum gravity direction. And yet the entire Toy Gravity Universe is sustainable (i.e. steady state or perpetual). Thinking of Godel's incompleteness

theorems; we realize that some "important" information is never to be found in any formal system. In this Toy Gravity Universe and in the visible universe also (when correctly interpreted); it is impossible to know how or when or why this Toy Gravity Universe began. The best that we can do with the mathematical language (no matter how sophisticated) is the best that we can do with the verbal language; describe the system and make predictions.

These gravitational disambiguities of time has been a collateral benefit of Toy Gravity Universe. More discussion about time in the conclusion.

Summary, Conclusion, Problems

Summary: This Toy Gravity Universe has started with a gravity gedanken experiment. Which resulted in the introduction of imaginary number masses, forces and dimensions as logical interpretations of Newton's gravity in the gravity gedanken experiment. Pushing these results to built a Toy Gravity Universe; we discovered the necessary idea of subUniverseR and subUniverseI as CPT symmetric T-duality related. With these hypotheses, this Toy Gravity Universe predicts the following:

- antihydrogen will neither fall down or up in CERN's upcoming antimatter gravity experiment, i.e. null result
- Standard Model of Elementary Particles changes to add quantum gravity charges of (+1,+i, -1, -i) to various particles
  - Matter carries QG charge +1
  - Antimatter carries QG charge +i
  - Photons carry two QG charge +1, +i
  - Quantum gravitons carry four QG charge +1, +i, -1, -i
  - Mesons carry QG two charge +1, +i
- $\mathbf{\Sigma}_{\text{visible universe}}$ of energy of cosmic redshift = $\mathbf{\Sigma}_{\text{visible universe}}$ of energy of CMB radiation.

In addition to these, other predictions are implied, other unsolved problems resolved, other solutions implied. The foundation of this non-relativistic quantum gravity field theory has been defined. The cosmological constant problem of fine tuning is not a problem. The cosmic redshift evidence, the CMB radiation evidence has been reinterpreted. Cosmic inflation has been reinterpreted as not a problem. Baryon asymmetry is no long a problem because of the CPT particles and CPT antiparticles in the CPT symmetric subUniverseI. The various multiverses of Tegmark and Greene, and the Anthropic Principle are not possibilities in this Toy Gravity Universe. The concepts of a quantum black holes and quantum white hole have been clarified with the definition of the quantum gravity BH_I/WH_R singularity and quantum gravity BH_R/WH_I singularity. The concepts of the quantum graviton, quantum gravity field, and the quantum gravity wave as geometrodyamic quantum gravity changes (i.e. carriers of spatial information, not energy information) have all been defined/described. The binary black holes merger event GW150914 has been reinterpreted to support this Toy Gravity Universe interpretation of a non inflationary universe (such as in the Concordance Model). Disambiguities of time have been discussed.

This Toy Gravity Universe is a sustainable universe; but like all model universe, it doesn't answer philosophic questions such as how our visible universe got started or how it will end. I

suggest that such answers are indeterminant answers in a Godel sense of the incompleteness of any logical system.

This paper has layered many steps to build a rich understanding of this Toy Gravity Universe. A shorter paper would not convey the nuance and possibility of this Toy Gravity Universe. As well, a shorter paper could more easily be dismissed as naïve or incorrect according to Feynman or Wonka. This Toy Gravity Universe is well reasoned, relatively simple to understand; but it disagrees in many ways with the dominant understanding of concepts like space, antiparticle, force. Despite those disagreements; this Toy Gravity Universe has been constrained by agreeing with all equations of classical and modern physics, constrained to keep all the constants of nature constant, constrained to accept all physical evidence. With those constraints, the only way to build a Toy Gravity Universe was to reinterpret theory (e.g. domains of relevance of equations) and thus also to reinterpret evidence with redefined concepts, physical explanations that lead to many predictions that can be tested. It has reinterpreted.

Conclusions: This Toy Gravity Universe builds gravity right to the quantum graviton. There are many open gravitational questions in the subUniverseR, which represents is our visible universe. Much work needs be done quantum gravitationally. As well, incorporating the core concept of this Toy Gravity Universe into other areas of physics and astronomy will be important. The quantum vacuum of intergalactic space is more than the quantum gravitational field; it is more than the gravitational space, shape and dimensionality of our 3-sphere subUniverseR; it is more than the geometricdynamically superflowing intrinsicly spinning quantum gravitons; it is more than white hole event horizon of gravitationally emerging antiparticles from the QG $\mathbf{\Sigma}BH_I/WH_R$-singularity; it is more than the galaxies of matter spiralling toward black hole event horizons and towards the QG $\mathbf{\Sigma}BH_R/WH_I$-singularity. The place that this Toy Gravity Universe describes is physical impossibile and logical incomplete without the inclusion of the electromagnetic, weak and strong forces, other physics, astronomy and poetry. Hopefully the implicit and explicit predictions of this Toy Gravity Universe will be useful in motivating experiments, observations, and new standard models.

As noted, there are gravitational disambiguities of time in this Toy Gravity Universe. This does not mean that I have arrived at a new single meaning of time; I have not. Nor have I resolved the conflicting meanings of time. They are all variously useful (i.e correct) meanings of time. Time is a fungible concept that emerges (in the P.W. Andreson[26] sense) spontaneously in many physical environments; just as the fungible concept of money emerges in many cultural transactional environments. Other fungible concepts, such as truth, beauty, elementary particle, reductionism, love, number, god and their opposites; emerge whenever we observe, think, feel, transact, teach, learn, enjoy. It makes little sense to pit one definition of such a concept as time against another definition. Such fungible concepts and their opposites can neither be ignored, reconciled, proved, nor disproved; but they can be understood or misunderstood. In a Godel sense, such concepts are forever incomplete.

The “problem” of time persists like so many fungible concepts/phenomenon; because it continually reinserts itself across a full spectrum of phenomenon. It is a useful concept which sometimes appears absolute, relative, or indeterminant in our words and equations. But it is forever incomplete as are all of our arts and sciences, politics and philosophy,

Thus this Toy Gravity Universe is vastly incomplete.

Problems: From prologue to gravity gedanken experiment to everystep towards the quantum graviton; I have waved my hands over your many physical and logical objections; because there was a many layered whole pink elephant, this Toy Gravity Universe, that I wished to describe.

If I had just presented the trunk of this pink elephant, you would have laughed at it, as naïve. But you have gotten this far; because you have suspended disbelief enough to allow me to share this living breathing pink elephant. I hope this ToyGU pink elephant crawls into your brain and seriously infects your work and scientific thinking.

I skip over the many little problems and objections; that I raised to myself at every step and that you have graciously ignored as you learned about this pink elephant. In time, I will learn if they are serious. But there are physics concerns that could break or seriously injure this ToyGU.

1) CERN antimatter gravity experiment. If the upcoming CERN antimatter gravity experiment shows that antihydrogen falls up or down (rather than null); then the concepts of this ToyGU will all collapse like a house of cards.
2) Neutrinos and mesons. The difference between subU_R "antiparticles" and Standard Model antiparticles may best be explored in neutrino and meson experiments. These highly specialized experiments may already support or disagree with my hypotheses
3) Spin. Intrinsic spin questions occur throughout this ToyGU. I am not familiar enough with the physical evidence. Rather than misspeak and confuse, I avoided; because intrinsic spin was not key in building toward the quantum graviton. However, intrinsic spin is also a concept area that might break my ToyGU.
4) Irreversibility. This ToyGU is irreversible at each quantum gravitational steps between the 4 manifolds of this ToyGU. I am surprised.
5) Symmetry. I assume that → +i → +1 → -1 →-i → symmetry between the 4 manifolds of this ToyGU can be represented by some standard symmetry group.

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