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Relatively Simple?
An Introduction to Energy Field Theory

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The analysis of Relativity in this paper indicates the existence of a space-filling field that accounts for the time dilation effects of both Special and General Relativity, giving new insight into the nature of space, matter and energy. New ideas are presented on Special Relativity and the "problem of space" and a mechanism for gravity is suggested.

Introduction

One of the most exciting, profound and difficult to understand theories in Physics is the theory of Relativity developed by Albert Einstein in 1905. The theory predicted a number of counter-intuitive and bizarre effects, which would occur most noticeably to objects that travel at very high speeds or are subjected to high accelerations (including intense gravitational fields).

Einstein found that some of the most basic of physical properties such as an object's mass & length change under the conditions mentioned; but perhaps most surprising of all, the very concept of time was required to be altered also. He found that the rate of time must, by necessity, change in order for other aspects of Physics to agree and make sense.

These effects are very real, not just theory or thought experiments, and have been verified by a number of carefully carried out 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.

I think the main reason why the effects are hard to believe (once one is over the initial shock of having the solidity of these concepts challenged at all) is that there is no apparent reason for them happening, except for the fact that both the theory and the experimental results say that it must be that way. If the effects could be seen to be caused by some part of the physical setup that can be visualized, they would be a lot easier to understand and believe.

It is interesting that the changing rate of time – or Time Dilation as it has come to be known – occurs under two different situations but with the same effect as the outcome. The two situations are those mentioned earlier: (a) very high speed, (b) high accelerations or strong gravitational fields. In both of these situations, time starts to run more slowly for the objects concerned. As the changing of the rate of time is such a fundamental change to the Physics in an object, I find it hard to believe that the same underlying principle is not causing the effect in both cases.

Relativity is comprised of two theories: (a) Special Relativity, (b) General Relativity. In essence, Special Relativity describes the effects on a body with high speed motion and General Relativity describes the effects on a body in a strong gravitational field. Both theories provide equations for calculating the change in the rate of time that occurs, either as a result of the object's speed or gravitational environment.

The aim of this paper is to demonstrate that both of these theories and their equations are linked, that the common link can be attributed to a field which fills space and can be seen as the root cause of the strange effects.

I should mention here that parts of this paper bear a striking resemblance to existing theory and means of explaining Relativity. This is an inevitable consequence of what I am trying to achieve – in trying to present the current facts in a new light and from a different metaphysical standpoint. I am not attempting to claim these existing parts as intrinsically new.

Section 1

Time Dilation Due to Special Relativity

Special Relativity asserts that a body moving at very high speed will experience a time dilation effect such that a clock moving with the body will run more slowly than an identical clock which remains stationary. This effect has been verified repeatedly to a very high degree of accuracy, and can be observed readily in a well equipped Physics Laboratory – the frequency of Synchrotron radiation, for example, provides direct indication of this effect occurring to electrons.

However, as motion is a relative concept how do we know which body is moving and which one is at rest – and therefore which of the two objects experiences the time dilation effect? For experiments carried out on Earth, we have no trouble in identifying the moving object, as the Planet we are on is automatically assumed to be stationary with respect to any other object we observe on its surface.

If we think about it further and picture a situation where the observed body is initially at rest with the Planet, then a force comes into play between the Planet and the body. We see that due to the vastly different inertia of the two objects – given the same magnitude of force acting on each of them – the small body acquires a much larger velocity than the large body (the Planet). This analysis justifies our selection of the smaller object as the one which is moving fast, and hence should experience the time dilation effect.

But there appears to be a problem: what if you are presented with a large body moving very rapidly past a small body, without knowing the prior history of the objects and how they acquired their large relative speeds – which body is moving fast and which one is stationary? Which one experiences the time dilation? They certainly cannot both be experiencing the effect to the same degree, or there would be no effect detected; so what aspect of the situation determines which of the objects has dilated time?

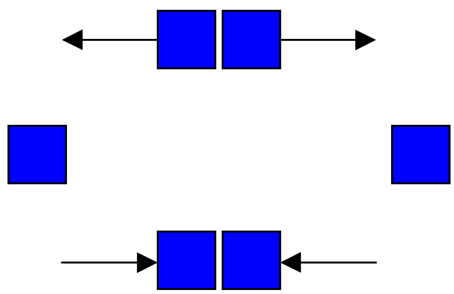
The solution, as I see it, is that the difference in the masses of the objects involved is the determining factor. As the Planet is vastly more massive than the electrons in the Synchrotron, for example, the Planet determines the reference frame against which the electrons are moving, and thus all but the tiniest fraction of the time dilation effect occurs to the electrons and not to the Planet.

What happens then when the objects are more equal in mass, or if they have identical mass? Consider the following thought experiment:

a

b

c



The diagrams above (a, b & c) represent two bodies with identical mass initially at rest with respect to one another, each with its own atomic clock which is carefully synchronized with the other body's clock. Both bodies then accelerate to relativistic speeds in opposite directions and then stop (diagram b); and then come back together (diagram c) and again stop. They then compare times on their clocks.

If one ignores the General Relativistic effects of acceleration (which are symmetrical in any case and so would affect each body's clock to the same degree), which body's clock would have experienced the time dilation and been running more slowly? Intuition says (and symmetry demands) that due to the completely symmetrical nature of the experiment, both clocks would read the same time when compared at the end of the experiment. If not, then why would one body be treated differently from the other? Neither body should occupy a preferred reference frame.

Would they *both* have experienced a time dilation with respect to a hypothetical point mid-way between them? There seem to be only three alternatives:

(1) Both bodies experience an equal time dilation, such that their clocks agree with each other at the end of the experiment.

(2) Neither object experiences a time dilation effect, despite their large relative speeds to one another.

(3) Any effects that occur are cancelled out by returning to the starting point: The Acceleration phase is an important part of the picture and cannot be ignored in order to look at the Special Relativity effects.

If option (3) was suspected, one would have to propose an argument along the lines that time in the two reference frames becomes ‘disjointed’ in some way whilst they are in relative motion (due to the acceleration phase), but then become re-synchronized once they decelerate and come back together – giving the same clock times when compared.

For that theory to work, the acceleration phase would have to somehow modify time for each body such that it always appears that it is the other body which is moving fast and thus has the dilated time. Then the deceleration phase would have to maintain this appearance whilst re-synchronizing time such that each body’s clock reads the same time at the end of the experiment!

Then there is the problem of an arbitrarily long coasting phase between acceleration and deceleration, in which any eventual clock comparison differences (due to relative motion) would be amplified – so the same magnitude of deceleration would have to ‘correct’ different time anomalies in different experimental situations. I think you will agree that this situation is unworkable.

Options (1) and (2) would appear to be indistinguishable to each of the two bodies concerned (in the absence of a third body to compare with), as in both cases each body’s clock would read the same time at the end of the experiment (so neither body would notice a time dilation effect on the other). However, there is a clear difference, and a different theory would be required to explain each of them.

Option (1) suggests that the presence of each body has an effect on the other body (when there is a relative motion between them) such that each body’s time is dilated. The larger the body is, the more effect it has on the other body (and vice versa), but if both bodies have equal mass, each is effected equally such that their clocks remain synchronized. A time dilation effect is only noticed (in the absence of a third reference point) when a difference in the mass between the two bodies exists – in other words: body A effects body B, more than body B effects body A (where body A is more massive than body B) despite the same relative speed between the two bodies.

Option (2) suggests that no time dilation effect occurs on either body (despite their relative motion). This is clearly in violation of Special Relativity, and experimental evidence. This violation could perhaps be avoided by supposing that a time dilation only occurs when there is a difference in mass between the two bodies. This is unlikely, however, as a third body of equal mass could be introduced into the thought experiment that remains at rest in the center. Option (2) would state that no time dilations exist between any of the clocks on the three bodies. This can hardly be considered as a likely model and will not be considered further.

By a process of elimination option (1) appears to be the correct model for what is happening.

As options (1) requires an effect to be felt on one body whose magnitude is determined by the other body's mass, the gravitational field appears to be implicated (in the absence of any other long-range mass dependent quantity). The gravitational field is a scalar field whose gradient gives us the gravitational acceleration and whose value at any given point gives us the gravitational potential.

$$a = -\frac{Gm}{r^2} \qquad\qquad \phi = -\frac{Gm}{r}$$

These two quantities bear a fixed relationship to one another: if you know the gravitational acceleration at a point, then you can readily calculate the gravitational potential for that same point. By convention ϕ is negative and tends to zero the greater the distance r from a mass. This being the case, a definite value for ϕ can be determined for any single point by integrating from infinity to that point.

It is interesting to notice that the time dilation effect can be caused by two different means: (a) relative motion (Special Relativity) (b) acceleration (General Relativity). This suggests to me the strong possibility that the same underlying principle is involved in both cases to cause a time dilation.

Due to the fixed relationship between the gravitational acceleration and the gravitational potential, the time dilation due to a gravitational acceleration could be equally well attributed to a gravitational potential level. This being the case, the time dilation effects of both Special & General Relativity can be unified, and visualized as being caused by a single scalar field proportional to the gravitational potential field.

If we suppose that the density of the scalar field determines the degree of time dilation, then a higher field density close to a large mass (large gravitational acceleration) causes a larger time dilation than a lower field density further away from the mass (weak gravitational acceleration). Also motion through this field would result in the effective field density acting on the fast moving body to be greater (due to the large volume of space swept out by the body) – again resulting in a time dilation. This effect will be explained further in Section 2.2

Section 2

Energy Field Theory

The gravitational potential ϕ is a scalar quantity that expresses the gravitational potential of a single body (with reference to a test body of unitary mass) generated by mass/energy, such that:

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

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

From the previous discussion about Relativity it appears that a scalar field proportional to ϕ is directly implicated in an explanation of the various odd effects that are known to occur – such as time dilation. I propose that a scalar field exists that is proportional to ϕ, and is defined as follows:

Let Φ be a scalar field, such that:

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

Where Φ_0 is the magnitude the field has in a region of space far from the body being considered, that has a gravitational potential of zero ($\phi = 0$).

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 being considered. The field has units of $\left(Jkg^{-1}\right)$ or equivalently $\left(m^2 s^{-2}\right)$.

$$\Phi = \Phi_0 - \left(\phi_1 + \phi_2 + \phi_3 + \ldots\phi_n\right) \left(Jkg^{-1}\right) \qquad (3)$$

It is interesting to note that the gravitational force constant G has units of $Nm^2 kg^{-2}$ which (as $1J = 1Nm$) is equivalent to $\left(Jkg^{-1}\right)\left(mkg^{-1}\right)$ which neatly expresses the relationship between how much work is done (per kilogram) by that mass, for every metre increase in separation from another mass that is supplying the Φ field. The alternate units of $\left(m^2 s^{-2}\right)$ indicate the deep connection between the Space dimension and the Time dimension present in this field – it constitutes the SpaceTime Continuum.

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 density Φ field, light's speed decreases – however, the high density Φ field also slows all other physical processes equally, such that the rate of time within that reference frame slows too.

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.

It should be noted that this interpretation is in keeping with current theory – but rather than requiring variable geometry, empty space is visualized as a 'fixed grid', but filled with a Φ field which varies in intensity, and light's velocity varies accordingly. This mental picture is much easier to visualize, simplifies the maths, and prevents absurdities such as the volume of the space occupied by a planet and its surrounding atmosphere being greater than that of the spherical shell that encloses it (light appears to travel through a greater distance of space near a planet or star, but rather travels more slowly through a higher density of the Φ field).

To some extent it is an arbitrary choice as to which quantities are held constant and which are required to change (the maths can be made to work out the same either way) but I think it makes more sense to keep space fixed and allow the speed of light to change (*cf Ockhams Razor*). All other types of waves have transmission speeds dependent on the medium they are travelling through, so why make a special case for light when an alternative explanation is available? Besides it is already acknowledged that light travels more slowly through other media (such as glass) than through air.

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

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

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

Section 2.1

General Relativity Considered:

Gravitational Acceleration/Potential :

The accepted time dilation due to General Relativity (as stated in "The Principle Of Relativity") is expressed as :

$$\gamma = \frac{\nu_0}{\nu} \qquad (6) \qquad\qquad \nu = \nu_0\left(1 + \frac{\phi}{c^2}\right) \qquad (7)$$

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

The above equation (7) can be derived purely from energy considerations:

Using the equation for the energy of a photon: $E = h\nu$ (8)

The energy of a photon (when emitted by the same type of electron transition in an atom) at two different gravitational potentials (with gravitational potential difference of ϕ) can be calculated by combining (8) and the energy/mass relation $E = mc^2$ with ϕ:

$$\Delta E = \phi\left(\frac{h\nu_0}{c^2}\right) \qquad (9)$$

Therefore by using (8) and (9) the energy of the photon in the lower potential compared with the photon at higher potential (after crossing gravitational potential ϕ) is:

$$h\nu = h\nu_0 + \Delta E \qquad (10)$$

Substituting (9) into (10) :

$$h\nu = h\nu_0 + \phi\left(\frac{h\nu_0}{c^2}\right) \qquad (11)$$

When rearranged, gives :

$$\nu = \nu_0 \left(1 + \frac{\phi}{c^2}\right) \text{ which is the same as (7).}$$

Both the terms ϕ and c^2 have units of Jkg^{-1}, the same units as the Φ field.
The term $\frac{\phi}{c^2}$ is a fractional representation of two quantities of this field.

Equation (7) can also 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.

Using (4) we can see that the potential difference between the source and detector is:

$$\phi = \Phi_0 - \Phi \qquad (12)$$

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

$$\Phi - \Phi_0 = k \times \Phi_0 \qquad (13)$$

so $$k = \frac{\Phi - \Phi_0}{\Phi_0} \qquad (14)$$

Substituting (12) into (14) gives:

$$k = -\frac{\phi}{\Phi_0} \qquad (15)$$

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

$$\nu = \nu_0 - k \times \nu_0$$
$$\Rightarrow \quad \nu = \nu_0 (1 - k) \qquad (16)$$

Substituting (15) into (16) gives:

$$\nu = \nu_0 \left(1 + \frac{\phi}{\Phi_0}\right) \qquad (17)$$

If we let $\Phi_0 = c^2$ then we have:

$$\nu = \nu_0\left(1+\frac{\phi}{c^2}\right) \qquad \text{which is equation (7)}$$

QED

Thus the full definition of the Φ field is: $\Phi = c^2 - \phi$ (18)

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. Quoting from page 6 of "Transient Mass Fluctuations":

"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 :

Potential = Φ = Global potential (c^2) + Local Potential ($-\phi$) $\left(Jkg^{-1}\right)$ (19)

And the quantity Φm expresses the total energy required to remove a body from this potential. As we are including the Global potential, this would equate to the energy required to remove the body from the Universe – if it were possible to do this.

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

Energy = $\Phi m \quad \Rightarrow \quad E = mc^2 - m\phi$ $(Joules)$ (20)

Perhaps the Φ field can be viewed as supplying mass with its energy (*cf Higgs Field*?).

Equation (20) **does not** indicate a variation of the famous equation $E = mc^2$, rather it indicates that a particle at rest in a gravitational well actually contains less energy than an equivalent particle at rest outside of the potential well (the 'E' refers to a different energy in each of the two equations). However, due to the slower rate of time in the potential well, it will appear to an observer (who is also in the potential well) that the particle still contains the amount mc^2 of energy. The way this occurs and why will be discussed at greater length in section 4.

One can imagine a photon falling into the gravitational well of the whole Universe, becoming more and more blue shifted until it is a very high-energy gamma ray or cosmic ray. It then contains enough energy that it can re-arrange into an electron and a positron at rest with respect to the Universe. The mass thus created will exist as a result of the global potential of the Universe. A similar effect occurs to other particulate matter, but in a slightly different way – the energy is gained as kinetic energy.

A photon's frequency is free to change as it traverses the gravitational field, but an electron (for instance) is said to have a fixed rest mass regardless of where it is, and so may be represented by a particular Compton wavelength. When it descends into the gravitational well, this wavelength must remain the same in order that the particle retains its identity as an electron. So it must gain energy in a different way. It does this by gaining kinetic energy – or the De Broglie wavelength of the particle changes.

This subject will be discussed at greater length in Section 4.

Acceleration and the Equivalence Principle :

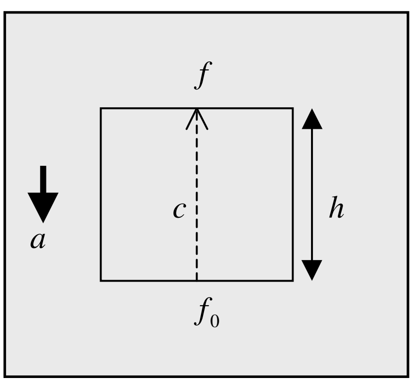
Consider a laser light pulse sent from a source to a detector across a known distance. In case A, the experiment is conducted in a uniform gravitational field, in case B the experiment is initially at rest with respect to the Φ field, and then accelerates with constant acceleration $\vec{a}$ at the moment the pulse is released. The acceleration is of equal magnitude in case A and case B.

A laser pulse of known frequency f_0 is sent from the source, across the known distance to the detector, where its frequency is recorded as f. Due to the Equivalence principle, both experiments find that $f \langle f_0$ by the same amount.

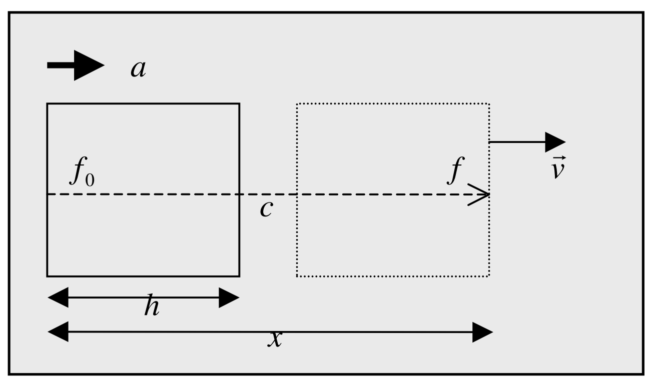
In case A, the frequency (or energy) of the photons are lower when detected as they have done work on crossing the gradient in the Φ field.

In case B, there are two effects that combine to give the same frequency shift as in A. The frequency of the detected light will be Doppler shifted due to the relative motion between the source and the detector, but also the detector will be moving at velocity v when the light pulse arrives, so there will be a time dilation on the detector due to its motion through the Φ field. Both of these effects are accounted for in the relativistic Doppler equation for light – equation (25).

A



B



The following equations describe case A :

$$f = f_0\left(1 + \frac{\phi}{c^2}\right) \qquad (21) \qquad\qquad \phi = -\int (a)\,dh = -ah \qquad (22)$$

where ϕ is the potential difference between the source and detector.

The following equations describe case B :

$$v = \int (a)\,dt = at \qquad (23) \qquad\qquad x = \int (at)\,dt = h + \frac{1}{2}at^2 \qquad (24)$$

$$f = f_0 \frac{\sqrt{1 - v/c}}{\sqrt{1 + v/c}} \qquad (25) \qquad\qquad t = \frac{x}{c} \qquad (26)$$

Substituting (24) into (26):

$$x = h + \frac{ax^2}{2c^2} \qquad (27) \qquad\qquad \frac{a}{2c^2}x^2 - x + h = 0 \qquad (28)$$

Solving for x using the formula for quadratic roots : $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$$x = \frac{1 \pm \sqrt{1 - 2ah/c^2}}{\left(a/c^2\right)} \qquad (29)$$

Combining (23) and (26) :

$$v = \frac{ax}{c} \qquad (30)$$

So substituting (29) into (30) :

$$v = c\left(1 \pm \sqrt{1 - 2ah/c^2}\right) \qquad (31)$$

Now, the velocity v cannot exceed the speed of light c so :

$$v = c\left(1 - \sqrt{1 - 2ah/c^2}\right) \qquad (32)$$

So we have an equation for v in terms of a. This equation can be substituted into the relativistic Doppler equation for light – equation (25) – to give the frequency shift seen in case B.

When this is done and equations (21) and (25) are compared using equal values for a, the results are almost identical. They are exactly equal to many decimal places in all but extreme cases. In extreme cases, other issues such as length contraction need to be considered also.

Section 2.2

Special Relativity Considered:

Part A:

Consider the following:

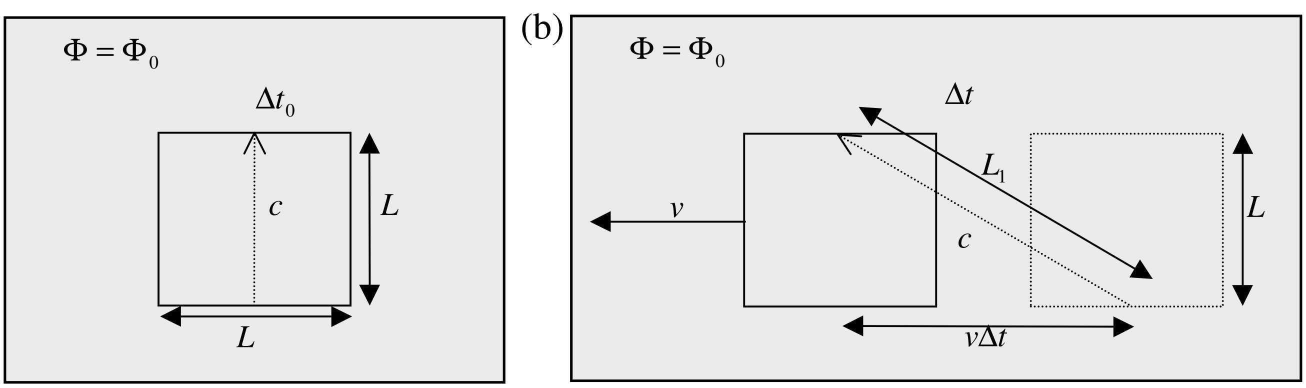
(a) A reference frame at rest in a region of space filled with a field with a magnitude of Φ_0.
(b) An identical reference frame to (a), moving with a velocity v through the same field with magnitude Φ_0.

Assume that the mass that is generating the field Φ_0 can be located, such that the relative motion of the frame with respect to the field can be established. Also the light travels with constant speed with respect to the Φ field, rather than the moving reference frame.

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 of the wavelets comprising the beam as it is being emitted.

(a) (b)



In this example, the Φ field has a value of Φ_0 so light will not be traveling through the field at reduced speed (so $c_\phi = c$), giving:

$$\Delta t_0 = \frac{L}{c} \quad (33) \qquad \Delta t = \frac{L_1}{c} \quad (34)$$

$$(L_1)^2 = (L)^2 + (v\Delta t)^2 \quad (35)$$

Using (33) and (35) we have

$$L_1 = \sqrt{(c\Delta t_0)^2 + (v\Delta t)^2} \quad (36)$$

Using (34) gives

$$(c\Delta t)^2 = (c\Delta t_0)^2 + (v\Delta t)^2 \quad (37)$$

Solving for Δt gives

$$\Delta t = \frac{\Delta t_0}{\sqrt{1-\left(\frac{v}{c}\right)^2}} \quad (38)$$

The Lorentz factor : $\gamma = \frac{\Delta t}{\Delta t_0} = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}}$ (39)

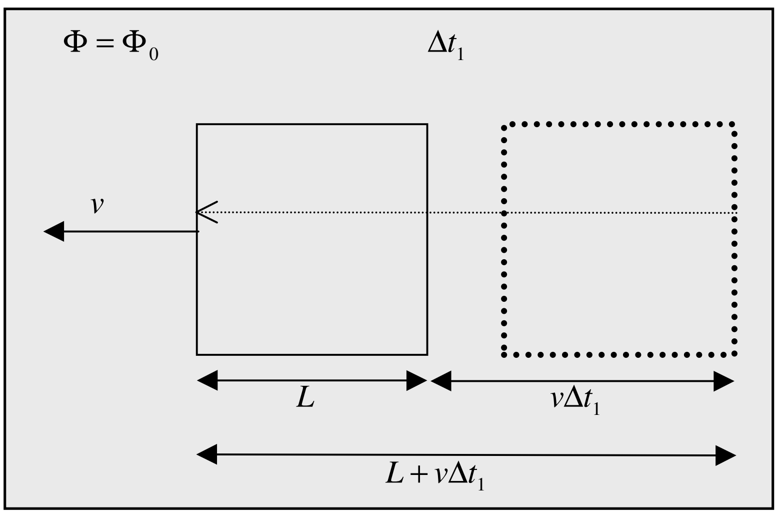
Equation (39) is the accepted (and verified) equation for calculating the time dilation due to relative motion.

Part B:

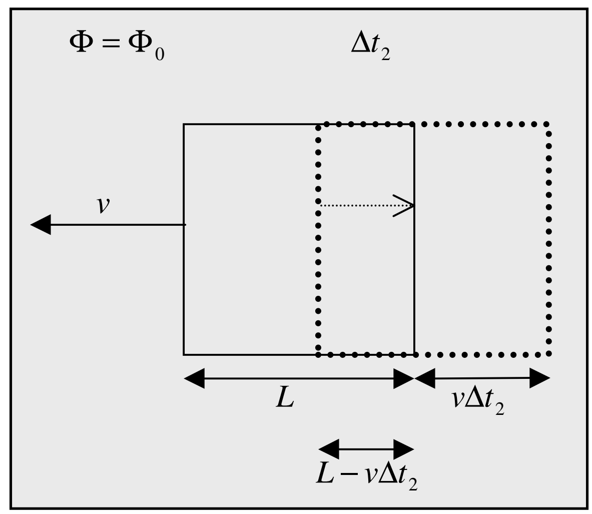
Now consider the same situation as depicted in (b), but with a light pulse sent across the reference frame parallel to the direction of motion

Consider the light's journey both in the direction of travel (c) and in the opposite direction (d) 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 (b) – where the light travelled perpendicular to the direction of motion.

(c)



(d)



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

$$\Delta t_1 = \frac{L + v\Delta t_1}{c} \qquad (40) \qquad\qquad \Delta t_2 = \frac{L - v\Delta t_2}{c} \qquad (41)$$

Solving for Δt_1 and Δt_2 gives :

$$\Delta t_1 = \frac{L}{(c - v)} \qquad (42) \qquad\qquad \Delta t_2 = \frac{L}{(c + v)} \qquad (43)$$

The round trip time is defined as :

$$\Delta t_a = \Delta t_1 + \Delta t_2 \qquad (44)$$

If Δt_a is the total time taken according to observer A who is stationary in the Φ field, and Δt_b is the total time taken according to observer B in the reference frame traveling at speed v through the field. If each observer knows the source of the Φ field and is able to determine their own relative motion with respect to it (indicating that observer B is moving relative to that field rather than observer A) then observer B is expected to have the dilated time, so each observer expects that $\Delta t_a \rangle \Delta t_b$.

$$\gamma_{parallel} = \frac{\Delta t_a}{\Delta t_b} \quad \text{by definition} \qquad (45)$$

According to observer B (using his clock), the time taken by the light pulse in his reference frame is simply:

$$\Delta t_b = \frac{2L}{c} \qquad (46)$$

For observer A, the calculation for the light pulse's travel time is a little more complicated, as the upstream & downstream times must be considered separately, and then summed :

Using equations (42) (43) and (44) gives :

$$\Delta t_a = \frac{L(c+v) + L(c-v)}{c^2 - v^2} \quad = \quad \frac{2cL}{c^2 - v^2} \qquad (47)$$

Then using (45) (46) and (47) he is able to calculate $\gamma_{parallel}$:

$$\gamma_{parallel} = \frac{\left(\dfrac{2cL}{c^2 - v^2}\right)}{\left(\dfrac{2L}{c}\right)} \quad = \quad \frac{c^2}{\left(c^2 - v^2\right)} \qquad (48)$$

So $$\gamma_{parallel} = \frac{1}{\left(\dfrac{c^2 - v^2}{c^2}\right)} \quad = \quad \frac{1}{1 - \left(\dfrac{v}{c}\right)^2} \quad = \quad \gamma^2 \qquad (49)$$

This finding appears, on the face of it, to indicate that the time taken for the light pulse traveling in a direction parallel to the direction of motion would be longer than the time taken for an equivalent light pulse traveling perpendicular to the direction of motion. In fact, the time dilation in the parallel direction appears to be the square of the time dilation in the perpendicular direction.

This situation was investigated in a famous experiment carried out by Michelson & Morley in 1887 in their attempts to discover the effects of the Earth's motion through the Luminiferous Ether. The expected result of the experiment was that a different travel time would be detected between the parallel & perpendicular light paths (indicated by a shift in interference fringes when the two beams are recombined).

However, much to the astonishment of the experimenters and the rest of the scientific community, the results of the experiment indicated no difference in travel times between the two light paths (within the accuracy of the measurements).

The Lorentz-Fitzgerald contraction was proposed to account for this unexpected result, and this formed part of the theory of Relativity. Special Relativity indicates that the length of an object moving at speed contracts to a shorter length as a direct result of the object's motion. This proposal has since been verified by experiment. However, at the same time as the problem was solved, the Ether theory was rejected in favour of Einstein's Relativity.

Fitzgerald showed that when Special Relativity is taken into consideration for solid objects, the forces holding that body together adjust is just such a way to cause the body's length to contract.

The length is shorter by an amount equal to the Lorentz factor.

$$\gamma = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}} \qquad (50)$$

So the length of the moving reference frame in the previous calculation is L_b rather than L, where :

$$L_b = \frac{L}{\gamma} \qquad (51)$$

If this new length is then used in the calculation for equation (47), then we have:

$$\Delta t_a = \frac{L_b(c+v)+L_b(c-v)}{c^2-v^2} \quad = \quad \frac{2cL_b}{c^2-v^2} \qquad (52)$$

Then using (45) (46) and (47) he is able to re-calculate $\gamma_{parallel}$:

$$\gamma_{parallel} = \frac{\left(\frac{2cL_b}{c^2 - v^2}\right)}{\left(\frac{2L}{c}\right)} = \frac{c^2}{\gamma\left(c^2 - v^2\right)} \qquad (53)$$

As we saw in equation (48) $\frac{c^2}{\left(c^2 - v^2\right)} = \gamma^2$ so $\gamma_{parallel} = \frac{\gamma^2}{\gamma}$ (54)

Finally, $\gamma_{parallel} = \gamma = \frac{1}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}$ (The Lorentz factor) (55)

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.

Discussion :

Due to the apparent constancy of the speed of light (c is always measured to be the same by any observer in any reference frame $\sim 3\times10^8 m\sec^{-1}$), if he didn't know he was moving with respect to the Φ field, B would write down:

$$\Delta t_b = \frac{2L}{c} \qquad (56)$$

This being simply the distance across the frame & back again divided by the speed of light c- which is always measured to be the same by any observer in any reference frame ($\sim 3\times10^8 m\sec^{-1}$). As you will notice by examining the units of c, it is in fact a ratio relating distance to time. It is this ratio that is preserved by light in all reference frames. Because of this apparent constancy of the speed of light in all reference frames, (56) must appear to be correct to observer B in any measurement he undertakes in his reference frame – regardless of his knowledge regarding his motion in the bigger picture.

So although he measures the speed of light to be c in his reference frame, its actual speed (when compared to a reference frame that is stationary with respect to the surrounding Φ field) over the round trip appears to be c_b (ignoring, for the moment, the asymmetry between the 'upstream' and 'downstream' legs of the journey).

Thus, we can see that: $$c_b = \frac{c}{\gamma} \qquad (57)$$

So although equation (56) appears to be correct for any measurement taken within his reference frame, he must modify the equation to account for equivalent measurements made in another reference frame that is stationary with respect to the Φ field. Thus he is then able to write:

$$\Delta t_{actual} = \frac{2L}{c_b} = \gamma \frac{2L}{c} \qquad (58)$$

It should be noted, however, that the light itself is still traveling through space at the same speed regardless of the observer's speed, but the length of the path it takes to travel between points in the observer's reference frame changes; thus causing a dilation of the time taken for all of the events that occur in that reference frame. So if the observer were to compare his measurements with equivalent measurements taken on a stationary reference frame, it would appear to him that light was traveling at the reduced speed c_b in his reference frame.

There exists an asymmetry in the travel times of the light pulses in the 'upstream' and 'downstream' directions, but due to the nature of the measurement of time intervals – which requires comparisons made with reference to a fixed point (a round trip) – the differences sum to give the same time dilation as one would get for light pulses traveling perpendicular to the direction of motion. Therefore, the different travel times occurring in the different directions is not detected.

Thus we see the same resultant time dilation for light traveling in a round trip either perpendicular, or parallel to the direction of motion of the reference frame through the Φ field. More complicated examples could be shown for other angles between these extremes – which yield the same overall time dilation for a round trip.

In real terms, for a small object (such as an electron) moving through a Φ field generated by a large object (such as a planet) the frequency of any radiation emitted by the electron is fixed almost at the point of emission by the planet's Φ field – which is the medium through which the light wave is moving. The frequency will therefore be influenced by both the electron's speed and the direction of the emitted light. The speed of the electron determines its time dilation – which affects the frequency of the light it emits – and the direction is important for Doppler shift considerations (also effecting the frequency of the detected light).

Section 3

Laser Cavity At Relativistic Speed:

Ok, so the timing of the light pulses can be explained and matches the experimental results, but what about other aspects of the electromagnetic waves that change as a result of objects moving at relativistic speed? For instance 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 (when operational) which can be thought of as being comprised of 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 comprising the standing wave is traveling 'upstream' and the other wave is traveling 'downstream'. To an observer moving with the laser cavity, he should not be able to detect any differences 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/her 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 (as 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. Also the frequencies of the upstream & downstream waves will be Doppler shifted due to the relative motion of the lasers 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 1 is a screen shot of the output of this program, modeling a laser cavity traveling at 40% the speed of light.

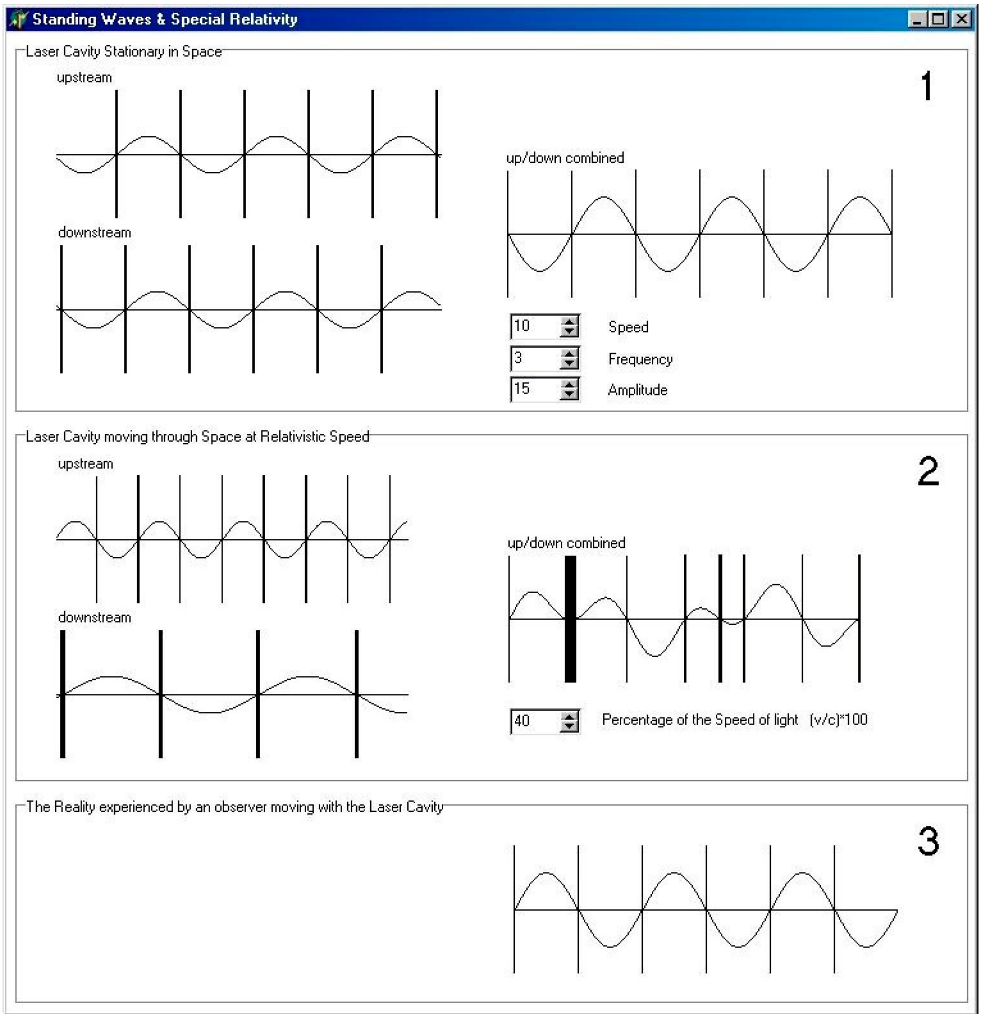


Figure 1

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 & 2, the two waveforms on the left-hand side are the upstream and downstream waves (respectively) as they exist in the space between the two reflectors of the laser cavity. The right hand side wave 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).

Light is usually considered to be a different type of wave than sound and should be treated differently. Indeed the Doppler shift equation for light waves is different than the equations used for sound waves. However, this different equation is simply due to the frequency shift due to time dilation, being included in the overall frequency shift detected between two objects that are moving with respect to each other.

Thus if one makes a frequency correction due to this time dilation prior to making other Doppler shift calculations, the same Doppler shift equation used for sound waves can be used for light waves. This makes sense as the light is traveling through the space-filling field at the local speed of light, in the same way that sound travels through the air at the (local) speed of sound. There is, of course, an obvious difference between sound and light waves in that light is not a compression wave in the way that sound is.

So 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 (as the mirror is moving at the same speed through the field as the gas atoms in the laser cavity, where the photons originate). 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:

$$f_e = \frac{f_0}{\gamma} \qquad \text{where } \gamma \text{ is the Lorentz Factor.} \qquad (59)$$

Then using the Doppler equation for a moving source, the frequencies of the upstream (f_{up}) and downstream (f_{down}) waves as they exist in the space-filling field, can be expressed :

$$f_{up} = f_e \frac{c}{c-s} \qquad (60)$$

$$f_{down} = f_e \frac{c}{c+s} \qquad (61)$$

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

$$s_{up} = c - s \qquad (62)$$

$$s_{down} = c + s \qquad (63)$$

How, you may ask, does the waveform shown in Box 2 appear to be the waveform in Box 3, to the observer traveling with the laser cavity. The answer lies in the different speeds at which the two waves (upstream & downstream) travel through the laser cavity. Imagine that sensors are in place along the length of the cavity that measure the electric fields magnitude and direction. The sensors send their readings at the speed of light (relative to the space-filling field through which the laser is traveling) down optical fibers. The readings from the sensors are received at a single point at either end of the laser cavity. Thus signals from further down the cavity take longer to reach that point than nearer ones. Also the signals travel to the downstream end more rapidly than to the upstream end.

Now 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, he need to construct a profile of the waveform using these signals. So in determining what the profile of the electric field in the laser cavity looks like at a given point in time, he needs to 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, he/she 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.

$$\Delta t = \frac{x}{c} \tag{64}$$

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

$$t_{emitted} = t_{measured} - \Delta t \tag{65}$$

This time correction will always be applied by the observer on the signals he receives regardless of the speed of the laser (and himself) because he always measures light to travel at speed c regardless of his speed through space.

So substituting (64) into (65) gives:

$$t_{emitted} = t_{measured} - \frac{x}{c} \tag{66}$$

This is the equation to be used for a laser that is at rest with respect to the space-filling field.

However, when he 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:

$$\Delta t_{up} = \frac{x_v}{s_{up}} \tag{67}$$

where x_v is the length-contracted distance to the sensor:

$$x_v = \frac{x}{\gamma} \tag{68}$$

Thus for the upstream direction substituting (62) and (68) into (67) gives:

$$\Delta t_{up} = \frac{x}{\gamma(c-s)} \tag{69}$$

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

$$t_{emitted} = t_{measured} + \Delta t_{up} - \Delta t \tag{70}$$

So substituting (69) and (64) into (70) gives:

$$t_{emitted} = t_{measured} + \frac{x}{\gamma(c-s)} - \frac{x}{c} \tag{71}$$

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 (71), 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:

$$t_{emitted} = t_{measured} + \frac{x}{\gamma(c+s)} - \frac{x}{c} \tag{72}$$

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.

Section 4

Particles in a Gravitational Field:

Consider a system of two neutrons allowed to fall together by mutual gravitational attraction. Neutrons are chosen because no other long-range force acts between them other than gravity. Initially they are at rest with respect to each other, and are separated by some distance – say one meter.

As the two particles accelerate towards each other they gain kinetic energy, such that when they crash into each other they both have a definite velocity. The kinetic energy gained by each Neutron must have come from one of two sources:

(1) Each Neutron gains energy from the gravitational field surrounding the other Neutron.
(2) Some of the energy comprising each Neutron is converted into kinetic energy.

Now suppose that when the Neutrons collide, the kinetic energy of both Neutrons is converted to a photon, which radiates away, leaving the two Neutrons next to each other at rest (ignore any strong nuclear effects that may occur). The result is that some gravitational potential energy has been converted to kinetic energy, and then lost from the system as a photon. However, we start with two Neutrons and end with two Neutrons, so where did the additional energy come from?

People are familiar with the concept of binding energy when talking about atoms or nucleons – that is the mass after combining two nucleons is less than the sum of the masses of the individual nucleons. It appears that a similar effect is occurring here, only with gravity this time.

So what is it that has changed about each of the Neutrons from the start of the experiment to the end of the experiment? In the light of the previous discussion about the Φ field, the obvious answer is that each Neutron is now in an environment of greater Φ field intensity. As particles can be thought of as three-dimensional wave structures, this means that the propagation of those waves in space will be slowed down (due to the time dilation in the greater Φ field).

The particle as a whole will therefore exist in a lower energy state at the end of the experiment than at the start. The energy difference is equal to the gravitational potential energy at the start of the experiment, the kinetic energy during the experiment, or the energy of the photon at the end of the experiment. All three of these energy forms are equal in magnitude.

Now which of the two possible mechanisms (1) or (2) above is more likely to be correct? It is known that the gravitational field has energy/mass (and is itself a source of gravitation). Also the gravitational field is inseparable from the mass that generates it, so the gravitational field of a Neutron is essentially an extension of that Neutron into the surrounding space. So the question is: does each Neutron get the energy from the other Neutron, or from itself by undergoing an internal re-arrangement of its structure? Either way, each Neutron gains an equal amount of kinetic energy at the expense of some other form of energy in the system.

When one talks about an electron falling into a potential well in a crystalline lattice and emitting a photon, the energy of the photon comes from the electron. Therefore it appears most likely that when a particle falls into a gravitational potential well, the particle undergoes an internal rearrangement, releasing some of its own energy which then appears as kinetic energy of the particle.

The alternate interpretation is that the gravitational field supplies the energy to the particle, appearing as kinetic energy. However, if the particle is then brought to rest, and the kinetic energy dissipated, the particle would have the same energy as when it started the experiment. It is a requirement that the particle be in a lower energy state at the end of the experiment than it was at the start, therefore this interpretation cannot be correct.

If the experiment were repeated with unequal masses – say an electron and the Earth – the amount of energy gained by each mass would be determined by the potential well generated by the other particle. So the Earth falling into the potential well of the electron would gain a tiny amount of kinetic energy, and the electron falling into the larger potential well of the Earth would gain a larger amount of kinetic energy.

The current understanding of gravitational potential energy talks about the potential energy of a system of masses, but does not attempt to say where this energy resides prior to conversion to kinetic energy when the masses fall together. It is essential, however, to know where the energy is in the system at all times in order to have a clear picture of the dynamics of the situation. All forms of energy are sources of gravitation, so the overall gravitational field is shaped by the location of the energy in the system. One may argue that such small amounts of energy and therefore gravitational field are of no consequence – but if one wishes to know for sure what is happening in a given situation, these small considerations are as important as larger ones, and may in fact confirm or deny the validity of a theory.

The next thing to do is to understand how the internal structure of a particle (such as an electron) changes when allowed to fall through a gravitational field such that a stationary particle becomes a moving particle. A good starting point is to examine what happens to the wavefront of a light ray as it passes through a gravitational field.

It is a known observation that a gravitational field bends light as it passes through. This is easily understood in Energy Field Theory as the slowing down of the light nearest the planet/star. As a result, the wavefronts comprising the light ray change direction (much like the rows of a marching band turning a corner).

As particles are comprised of waves in a three dimensional standing wave pattern, these waves will be affected by a gravitational field in a similar way to light waves. A simple model of a particle can be constructed by trapping a single photon of light between two mirrored surfaces – such that a standing wave is produced. There will exist a certain number of nodes/anti-nodes in the space between the mirrors, and therefore a characteristic frequency of this 'particle' (this characteristic frequency is analogous to the Compton wavelength of a particle).

A stationary particle's properties remain the same when at different gravitational potential levels – yet the overall energy of the particle changes. How can we reconcile these two ideas? For our model particle to retain the same character at different gravitational potentials, it needs to retain the same wave structure in space (i.e. the number of nodes/anti-nodes and characteristic frequency). The rate at which these waves travel, however, is able to change without disrupting this pattern. So at a lower gravitational potential, the standing wave between the mirrors oscillates more slowly.

When a particle moves to a region of lower gravitational potential, its waves oscillate at a slower - So the concept of energy is relative to the observer's location. A particular wave structure appears to have more/less energy as it moves between gravitational potential levels.

Due to this effect, a stationary particle at a gravitational potential of zero will contain more energy than it needs to form the same type of particle in a gravitational potential well. So when traversing the potential gradient to it's destination, the excess energy is shed as kinetic energy. Then when the particle is stopped, the excess kinetic energy is lost to the environment – leaving the particle stationary. The waves comprising the particle will be moving more slowly (thus lower energy) but the structure will remain the same.

Therefore, the particle modeled by the photon between two mirrors will be affected in a similar way. The photon will become blue shifted (altering the number & position of the nodes - altering the "particle's" characteristics) when lowered into the potential well (due to Doppler shifting of the light waves during acceleration of the mirrored surfaces), unless some energy is extracted. If a photon is emitted to extract the extra energy, then the waveform in the cavity between the mirrors can retain its characteristics. The resulting wave will look the same, but will oscillate more slowly.

A skeptic may say: “But if the particle has lower energy, it will have lower mass and will not generate as much gravitational attraction.” This is true from the point of view of an outside observer, however any measurements made by an observer at the same gravitational potential as the particle will not show any changes to the particle’s properties. This is due to the slower rate of time at that location. Any force measured by the observer is actually weaker than it appears because time is running more slowly. For example, the velocity attained by a test mass influenced by the gravity of our particle is given by the equation: $v = at$. Thus an acceleration of half the strength, operating for twice the time results in the same velocity being attained.

Observations made by another observer in a region of zero gravitational potential (where time is not dilated) will discover the truth – everything is happening more slowly within the potential well. Thus a photon emitted in the gravitational well appears to be blue to an observer inside the well, but to the external observer it is red.

I hope to return to the analogy between light and matter later, in an attempt to explain how the structure of the particle changes when traversing a gravitational field.

If one views a particle and its surrounding gravitational field as a single waveform, some insight into the mechanism by which gravity operates may be gained. We know from General Relativity (also by Energy Field Theory) that the rate at which time runs is determined by the level of the gravitational potential. If this understanding is overlayed with the picture of a particle as a three dimensional standing wave extending into space with diminishing amplitude, then some conclusions may be drawn. The regions of highest mass/energy density are located where the greatest wave activity occurs. These regions are also associated with the slowest rate of time.

Two inferences can be drawn from this analysis:

(1) Mass/energy is a property of wave activity.
(2) The presence of one wave in space, slows the progress of other waves through that same space.

It must be said that the effect mentioned in point (2) is a very small effect (the amount of time dilation due to gravitational potential level is quite small) and waves such as photons pass through each other in great numbers essentially unhindered. However even photons generate a gravitational field and therefore lead to a slight slowing in the rate of time in their immediate viscinity.

More generally, one property of space feeds back, affecting another property of that space. The level of activity in the space affects its ability to respond to other activity – and therefore to transmit that (wave) activity.

Now we are getting closer to being able to attach physical reality to the Φ field that I have mentioned so often. The level of the Φ field is associated with the level of wave activity in a region of space.

The speed of light is known to be affected by the Permittivity/Permeability of the space it is traveling through. Indeed, the equation expressing this relationship is:

$$c = \frac{1}{\sqrt{\varepsilon \times \mu}} \qquad (73) \qquad \text{where} \qquad \varepsilon = \text{Permittivity}$$

$$\mu = \text{Permeability}$$

If the product of the Permittivity and Permeability changes, then the speed of light, and hence the refractive index of the medium changes too. This appears to be a similar effect as is described by the Φ field intensity. Therefore the following relation appears to be valid:

$$\Phi \propto n \qquad (74) \qquad \text{where} \qquad n = \text{Refractive index}$$

From this it appears that a wave in space alters the refractive index (or gravitational potential or Φ field intensity) of that space slightly, such that other waves are slowed slightly when traveling through that space.

The nature of this refractive index is different to a normal refractive index though, as all wave activity (including nuclear processes) is slowed – not just the passage of light. The understanding of this requires more work.

Section 5

Vacuum Energy/Zero Point Energy:

The Standard Model of Physics speaks of energy only in quantized units (quanta). However Quantum Mechanics speaks of Vacuum Energy, or Zero Point energy; and it is realized that electric, magnetic & gravitational fields all possess energy. Yet these forms of energy are of a more continuous nature and not quantized when in free space. For example, the electric and magnetic fields in the space around an electron. Each field is formed by a quantized particle (the electron), but at any region in space they are a particular (un-quantized) value, and form a smooth gradient in space.

I see the particles as stable wave structures surrounded by a ‘choppy sea’ of sub-quantum energy waves – much in the same way as high and low pressure regions form stable structures in the atmosphere. Therefore when the small sub-quantum waves add up to a large peak at a region in space, a virtual particle is said to have formed. These virtual particles are known to exist in the vacuum and they have real properties capable of changing the Physics of a situation. They only exist very fleetingly, then disappear into the vacuum once more – consistent with passing wave crests momentarily summing to form a virtual particle.

In a quote from Einstein's book "The Meaning Of Relativity" (p80), the energy bound up in space is made apparent:

"It must be remembered that besides the energy density of the matter there must also be given an energy density of the gravitational field…".

The energy bound up in the gravitational field in this way possibly accounts for much of the so called “missing mass” or “dark matter” in the Universe?

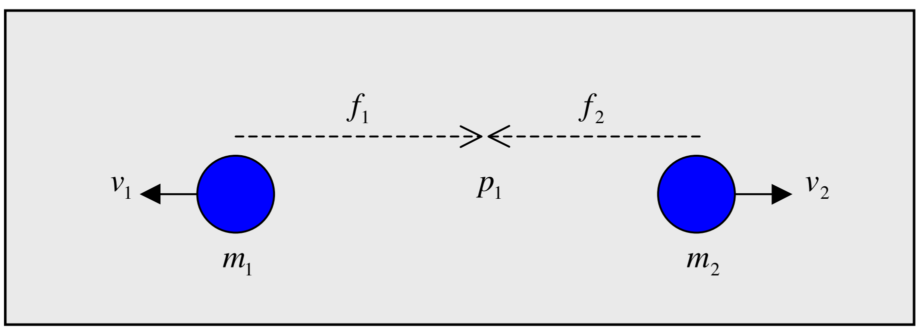
Section 6

Special Relativity In More Detail:

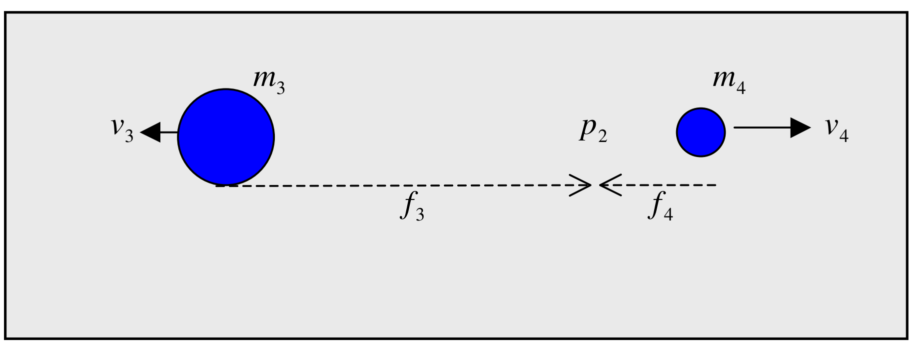
I have discussed the derivation of the time dilation due to Special Relativity for a reference frame that is moving with respect to the Φ field, when compared to another reference frame that is stationary with respect to the Φ field. What about the more general case of two objects both moving with respect to the Φ field?

If we return to the discussion of Section 1, regarding the motion of two masses from a common starting point that is stationary with respect to the Φ field, then we can analyze the situation further. If the two bodies push off from one another with equal force, then the two masses attain velocities in either direction away from the center of mass. See the diagram below - Two cases are considered: Case A (equal masses) and Case B (unequal masses). The dashed lines represent laser beams from identical lasers.

A



B



In each of the cases A and B there will exist a point (p_1 and p_2) somewhere between the two masses where the field effects due to the two masses will be of equal magnitude, and will either add up to give double the effect, or subtract to cancel their effects. Looking at case A : It has already been established that the potentials ϕ_1 and ϕ_2 due to m_1 and m_2 obey the superposition principle, so there will be a positive addition of the two fields. However, the motion through the Φ field is a vector quantity rather than a scalar, so one would expect the two motion vectors (one accorded to each of the fields of m_1 and m_2) to cancel each other when added together. If this is so, then we can be assured that this point is truly considered to be at rest, and therefore should not experience any time dilation effects due to the motions of m_1 and m_2.

If we make this reasonable assumption, then a general form of the Special Relativity time dilation equation can be derived. This equation gives the time dilation that applies between any two bodies, given the velocities of each body with respect to the Φ field at their location. This general form of the time dilation reduces to the Lorentz factor, as it should, when all of the motion is applied to one of the bodies – the other considered to be stationary.

For A : $m_1 = m_2$ (75) $v_1 = -v_2$ (76)

For B : $m_3 = km_4$ (77) $v_4 \rangle v_3$ (78)

The frequencies mentioned here ignore General relativistic effects due to the gravity of the masses, and Doppler effects due to their motion. They represent comparisons of the emission frequencies of identical lasers on each of the bodies, whose frequencies have been altered due to Special Relativistic time dilation only.

If f_0 is the frequency of a known laser source (at the stationary point) then the following time dilations follow:

For A : $\gamma_{a1} = \frac{f_0}{f_1}$ (79) $\gamma_{a2} = \frac{f_0}{f_2}$ (80) $\gamma_{a3} = \frac{f_1}{f_2}$ (81)

Due to the symmetry in A, $f_1 = f_2$, so :

$$\gamma_{a1} = \gamma_{a2} = \frac{1}{\sqrt{1 - {v_1}^2 / c^2}} \qquad (82) \qquad\qquad \gamma_{a3} = 1 \qquad (83)$$

For B : $\gamma_{b1} = \frac{f_0}{f_3}$ (84) $\gamma_{b2} = \frac{f_0}{f_4}$ (85) $\gamma_{b3} = \frac{f_3}{f_4}$ (86)

$$\gamma_{b1} = \frac{1}{\sqrt{1 - {v_3}^2 / c^2}} \qquad (87) \qquad\qquad \gamma_{b2} = \frac{1}{\sqrt{1 - {v_4}^2 / c^2}} \qquad (88)$$

Rearranging (84) and (85) gives:

$$f_3 = \frac{f_0}{\gamma_{b1}} \qquad (89) \qquad\qquad f_4 = \frac{f_0}{\gamma_{b2}} \qquad (90)$$

Substituting (89) and (90) into (86) gives :

$$\gamma_{b3} = \frac{\gamma_{b2}}{\gamma_{b1}} \qquad (91)$$

So, by substituting (87) and (88) into (91), a general form of the Special Relativistic time dilation for two moving bodies is obtained :

$$\gamma_{b3} = \frac{\sqrt{1 - {v_3}^2 / c^2}}{\sqrt{1 - {v_4}^2 / c^2}} \qquad (92)$$

This equation should be valid for any two bodies in a system where v_3 and v_4 are the velocities of the bodies relative to the Φ field at their locations.

As you can see, if all the motion is attributed to m_4 then v_3 becomes zero and (92) reduces to the usual Lorentz factor (55).

Determining the velocity of an object

The problem now becomes how do we determine the velocity of any body with respect to the Φ field? The answer to this question is most easily obtained by considering a Universe consisting of only two objects, such as in case B above.

The ϕ field of an object is produced by the mass of that object, and so is moving at the same velocity as the object itself (assuming no acceleration). Thus there will be a flux of the ϕ field of one object through the space occupied by the other object, and vice versa. The two field fluxes will add in a vector fashion, resulting in an overall field flux at any given point.

The resultant flux of the Φ field will have to be a vector addition of all the Φ components from each of the masses in the system. At the zero velocity point, all the vector components would cancel exactly. In case A, due to the symmetry of the situation, this point (p_1) will be at the midpoint of the line connecting m_1 and m_2 (as will the center of mass), however in case B the zero velocity point (p_2) will be at some fraction of the distance along the line connecting m_3 and m_4.

At the zero velocity point, the vector component due to m_3 must exactly cancel the vector component due to m_4, in order that the velocity through the field at this point equals zero. If we say that ϕ_3 is the field contribution made by m_3, and ϕ_4 is the field contribution made by m_4, then we are looking for a quantity such that:

$$V_1 + V_2 = 0 \quad (93)$$

Where V_1 and V_2 are vectors representing the flow of the Φ field.

If we let :

$$V_1 = \phi_3 v_3 \quad (94) \qquad V_2 = \phi_4 v_4 \quad (95)$$

Then (93) becomes :

$$\phi_3 v_3 + \phi_4 v_4 = 0 \quad (96)$$

This type of vector needs to be a function of the field generated by a mass, and the velocity of that mass with respect to the observer. As the gravitational field generated by the mass diminishes in intensity with distance from the mass, then the mass's influence on the observer will also have to diminish accordingly. This leads to the situation where, despite a large relative speed between the two bodies, there is very little time dilation on either body (due to the other body's field) because of the large separation between them.

If you think about it, this must be the case. If the relative speed was the only determining factor in setting the time dilation factor, then there would be a 'tug of war' between every body in the Universe and every other body – each trying to assert that the other is moving at a certain speed and should therefore have a particular time dilation.

If one imagines a system of many masses that explodes from its center of mass (such as the Universe during the Big Bang), then after some time there will be a distribution of masses expanding into space. At some location well away from the center, there will exist an environment of masses all traveling at similar velocities. As each mass contributes to the overall Φ field, and the magnitude of the contribution made depends on distance, then the local environment for each mass in this region will be of a Φ field mainly determined by its neighbors. Thus the field will be almost stationary relative to each of these masses.

Incidentally, this effect would also exist to some extent in the spiral arms of galaxies, and may effect the calculations of galaxy rotation rates (due to a rotating space/reference frame). The rotation rates of galaxies differ greatly from the predicted rates using the standard model of Physics (leading to the inferred dark matter).

In another example, using case A in the diagram above: If an electron in a Synchrotron (located on m_1) moving at a known speed with respect to m_1 has a certain time dilation, then if the relative speed was the only determining factor in setting the time dilation factor, the amount of that time dilation would vary greatly depending on the electron's direction of motion with respect to m_2. If it were moving towards m_2, then m_2 would assert that it is traveling more slowly, and would therefore have a smaller time dilation. On the other side of the Synchrotron (when the electron is moving away from m_2) it would have a larger velocity with respect to m_2, and would have a larger time dilation. In the meantime the velocity of m_1 with respect to m_2 remains constant, so that the time dilation of m_1 would also be constant. This means that any variation in the time dilation of the electron would be apparent to an observer on m_1. This is not observed, so it is clear that the field from m_1 affects the electron more strongly than the field from m_2.

I should make the point here, that there would be a very slight difference in the time dilations on either side of the Synchrotron in the case above, but the amount of the effect will depend greatly on the distance from m_2 and the mass involved.

In an experiment carried out on Earth (in October 1977 by Joseph Hafele and Richard Keating) using atomic clocks flown around the world in airplanes, just such a difference has been detected. In this case, the experiment noted a difference in time dilations between an Eastward flying airplane and an airplane flying Westward. The difference in the recorded time dilations being due to the airplane's different velocity relative to space's Φ field between East/West, due to the Earth's rotation. The velocity differs because the atmosphere rotates with the Earth, but the airplane flies with constant velocity relative to the atmosphere, not with space.

So the velocity of any mass relative to the Φ field will be based on a sum of all the $\vec{V}$ contributions made by all of the other masses in the system. The equation suggested by this requirement is :

$$v_\phi = -\frac{1}{\Phi}(\phi_1 v_1 + \phi_2 v_2 + ...\phi_n v_n) \qquad (97)$$

where : $$\Phi = -\sum_1^n \phi \qquad (98)$$

Hopefully by calculating v_ϕ for each of the two masses, and plugging the answers obtained into equation (92), an appropriate time dilation for one mass with respect to the other mass will be obtained.

Testing equation (97) for the situation usually encountered (i.e. a small mass moving relative to a large mass) yields the correct answer:

$$m_3 \rangle\rangle m_4 \qquad (99)$$

At separation r :

$$f = f_0\left(1+\frac{\phi}{c^2}\right) \qquad (100) \qquad\qquad \phi_4 \to 0 \qquad (101)$$

Thus (97) becomes :

$$v_{\phi 3} = \frac{1}{(\phi_3+\phi_4)}\phi_4 v = 0 \quad (102) \qquad\qquad v_{\phi 4} = \frac{1}{(\phi_3+\phi_4)}\phi_3 v = v \qquad (103)$$

$$\gamma = \frac{\sqrt{1 - {v_{\phi 3}}^2 / c^2}}{\sqrt{1 - {v_{\phi 4}}^2 / c^2}} = \frac{1}{\sqrt{1 - v^2 / c^2}} \qquad (104)$$

Thus the usual Lorentz factor is obtained, as it should be.

These tests indicate that equation (97) gives the correct answer in the special case where all the motion can be ascribed to one object (due to the large difference in masses). However, more rigorous testing – perhaps, computer modeling, is required for more complex cases.

Section 7

Particles and Forces in general:

The wave nature of condensed matter is well accepted in Physics. Wave properties such as the de Broglie wavelength of a particle or the Schroedinger wave equation for an electron's orbital are commonplace. If one accepts that solid particles are in fact dynamic standing waves then a number of things follow naturally from this.

First of all the link between energy & matter is made clear, as every solid particle can be viewed as a sort of *vortex* or self-sustaining waveform (Solitons, or Dirac's Spinor functions come to mind in the case of electrons and positrons). Matter is sometimes referred to as 'Hard Light' by Physicists; this connection is easier to understand when matter is viewed this way.

The structure of particles, such as the electron can be modeled as inward and outward spherical waves that embody the particle's Compton and de Broglie wavelengths (see "The Physical Origin of Electron Spin", page 4).

Each of the different types of particles that exist in nature could be seen to be essentially stable solutions to some general wave equation which is capable of describing all stable configurations of three dimensional waves in the Φ field. Some solutions are more stable than others and therefore can undergo very rapid dynamic rearrangements of energy to new stable configurations. So all of the vast menagerie of fundamental particles could be seen as stable solutions to the problem of how to form a stable, time independent (or almost), three dimensional wave form in the Φ field by following all the rules that Physics allows. Photons are an interesting special case here in that they only exist at the speed of light. This suggests that they are physically constrained in two dimensions but free in the third, so that they are able to propagate energy in that free direction.

Also, forces, the mysterious fields that cause one piece of matter to affect another are easier to understand. Imagine that each particle is a dynamic 3D wave in a ubiquitous field and is constantly 're-drawing' itself millions of times per second (similar to computer animation) following a Huygens' construction. Some external influence then causes a disturbance in the field near the particle such that its re-drawing process will be warped. Each point in the field follows the Physical laws that the field must obey. Thus the particle re-draws itself slightly to the left/right as the case may be and the particle has moved under the influence of the force.

In the case of Gravity, the effect of the force is most likely a direct consequence of the dilation of time across the particle, such that the particle re-draws itself towards the slower rate of time (much like a light ray bending towards a mass). For other forces similar explanations (involving charge etc) would account for the action of the forces. For the extreme conditions of nuclear forces things are not so clear, but the energy density of the waves being considered may account for the strength of the forces and the speed of the rearrangements. The same principle probably applies.

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