A Classical Reconstruction of Relativity

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Abstract

By inverting a key assumption of Relativity Theory, one can understand its predicted odd effects of time dilation, length contraction and mass increase in terms of Classical Physics. The belief that must be suspended is that "Light always travels at constant speed". The alternative premise is that "Light and matter waves travel through a field generated by mass, at a variable speed determined by the field's intensity". This new premise also leads to a Classical explanation for the attraction of Gravity.

Introduction

One of the most exciting, profound, yet hard-to-fathom theories in Physics is Einstein's Theory of Relativity. The theory predicts several counter-intuitive, bizarre effects such as time dilation, length contraction and mass increase. These effects occur most noticeably to objects that travel at very high speeds, or are subjected to high accelerations, as in intense gravitational fields. These effects are real - not just theory, or thought experiments - and have been verified, by carefully-performed experiments, to a high degree of accuracy.

Even when presented with these experimental proofs, many people have great difficulty believing that the effects actually occur. If the cause of the effects could be visualized, and explained in terms of Classical Physics concepts, they would be much easier to understand, and believe.

Einstein's Relativity comprises two theories: Special Relativity (1905), and General Relativity (1915). Special Relativity describes the effects on a body that has high speed motion, and General Relativity describes the effects on a body due to a gravitational field. Both theories provide equations for calculating the change in the rate of time ("time dilation") that occurs, either as a result of the object's speed, or its gravitational environment. One of the core assumptions of Relativity is that light always travels at a constant speed, and the claim made by Relativity is that this leads to effects such as length contraction and time dilation.

It is interesting that two different situations, very high speed, and strong gravitational fields, yield the same effect of time dilation. In both situations, time "slows down" for the objects concerned. Given the same fundamental change to the physics of an object, what if the same underlying principle were causing the effect in both cases?

This essay will demonstrate that both of these theories (Special and General Relativity), and their equations, describe the effects of a common causal factor. This factor is an energy field generated by matter, which fills space, and can be considered the root cause of the "strange" effects.

By suspending Relativity's assumption that light speed is constant, and by instead positing that light and matter waves flow through an energy field, at a rate determined by the field's intensity, I will show how all of the odd effects of Relativity can be explained in terms of Classical Physics Field Theory.

The proposal:

(a) That space is filled with an energy field that is generated by mass and, the field is proportional to the gravitational potential **[1, 2, 4]**.
(b) The field at any point in space is the sum of all the field contributions made by all masses in the causally connected Universe.
(c) That matter waves and light waves are transmitted through the field at a speed that depends on the intensity of the field. Thus, waves travel through the field more slowly where it is intense (such as in the space near a star).
(d) Matter waves and light waves flow through the field much like water waves flow through water - so that they can be flowing 'upstream' or 'downstream' with respect to the field.

The gravitational potential ϕ is a scalar quantity that expresses the gravitational potential of a single body generated by mass/energy:

$$\phi = -\int_{\infty}^{r} (a) dr \qquad = -\frac{Gm}{r} \qquad \left(Jkg^{-1}\right) \tag{1}$$

where a is the acceleration due to the gravitational force acting on a body that has unitary mass.

I propose that a (positively signed) scalar field exists that is proportional to ϕ, and is defined as follows:

Let Φ be a scalar field, such that:

$$\Phi = \int (a) dr = \Phi_0 - \phi \qquad \left(Jkg^{-1}\right) \tag{2}$$

where Φ_0 is the integration constant, that is, the magnitude the field has in the absence of the body being considered (i.e. if $\phi = 0$). The Φ field is visualized as a field extending into space around all bodies with mass/energy. It is known that the principle of superposition applies to the gravitational potential field, so the value of the Φ field at a point in space is the sum of all the field contributions made by all the masses in the system **[7]**.

$$\Phi = \Phi_0 - \left(\phi_1 + \phi_2 + \phi_3 + ... + \phi_n\right) \qquad \left(Jkg^{-1}\right) \text{ or equivalent } \left(m^2 s^{-2}\right) \tag{3}$$

Now, suppose that the constancy of the speed of light c were expressed in different terms - such that it is determined by the value of the Φ field. In a high intensity Φ field, light's speed decreases. However, the high intensity Φ field also slows all other physical processes equally, such that the rate of time within that reference frame slows too. Everything in the Universe is composed of waves. Ultimately the rate at which physical processes occur is determined by the speed at which these waves propagate. The speed of light's apparent constancy then results from the time dilation that accompanies light's change in speed. The quantity $c_\phi \gamma = c$ remains constant, where c_ϕ is the speed of light in the Φ field, and γ is the

General relativistic time dilation factor. To an outside observer (in a weaker Φ field) observing the reference frame, both the rate of time and the speed of light of the observed frame are slower.

The following definitions follow from the above discussion, and will be used through the rest of this essay:

$$\Phi = \Phi_0 - \phi \qquad (Jkg^{-1})$$ The definition of the Φ field near a mass m (4)

$$c_\phi = \frac{c}{\gamma} \qquad (m\sec^{-1})$$ The speed of light in a field of magnitude Φ (5)

Light is a Classical Wave

Light is treated as a different sort of wave than other types of waves, such as sound waves or water waves. This is indicated by the fact that Doppler frequency shift equations used for sound or water waves do not hold for light waves. However, light waves *can* be treated as *normal* Classical waves if one takes the Doppler-shift equation for light and splits it into two component parts:

(1) The usual Doppler-shift attributed to other types of waves.
(2) A relativistic frequency shift of the emitted light at its source.

If the frequency of the emitted light is frequency-corrected due to the source's motion prior to applying the normal Doppler-shift equation, then the resulting frequency shift is the same as that given by the equation normally used for calculating the Doppler-shift for light.

Doppler-shift equation for *normal* waves (6):

$$f' = f \times \frac{c}{c+v} \qquad (6)$$

Doppler-shift equation for light (7):

$$f' = f \times \sqrt{\frac{1-\frac{v}{c}}{1+\frac{v}{c}}} \qquad (7)$$

Where: c is the transmission speed of the wave.
v is the recession speed of the source.

For a light source moving at speed v, Relativity states that the frequency of the emitted light will be:

$$f_{emitted} = f \times \sqrt{1-\frac{v^2}{c^2}} \qquad (8)$$

So, treating light as a *normal* wave, the total Doppler-shift should be :

$$f' = f_{emitted} \times \frac{c}{c+v} \qquad (9)$$

$$f' = f \times \sqrt{1-\frac{v^2}{c^2}} \times \frac{c}{c+v} \qquad (10)$$

To prove that this treatment is correct, it is necessary to show that (7) and (10) are equivalent. This proof follows:

Using (10) gives: $\frac{f'}{f} = \sqrt{1-\frac{v^2}{c^2}} \times \left(\frac{c}{c+v}\right)$ so... $\left(\frac{f'}{f}\right)^2 = \left(1-\frac{v^2}{c^2}\right) \times \frac{c^2}{(c+v)^2} = \frac{c-v}{c+v} = \frac{1-\frac{v}{c}}{1+\frac{v}{c}}$

thus $$f' = f \times \sqrt{\frac{1-\frac{v}{c}}{1+\frac{v}{c}}}$$ which is the same as (7). Q.E.D.

The Doppler equation for sound waves can be applied to light waves, also, if one splits the Doppler equation for light into its two component parts. Thus the same general Doppler equation can be used for all types of waves

General Relativity Considered

Gravitational Acceleration/Potential:

The accepted time dilation due to General Relativity **[6]** is: $$\gamma = \frac{\nu_0}{\nu} \qquad (11) \qquad\qquad \nu = \nu_0\left(1+\frac{\phi}{c^2}\right) \qquad (12)$$

where $\phi = -\frac{Gm}{r}$ is the gravitational potential difference between the source of the photon and the detector.

Equation (12) can be derived from Φ field considerations alone:

Let: Φ = field intensity of the source of the photon. Φ_0 = field intensity at the detector of the photon.
We can see that the potential difference between the source and detector is:

$$\phi = \Phi_0 - \Phi \qquad (13)$$

The field at the detector is the fraction k times more intense than the field at the source.

$$\Phi - \Phi_0 = k \times \Phi_0 \qquad (14) \qquad \text{So...} \qquad k = \frac{\Phi - \Phi_0}{\Phi_0} \qquad (15)$$

Substituting (13) into (15) gives:

$$k = -\frac{\phi}{\Phi_0} \qquad (16)$$

So the frequency of the photon at the detector will be less than the frequency at the emitter by the quantity $k \times \nu_0$:

$$\nu = \nu_0 - k \times \nu_0 \qquad \Rightarrow \qquad \nu = \nu_0 (1 - k) \qquad (17)$$

Substituting (16) into (17) gives: $$\nu = \nu_0 \left(1 + \frac{\phi}{\Phi_0} \right) \qquad (18)$$

If we let $\Phi_0 = c^2$ then we have: $$\nu = \nu_0 \left(1 + \frac{\phi}{c^2} \right)$$ which is the same as equation (12). Q.E.D.

Thus the full definition of the Φ field is: $$\Phi = c^2 - \phi \qquad (19)$$

So the Φ field is completely defined, and can account for the time dilation due to General Relativity. The value of c^2 can be understood as the field contribution from the whole Universe. Performing a calculation of $\frac{GM}{R}$, using values for the Universe, yields c^2. Other research backs up this finding **[8]**:

> "The well known solution for ϕ here is just the sum of the contributions to the potential due to all of the matter in the causally connected part of the Universe (that is, within the 'particle horizon' in the parlance of cosmologists). When calculated, this turns out to be roughly GM/R, where M is the mass of the Universe and R is about c times the age of the Universe. Using reasonable values for M and R, GM/R computes to a value of about c^2. Not only does GM/R have roughly the numerical value of c^2, it has the same dimensions too. This seems to suggest a deep connection between ϕ and c^2."

This field definition embodies Mach's Principle in the way it includes the contributions from all the matter in the Universe. Thus Φ represents the total potential of a body :

Total Potential = Φ = Global potential (c^2) + Local Potential ($-\phi$) $\left(Jkg^{-1}\right)$ (20)

and the quantity Φm expresses the total energy required to remove a body from this potential.

Energy = Global potential energy (mc^2) + Local Potential energy ($-m\phi$)

Energy = $\Phi m \quad \Rightarrow \quad E = mc^2 - m\phi$ $\left(Joules\right)$ (21)

Special Relativity Considered

Part A - Light moving perpendicular to the direction of Motion:

Consider the following:

(a) A reference frame at rest in a region of space filled with a field of magnitude Φ_0.

(b) An identical reference frame to (a), moving with a velocity v through the same field with magnitude Φ_0.

Please refer to Figure (1) below. A pulse of laser light (depicted as the dashed arrow) is sent across the reference frame (from a source connected to the reference frame) perpendicular to the direction of motion through the Φ field. In the stationary frame, the path length taken by the light is L as expected; but in the moving frame the path taken is longer (L_1) due to the constant flow of the Φ field through the frame, and the fact that the light moves with a certain velocity with respect to the field, rather than the moving reference frame.

A moving laser will emit a beam that follows the path given by L_1. This can be demonstrated with a Huygens construction **[10]** of the wavelets comprising the beam as it is being emitted.

Stationary Frame Moving Frame

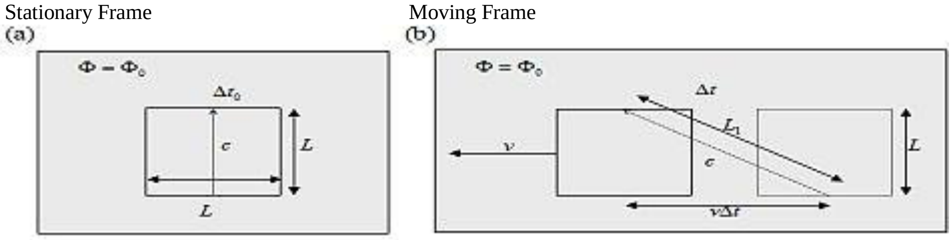

Figure (1)

In this example, the $\Phi = \Phi_0$ so $c_\phi = c$:

$$\Delta t_0 = \frac{L}{c} \quad (22) \qquad \Delta t = \frac{L_1}{c} \quad (23)$$

$$(L_1)^2 = (L)^2 + (v\Delta t)^2 \quad (24)$$

Using (22) and (24) we have: $$L_1 = \sqrt{(c\Delta t_0)^2 + (v\Delta t)^2} \quad (25)$$

Using (23) gives: $$(c\Delta t)^2 = (c\Delta t_0)^2 + (v\Delta t)^2 \quad (26)$$

Solving for Δt gives: $$\Delta t = \frac{\Delta t_0}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \quad (27)$$

The Lorentz factor **[7]** : $$\gamma = \frac{\Delta t}{\Delta t_0} = \frac{1}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \quad (28)$$

Equation (28) is the accepted (and verified) equation for calculating the time dilation due to relative motion.

Part B - Light moving parallel to the direction of Motion:

Please refer to Figure (2) below. Now consider the same situation as depicted in Fig 1(b), but with a light pulse sent across the reference frame parallel to the direction of motion. Consider the light's journey both in the direction of travel, Fig 2(a), and in the opposite direction, Fig 2(b), as separate cases, then combine the results to give an overall, round-trip result. The reference frame travels different distances in each case as $\Delta t_1 \rangle \Delta t_2$. This means that the actual time dilation is different in each direction, but it can be demonstrated that for a round trip the total time dilation during the trip is the same as it was in Fig 1(b) – where the light travelled perpendicular to the direction of motion.

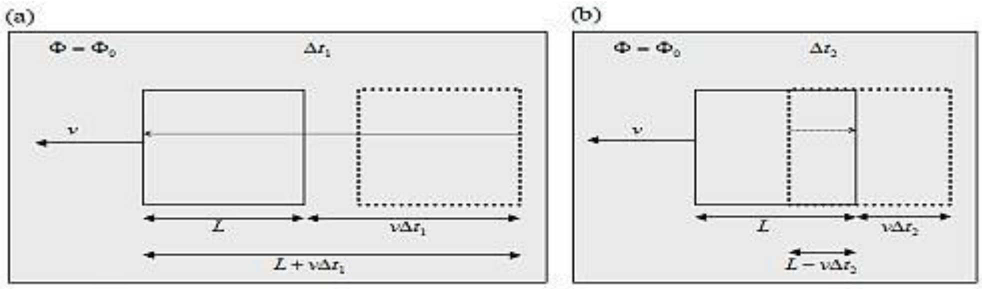

Figure (2)

In this example, the Φ field has a value of Φ_0 so $c_\phi = c$, giving:

$$\Delta t_1 = \frac{L + v\Delta t_1}{c} \quad (29) \qquad \Delta t_2 = \frac{L - v\Delta t_2}{c} \quad (30)$$

Solving for Δt_1 and Δt_2 gives : $$\Delta t_1 = \frac{L}{(c - v)} \quad (31) \qquad \Delta t_2 = \frac{L}{(c + v)} \quad (32)$$

The round trip time is defined as : $$\Delta t_a = \Delta t_1 + \Delta t_2 \qquad (33)$$

Let Δt_a be the total time taken by the light pulses to complete the round trip in reference frame A that is traveling at speed v through the Φ field, and Δt_b be the total time taken by similar light pulses in reference frame B that is stationary in the Φ field. If the source of the Φ field is known, and we are able to determine each frame's relative motion with respect to it (indicating that frame A is the one moving relative to that field and frame B is not), then we expect that $\Delta t_a \rangle \Delta t_b$ because in Frame A the light has had to travel further than the light in Frame B had to.

So the time dilation factor $$\gamma_{parallel} = \frac{\Delta t_a}{\Delta t_b} \quad \text{by definition} \qquad (34)$$

For Frame B, the time taken by the light pulse in his reference frame is simply:

$$\Delta t_b = \frac{2L}{c} \qquad (35)$$

For Frame A, the upstream & downstream times must be considered separately, and then summed :
Using equations (31) (32) and (33) gives :

$$\Delta t_a = \frac{L(c+v)+L(c-v)}{c^2-v^2} = \frac{2cL}{c^2-v^2} \qquad (36)$$

Then using (34) (35) and (36) we are able to calculate $\gamma_{parallel}$:

$$\gamma_{parallel} = \frac{\left(\frac{2cL}{c^2-v^2}\right)}{\left(\frac{2L}{c}\right)} = \frac{c^2}{\left(c^2-v^2\right)} \quad (37) \quad \text{So} \quad \gamma_{parallel} = \frac{1}{\left(\frac{c^2-v^2}{c^2}\right)} = \frac{1}{1-\left(\frac{v}{c}\right)^2} = \gamma^2 \qquad (38)$$

Also the length is shorter by an amount equal to the Lorentz factor. So the length of the moving reference frame in the previous calculation is L_γ rather than L, where :

$$L_\gamma = \frac{L}{\gamma} \qquad (39)$$

If this new length is used in the calculation for equation (36), we have:

$$\Delta t_a = \frac{L_\gamma(c+v)+L_\gamma(c-v)}{c^2-v^2} = \frac{2cL_\gamma}{c^2-v^2} \qquad (40)$$

Then using (34) (35) and (36) we are able to re-calculate $\gamma_{parallel}$:

$$\gamma_{parallel} = \frac{\left(\frac{2cL_\gamma}{c^2-v^2}\right)}{\left(\frac{2L}{c}\right)} = \frac{c^2}{\gamma\left(c^2-v^2\right)} \qquad (41)$$

Substituting (37) into (41) : $$\gamma_{parallel} = \frac{\gamma^2}{\gamma} = \gamma = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}} \qquad (42)$$

Thus, we can see that the times taken for a light pulse to travel in the perpendicular and parallel directions are equal, despite the motion of the experimental apparatus and the observer through the Φ field. This is the same outcome as predicted by Special Relativity theory.

Modeling a laser moving at Relativistic speed:

We have seen how the timing of the light pulses can be explained and matches the experimental results, but what about the frequency & phase of the waves? A laser's resonating cavity provides a good experimental test-bed for these considerations, as it contains a standing wave which can be thought of as comprising two sinusoidal waves traveling at the same speed, but in opposite directions, and with matching frequencies.

Thus, according to my proposal, if the operating laser is brought up to relativistic speed through space, one of the waves composing the standing wave is traveling 'upstream' and the other wave is traveling 'downstream'. To an observer moving with the laser cavity there should not be any detectable difference in the laser's operation, or the structure of the standing wave contained within it, when it is moving compared to when it is stationary. Of course, if he looks to another (stationary) reference frame, he will discover the time dilation that exists in his reference frame and therefore be able to deduce that the laser is in actual fact running more slowly too.

In modeling the moving laser cavity, several different effects must be considered at the same time. The path length taken between the reflecting mirrors of the laser cavity by the upstream & downstream waves will be different, since they are traveling at the local speed of light through the field that fills space. Due to the time dilation that exists in the atoms of gas inside the moving laser (that are moving with the laser), the initial frequency of the light emitted into the cavity will be lower than for an equivalent stationary laser. The frequencies of the upstream and downstream waves will also be Doppler-shifted due to the relative motion of the laser's mirrors through the space-filling field (higher for the upstream & lower for the downstream), and as shown earlier, the length of the cavity will be contracted.

I have written a computer program to model all of these various effects simultaneously. This model clearly shows how the actual electromagnetic waveform changes in space due to the relativistic motion, and yet to the observer traveling with the cavity, the waveform appears to be unchanged from its appearance when at rest. Figure (3) is a screen shot of the output of this program, modeling a laser cavity traveling at 40% the speed of light.

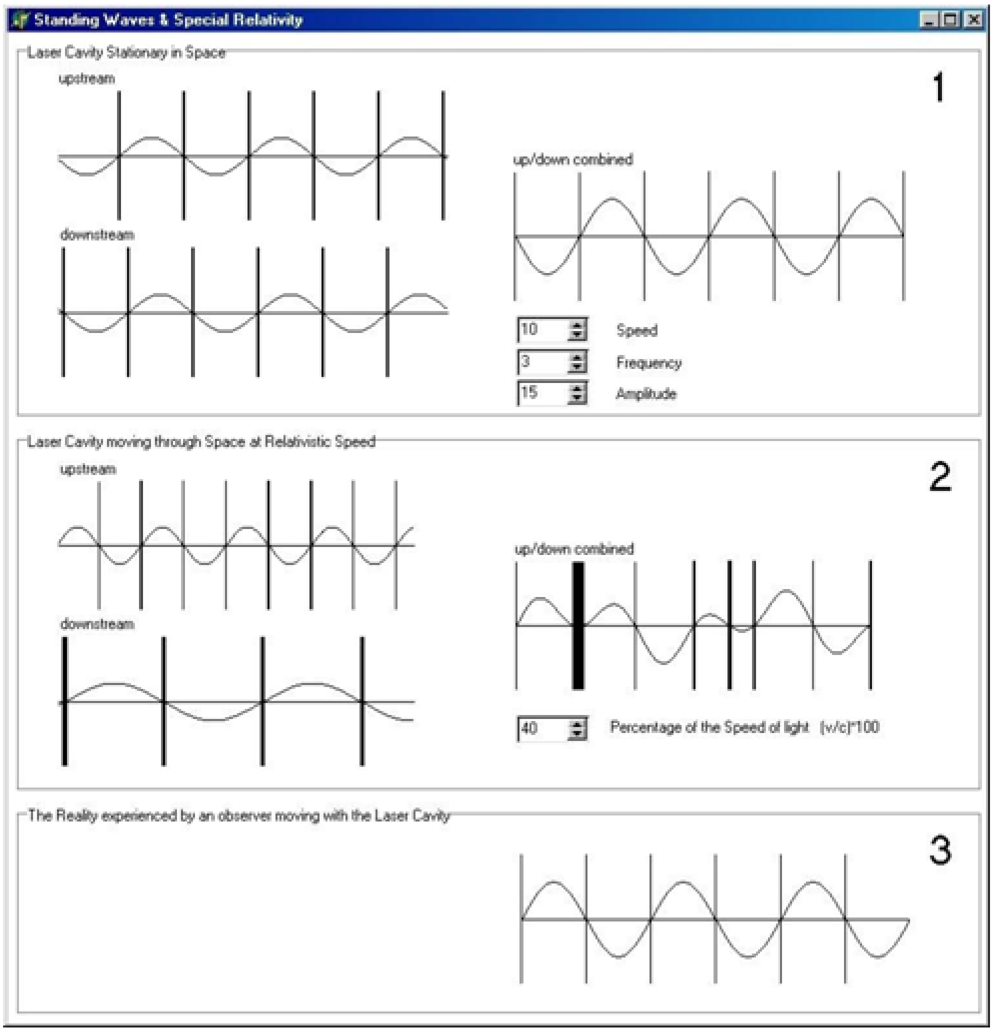

Figure 3

Box 1 depicts the laser cavity as it operates when stationary in the space-filling field.
Box 2 depicts the laser cavity as it operates when traveling at 40% of the local speed of light.
Box 3 depicts the operation of the cavity as measured by an observer traveling with the laser.

In boxes 1 and 2, the two waveforms on the left are the upstream and downstream waves (respectively) as they exist in the space between the two reflectors of the laser cavity. The waveform on the right is the sum of the upstream and downstream waves, and thus represents the actual electromagnetic wave that exists in the space inside the cavity. The black vertical lines intersecting the waveforms indicate points where the electric field is zero (the nodes of the standing wave, for example).

As I showed earlier, light is a Classical wave, so the normal Doppler-shift equation can be used. The upstream wave will be blue-shifted in the space inside the cavity, but will arrive at the upstream reflector with the same apparent frequency as when it was emitted (since the destination mirror is moving at the same speed as the source of the photons). Similarly, the downstream wave will be red-shifted in the space inside the cavity, but will arrive at the downstream reflector with the same apparent frequency as when it was emitted.

If f_0 is the frequency of both the upstream and downstream waves in the laser cavity when it is at rest, and f_e is the frequency of the light emitted into the laser cavity when it is moving, then:

$$f_e = \frac{f_0}{\gamma} \qquad \gamma \text{ is the Lorentz Factor.} \tag{43}$$

Using the Doppler equation for a moving source, the frequencies of the upstream (f_{up}) and downstream (f_{down}) waves are:

$$f_{up} = f_e \frac{c}{c-s} \tag{44}$$

$$f_{down} = f_e \frac{c}{c+s} \tag{45}$$

Also, the apparent speeds of the waves traversing the cavity can be expressed :

$$s_{up} = c - s \tag{46}$$

$$s_{down} = c + s \tag{47}$$

The observer knows how far down the cavity each sensor is, and expects that the time taken by the signal from that sensor to reach the point at the end of the cavity to be proportional to the sensor's distance from the end of the cavity. In order to get a picture of the electric field inside the cavity, the observer needs to construct a profile of the waveform using these signals. To determine what the profile of the electric field in the laser cavity looks like at a given point in time, one must apply a time correction to the received signals, such that a set of signals from all the sensors actually correspond to the same moment in time. In applying this correction, the observer will naturally assume that the time taken by the signal Δt is simply the distance that the sensor is from the end of the cavity x divided by the speed of light c .

$$\Delta t = \frac{x}{c} \tag{48}$$

So the time that a particular signal was emitted at its source is given by :

$$t_{emitted} = t_{measured} - \Delta t \tag{49}$$

This time correction will always be applied by the observer on the signals he receives, regardless of the speed of the laser (and the observer), because one always *measures* light to travel at speed c regardless of one's speed through space. So substituting (64) into (65) gives:

$$t_{emitted} = t_{measured} - \frac{x}{c} \tag{50}$$

This is the equation to be used for a laser that is at rest with respect to the space-filling field. However, when the observer is traveling at speed, the time $t_{measured}$ (the time at which the signal from a sensor reaches the end of the laser cavity) will actually be different than the value it has for a stationary laser. It will also be a different value depending on which end of the laser cavity the signals are taken to. For a moving laser, if the signals are taken to the upstream end of the laser cavity, the time taken for the signal to reach that point will be:

$$\Delta t_{up} = \frac{x_v}{s_{up}} \tag{51}$$

$$x_v = \frac{x}{\gamma} \tag{52}$$

where x_v is the length-contracted distance to the sensor. Thus for the upstream direction, substituting (46) and (52) into (51) gives:

$$\Delta t_{up} = \frac{x}{\gamma(c-s)} \tag{53}$$

For a moving laser, an observer will calculate $t_{emitted}$ to be :

$$t_{emitted} = t_{measured} + \Delta t_{up} - \Delta t \tag{54}$$

So substituting (53) and (48) into (54) gives:

$$t_{emitted} = t_{measured} + \frac{x}{\gamma(c-s)} - \frac{x}{c} \tag{55}$$

If a plot is then made of all the signals from the sensors that have the same value of $t_{emitted}$ then that plot represents a profile of the electric field as measured by the observer moving with the laser. As a result of the correction equation (55), the waveform in Box 2 is transformed into the waveform shown in Box 3. The waveform in Box 3 is a standing wave just like that in Box 1, but it oscillates more slowly as a result of the time dilation that accompanies the laser's motion. Its oscillation is slower by a factor of $1/\gamma$. For the downstream direction, the equation is:

$$t_{emitted} = t_{measured} + \frac{x}{\gamma(c+s)} - \frac{x}{c} \tag{56}$$

Also to be noted from this model is that when the upstream and downstream waves are summed, the distance between the nodes of the standing wave are shorter by the exact amount required by relativistic length shortening. Therefore, we can now understand how the length contraction occurs: from the summation of the higher & lower frequency waves.

Relativistic Mass Increase

The key to understanding mass increase is the understanding that solid matter is actually composed of standing waves that can be thought of as being the sum of an 'upstream' and a 'downstream' wave. Each of the two waves that comprise a particle has a certain energy associated with it (depending on that wave's frequency), and the total energy of the particle is the sum of the energies of the 'upstream' and 'downstream' waves. Once this total energy has been calculated, then the mass equivalent for that energy can be calculated using the usual equation: $E = mc^2$ (57)

We can use the standing wave inside a laser's resonating cavity as a model for a particle, because it is composed of an 'upstream' and 'downstream' wave that are summed, resulting in a standing wave. The proof that this approach can work mathematically follows: Let e_0 = energy per unit length of the upstream/downstream wave. Since there are two waves inside the laser's cavity (upstream & downstream), the total energy of the waves inside the cavity is:

$$E_{stationary} = 2 \times \left(e_0 \times L_0\right) \qquad \text{Where } L_0 \text{ is the length of the laser's cavity.} \tag{58}$$

For a laser (or particle) that is moving at Relativistic speed, the following equations apply:

Let: e_{up} = energy per unit length of the upstream wave. e_{down} = energy per unit length of the downstream wave.

The frequency of the upstream wave and downstream wave are:

$$f_{up} = f_0 \times \frac{c}{c-v} \tag{59}$$

$$f_{down} = f_0 \times \frac{c}{c+v} \tag{60}$$

Where f_0 is the frequency of the upstream/downstream waves in the stationary laser.

Since the energy per unit length of a wave is proportional to the wave's frequency ($e \propto f$), then (59) and (60) can be rewritten as :

The energy per unit length of the upstream wave is: $$e_{up} = e_0 \times \frac{c}{c-v} \tag{61}$$

The energy per unit length of the downstream wave is: $$e_{down} = e_0 \times \frac{c}{c+v} \tag{62}$$

So the total energy of the waves inside the moving laser's cavity (or comprising a moving particle) is expressed as :

$$E_{moving} = \left(e_{up} \times L\right) + \left(e_{down} \times L\right) \tag{63}$$

where L is the contracted length of the laser cavity due to the laser's Relativistic motion:

$$L = \frac{L_0}{\gamma} \tag{64}$$

and γ is the Lorentz factor due to Special Relativity : $$\gamma = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}} \tag{65}$$

So by substituting (61), (62) and (64) into (63) we have the following :

$$E_{moving} = \frac{L_0}{\gamma}\left(e_0 \times \frac{c}{c-v} + e_0 \times \frac{c}{c+v}\right) \tag{66}$$

$$E_{moving} = \frac{L_0 e_0}{\gamma}\left(\frac{c\left(c+v\right)+c(c-v)}{c^2-v^2}\right) = \frac{L_0 e_0}{\gamma}\left(\frac{2c^2}{c^2-v^2}\right) = \frac{2L_0 e_0}{\gamma}\left(\frac{1}{1-\left(\frac{v}{c}\right)^2}\right) \tag{67}$$

Then by substituting (65) into (67) : $$E_{moving} = \frac{2L_0 e_0}{\gamma} \times \gamma^2 = 2L_0 e_0 \gamma \tag{68}$$

Finally, by substituting (58) into (68) we have : $$E_{moving} = \gamma \times E_{stationary} \tag{69}$$

and by converting Energy into mass equivalent (equation (57)) : $$m_{moving} = \gamma \times m_{stationary} \tag{70}$$ Q.E.D.

The exact mass increase predicted by Special Relativity can be explained and calculated using this new model, where a moving mass can be modelled as comprising an upstream and a downstream wave, each with different frequencies, hence energies. When the mass equivalent of these waves' energies are summed, the correct mass increase is obtained.

An Explanation for Gravitational Acceleration

A particle can be modeled as a standing wave composed of inward and outward traveling spherical waves **[9]** that each reflect at the combined standing wave's nodes – thus an inward wave becomes an outward wave and vice versa at each reflection. A balance is achieved in the distribution of the inward and outward waves' amplitude (and hence momentum) such that the natural shape for a particle in free space is spherical. As the outward waves travel away from the center of the particle and into space, they decrease in amplitude and energy density; but they are perfectly balanced by the inward waves that increase in amplitude and energy density as they converge towards the center of the particle.

To see how such a wave structure behaves in a gravitational field, we must consider how each of the component waves are affected by the gravitational field **[3]**. The gravitational field itself is a field of varying time dilation. The closer one gets to a mass where the gravitational potential is greater, the more time is dilated (running slowly). The effect is very small, but when it has an effect on waves that are traveling very fast, and which remain in the field for a considerable period of time, the result is gravity, as we know it.

Normally, light waves do not stay within the gravitational field for very long because their speed is so high, so only a slight bending of the wave occurs toward the mass. The waves that make up matter are affected in the same way, but they remain localized in the field for much longer, so the effects are much more noticeable.

To see what the effect on the waves of a particle would be, we need to do the following math. From my earlier analysis of moving standing waves, we saw that for a standing wave (particle) that is traveling along at speed v :

$$\frac{f_{high}}{f_0} = \frac{c}{c-v} \qquad (71) \qquad\qquad \frac{f_{low}}{f_0} = \frac{c}{c+v} \qquad (72)$$

('high' and 'low' refer to the frequencies of the waves compared to the original frequency f_0)

And from General Relativity **[5]** we know that when a wave travels from one gravitational potential to another, its frequency (which equates to energy) changes. Thus for a standing wave (particle) that is placed in a gravitational field with acceleration a :

$$\frac{f_{high}}{f_0} = 1 + \frac{ah}{c^2} \qquad (73) \qquad\qquad \frac{f_{low}}{f_0} = 1 - \frac{ah}{c^2} \qquad (74)$$

The time taken for light to travel the vertical distance h is given by: $$t = \frac{h}{c} \qquad (75)$$

If a particle is held stationary in a gravitational field by an upward force, such as from a table top, the waves at the bottom of the particle travel very slightly slower than the waves on the top (due to the greater gravitational potential at the bottom), so in order for the standing wave to remain a continuous waveform, the waves at the bottom must bunch up (get closer together) so that the same number of wave crests travel from top to bottom as from bottom to top. As the downward waves slow down and bunch up as they move into a region of higher gravitational potential, their frequency increases, as does the momentum they carry, thus the force they impart on the table on which they are resting increases.

If the table is suddenly removed, the first thing that happens is that the opposing force from the waves comprising the table is removed, so the bunched up waves at the bottom of the particle spread out to restore the particle's normal spherical geometry. Once this occurs, however, the number of wave-crests propagating from the bottom of the particle to the top decreases. Similarly, the upward wave reflecting at the node to form the downward wave will arrive at the bottom as a slightly higher frequency wave because it is reflected and Doppler-shifted at a node that is moving downwards. By this method the change is transmitted from one node to the next and affects the whole particle's wave structure.

Consequently, a moment after the table is removed, the particle becomes a standing wave composed of a higher frequency down wave and lower frequency up wave. As a result, the particle will gain more momentum in the downward direction, and the standing wave's nodes (and therefore the whole particle) will attain a downward speed (v). This is the configuration for a particle in motion. So to calculate this speed (v) for a particle accelerating in a gravitational field for the period of time (t), we can perform the following operations on the above equations:

Substitute (71) and (75) into (73): $$\frac{c}{c-v} = 1 + \frac{at}{c} \quad \text{so:} \quad c = (c-v)\left(1 + \frac{at}{c}\right)$$

and... $$c = c + at - v - \frac{vat}{c} \quad \text{so:} \quad \frac{vat}{c} = at - v \qquad (76)$$

Then substitute (72) and (75) into (74): $$\frac{c}{c+v} = 1 - \frac{at}{c} \quad \text{so:} \quad c = (c+v)\left(1 - \frac{at}{c}\right)$$

and... $$c = c - at + v - \frac{vat}{c} \quad \text{so:} \quad \frac{vat}{c} = -at + v \qquad (77)$$

Then substitute (76) into (77) : $$at - v = -at + v \quad \text{so:} \quad 2at = 2v$$

thus... $$v = at \qquad \text{Q.E.D.} \qquad (78)$$

I have derived the classical velocity that a particle achieves when it is accelerated by gravity for a period of time (t) by considering only the time dilation effect in the gravitational field and its effect on the frequencies of the upward and downward waves. It appears that the acceleration due to gravity is explained by the following four-step process:

The Primary Cause:

(1) An increase in frequency (hence momentum) of the downward component of the particle's standing wave, due to the slowing of waves in a higher gravitational potential. Similarly, a decrease in frequency of the upward component wave, due to a speeding-up of waves in a lower gravitational potential.

Secondary Considerations:

(2) The higher momentum downward wave then pushes the standing wave's nodes downward.
(3) The reflected upward wave is then Doppler-shifted to a slightly lower frequency.
(4) The upward/downward waves then continue to reflect backwards and forwards between the nodes, constantly undergoing small Doppler-shifts, causing momentum to build in the downward direction.

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