The Proper Light Speed

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Abstract

The weak, strong, gravitational, and electromagnetic forces collectively propagate at a rate that is bounded by the speed of light. Since all of the particles within a clock communicate with each other through these forces, when the speed of light dilates, the clock speed changes giving the illusion of time dilation. This can be confusing because the clock slows down, but only due to light speed slowing down, not time itself physically dilating. When you try to measure the speed of light, the clock speed therefore changes proportionally with the change in light speed, so you always measure a value of c no matter what the local speed of light is or how much it changes.

Rather than proper time, you have proper light speed, which is how a specified reference frame perceives the speed of light relative to a stationary reference frame in zero-g. The faster an object moves, the slower its proper light speed, which means that all of the fundamental forces slow down causing the moving clock to tick slower than the stationary one. When a muon travels at relativistic speeds, its proper light speed is slow, so all of the forces involved in its decay are slow, causing it to exist for a longer clock-time in the stationary reference frame.

The presence of matter changes the local index of refraction, causing light to curve and change velocity. The event horizon of a black hole is where the speed of light is zero. Inside the event horizon, the speed of light is reversed, causing all matter and energy to be forced towards the event horizon, not a singularity.

If x is nothing, then by definition, all components of x are also nothing. That is, if a and b are components of x, then [a = x] - [b = x] = x proving that if A - B ≠ x, then A and or B are not components of x. Thus, even in quantum mechanics, something never comes from nothing. Since you cannot produce something from nothing, and something exists today, the fundamentals for said something have always existed. As shown below, time therefore has always passed.

We therefore need to consider a model of the universe in which time has always passed, and the universe was organized from fundamentals that have always existed.

Definitions

System (**A**) refers to an object with a given state A_n. An **isolated system** is one in which a state change cannot be caused by anything outside of the system (or vice versa), and where nothing leaves or enters.

Existence is the state of being. **Clarification:** If some property of X is measured, then X exists. If X exists, this does not mean that some property of X can be measured.

Universe (**U**) refers to all of the fundamental components of what is referenced in General Relativity as our spacetime object. If anything exists beyond the universe, that isn't included in the definition. In the case of cyclic models in which a new universe emerges from within the previous, both the old and the new universe are included in the definition.

All Existence (**AE**) refers to all of the fundamental components of all that exists. If anything exists beyond this universe, AE includes the fundamental components of that as well. AE is by definition isolated since P_2 below holds. Thus, U ⊆ AE.

Nothing (∅) is defined as the absence of existence. Mathematically, if C = ∅, then $\forall\ C_i \subseteq C$, $C_i = \varnothing$. **Clarification:** This is important for showing that at no point can we actually produce existence from non-existence, but we can produce something from something else in such a manner as to conserve certain properties.

E is an event $E_n \equiv A_n \rightarrow A_{n+1}$ of system **A** going from one state to the next.

Causality means that cause precedes effect.

Time is the changing of states of AE: { d[t] ⇔ d[state of AE] }. **Clarification:** As AE changes states (time), light travels, the clock ticks, and we measure what we call time against the local speed of light. Thus, when measuring a distant event somewhere with a different local speed of light, the appearance of time dilation occurs. Time, as used herein, references instantaneous time, as time doesn't need to be measurable to pass.

Premises

P_1: Given an infinite period for an isolated system **A** with a finite set of distinct possible states, any event E that is possible will happen. (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| < ∞, 1 < m < ∞, 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 ∈ [1,m] where i ≠ 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 $t \rightarrow \infty$ since $t_b < t$.

P_2**:** You cannot create something from nothing.

Proof: If C = ∅, then $\forall\ C_i \subseteq C$, $C_i = \varnothing$. If we then wish to construct D | D = $C_i \mp C_j$, we see that we get D = $[C_i = \varnothing] \mp [C_j = \varnothing] = \varnothing$. It follows that if D ≠ ∅, C ≠ ∅.

Clarification: *In quantum mechanics we produce a particle and antiparticle pair with properties that add to ∅ : That is, A+-B=∅***.** *Two properties adding to nothing is not the same as producing something* *from nothing.* If A and B are produced | A=B, both A and B still need to be produced from something. We need to realign our physics and terminology with logic.

P_3: Time is a property of existence.

Proof: If X can be measured in time, then X must first exist. Thus <u>Time ⇒ Existence</u>.

If X exists, then X's existence can be mapped to the ticking of a clock. Thus, <u>Existence ⇒ Time</u>.

Proof: Let Y represent some component of AE that changes so that we can use Y as a clock. If no such Y exists, then the universe couldn't begin as that would be a change of state of AE. It follows that since the universe began, Y exists. Thus the existence of X can be mapped to the ticking of a clock.

Clarification: When it says that AE changes states, it doesn't mean that everything everywhere has to change. A state change occurs if any part of AE changes.

P_4: Time and AE have always existed, their existence doesn't violate causality, and each state of AE is finite in time.

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| = ∞:
   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 ≤ n, where k $\in$ Z ⇒ |A| = ∞.

Since AE is isolated because P_2 holds, and it has at least 2 states that are not ∅, we can let **A** = AE.

1. Since |A| = ∞, and time is a property of existence, AE and time have always existed.

2. Since $\exists\ A_{k-1}$ (cause) $\forall\ A_k$ (effect), every effect has a cause. Thus AE always existing doesn't violate causality.

3. By 2) a) each state cannot exist for an infinite period (a last state might be excluded from this).

The Proper Light Speed Theory

(The Proper Light Speed theory is based on the framework of GR, and it is only intended to show that the above claims are consistent with experimentation. If GR were to be replaced with some other theory, it would not change the validity of the above claims, nor would it change the postulates stated below.)

In this model, U ⊆ AE, and time is a change of state of AE. As time passes, light travels at some rate relative to time. Since all measurement devices effectively operate on light, we therefore measure events against the speed of light, not directly against time. Essentially time passes, light travels causing clocks to tick, and then we measure events against the clock. Since time is a property of existence, it follows that time can't go to 0, and thus the speed of light is what dilates, not time. Since our ability to measure time is dependent on the speed of light, when the speed of light slows down it can appear as if it is time that is dilating. It follows that as what is referred to as the proper time $\boldsymbol{\tau}$ decreases, the speed of light is what actually decreases $\Rightarrow\ c_0 dt = \mathrm{c}d\boldsymbol{\tau}$, where c_0 is the proper speed of light. Since $\mathrm{c}d\boldsymbol{\tau} = \sqrt{g_{\mu\nu} dx^{\mu} dx^{\nu}}$, it therefore follows that $c_0 = \sqrt{g_{\mu\nu} \frac{dx^{\mu}}{dt} \frac{dx^{\nu}}{dt}}$ where $g_{\mu\nu}$ is the metric tensor. The equations of general relativity are used without time dilation to show that it is the speed of light that changes, and this change in the speed of light results in what is observed as time dilation, and length contraction, without either actually occurring. This theory shows that light experiences time in the same capacity as everything else, hence why light <u>can</u> move.

Postulate 1: Time runs at a constant rate throughout AE, but our ability to measure time is tied to the local speed of light.

Postulate 2: To someone observing the effects of what we call time dilation, one cannot tell if it is the speed of light, or time that is changing.

Starting with the Schwartchild metric having only radial components, we get $c_0 = \sqrt{\frac{r-r_s}{r} c^2 - \frac{r}{r-r_s} v^2}$, where the Schwartzchild radius $r_s = \frac{2GM}{c^2}$. Plotting this as in Figure 1, we see that c_0 changes as a function of r, r_s, and v. Therefore:

$$c_0(r,\ r_s,\ v) = \sqrt{g_{\mu\nu} \frac{dx^{\mu}}{dt} \frac{dx^{\nu}}{dt}} \quad (1)$$

Thus, the proper speed of light is tied to velocity. Setting $r_s = 0$, and v = c, we see that $c_0 = 0$ meaning that light doesn't observe other light catching up to it: This holds true for light regardless of what the local speed of light C is. From Figure 1, we see that the magnitude of the local speed of light is the first term in the metric which for the Schwartzchild metric yields:

$$C = \sqrt{\frac{r - r_s}{r}}\, c \quad (2)$$

It follows that since c was measured on earth, the actual speed of light in zero-g would need to be modified by the inverse of equation (2): We shall ignore this.

Since $|c_0| \le \sqrt{\frac{r-r_s}{r}}c$, and $\lim_{r^+ \to r_s} \sqrt{\frac{r-r_s}{r}} = 0$, it follows that $c_0(r_s, r_s, v) = 0$ which $\Rightarrow$ v = 0 for both light and mass at the event horizon of a black hole, and that the event horizon is never actually reached.

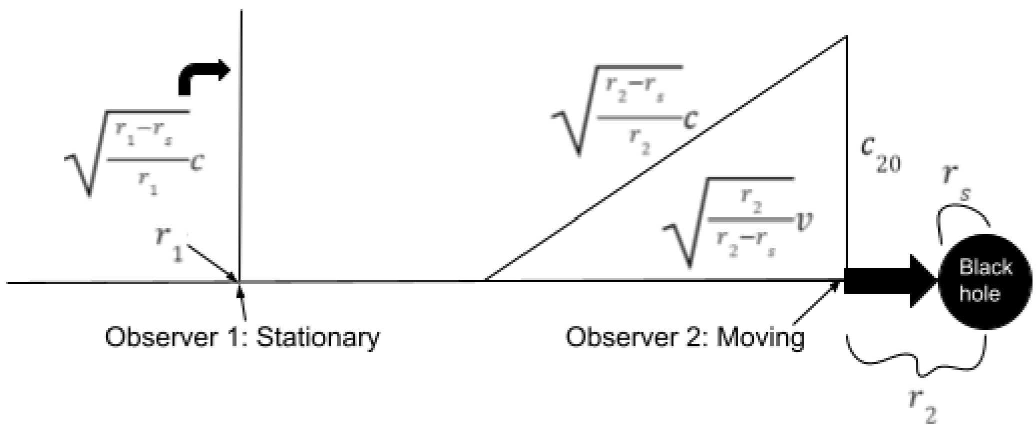


Figure 1: Shows the relationship between the components of the Schwartzchild metric.

From Figure 1, suppose that observer 2 starts at $r_2 = \infty$ (far left), and moves towards Observer 1. The proper velocity is:

$$v_0 = \sqrt{\frac{r_2}{r_2 - r_s}}\, v_2 \quad (3)$$

So initially, the proper velocity is $v_0 = \sqrt{\frac{\infty}{\infty - r_s}}\, v$ = v. This means that when Observer 2 passes Observer 1,

$v_0 = \sqrt{\frac{r_1}{r_1 - r_s}}\, v_1 = \sqrt{\frac{r_2}{r_2 - r_s}}\, v_2$, where v_1 is the velocity of Observer 2 according to Observer 1. Since v_2 is the velocity of Observer 2 as viewed from a stationary reference frame at r_2, for Observer 1,

$$v_1 = \sqrt{\frac{r_2(r_1 - r_s)}{r_1(r_2 - r_s)}}\, v_2 \quad (4)$$

Since this is also constant, as $r_2 \to r_s$, $v_2 \to 0$. It follows that Observer 1 sees Observer 2's velocity go to 0, and Observer 2 sees their velocity remaining the same. This is only possible because all velocities are measured against their local speeds of light (see the definition of Time above). This tells us that:

$$v_0 = \frac{c}{c_0}\frac{dr}{dt} \quad (5)$$

where c_0 is the proper speed of light at r, and $\frac{dr}{dt}$ is how quickly r changes with time (not relative to light) as viewed from r = ∞. For example, $v_0 = \frac{c}{c}\frac{dr}{dt}$ at r = ∞; and since $c_0(r_s, r_s, v) = 0$, $\frac{dr}{dt} = 0$ at the event horizon. For light, $c_0 = 0$, so $\frac{dr}{dt} = 0$ as perceived at r = ∞ (you can't see light once it is gone). It's important to note that length contraction doesn't physically occur. If we wanted to say that there is some clock time $\boldsymbol{\tau}$ in the universe relating velocity to the local speed of light such that $v_0 = \frac{dr}{d\boldsymbol{\tau}}$, then $\frac{dr}{d\boldsymbol{\tau}} = \frac{c}{c_0}\frac{dr}{dt} \Rightarrow c_0 dt = c d\boldsymbol{\tau}$ which is what we concluded above. In fact, all we really care about is the relationships between clock speeds so it is easiest to use $\boldsymbol{\tau}$ in calculations, but in reality it is the speed of light that dilates, not time. This leads us to:

Postulate 3: The proper time $\boldsymbol{\tau}$ ties velocity to the local speed of light (not to time). Therefore, we replace t with $\boldsymbol{\tau}$ in all of our non-relativistic equations, and we replace c with C. To observe what the function looks like locally we leave it in terms of $\boldsymbol{\tau}$, and to see what it would look like from far away we convert $\boldsymbol{\tau}$ into t using the metric. To a distant observer $\boldsymbol{\tau}$ goes to 0 at the event horizon so all motion stops: To an observer headed towards a black hole, nothing changes. The laws of physics are the same everywhere but they play out according to the local speed of light. Thus, if there are any inconsistencies, this needs to be addressed in the equations of our local laws, not necessarily in the metric (or this theory).

Example (Free Particle over a small distance and slow velocity): The time solution is of the form $\Psi(\boldsymbol{\tau}) = Ae^{-i\omega\boldsymbol{\tau}}$. Thus $\Psi(t) = Ae^{-i\omega\sqrt{\frac{r-r_s}{r}}*t}$, which means that to an observer in zero-g, the time component of the particle's wave is stretched out due to the slower speed of light in the field compared to out of the field.

These differences might seem minute, but this is important because time is not actually a dimension: Time is a property of existence, and therefore the structure of this "lightspace" doesn't include time. This means that wormholes do not exist, time travel into the past is impossible, length contraction doesn't physically occur, causality always holds in relation to t, yet black holes still exist.

Deriving Maxwell's Equations of light in a gravitational field: From equation (1), for a photon traveling in a plane containing the COM of some object of mass M we get ($c_0 = 0$ for light):

$$\frac{r-r_s}{r}c^2 - \frac{r}{r-r_s}\left(\frac{dr}{dt}\right)^2 - r^2\left(\frac{d\theta}{dt}\right)^2 = 0 \quad (6)$$

From Figure 2, we see that the components of equation (6) require a velocity vector of:

$$\overline{v} = < \frac{dx}{d\boldsymbol{\tau}} = \sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}cos(\theta) - r\frac{d\theta}{dt}sin(\theta), \frac{dy}{d\boldsymbol{\tau}} = \sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}sin(\theta) + r\frac{d\theta}{dt}cos(\theta) > \quad (7)$$

Where x = rcos(θ), y = rsin(θ), and r = $\pm\sqrt{x^2 + y^2}$. Thus:

$$\frac{dy}{dx} = \frac{\sqrt{\frac{r}{r-r_s}}sin(\theta) + r\frac{d\theta}{dr}cos(\theta)}{\sqrt{\frac{r}{r-r_s}}cos(\theta) - r\frac{d\theta}{dr}sin(\theta)} \quad (8)$$

Notice that $\boldsymbol{\tau}$ is used instead of t as required by postulate 3. Dividing the x-component in equation (7) by dx, squaring both sides, and multiplying by $\partial^2 E_x$ yields:

$$[\sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}cos(\theta)\ -\ r\frac{d\theta}{dt}sin(\theta)]^2\frac{\partial^2E_x}{\partial x^2}=\frac{\partial^2E_x}{\partial\boldsymbol{\tau}^2}\quad(9)$$

Repeating the same process for the y-component we get:

$$[\sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}sin(\theta)\ +\ r\frac{d\theta}{dt}cos(\theta)]^2\frac{\partial^2E_y}{\partial y^2}=\frac{\partial^2E_y}{\partial\boldsymbol{\tau}^2}\quad(10)$$

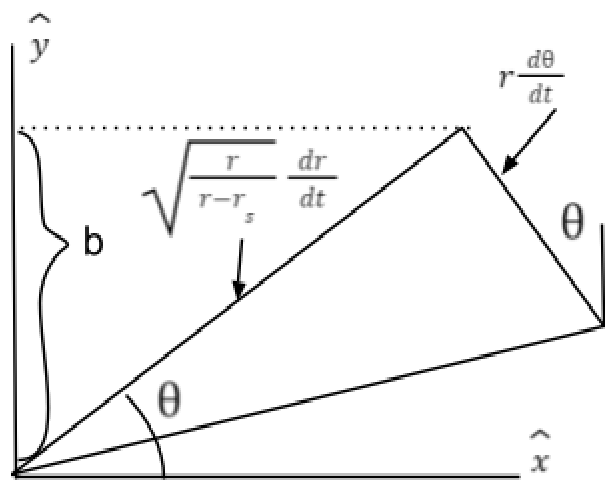
Equations (9) and (10) are Maxwell's Equations for light in a gravitational field in the $\widehat{x}$ and $\widehat{y}$ directions respectively, where the light is traveling through some plane going through the COM. Notice that when $r_s = \theta = 0$ equation (9) yields:

$$[\frac{dr}{dt}\ =\ c]^2\frac{\partial^2E_x}{\partial x^2}=\frac{\partial^2E_x}{\partial\boldsymbol{\tau}^2}\quad\text{(Maxwell's Eq for light in zero-g, }\widehat{x}\text{ - direction)}$$

Likewise, when $r_s = 0$, and $\theta = \frac{\pi}{2}$, equation (10) yields:

$$[\frac{dr}{dt}\ =\ c]^2\frac{\partial^2E_y}{\partial y^2}=\frac{\partial^2E_y}{\partial\boldsymbol{\tau}^2}\quad\text{(Maxwell's Eq for light in zero-g, }\widehat{y}\text{ - direction)}$$

Figure 2: This figure shows how the components of equation (6) fit geometrically. For a mass positioned at (0,0), a photon released in the x-direction from (x=0, y=b) will curve downwards.



Clarification: Since the proper time of spacetime is also 0 for light, these equations can be derived using the spacetime metric as well.

Experimental Results

Appearance of Time Dilation: From equation (3), $v_0 = \sqrt{\frac{r}{r-r_s}}\ v$. Thus $\frac{dr}{d\boldsymbol{\tau}}\sqrt{1\ -\ \frac{r_s}{r}} = \frac{dr}{dt}$, and therefore $d\boldsymbol{\tau} = \sqrt{1\ -\ \frac{r_s}{r}}dt$ which is of course the exact Schwartzchild solution for the time dilation of a non-rotating object in space.

Black holes: Since $c_0(r,\ r_s,\ v) = 0$ for light, equation (1) yields $\frac{dr}{dt} = \pm\frac{r-r_s}{r}c$ (assuming no radial components). $\frac{dr}{dt} = -\frac{r-2}{r}c$ is plotted in Figure 3, where we see that inside the event horizon the velocity is positive, and outside the event horizon the velocity is negative. Therefore, all of the light of a black hole moves to the event horizon, and mass follows. Thus, there isn't a singularity inside of a black hole. If you consider the acceleration of light $\frac{d^2r}{dt^2} = \frac{r-r_s}{r^3}c^2 s$, you see that inside the event horizon, the acceleration changes direction. These results are consistent with Susskind's proof that the amount of information inside of a black hole is proportional to the surface area of the event horizon as all of the information is actually on the event horizon separated by what is assumed to be the minimal distance allowed by quantum mechanics. Notice that the acceleration for light is 0, not ∞, at the event horizon.

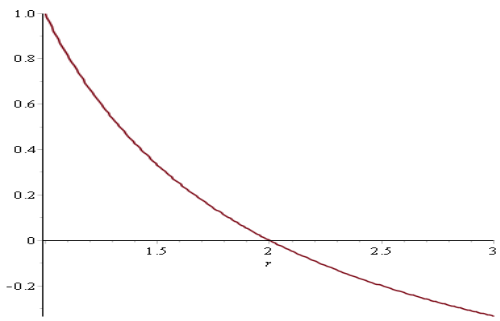


Figure 3: This is a plot of the velocity of light which shows that light always moves towards the event horizon (shown as r = 2), not a singularity.

Gravitational Redshift: Using equation (9) in only the $\hat{x}$ - direction yields:

$$\left[\sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}\right]^2 \frac{\partial^2 E}{\partial r^2} = \frac{\partial^2 E}{\partial \tau^2} \quad (11)$$

Since there aren't any rotational velocities, equation (6) tells us that $\frac{r-r_s}{r}c^2 = \frac{r}{r-r_s}\left(\frac{dr}{dt}\right)^2$. Thus, equation (11) becomes:

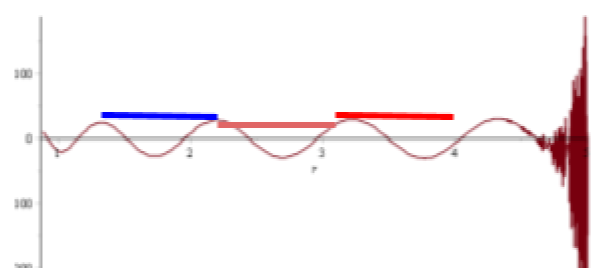
$$\frac{r-r_s}{r}c^2 \frac{\partial^2 E}{\partial r^2} = \frac{\partial^2 E}{\partial \tau^2} \quad (12)$$

Setting E = R(r)$\mathbf{T}(\boldsymbol{\tau})$ we get:

$$\frac{d^2R(r)}{dr^2} = -\left[k^2\frac{r}{r-r_s}\right]R(r) \quad (13)$$

The solutions for equation (13) are Whittaker functions shown in figure 4 for arbitrary values simply to show the shape. As you can see from the red and blue stripes, gravitational redshifting occurs as the photon gets further and further from the event horizon.

Figure 4: The blue and red stripes are the same length, thus, this figure shows a gravitational redshift as the light gets further from the event horizon on the left.



From equation (13):

$$k\sqrt{\frac{r}{r-r_s}} = \frac{2\pi}{\lambda} \quad (14)$$

Thus:

$$\lambda = \frac{2\pi}{k}\sqrt{\frac{r-r_s}{r}} = \lambda_\infty\sqrt{\frac{r-r_s}{r}} \quad (15)$$

Where equation (15) is the exact relationship between λ and λ_∞ as predicted by GR.

Gravitational Lensing: From equation (11), C = $\sqrt{\frac{r-r_s}{r}}\, c = \sqrt{\frac{r}{r-r_s}}\frac{dr}{dt}$. This suggests that the index of refraction is either $n_1 = \frac{r}{r-r_s}$, or $n_2 = \sqrt{\frac{r}{r-r_s}}$, depending on the frame of reference. When deriving the gravitational lens equation for GR using a Fermat Surface, n = $\sqrt{(\frac{r+r_s}{r-r_s})}$ (Bacon). Setting n_1 equal to n we get: $\sqrt{(\frac{r+r_s}{r-r_s})} = \boldsymbol{\alpha}_1\frac{r}{r-r_s} \Rightarrow \boldsymbol{\alpha}_1 = \frac{\sqrt{r^2-r_s^2}}{r}$ which is ~1 for the exterior of anything that isn't a black hole. Setting n_2 equal to n we get $\sqrt{(\frac{r+r_s}{r-r_s})} = \boldsymbol{\alpha}_2\sqrt{\frac{r}{r-r_s}} \Rightarrow \boldsymbol{\alpha}_2 = \sqrt{\frac{r+r_s}{r}}$ which is also ~ 1 for the same. Using the calculus of variations to minimize the functional $\int_b^R N\sqrt{1 + r^2(\frac{d\theta}{dr})^2}\,dr$, where N ∈ {n, n_1, n_2} and θ is as shown in Figure 2, we can derive θ(r). However, the solutions are integrals, so it is easiest to compare $\frac{d\theta}{dr}$ as shown in Figure 5 where we use the mass of the sun. It is important to note that the left side doesn't matter since those points are inside of the sun. In fact, $r_{sun} \cong 6.96 * 10^8$ meters, so the entire plot shown in Figure 5 is still inside of the sun. This means that the predictions of this theory and those of GR are identical in any region that can be tested in our solar system.

$s := 2900:$
$A := -1:$
$B := -1:$
$F := 1:$

$$Usingn := \frac{\sqrt{-(A^2 r - A^2 s - r^3 - r^2 s)\,(r-s)\,A}}{(A^2 r - A^2 s - r^3 - r^2 s)\,r}:$$

$$Usingn1 := \frac{F\,(r-s)}{\sqrt{-(-Fs + Fr - r^2)\,(-Fs + Fr + r^2)}\,r}:$$

$$Usingn2 := \frac{\sqrt{-(B^2 r - B^2 s - r^3)\,(r-s)\,B}}{(B^2 r - B^2 s - r^3)\,r}:$$

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plot( [ Usingn, Usingn1, Usingn2 ], r = s ..20 s, legend = [ "Usingn", "Usingn1", "Usingn2" ] )
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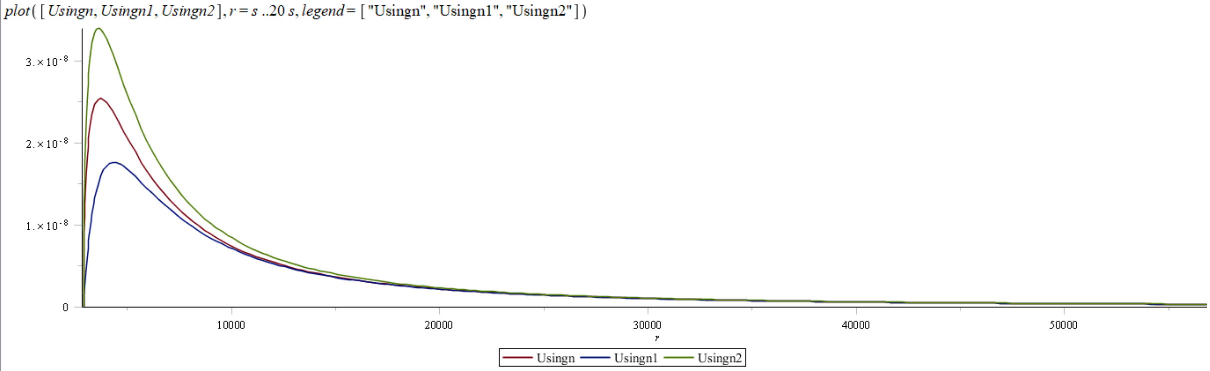

Figure 5: (Units in meters) These are plots of $\frac{d\theta(r)}{dr}$ where $s = r_s = r_{s,\,sun}$. They are only meant to show the relationship between the solutions as the constants were arbitrarily selected. Note that every point on this plot is still inside of the sun, so in the region where this is testable, the solutions are identical.

Gravitational Waves: It appears that there exists some fabric of lightspace that expands and contracts based on energy density, and this expanding and contracting changes its local index of refraction in the same capacity as time was thought to do so. It thus makes sense that such expanding and contracting would propagate through space as a wave.

The Universe's Expansion: Has not been looked into.

Muon Decay: From Figure 1, $c_0^2 = \frac{r-r_s}{r}c^2 - \frac{r}{r-r_s}\left(\frac{dr}{dt}\right)^2$. In zero-g this yields: $c_0^2 = c^2 - v^2$, and restructuring this gives us: $\frac{c_0}{c} = \sqrt{1 - \left(\frac{v}{c}\right)^2}$, so any perceived effects of special relativity are immediately recovered without time and length contraction, and gravity is already built-in. So 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:

$$\boldsymbol{T}_{1/2}(c_0) = \boldsymbol{\tau}_{1/2}\frac{c}{c_0} \quad (21) \quad \text{(Approximation)}$$

Thus, the faster the particle moves, the slower the particle perceives light, and thus everything that occurs within the particle is slowed down without the need for time or length contraction.

Length Contraction: Imagine that Muons are produced at a height H above the surface of the earth, and that the percentage of Muons to hit the surface before decaying is consistent with the predictions of special relativity (which it is). It should be abundantly clear that H didn't physically shrink. Thus, while special relativity does yield the correct answer, how it got to the correct answer is not valid. The only logical conclusion here is that H stays the same, and the particle's decay rate depends on how the particle perceives light as shown in equation (21). This makes sense because all of the forces involved communicate at a rate that is governed by the speed of light. Thus, special relativity is wrong.

Additional Definitions and Claim

Deterministic refers to an event $E_n \equiv A_n \rightarrow (C_{a1}A_{a1} \vee C_{a2}A_{a2} \ldots \vee C_{am}A_{am})$ with <u>fixed</u> probabilities (C_{a1}, C_{a2},... C_{am}) respectively. The fact that there is a fixed weight or probability, tells us that there is an underlying rule that ensures those weights are obeyed. In the classical case am = n+1, $A_n \rightarrow A_{am}$, and C_{am}=1. In the quantum case, A_{a1} through A_{am} represent the possible states, and C_a through C_{am} are the probabilities of those states. Thus quantum mechanics is deterministic.

Free Will refers to an event $E_n \equiv A_n \rightarrow (C_{a1}A_{a1} \vee C_{a2}A_{a2} \ldots \vee C_{am}A_{am})$ where the respective probabilities (C_{a1}, C_{a2},... C_{am}) are <u>not fixed</u>.

Suppose that you have a dart board with different states or sections ($A_{a1} \vee A_{a2} \ldots \vee A_{am}$), each with their respective probability (C_{a1}, C_{a2},... C_{am}) of getting hit. As long as the board is far enough away that one's skill in throwing darts is not valuable, the probabilities of each state can be calculated based entirely on the areas of each state in relation to the others (ignoring misses). This is only true because everything about the dart is deterministic. If the dart had free will, there would be no way to assign such probabilities.

Claim 1: There must exist G = {..., $A_{n-1,j}$, $A_{n,j}$} $\subsetneq$ AE where $A_{n,j} \subsetneq A_n$| G has free will, and G organized U.

In this section a case is made for why the author believes that each standard model pertaining to the beginning of the universe isn't possible:

Conformal Cyclic Cosmology:

Let u be a m-dimensional volume in which the laws of quantum mechanics, and general relativity hold, and let u $\subseteq$ U. Since space is expanding $\exists$ some distance D in which 2 events are non-existent to each other due to the finite speed limit c. We thus define a point P in U in which event $E_{n,P\pm\epsilon} \equiv U_{n,P\pm\epsilon} \rightarrow U_{n+1,P\pm\epsilon}$ representing the universe's beginning (or this cycle of it) occurs, and then define u as being the volume enclosed by distance D around P in m-space. Since space expands uniformly, there is nothing unique about point P, thus every point in u has the same probability for a similar event $E_{a,i}$ (a $\geq$ n) to occur. We thus establish all of the points in u as a grid, where each point is separated by a planck length l_p: We then define t_{min} (from P_1) to be the Planck time | every t_{min} an event $E_{a,i}$ could occur at each point in u (outside of the light radius of P). We now calculate the probability that $E_{n,P\pm\epsilon}$ is the only such event that occurs in u over time D/c, for m = 3.

Let the radius of a sphere be a multiple (k) of l_p. We divide the area of the sphere by the area of an equilateral triangle of side length l_p, to get the ~ number of triangles that grid the sphere. Thus, the approx. number of triangles ▲(k) is:

$$▲(k) \cong \frac{4Pi(k*l_p)^2}{(\frac{l_p^{\ 2} sin(Pi/3)}{2})} = \frac{16Pi(k)^2}{\sqrt{3}}$$

The number of triangles on the surface of the sphere relates to the number of points *(k) by the approx. relation $*(k) \cong \frac{1}{2}$▲(k). Thus:

$$*(k) = \frac{8Pi(k)^2}{\sqrt{3}}$$

It follows, that at the moment of $E_{n,P\pm\epsilon}$, there existed $\frac{8Pi}{\sqrt{3}}\sum_{k=1}^{q}(k)^2$ opportunities for $E_{a,i}$ to occur elsewhere within u, where q = ⌊D/l_p⌋. By the time that light from P reached the next planck length to communicate that $E_{n,P\pm\epsilon}$ occurred, another $\frac{8Pi}{\sqrt{3}}\sum_{k=2}^{q}(k)^2$ opportunities passed, followed by $\frac{8Pi}{\sqrt{3}}\sum_{k=3}^{q}(k)^2$ the following t_{min}... Thus, the number of opportunities for $E_{a,i}$ to occur in D is:

$$\begin{aligned}\frac{8Pi}{\sqrt{3}}\sum_{j=1}^{q}\sum_{k=j}^{q}(k)^2 &= \frac{8Pi}{\sqrt{3}}\sum_{j=1}^{q}\left(\frac{q(q+1)(2q+1)}{6} - \frac{(j-1)j(2j-1)}{6}\right)\\ &= \frac{4Pi}{3\sqrt{3}}\left(q^2(q+1)(2q+1) - \sum_{j=1}^{q} j(2j^2-3j+1)\right)\\ &= \frac{4Pi}{3\sqrt{3}}\left(q^2(q+1)(2q+1)-\left[2\left(\frac{q(q+1)}{2}\right)^2-3\frac{q(q+1)(2q+1)}{6}+\frac{q(q+1)}{2}\right]\right)\\ &= \frac{2q^2Pi}{\sqrt{3}}(q^2+2q+1)\end{aligned}$$

If we now think of each point in u as a die with η distinct states in which only 1 results in $E_{a,i}$, then the probability that $E_{a,i}$ doesn't ever occur in u over time D/c is $\left(\frac{\eta-1}{\eta}\right)^{\frac{2q^2Pi}{\sqrt{3}}(q^2+2q+1)}$. If we set this to greater than or equal to what is typically considered to be "impossible" we get $\left(\frac{\eta-1}{\eta}\right)^{\frac{2q^2Pi}{\sqrt{3}}(q^2+2q+1)} \geq 10^{-50}$, which $\Rightarrow \eta \geq \frac{1}{1-10^{\frac{-25\sqrt{3}}{q^2Pi(q+1)^2}}}$. This means that the vacuum of space must have at least η distinct states (not energy levels) with one being able to cause $E_{n,P\pm\epsilon}$. Using just the values for when D is one light-second we get $\eta > 10^{170}$. There isn't anything in the vacuum that is known to even remotely come close to this value. Thus $E_{a,i}$ should have occurred many times over, and those events occurring should be apparent in the cosmological data: We should observe galaxies and radiation heading towards us from all directions.

In addition to this, if $E_{a,i}$ and $E_{n,P\pm\epsilon}$ both occur, which according to P_1 this must happen at some point, neither event is aware of the other, so the scale factor in the Conformal Cyclic Cosmology model could not be coordinated leading to inconsistencies.

It follows that the CCC model of cosmology, or any theory attempting to "smoothly" cycle through universes, suffers from these issues.

Other Cyclic Models:

These models are either known to violate the laws of entropy, or they are known to require a beginning a finite number of cycles into the past.

Big Bang Model:

From P_4- 3, the universe cannot exist in a singularity state for an infinite period. So, the BB could occur, but a non-singularity state had to precede the singularity in which our universe emerged: This can't happen without violating the laws of entropy unless an outside force caused it ([non-singularity state → singularity state (for all of U)] is a decrease in total entropy.).

Multiverse:

This model has the same issues as the CCC in that we should observe interactions of other universes with our own, and those interactions should be apparent through the CMB which they aren't. Additionally, unless the universes get recycled, they must be made from nothing (even if AE is infinite) violating P_2.

Conclusion: The universe can't be cyclic (infinitely), it can only begin with a BB if the BB were started from an outside force, and the multiverse isn't supported by the cosmological data. The only other known option is that the process that organized U is controlled. Therefore there must exist G = {..., $A_{n-1,j}$, $A_{n,j}$, $A_{n+1,j}$,..} $\subsetneq$ AE where $A_{n,j} \subsetneq A_n$| G has free will, and G organized U.

Claim 2: G has the properties attributed to God in the bible, assuming that such qualities are obtainable.

Proof: Let T represent all time, and divide T into 2 infinite periods $T_1$and T_2, where T_1 precedes T_2. Since T_1 is infinite, by P_1, if it is possible for G to become perfect, obtain all knowledge, develop moral codes that statistically yield the best results, and organize universes, then G has done so in T_1. Since T_2 is also infinite, G obtained these qualities an infinite time ago. Thus, no matter how far back you go in time, G has these qualities, hence why "God is the same yesterday, today, and forever". While this is not a proof that the bible is valid, it is a proof that the bible got this correct.

Conclusion

In this paper we showed that time is a property of existence. It was then shown that the same experimental results of GR can be achieved by allowing time to pass at the same rate while also allowing the local speed of light to vary. This approach shows that what we perceive as time, is tied to our local speed of light, and thus the appearance of time dilation occurs when measuring time where the local speed of light is different than our own. This approach yields the same results as predicted by GR for gravitational lensing (approx.) and redshifting, and it removes all paradoxes known to the author at the time of writing: time travel into the past is impossible; there are no singularities of a black hole; all laws of physics hold everywhere (assuming they hold locally) when they are written in terms of C and $\boldsymbol{\tau}$; time passed before the universe began thus allowing it to make sense for the universe to begin in the first place; and you never have to create something from nothing. This theory points to a universe that was organized from fundamentals that have always existed, not created from nothing.

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Above all else, the KJV was used as this theory was structurally organized according to the bible.

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