Solving the Cosmological Constant Problem

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Abstract: In following on from the preceding papers [1-13], this paper presents the case for the disparity between vacuum energy [14] and the associated metric expansion of space energy requirements. A solution is provided to this problem while correctly deriving the value for the Lamb shift radiation as evidence for vacuum energy marrying up correctly with a newly proposed large scale cosmological model, such in the context of a revised understanding of the redshift effect and associated scaling system for the Planck constant [13]. The process of proof presented here is by taking a close look at the theory behind the metric expansion of space, those calculations, and any of those associated assumptions of theory and modelling of time and space in those calculations and observations that could lead to the cosmological constant problem, and thus determine in fact why the value for the proposed energy of space needs to be so disproportionate compared to the known vacuum energy value. Above all, this paper shall present proof for *vacuum energy* in a steady-state reality, such by using the fundamental basis of the phi-quantum wave-function scaling system in deriving the temperature value of the CMBR and Boltzmann constant, and finally proof for the precession of the perihelion of Mercury which is demonstrated to be directed related to the vacuum energy of space and CMBR.

1.   INTRODUCTION

In following on from the preceding papers [1-13], this paper presents the case for the disparity between vacuum energy [14] and the associated metric expansion of space energy requirements. A solution is provided to this problem while correctly deriving the value for the Lamb shift radiation as evidence for vacuum energy marrying

up correctly with a newly proposed large scale cosmological model, such in the context of a revised understanding of the redshift effect and associated scaling system for the Planck constant ([13]: p9-11).

Upon this introduction (1.), this paper shall first (2.) address the setting of logic used in this paper detailing how contemporary theories are using the notion of time and space upon a limited theoretical licence leading to limited models of reality. Then (3.), the basics of the cosmological constant problem are addressed, following which (4.) is presented an account of the fundamentals of relativity theory, fundamentals that first announced the idea of a cosmological constant, focussing in on any details that could improperly account for the considered observed redshift of stars in the presumed metric expansion of space. Following this (5.), a review of quantum electrodynamics will present an assessment of the photon in regard to relativity theory and how this could contribute to the vacuum energy of relativity's spacetime both on the local level and then metric expansion of space level, while accounting for any experimental misdemeanours leading to the formulation of incorrect calculations regarding the photon. Following this (6.), a solution for the general cosmological constant problem is presented, together with correct derivations of the CMBR value and associated temperature and Boltzmann constant. Then, a general overview of the idea of light in space is presented, highlighting how this new theory is able to reach all the levels of Einstein's classical proof of relativity while not requiring magical fixes such as dark energy and dark matter, using a new version of the standard model of particles, and an updated form of quantum mechanics, all of such as the general cosmological shape for time, space, energy, and mass in this cosmological constant solution context, presenting a new system of proof for the perihelion precession of Mercury. This shall be sectioned as follows:

1. Introduction.
2. The general context of criticism.
3. The cosmological constant problem (vacuum catastrophe).
4. Relativity theory.
5. Quantum Electrodynamics (QED) and the Photon.
6. Cosmology theory: modelling a means to validate the end.
7. Conclusion.

In short, the aim here is to present a solution to the cosmological constant problem by taking a close look at the theory behind the metric expansion of space proposal, those calculations, and any of those associated assumptions of theory and modelling of time and space in those calculations and observations that could lead to the cosmological constant problem, and thus determine why the value for the observed energy of space is so greatly disproportionate to the proposed value that the metric expansion of space theoretic modelling requires. The problem, the discrepancy, shall be presented as a combination of two things:

A. <u>The problem is one of observation and calculation</u>; namely, does the value of energy of space *change* as space expands, if indeed it expands, and does relativity theory fail to account for this, and if so, does relativity theory need amending?

B. <u>The problem is one of theory</u>; namely, is the metric expansion of space the only description for the redshift effect and if not what impact does this have on relativity theory and QED if a theory-model other than the metric expansion of space can account for the observed redshift effect of stars?

To determine where the problem lies, the history of the cosmological constant will be presented, tracing all the associated theories and models for time and space along that course. The use of dark energy and dark matter

are extraordinarily huge fixes, accounting for 80% of mass and energy of all reality, which is a huge value, casting great doubt over cosmology theory, leading one to suspect that there must be something fundamentally flawed with a key piece of theory used in cosmology. In this paper, the solution to the cosmological constant problem will be presented in the context of the preceding series of papers [1-13] on this related topic of time-space theoretical physics as the most efficient course of presentation while also solving the problem of dark energy and dark matter. Above all, this paper shall present proof for *vacuum energy* and *cosmological constant* being in parity.

2.   THE GENERAL CONTEXT OF CRITICISM

The aim here in this section is to set the general stage of the criticism of what is to be presented, to then present the key problem regarding the cosmological constant and then more broadly the associated problem itself of cosmology theory.

2.1   How "outdated" is ***modern physics theory*** compared to ***new data***?

Most of the current models for time and space applied in physics were contrived before computers, before computer-assisted telescopes, before in fact most of the data we have on the perceived universe. Is it possible that contemporary observed data suggests that the basic theories underlying any such physics theory being evaluated are proving to be incorrect owing to observed data not matching up with those basic underlying theories? The most strategic recent fixes have been dark matter [16] to account for how galaxies would be kept together, and dark energy [17] to account for the accelerating expansion of space containing galaxies held together by dark matter. Is this a sign that something is fundamentally wrong with modern physics theory based on a century old theory in requiring all these theoretical add-ons?

The latest theoretical fixes aim to marry up quantum electrodynamics (QED) [18] and cosmology theory via relativity theory [19], and foremost here is "string theory", a *theoretical framework in which the point-like particles of particle physics are replaced by one-dimensional objects called strings,* aiming to link the very small (particles) with the very large (astrophysics, black holes, etc) [20]. String theory though sits on both relativity theory and QED, the aim of each as one to explain cosmology theory. Yet all of such modelling has been based on a type of "surf-set" wave of ideas from the initial premise of "*spacetime*" presented by Einstein and then built upon. Yet what is the drive for physics theory to join our local laws of atomic physics and associated particles with what is observed of the stars?

2.2   The assumption of the stars being solar systems.

The idea that the stars are solar systems in their own right *is* a "model", the first such model coming about care of Giordano Bruno circa 1584 [21]. The key consideration therefore is that if light from observed stars are solar systems in their own right then they must obey local conditions consistent with our own to "be" solar systems, and therefore that if "that" model-association is to be used universally it ***must*** obey the "principle of relativity", namely that our ***own local laws of science*** must apply to observed stars as solar systems in their own right if such is the case. Thus, if the data from the stars contradicts our own local laws of science as a solar system, then the premise of the stars being solar systems must be questioned,

In short, if the stars are solar systems, as science holds such a proposal, they, the stars, must obey the same local laws of science, Yet, where is the grace of opinion that suggests stars operate by different laws as a "fix" of scientific theory that does not exist here locally in such a manner as to exempt this solar system from observed "star-laws" of "other solar systems" to uphold a model as a "fix"? To suggest that other stars as solar systems in the vastness of space operate by a different process of science that cannot be demonstrated in our own laboratories suggests that we are "unique" as a solar system, otherwise there is a greater science out there we need to understand in the cosmos, despite it not working here *scientifically*.

Indeed, the problem of contriving theories with magical fixes is stretching scientific protocol, hence the desperate need for physics to prove dark matter and dark energy exist. And if dark matter and dark energy cannot be found to exist? If physics theory cannot explain the stars using local laws, then two conclusions can be reached:

(I)   The local laws do not apply universally,

(II)   Universal laws, laws that may exist elsewhere, may not work here, thus making what is perceived of the stars being an entirely incorrect lens of previous star/solar-system theory.

The more impossible it becomes to explain the stars using our local laws of science based on new observed data in the context of the stars being solar systems, the more such "impossibilities" of similarity should place the stars as solar systems in dispute given our own solar system is taken as "more real" than the phenomena of the stars. Yet, what indeed is a theoretical model if not for an amalgamation of mathematical cords stringing together a tune that matches observed phenomena? Why can't mathematical modelling be the magical fix to link the small scale with the large scale? Should mathematical modelling that is used for the outer observed cosmos be consistent with mathematical modelling that explains local phenomena such as the atomic particles and light? Can mathematical modelling step in and explain "why" dark energy and dark matter cannot be found anywhere, why it is considered as dark? Can mathematics be a "fix" for physics?

2.3   Theories based primarily on mathematics.

Primarily, when considering mathematically modelling, the question is whether or not physics must obey mathematics or hold more closely to observation and data. Indeed, mathematics is a tool to describe observed phenomena into theories, theories that then present words with meaning that can work locally in this solar system as a process of creating matching observed phenomena through experiment. To suggest a primordial mathematical process that explains reality, which dictates physics, then that mathematics must also include ideas of consciousness, a key ingredient of reality. Moreover, as with the "principle of relativity", a mathematics we understand locally that suits local evidence should be *required* to fulfil *the assumption* the stars are solar systems like our own, and nothing else. The question therefore can be put, "how do purely theoretical mathematical models of reality work in the lab therefore, or even beyond Pluto to the Oort cloud perhaps, places we can research in a reasonable lifespan of social scientific axiomatic existence?"

Most agree that mathematics should cleave to observed reality and to structure itself as equations into words to explain observed phenomena to then assess models of those theories and associated mathematics in the lab consistent with observed phenomena. The ultimate quest for mathematics is to derive all observed phenomena, yet mathematics cannot derive "*all of it*" as a process given the nature of the observational reference "deriving" the concept of mathematical congress itself. Observation essentially is a

very difficult concept to understand, as technically it relies on the idea of "light" "in space". Simply, the idea of "light" outside the concept of "measurement" is a contentious subject, namely whether light is a particle without mass or a wave or both? Does light exist if one cannot observe it because there is nothing to use to observe light which may still nonetheless exist in space?

2.4 The issue of measuring light as the observer reference

In the model presented here in this paper and preceding papers [1-13], the mathematics of space is not what needs closest inspection, it is "light", which although can be explained in regard to particles and thus the atom as a photon, yet outside the atom it's a different scenario, where there are no measurements for light other than once again particle-based ones as reference points of measurement of light. The difficult thing about light is that it can only be explained using particle observation reference markers of an atomic basis. The work presented here in this paper and preceding papers [1-13] acknowledges this feature of light, namely that light can be understood in the context of a particle and as also a wave, as described by the "phi-quantum wave-function" ([2]: p7-13), which accurately calculates $E = hf$ ([3]: p3) on the particle reference of the wave-function. Yet, outside of the particle reference, light should not be so quickly assumed to be granted explicit definition owing to its state of not being observed, as this paper shall highlight. There are though features of light that can be "derived", especially with observational data, primary being that light travels at "c" ([2]: p13) beyond the particle reference. Yet to "assume" that light is a particle beyond its observed particle reference "device of observation" is another "assumption" in modern physics theory, an assumption in league with the assumption of stars being solar systems like our own, an assumption that shall need to be addressed.

2.5 The issue of gravity as inertia

Another key issue that contemporary scientific theory largely structures itself upon is the idea of gravity equating to inertia, as per special and general relativity theories. Gravity is defined by the Encyclopedia Britannica as [22] :

> ***Gravity***, *also called* ***gravitation***, *in mechanics, (is) the universal force of attraction acting between all matter. It is by far the weakest known force in nature and thus plays no role in determining the internal properties of everyday matter.*

That's an interesting definition, given gravity is considered as inertia and used in the standard model (SM) of particle physics and QED. Nonetheless, the Encyclopedia Britannica defines Inertia as [23]:

> ***Inertia***, *property of a body by virtue of which it opposes any agency that attempts to put it in motion or, if it is moving, to change the magnitude or direction of its velocity. Inertia is a passive property and does not enable a body to do anything except oppose such active agents as forces and torques. A moving body keeps moving not because of its inertia but only because of the absence of a force to slow it down, change its course, or speed it up.*

In common usage, the term "inertia" may refer to an object's "amount of resistance to change in velocity" or in simpler terms, "resistance to a change in motion" (which is quantified by its mass), or

sometimes to its momentum, depending on the context. The term "inertia" is more properly understood as shorthand for "the principle of inertia" as described by Newton in his first law of motion [24]: *an object not subject to any net external force moves at a constant velocity; or, an object will continue moving at its current velocity until some force causes its speed or direction to change.* The problem becomes apparent later in the centuries in greater contemplation of the idea of field forces, namely that Gravity as a field force of nature, a fundamental one, is not necessarily inertia.

For instance, if something is in free fall to a planet, it is under the influence of gravity. That is not inertia. Inertia would be the resistance of that free-fall. Effectively, inertia is the quality of a physical construct that represents what is required to "resist" it's natural state in the context of its natural force field association. The question that should be asked is, "what are the implications of equating gravity with inertia in absolute considerations?".

The key problem is that on the one hand the idea of gravity as a field force associated to other field forces "should" be a natural thing, yet on the other hand the idea of gravity as "inertia" suggests that there is a component of regard for gravity that represents a resistance to what is "natural", to what is a "natural" field force. Ultimately therefore, if gravity is a fundamental field force tied in with other field forces, and gravity is associated fundamentally to space and time, then "that" model of spacetime would be "erroneous" because it is in error of what is natural in using the concept of "inertia".

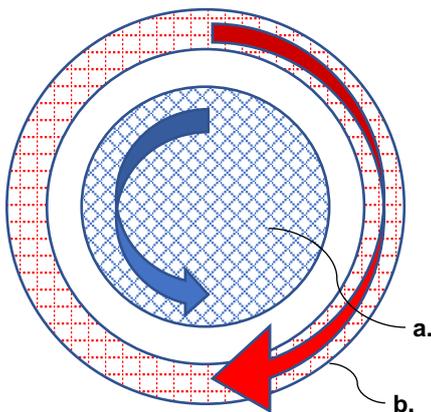Consider figure 1 as a universal context of gravity considered as inertia.

Figure 1: A schematic representation outlining the two different ideas of action and reaction, merely a symbolic representation, not a representation of shape or size in space and time. The direction of the arrows here merely signify the idea of inertia, namely mass and thus gravity (red arrow) defined as a reaction to what would otherwise oppose it, and in the case of a united reality, that anything else would be everything else in reality in its primary active state (blue shaded region and arrow).

How did Einstein try to get around this issue of gravity as inertia? He embedded the idea of gravity as inertia "into" *spacetime*. Why? He had no other choice but to make the idea of "inertia" "fundamental" to everything, to all space and time, in order to avoid the paradox of action-reaction between concepts in space and time. And so, he envisaged the concept of "*spacetime*" as a platform for "inertia". Yet was this the right thing to do?

2.6   The issue of Einstein's "*spacetime*"

As presented, Albert Einstein's theory of special relativity was built on the understanding of inertial frames of reference as developed initially by Galileo and Newton. While Einstein's theory changed the meaning of many Newtonian concepts such as mass, energy, and distance, Einstein's concept of inertia

remained unchanged from Newton's original meaning, resulting in the fact that the principle of relativity could only apply to inertial reference frames. To address this limitation, Einstein developed his general theory of relativity which provided a theory including non-inertial (accelerated) reference frames, and he achieved this rather mischievously by *generalizing* special relativity in *refining* Newton's law of universal gravitation, providing a unified description of gravity as a geometric property of space and time, or *spacetime*, namely that the curvature of *spacetime* would be directly related to the energy and momentum of whatever matter and radiation are present. Essentially, with such a summary, Einstein presented Newtonian mechanics as a *limiting case* of (special) relativistic mechanics, and thus a *summary* of inertial logic neatly described as the *concept of gravity* as a *curvature* of "*spacetime*"; to negate the problem of inertia, of action and reaction, Einstein's Special relativity was defined *in the absence of gravity*, **yet** with general relativity it was contrived for there to be no global inertial frames yet "approximate inertial frames" *moving alongside freely falling particles*. Essentially, inertial frames still existed in Einstein's *spacetime*, yet they were translated into the language of *spacetime* in such a way that the straight time-like lines that define a gravity-free inertial frame were deformed to lines curved relative to each other, suggesting that the inclusion of gravity necessitated a change in *spacetime* geometry ***as that curve***. Consider figure 2.
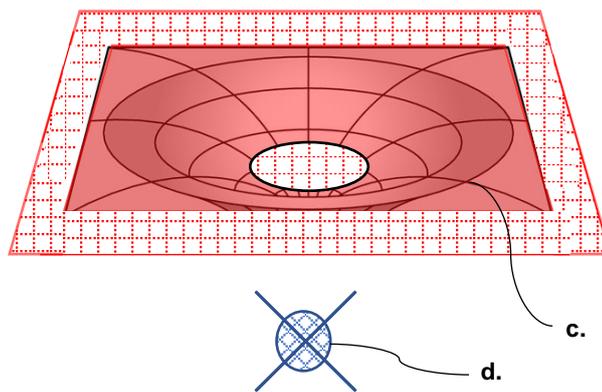

Figure 2: The red arrows and associated mass grid from figure 1 now become a part of an entire *spacetime continuum*, gravity as a curvature of *spacetime* (c.), thus enforcing the theorised matrix of reality as *spacetime* to conform to inertial gravity. The primordial "cause" of reality from figure 1 (blue shaded region) has been squeezed out of existence (d.).

Here, the only initial "cause" would be the blue shaded region of image 1 (a.) that would now be discounted (d.) in the absence of being integrated properly into *spacetime* (c.), of a supposed endless reactionary inertial event of *spacetime*, also known as the big bang, and that's no coincidence, as such is the only way any such *inertial* theory of *spacetime* can be advanced in the form of cosmology. Essentially, with the employment of *spacetime*, all of reality has now become regarded as an inertial system. Consequently, owing to this "new twist" on the concept of inertia as gravity, inertia is still an embedded construct into *spacetime* theory requiring a new set of mathematical equations that transform ***invariants*** (another way of saying "*properties that are constant*") from one location of *spacetime* to another. The implication of using those lines is suggesting that light would follow those lines of inertia in cleaving to the shape/curvature of *spacetime*, as it only could, suggesting that light is a process ***of*** this inertial *spacetime* and thus must be considered in inertial transformation equations, as another "reactionary" push-pull action-reaction inertial construct. This paper will highlight that such a code of equations and symmetries of light (as such an inertial particle construct) results in a fallacious understanding of starlight and its associated theoretical event-horizon that defies the logic of its genesis (BBT), not to mention a universal model that defies observed data leading to the cosmological constant problem.

This paper shall highlight the great problem of general relativity, namely its failure to properly and fundamentally note that gravity is a real force of nature, and that inertia is a resistance to a real force of nature, a resistance to a natural state; if gravity were inertia it would be a field force that resists all other field forces, which it is not. Simply, gravity being a "reaction" to *spacetime* as inertia, a resistance to what can only be something more fundamental as inertia, as this paper shall highlight, *defies logic*, as essentially a *curvature* of *spacetime* would be a *feature* of *spacetime* and thus a feature of the process of what would be *natural* and not something that otherwise resists it as "inertia". The ultimate basis therefore in using inertial theory, *inertia* as a tool of enquiry, would be a *fallacious* platform, something that does not *accord* with nature. Clearly therefore there are a number of inconsistencies in the basic axioms of contemporary physics theory requiring further examination, inconsistencies which could account for the cosmological problems faced by physics theory. The BBT theory for instance, a result of relativity and thus inertial theory, prescribes a beginning of unknown cause and an end of unknown determination, essentially refuting the basis of inertia, of known action-reaction, that lead to its formulation. Understandably, the cosmological constant problem is a part of this flawed construction of inertial logic. What exactly is the cosmological constant problem though?

3.   THE COSMOLOGICAL CONSTANT PROBLEM (VACUUM CATASTROPHE)

Albert Einstein initially introduced the idea of the cosmological constant into his field equations of general relativity to counterbalance the effect of gravity, aiming for a steady-state general equation. That is an interesting point, given that it **clearly suggested** his creation of inertial *spacetime* was "out of balance", needed balancing, something to expect in using "inertia" in a unified *spacetime* template, as highlighted by Edwin Hubble who presented evidence from his own observations that the Universe was in fact expanding via his calculations of the redshift effect of starlight. Einstein thus removed the cosmological constant from his equations, referring to it as his 'greatest blunder', despite his calculation for steady-state space as the cosmological constant being the closest estimate for the value of vacuum energy, the energy of static-local space, as shall be highlighted.

Recently, the idea of the cosmological constant returned to the forefront of physics theory in 1998 when it was discovered via analysis of observed data of distant star-light that the universe was not just expanding, yet was doing so at an accelerating rate. In this recent case, the cosmological constant was employed to bear mention for that acceleration, which is where the new problem for "that" amount of energy required became almost ludicrous, a value of $\sim 10^{113}$ Joules per cubic metre, in comparison to the value of 10^{-9} joules per cubic metre for the calculated value of vacuum energy, a difference of the order of $\sim 10^{122}$. Indeed, there was a problem with the theory behind the theorised energy of expanding space and the calculated value of vacuum energy.

Subsequently, a new form of energy has been employed called "dark energy" to account for this massive amount of energy required for this metric expansion of space to explain the observed redshift effect of light from the stars. In short, the adjusted metric expansion of space value for the cosmological constant predicted by quantum field theory is enormous in comparison to the experimental value obtained from vacuum energy, a staggering difference of magnitude of the factor of 10^{122}; this value is so large, that such a large contribution from vacuum energy would not have allowed the Universe to form in the first place. This, of course, means something must be missing. The *cosmological constant problem*, as it is termed, represents the divide in physics between the theoretical (metric expansion of space) and calculated value of vacuum energy. More simply, *the cosmological constant problem seems to be central to the value and process of vacuum energy in space and how that steps up to be involved in the proposed metric expansion of space value.* So, what is vacuum energy? This section will examine the nature of space and its

energy value on a basic level, and how this is supposed to match the gross scale of light and associated energy in space in regard to the stars.

3.1   VACUUM ENERGY

Vacuum energy [14] is considered to be the underlying background energy that exists in space throughout the entire observable Universe. The vacuum energy is considered as a form of zero-point energy (minimum energy of a quantum system) that relates to the quantum vacuum (the state of a quantum at zero-point energy), the quantum state with the lowest possible energy containing no particles; the term "zero-point field" is often used as a synonym for the vacuum state of an individual quantized field.

The effects of vacuum energy can be experimentally observed in various phenomena such as spontaneous emission [25], the Casimir effect [26] and the Lamb shift [27]. These effects are thought to influence the behaviour of the Universe on cosmological scales, which thus gives rise to the problem of the energy required for the accelerating expansion of space containing the zero-point field of light; in other words, the amount of energy required is an absolutely huge value compared to the localised atomic based value of vacuum energy. Consequently, using the upper limit of Einstein's cosmological constant, the vacuum energy of free space has been estimated to be 10^{-9} joules per cubic meter. However, the calculated value for the accelerating expansion of space in aiming to satisfy the local equations for vacuum energy present the need for a level of energy of preposterous proportions, and thus the discrepancy of values for vacuum energy for the small scale compared to the more distant accelerating expanding space scale is known as the cosmological constant problem.

3.2   EVIDENCE FOR VACUUM ENERGY

According to the quantum field theory model, the universe is comprised of continuous fluctuating fields, both matter fields and force fields, all such fields considered to have zero-point energy. Zero-point energy is generally regarded for being responsible for the idea of spontaneous emission, the process in which a quantum mechanical system of the atom and associated elementary particle transitions from an excited energy state to a lower energy state (e.g., its ground state) and emits a quantised amount of energy in the form of a photon. Spontaneous emission is ultimately responsible for most of the light we see all around us. Owing to the limitation of definitions used in classical electromagnetic theory (EMT), spontaneous emission could not be thoroughly explained by EMT. Dirac, in building upon EMT, derived the rate of spontaneous emission accurately from first principles in his quantum theory of radiation, the precursor to the theory which he later termed quantum electrodynamics (QED). However, there was noticed to be a phenomena of energy emission of the atom that did not quite fit Dirac's model, known as the Lamb shift, a difference in energy between two energy levels ($2S_{1/2}$ and $2P_{1/2}$) of the hydrogen atom. In short, the Lamb shift phenomena highlighted the presence of "vacuum energy" that teased out these emissions from the atomic/elementary-particle reference, namely that the interaction between vacuum energy fluctuations and the hydrogen electron prompted these different orbital energy emissions known as the Lamb shift. This effect was first measured in 1947 in the Lamb–Retherford experiment on the hydrogen microwave spectrum, a measurement that necessitated an ad-hoc remodelling of the then physics-model (also known as *renormalization*) to manage the divergences.

The real question therefore seems to be, "why does the zero-point energy of the vacuum *locally* not lead to a large cosmological constant as what should be observed *way away for the metric expansion of space locality* (far off in the accelerating expansion of space as is observed with the metric expansion of space and associated redshift effect)? What cancels that huge amount of required energy out if it is in error, especially in a universe that demonstrates a relatively constant CMBR (vacuum energy) value? Or is there something wrong with either the proposal of vacuum energy or indeed the metric expansion of space? Various theories propose a mathematical anthropic solution, arguing that we live in one region of a vast multiverse that has different regions with different vacuum energies, proposing that only regions of small vacuum energy such as the one we live in are reasonably capable of supporting intelligent life. Yet this contradicts the need to present a model of the stars as solar systems as per following the tenet of stars as solar systems adhering to our own local laws of science, as per section 2.This problem will be solved in examining the problem itself not just with relativity theory, yet it is close relative, quantum electro-dynamics (QED).

4.   RELATIVITY THEORY

4.1   THE PRINCIPLE OF RELATIVITY

The first issue to consider for relativity theory is the principle of relativity, the requirement that the equations describing the laws of physics have the same form in all admissible frames of reference, namely that scientific laws locally in this solar system must apply elsewhere. The principle of relativity appeared first in physics care of Newton and his laws of conservation of energy and momentum in the context of his inertial description of mass and thus gravity. With the advent of relativity theory, the idea of the principle of relativity moved to the ideas of symmetries and associated inertial transformations as a process of mathematics and associated theory to uphold the notions of the principle of relativity. In short, the principle of relativity is central to a certain process of interaction between objects such that the process of inertia, conservation of energy and momentum, is still a context and a type of application of the "principle of relativity" where basic traits of space and time such as mass and energy are conserved through what Einstein termed as *spacetime*.

The "theory" of relativity though is something else. The theory of relativity is commonly considered to represent two interrelated theories by Albert Einstein, special relativity and general relativity; Special relativity applies to all physical phenomena in the absence of gravity, while general relativity explains the law of gravitation and its relation to other forces of nature. The theory took theoretical physics and astronomy to a new level, superseding Isaac Newton's theory of mechanics. Of interest was Einstein's continued use of Newton's idea of mass equating with inertia, while departing from Newton's claim that Gravity was an immediate force, considering it instead to be a field effect travelling at light speed as a curvature of what he termed as "*spacetime*", a unified entity of space and time. As such, relativity theory ushered a level of inquisition prompting the science of elementary particles and their fundamental interactions, subsequently predicting cosmological phenomena that met the description of what is termed today as, for instance, neutron stars and black holes.

The "*principle of relativity*" in using Einstein's *theory of relativity* though leads to the vacuum catastrophe, meaning that the basis for the "principle" of relativity, that local laws apply to the stars, could be in fact false, and that therefore the stars themselves could have been improperly regarded as solar systems obeying laws such as our own. Key to Einstein's theory of relativity is the idea of using inertial mass

as gravitational mass in his equations, an idea first promoted by Newton. Yet why did Einstein conclude inertial mass was gravitational mass? That is what was considered at the time care of Newton's work, namely that it was such a widely accepted concept, and thus it was a carried "assumption". As an assumption therefore, it needs to be examined.

4.2   SPACETIME, INERTIAL MASS, AND GRAVITATIONAL MASS

On the surface of the concept of mass as inertia, it becomes apparent that inertial mass as gravitational mass creates the precedent of implicitly suggesting that gravity is the reaction of everything, yet the everything of "what"? In Newton's time the "everything" was little known, and so Newton could be forgiven for suggesting inertia could be considered as mass. Yet gravity *as inertia* , Einstein suggested, is the curvature of *spacetime*, and thus **as inertia** must be a reaction, like "inertia", to "something". To what though? The idea of space and time (Einstein states as *spacetime*) logically is a fundamental tenet, a primordial tenet of reality, and yet if gravity is a "curvature" of *spacetime*, and gravity is as "inertia", then gravity as a "curvature" of *spacetime*, a feature of *spacetime*, would be a result it would seem of space interacting with time as one. Yet, in suggesting that, in creating such a broad-brush stroke of theory, where is the possibility to understand gravity with any other greater granularity of opinion if gravity is a *reaction* to *spacetime* as a curvature, yet a part of *spacetime* as the curvature of *spacetime*, thus implying inertia into all of *spacetime*? The only requirement through such an employment of *spacetime* is to measure light and particles in relative motion with each other using inertial equations of gravity, which thus enforces the idea of light being intricately associated to gravity, as a particle, yet as calculations suggest, with zero mass. Consequently, Einstein could only present that gravity moves with time as light at light speed and due to different objects moving at different speeds gravity changes for those different relative movements and their apparent relative times, and thus simply with different gravity field effects for bodies there are different "time" dilations with light.

At the core of it, the theory of relativity is a "*process*" of theory, a particular "*view*" of space and time and gravity as one, as *spacetime*, so understandably it will give an accurate set of equations to explain known data *pursued* in that context, and perhaps make predictions of observed reality in that same *spacetime* context. Yet, that does not make relativity theory a "complete" model for reality. Why indeed is relativity theory **unable** to formulate the equation that links G with EM? This failure is due to the fact that on the one hand gravity is a "reaction" to *spacetime* while on the other hand being an *ingredient* of *spacetime*, and this is on top of the fact that light is a constant in *spacetime* that gravity as a field effect as speed "abides by". In other words, the wording of that theory invalidates the idea of further deriving a mathematical link between G and EM, as the link is already formed through the use of words in the underwriting of the theory of relativity itself. Thus the problem with relativity theory and associated thought experiments is the idea of playing by the rule that all the field forces operate at the speed of light, while also suggesting that gravity is as inertia and thus a "*reaction*" to what is natural despite it being presumably a feature of what is considered to be natural by choice of words as a definition, namely *spacetime* and a curvature thereof.

Arguing a case against the theory of relativity though is insufficient to solve the cosmological constant problem, the vacuum catastrophe, while focussing on the principles of mass as inertia alone as the sole cause for theoretical distress in this case. The idea of "light" needs to be addressed, for such is the other assumption Einstein used in his theory, namely the idea of light and the reference of the observer while considering mass and thus gravity as inertia. Consequent to relativity, the idea of using "inertia" in equations to explain bodies in motion relative to each

other from an "observational" light-based reference required the need to explain the idea of light in terms of a particle, in terms of "inertia", and such could be the central issue of the "vacuum catastrophe".

5. QUANTUM ELECTRODYNAMICS (QED) AND THE PHOTON

In this chapter, QED will be reviewed, and how the Lamb shift effect brought into effect QED, and thus the photon, and thus how there is such a thing as vacuum energy, and thus why the vacuum catastrophe is such an issue with the current cosmological model given the vast basis QED represents to cosmology theory.

5.1 QED

In particle physics, quantum electrodynamics (QED) is the relativistic based quantum field theory of electrodynamics describing how light and matter interact with each other. QED is the first theory that links "as a theory" quantum mechanics with special relativity. QED achieves such by taking the ideas of the theory of relativity and applying it to quantum mechanics, to the behavior of light on the atomic scale. In short, QED mathematically describes phenomena involving electrically charged elementary particles interacting via the exchange of photons by representing the quantum component of classical electromagnetism theory. QED is thus considered the bridge between light and particles.

In theoretical terms, QED is a perturbation theory, a theoretical bridge, of the electromagnetic quantum vacuum. Paul Dirac first formulated quantum theory, computing the coefficient of the spontaneous emission light of an atom. Amendments to the theory as per newly constructed perturbation models (mathematical "bridging" algorithms between particles emitting light), and associated improvements in microwave technology made it possible to take more precise measurements of the photon energy shift levels of a hydrogen atom, now known as the Lamb shift. These experiments however exposed discrepancies which the then theory was unable to explain, requiring QED "renormalization" of the perturbation theory, an ad-hoc re-modelling, to explain the Lamb shift, an adjustment to the then QED-perturbation model.

As such, the idea of light became synonymous with how it was defined by the observer, and not just observer, yet the mechanics itself of absorption and release of quanta on an atomic level by elementary particles in regard to light defined thus as also a particle, as the photon. Consequently, the photon became considered as not just the carrier of light, *yet a particle in its own right*, a valued member of the standard model family of elementary particles (SM). Central to this "particle" nature of light is the Schrödinger wavefunction and associated equation describing the nature of light "on the atomic level" describing the wave function of what is termed the quantum-mechanical system, considered as the most complete description that can be given of a physical system (atomic/elementary-particle reference system).

Solutions to Schrödinger's equation describe not only molecular, atomic, and subatomic systems, yet also aim to explain macroscopic systems such as the cosmos. Schrödinger's equation is central to all applications of quantum mechanics. The problem though existed for light not central to the atom and elementary particles, yet "beyond" the atom. To understand this problem, all physics could do was somehow employ the understanding of light where it was understood best, namely the atomic reference (and associated elementary particles) and to apply that understanding through a process of mathematical theoretical "*transformations*" between atomic references (and associated elementary particles) that must abide by transformation "symmetries", or rather "similarities", as per the need to uphold the "principle of

relativity", requiring what is termed "*perturbations*" to account for the behavior of light beyond the atomic (and associated elementary particle) reference.

5.2   THE PHOTON

The photon is considered as the quantum of the electromagnetic field including electromagnetic radiation such as light and radio waves, and the force carrier for the electromagnetic force (even when static via virtual particles). The photon, considered as a zero-mass particle (invariant zero-mass, or "it's always zero mass"), is defined through observation and calculation as moving at the speed of light in space, space considered as a vacuum. As with all elementary particles in the SM, photons are currently best explained by quantum mechanics and exhibit wave–particle duality, exhibiting properties of both waves and particles. The photon's wave and particle qualities are two observable aspects of a single phenomenon, the problem of wave-particle definition being one of "measurement" of light, namely the need to use a particle reference to measure that process of light, and thus a "cast" so to speak of that phenomenon being described for what would otherwise be unmeasurable yet existent as a wave-particle *beyond* the particle measurement reference. The photon is nonetheless though, as relativity theory, a "model" for light based on "how" light is "measured", a model that is employed to explain a vast swathe of observed phenomena, as it should. The benefit of the photon model is that it accounts for the association between light's energy and frequency as per the Planck equation, $E = hf$, relevant to the particle reference upon which the equation is based, and thus explains how matter and electromagnetic radiation are in thermal equilibrium. Photons nonetheless and other elementary particles are embedded, as they only can be in using inertial theory, in the idea of "*spacetime*", and in being embedded in the concept of *spacetime*, like gravity, must have a type of "process" of relationship with each other in *spacetime*, together with a type of "symmetry"; simply, in the SM (standard model of particles) photons and other elementary particles are described as a necessary consequence of physical laws of particles together with light having a certain *symmetry* at every point in *spacetime*, a certain "consistency" of laws which they must exist and operate by. Once again, this concept of "symmetry" is a *requirement* of inertial *spacetime*, to keep the cause-effect scheme of *spacetime* <u>consistent</u>.

5.3   QUANTUM MECHANICS

The intrinsic properties of particles, such as charge, mass, and spin, are all upheld by the idea of *symmetry* through *spacetime*, a physical or mathematical feature of the system (observed or intrinsic) that is preserved or remains unchanged under a process of transformation. Consider figure 3.
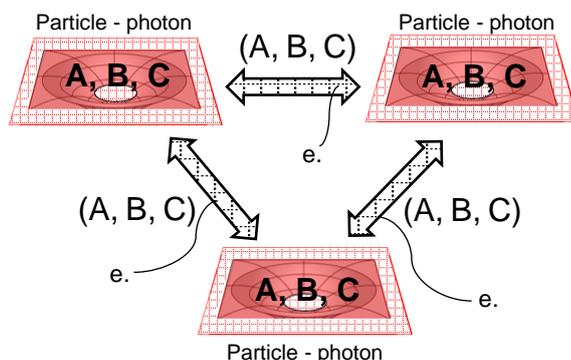

Figure 3: A, B, C here represent qualities of a particle-photon reference "transformed" (e.) through space, considered as symmetrical.

It is a simple process of transforming the quality of a particle or light through "*spacetime*". According to symmetry modelling specifications, a grouping of particular transformations may be *continuous* (such as rotation of a circle) or *discrete* (e.g., reflection of a bilaterally symmetric figure, or rotation of a regular polygon). Continuous and discrete transformations give rise to corresponding types of symmetries. Continuous symmetries can be described by *Lie groups* while discrete symmetries are described by *finite groups*. These two concepts, Lie and finite groups, are the foundation for the fundamental theories of quantum mechanics (QM), as they represent the process of how the "principle of relativity" is upheld between elementary particles, and associated atoms, and that conveyance of light and energy via the photon. The most fundamental tenet of "symmetry" as a feature of the principle of relativity is the photon as a particle operating at the speed of light known in mathematical terms (of symmetry grouping) as the Poincaré group [28] (described today as the *homogeneous Lorentz group* with scalar multipliers), the symmetry group of special relativity. Another important example is the required *invariance* of physical laws under arbitrary differentiable coordinate transformations, which is an important idea in general relativity. The process here is creating a mathematical theoretical framework that explains the process of light in space between the photonic activity of particles, to explain and thus predict (ideally) the behavior of a photon, and how particles can communicate with each other via photon and thus energy. And this is where the idea of "*perturbation theory*" comes to the forefront, namely the "*need*" to **fix** theories to observed data, to create models of *spacetime*, *symmetries*, *invariant symmetries*, that explain the association of particles via the photon through *spacetime*, and associated energies and behavior of *spacetime*, paradoxically though the very platform upon which the vacuum catastrophe becomes pronounced. It is as though despite all these small-scale ad-hoc fixes to explain local inertial *spacetime*, the end result is catastrophic in terms of calculating the light from the stars in the context of the observed redshift effect of light.

5.4   PERTURBATION THEORY

Perturbation theory is a process of using mathematical models to find an approximate solution to a problem, by starting from the exact solution of a related, simpler problem. Essentially, it is a theoretical mathematical "add-on" to explain and thus ideally "predict" a process. Dark matter and dark energy could be considered as perturbation constructs, despite their lack of existence, they are hypothetical solutions nonetheless that aim to solve a problem that is considered unsolvable without their presence. Mathematical models to explain the existence of dark energy and dark matter, such as Hilbert space [29], a cosmic-level perturbation theory in many respects, is much like creating a mathematical primary "aether" that can harbor the ideas of dark energy and dark matter, much like linking anything it wants, a "new" reality outside the one we live in, in all appearance, a platform that stiches everything together. Yet is it contradicting the principle of relativity, of symmetries and invariances?

Essentially, both perturbation and symmetry are the way science explains light extra-atomically, and thus takes advantage of the idea that there exists a type of mathematical matrix between particles, a mathematical matrix that can explain light as though moving through a mathematical aether, when in fact it is an entirely fabricated notion as technically nothing can be known of light between particles given there is nothing to measure light between particles other than other particles. Why is this a problem, namely being purely mathematical especially with "add-ons" in theory? According to the principle of relativity, a continuity of laws (invariance and symmetry) in those mathematical perturbations (theoretical add-ons) must be acknowledged and upheld, yet such is not always the case according to observed data, and thus

mathematical models are considered as a useful employment to explain the behavior of light beyond the particle in the context of *spacetime* where those observed discrepancies of data occur, which though then act, those perturbations, in defiance of the principle of relativity and associated symmetry and invariance requirements, a theoretical malleability *spacetime* should not be allowed to possess owing to its scientific constitutional design description and that of the photon. Consider figure 4**.**
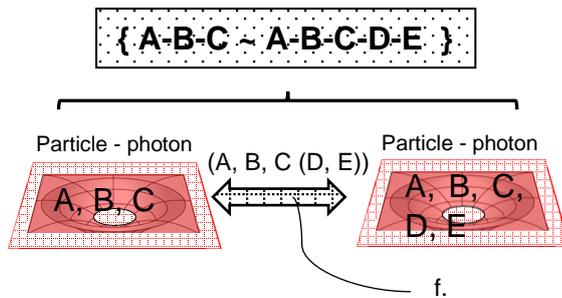

Figure 4: here, D and E are not usually predicted with the standard transformation of A-B-C, so a model is required, **{ A-B-C ~ A-B-C-D-E }**, the perturbation transformation as (f.). D and E may be qualities that represent fixes, like dark energy and dark matter

The question is whether mathematics can dictate outcomes for science, as per perturbation theory, like the current proposal of Hilbert space [29], without acknowledging the intended obligations of physics theory regarding the principle of relativity that the idea of *spacetime* was founded upon, and the associated need to uphold the associated symmetries and invariances regarding the known model for light as the photon. Indeed, it is entirely possible to "*create*" hyper-dimensions of space that can enhance "in theory" the local vacuum energy value to bring to bear on what dark energy seeks to achieve, and the same process for dark matter can be applied. Yet to what end and at what expense? Are the fundamental tenets of how relativity theory was constructed for *spacetime* and the photon being defied? Consider figure 5.
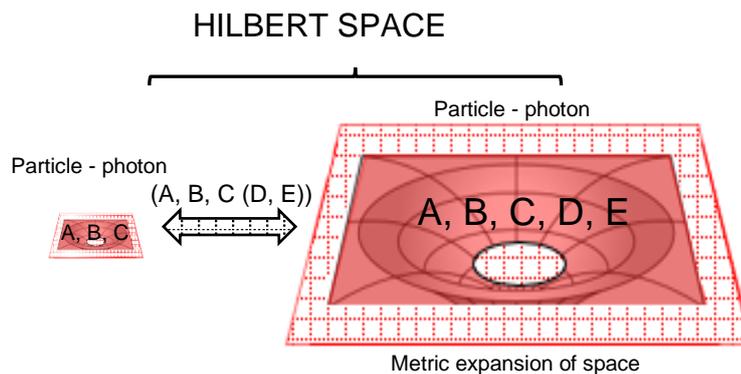

HILBERT SPACE

Figure 5: The idea here is the notion of needing to use the articles of "D" and "E" as dark energy and dark matter respectively to accommodate for the metric expansion of space.

In figure 5, the idea there is the notion of needing to use the articles of "D" and "E" as dark energy and dark matter respectively to accommodate for the metric expansion of space using (for instance) the Hilbert space model in order to account for the vacuum catastrophe, as a process of explaining through mathematics how dark energy and dark matter could exist. What though is governing this use of these hyper-dimension perturbations that seeks to link anything in physics of any magnitude without first bearing regard to the laws allowed in using the idea of *spacetime* and the photon and those associated symmetries and invariances? The case in regard to this paper is the cosmological constant problem, and whether

perturbation theory can solve it with mathematical "fixes", or is the problem more embedded in relativity theory, QED, and QM; to design a simple fix as a mathematical perturbation may seem well and good on paper, yet is it breaking the *principle of relativity* if proposed properties of cosmology such as dark energy and dark matter are nowhere to be found in this solar system, in this local reality? Indeed, it is. The fix therefore can only come in either adhering to the required symmetries and invariances for *spacetime* and the photon, <u>or re-designing the concept behind, the model of, *spacetime* and the photon itself</u>.

5.5   <u>MATHEMATICAL PERTURBATION THEORY</u>

The key issue for *spacetime* now requires the idea of inertial transformations using mathematical modelling. The quaternionic process for Hilbert space [30] for instance is a mathematical platform that accommodates for the idea of *spacetime*, 3-d space and 1-d time, which thus incorporates such *spacetime*-design dimensional restrictions into its entire process despite the infinite mathematical lattices proposed in that model. Other spatial models are possible, not just 4-d, not just 3-d space using complex numbers and 1-d time, yet 2-d time separate to 3-d space, while still using an arrow of time through 3-d space from those outer 2-d time dimensions, as presented in the papers central to the solution offered in the paper to the cosmological constant problem [1-13]. The Quaternionic process is just one process. Yet what can the quaternionic processes "*theorize*" ad-hoc while being solely based on the idea of "*spacetime*"? To explain what "*spacetime*" seeks to resolve, dark matter and dark energy? In what "*real*" manner though? If the quaternionic system is based on the foundation of 3-d space using hyper dimensions, complex number orientated, placating the algorithm *as* "time", it **will indeed** give a **complete analysis of "spacetime" theory,** no question about that. Yet the question being asked is, "**are those results any good**"? "**Are those results relevant to our local reality**?"

For instance, on the one hand the quaternionic system based on *spacetime theory* is trying to resolve the idea of dark matter and dark energy suggesting they have no relevance to our local reality other than a theory explaining the redshift effect and why dark matter and dark energy cannot seem to exist locally, and on the other an **alternative** algorithm of mathematics for space and time can be employed that **more clearly** explains what exists "**locally**" leading to **more relevant** discoveries, "*locally*". With the quaternionic *spacetime* system one is merely creating an arrow of time **where the beginning of time is unknown of that arrow** and **the end of that time arrow is unknown**, yet that theory presumes to explain all of the cosmos through all time, which essentially is illogical; it would be more logical **to address a beginning and end for time in a logical equation**, and then derive all field equations, constants, and dimensions henceforth using that algorithm for time. What would such an equation-algorithm look like? It would be more efficient and less complicated to allow time to step outside of the spatial dimension, creating the ideas of *time-before* and *time-after* around the spatial manifold of *time-now,* thus breaking Einstein's notion of *spacetime*. This process has been explained in the previous papers [1-13], especially papers 1 [1] and 2 [2]. The first paper [1] presented the initial notion of that time-algorithm, and then the second paper [2] expanded on that with geometry and associated **phi-quantum wave-function**. Then those first two papers were used as the basic resource to "build" that time function with 3-d space using the subsequent papers [3-13], deriving the Rydberg constant ([1]: p15), equations for EM ([2]: p13-14), G ([2]: p13-14), fine structure constant ([2]: p12), Planck's constant ([2]: p13), "c" ([2]: p13), CMBR value ([4]: p17), Avogadro's number ([4]: p16), the standard model of particles ([4]: p8-15), maximum redshift value ([13]: p9), distance of the Oort cloud to the sun ([13]: p9), and so on. It was then decided to use all those equations and associated reasoning (**phi-**

quantum wave-function and associated scaling system) to tackle the cosmological constant problem, as per this current paper.

The problem of the vacuum catastrophe now comes to the forefront, a calculation not predicted via all current models of symmetry grouping, associated invariances, and perturbation theory; using the principle of relativity, the value of vacuum energy on the level of the atom should account for the vacuum energy of the metric expansion of space as suggested by observed phenomena of the stars as per the redshift effect, yet it doesn't. The question is, "why"? Symmetry groups and perturbation theory aims to stitch together relativity theory with QED using inertia as gravity and the associated understanding of the photon. Yet such an entire theoretical process achieves nothing if it leads to an absurd conclusion regarding the stars. Is the notion of the stars therefore being solar systems entirely inaccurate in being an accomplice to the need for perturbation theory to fix a 10^{122}-magnitude error?

Essentially, QED describes the process of interaction between light and particles, between light and the atom, how light is released from atomic particles, and how light is absorbed by the atomic particles, and all those processes, and it does this with the focus on the theory itself of relativity and associated "perturbation" constructs/models in association to the primary basis of *spacetime*, and does this as QED, as quantum electrodynamics, and thus primarily "light" as a particle, as what is called a "photon", which then explains, ideally, how all matter works in the context of "c" as a universal constant. The end result of QED though is that it has calculated the vacuum energy to be a certain value, which when married up with the metric expansion of space, that model when aiming to explain the redshift of light from the stars, leads to the need for a ludicrous amount of energy. So, what has gone wrong? If symmetry grouping and associated invariances and perturbation theories work locally, yet do not work for the appearance of the stars, an issue has been overlooked that is astronomical in its scale, and the proposal here in this paper is that such could have something to do with a fundamental feature of relativity theory itself, of *spacetime* and the photon.

To be open to this new solution one needs to recognise that there is one key "fact" regarding the photon that has been largely assumed, namely that it is a model based on the "particle reference" of an obsveror or observational device of light, both as an absorber or emitter of light bearing the qualities of that particle source. Yet, "nothing" is known of light beyond the atom, and thus any such knowledge can only be predicted owing to the fact that light in space is what it is, it is light in space that by definition has no real characteristic other than "how" it can be "measured" through the reference of an obsveror/observational-construct. To assume that the formula for light appropriate for the atom such as $E = hf$ accords with the propagation of light in space as a propagation process of *invariant symmetry* is a fundamental assumption which makes no logical sense, as space itself and its association with light would be entirely different to the association of light with a particle construct (and associated elementary particle framework). To be logical, if the energy of light relevant to the atom/elementary-particles is governed by $E = hf$, and the energy of light is most intimately associated *to its frequency*, then the value of the energy of light in space devoid of particulate matter, a pure vacuum, should revert to the pure state of $E = f$ as presented in paper 13 ([13]: p 12-13). As the following section shall demonstrate, the solution to the cosmological constant problem can be found through such a logic without betraying the repository of observed cosmological data.

6.   COSMOLOGY THEORY: MODELLING A MEANS TO VALIDATE THE END.

A simple notion to consider in this entire solution process (to be presented in this section) is that *the means must validate the end*, that relativity needs to explain cosmology accurately to be useful. The inertial process, the process of cause and effect, employed by relativity, indeed works for this solar system, our own almost momentary

level of scientific existence, as it should, yet it does **not** work for what the light of the stars offer, as fixes such as dark energy and dark matter are required there, fixes not found here locally, which is understandable, namely that using the idea of inertia should work locally, as it must in an almost immediate regard of space and time appreciation, yet to use the idea of inertia can only find itself asking what the ultimate initial cause was and what the ultimate effect must be, hence the problem with the idea of expanding space based on redshift observations, and thus the problem of the big bang theory, all because the idea of "inertia" as cause and effect creates a time paradox, a universal one, namely what was the great beginning cause and what will be the great end effect.

The case presented in this section is that "inertia" as a concept must be superseded through using the concept of time as a type of mathematical lever outside of what is commonly considered as "now" *spacetime*, a lever of *time-before* and *time-after*, a lever of time as an algorithm that must derive, as it does, what it must in replacing the idea of inertia, namely a general solution to the concept of the beginning and end, as an algorithm of time employing the concepts of *time-before* and *time-after* around *time-now*, while of course explaining the redshift of light and associated phenomena of light of the stars without using what cannot be proven locally (dark matter and dark energy). Clearly this new process must explain all phenomena relativity has aimed to explain locally, and then explain the phenomena of light from the stars, which it does. Einstein achieved theories relevant to observed data central to the gravitational redshift of light, the precession of the perihelion of Mercury, and light cleaving to *spacetime* (bending around massive objects), that triumvirate known as the "classical proof" for relativity theory. Yet, that is local. That is to be expected with an inertial take of reality, locally. Einstein did not predict the SM (the standard model), did not predict QED (quantum electrodynamics), did not predict QM (quantum mechanics), did not predict the hypothesis based on observed galaxy data of the accelerating expansion of the universe and thus "vacuum crisis", and **did not** expect the inclusion of dark energy or dark matter. So, the solution to the cosmological constant problem must also be able to go above and beyond Einstein's own classical proof for relativity theory.

If the principle of relativity must be upheld and thus the universe is homogenous and isotropic (local laws applying universally), if symmetry must exist (same phenomena-type and processes transferrable from one atom to the next), and thus if the idea of dark energy being responsible for the expansion of *spacetime* can't be employed because it doesn't exist locally, hasn't been proven to exist locally, and dark matter holding galaxies together can't be employed as it too does not exist locally, hasn't been proven locally, then the simplest conclusion is that galaxies are not being held together by dark matter, and thus the universe isn't expanding in the way it is thought to. In other words, the metric expansion of space is not occurring, and thus the redshift of light from the stars can only be a result of another process, and thus perhaps most practically, the system must be "steady state" while still generating the feature of a "redshift" effect of light. In breaking this down, if the principle of relativity must be upheld, the following is largely apparent:

a. There is no dark matter, as it does not exist locally.
b. There is no dark energy, as it does not exist locally.
c. There is no metric expansion of space, given the cosmological constant problem.
d. There is no great beginning to warrant a metric expansion of space.

The redshift effect would be therefore due to a feature of light in steady-state space, a feature that needs to explain:

1. Data central to particle physics and thus the standard model and quantum-mechanics.
2. Data central to cosmology and the redshift effect.

The argument appears now to focus on relativity theory, and thus a new accomplice for the principle of relativity with the focus on light and space. Yet, as per the previous chapter, to go to the core of the problem is to confront the proposed idea of *spacetime* itself and associated use of gravity as inertia. Given the complexity of providing the solution, given the complexity of the riddle itself of the cosmological constant problem, this chapter will first review the previous paper [13] in this series of papers [1-13], and then solve the cosmological constant problem.

6.1   SPACE, AND THE REDSHIFT EFFECT [13]

To challenge the idea of the metric expansion of space, to challenge that idea from where it took root, to account for the redshift effect, one must consider the process of *light* propagating through space as a *redshift* through static space, a pure vacuum, as the only alternative to "space" *expanding*, if indeed space is static, such as a process of the redshift effect of light. This case was presented in paper 13 [13]. There, the fundamental idea of the "principle of relativity" (namely that what holds locally must apply generally in space if the assumption exists that stars are solar system like our own operating by the same laws of physics) is upheld.

To dispute the metric expansion of space has great implications, the primary one being disputing the big bang, and yet most fundamentally the initial ingredients of the mathematical modelling responsible for explaining how galaxies are held together in the context of the metric expansion of space, as per Einstein's General relativity. Yet, it is possible to do such, to make that challenge, while upholding all astronomical data, while deriving all key equations and constants for EM and G, light and mass, creating new analogues for SM, QED, QM, all accompanying the "principle of relativity". Nonetheless, there is no simple fix to properly refuting the metric expansion of space. It is a fundamental fix.

As presented in paper 13 [13] and preceding papers [1-12], the solution is found in understanding that <u>there is no direct symmetry transformation for light as a photon in space according to $E = hf$</u>, and thus the basis of such symmetry, invariance, and perturbation, is flawed, and thus relativity theory itself must be questioned, as explained here in section 5. The focus must therefore be on the idea of space and time, not as *spacetime* as Einstein proposed, yet how space and time relate to each other in the absence of the idea of inertia, in the absence of using the notion of inertia as mass. According to the case presented in paper 13 [13] and its preceding papers [1-12] ultimately the relationship between time and space, or even the relationship of time with itself in regard to space (if space is as a pure vacuum as "0"), can ultimately only be a "*ratio*" that compliments the association of time with space as a feature of the unique dimensional identities of time and space relating to each other with mathematical reasoning.

As presented in paper 13 [13] a key problem of QED *is it's use of the Planck equation as a symmetry gauge process in the perturbation theory of space*, or more simply, does $E = hf$ actually govern the propagation of light beyond a particle given that light as a photon can only been measured from a particle reference and associated process of measurement interaction? Is not $E = hf$ an "assumption" in "particle free space"? The proposal in paper 13 ([13]: p9-10) of $E = f$ as the basis for the propagation of light was not the idea of tired light [31], as tired light is a concept of light losing energy and thus diminishing frequency as it propagates through space allegedly producing a redshift effect, a concept Zwicky promoted for a steady state reality (as astronomical observations show, the stars themselves do not show features of the tired light phenomena and associated scattering [32]). The concept for the propagation of light in space and associated redshift presented in paper 13 [13] was built upon the re-modelling of space and time using the concept of time from a new a-priori as per the preceding papers [1-12] where space is kept as 3-d, as per papers 1 ([1]: p2-15) and 2 ([2]: p3-9), yet applies the dimension of time uniquely to it as a ratio value relevant to space

through first presenting two new levers for time, *time-before* and *time-after*, around *time-now*, as presented in paper 1 ([1]: p2-5). In a way it is like Hilbert space, yet not, it is time, an algorithm for time, which as a wavefunction as per paper 2 ([2]: p3-9) takes upon, is fluid with, an infinite number of virtual temporal dimensions with 3-d space given the vacuum (0) nature of space and the "c" nature of light in space. It demonstrates all the local functionality Hilbert space aims to explain (colour perception, etc) yet without the issue of being "ad-hoc" or violating initial conditions of foundational theory.

As mentioned, the process of this theory is via local proof in this reality, while also deriving all known equations and constants for EM and G, mass and energy, the Rydberg equation, fine structure constant, Planck constant, CMBR, distance of Oort cloud from sun, and so on, "derived" from this new a-priori for time distinct from yet intimately connected to space. Despite it achieving what it has, it's "different" to the generally expected outcomes of cosmology in that the stars are not necessarily independent solar systems themselves yet a process upon a different scale of distance from the sun highlighting ***atomic*** decay ([13]: p13-19), atomic decay which as a process would affect the redshift effect of light as it appears with stellar phenomena, all of such without altering or conflicting with any of the cosmological data; here with this new a-priori for 3-d space with the associated application of a time-algorithm, both real and demonstrable, not as *spacetime* though, *all* the *local* features of *perceivable* physics are derived both as equations and constants of equations, observational and calculated facts, in this solar system. Logically, this new a-priori approach should form a link between EM and G that *does not* depend on hyper-virtual imaginary space and associated mathematics, and thus should incur a *real* result, a *real* link between EM and G, as presented in the research papers 7 [7] and 12 [12].

6.2   SOLVING THE COSMOLOGICAL CONSTANT PROBLEM

In therefore leading on from paper 13 [13] regarding the principle of light propagating through space as $E = f$ ([13]: p10], the key concept there being the idea of light as energy in space equating purely to the frequency of light in space as a pure vacuum, the solution to the vacuum catastrophe can be found directly from such an equation.

On the atomic level there are particles and particle interactions that lead to the absorption and release of energy as light, yet in the pure vacuum the conclusion was reached that in the absence of those particles light behaves according to a different mechanism, a mechanism which clearly can ***only be derived*** and not directly observed, as to observe light is to require a particle receiver to register that light. Thus, to derive the concept of $E = f$ something cosmological had to be demonstrated to exist in order to prove that notion, and in the case there the distance of the Oort cloud from the sun was derived using Plank's constant with the suggestion that the Oort cloud would represent the greater perimeter of reality where the phenomena of the stars takes shape, directly indicating that the basis of the stars being solar systems like our own is perhaps fallacious, leading more to the idea that star-light is a complicated array of atomic debris undergoing decay releasing light according to different distances and thus frequencies of light in accordance with the phenomena of the redshift effect. One step further is required though to demonstrate this notion correct, and that is correctly calculating the vacuum energy together with the Lamb shift effect of light from the atom, and placing that vacuum energy correctly with the calculation of the observed appearance of the stars and their proposed distance from the sun.

6.2.1   EXAMINING THE GOLDEN RATIO ALGORITHM OF TIME FOR SPACE

Ultimately, the equation $E = f$ represents the idea of "f" as the golden ratio, f as φ and $-\frac{1}{\varphi}$, and thus both as -1, as per the following equations:

$$E = \varphi \ (time \ as \ frequency), \textit{(as one possible temporal variable of the wavefunction)} \tag{1.}$$

$$E = -\frac{1}{\varphi} \ (time \ as \ frequency), \textit{(as another possible temporal variable of the wavefunction)} \tag{2.}$$

$$E^2 = (-1)(space \ as \ distance), \textit{(as the combined wavefunction for time in space)} \tag{3.}$$

Note that equation 3 is not s^{-2} (frequency-squared), yet "$space$", distance as the basic measurement of "space". This is so in regard to space, as per paper 2 ([2]; p4, fig1-2), where φ and $-\frac{1}{\varphi}$ have that certain relationship with space as a singular wavefunction, as per equation 4:

$$\varphi^2 + \frac{1}{\varphi^2} \sim 3, \textit{(3 dimensions of space, and thus volume)} \tag{4.}$$

Consider therefore that we have the following:

$$E = \varphi \ (or -\frac{1}{\varphi}) \ (as \ frequency), \text{ and } E^2 = (-1)(as \ distance) \tag{5.}$$

The question now is what the relevance of this is.

6.2.2   ZERO-POINT ENERGY AND THE LAMB SHIFT EFFECT

According to contemporary physics, zero-point energy (ZPE) is considered to be the lowest possible energy that a quantum mechanical system may have. In the case here, the zero-point energy of space, that energy of space, would represent the value of E^2 as per the equation $E^2 = (-1)(as \ distance)$, as a process of energy being released to space, absorbed by space, space as that negative energy platform. Current estimates present that value to be of the order of $10^{-9} \ Jm^{-3}$. According to the fact that the work here thus far through the papers have successfully derived the equations for EM and gravity, the fine structure constant, the CMBR, Rydberg constant and equation, it should be possible to derive the value for the zero-point energy of space as the cosmological constant.

Therefore, in carrying the context of all previous equations in this series of papers [1-13] and thus in the context of the energy of light measured in joules and in the context of space being 3 dimensional (distance cubed) for E, then the value of the absorption of energy of space can be considered for the purpose of calculating the vacuum energy of space a volume value, and thus we have an amended equation for space as:

$$E(Joules) = (-1) \ (metres^3) \tag{6.}$$

$$\frac{E(Joules)}{(metres^3)} = negative \ energy \ value \ for \ space \ as \ Jm^{-3} \tag{7.}$$

This basically is taking a square-root value of equation 3 to bring into effect E from a scale of distance to thence a scale of volume in regard to energy as joules.

This value of energy now needs to be re-integrated to the atomic level, namely the relationship of this general energy level to the particle reference, and so the focus now becomes on this theory's own phi-quantum wave-function distance scales (compression), as per paper 4 [4].

Regarding the distance-compression scales, paper 2, Golden Ratio Axioms of Time and Space, ([2]: p3-17) initially presented the feature of the atom in relation to energy and light (photon) which was then incorporated into the description of what was termed the *Phi-Quantum Wave-Function Error Gradient* ([4]: p16), the condition of time needing to define/trace "π" as the unfolding of the wave-function of light, as summarised in figure 6.

Figure 6
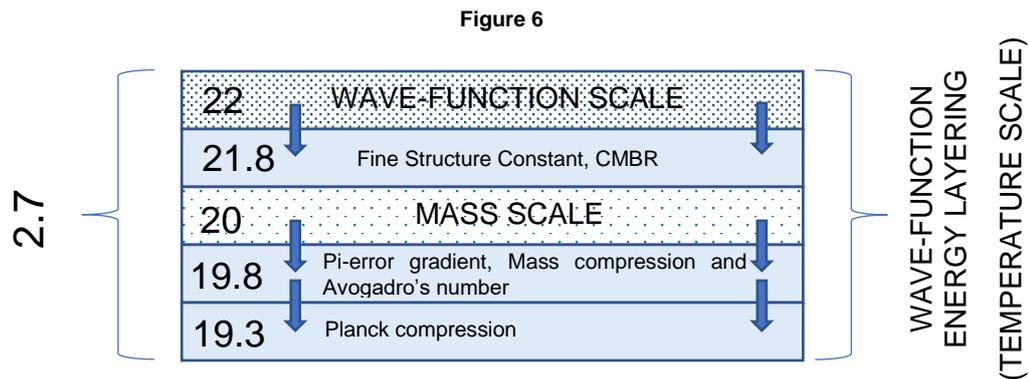
The idea here to calculate energy is to find the distance-compression scales in play, to understand they abide by equation 3 here, and to then find the square-roof of that value as per equation 6.

The idea of the π error gradient was presented to calculate the value for Avogadro's number relevant to the mass of a neutron, as in paper 4 ([4]: p16). Yet there is another feature to the phi-quantum wave-function as it becomes expressed extra-atomically, namely two key distance perturbation factors in regard to the mass scale, namely a $\frac{21.8}{20}$ perturbation as distance and a $\frac{19.8}{20}$ perturbation, both as based on "20" as distance, together representing a general π error gradient perturbation as V_A, as per equation

$$V_A = \frac{21.8}{20} \times \frac{19.8}{20} = 1.079 \qquad (8.)$$

Another feature to consider is that the compression that occurs regarding mass on this phi-quantum wave-function level is of the order of $\frac{0.2}{19.8}$, or in other words "0.2" $(20 - 19.8)$ is lost to space for every phi-quantum wave-function atomic reference 19.8 length result. And this would happen "per" the maximum distance of space in total factored with V_A. This is useful in calculating the effect of negative energy (space), the "vacuum energy of space", on the atomic reference, a case of relating this value to the overall maximum theorised distance of light propagating in space.

As per paper 13 ([13]: p11), the distance of Oort region to the sun is ~ 1.1×10^{16}m. Thus, E^2 for space as distance (as per equation 6) would be:

$$\frac{0.2}{19.8} \times \frac{V_A}{1.1 \times 10^{16}} \tag{9.}$$

Now, incorporating this in with equation 7 (calculating the root of equation 9), the following value for energy per metric volume of space (in Jm^{-3}) is arrived at thus:

$$\sim 10^{-9} \, Jm^{-3}$$

This value of energy would represent a basic background level of energy that is absorbed **from** atomic matter, from the fundamental process of $E = hf$, from the atom, a value consistent with the estimated value of the vacuum energy of space [33].

To explain the Lamb shift is such, as it would be the natural effect of $E = f$ on anything that exists in the system "within" the atom, that which would be responsible for the vacuum energy of space itself to address the idea itself of being that complete $\frac{E(Joules)}{(metres^3)}$ construct, a natural background effect on the atom. What "frequency" would such energy be released from the atom at? Here, on the atomic level, in the context of $t_N = 1$, as the spatial reference, as defined by the time-algorithm, $t_N = \frac{1}{f}$ and thus if $d = \frac{1}{f}$, then frequency would represent:

$$f = \frac{1}{10^{-9}} \cong 10^9 Hz \tag{10.}$$

This value is consistent with the measured value of the Lamb shift effect of $\sim 1GHz$.

6.2.3   CMBR

In now going back to paper 4 ([4]: p16-17) where the idea of the CMBR was presented in regard to Avogadro's number and associated compression scaling of the phi-quantum wave-function, the following was presented:

> Note that the phi-quantum wave-function (π) error gradient is a measure of length[3] (and thus volume). Thus, the value states that there is a standard for the organisation of mass such that a uniform increase in volume (length[3]) would exist for the number of associated atoms for any given value of background pressure (heat, pressure, etc.). For simplicity, the following would be true:
>
> $$\pi \, error \, gradient = 6.022 \cdot 10^{23} \cdot mass \, of \, neutron \qquad ([4], eq9)$$
>
> In other words, $6.072 \cdot 10^{23}$ neutrons with a factored **_total_** phi-quantum wave-function error gradient would result in the value of 1g.
>
> How though is the $\pi \, error \, gradient$ a function of "time" regarding N_A and not mass? As a function of time, the $\pi \, error \, gradient$ would represent the value of t_A as 21.8 (as the extra-atomic 21.8 "time-quantised" reference, and not the 19.8 compressed mass reference) per N_A as a way to factor in the atomic reference from the standpoint of a basic value for time. Thus, the following would be true:
>
> $$t_A = \frac{21.8}{N_A} \qquad ([4], eq10)$$

Thus, as a representation of "time" as t_B, the following applies:

$$t_B = \sqrt{\frac{21.8}{N_A}}$$

([4], eq11)

This is a value of $\sqrt{\frac{21.8}{6.02 \cdot 10^{23}}}$ which equates to $6.02 \cdot 10^{-12}$ s. In the context of $t_N = 1$, as the spatial reference, as defined by the time-algorithm, $t_N = \frac{1}{f}$, we have a value of $1.66 \cdot 10^{11}$ s^{-1}, 166 GHz (per time-now).

How is this value significant? Basically, regarding the error gradient, there is an equal value of time that would account for a type of electromagnetic manifestation of time of the value of $166 GHz$ on an extra-atomic level (21.8). Is there any evidence of this in nature? This value of 166 GHz is well within our findings for the cosmic background microwave radiation which peaks in intensity at 160 GHz. Is the cosmic background microwave radiation in fact an ever-present feature of atomic existence and not a relic of an initial explosion (big bang)?

As a refinement to the value of the CMBR, it only seems necessary to alter equation 10 from paper 4 ([4]: p17, eq10) to factor in the value of V_A, and thus as per equation 11:

$$t_A = \frac{21.8 \cdot V_A}{N_A}$$

(11.)

Through the same calculation process as per paper 4 ([4]; p17)

$$t_B = \sqrt{\frac{21.8 \cdot 1.079}{N_A}} = 6.25 \cdot 10^{-12} \text{ s}$$

(12.)

Once again, in the context of $t_N = 1$, as the spatial reference, as defined by the time-algorithm, $t_N = \frac{1}{f}$, we have a value of $1.60 \cdot 10^{11}$ s^{-1}, 160 GHz (per *time-now*), the correct observed value of the CMBR.

6.2.4 <u>TEMPERATURE SCALING AND THE BOLTZMANN CONSTANT</u>

The concept of temperature in the phi-quantum wave-function scaling system employed here would represent a scaling system of energy according to the phi-quantum wave-function scaling system, ***and thus a scaling factor of that part of the phi-quantum wave-function that is being perturbed***, and here this value would represent a value of 2.7 (figure 6) factored with the maximum length of the scaling system of the phi-quantum wave-function (22) ***per*** the CMBR related scaling reference (21.8), the amount from the 22 reference of the wavefunction to the 19.3 level, factored to the overall length (22) per each CMBR (21.8) scale, as a scaling of energy release from the general phi-quantum wave-function. Simply the scale ***as a scale*** would need to represent the "amount" perturbed in total (2.7), while being directly proportional to the overall scale (22), "per" the level of scaling the effect is being measured from (21.8). Such would represent the basic scaling of energy as a component of energy scaling, ***<u>as temperature</u>***, in regard to the phi-quantum wave-function. Here a value of 2.725 for the (21.8) level, as per equation 14.

$$2.7 \times \frac{22}{21.8} = 2.725 \ (temperature) \tag{13.}$$

Such would be a basic level of temperature measurement as according to the idea of the CMBR. So, what is the energy level of the CMBR per this scaling system? The value of energy for the CMBR as t_A would be a value according to equation 11, and thus, as per equation 14:

$$t_A \ = \frac{21.8 \cdot V_A}{N_A} = \ 3.906 \ \times 10^{-23} \ J \tag{14.}$$

The ratio therefore of this value to the temperature scaling system (for conventionality, let us give the units of Kelvin) would be as follows, equation 15:

$$\frac{3.906 \times 10^{-23} \ J}{2.725 \ K} = 1.433 \times 10^{-23} \ J \ K^{-1} \tag{15.}$$

However, the negative energy of space needs to be subtracted from this value, energy associated to space "beyond" the standard scaling system. What is the value of this negative energy of space? The energy of space as the negative energy vacuum of space would represent a "negative" value. This value can be simply extracted from equation 10, $E \sim 10^9 Hz$, and applied to $E = hf$, as a representation of what can be measured of this energy in regard to a particle reference, despite this value not being related to the article scaling system reference, as by definition it represents space. Thus, the following equation 16 applies for a unit scaling system of space:

$$E \ = \ 6.624 \ \times 10^{-34} \times 10^9 \ = \ 6.624 \ \times 10^{-25} \ J \tag{16.}$$

This is a negative value.

In taking the positive value, and subtracting the negative value, the following results in equation 17:

$$t_A - E \ = \ 1.433 \ \times 10^{-23} - \ 6.624 \ \times 10^{-25} \ = \ 1.37 \times 10^{-23} \ J \ K^{-1} \tag{17.}$$

This would be a measure of the energy in joules per this energy scaling system of measurement in terms of volume of space and associated scaling (temperature). This value is similar to the value of the Boltzmann constant value of $1.38 \ \times 10^{-23} J \ K^{-1}$, which is not surprising, as it represents the very same concept, as the characteristic of space and thus volume for the wave-function **is the scaling system**, which can thus only represent a mechanism of **temperature/energy/heat release measurement** according to a fundamental scaling system for space regarding time and thus a wavefunction for light, as presented in paper 2 ([2]: p2-11).

6.2.5   EVENT HORIZON _E=f_ SCALE

What is interesting to note is that the idea of t_A for EM is $t_A \ = \frac{19.8}{N_A} \cdot (\frac{21.8}{20})^2$, or, in other words, the t_A energy component of the EM radiation component of space associated to mass as

factored with Avogadro's number (a system "cast" for mass and energy) **is equivalent to** a factor of the *mass* compression scale (19.8) and the factor of the *EM* compression scaling (of mass) "squared" $(\frac{21.8}{20})^2$. This equation says that the "structure" of light in space with mass is held together by such an Avogadro *cast* of mass and energy.

The principle point here is that on that spatial event horizon, in that theoretic end-zone region, particle matter would undergo a type of **atomic decay** while as though being held in a gravitational cast of space, which requires thorough theoretic modelling, reserved for a subsequent paper. To note here though is the phi-quantum wave-function scaling system that has been developed and deployed through the papers, namely it being the structure for all the relevant constants for energy and mass in a consistent fashion, describing the functions therewith and inter-relationship between those constants and values in a manner that accurately describes the physical reality of those constants and values according to contemporary observations and associated descriptions.

Therefore, with the calculation here of the vacuum energy and associated cosmological constant, it can be proposed that there exists a scale of *E = f*, energy equating to primarily frequency, which naturally would be a condition "outside" the particle reference marker of light ([13]: p 8-9). Such a process generates a "**scale**" for space and the propagation of light that describes the distance between the sun and the proposed Oort cloud, and it does this as a mathematics that derives the G and EM equations and constants, the CMBR, the redshift effect, Rydberg equation and constant, Avogadro's number, and the Lamb shift; the only thing the mathematics of the theory leaves to the unknown *is* extra-atomic light (light beyond the particle observation reference). Thus, *if* light is based on a fundamental quintessential unknown property *in* space, simply because all forms of measuring it require an atomic reference, then it must remain as such other than realizing the notion, the fundamental notion, that light can only be driven in its propagation through space according to the event-horizon equation of $E^2 = (-1)(d)$. The next question therefore is, "in what manner does this happen"?

6.2.6   PERIHELION PRECESSION OF MERCURY (AND PLANETS)

This modelling should now be able to account for the perihelion precession by considering that there are "two" features in play regarding the vacuum energy central to "mass", "two" adjustments that Newton would not have been aware of, "two" adjustments although that Einstein's inertial *spacetime* theory would need to account using its own formula types for inertial *spacetime*. These two features are central to the basic notion of the "mass" structure of the phi-quantum wave-function and the two central features of variation there, firstly the mass compression factor from the standard factor of 20 to 19.8, and the quantised effect of light (factor of 21.8) in comparison to mass (standard factor of 20). These two "alterations" would represent a type of **perturbation of the "play" of mass and energy in space**. What is the nature of this perturbation though?

As presented via calculation in this paper, gravity, in being associated to space *(the clear indication being the feature of "negative energy" of space and its association to gravity through observed data)*, can only be the way the system of space aims to bring mass together *instantaneously*, mass moving relatively from for instance v = 0 to v = infinity (immediate). Yet, it clearly would not be possible for mass to violate the speed of light and thus energy given such a

primary process of energy and light. Thus, although gravity would be an immediate force, has to be, the principle of $E = f$ would limit the relative speed of masses with each other, and thus the prediction in this paper is that mass approaching light speed would disintegrate to pure energy, and not lead to an exponentially high level of gravity as Einstein's *spacetime* predicts. So, what would occur as a general dynamic of light and mass in this entire scheme, upon this calculated level of vacuum energy? As presented in paper 3 ([3]: p4, eq3)

> *Now we must consider a new process for time beyond the designed temporal wave function; we must also consider that time would still, beyond the intended design of the temporal wave function, seek a way of upholding its need to trace a perfect circle given the atomic context cannot be undermined, yet developed upon. How indeed can such be done in accommodating for the "x" error factor?*
>
> *There is one way of exploiting this "x" error factor and that is to consider the "imaginary" component of the time-equation, namely i, namely in breaking the standard condition of the golden ratio and replacing it with the notion of i.*
>
> *For instance, ultimately t_A as per eq.7 of paper 1 ([**Error! Reference source not found.**]; p 4, eq7) would need to be upheld as $t_B^2 = \varphi \cdot -\frac{1}{\varphi} = -1$.*
>
> *In considering the other solution to t_B^2 gives t_B the value of "i", and thus time-after t_A becoming -1 (i^2), hence the equation for time becoming $t_B + 1 = -1$.*
>
> *This can be expanded to $t_B + 1 = t_B - t_A$, if indeed $t_B - t_A = -1$.*
>
> *Thus, we get the following: $t_B + 1 = t_B(1 - t_B)$.*
>
> *Now let us add in a spatial-temporal component "x" that represents the carrier of new "x" condition, this new error scale in play:*

$$x_{(t_B+1)} = x_{t_B}(1 - x_{t_B}) \qquad ([3], eq2)$$

> *The scale of the error for "x" needs to be considered, and so we must add a new constant k; thus repairing eq. 2 we now have:*

$$x_{(t_B+1)} = k \cdot x_{t_B}(1 - x_{t_B}) \qquad ([3], eq3)$$

> *This constant k would represent a feature that highlights a sensitivity to the underlying temporal wave function atomic processes at play, as what we can term "initial conditions" for the error "x".*
>
> *This equation would represent how any condition for "x" would evolve in time, would propagate through time, having an underlying structure in being the erroneous feature of the golden ratio time-equation, namely the disparity between the value for π used for the temporal wave function and the true value for π.*

The suggestion is that the two features of perturbation based on the vacuum energy would represent an "initial condition" process amounting to, in the case of a planet, *orbital perihelion precession*, and here the idea of V_A (equation 8) needs to be factored in. Therefore, if classical mechanics predicts the precession of the perihelion of Mercury as 532 arcseconds per century *relative to the inertial ICRF (international celestial reference frame)*, a factor of 1.079, V_A, needs to be put in play to account for the Vacuum energy heat releases from the atomic mass and EM compressions, as per equation 19:

$$532 \times 1.079 \; = \; 574 \; arcseconds \; per \; century \qquad (18.)$$

This value is in accordance with the known precession of the perihelion of Mercury *relative to the inertial ICRF* [35].

The issue is how all these independent properties of mass and energy and light can work together and adjust each other to work together, not as action and reaction, as inertial effects, yet a continuity, a precise harmony. The result is not action-reaction as per inertia, yet "how" the entire scheme works together as one, one part scaled with another feature ***through a common temperature-based scaling system***, ultimately complimenting an overall "initial condition" environment of field force effects and associated phenomena presenting the observable reality we can confirm through research and testing.

As a quick summary of the lead-up papers, the following has been achieved regarding this researchable and testable reality:

- ***Paper 1 [1]*** was the basic proposal for the concept of the equation for time, where the algorithm for time was presented as a basic "proposal" of *time-before* and *time-after* around space as *time-now*.
- ***Paper 2 [2]*** followed through that basic proposal in creating the necessary spatial dimensions for time and associated wave-function given that the time-algorithm in paper 1 could approach the idea of the Rydberg constant and equation, together with equations for G and EM.
- ***Paper 3 [3]*** then presented the Planck scale regarding the energy of a photon according to this new wave-function description for light.
- ***Paper 4 [4]*** then presented the case for the nature of particles based on the idea of the phi-quantum wave-function, proposing that particle matter is based on a vibratory resonance of the time wavefunction for the photon derived from the new time-algorithm.
- ***Paper 5 [5]*** then presented the case of time as energy, a fundamental principle to be acknowledged in an overall steady state space system, presenting the feature of entropy and enthalpy on an atomic and macroscopic scale, an important preliminary paper for the later redshift equation of paper 13.
- ***Paper 6 [6]*** then presented the case of the relativity of time, the new description of relativity compared to Einstein's relativity, an important comparison.
- ***Paper 7 [7]*** then presented the process of proof of G emerging from EM.
- ***Paper 8 [8]*** then presented the idea of the time-algorithm as an extension of paper 6's description of the relativity of time.
- ***Paper 9 [9]*** then analysed the problem of inertia, core to the problem of Einstein's relativity theory and associated use of inertia, an important preliminary paper for this current paper.
- ***Paper 10 [10]*** presented a scientific account of the nature of the observer, the reference of the observer, in the new description of relativity theory, a key detail to the new description of the relativity of time, together with an extension from paper 3, presented as a way of highlighting how this scientific theory links with known philosophical models of consciousness.
- ***Paper 11 [11]*** presented an historical analysis of cosmology theory in the context of the new theory for time and space.
- ***Paper 12 [12]*** presented the case for gravity being an immediate field force effect while highlighting problems with Einstein's employment of inertia.

- ***Paper 13 [13]*** then discussed the nature of light and the redshift effect, how the redshift effect becomes a phenomenon in this new time and space theory, accurately deriving the distance of the Oort cloud from the sun and the known maximum redshift factor.
- ***Paper 14 [14]*** has given a general overview of modern physics theory to present a solution to the vacuum catastrophe, the cosmological constant problem, while deriving the value for the Lamb shift, CMBR and associated temperature value, Boltzmann constant, and perihelion precession factor for Mercury/planets (compared to classical Newtonian physics).

In solving the cosmological constant problem, namely deriving the right value for the vacuum energy of space and associated CMBR temperature, it becomes clear that the primary field forces in reality such as electromagnetism and gravity would exist by virtue of being primary field forces. Inertia alternatively exists as a "concept", a "way" of measuring something, a way that is "reactive", and thus not "primary", a process entire of itself as a way to *change the natural state of a body at rest* if indeed the entire system of nature working as one, the field forces of G and EM working as one, is a state of rest. For physics to use inertia the way it has in regard to space and time as *spacetime* is to suggest that *spacetime* is always in a reactionary state to make that *spacetime* a process of cause-effect happen, and thus mass and light also a part of that "reactive" process of *spacetime* (light, as per QED and its particle-nature).

If one wanted to create a universe that came from nothing, one would combine space with time, create the two as one, and then use the idea of inertia for both mass and light as gravity as *spacetime*, as a reaction to the initial unknown nothing. Yet, is such a theoretic approach the *real* account of reality or a notion based on the false pretence of "inertia" and associated offshoot theories such as the Big Bang, of everything coming from nothing in an accelerating expanding universe as per the considered notion of the metric expansion of space owing to how the observation of the redshift effect of light from the stars has been interpreted into scientific syntax? It becomes apparent that by the process of using "inertia", relativity theory has led to the invention of the concept of the big bang start date of time, and invented a direct association of time with space, as *spacetime*, as an inertial event, an "aftershock" as that theory proposes of cosmology, namely that the local laws of reality would become evident as a reaction to that event, a resolution of that event, as per considering gravity as "inertia", which consequently requires the key magical inclusions of dark matter and dark energy. Indeed therefore, in the mind of science and presumably all human thought, time like space can be invented as a "way" of seeing a reality that can't be fully explained where more models must thus become apparent to explain dark matter and dark energy, while aiming not to violate the principle of relativity and those associated initial conditions of theory for *spacetime*, those symmetries and invariances and associated mathematical transformations.

There are so many problems with cosmology as a concept alone given the current modelling and associated apparent extreme distance between the observed stars in those current models, the cosmological problem pales into insignificance, yet it is in no way an insignificant problem, as this paper has aimed to demonstrate. It would be unconscionable not to question again the basis of the premises brought forward a century ago for time and space, to not present a new set of start points for space and time and the observer, and new mathematics, based on *new data* that this century has presented, data that has clearly confounded premises of modelling set a century ago. Given the alternative theory presented here, the solution to the cosmological problem, and successfully so, it is clear that science should focus on primarily on *data*, and *then* stitch that data together without showing prejudice to favoured models. Models need to be evaluated as an a-priori of science, as a process, as an a-priori process. Such must be a constant process. If a new model can be established that explains all the data, yet that model confronts the nature of the stars themselves, is science theory ***held*** by a "***belief***" in the nature of the stars? In short, using fundamentally real and perceivable tools for any work should produce fundamentally real and perceivable results, otherwise the

problem is with the theory, and if not the theory, the problems rests with the outlook of the observer and a hoped-for result that detracts from true science.

In all, this series of papers [1-13] present a mathematical look at time and space using a new algorithm for time with an associated attached-contiguous "vacuum" of space, as via a temperature scaling system. The presentation of the papers have been such to initially introduce the broad concepts of theory (papers 1-6 [1-6]) and then associated proof (paper 7 [7]), following which papers 8-14 [8-14] then took a more comparative tone to similar/current contemporary ideas of physics, and why the new algorithm can demonstrate itself as being *a more accurate model for time than Einstein's notion of spacetime*.

7.   CONCLUSION

This paper, in providing a solution for the cosmological constant problem, has highlighted that the concept of inertia fails to properly explain the propagation of light in space and those laws of conservation of energy and momentum, leading to the cosmological constant problem, highlighting that inertia is merely a "chosen" property, a "way", of regarding mass and thus gravity in what appears to be a limited approach to the concept of space and time. The proposal is that according to an *ultimate* theory, all the field forces would work as one, that they would not react against each other as inertia would otherwise prescribe, that the field forces would not be a *reaction against* the concepts of space and time leading to catastrophic theoretical results and associated violations of initial theoretical conditions. In short, one can choose to use the idea of inertia in their equations, as specified from Newton to Einstein to obviously today, or one can see the limitation of that approach to regarding the field forces and the ideas of space and time as *spacetime* in hoping to reach a unified field theory while dealing with discrepancies such as the cosmological constant problem. As this paper has presented, other equations, equations that do not employ inertia, can be used to link observed data more efficiently and in a more interlinked manner than the inertial equations. The observed reality is not being disputed, only how it is analysed with models of thought and mathematics and then theory, here though by avoiding the concept of "inertia" as an *a priori*.

Conflicts of Interest

References

For ease of search functionality, the complete PDF of Temporal Mechanics containing all its current papers as listed here [1-35], is available from the following link (Non-Open Access):
https://transactions.sendowl.com/products/78257031/AE5EA60A/view

1.   Jarvis S. H. (2017), Gravity's Emergence from Electrodynamics, DOI: 10.13140/RG.2.2.35132.28804/1, https://vixra.org/abs/1704.0169
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