

Interdisciplinary Communication: from Gravitational Waves to Multiuniverses

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Abstract

The prospect of communication with other universes utilizing High-Frequency Gravitational Waves (HFGWs) is discussed. Global communications via HFGWs were analyzed by us in 2012 [1]. We extended communications involved in that paper to intercommunication with exoplanets within our Universe in 2016 [2], both of those studies are summarized. Herein we further extend communication to the possibility of interacting and perhaps communicating with other universes – the “multiuniverse connection.” Our method, involving Rigor and Inter-Disciplinary resources, is scientific curiosity satisfied by imaginative reasoning. The recently published Theory of Our Universe by R. M L Baker, Jr. [3] and a working hypothesis on Non-Varying Rate of-Time (NVRT) Processes, are a result of such reasoning, and are discussed in simplified terms. The Theory involves the rollout of our Universe in space and in time, essentially spacetime itself rolling out. Time rolls out from the smallest meaningful time, termed Planck Time and from the smallest meaningful distance, termed Planck Length (both are quantum-mechanical concepts). They rollout in concert with rate of time starting out extremely fast and slowing and the dimensions or space starting out extremely small and growing. There is no need to assume dark matter or dark energy in this Rollout Theory of our Universe; neither one of which have been independently observed. Furthermore, observations of celestial objects and of their motion leading to the Hubble constant have produce anomalous results that can be explained by this Rollout Theory. The discussion of this new Theory leads directly to the discussion of the osculation points or frontiers we may have with other universes, based on a United States Patent Section on Spacetimeuniverse Geometry [4]. A result is that we propose these osculation points or frontiers might be a basis for intercommunications with multiuniverses. We conclude that an “interdisciplinary” approach to communications is absolutely necessary. Also we strongly recommend to develop HFGW detection and to study their possible laboratory HFGW generation. Einstein was reported to have commented that: “Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand.” We concluded that the future will be forged by innovative, imaginative “out of the box” thinking and we also conclude that this paper embraces these attributes.

Keywords: *Exoplanets, Archeology, Xenoarchaeology, multiuniverse, rollout of universe, Non-Varying Rate of-Time , Planck Time, Planck Distance, high-frequency gravitational waves, interdisciplinary communications, dark matter, dark energy, early universe, quantum foam, quantum fog*

1. Introduction

The value of gravitational-wave studies, especially High-Frequency Gravitational Waves (HFGWs), to global communications as well as to inter-exoplanet communications and of potential multiuniverse intercommunications is discussed. With regard to HFGW global communication, we rigorously discuss the transmission and reception devices involved. With regard to exoplanets, the ability to achieve two way communication while the exoplanets are viable was discussed by us [2] in an interdisciplinary fashion and is summarized herein. The HFGWs are considered to be the key in actually observing our early universe at a time only a picosecond or less from our Universe's beginning. Beckwith and Baker [5] suggested the value of such high-frequency gravitational wave detection, which cannot be achieved by the existing very-low-frequency LIGO interferometer detectors. In that regard, we provide examples of HFGW detectors that might be utilized including the Li-Baker Detector [6-10]. Such HFGW observations are expected to lend credence to the Rollout Theory of our Universe. This new Theory for our Universe will be discussed in a simplified, yet rigorous manner using, for example, an analogy to an Olympian race. Concerning the Section on Multiuniverse Communication, we recognize that the term "multiuniverse" is meant herein to differ from the term utilized by many Physicists: "multiverse." As noted by Greene on pages 306 and 385 [11] a multiverse is a "... patchwork of widely separate 90-billion-light-year regions, with each region having evolved independently of the other." Whereas a multiuniverse is rigorously defined herein as any collection of universes including ours.

2. Global Communication

Global communications via HFGWs were analyzed by us in 2012 [1] and are summarized herein. For over 1000 years electromagnetic radiation, initially light, has been utilized for long-distance communication. Heliographs, telegraphs, telephones and radio have all served our previous communication needs. Nevertheless, electromagnetic radiation has one major difficulty: such radiation is easily absorbed. We consider a totally different radiation, a radiation that is not easily absorbed: gravitational radiation. Such radiation, like gravity itself, is not absorbed by earth, water or any material substance. In particular, we discuss herein some means to

generate and detect HFGWs, and how they can be utilized for global communication as shown schematically in Figure 1. As shown in the figure, direct HFGW communication, for example from Russia directly through our Earth to Venezuela can be achieved as well as HFGW communications to and from aircraft in the sky and vessels under the water.

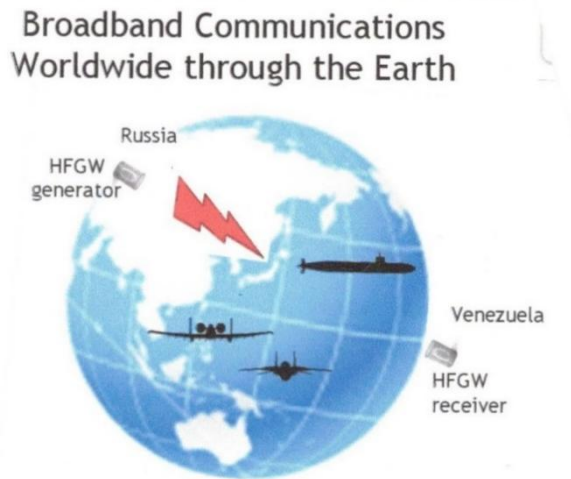


Figure 1. Broadband Global High-Frequency Gravitational Wave Communication, in space, on Earth and undersea.

There are two barriers to the practical utilization of HFGWs: they are extremely difficult to generate (a large power required to generate very weak HFGWs) and weak HFGWs are extremely difficult to detect. As was demonstrated theoretically in [1] and exhibited graphically in Figures 2, 3 and 4 HFGW phase-coherent generation utilizing an array of in-phase micro-electro-mechanical systems or MEMS resonator elements as shown Figures 2 and 3 is well understood. We now theoretically have the possibility to generate a significant HFGW signal since the HFGW flux is proportional to the square of the number of elements exhibited in Figure 3. The assembly of these elements into a double helix is shown in Figure 4 and discussed in detail on pages 96-112 of [9] and in [12 -14]. This process solves the transmitter difficulty.

Three HFGW detectors have previously been built [2]; but their sensitivity is insufficient for meaningful HFGW reception; greater sensitivity is necessary. A new Li-Baker HFGW detector, discussed herein [6-10], is based upon an effect discovered by Fangyu Li of Chongqing University, China and Patented in 2001 by R. M L Baker, Jr., [7]. The Li Effect or Li Theory was first published in 1992. Subsequently, the "Li effect" has been the subject of many peer-reviewed research journal articles (e.g., [6]). The key results, and signal-to-noise study can be found in Woods, et al. [8] and there is a detailed discussion of the coupling between HFGWs, a magnetic field and a microwave beam in Li, [10].

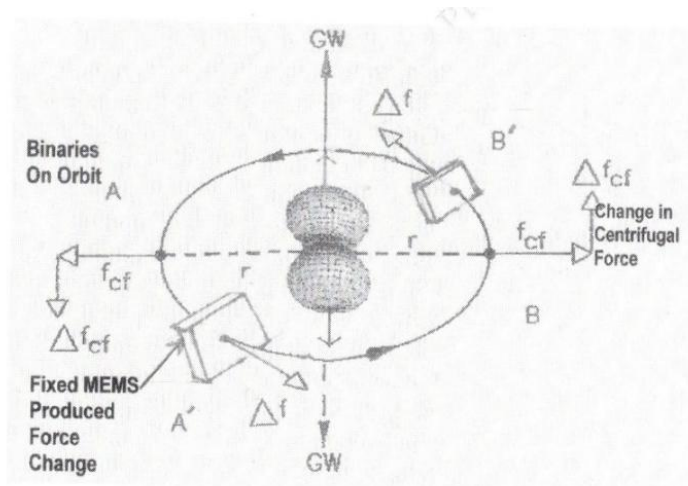


Figure 2. An element for generating High-Frequency Gravitational Waves in the Laboratory utilizing a pair of force-change Δf s or “jerks” , defined as a quick or impulsive change in force, created by MEMs, producing a radiation pattern between them. From Figure 9-3 of [9].

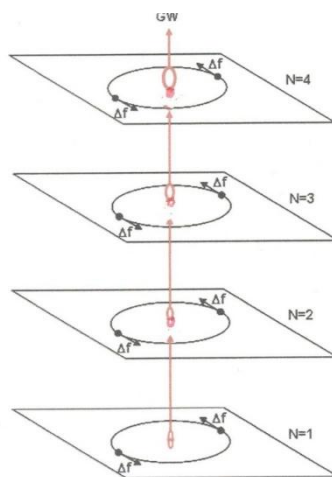


Figure 3. Stack of HFGW generation elements to produce a laboratory HFGW beam segment. From Figure 9-4 of [9],

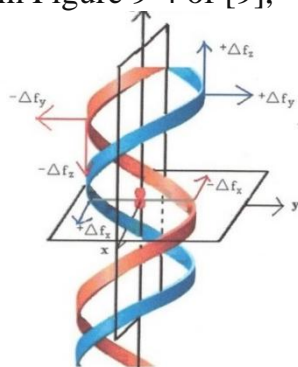


Figure 4. Double helix assembly of HFGW beam segments to achieve an HFGW transmission. From Figure 9-5 of [9].

Four-kilometer long LIGO vacuum tunnel or Interferometer "Leg" by NASA.



Figure 5. Could LIGO be a receiver of the HFGW transmissions?

Similar to old-fashioned radio antennas that detect low-frequency radio waves

That cannot detect high-frequency television waves!



Figure 6. LIGO cannot detect High-Frequency Gravitational Waves.

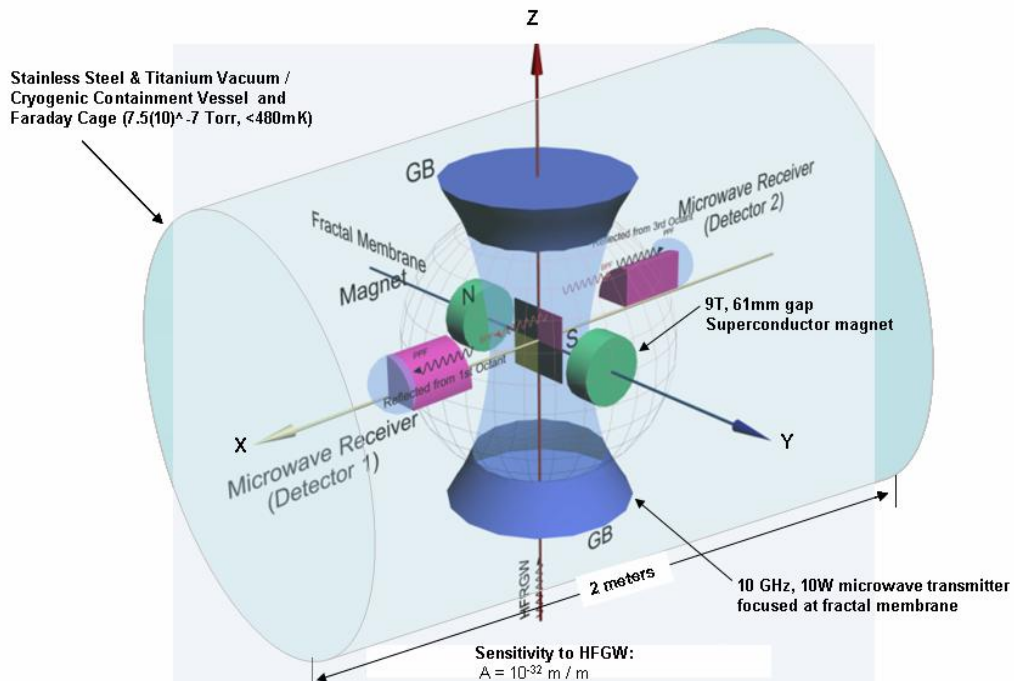


Figure 7. The patented Li-Baker High-Frequency Gravitational Wave Detector [7] can serve as a receiver of HFGW global communications.

By the way, the Li Effect is very different from the classical inverse Gertsenshtein Effect, sometimes proposed as a HFGW detection means. In the Li effect, a gravitational wave moving along the x-axis in Figure 7 interacts with a laboratory-generated strong Gaussian electromagnetic (EM) wave, moving along the z-axis, in Figure 7, in the presence of a pulsed magnetic field along the y-axis of Figure 7. In the proposed (inverse) Gertsenshtein Effect detectors there is no laboratory-generated electromagnetic wave and the Gertsenshtein Effect is extremely small and has no practical value for HFGW detection. On the other hand, the Li-Baker Detector, working in concert with the HFGW transmission means previously discussed in this Section, is predicted to achieve a sensitivity to satisfy HFGW global communication needs. Not only that, but as discussed in Section 5, an extremely high-frequency Gaussian beam could play a vital role in the prospect of communication with other universes!

3. Exoplanet Communications

Three advances have been proposed as a pathway to the cataclysmic event of our first encounter with intelligent extraterrestrial beings [2]. First, discovery of very large numbers of extraterrestrial planets, “exoplanets” (possibly as many as 10^{23} in our Universe); second, artificial education implanted into our brain and the introduction of electronic components into the human body evolving into a cybernetic and biological “cyborg.” An evolution to cyborgs (probably spherical in shape) might allow advanced civilizations to endure hundreds of thousands of years. Third, the recent development of high-frequency gravitational wave (HFGW) detectors; the communication means of choice for an advanced, cyborg civilization since they are not easily absorbed like electromagnetic radiation. Six HFGW detectors are presented for application to our first encounter with intelligent extraterrestrial beings. Numerical estimates are made for the failure of extraterrestrial civilizations such that no two exist at the same time (Fermi’s Paradox). We conclude that there might remain at least $\approx 1.48 \times 10^8$ exoplanet civilizations still “living” and intercommunicating with HFGWs at any one time in any one region of our Universe. The first cataclysmic encounter with them is expected to be interception of their interstellar HFGW communications. The predicted frequency of intercepted messages under one set of assumptions is at least 1500 per day. After decoding the intercepted messages, keys may be found to improve vastly the present and future quality of life for us earthlings. Advanced beings might utilize direct brain-to-brain communication and we conclude that research into brain-to-brain communication and HFGW detection should be encouraged. Based upon the potential 1500 intercepted messages per day; how soon will we discover alien life? Based upon the Kepler Satellite Observatory data there are approximately as many exoplanets as stars. That does not mean that there is an exoplanet around every star, but rather that, for example, for

every 8 stars there may be one star with 8 planets around it, like our Sun, or two of these stars with 4 exoplanets around each or one with 5 orbiting exoplanets and one with 3, etc We believe in the importance not only to predict how many exoplanets are around our region of the Universe, but also how these cyborg-stage, interstellar-communicating, civilized-entities may mutually function. Although these “Cyborg Civilizations” may be composed of immortal entities, they may also exhibit a “mean time to failure”, essentially the aforementioned Fermi’s Paradox! That is they may destroy themselves: self-destruct due to their advanced mind-controlling brain’s nightmares as in the movie “Forbidden Planet” or have conflicts like the “Star Wars” sagas and obliterate each other or be destroyed like the dinosaur extinction such as discussed by Erwin [15]. Therefore civilizations “blink” on and off and there may never be two advanced civilizations “operating” or “intercommunicating” at any given time. Fermi reasoned that this would explain why Earth may never be visited by an advanced exoplanet civilization—there would never be “UFOs”! (By the way, we call such UFO “sightings” Anomalistic Observational Phenomena or AOP’s since many of them are not Unidentified, not actually Flying and not solid Objects.) Let us pursue this last point in more detail. Consider the time line or string of Figure 8. Point A is the beginning of our Universe about 13.7 billion “years” ago*. Point B is the beginning or birth of an exoplanet’s first “spark” of life. Point C is the start of the advanced or Cyborg Civilization stage during which an advanced civilization will, according to this theory, utilize interstellar communication with other advanced civilizations that may be intercepted by earthlings. Let us introduce some arbitrary numbers—all very speculative. Suppose that half of all exoplanet civilizations “started”, their B, 8 billion “years” ago or some $13.7 - 8 = 5.7$ billion “years” after A and had already reached D (demise). That is, let us assume that we should consider only half of the exoplanet-bearing stars in our vicinity of the Universe as possible candidates for interstellar communication; the rest having already met their demise. Various archeological or Xenoarchaeology estimates show that the “spark of life,” on Earth started about 3.6 billion “years” ago. If we earthlings are now on the verge of the interstellar-communication interception phase, at C, then the time interval between B and C about is about 3.6 billion “years”. Based upon very speculative estimates of the explosive increase in longevity of earthlings due to the rapid evolution to a biological/electronic or Cyborg life-form and the inherent desire for a long productive lifetime (resulting from repairable and/or replaceable “parts”). We estimate that there would be lifetimes of several thousand “years” and thousand-year-long generations. Of course, our major interest is in the interstellar communication and/or cyborg phase of and exoplanet civilization’s life that is between C and D.

* In Section 4 we will demonstrate that “years” , “minutes” and “seconds” are of smaller apparent “duration “ near time 0; that is, a year might *appear* to be a millisecond since time was moving so fast back then.

Consider this interval's time period in terms of the number of a civilization's generations (single step in the line of descent from an ancestor and the usual period of a society's evolutionary steps) prior to its demise. For example, if demise occurs after 400 of the 1000 year-long generations or $400 \times 1000 = 400,000$ years, then this would be the window of opportunity for these advanced civilizations to accomplish interstellar communication. Please see Table 1 of [2] for other numbers of generations and their lengths in years utilized to determine the time between C and D. As a point of reference after emerging in Africa about 60,000 years ago, our lifetimes have averaged from about 30 to 75 years and generations have varied very roughly from 15 to 25 years in length. In Figure 9 the green communications loop would occur when a communication from one viable exoplanet reaches a neighboring viable exoplanet, is quickly returned and received by the sending exoplanet prior to its demise (D). The red loop is when this process does not occur due to the premature demise of the sending exoplanet's life forms.



Figure 8. Exoplanet advanced civilization time line from the beginning of our Universe, A, to a civilization demise, D. From Figure 3 of [2].

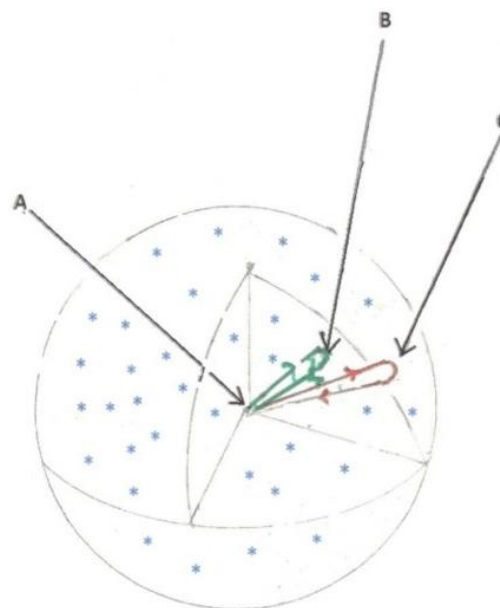


Figure 9. The boundary sphere of radius 5000 light years containing stars in the neighborhood of our Sun whose advanced civilizations could intercommunicate prior to demise **A-B** and those whose intercommunication would fail because the sending/receiving exoplanet's demise **A-C**. From Figure 4 of [2].

4. Rollout Theory of Our Universe and Non-Varying Rate of Time Processes

The Rollout Theory is essentially Dr. Baker's new Theory of Our Universe. Allow us to utilize an analogy to this Theory with an Olympic runner starting out on a track just like our Universe was starting out from its beginning: The analogy of the race commences with the sound of a starting pistol, whose report lasts a fraction of a second. This very short time interval, the very shortest meaningful time interval to the runner, we consider to be an analogy to "Planck time," which is the shortest meaningful measure of time in Our Universe and is related to quantum mechanics. The starting blocks are lined up on a start line probably an eighth of an inch or so in width, but the shortest meaningful length relative to the track's length as far as the runner is concerned. We consider this an analogy to "Planck Length," which is the shortest meaningful measurement length in our Universe. The runner runs down the track – the distance the runner travels down the track is like the space dimension increasing or rolling out in spacetime – the dimension grows! Now our idea is that the timer's stop watch starts out running very fast, then due perhaps to some imperfection, the stopwatch's hand or the stopwatch *rate* of change of TIME slows down. Thus in the rollout of the four-dimensional fabric of spacetime, the three space dimensions (e.g., depth, width and height) grow as does the time dimension, *but* the time dimension's *rate* of growth slows during the spacetime rollout. A pictorial representation is shown in Figure 10. Also shown there is the standard or current "Big Bang" Theory suggested by Guth, for example discussed in [16].



Figure 10. Representation of a New Theory of Our Universe.

In Figure 11 we see a representation of a race that is executed by a 4-minute Olympic miler. That is by a runner who consistently runs a mile distance in 4 minutes. In this case we utilize the fictitious example of a race carried out 13 billion “years” ago. In this race we assume the speed of time is 60 times greater than today. As is shown in the figure, as the time “speeds up”, there is the necessity for the distance to contract. Why? Because if the track was just SAME length as today, then the time-keeper’s stop-watch hand, which is whirling around 60 times faster than today’s stop-watch’s hand, would reach the 6 HOUR point on its dial when the racer crossed the finish line! So instead of a 4-minute mile the runner would take 4 hours, which is wrong! This race is seen by us as the race was billions of years ago. That is back then to today, the speed of time has slowed by a factor of 60 while the measure of distance (e.g., a mile-long track) must have contracted by the same factor! Specifically, the scene as viewed today, as perhaps through a telescope, is of a miniature world going very fast! Of course, if you existed back then everything would be exactly as today – the 4-minute miler running over a regular mile-long track and taking exactly 4 minutes to do it.

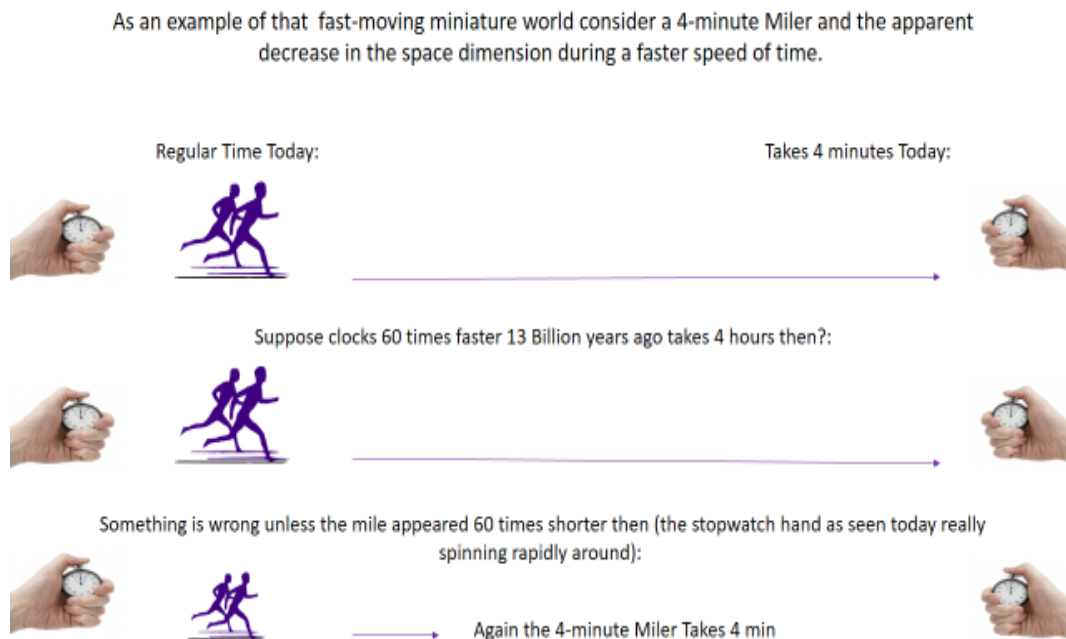


Figure 11. As an example of that fast-moving miniature world consider a 4-minute Miler and the apparent decrease in the space dimension during a faster speed of time 13 billion years ago (13 billion light years away).

Our proposed working hypothesis^{**} or Theory of our Universe starts out with spacetime having initial conditions of Planck Time and Planck Length (as was already noted: the smallest meaningful measure of time and the smallest measurable measure of distance according to quantum mechanics). From those initial conditions we derive in [3], with a simple derivative, that

spacetime initially “Rollsout” at the speed of light. Straight forward arithmetic – no complicated equations!

As shown in Figure 11 the amount that time slows down is directly proportional to the amount that space (dimensions -----) grow. Another reason for this is in order to keep the speed of light a constant in all “scenes” as described in Figure 12. That is the laws of Physics are never changed. More than that. In each scene or moment *all the laws of Physics: general and special relativity, Schoedinger’s equation, the growth of entropy, every single feature or theory of physics remains invariant!* Of course, what happens to the photons *on the way from the scene to your eye can be effected*. The Doppler effect, gravitational lensing, all “curved” space geometry, which can change the photon’s path or frequency, but can **never change** the laws of Physics where the photon was created!

At the beginning of our Universe the (change in the space dimensions) divided by the (change in the speed of time) equals (zero to the Planck Length during Planck Time)/(zero to Planck Time during Planck Time), which *by the definition of Planck Time*, equals the (speed of light). We speculate that this **Fundamental Equation** (1) as a working hypothesis is correct at the beginning of our Universe:

$$\text{(Change in the space dimensions)} \\ = \text{(speed of light)} \times \text{(change in the speed of time)} \quad (1)$$

Equation (1) can be rearranged as:

$$\text{(Change in the space dimensions)/ (change in the speed of time)} \\ = \text{(speed of light)} \quad (2)$$

Applying Equation (2) to the beginning of our Universe is interpreted as meaning that initially spacetime moves out at the speed of light. Also of great importance is that this **Fundamental Equation** (1) shows that the speed of time and the space dimensions move in concert **Why?** Because, as we noted, if the space dimensions were just same length as today, then the time-keeper’s stopwatch hand whirring around fast than today’s stopwatch hand would reach the 6 HOUR point when the racer crossed the finish line!. As our Universe progresses, the change in a space dimension is inversely proportional to the speed of time change (or rate) according to an extension of the **Fundamental Equation** (1) to all times. This proportionality has been depicted by Figures 11 and 12.

** A working hypothesis is defined (Wikipedia) as a hypothesis that is provisionally accepted as a basis for further research in the hope that a tenable theory will be produced, even if the hypothesis ultimately fails or is significantly modified (Isaac Newton’s Principia Mathematica, as significantly modified by Einstein, is an example). It is essentially an encouragement for further research and analyses.



The speedy photon's speed, $c = 186,282.397$ miles per second and is the same in all frames of reference according to Einstein's special theory of relativity



Smaller second offset by smaller "standard" mile! After time "zero" or Planck time, the speed of time slows and the space dimension grows from the infinitesimal Planck length to today's. Both changes (slow/grow) in the same proportion to insure the constancy of the photon's speed of light!



Figure 12. The constancy of the speed of light is assured by increases in dimensions as speed of time reduces.

What about galaxies and black holes? As depicted in Figure 13, our working hypothesis, to be confirmed by observations, is that due to distance shrinking, galaxies would appear smaller and because of the increased rate or speed of time their rotational rate would appear to be faster. Galaxies are not pulling apart at these higher rotational rates and smaller sizes There would be no need to invent dark matter (that has never been independently observed) to allow for these higher rotational rates and more compact sizes. No! The higher speed of time and smaller dimensions explains it! Black holes, like galaxies are more compact, (or their event horizons), would be smaller in radius and the **motion of stars being drawn in faster**. In the case of the black-hole mergers that would *appear* to occur at a faster pace, that is "mergers per billion years" OUR billion years, would appear to be greater. But remember, a billion years according to *their* fast-moving time would *appear to be shorter to us earthlings who are observing them and measuring time with our slower-moving clocks (due to our slower speed of time)*! Therefore, we would also expect to see more black-hole mergers or a higher density of them (no surprise, just like the higher number density of all stellar objects back then) .Nevertheless, we believe to be useful the LIGO observations of black hole mergers (back in time nearer our Early Universe) be analyzed to determine if they were occurring slightly faster than they are today! Let us consider other astronomical observations. If our telescopes were able to detect photons arriving from the very early universe, then that scene would exhibit an extremely rapid speed of time. For a fictitious example, a possible star-formation process back then would last a thousand years to occur, but to us looking at photons from that early time that same process might "appear" to last only a microsecond! If we viewed photons from a scene only 10 billion years ago (that is, 10 billion light years away), then time rate of change might have greatly dropped the speed of time. Therefore, that same star-formation process would again last a thousand years to occur, but in this fictitious example, would to us looking

at photons from only a 10 billion light year distant scene, might “appear” to last only $9/10^{\text{th}}$ of the time as measured today or 900 years to occur. And so on, until we observe that same thousand-year process “up close” in today’s time.

By the way, as depicted in Figure 4, that 10-billion-year-ago scene might show the size of objects, for example galaxies, a little bit smaller (actually, 0.9 smaller in this fictitious example) in order to keep the speed of light be its same constant value in that scene.

Alexander Karimov suggests “... time flow of an individual object is a real physical value ... time for the single object (subsystem) and time for the whole system (macrosystem) *can be different*” [24] — italics and bold type added for emphasis. There can of course, be many possible causes or working hypotheses for the Muon decay time shortening if indeed that shortening exists, which the authors believe the shortening obviously does [25]. The speculative cause or working hypothesis that is suggested by the foregoing quote is the:

Proposition (page 65 of [25]) that some complex processes or sub systems are “marching” to their own intrinsic” time” or timeframe that is independent of the flow of “time” in our Universe. (We call them *Non-Varying Rate-of-Time (NVRT) Processes.*)

Galaxies APPEAR to rotate faster in the past if time was moving faster then. Astronomers have attributed this to a lot more mass or matter in them that holds them together so they can rotate fast and not pull apart. They call it “Dark Matter”

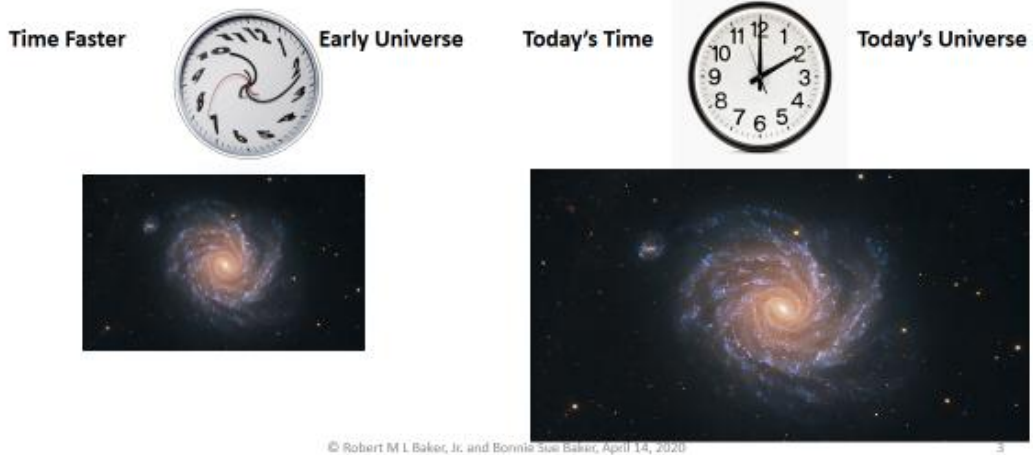


Figure 13. Simply put: by using arithmetic, as time slows space (dimensions) grow!

An interesting feature of the proposed Rollout Theory is that the Theory requires the apparent size of objects to be smaller when time is moving faster. Also, as footnoted in Section 3, the length of hours, minutes, seconds, etc. would be apparently smaller. We believe that the point when we commence seeing early features of our Universe, is such that those early features are already 100-billion-years old as in Figure 14!

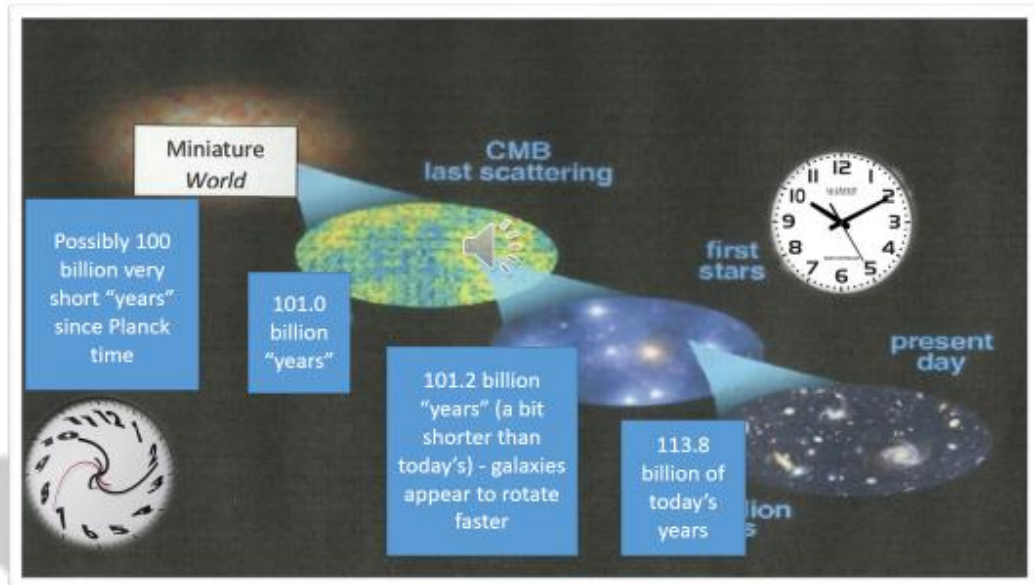


Figure 14. This is our concept, or working hypothesis, with the high rate of change of time and very short years in the early universe, years then seem like seconds or microseconds as viewed today! From Fangyu Li.

By “complex” is meant those transient processes or subsystems that involve one or more quantum-mechanical sub-reactions, some well understood and some not well understood, that in total comprise a complete, possibly multiple-step process *having a well-defined beginning and end* .. Besides Muon decay there may be other such process that we define as ***Non-Varying Rate of-Time (NVRT) Processes***. Such processes, according to our working hypothesis, may include those that generate Big-Bang Nucleosynthesis (BBMs), Oh My God (OMG) very high-speed particles, Fast Radio Bursts (FBRs), Soft Gamma ray Repeaters SGRs (the latter two possibly from Magnetars) and perhaps weak nuclear reactions of proton-proton chain (affecting stellar luminosity but more likely **not** to be NVRT processes since they probably are “space-coordinate” dependent). We will concentrate on Muon Decay since we have studied that process in some detail [25]. By the way, galactic motion, black-hole mergers, Nova and other more extensive in motion and less quantum-mechanical in operation are **not** NVRT processes. Unlike the hypothetical Muon runners to be discussed next, they recognize the three space dimensions. Also their time varies as time mainly does in our Universe. They have no “fixed-rate wristwatches” like the hypothetical Muons , to be described later, have! ! In particular, if the observable output of celestial objects are not NVRT

processes, then in the early universe the frequencies of such observables will appear to be higher because of the higher speed of time then. The reddening of stars will be less since their spectra moves toward its bluer, higher frequency end and diminishes the Doppler-Effect determined speed. The apparent increase speed (acceleration) between celestial objects near the beginning of our Universe of $6.75 \pm 0.05 \times 10^4$ m/s per Mpc to those nearer our time of $7.4 \pm 1.5 \times 10^4$ m/s per Mpc (page 11 of [3]) is simply due to the somewhat higher speed of time back then and its effect on Doppler-determined speed:. No dark energy need be assumed!

In order to understand how such processes might react to the slowing of the rate of time as our Universe grows, we utilize another fictitious tale of a tribe called the “Muons” who developed billions of years ago near the beginning of time and exist even today. The Muons all have the unique capability to consistently run a mile in exactly four minutes. Recently a Muon runner came to my mile-long track. She asked if she could borrow my watch since she had misplaced hers. I agreed and handed over my watch with the admonition that my watch *only* showed the correct time in my location or scene at this specific local time. She looked at the watch and exclaimed: “...it is absolutely identical to the watch that I and my entire Muon tribe had used for billions of years ... its rate of time is exactly the same, not too fast and not too slow, as the watch I had always had and lost!” If there is one thing these Muons know about, it is TIME!

The Muon runner ran my mile-long track and at its end, while looking at her “new” watch, she whistles (sounds like high C) and exclaimed “Perfect! My wristwatch shows exactly four minutes!” She told me that the Muons could not actually “see” the track – as a matter of fact, they could not judge or “see” any distance! “We Muons cannot recognize or even copenhend the three dimensions of space – we only recognize the time dimension.” She said.

We now consider that fictitious fast-moving miniature World 13 billion “years” ago described in Figure 11. At that scene the race starter directs a Muon 4-minute miler to run his race. Of course, viewed from our earthbound Astronomical Observatory, the race starter’s watch is just racing around. Its hands moving 60 times faster than the one at our Observatory. The race starter in the 13-billion – “year” old scene watches the Muon run the mile. “Good grief, they are taking a terribly long time to run that mile -- to me the run appears to take him four hours!” While the Muon runs he starts to whistle with a very strange, very low, deep bass sound. Because the race took so long the officials decided to re-run the race every eight hours.

Meanwhile, back at the Observatory, according to their stopwatch, the Muon run takes exactly four minutes and if they could hear it, then its whistle would have its usual high-pitch sound. Also the races start

apparently every eight minutes as far as they can observe. That is, while local Observatory observers is watching the number of races per hour is 60 times more frequent than if the race -series was held today at my one-mile track.

What else does this example apply to? Let us suppose as a working hypothesis that, say, Nucleosynthesis is similar to Muon decay and is a ***Non-Varying Rate of-Time (NVRT) Process*** and marches to its own drum as it were. If we were able to observe this process in operation today, then if observed in operation from scenes billions of years ago, the process would appear to take the same amount of time and release the same frequency of radiation as today, BUT its rapidity of occurrence would appear greater than that rapidity would be found today. In a sense we are observing *compressed* time from a vantage point of *uncompressed* time. Therefore, over a given length of time here at our Observatory there would be 60 more occurrences as we watched back then (in our fictitious example of Figure 11). So as we might observe Nucleosynthesis from afar through our telescopes today the process would occur more frequently more frequently than in today's local universe! Again, this result is not surprising since the number frequency of events is quite naturally larger as we observe times closer and closer to time 0, the beginning of our Universe. That is, the density of the Universe is greater the further back we go in time.

By the way, as depicted in Figure 13, that 10-billion-year-ago scene might show the size of objects, for example galaxies, a little bit smaller (actually, 0.9 smaller in the fictitious example) in order to keep the speed of light be its same constant value in that scene. But remember, a billion years according *their* fast-moving time would *appear to be shorter to us earthlings* in our Observatories *who are observing them and measuring time with our slower-moving clocks (our slower speed of time)*! Therefore, as we have stated, we would also expect to see more black-hole mergers, Nucleosynthesis. Fast Radio Bursts, occurrences or a higher number density of them (no surprise again, just like the higher number density of all stellar objects back then). Nevertheless, we believe in the usefulness of the LIGO observations of black hole mergers (back in time nearer our Early Universe) being analyzed to determine if the mergers were occurring a little faster than they are today!

In conclusion: the Rollout Theory is superior to the Big Bang Theory mainly for two reasons:

- 1) Astronomers have interpreted the observational fact the billions of ***years*** ago (or billions of light-year distant) galaxies are rotating faster than they are today and not pulling apart! So they suggest that there is more matter in the galaxies to hold them together and that matter they call "Dark Matter" ***but even after many decades of searching***

no scientist has ever independently observed dark matter! Whereas the increased rotational rate of distant Galaxies is a natural consequence of our new Rollout ***there is no need for dark matter in the rollout theory!!!!***

- 2) In the conventional Big Bang Theory of our Universe "... that the nascent Universe passes through a phase of exponential expansion driven by positive vacuum energy density" [16]. Whereas in the Rollout Theory of our Universe "... that our Universe rolled out with time moving fast and with infinitesimally small dimensions and that these spacetime coordinates are growing." By Occam's razor the simpler Rollout Theory is to be preferred.

5. Multiuniverse Communication ("fun")

This Section 5 is more than a working hypothesis, this Section is ***pure speculation!***

Why do scientists work on "things"? We answer: "... mainly for **fun**." We say "mainly" since we scientists, like other life forms, must follow the dictum: "Survival of the fittest!" For example, **fun**-loving nuclear physicists had to earn a "living" and at one time needed to survive Hitler. In this latter case "for survival" they turned for a while to the very practical and painstaking development of the Atomic Bomb. Therefore, let's now have some **fun** and consider here multiuniverse communication.

But first, we must also commence this section with the acknowledgement that the coauthors attended a lecture delivered by Brian Greene around the year. 1999 at the Griffith Park Observatory in Los Angeles that mainly concerned string theory. This lecture together with R. M L Baker's UCLA lecture notes from 1950s to the 1970s lead to a section of our 1999 Patent [4] on "SpaceTimeUniverse Geometry" and the conjecture that the intractable frontier between a smooth spacetime (universe) fabric and Greene's apparent, "... violent fluctuations of the quantum world on short distance scales." p. 129 [17] is nothing more or less than the interface between osculating universes possibly at the "beginning of time" (in my Theory [3], near Planck Time). We further suggest that entities shift back and forth at will! Possibly smooth transitions from one osculating ("touching" or "kissing") universe to another with mass/energy and momentum conserved and entropy constant as discussed in [3]. The Figure 15 illustrates our concept and could be defined as the "Fifth Dimension": Just like locating a person as being on the corner of 5th street and first avenue (like x, y) on the third floor (like z) at 2pm (like t) and in the Ambassador Hotel (*universe*).

We will now paraphrase the relevant section in [4]:

“All universes are not necessarily viable: some may be massless, some may be of no physical significance, and some may have no chance at all to lead to life as we know it. According to this conjecture or working hypothesis, the intractable frontier between a smooth *Spacetimeuniverse* (STU) fabric or geometry and apparent, quantum-mechanical `frenzy` at small scales (such as Planck Time and Planck Length) is nothing more or less than the interface between osculating universes in which entities could shift back and forth at will--possibly smooth transitions with mass/energy and momentum conserved and entropy constant, (the speed of time certainly may not be translated) possibly at the initial condition or ‘birth’ of multiuniverses or *even at other frontiers.*”

SPACETIME UNIVERSE OR FIFTH DIMENSION

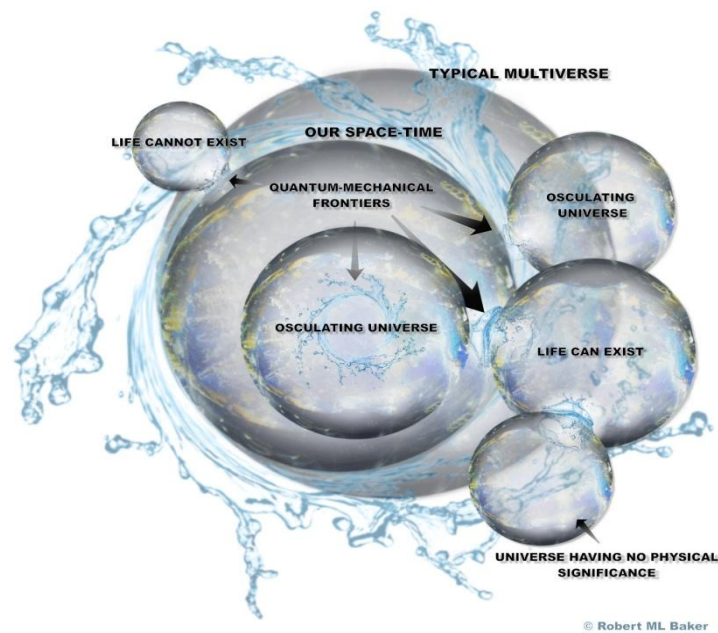
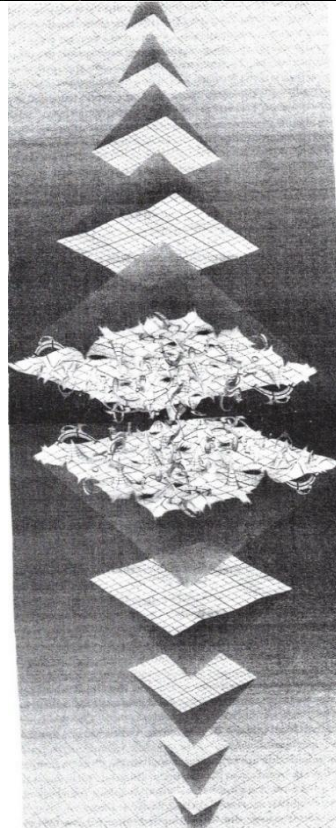


Figure 15. Relationship of universes and their frontiers or osculation points comprising the Space-Time-Universe (STU) multiuniverse, fifth dimension. From [18].

To put a fine point on this “**fun**” concept we turned to the cone-like figure on page 128 of [17]. The figure is an excellent picture of the *quantum foam* (which we will term *quantum fog*, similar to the “fog of war” – you do not know quite what is in there) a term first suggested by Wheeler [19, 20]. But the figure appears to be upside down or inside out! The drawings get larger as “things” in our Universe get smaller. Maybe if at the bottom we sprinkled in some stars and galaxies and add the label “Our Universe” we might perceive better the idea. Just for **fun**, let’s put another of these universe cones on top facing down and add the term “Other Universes”. Please take a look at the next Figure 16. We believe relationship does exist between the quantum fog at small distances and the beginning of our Universe or more generally *the quantum fog at small distances of universes, as in Figure 16.*

Let us return to the question of communication of some sorts with other universes. In a sense we are creatures in “solitary confinement” stuck on our planet amongst a myriad of exoplanets that are stuck in our Universe with us. In turn we suggest that we are amongst other universes. Like such “prisoners” how do we communicate to these “others”? We knock on our prison-cell “Walls” and hope for an answer. What are these “Walls”? We believe they are the quantum fog osculation points or frontiers that we hypothesize connects us to our surrounding neighbor multiuniverses! But how do we “knock”?

Other Universes



Our Universe

Figure 16: The quantum fog at small distances of universes. Adapted from Figure 5.1, page 128 of [17].

The problem is to “get into” the quantum fog” you must be unimaginatively small, 1.616×10^{-35} meters, a Planck Length, and/or unimaginatively quick, a Planck Time, around 5.4×10^{-43} seconds (the time required for a photon to traverse a Planck Length) .First, let us consider where these numbers come from. Basically, Max Planck was trying to come up with a way to establish a system of units based solely on fundamental constants of our Universe. Planck stated: “These (constants) necessarily retain their meaning for all times and for all civilizations, even *extraterrestrial* and non-human ones, and can therefore be designated as ‘natural units’” [21]. This is the same concept as was utilized by Samuel Herrick, C. Jeffery Hilton and R. M L Baker, Jr., in the 1940s -1950s [22, 23] for astrodynamic units based upon “universal” constants. In Planck’s case, the fundamental measure of distance (space) was Planck Length, which he defines as $\sqrt{\hbar G/c^3}$, where \hbar is Planck’s constant, G is the universal gravitational constant and c is the speed of light. But why is Planck’s length the smallest measurable length? The answer to that question awaits a comprehensive quantum theory of gravity. Right now we consider this value to be the *best estimate* because this value is the essence of Heisenberg’s uncertainty principle that such a length exists and this Planck Length is now *the best estimate that we have for the length*. We leave the matter to the reader to delve into these questions further, for now we will explore how to “reach into” the quantum –fog-bank frontier other universes assuming that such a minimum length and time exist and they (components of the fog) are the appropriate portal. But first, we propose the following Laws:

1. All universes of interest are created with the same physical constants, for example \hbar , G and c . (Planck’s assertion).
2. All universes of interest are **not** created at the same time (Baker’s assertion, page 134 of [9] and possibly Hawking’s)).
3. After conception, all universes of interest exhibit a decrease in the speed of time (to be proven or disproven by observational evidence in our Universe and assumed for all other universes of interest).

These Laws lead to a conclusion that a unique feature, identification or “name tag” of every universe of interest is its speed of time at a specific time in our Universe. When we “knock” at the “wall” how interesting to know what universe “door” or “wall” we were knocking on.

The concept we propose is to generate an extremely high-frequency gravitational wave (HFGW) in order to execute the imaginary “horserace” described on pages 135-137 of [9]. The HFGW pulses are the “horses.” First, we will look into the starting gates of such a horserace. The gate opening is like the starting gun and starting location of the gates is like the starting blocks of the runners utilized in a previous discussion in section 4. Therefore, all the horses do not leave the gate at the same time. Since there is no interaction among the gates and the gate mechanism capabilities are

randomly distributed (requirements for a random distribution) the initial distribution of the horses will be Gaussian. As discussed on page 135 of [9] we will consider the distribution or histogram of the horses at any arbitrary point during the race. Furthermore, we consider the horserace as proxy for a beam composed of a train of pulses (“horses”). Just like the starting gates the GW pulses are generated by “jerks” of masses (Figure 2 and [12]) and all of these masses (like the starting gates) are not “exited” or jerked at exactly the same instant. But most importantly, these proxy racehorse HFGWs run **at exactly the same speed**, the speed of light. Therefore, the Gaussian distribution of the HFGW pulses (like the racehorses of Figure 17) remain the **same** after its generation.

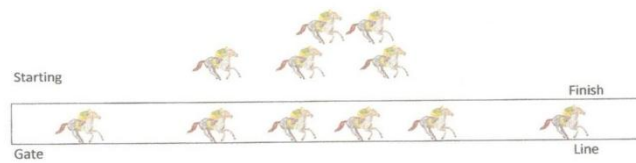


Figure 17. Horserace without time travelers out of the starting gate in a Gaussian-like distribution. From Figure 11-3 of [9].

To enter in the quantum fog and follow the “horserace”, we submit that the pulses’ length and/or separation in time should be on the order of a Planck Time, which is directly related (by the speed of light) to Planck Length. This is a tall order since X-rays have their shortest wavelengths on the order of 10^{-12} meters versus 10^{-35} meters for Planck Length. Let’s consider those horses/pulses “jumping in and out” from an “adjoining” universe. First of all, from the three Laws just identified, **they will be running at different speeds of time!** Second, we cannot really measure individual pulses, but due to their dispersion in speeds of time their distribution in a HFGW beam may change as in Figure 18.

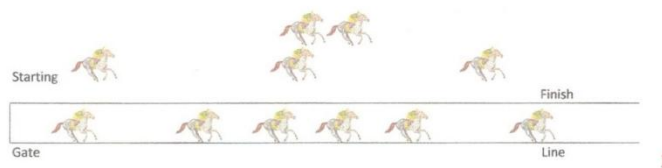


Figure 18. Horserace with time-traveling horses plucked in and out of the race and more evenly distributed, approaching a solitary wave. From Figure 11-4 of [9].

In [9] we discuss such “universe jumpers” as “Time Travelers” here we treat them as “*Speed of Time Travelers.*” So how would these HFGW pulses from another universe jumping into our HFGW beam and ours jumping out change the HFGW distribution in the quantum fog? We propose that the distribution would approach a single solitary wave. So that means a

tendency to lower and lower frequency as detection time after the triggering HFGW emission time

Back to the problem of the over 20 orders of magnitude increase in HFGW frequency to place the super-high HFGWs in the quantum fog. One idea is to increase effectively the number of lanes in the “track” of runners, horses and/or HFGW pulses. *The real concept is to start or trigger the “race” or HFGW emissions at say 10^{11} times a second and then start that “starting sequence” 10^{11} times per second!* (A considerable engineering design problem, but possibly not impossible. Essentially a double super frequency multiplier in which distortion is not important.) Now we are approaching a “triggering” frequency that is in the quantum fog! Next how do we detect this triggering change? Since the HFGW frequency is dropping we must wait after the trigger until the frequency reaches a low enough frequency to allow for detection by for example, the Li-Baker detector. How long this takes maybe associated with a universe speed-of-time “name tag” suggested by the proposed Laws.

But we must step back now and take a serious and more rigorous view of the prospect such a “*multiuniverse connection.*” The situation in some ways may be similar to the *infinite monkey theorem* that states that a [monkey](#) hitting keys at [random](#) on a [typewriter](#) keyboard for an [infinite](#) amount of time will [almost surely](#) type any given text, such as the complete works of William Shakespeare. The solution to an analogous problem is for a one-in-a-trillion chance of success, there would need to be $10^{360,641}$ observable universes made of monkeys as numerous as all the protons in our Universe! Also similar is the fact that all the molecules in a room could collect in one corner – possible, but so improbable that collection of molecules would never happen. How then, do we get a triggering signal into the quantum fog of our Universe? At this point in our analyses we believe in the importance of recognizing that the numerical value of Planck Time is based upon Heisenberg’s Uncertainty Principle and is itself uncertain! Our trigger is to launch a train of pulses like the fictitious horses in the horserace and determine if replacement pulses (horses) show up randomly each having a different speed of time – essentially looking for an approach to a solitary wave. Possibly we do not need to have the pulses of very short duration and very close together. Maybe our “horses” are very, very fat and strung out very, very far apart in the fictitious horse race – furthermore we must assume that the time-keeper’s stop watches are of extremely poor precision! In essence we are looking for very tiny replacement ponies that are very close together on the track. Maybe transmitting as high a frequency Gaussian Beam as possibly can be achieved in the Li-Baker detector will allow for detecting these replacement ponies.

So what is the “knock on the prison wall”? Launching our extremely high-frequency “trigger” Gaussian Beam in a Li-Baker HFGW detector might to

do it. Hopefully, the success of that “knock” will not have only one chance in a trillion from one out of $10^{360,641}$ other multiverses to be successful in receiving an “answer”!!! The quantum-mechanics conclusion for this quantum mechanical interface is *that: most certainly the “knock on the prison wall ” will always be answered and always replied to and also that the “knock” will never be received and never replied to by a universe or universes osculating with our Universe, some of the time.* Of course, we always assume “someone” is out there, eager to communicate with us... be they from exoplanets or other universes. Their eagerness is a wonderful expectation! Hope springs eternal.

6. Conclusions

We conclude that an “interdisciplinary” approach to communications is absolutely necessary. For example, with regard to Global HFGW communications of Section 2, Physics is required with both transmission/generation and reception/detection of such HFGW communications as is Electronics and Engineering. In connection with Exoplanet Communications of Section 3, Celestial Mechanics, Xenoarchaeology, Astrobiology disciplines and especially Exobiology need to be included. Cosmology is necessary for an understanding of Section 4. In Section 5, not only is an understanding of Cosmology and Observational Astronomy necessary, but Statistics and Theoretical Physics is involved at the very basic level.

With regard to “rigor”, its definition is: “Exactness, Precision” (Webster’s New International Dictionary, Second Edition). As applied to Communications there are two objectives to rigors:

1. To seek high-fidelity and error-free transmission signals.
2. To seek exactness in theoretical analyses of communication means. In this case, we find such exactness in the Global Communication analyses of Section 2. Specifically, the generation of HFGWs, although yet to be achieved, is well documented herein. Likewise well documented is the analyses of the several HFGW detectors already built and especially well documented for the Li-Baker HFGW detector. In Section 3 the analyses of interplanetary communications including exoplanets is more conjectural since the study of exoplanets its self is conjectural. Both the theoretical analyses of sections 4 and 5 are by their very nature more speculative, especially in Section 5, but such analyses are necessary as Observational Astronomer’s find serious discrepancies in the conventional “Big Bang” approach.

There are several more specific conclusions and recommendations to be made. Although there have been many important discoveries resulting from the low-frequency gravitational wave detectors such as LIGO and Virgo, especially in the study of black hole mergers, we strongly recommend that we develop HFGW detection and to study their possible laboratory HFGW generation. The concept of time as marching along at a constant pace must be modified to allow for the speed of time or rate of time to decrease. In this regard, as suggested in [25], utilizing more precise timing apparatus, muon decay time should be measured to confirm the hypothesis that decay time is shortening and time in our Universe is slowing^{***}. Finally, our whole understanding of our Universe as well as other universes must be re-examined.

Einstein was reported to have commented that: “Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand.” We conclude that the future will be forged by innovative, imaginative “out of the box” thinking and we also conclude that this paper embraces these attributes.

^{***}.If there is a statistically significant variation of Muon decay rate over time, e.g., alternating between above 2.3 ps and below 2.0 ps over two or more time intervals and *not* a gradual shortening of Muon decay time, then the NVRT working hypothesis of [25] will need to be revisited. Also if the speed of time computed from different NVRT processes produces statistically significant different time rates of change or slowdown of our Universe over the same period of time, then in the working hypothesis of the slowing of the speed of time throughout our Universe needs reconsideration. Perhaps the difficulty in estimating the speed of time in our Universe is similar to the difficulty of measuring the speed of a boat across the water if the only viable reference point is a leaf in the water (page 11 of [3]). Perhaps the “leaf” is like a NVRT and we may need more than one to measure our local rate or speed of time!

7. Acknowledgments

Fangyu Li and Andy Beckwith (our mentors in Cosmology), Nagib Callaos, Paul Murad, C. Clive Woods, Gary Stephenson and Giorgio Fontana have provided encouragement for many of our "out of the box" ideas including our Theory of our Universe or Rollout Theory. Mounir Belgacem has given valuable assistance with the preparation of the figures and Conner J. Baker was especially valuable in the preparation of Section 4. David Mathes provided most helpful guidance and corrections to our manuscript. Very special thanks to Jeremy Horne's very kind remarks concerning our research ^{iv}. Transportation Sciences Corporation has provided support for the entire project.

iv The Bakers are working on seminal research, not simply because of the mechanical aspects of cosmological physics but the philosophy underpinning it, this time concerning "interdisciplinary". Their keen realization of context and its foundation - origins - is reflected by going back in two ways: cosmological origin and the smallest of the smallest, Planck length. Philosophers also know context and history in terms of "becoming", something subsuming its past, a requirement for our understanding of that something. Of particular note is their looking to "building blocks", like time and space to suggest a gateway to a more expansive "interdisciplinary", the intercommunication with another universe or even dimension. No doubt they are appreciative of Edwin Abbott's [*Flatland, A romance of many dimensions*](#). Indeed their entertaining the changeability of dimensions may be a solution to the Abbot problem. Real philosophy, indeed!

As I was going through their abstract for the last time from an editorial/proofreading standpoint, my eyes landed on "our Universe", wondering if "universe" should be capitalized. Is it a proper noun? Personally, I see it equivalent to "Earth", a special entity, i.e., a particular thing, a proper noun, going even further and arguably more radical, an organic entity, [*perhaps conscious*](#). NASA does not seem to like this idea, saying not to use the upper-case style. I came across a National Public Radio (NPR) article describing the universe in which we live as "the Universe", ours being, perhaps one among many. In the article, we also see, "our Universe", just like the Bakers. You see, already we are caught in a debate about meaning at the Meta and object-level of discussion about "universe" or "Universe". Do we capitalize "universe"? Do we capitalize "Universe"? I am going to pass on this one, allowing the Bakers' deep philosophy to unfold before us. As an aside, we should note the many decades of Bob Baker working with NASA in training astronauts and his authorship of numerous Astrodynamics books.

It is wonderful that the Bakers are willing to tackle the fundamentals of our existence by looking to the Queen of sciences, Philosophy, a task insurmountable to most researchers. One should be reminded of ancients contemplating in the same way the Bakers are, Plato's *Timeus* an example.

Admittedly, as a philosopher-scientist, I am advertising for my discipline, but I see the Bakers in the fine company of the natural philosophers like Newton, Leibniz and Descartes. Perhaps no final answers will come with this paper, but to arrive at the truth, you need to take the right road, the Bakers having identified it.

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