The Proper Light Speed (PLS)

(A unification of Gravity, and Quantum Mechanics V3)

Author: Russell R. Smith
Email: *SmithCoDev@gmail.com*
Orcid: https://orcid.org/0009-0001-5302-9646
Date: 02/04/2024

ABSTRACT

The constancy of the speed of light is the foundation of modern physics, as it has been tested over and over. However, it is wrong. Einstein did an amazing job with both the special and general theories of relativity, but he did make one mistake, and since his theories were so accurate in describing experimental outcomes, the rest of physics was then based on that one mistake. That one mistake being that the speed of light is a constant. The speed of light is always measured as constant because our concept of time is a function of the proper speed of light. In this article, a mathematical framework is constructed in which:

1. The principles of the Lorentz Transformation are obeyed.
2. The experimental results for gravitational lensing, gravitational redshifting, time dilation, and relativistic muon decay are satisfied.
3. Velocity curves for galaxies are accurately predicted without the need for dark matter.
4. Space is non-local.
5. The discreteness of quantum mechanics is united with the smoothness of GTR.

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

Let S represent the coordinate reference frame (zero-g, zero-velocity), and let P represent the proper coordinate reference frame in a gravitational field and or that is moving in the x-direction relative to S as clarified in the context. The following definitions apply unless otherwise specified:

RF: Reference Frame.
GTR: General Theory of Relativity.
STR: Special Theory of Relativity.
QM: Quantum Mechanics.
t: This is the real time in S, and the measured time in P.
c: This is the real speed of light in S, and the measured speed of light in P.

t_0: This is the real time in P relative to t in S.

c_0: This is the real proper speed of light in P relative to S. That is: $[c_0] = \frac{dist}{t}\ not\ \frac{dist}{t_0}$.

R(^{0}): Represents a real value for the variable ^{0}.
M(^{0}): Represents a measured value for the variable ^{0}.
Galilean Transformations:

$$x_0 = x - vt$$
$$y_0 = y$$
$$z_0 = z$$
$$t_0 = t$$

THEORETICAL FRAMEWORK: KEY CONCEPTS

Using the Galilean Transformations, derive the modified Lorentz Transforms for a variable speed of light:

$$x_0 = ax - bt$$
$$= a(x - \frac{b}{a}t)$$

Since this has to reduce to the Galilean Transformations when a = 1:

$$x_0 = a(x - vt) \quad (1)$$

It follows that:

$$a^2(x - vt)^2 + y_0^2 + z_0^2 - c_0^2t^2 = x^2 + y^2 + z^2 - c^2t^2$$

Which reduces to:

$$a^2(x - vt)^2 - c_0^2t^2 = x^2 - c^2t^2 \quad (2)$$

Solving equation (2) for a:

$$a = \sqrt{\frac{x^2+c_0^2t^2-c^2t^2}{(x-vt)^2}}$$

Substituting this in for a in equation (1) :

$$x_0 = \sqrt{\frac{x^2+c_0^2t^2-c^2t^2}{(x-vt)^2}}(x - vt)$$
$$= \sqrt{x^2 + c_0^2t^2 - c^2t^2} \quad (3)$$

Where $c_0t = X_0$ is the distance that light travels in P, and $ct = X$ is the distance that light travels in S. Therefore, equation (3) can be written as:

$$x_0 = \sqrt{x^2 + X_0^2 - X^2} \quad (4)$$

Now consider the following:

$$dX_0 = c_0 dt = c\, dt_0 \quad (5)$$

This formula says that if c_0 changes, it produces the same result as if dt_0 changed by the same percentage instead. Since v is constant:

$$t_0 = \frac{c_0}{c} t \quad (6)$$

Therefore, the modified Lorentz Transformations are:

$$x_0 = \sqrt{x^2 + X_0^2 - X^2} \quad \Leftrightarrow \quad x_0 = \sqrt{x^2 + c_0^2 t^2 - c^2 t^2}$$

$$y_0 = y$$

$$z_0 = z$$

$$t_0 = \frac{c_0}{c} t$$

Where (x, y, z, c_0, t) determine everything regarding the transformations.

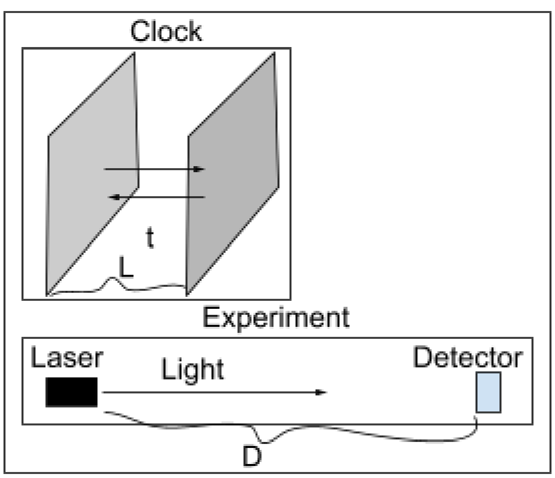


Figure 1: A light clock is used to measure the time it takes for light to travel from the laser to the detector in a stationary RF.

Now consider the stationary experiment depicted in Figure 1 where a light clock is used to measure how long it takes a photon to get from the laser to the detector. The number of passes $\mathcal{P}$ inside of the light clock is just:

$$\mathcal{P} = \frac{D}{L} \quad (7)$$

Now, let $|c| = f(t, \varepsilon) > 0$, where ε is the total distance traveled by the photon relative to the RF containing the clock and the experiment. Furthermore, let L|D, and let the time of travel between one mirror and the next be defined as $\Delta t = t_n - t_{n-1}$. Since the light in the clock changes speed exactly the same as the light in the experiment, the distances $\int_{t_{n-1}}^{t_n} f(t, \varepsilon)dt$ over each pass in both the clock and the experiment are the same. This results in:

$$\frac{D}{L} = \sum_{n=1}^{P} \frac{\int_{t_{n-1}}^{t_n} f(t,\varepsilon)dt}{\int_{t_{n-1}}^{t_n} f(t,\varepsilon)dt} = \mathcal{P} \quad (8)$$

It follows that no matter how much the speed of light varies, the same value of $\mathcal{P}$ is measured. Since $\mathcal{P}$ is intricately tied to t (as shown below), this explains why the speed of light is always measured as a constant.

Notice that:

$$\begin{aligned} [D] &= [L][\mathcal{P}] \\ &= \frac{[dist]}{pass} pass \\ &= [c][t] \\ &= \frac{[dist]}{[t]} [t] \end{aligned}$$

Therefore if $[c] = \frac{[dist]}{[t]}$, then [t] is analogous to $[\mathcal{P}]$. Now we can do some mathematical trickery and write:

$$\begin{aligned} \frac{[dist]}{pass} pass \frac{[t]}{[t]} &= \frac{[dist]}{[t]} [t] \\ &= [c][t] \end{aligned}$$

But you can also let $L \to 299792458\ m$ so that $c = \frac{299792458\ m}{s} = \frac{299792458\ m}{pass}$ to see that $[t]$ are indeed analogous to $[\mathcal{P}]$. This tells us that our concept of time is just the relationship between 2 events, and the distance that light traveled between them occurring. Therefore we might as well let $L \to D$, and write $D = L = c$ so that $[c] = [dist]$. This just puts our concept of time into perspective. It is very counterintuitive, but light doesn't require time in order to propagate. Light simply propagates independent of time, and then we measure time based on how far the light traveled. In some parts of the universe light travels further than in other parts resulting in time dilation. Therefore, $[c] = [dist]$, and the Time Independent Lorentz Transformations modeling reality without observation are:

$$x_0 = \sqrt{x^2 + (X_0^2 = c_0^2) - (X^2 = c^2)} \quad (9)$$

$$y_0 = y$$

$$z_0 = z$$

If we want to take a time measurement, then we first invent the concept of time by setting $[c] = \frac{[dist]}{pass} = \frac{dist}{[t]}$, and then we use the Time Dependent Lorentz Transformations which are:

$$x_0 = \sqrt{x^2 + c_0^2 t^2 - c^2 t^2} \quad (10)$$

$$y_0 = y$$

$$z_0 = z$$

$$t_0 = \frac{c_0}{c} t \quad (11)$$

In other words, the universe works all on its own independent of time, and if we want to take a time measurement we have to invent the concept of time to do so. This is very very counterintuitive and it goes against everything that we understand in modern physics, but there isn't any way around it. Time is a man made concept, just a convenient parameter. As shown below, making this adjustment allows for a smoother unification of GTR, QM, and Maxwell's Eq's.

In GTR, $cdt_0 = \sqrt{g_{\mu\nu} dx^{\mu} dx^{\nu}}$, where $g_{\mu\nu}$ is the metric tensor. From equation (5) it follows that $c_0\, dt = \sqrt{g_{\mu\nu} dx^{\mu} dx^{\nu}}$, and therefore:

$$c_0 = \sqrt{g_{\mu\nu} \frac{dx^{\mu}}{dt} \frac{dx^{\nu}}{dt}} \quad (12)$$

It is important to note that equation (12) is dependent on time because we have constructed it in such a way as to be. In the Time Independent Lorentz Transformations, $[c] = [dist]$, and therefore $[\frac{dx^{\mu}}{dt}], [\frac{dx^{\nu}}{dt}] = [dist]\ or\ [angle]$ and thus c_0 is time independent in such cases.

Since the universe functions without time, the only parameter that is left to govern the fundamental forces is c_0. That is, the real values R(^{0}) for fundamental forces are:

Strong Force: $R(g) = g(c_0)$

Electromagnetic Force: $R(\gamma) = \gamma(c_0)$

Weak Nuclear Force: $R(W) = W(c_0)\ and\ R(Z) = Z(c_0)$

Gravitational Force: $R(G) = G(c_0)$

And since all RFs measure the speed of light to be constant, the measured values M(^{0}) are:

Strong Force: $M(g) = g(c)$
Electromagnetic Force: $M(\gamma) = \gamma(c)$
Weak Nuclear Force: $M(W) = W(c)\ and\ M(Z) = Z(c)$
Gravitational Force: $M(G) = G(c)$

The proper speed of light c_0 regulates everything in the universe. The fundamental forces, and our measurement of time, change proportionally with c_0 ensuring that the physics remains the same everywhere. Additionally, energy density regulates c_0 according to equation (12).

The PLS theory introduces the concept of real R(^{0}) versus measured M(^{0}) values. Let two RFs S_1 and S_2 be in coordinate space. $R(c,\ t) = (c,\ t)$ signifies that the real speed of light is c, and the real time is t. Since every RF measures the speed of light to be c, $M(c,\ t) = (c,\ t)$ in both RFs. Therefore, in coordinate space, $R(c, t) = M(c, t)$. As $S_2 \rightarrow$ P by moving into a gravitational field, the measured values $M(c,\ t) = (c,\ t)$, but $R(c,\ t) = (c_0,\ t_0)$ describes what is really happening relative to S_1. This means that there is a distinction between what is real and what is measured when not in coordinate space, and that distinction is due to the changing speed of light. Take an electron for example. The electron has an electric field that is mediated by the photon. In both S_1 and P the electron is quantized, but when the the electron is in P, $M(c,\ t) = (c,\ t)$ and $R(c,\ t) = (c_0,\ t_0)$ so the force carriers propagate slower relative to S_1 but they are measured as being the same in P. This distinction between what is real and what is measured is what allows the discreteness of quantum mechanics to be united with the continuity and smoothness of GTR. In reality, everything is quantized, but that quantization is viewed as continuous due to the variable speed of light.

EMPIRICAL ASSESSMENT OF PLS AND GTR

If the light clock in figure 1 is moving at c in the same direction as the light inside of it, then $c_0 = 0$. This interpretation is uncanny but important. Therefore, from the photons RF:

$$0 = \sqrt{g_{\mu\nu}\frac{dx^{\mu}}{dt}\frac{dx^{\nu}}{dt}}$$
$$= \sqrt{g_{\mu\nu}dx^{\mu}dx^{\nu}} \quad (13)$$

Where $\sqrt{g_{\mu\nu}dx^{\mu}dx^{\nu}}$ models the lightlike path of GTR. Therefore the PLS theory makes the same predictions as GTR regarding light propagation and therefore it is automatically consistent with gravitational lensing / redshifting, and Maxwell's equations. However it doesn't necessarily make the same predictions as GTR in terms of everything else such as velocity curves.

Since the Schwartzchild metric models the geodesic near a non-rotating massive object, it is appropriate for use in determining the real speed of light in a stationary RF. Starting with:

$$c_0 = \sqrt{\frac{r-r_s}{r}c^2 - \frac{r}{r-r_s}(\frac{dr}{dt})^2 - r^2(\frac{d\theta}{dt})^2 - r^2 sin^2(\theta)(\frac{d\varphi}{dt})^2} \quad (14)$$

Where $c_0 = 0$ from the photons RF, the real proper speed of light from the S RF is:

$$R(c) = \sqrt{\frac{r-r_s}{r}}c \quad (15)$$

Since tensors are invariant, this can be interpreted as $\sqrt{\frac{r-r_s}{r}}c$ being the hypotenuse of a triangle formed from the elements in equation () with $c_0 = 0$. So in the lights RF $c_0 = 0$, but in reality the light is still moving so its real velocity R(c) is non-zero.

Since the PLS theory makes the same predictions as GTR in regards to geodesics we can start with the gravitational redshift equation of GTR:

$$\lambda = \lambda_{\infty}\sqrt{\frac{r-r_s}{r}} \quad (16)$$

In P, it follows that $R(c) = R(f)\lambda$, and using equations (15) and (16), this results in:

$$R(f) = \frac{\sqrt{\frac{r-r_s}{r}}c}{\lambda_{\infty}\sqrt{\frac{r-r_s}{r}}}$$
$$= \frac{c}{\lambda_{\infty}} \quad (17)$$
$$= const$$

However, in P, $M(c) = c = M(f)\boldsymbol{\lambda}$. Using equations (15) and (16) again, this results in:

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

$$= \frac{c}{\lambda_\infty}\sqrt{\frac{r}{r-r_s}} \quad (18)$$

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

$$R(E) = \frac{c}{\lambda_\infty}h \quad (19)$$

$$M(E) = [\frac{c}{\lambda_\infty}h]\sqrt{\frac{r}{r-r_s}} \quad (20)$$

$R(E)$ is constant because even though the wavelength decreases with a decrease in radius, R(c_0) slows down as well and those differences exactly cancel. Notice that R(E) is quantized by h, and M(E) is smooth and continuous for $r > r_s$.

From equations (19) and (20), it follows that in P:

$$M(E) = R(E)\sqrt{\frac{r}{r-r_s}} \quad (21)$$

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, when viewed from the R_s RF. Notice that both the speed of light and the proper time scale the same.

In table 1 above, a presentation of how the real and measured quantities for a photon change with a decrease in r-value. In regards to particles with mass, it makes sense that velocities scale with c_0, so that the relationship between time and velocity remains the same everywhere. Therefore:

$$R(v) = M(v)\frac{c_0}{c} \quad (22)$$

Now consider the following:

$$\frac{m(M(v))^2}{r} = \frac{M(G)Mm}{r^2} \text{ or equivalently } M(v)^2 = \frac{M(G)M}{r}$$

Using equation (22) yields:

$$R(v)^2 (\frac{c}{c_0})^2 = \frac{M(G)M}{r}$$

$$R(v)^2 = \frac{M(G)M}{r} (\frac{c_0}{c})^2 \quad (24)$$

suggesting that either the mass or the gravitational constant M(G) isn't so constant. Now consider:

$$\frac{m(M(v))^2}{r} = \frac{\mu q_1 q_2}{2\pi r^2} \quad \Rightarrow \quad R(v)^2 = \frac{\mu q_1 q_2}{2\pi m r} (\frac{c_0}{c})^2$$

Therefore, if mass decreases with $(\frac{c_0}{c})^2$, then the real coulomb force doesn't and this is wrong since it is mediated by the photon. It follows that:

$$m = m \quad (23)$$

$$R(q) = M(q)\frac{c_0}{c} \quad \text{OR} \quad R(\mu) = M(\mu)(\frac{c_0}{c})^2 \quad (24)$$

$$R(G) = M(G)(\frac{c_0}{c})^2 \quad (25)$$

This means that:

1) The rest mass is the same in all reference frames.
2) If $R(q)$ is quantized, then M(q) isn't (and vis vera) OR If $R(\mu)$ is quantized, then M(μ) isn't (and vis vera).
3) If R(G) is constant (assumed to be), then M(G) increases with a decrease in radius. Therefore the expected velocity of stars in orbit is:

$$M(v)^2 = \frac{M(G)M}{r} = \frac{(R(G) = const)M}{r} (\frac{c}{c_0})^2 \quad (26)$$

And therefore M(v) should be a factor of $\frac{c}{c_0}$ larger than that predicted in GTR.

Since the stars in a spiral galaxy are in orbit in a plane, $\frac{dr}{dt} = \frac{d\varphi}{dt} = 0$, and $M(v) = rd\Theta$ in equation (14). Therefore:

$$c_0 = \sqrt{\frac{r - r_s}{r} c^2 - M(v)^2}$$

$$= c\sqrt{\frac{r - r_s}{r} - \frac{M(v)^2}{c^2}}$$

Resulting in:

$$(\frac{c}{c_0})^2 = [\frac{r - r_s}{r} - \frac{M(v)^2}{c^2}]^{-1} \quad (27)$$

Using equations (26) and (27):

$$M(v)^2 = \frac{(R(G) = const)M}{r}\left[\frac{r-r_s}{r} - \frac{M(v)^2}{c^2}\right]^{-1}$$

Solving for M(v):

$$M(v) = [\sqrt{r(rc - r_s c + \sqrt{c^2(r^2 + r_s^2) - 2rc^2 r_s - 4R(G)Mr})c}]/(\sqrt{2}r) \quad (27)$$

$$R(v) = \sqrt{\frac{R(G)M}{r}} \quad (28)$$

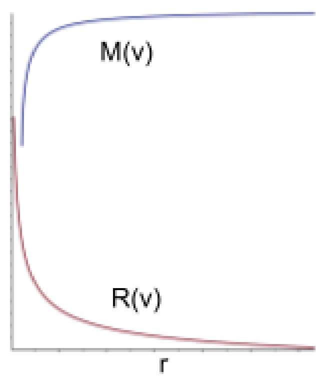


Figure 2: The real velocity vs the measured velocity as a function of galactic radius..

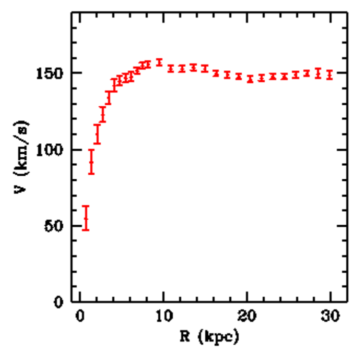


Figure 3: "*The rotation curve for the galaxy NGC3198 from Begeman 1989"* (White, n.d.)

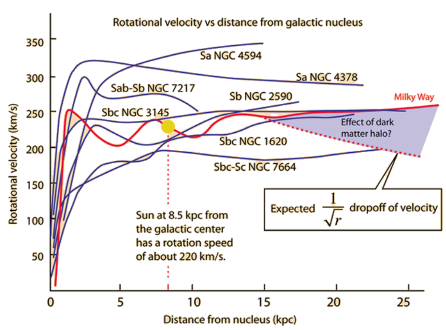


Figure 4: Rotational velocities for a variety of spiral galaxies (Nave, n.d.).

As shown in Figure 2, M(v) closely models the velocity curve in Figure 3 without the need for dark matter. As shown in Figure 4, there are a variety of velocity curves for different galaxies. It is believed that reintroducing the $\frac{dr}{dt}$ and $\frac{d\varphi}{dt}$ terms back into the metric (can) resolve any differences.

Therefore the real and measured forces of gravity are:

$$R(F) = \frac{(R(G)=const)mM}{r^2} \quad (29)$$

$$M(F) = \frac{(G_{real} = const)mM}{r(r - r_s)} \quad (30)$$

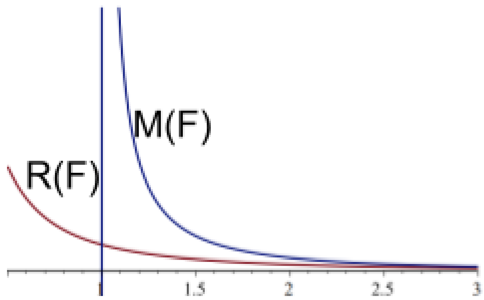


Figure 5: In this figure R(F) is depicted in red, and M(F) in blue. Since the measured force M(F) is substantially larger than that predicted in GTR, the velocity of orbiting stars must be also.

From Figure 5, the real force R(F) (red) is the same as that predicted in GTR, and the measured force M(F) (blue) is what gets observed. Since the measured force is substantially larger than that predicted in GTR, M(v) of orbiting stars must be also.

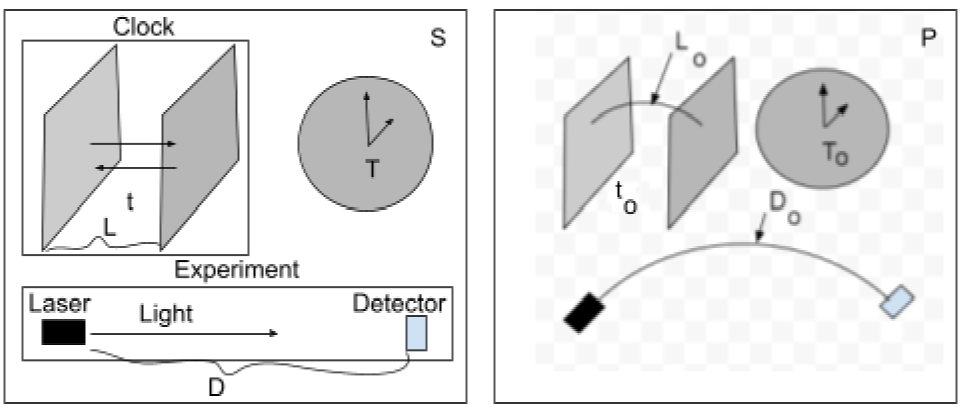


Figure 6: Two RF's S and P both contain identical experiments in which a light and analog clock are used to measure the time it takes light to travel from the laser to the detector.

In Figure 6, there is the same experimental setup for the S RF as that shown in Figure 1 with the addition of an analog clock. Additionally, there is the same setup in a gravitational field. The times measured by each clock are represented by t, T, t_0, and T_0 respectively as shown in the figure. From equation (7), the number of passes in S is:

$$\mathcal{P} = \frac{D}{L}$$

In P, the curvature inside the clock and inside of the experiment are the same therefore $\mathcal{P}$ remains the same (this can be shown by letting $L_0 \to D_0$). Therefore:

$$\mathcal{P} = \frac{D_0}{L_0}$$

According to GTR:

$$D = L\mathcal{P} = ct \quad (31)$$

and

$$D_0 = L_0\mathcal{P} = ct_0 \quad (32)$$

Solving both equations for $\mathcal{P}$ and setting them equal to each other results in:

$$\frac{ct}{L} = \frac{ct_0}{L_0}$$

$$\therefore t_0 = \frac{L_0}{L}t \quad (33)$$

The total time of travel for the experiment in the P RF is increased by a factor of $\frac{L_0}{L}$ according to the S RF. Now, let's look at the PLS interpretation.

$$D = L\mathcal{P} = ct \quad (34)$$

and

$$D_0 = L_0\mathcal{P} = c_0 t_1 \quad (35)$$

Since $[c_0] = \frac{dist}{t}\ not\ \frac{dist}{t_0}$ as stated in the definitions, t_1 is a coordinate variable. From equation (6), $t_0 = \frac{c_0}{c}t_1$. Solving equations (34) and (35) for $\mathcal{P}$ and setting them equal to each other results in:

$$\frac{ct}{L} = \frac{c_0 t_1}{L_0}$$

Replacing t_1 with $\frac{c}{c_0}t_0$ yields:

$$\frac{ct}{L} = \frac{c_0}{L_0}\frac{c}{c_0}t_0$$

$$\therefore t_0 = \frac{L_0}{L}t \quad (36)$$

Comparing equations (33) and (36) we see that GTR and PLS produce the same gravitational time dilation results. The only way that I know to explain this is that the time dilation of GTR is really caused by light speed dilation: as stated above, time is a function of the proper speed of light. Notice that the light clock and the analog clock actually read the same value meaning that all clocks are in principle light clocks.

ASSESSMENT OF PLS AND STR

From equation (14) without rotational velocities, $c_0^2 = \frac{r-r_s}{r}c^2 - \frac{r}{r-r_s}(\frac{dr}{dt})^2$. In zero-g this yields $c_0^2 = c^2 - v^2$, and restructuring yields:

$$\frac{c_0}{c} = \sqrt{1-(\frac{v}{c})^2} \quad (37)$$

so any experimental results of STR are recovered, they are just explained in terms of light speed dilation not time dilation. For example, the lorentz factor appearing in the relativistic decay equation can be interpreted further as meaning that the half life of a particle is a function of how the particle perceives light. That is:

$$\boldsymbol{T}_{1/2}(v) = T_{1/2}\frac{t}{t_0} \quad \text{(STR, 38)}$$

$$\boldsymbol{T}_{1/2}(c_0) = T_{1/2}\frac{c}{c_0} \quad \text{(PLS, 39)}$$

While it is certainly possible to write $\frac{c_0}{c} = \frac{L}{L_0}$, making such an association doesn't seem necessary. M(v) can be greater than c, but R(v) cannot be.

ASSESSMENT OF PLS AND QM

As stated in the "THEORETICAL FRAMEWORK: KEY CONCEPTS" section, all of the fundamental forces and time change with c_0 so that the physics remains the same everywhere. This means that the real energy Ē for a particle with mass m, and no velocity is:

$$R(\bar{E}) = mc_0^2$$

And since $M(c) = c$ in all RF's:

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

It follows that when a particle has a non-zero velocity:

$$\begin{aligned} M(\bar{E}) &= \sqrt{m^2M(v)^2c^2 + m^2c^4} \\ &= cm\sqrt{M(v)^2 + c^2} \quad (40) \end{aligned}$$

and

$$R(\bar{E}) = \sqrt{m^2R(v)^2c_0^2 + m^2c_0^4}$$

$$= \sqrt{m^2 (M(v) \frac{c_0}{c})^2 c_0^2 + m^2 c_0^4}$$
$$= mc_0 \sqrt{(M(v)\frac{c_0}{c})^2 + c_0^2}$$
$$= mc_0^2 \sqrt{(M(v)\frac{1}{c})^2 + 1}$$
$$= m\frac{c_0^2}{c}\sqrt{M(v)^2 + c^2} \quad (41)$$

Therefore:

$$M(\bar{E}) = (c^2/c_0^2) R(\bar{E}) \quad (42)$$

As explained in the "THEORETICAL FRAMEWORK: KEY CONCEPTS" section, in coordinate space M(c, t) = R(c, t), and earths RF is almost identical to coordinate space where $R(c) \approx 0.9999999993c$ (ignoring velocities). Therefore, the Schrodinger Equation could model an observable or it could model the real. Therefore we consider both:

The Schrodinger Equation as a measurable

$$i\hbar\frac{\partial \Psi_1}{\partial t} = [-\frac{\hbar^2}{2m}\nabla^2 + V(..., t, c)]\Psi_1 \quad (M(\bar{E})\text{-invariant: } \Psi_1(t,c), 43)$$

$$i\hbar\frac{\partial Y_1}{\partial \boldsymbol{\tau}} = [-\frac{\hbar^2}{2m}\nabla^2 + V(..., \boldsymbol{\tau}, c_0)]Y_1(\frac{c_0}{c})^2 \quad (R(\bar{E})\text{-changes: } Y_1(\boldsymbol{\tau},c_0), 44)$$

The Schrodinger Equation as a real

$$i\hbar\frac{\partial \Psi_2}{\partial t} = [-\frac{\hbar^2}{2m}\nabla^2 + V(..., t, c)]\Psi_2(\frac{c}{c_0})^2 \quad (M(\bar{E})\text{-invariant: } \Psi_2(t,c), 45)$$

$$i\hbar\frac{\partial Y_2}{\partial \boldsymbol{\tau}} = [-\frac{\hbar^2}{2m}\nabla^2 + V(..., \boldsymbol{\tau}, c_0)]Y_2 \quad (R(\bar{E})\text{-changes: } Y_2(\boldsymbol{\tau},c_0), 46)$$

Example (The Schrodinger Equation as a measurable): Set the gravitational potential = 0 ⇒ V = 0, and solve equations () and () for a free particle:

$\Psi_1 = R_{11}(r)T_{11}(t) \Rightarrow T_{11}(t) = Ae^{-ik^2 t}, R_{11}(r) = A_1 sin(\sqrt{\frac{2m}{\hbar}}kr) + A_2 cos(\sqrt{\frac{2m}{\hbar}}kr)$:
$Y_1 = R_{12}(r)T_{12}(\boldsymbol{\tau}) \Rightarrow T_{12}(\boldsymbol{\tau}) = Ae^{-ik^2\boldsymbol{\tau}}, \frac{d^2}{dr^2}(R_{12}(r)\frac{r-r_s}{r}) = \frac{-2mk^2}{\hbar}R_{12}(r)$, therefore:

$$R_{12}(r) = B_1 e^{-ikr\sqrt{2m/\hbar}} * r * KummerU\left(1 + i\sqrt{\frac{m}{2\hbar}}kr_s,\ 2,\ 2i\sqrt{\frac{2m}{\hbar}}k(r - r_s)\right) +$$
$$B_2 e^{-ikr\sqrt{2m/\hbar}} * r * KummerM\left(1 + i\sqrt{\frac{m}{2\hbar}}kr_s,\ 2,\ 2i\sqrt{\frac{2m}{\hbar}}k(r - r_s)\right)$$

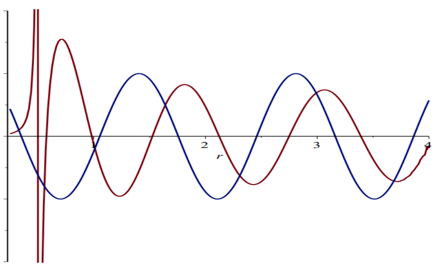


Figure 7: R_{11}(r) (blue) represents the measured value, and $R_{12}(r)$ (red) represents what is really happening near an event horizon at $r_s = \frac{1}{2}$. The real wavelength decreases, while the measured wavelength remains constant.

In figure 7, the red function represents the real wave function, and the blue function represents the observed wave function. The real wavelength decreases as the particle approaches the EH, while the measured wave function remains constant.

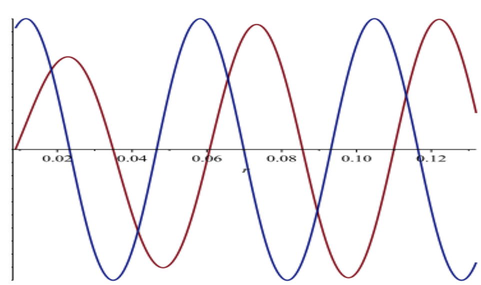
Example (The Schrodinger Equation as a real): Set the gravitational potential = 0 ⇒ V = 0, and solve equations () and () for a free particle:

$\Psi_2 = R_{21}(\mathrm{r})T_{21}(\mathrm{t}) \Rightarrow\ T_{21}(t) = Ae^{-ik^2t}, \frac{d^2}{dr^2}\left(R_{21}(r)\frac{r}{r-r_s}\right) = \frac{-2mk^2}{\hbar}R_{21}(r)$, therefore:

$$R_{21}(r) = C_1(r - r_s)e^{-ikr\sqrt{2m/\hbar}} * r * KummerU\left(1 - i\sqrt{\frac{m}{2\hbar}}kr_s,\ 2,\ 2i\sqrt{\frac{2m}{\hbar}}kr\right) +$$
$$C_2(r - r_s)e^{-ikr\sqrt{2m/\hbar}} * r * KummerM\left(1 - i\sqrt{\frac{m}{2\hbar}}kr_s,\ 2,\ 2i\sqrt{\frac{2m}{\hbar}}kr\right)$$

$$Y_2 = R_{22}(\mathrm{r})T_{22}(\boldsymbol{\tau}) \Rightarrow T_{22}(\boldsymbol{\tau}) = Ae^{-ik^2\boldsymbol{\tau}}, R_{22}(r) = D_1 sin\left(\sqrt{\frac{2m}{\hbar}}\,kr\right) + D_2 cos\left(\sqrt{\frac{2m}{\hbar}}\,kr\right)$$

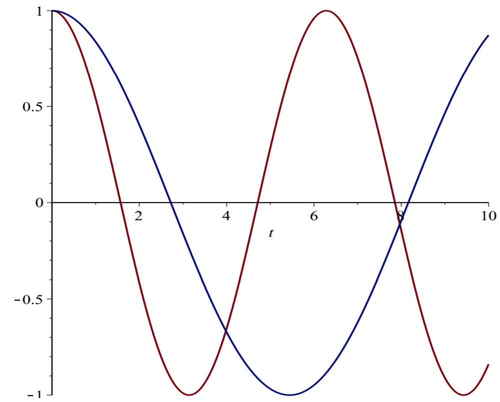
Figure 8: R_{21}(r) (red) represents the measured value, and $R_{22}(r)$ (blue) represents what is really happening near an event horizon at $r_s = 0.0088$. The measured value converges to 0, and the real value remains the same.



In Figure 8, the red wave represents what is measured, and the blue wave represents what is real.

Time component from both examples above:

Figure 9: In this plot, T(t) is plotted in red, and $T(\boldsymbol{\tau} \rightarrow \sqrt{1 - \frac{r_s}{r}}\, t)$ is plotted in blue as a function of t to model what is really happening relative to S. From the S RF, the time component of the P RF would appear "drug out" as if everything were slowing down.



The time components of Ψ_1 and Ψ_2 are of the form $Ae^{-ik^2 t}$, and the time components of Y_1 and Y_2 are of the form $Ae^{-ik^2 \boldsymbol{\tau}}$. Therefore, in both respective reference frames the time component is the same. In order to see what the P RF looks like from the S RF, $\boldsymbol{\tau} \rightarrow \sqrt{1 - \frac{r_s}{r}}\, t$ as shown in Figure 8.

AUTHORS INTERPRETATION OF THE PLS THEORY

Everything has the ability for change, and that property is often associated with the concept of time, but that association is wrong. Time is just a man made concept for taking measurements with light. Using the Schwartzchild metric as an example:

$$c_0 = \sqrt{\frac{r-r_s}{r}c^2 - \frac{r}{r-r_s}\left(\frac{dr}{dt}\right)^2 - r^2\left(\frac{d\theta}{dt}\right)^2 - r^2 sin^2(\theta)\left(\frac{d\varphi}{dt}\right)^2}$$

Replacing dt with $\frac{dX}{c}$ where X is the distance light travels in the $\hat{r}$ - direction in the S RF yields:

$$c_0 = \sqrt{\frac{r-r_s}{r}c^2 - \frac{r}{r-r_s}c^2\left(\frac{dr}{dX}\right)^2 - r^2c^2\left(\frac{d\theta}{dX}\right)^2 - r^2 sin^2(\theta)c^2\left(\frac{d\varphi}{dX}\right)^2}$$

$$= \mathrm{c}\sqrt{\frac{r-r_s}{r} - \frac{r}{r-r_s}\left(\frac{dr}{dX}\right)^2 - r^2\left(\frac{d\theta}{dX}\right)^2 - r^2 sin^2(\theta)\left(\frac{d\varphi}{dX}\right)^2}$$

Hence:

$$\frac{c_0}{c} = \sqrt{\frac{r-r_s}{r} - \frac{r}{r-r_s}\left(\frac{dr}{dX}\right)^2 - r^2\left(\frac{d\theta}{dX}\right)^2 - r^2 sin^2(\theta)\left(\frac{d\varphi}{dX}\right)^2} \quad (47)$$

Where $\frac{dr}{dX}, r^2\frac{d\theta}{dX}, r^2\frac{d\varphi}{dX}$ are non-local relationships between distances in space. Since $\widehat{X} = \widehat{r}$, the metric describes a 3-dimensional space where the index of refraction is:

$$n = \frac{c}{c_0} = c[\sqrt{g_{\mu\nu}\frac{dx^\mu}{dt}\frac{dx^\nu}{dt}}]^{-1} \qquad (48)$$

$V = \{R(x),\ R(y),\ R(z)\}$ is a vector space over the field R^3.

CONCLUSION

In conclusion, the challenges encountered in harmonizing Quantum Mechanics (QM) and General Theory of Relativity (GTR) primarily stemmed from the assumption of a constant speed of light. Upon removing this constraint, it is noteworthy that all reference frames continue to measure the speed of light as c, given that time is intricately linked to the speed of light. However, this alteration facilitates a compatibility between gravity and QM in crucial aspects, including the definition of time, the interplay of discreteness versus smoothness, and considerations of locality. This reevaluation opens up avenues for a more nuanced understanding of the interface between quantum and gravitational phenomena.

REFERENCES

The 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>

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.