THE PROPER SPEED OF LIGHT

A UNIFICATION OF PHYSICS USING A VARIABLE SPEED OF LIGHT (PLS)
Revision X+3

Author: Russell R. Smith
Email: *SmithCoDev@gmail.com*
Orcid: https://orcid.org/0009-0001-5302-9646
Date: 03/07/2024

ABSTRACT

For decades, physicists have pursued the elusive "Theory of Everything," yearning to weave the disparate threads of quantum mechanics and gravity into a unified tapestry. This paper argues that a single, seemingly innocuous assumption has obstructed this grand ambition. That assumption being the constancy of the speed of light. This article presents a revolutionary mathematical framework that challenges this cornerstone belief, demonstrating how a variable c paves the way for unification. As demonstrated herein, the spacetime metric is restructured resulting in the following:

1. The velocity curves of galaxies are accurately modeled without the need for dark matter.
2. The expansion of the universe is predicted without the need for dark energy.
3. The infinite force of gravity at singularities is resolved.
4. Experimental results related to special and general relativity are modeled in terms of optics.
5. Maxwell's equations are derived for a gravitational field.
6. A means in which the universe emerged without violating philosophical truths is presented.
7. Why the speed of light is what it is, rather than some other value, has been resolved.

INTRODUCTION: THE QUEST FOR A UNIFIED THEORY

For over a century, two pillars have supported our understanding of the universe: quantum mechanics, governing the subatomic realm, and general relativity, describing gravity and spacetime on grand scales. However, these seemingly complementary theories exhibit a fundamental incompatibility. Quantum mechanics thrives on probabilities and discrete energy levels, while general relativity paints a deterministic picture of continuous spacetime curvature. This dissonance leads to a pressing question: how can we reconcile these two cornerstones of modern physics into a single, unified framework?

The quest for a quantum theory of gravity, unifying these seemingly disparate descriptions, remains one of the greatest intellectual challenges in physics. It promises a profound understanding of phenomena currently shrouded in mystery, such as the Big Bang singularity and the behavior of matter within black holes. This journey has spawned numerous approaches, each aiming to bridge the chasm between the quantum and the gravitational.

String theory, one prominent contender, envisions the fundamental building blocks of the universe as tiny, vibrating strings instead of point-like particles. As these strings vibrate in different modes, they give rise to the various particles and forces observed. In its most advanced formulations, string theory incorporates additional dimensions beyond the familiar 3+1 spacetime, potentially providing a platform for unifying gravity with the other forces.

Another contender, **loop quantum gravity**, takes a radical approach. Instead of attempting to quantize spacetime itself, it proposes that spacetime emerges from a network of discrete, finite structures called "loops." This approach aims to resolve the infinities plaguing traditional attempts to quantize gravity and offers a new perspective on the nature of spacetime.

Beyond these leading candidates, numerous other frameworks are actively explored, each offering unique insights and perspectives on the problem of unification. Whether through the elegant mathematics of string theory, the radical reimagining of spacetime in loop quantum gravity, or alternative avenues still under development, the pursuit of a unified theory continues to push the boundaries of our understanding of the universe.

In this research paper we aim to contribute to the ongoing quest for a unified understanding of our universe, revealing the deeper connections that bind its fundamental constituents.

DEFINITIONS

RF: Reference Frame.
S: Is a coordinate RF (zero-g, zero-velocity).
P: Is a moving RF (zero-g).
G: Is a stationary RF in a gravitational field.
A: Is any RF.

GTR: General Theory of Relativity.
STR: Special Theory of Relativity.
QM: Quantum Mechanics.
PLS: The theory disclosed herein.

t: This is the time as it passes in the S RF.
c: This is the measured speed of light in all RFs locally.
t_0**:** This is the time as it passes in the A RF.
c_0**:** This is the speed of light in the A RF (measured relative to t: $[c_0] = \frac{dist}{t}$).

R(^{0}): Represents a real value for the variable ^{0}: $R(A * B) = R(A)R(B)$.
M(^{0}): Represents a measured value for the variable ^{0}: $M(A * B) = M(A)M(B)$.

THEORETICAL FRAMEWORK: KEY CONCEPTS

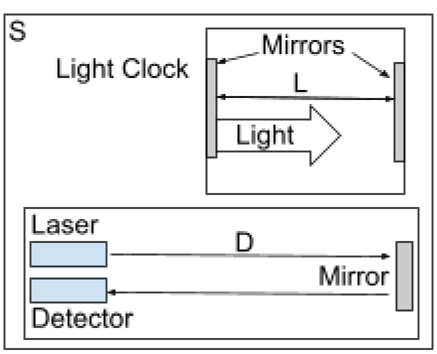


Figure 1: A light clock is used to measure the time of travel between the laser-mirror-detector in S.

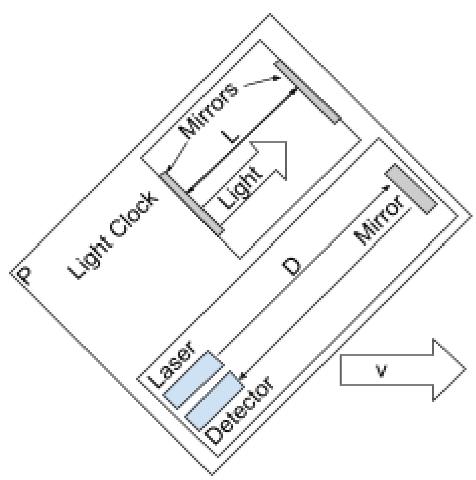


Figure 2: The system in Figure 1 is rotated and translated at velocity v.

Initially we set up a means of measuring time in which the speed of light is measured to be the same locally in all reference frames, while varying universally. In figure 1 a light clock is used to determine the speed of a photon that travels from a laser, reflects off of a mirror, and then hits a detector. Let L|D, so that the distance traveled in both directions is the same for the photon in the clock and the photon from the laser. The number of passes $\boldsymbol{\mathcal{P}}_{SS}$ in the light clock is such that:

$$d\boldsymbol{\mathcal{P}}_{SS} = \frac{2}{L} dD \quad (1)$$

Where the second subscript signifies which RF is being measured, and the first subscript signifies which RF it is measured from. Notice that even if the system is rotated then translated at v as shown in figure 2, the time of travel $\boldsymbol{\mathcal{P}}_{PP} = \boldsymbol{\mathcal{P}}_{SS}$ therefore all RFs measure their own local speed of light to be c. Notice that $c \propto L$ where $[L] = \frac{[dist]}{pass} = [c] = \frac{[dist]}{[time]}$ suggesting that time is dimensionally consistent with the number of passes within the light clock. The laser can now be replaced with any other event and as long as that event is regulated by light then the relationship between the event and time stays the same: we will show this to be the case.

With that said, let t be a universal time such that $dt = \eta d\boldsymbol{\mathcal{P}}_{SS}$ for some constant η. Furthermore, let light in all RFs propagate relative to the universal time t such that the speed of light in S is c, and the speed of light in A is $c_0 = kc$ for some $k \in [0, 1]$ (Notice that $\boldsymbol{\mathcal{P}}_{PP} = \boldsymbol{\mathcal{P}}_{SS}$ regardless of k). If the difference that light travels in the A RF relative to the S RF is ε, then:

$$d\boldsymbol{\mathcal{P}}_{SA} = \frac{dD - d\varepsilon}{L} \quad (2)$$

where $\boldsymbol{\mathcal{P}}_{SA}$ is time dilated relative to $\boldsymbol{\mathcal{P}}_{SS}$. From equation (1), $d\boldsymbol{\mathcal{P}}_{SS} = \frac{dD = cdt}{L}$; and from equation (2), $d\boldsymbol{\mathcal{P}}_{SA} = \frac{dD - d\varepsilon = c_0 dt}{L}$, therefore $\frac{cdt}{d\boldsymbol{\mathcal{P}}_{SS}} = \frac{c_0 dt}{d\boldsymbol{\mathcal{P}}_{SA}}$ resulting in:

$$d\boldsymbol{\mathcal{P}}_{SA} = \frac{c_0}{c} d\boldsymbol{\mathcal{P}}_{SS} \quad (3)$$

Since $dt = \eta d\boldsymbol{\mathcal{P}}_{SS}$, it follows that the proper time $dt_0 = \eta d\boldsymbol{\mathcal{P}}_{SA}$. Therefore:

$$dt_0 = \frac{c_0}{c} dt \quad (4)$$

Notice that length contraction doesn't occur as D and L are the same in all RFs (the experimental results of STR that are attributed to length contraction will be modeled in terms of light speed dilation).

Figure 3: RF P moves to the right, relative to S, resulting in only the vertical component of the photon being observed in P.

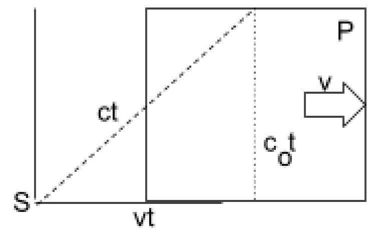


Figure 3 represents the typical setup for the derivation of time dilation in STR where ct_0 is replaced by $c_0 t$ (t is the universal time in which light propagates relative to). Using the pythagorean theorem:

$$c_0^2 + v^2 = c^2$$

$$\Rightarrow c_0^2 = c^2 - v^2$$

$$\Rightarrow c_0 = c\sqrt{1 - (\frac{v}{c})^2} \quad \text{(STR analogue, 5)}$$

Inserting equation (5) into equation (4) yields $dt_0 = \sqrt{1 - (\frac{v}{c})^2}\, dt$, so the time dilation of PLS is the same as that for STR; it is just attributed to light speed dilation. $cdt_0 = \sqrt{g_{\mu\nu} dx^{\mu} dx^{\nu}}$ in GTR, and from equation (4) $c_0 dt = c\, dt_0$. It follows that:

$$c_0\, dt = \sqrt{g_{\mu\nu} dx^{\mu} dx^{\nu}} \quad (6)$$

and therefore:

$$c_0 = \sqrt{g_{\mu\nu} \frac{dx^{\mu}}{dt} \frac{dx^{\nu}}{dt}} \quad \text{(GTR analogue, 7)}$$

Equation (1) tells us that if light propagates independent of time, time can still be measured based on how far light traveled. In this sense, a property of light might be the ability to change, and time is a man-made construct that is based on how much light changes between events. It is a bit counterintuitive because we typically associate time with the ability for change but this association might not be accurate. To be clear, the universe might exist and function independent of time, and we invented time by effectively picking a distance L from equation (1) in which to divide D (along with a coefficient η): when stars, or planets are used as a clock this is only possible because of light. To really drive this point home, picture the universe hypothetically staying the same but without the propagation of light. In this case, both $\boldsymbol{\mathcal{P}}_{PP}$ and $\boldsymbol{\mathcal{P}}_{SS}$ become zero, and while stars and planets would still move, there wouldn't be any way to measure such changes. Even the Cesium atom clock is dependent on the distance that light travels (The second is based on the hyperfine level transition within the ground state of the Cs-133 atom that occurs upon absorption or emission of electromagnetic radiation at a specific, precisely defined frequency. The number of oscillations within the atom just help to form the coefficient η as the number of oscillations is easier to measure than the distance that light travels.). One could argue that the propagation of light within the structure of the atom, or within a group of atoms, forms a light clock. Therefore, without the propagation of light, a new means of measuring time would need to be invented.

With that said, time doesn't exist ontologically: (x, y, z) exist independent of observation, and time does not. While it is true that even without observation, the number of passes inside of the light clock remains the same, the reality is that the universe doesn't care about or depend on this happening; the number of passes in the light clock is only valuable to us. It therefore makes sense to remove time as an independent variable and define $dX \equiv cdt$ and $dX_0 = c_0 dt$ where X and X_0 are the distances that light travels in S and A between events respectively. In this case $[c] = [dist]$, and time DNE. It follows that equation (6) becomes:

$$dX_0 = \sqrt{g_{\mu\nu} dx^{\mu} dx^{\nu}} \quad (8)$$

Where $dx^{\mu=0} = \frac{dX}{c}$ in the metric and everything is only dependent on distances in 3-space. If $g_{\mu\nu} = 0$ when $\mu \neq \nu$, since the signature of the metric is (+,-,-,-), the hypotenuse formed from the terms in equation (8) always contain the light term dX suggesting that perhaps the electromagnetic force is the driving force for all of the other terms: you can't exceed the "speed" of light because light is the driving force for everything, and light doesn't actually have a speed because we measure time based on how far light travels. So time only exists epistemologically, but it is such a convenient parameter that we continue to use it, and to refer to terms like speed.

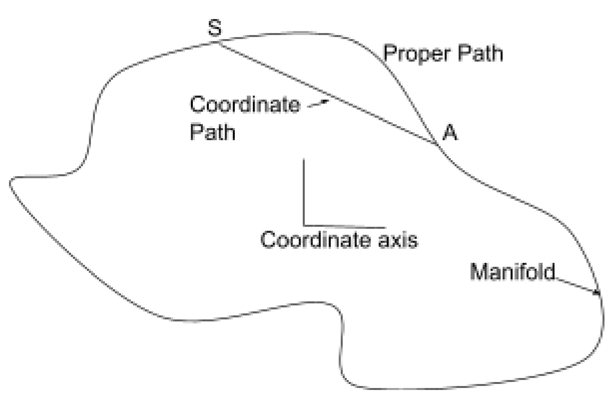


Figure 4: A manifold connecting RFs S and A is shown in which the real distances are those along the manifold, not those traversed along the straight line in coordinate space.

In equation (6), $g_{\mu\nu}$ converts coordinate differentials into a path differential along the manifold in which the metric applies. At each point on the manifold there is a tangent space in which Euclidean geometry applies over small distances. Through integration from S to A in coordinate space, the path length along the manifold is obtained (the distance in coordinate space is just a line from S to A (see figure 4)). For a differential length $d\varepsilon$ along the manifold:

$$\begin{aligned} R(v_\varepsilon) &= \frac{d\varepsilon}{dt} \\ &= \frac{d\varepsilon}{dt_0}\frac{dt_0}{dt} \\ &= M_{AS}(v_\varepsilon)\frac{c_0}{c}\Big|_A \quad (9) \end{aligned}$$

Where $\frac{c_0}{c}$ is evaluated at A. So equation (9) tells us that a measured velocity in A is not always bounded, but a real velocity is: the clock in the A RF slows down relative to t while the distance traveled remains the same resulting in the A RF perceiving their velocity to have increased. As $R(v_\varepsilon) \to c$, $c_0 \to 0$, and thus $M_{AS}(v_\varepsilon) \to \infty$. Now consider equation (6) where $g_{\mu\nu}$ is the Schwarzschild metric with $d\varphi = 0$. All of the terms are real values along the manifold thus:

$$c_0 = \sqrt{\{R(c^2) = \frac{r-r_s}{r}c^2\} - \{R(v_r^2) = \frac{r}{r-r_s}(\frac{dr}{dt})^2\} - \{R(v_\theta^2) = r^2(\frac{d\theta}{dt})^2\}} \quad (10)$$

It follows that:

$$R(c) = \sqrt{\frac{r-r_s}{r}}c \quad (11)$$

And when velocities are zero:

$$c_0 = \sqrt{\frac{r-r_s}{r}}c \quad (\frac{dr}{dt} = \frac{d\theta}{dt} = 0,\ 12)$$

So a stationary RF in a gravitational field has a reduced local speed of light (relative to t), and as that RF speeds up, the speed of light within that RF decreases. If you are in the A RF orbiting an object of mass M, then you have to look at S to see your rotational velocity. Therefore $M_{AS}(v_\theta) = \sqrt{\frac{GM}{r}}$ (derived from $\frac{mv^2}{r} = \frac{GMm}{r^2}$), thus equation (9) becomes:

$$R(v_\theta) = \sqrt{\frac{GM}{r}}\sqrt{\frac{r-r_s}{r} - \frac{R(v_\theta^2)}{c^2}} \quad (\frac{dr}{dt} = 0,\ 13)$$

Solving equation (13) for $R(v_\theta)$ yields:

$$R(v_\theta) = \sqrt{\frac{(r-r_s)}{r}}\sqrt{\frac{GMc^2}{GM+rc^2}} \quad (14)$$

In order to model the velocity curve of a galaxy, M needs to be replaced with a volume integral of the density in equation (14). This equates to replacing M with $\int_0^r 2\pi R\rho(R)H(R)dR$ where ρ is the mass density of the galaxy and H is the galactic thickness at r.

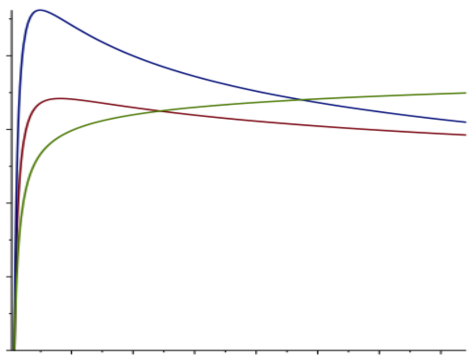


Figure 5: This is a plot of equation (14) with $R\rho(R)H(R) \in \{R^{-0.25},\ 0.5R^{-0.5},\ 4R^{0.1}\}$.

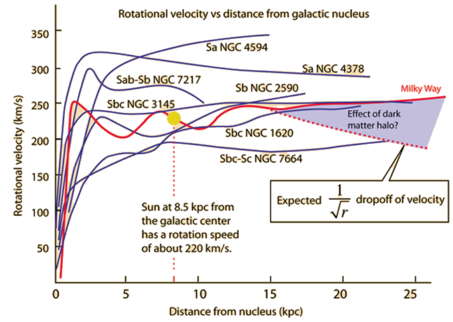


Figure 6: Rotational velocities for a variety of spiral galaxies (Nave, n.d.).

Choosing to write $R\rho(R)H(R) = \frac{RK}{R^{\alpha+\beta}}$ for some constant K, where $\rho(R) = \frac{1}{R^{\alpha}}$ and $H(R) = \frac{1}{R^{\beta}}$ give approximations to the density and thickness of the galaxy at r = R, produces the graphs shown in figure 5 which are strikingly similar to the velocity curves of galaxies shown in figure 6 but without the need for dark matter. Introducing $\frac{dr}{dt}$ into equation (13), and recognizing that we are in a gravitational field so we do not perfectly observe R(v), opens the door for further alignment between PLS and observation.

From equation (7), $c_0 c = \sqrt{g_{\mu\nu}\frac{dx^{\mu}}{dt}\frac{dx^{\nu}}{dt}}\ c$, and therefore $c = c_0\{c\,(g_{\mu\nu}\frac{dx^{\mu}}{dt}\frac{dx^{\nu}}{dt})^{-1/2}\}$ where the {R(n)} term is the real index of refraction. Thus:

$$R(n) = c\,(g_{\mu\nu}\frac{dx^{\mu}}{dt}\frac{dx^{\nu}}{dt})^{-1/2} \qquad (15)$$

$$\Rightarrow R(n) = dX\,(g_{\mu\nu}dx^{\mu}dx^{\nu})^{-1/2} \qquad (16)$$

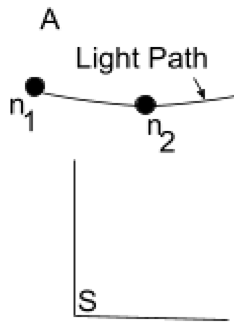


Figure 7: In the S RF, space is flat, and therefore the index of refraction is 1. As the A RF moves away from S towards a massive object, the index of refraction of space changes resulting in light curving.

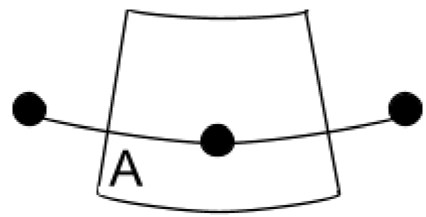


Figure 8: The A RF deforms so that the curved path of light in figure 7 appears straight in A.

Where equations (15) and (16) produce a scalar value for each point in 3-space representing the index of refraction as shown in figure 7. According to Fermat's Principle, the time that light takes to travel the light path in figure 7 is $t = \int \frac{c_0 dt}{c_0} = \int dt$, and in the A RF $t_0 = \int \frac{c_0 dt}{c}$ where differentiation yields $c dt_0 = c_0 dt$ (which is equation (4) above). Notice that $t_0 = \int \frac{c_0 dt}{c}$ implies that $n = 1$ in the A RF meaning that the A RF deforms as shown in figure 8 so that the path that light takes appears straight from A.

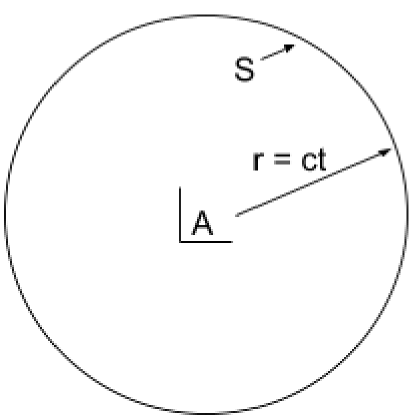


Figure 9: The S RF recedes away from us at velocity R(v) = c.

If the S RF forms a spherical shell around us in which the radius is increasing at $R(v) = c$ as shown in figure 9, then equation (9) tells us that the shell will appear to be receding at infinite velocity. Thus the expansion of space is an illusion caused by the variable speed of light: dark energy doesn't exist, and space is not being created.

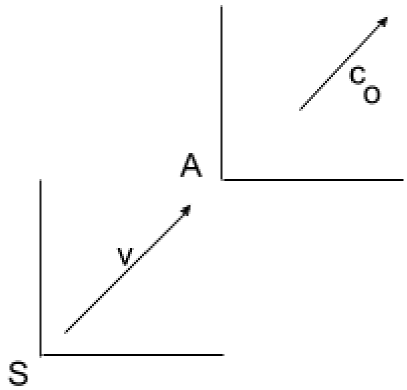


Figure 10: The speed of light in the A RF is c_0, and the A RF is moving away from S at speed v.

In figure 10, the A RF recedes from the S RF at velocity v, and light in the A RF travels at c_0. The net maximal velocity is therefore $|v| + c_0$, and using the Schwartzchild metric yields $|v| = \sqrt{\frac{r-r_s}{r}c^2 - c_0^2} = \sqrt{\frac{r}{r-r_s}(\frac{dr}{dt})^2 + r^2(\frac{d\theta}{dt})^2}$. Since $c_0 = 0$ for light, it follows that $|v| + c_0 = \sqrt{\frac{r-r_s}{r}}c = R(c) \leq c$ so all real velocities everywhere in the universe do not exceed c. Notice that if c_0 were to change direction in A (figure 10), light would still be traveling at $R(c) = \sqrt{\frac{r-r_s}{r}}c$ relative to some point on the S RF in figure 9.

In our current mathematical framework:

A) Light propagates independent of time, and time is measured based on the distance that light travels;
B) The electromagnetic force is the only fundamental force;
C) The expansion of the universe is an illusion caused by the variable speed of light. Thus dark energy is accounted for.
D) The experimental predictions of STR are attributed to light speed dilation rather than length contraction;
E) Experimental results of STR and GTR are entirely modeled using optics acting on 3-space.
F) The real velocity of everything in the universe remains bounded by c.
G) Philosophical truths need not to be violated. Since you cannot produce something from nothing, that something's fundamentals have always existed. Therefore, if a change occurred, then change has always been possible . This introduces the logical equivalent of what is typically considered to be eternal time where we have to invoke statistical

guarantees on anything that has a non-zero probability of occurring (with restrictions) in order to fully understand the existence of the universe.

H) Velocity curves of galaxies are modeled without the need for dark matter.

I) n: (x,y,z) →(x,y,z) separates the laws of physics from the 3-dimensional space in which they are applied, suggesting that this universe is a simulation: the laws of physics representing the code of the simulation, and the screen representing what we experience (If you were to observe something being produced from nothing, it would therefore be analogous to pixels changing color on a screen). Light simply moves, and the laws of physics tell it where to go.

ASSESSMENT OF PLS AND STR

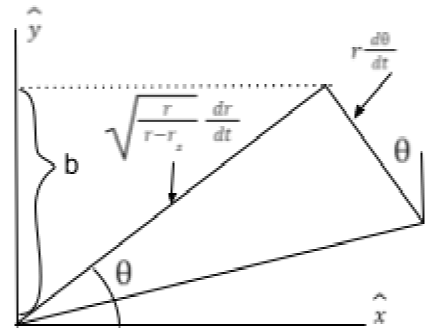
From equation (10) without rotational velocities, $c_0^2 = \frac{r-r_s}{r}c^2 - \frac{r}{r-r_s}\left(\frac{dr}{dt}\right)^2$. In zero-g this reduces to $c_0^2 = c^2 - v^2$, and restructuring yields:

$$\frac{c_0}{c} = \sqrt{1 - \left(\frac{v}{c}\right)^2} \quad (17)$$

so all experimental results of STR are recovered, they are just explained in terms of light speed dilation not time or length contraction. As an example, consider **muon decay**: When muons are produced in the atmosphere, using the non-relativistic decay equation suggests that they should decay before reaching earth's surface. However, observation is consistent with the notion that the muon undergoes both time and length contraction. According to STR, the muon experiences time dilation, and it also experiences length contraction to prevent it from exceeding the speed of light in its own RF. In the PLS model, equation (9) tells us that the measured velocity of the muon can be infinite as long as the real velocity is bounded by c, so length contraction is not necessary. Additionally, the faster the muon moves, the slower its proper speed of light, and thus all of the quantum interactions involved in its decay take longer relative to coordinate space. Light speed dilation takes the place of both time and length contraction.

MAXWELL'S EQUATIONS

Figure 11: This figure shows how the components of equation (10) fit geometrically. For a mass positioned at (0,0), a photon released in the x-direction from (x=0, y=b > 0) will curve downwards.



From equation (10), for a photon traveling in a plane containing the COM of some object of mass M we get (φ = 0):

$$\frac{r-r_s}{r}c^2 - \frac{r}{r-r_s}\left(\frac{dr}{dt}\right)^2 - r^2\left(\frac{d\theta}{dt}\right)^2 = 0$$

From Figure 11, adding up the components in the $\hat{x}$ and $\hat{y}$ directions result in:

$$< \frac{dx}{dt} = \sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}cos(\theta) - r\frac{d\theta}{dt}sin(\theta), \frac{dy}{dt} = \sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}sin(\theta) + r\frac{d\theta}{dt}cos(\theta) > \quad (18)$$

where

$$\frac{dy}{dx} = \frac{\{\sqrt{\frac{r}{r-r_s}}\frac{dr}{d\theta}\}sin(\theta) + rcos(\theta)}{\{\sqrt{\frac{r}{r-r_s}}\frac{dr}{d\theta}\}cos(\theta) - rsin(\theta)} \quad (19)$$

The polar coordinate transformation dy/dx is:

$$\frac{dy}{dx} = \frac{\{\frac{dr}{d\theta_p}\}sin(\theta_p) + rcos(\theta_p)}{\{\frac{dr}{d\theta_p}\}cos(\theta_p) - rsin(\theta_p)} \quad \text{(polar, 20)}$$

Comparing equations (19) and (20), implies that $\frac{dr}{d\theta_p} = \sqrt{\frac{r}{r-r_s}}\frac{dr}{d\theta}$. Therefore:

$$\theta = \sqrt{\frac{r}{r-r_s}}\theta_p + B \quad (21)$$

$$r^2 = x^2 + y^2 \quad (22)$$

$$x = rcos(\theta_p) \quad (23)$$

$$y = rsin(\theta_p) \quad (24)$$

Dividing the x-component in equation (18) by dx, squaring both sides, and multiplying by $\partial^2 E$ yields:

$$[\sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}cos(\theta)\ -\ r\frac{d\theta}{dt}sin(\theta)]^2\frac{\partial^2 E}{\partial x^2}=\frac{\partial^2 E}{\partial t^2}\quad (25)$$

Notice that when $r_s\ =\ \theta\ =\ 0$ equation (25) yields $\frac{\partial^2 E_x}{\partial x^2}=\frac{1}{c^2}\frac{\partial^2 E_x}{\partial t^2}$. Repeating the same process for the y-component we get:

$$[\sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}sin(\theta)\ +\ r\frac{d\theta}{dt}cos(\theta)]^2\frac{\partial^2 E_y}{\partial y^2}=\frac{\partial^2 E_y}{\partial t^2}\quad (26)$$

Now, let us consider Maxwell's equations where the charge and current density are zero (since the S-metric pertains to such). The derivation of these equations does not depend on μ or ε being constant so we can start directly with Maxwell's Equations and calculate με. Therefore:

$$\nabla\cdot E\ =\ 0,\ \nabla\cdot B\ =\ 0,\ \nabla\times E\ =-\frac{\partial B}{\partial t},\text{ and }\nabla\times B\ =\ \mu\varepsilon\frac{\partial E}{\partial t}\quad (27)$$

Deriving the wave equation in free space using equations (27) yields:

$$\nabla\times\{\nabla\times E\}\ =\ \nabla\times\{-\frac{\partial B}{\partial t}\}$$

$$\nabla\{\nabla\cdot E\}-\nabla^2 E\ =-\frac{\partial}{\partial t}\{\nabla\times B\}$$

$$\nabla^2 E\ =\ \frac{\partial}{\partial t}\{\mu\varepsilon\frac{\partial E}{\partial t}\}$$

$$=\ \frac{\partial(\mu\varepsilon)}{\partial t}\frac{\partial E}{\partial t}\ +\ \mu\varepsilon\frac{\partial^2 E}{\partial t^2}\quad (28)$$

Comparing equations (25), ()26), and (28):

$$\frac{\partial(\mu\varepsilon)}{\partial t}\ =\ 0$$

$$\frac{1}{(\mu\varepsilon)_x}\ =\ [\sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}cos(\theta)\ -\ r\frac{d\theta}{dt}sin(\theta)]^2\quad \text{(x-direction, 29)}$$

$$\frac{1}{(\mu\varepsilon)_y}\ =\ [\sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}sin(\theta)\ +\ r\frac{d\theta}{dt}cos(\theta)]^2\quad \text{(y-direction, 30)}$$

Therefore, maxwell's equations take the form of equations (27), subject to the constraint in equation (29) and (30), in which equations (21) - (24) convert everything into functions of (r, Θ, t) or (x,y,t) to be solved. Notice that equations (27) model the real, not the measured, behavior of light since the differentials are with respect to t. Using equation (4) to replace dt in equations (27) with $\frac{c}{c_0}|_A dt_0$ models what the observer in the A RF would observe (c_0 is evaluated at the A RF, not taken as zero).

Notice that, with $\Theta = 0$, equation (25) reduces to $[\sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}]^2\frac{\partial^2 E}{\partial r^2}\ =\ \frac{\partial^2 E}{\partial t^2}$. Using equation (10), $\frac{r}{r-r_s}(\frac{dr}{dt})^2$ can be replaced with $\frac{r-r_s}{r}c^2$, therefore:

$$\frac{r-r_s}{r}c^2\ \frac{\partial^2 E}{\partial r^2} = \frac{\partial^2 E}{\partial t^2}$$

Setting E = R(r)$\mathbf{T}(t)$, and solving for R(r) yields:

$$\frac{d^2R(r)}{dr^2} =-\ [k^2\frac{r}{r-r_s}]R(r) \quad (31)$$

Therefore:

$$k\sqrt{\frac{r}{r-r_s}} = \frac{2\pi}{\lambda} \quad (32)$$

Thus:

$$\lambda = \frac{2\pi}{k}\sqrt{\frac{r-r_s}{r}} = \lambda_\infty\sqrt{\frac{r-r_s}{r}} \quad (33)$$

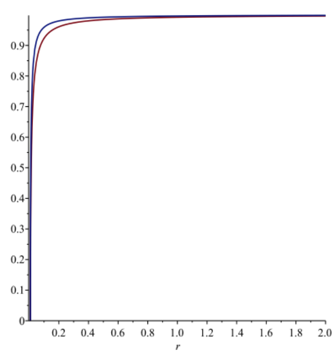


Figure 12 :This is a plot of $\lambda = \lambda_\infty\sqrt{\frac{r-r_s}{r+r_s}}$ from GTR (red) vs $\lambda = \lambda_\infty\sqrt{\frac{r-r_s}{r}}$ from PLS (blue). The Schwartzchild radius used is 0.0088m.

In figure 12, the gravitational redshift equation of GTR ($\lambda = \lambda_\infty\sqrt{\frac{r-r_s}{r+r_s}}$) (red) is plotted alongside equation (33) for $r_s = 0.0088m$ (the Schwartzchild radius of earth).

ASSESSMENT OF PLS AND GTR

Since lengths don't contract $R(c) = R(f)\lambda$, and using equations (33) yields:

$$R(f) = \frac{\sqrt{\frac{r-r_s}{r}}\,c}{\lambda_\infty\sqrt{\frac{r-r_s}{r}}}$$

$$= \frac{c}{\lambda_\infty} \quad (34)$$

$$= const$$

However, $M(c) = c = M(f)\boldsymbol{\lambda}$. Using equation (33) again, this results in:

$$M(f) = \frac{c}{\lambda_\infty \sqrt{\frac{r-r_s}{r}}}$$

$$= \frac{c}{\lambda_\infty}\sqrt{\frac{r}{r-r_s}} \quad (35)$$

It follows that the real and measured energy (E) are:

$$R(E) = \frac{c}{\lambda_\infty}h \quad (36)$$

$$M(E) = [\frac{c}{\lambda_\infty}h]\sqrt{\frac{r}{r-r_s}} \quad (37)$$

The $R(E)$ is constant: even though the wavelength decreases with a decrease in radius, R(c_0) slows down and those differences cancel. Notice that R(E) is quantized by h, and M(E) is smooth and continuous for $r > r_s$. From equations (36) and (37), it follows that:

$$M(E) = R(E)\sqrt{\frac{r}{r-r_s}} \quad (38)$$

PROPERTY VALUES OF A **PHOTON** AS r DECREASES					
	Speed of light	Clock Speed	λ	f	Energy
Real (R_s RF)	Decrease $\sqrt{\frac{r-r_s}{r}}\,c$	Decrease $d\boldsymbol{\tau} = \sqrt{\frac{r-r_s}{r}}\,dt$	Decrease $\lambda_\infty\sqrt{\frac{r-r_s}{r}}$	Constant $\frac{c}{\lambda_\infty}$	Constant $[\frac{c}{\lambda_\infty}h]$
Measured (R_s RF)	Constant c	Constant Change t	Decrease $\lambda_\infty\sqrt{\frac{r-r_s}{r}}$	Increase $\frac{c}{\lambda_\infty}\sqrt{\frac{r}{r-r_s}}$	Increase $[\frac{c}{\lambda_\infty}h]\sqrt{\frac{r}{r-r_s}}$
Table 1: Shows the relationship between the given quantities as r decreases. Notice that both the speed of light and the proper time scale the same.					

How the real and measured quantities for a photon change with a decrease in r-value is clarified in table 1.

Balancing the gravitational and centripetal forces yields $\frac{M_{AS}(mv_\theta^2)}{r} = \frac{M_{AS}(GMm)}{r^2}$ therefore:

$$M_{AS}(v_{\theta}) = \sqrt{\frac{M_{AS}(GM)}{r^2}} \quad (39)$$

Inserting equation (39) into equation (9) yields:

$$R(v) = \sqrt{\frac{M_{AS}(GM)}{r^2}\frac{c_0}{c}}$$

This suggests that the real values for G and M are such that $R(GM) = M(GM)(\frac{c_0}{c})^2$ where the subscripts are dropped. Therefore either:

$$R(M) = M(M)(\frac{c_0}{c})^2 \quad \text{(Case 1, 40)}$$

OR

$$R(G) = M(G)(\frac{c_0}{c})^2 \quad \text{(Case 2, 41)}$$

Where $M(M)$ and $M(G)$ must be constant in order to be consistent with the velocity curves in figure 5. **It follows that the Einstein equations have to model the measurables**, not the reals, otherwise G could not be considered constant in their derivation. We shall briefly consider each case, and some advantages to each:

Case 1:

Mass is an emergent property in which the real value is determined by the local speed of light. This is interesting because if we insert equation (40) into the gravitational force equation, there are two points in which to evaluate $\frac{c_0}{c}$: one for M and one for m. It seems logical to assume that since $\frac{c_0}{c}|_{r=r_s} = 0$, the force of gravity would need to be zero but this is not correct. Since $c_0 = v = 0$ at the EH, the mass never gets there and thus we can treat the $M(\frac{c_0}{c})^2$ as constant non-zero in which the value of M has to be substantially greater than expected in order to account for the $(\frac{c_0}{c})^2$ term. The real gravitational force becomes:

$$R(F_g) = \frac{G*R(Mm)}{r^2}$$

$$= \frac{G*M(Mm)}{r^2}(\frac{c_0(r1)}{c})^2(\frac{c_0(r2)}{c})^2 \quad (42)$$

If two masses are in a gravitational field, r1 is the radial component of mass M in the gravitational field, r2 is the radial component of mass m in the gravitational field, and r is the distance between them. Additionally, the measured gravitational force becomes:

$$M(F_g) = \frac{G*M(Mm)}{r^2} \quad (43)$$

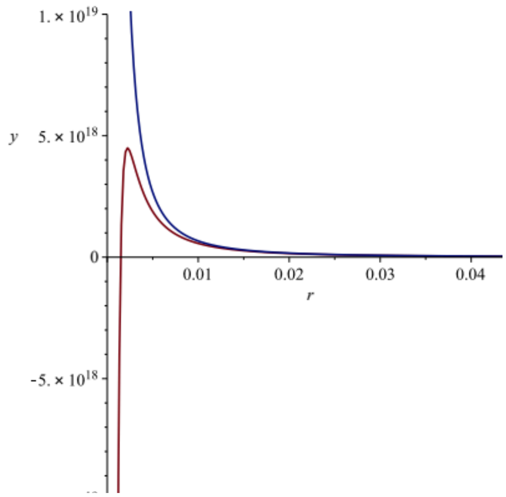


Figure 13: The real gravitational force (red) is plotted vs the measured gravitational force (blue). The real gravitational force tapers off, then drops to zero before becoming negative. Since the velocity at the event horizon is zero, particles never get there. Anything inside of the event horizon is pushed outwards.

A plot of equations (42) and (43) are shown in figure 13 with $\left(\frac{c_0(r1)}{c}\right)^2 = 1$. Notice that if the particles could reach the event horizon (which they can't), the real force (red) becomes zero. Additionally, the real force inside of the EH is negative meaning that any particle contained inside of the EH is forced outwards. This resolves any issues with singularities.

Additionally, in regards to QM, the real and measured energy values would be:

$$R(\bar{E}) = [M(M)\left(\frac{c_0}{c}\right)^2]c^2$$
$$= [M(M)]c_0^2 \quad (44)$$

and

$$M(\bar{E}) = mc^2 \quad (45)$$

Case 2:

In this case, the gravitational "constant" has a slight fudge factor resulting in:

$$R(F_g) = \frac{R(G)Mm}{r^2}$$
$$= \frac{M(G)Mm}{r^2}\left(\frac{c_0}{c}\right)^2 \quad (46)$$

And

$$M(F_g) = \frac{M(G)Mm}{r^2} \quad (47)$$

Equations (46) and (47) produce the same curves as that in figure 13 so the real force becomes negative inside the EH pushing matter outwards, and the real force at the EH drops to zero. Thus, this case also resolves all of the conflicts at the singularities.

Since all of the matter inside of a black hole is forced outwards, all of the information inside of the black hole is at the event horizon. It therefore makes sense that the amount of information inside of a black hole is proportional to the surface area of the EH as Bekenstein suggested.

THE QUANTUM NATURE OF GRAVITY

This section is just something that is perhaps worth considering: not claimed to be true.

Photons In A Relatively Stationary RF: The momentum p of a photon is $\frac{h}{\lambda}$. Using equation (33), the measured momentum of k photons is:

$$M(p) = \frac{hk}{\lambda_\infty \sqrt{\frac{r-r_s}{r}}}$$

$$= \frac{hk}{\lambda_\infty}\sqrt{\frac{r}{r-r_s}} \quad (48)$$

Therefore the measured force exerted by the photon as it is omitted from an object O is:

$$M(F) = \frac{hk}{\lambda_\infty}\frac{d}{dt}\left(\sqrt{\frac{r}{r-r_s}}\right)$$

$$= \frac{hk}{2\lambda_\infty}\left(\frac{dr}{dt}\right)\left(\frac{1}{\sqrt{r(r-r_s)}} - \frac{\sqrt{r}}{(r-r_s)^{1.5}}\right)$$

$$= \frac{hk}{2\lambda_\infty}\left(\frac{dr}{dt}\right)\left(\frac{r-r_s}{\sqrt{r}(r-r_s)^{1.5}} - \frac{r}{\sqrt{r}(r-r_s)^{1.5}}\right)$$

$$= \frac{hk}{2\lambda_\infty}\left(\frac{dr}{dt}\right)\left(\frac{-r_s}{\sqrt{r}(r-r_s)^{1.5}}\right)$$

Since M(F) is a measurement, $\frac{dr}{dt} = c$. Additionally, since r_s is the Schwartzchild radius it can be replaced with $\frac{2GM}{c^2}$. Therefore:

$$M(F) = \frac{-GMhk}{c\lambda_\infty}\left(\frac{1}{\sqrt{r}(r-\frac{2GM}{c^2})^{1.5}}\right) \quad (49)$$

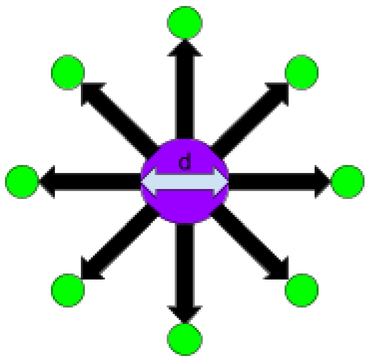


Figure 14: An object O (purple) of diameter d radiates a uniform field of virtual photons (green) in all directions. All of the photons produce the same momentum on O uniformly resulting in a net acceleration of zero for O.

In Figure 14, the mathematical framework is illustrated in which an object O, of diameter d, radiates a uniform field of virtual photons in all directions. This results in a force acting on O, but since the field is uniform the net force on O is zero.

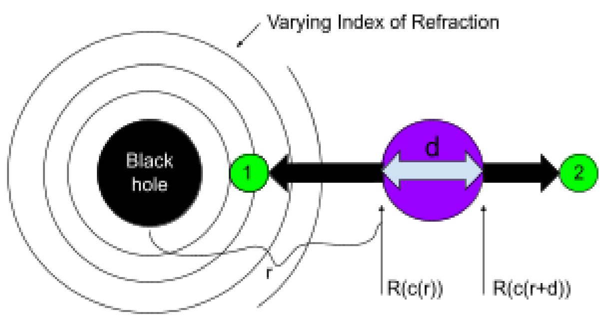


Figure 15: Object O from Figure 1 is placed into a non-uniform gravitational field that is produced by the presence of a black hole. The momentum produced by virtual particle 1 is greater than the momentum of virtual particle 2 producing a type of anti-gravity.

In Figure 15, object O is placed into a gravitational field. From equation (49), the measured force exerted on O due to virtual photon 1 being emitted is:

$$M(F_1) = \frac{-GMhk}{c\lambda_\infty}\left(\frac{1}{\sqrt{r}(r-\frac{2GM}{c^2})^{1.5}}\right)$$

And the force exerted on O due to virtual photon 2 being emitted is:

$$M(F_2) = \frac{-GMhk}{c\lambda_\infty}\left(\frac{1}{\sqrt{r+d}(r+d-\frac{2GM}{c^2})^{1.5}}\right)$$

The magnitude of the net force is therefore the difference:

$$\left|M(F_{net})\right| = \frac{GMhk}{c\lambda_\infty}\left(\frac{1}{\sqrt{r}(r-\frac{2GM}{c^2})^{1.5}} - \frac{1}{\sqrt{r+d}(r+d-\frac{2GM}{c^2})^{1.5}}\right)$$

$$= \frac{GMhk}{c\lambda_\infty}\left(\frac{1}{\sqrt{r}(r-\frac{2GM}{c^2})^{1.5}} - \frac{1}{\sqrt{r+d}(r+d-\frac{2GM}{c^2})^{1.5}}\right) \quad (50)$$

Notice that $M(F_{net})$ is 0 for a point particle ($d \to 0$). Notice that this force actually pushes O away from the black hole. This is resolved if the photons are omitted internally passing from side to side. This doesn't violate conservation of energy or momentum within the particle because the photons are absorbed, and on absorption approx. the same force is produced (if O doesn't move).

While photons do not mitigate the strong force, applying this principle to the transfer of gluons within the nuclei might end up beneficial.

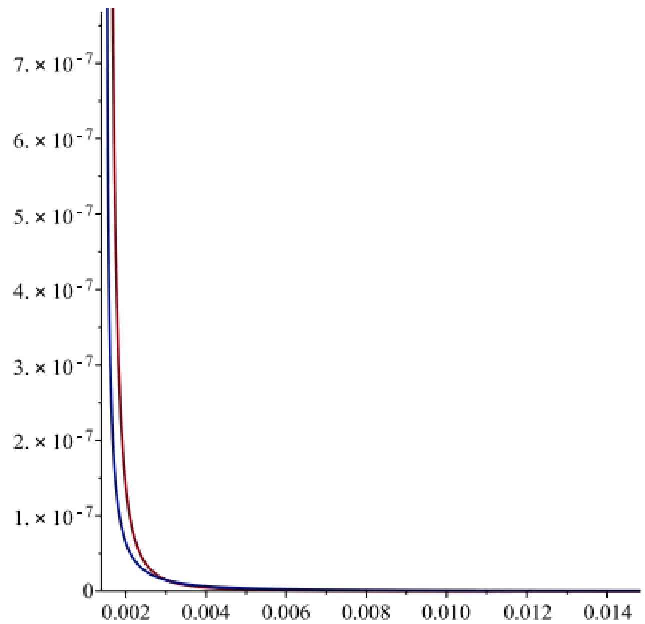


Figure 16: This graph shows $\left|M(F_{net})\right|$ (red) and $R(F_g)$ (blue). $\left|M(F_{net})\right|$ is not compatible as is with $R(F_g)$.

FUNDAMENTAL PRINCIPLES AND PROOFS

P_1: For an isolated system **A** characterized by having a finite set of distinct possible states, any event E_n that remains possible will inevitably happen (A variation of the Poincare Recurrence Theorem.).

Proof: Let B = $\{B_1, \ldots B_m, B_{m+1}\}$ be the set of distinct states of **A** (which is in state B_j), and let $E_j \equiv B_j \rightarrow B_{j+1}$ be an event with a probability $P_1(E_j) = \varepsilon_j$ of occurring, where $0 < \varepsilon_j \leq 1\ \forall\ j \in [1, m]$. It follows that $P_1(\neg E_j) = 1 - \varepsilon_j$, and $P_k(\neg E_j) = (1 - \varepsilon_j)^k$ where k is the number of opportunities. Since $|B| < \infty$, $1 < m < \infty$, and thus we define an infinite period T = $\{T_1, T_2, \ldots T_m\}$ | [$T_j = \frac{T}{m} = \infty$ and $T_i \cap T_j = 0$] $\forall$ i $\in$ [1,m] where i $\neq$ j. We also define some minimal unit of time $\infty > t_{min} > 0$ in which a state change can occur | $k = \lfloor \frac{t}{t_{min}} \rfloor$. Since $\lim_{t \rightarrow T_j} P_{\lfloor \frac{t}{t_{min}} \rfloor}(\neg E_j) = 0\ \forall$ j, all of the states of **A** have a 0 probability of not occurring in T. Since T is arbitrary, this holds for any infinite period. If such a t_{min} doesn't exist, then ε = 0.

Clarification: *Suppose that A and B are 2 mutually exclusive events each with a non-zero probability of occurring | once either A or B occurs, the probability of the other event occurring becomes 0.*

Let t_a and $t_b \in$ [0, t) be the respective time periods in which events A and B remain possible. We let A represent the event that occurs, and since A and B are mutually exclusive, they cannot occur at the same time. Thus, $0 \leq t_b < t_a \leq t$. Thus event B not occurring doesn't violate P_1 even as $t \to \infty$ since $t_b < t_a$.

P_2**:** The generation of existence from a state of nonexistence is inherently precluded.

Proof: Let nothing ∅ be defined | ∅ = {0}, and suppose that $y \notin \emptyset$. Then k components of $\frac{y}{k}$ must also exist for each k ∈ N. Since $[\lim_{k \to \infty} k(\frac{y}{k}) = y]$, and $[\infty(0) = 0]$, $\frac{y}{k} \neq 0$ proving that $\frac{y}{k} \notin \emptyset$ ∀ k. In other words, y cannot be produced from even an infinite amount of nothing. This can be summed up with the following diagram:

.
.
.
______________________________ 0 ______________________________……
_______________0_______________ + _______________ 0 _______________ ……
_______0_______ + _______0_______ + _______0_______ + _______0_______ ……
(0 + 0) + (0 + 0) + (0 + 0) + (0 + 0) + (0 + 0) + (0 + 0) + (0 + 0) + (0 + 0) ……

Furthermore, suppose that $a \in z$, and $a \notin \emptyset$. It follows that $z \neq \emptyset$. Therefore ∀ $b_i \in \emptyset$, $b_i = \emptyset$ thus$[b_i = \emptyset] \pm [b_k = \emptyset] = \emptyset$ proving that even conserved quantities cannot be produced from nothing.

Clarification: It is important to establish the fact that numbers and variables do not exist ontologically. We can write symbols down that represent their existence, and that is where some of the issues in physics arise. Just because we can write two 0's as $\frac{0}{0}$ doesn't mean that you could actually take two nothings in reality and divide them. The difference between epistemological and ontological existence makes all of the difference. Additionally, since ∅ doesn't exist it is not required to follow any logic principles or laws of physics, but ∅ doesn't exist for it to matter. For some reason, some physicists have tried using this argument to produce a universe from nothing.

P_3: The entirety of All that Exists (AE) has always existed at the fundamental level, and each state within the realm of AE is finite in continuous duration.

Proof: Let **A** represent an isolated system in the state A_{n+1} where A is the set of all states of **A** in order of occurrence; A_n and $A_{n+1} \in$ A; n $\in$ Z; and $A_{n+1} \neq \varnothing$. Let $\check{T}(A_i)$ be the length of time in which **A** is in state A_i.

1) Prove that if $A_c \in$ A, then $A_c \neq \varnothing$:

   Since $A_{n+1} \neq \varnothing$, and **A** is isolated, then by P_2, $A_c \neq \varnothing$.

2) Prove that $A_{n-1} \in$ A:

   a) Suppose that $\check{T}(A_n) = \infty$. Since $|\{A_n, A_{n+1}\}| = [2 < \infty]$, by P_1, state A_{n+1} isn't possible, contradicting the premise that $A_{n+1} \in$ A. Since **A** is isolated and P_2 holds, by contradiction, $\check{T}(A_n) < \infty$, thus $A_{n-1} \in$ A.

   b) Suppose that $\check{T}(A_n) < \infty$. Since P_2 holds, $\exists\ A_{n-1} \in$ A.

3) Prove that the $|A| = \infty$:

   Since A_n and A_{n+1} being elements of A proves that $A_{n-1} \in$ A, A_{n-1} and A_n being elements of A proves that $A_{n-2} \in$ A. It follows that $\exists\ A_{k+1} \in$ A $\forall$ k $\leq$ n, where k $\in$ Z $\Rightarrow |A| = \infty$.

AE is isolated because P_2 holds, and it has at least 2 states that are not $\varnothing$. The association **A** = AE can therefore be made.

1. Since $\exists\ A_{k-1}$ (cause) $\forall\ A_k$ (effect), every effect has a cause, and the property of time has always existed.
2. From 2) $\check{T}(A_n) < \infty\ \forall\ A_n \in \mathbf{A}$.

WHY THE UNIVERSE EXISTS

From P_2, the production of something from nothing is precluded: it follows that since something exists, that something's fundamentals have always existed. From P_3, AE has always had the ability for change. These two attributes guarantee that AE is closed and isolated, and that the logical equivalent of eternal time has passed. We define that eternal period as T, and divide it into 2 infinite periods T_1 and T_2, where T_1 precedes T_2. By P_1, if an event can only occur once, then it must have occurred in T_1. It follows that since the universe is finite in age, it could not have begun in T_1 proving that if universes naturally occur, then an infinite number of universes have emerged. We therefore define a volume element V containing the universe U such that $U \subset V \subset AE$. It follows that even if AE is infinite in size, an infinite number of universes have emerged and passed through V. It would therefore be guaranteed that we observe such remnants in our universe. The fact that we do not observe such remnants proves that universes cannot occur naturally.

If it is possible, then at some point in T_1 fundamentals naturally came together to form God. Since T_1 precedes T_2, God has existed for an infinite period. By this same logic: God is perfect; God has developed rules that yield the best statistical outcomes; God is unchanging.

It follows that the universe was intelligently designed in which the laws of physics operate on 3-space (via n) in the same manner that a software program operates on the screen. Therefore all Miracles are logically equivalent to changing the code. Science is deriving the equations in which God inserted into the program.

CONCLUSION

The variable speed of light results in the illusion of space expansion, while all real velocities remain bounded by c: thus dark energy doesn't exist. The same equation that shows dark energy doesn't exist, also produces the correct velocity curves for galaxies: thus dark matter doesn't exist either. Time being a function of the speed of light ensures that the same value of c is measured at each point in space. The real gravitational force inside of the event horizon is negative thus it forces everything towards the event horizon resolving any issues associated with a singularity. The laws of physics are entirely separable from the 3-space in which the universe is contained in the same capacity that a program is separated from the screen: this suggests design in which physics is deriving the equations written in the program.

REFERENCES

KJV

Bacon, David, "Observational Cosmology (Gravitational Lensing)." Institute Of Cosmology and Gravitation, https://icg.port.ac.uk/~schewtsj/TPCosmoV/L2/S8%20SL.pdf

White, S. D. M. (n.d.). Dark matter: Rotation curves. https://w.astro.berkeley.edu/~mwhite/darkmatter/rotcurve.html

Nave, R. (n.d.). Galactic velocity curves. [HyperPhysics]. Retrieved from http://hyperphysics.phy-astr.gsu.edu/hbase/Astro/velcurv.html

Smith, R. R. (2023). Mathematical proof that time has always existed, and the real structure of the universe that results from it. Self-published document. <https://drive.google.com/file/d/1IQF-7Q67hKmiPESAzIKQTSeCWyZTzGFQ/view?usp=drive_link>

Smith, R. R. (2023). The Proper Light Speed. Self-published document. <https://drive.google.com/file/d/1GL3KjD1TZZvGfBUIdFNAYU-OYv-D8mHi/view>

Smith, R. R. (2023). Mathematical proof that time has always existed, and the real structure of the universe that results from it. Self-published document. <https://drive.google.com/file/d/1SOYsRximJKIPB6WVpjGDODernBxx_O1F/view?usp=drive_link>

Smith, R. R. (2024). The Unification Of Physics Using A Variable Speed Of Light. Self-published document. <https://drive.google.com/file/d/1yHXz-Q0DwuFUBBXkztUpiWaZpQOEER1Y/view?usp=sharing>

Weideman, T. "3.1: The Free Particle." LibreTexts, n.d., https://phys.libretexts.org/Courses/University_of_California_Davis/UCD%3A_Physics_9HE_-_Modern_Physics/03%3A_One-Dimensional_Potentials/3.1%3A_The_Free_Particle.

Weideman, T. "3.2: Infinite Square Well." LibreTexts, n.d.,https://phys.libretexts.org/Courses/University_of_California_Davis/UCD%3A_Physics_9HE_-_Modern_Physics/03%3A_One-Dimensional_Potentials/3.2%3A_Infinite_Square_Well.

"Metric tensor (general relativity)." Wikipedia, The Free Encyclopedia, Wikimedia Foundation, 11 July 2023, https://en.wikipedia.org/wiki/Metric_tensor_(general_relativity).

"Minkowski space." Wikipedia, The Free Encyclopedia, Wikimedia Foundation, 22 July 2023, https://en.wikipedia.org/wiki/Minkowski_space.

"Gravitational lens" Wikipedia, The Free Encyclopedia, Wikimedia Foundation, 12 August 2023, https://en.wikipedia.org/wiki/Gravitational_lens.

"Spherical coordinate system" Wikipedia, The Free Encyclopedia, Wikimedia Foundation, 29 August 2023, https://en.wikipedia.org/wiki/Spherical_coordinate_system.

"Gravitational lensing formalism" Wikipedia, The Free Encyclopedia, Wikimedia Foundation, 28 June 2023, https://en.wikipedia.org/wiki/Gravitational_lensing_formalism.

"Einstein ring" Wikipedia, The Free Encyclopedia, Wikimedia Foundation, 29 August 2023, https://en.wikipedia.org/wiki/Einstein_ring.