

It can be inferred that the right side of the equation represents the difference between two potential energies. I know, by definition, its values are fixed for a given point. Therefore, the right side is anticipated to represent the difference between potential energy levels. This right side expression can be manipulated into its common form beginning with:

$$\frac{1}{2}mv_{c1}^2 - \frac{1}{2}mv_{c2}^2 = \frac{1}{2}m(v_{c1} + v_{c2})(v_{c1} - v_{c2})$$

For sufficiently short distances such as in the Pound-Rebka experiment:

$$\frac{1}{2}m(v_{c1} + v_{c2})(v_{c1} - v_{c2}) = \frac{1}{2}m(2v_c)(\Delta v_c)$$

Taking the right side alone and simplifying it:

$$\frac{1}{2}m(2v_c)(\Delta v_c) = mv_c\Delta v_c$$

The incremental exceleration for the speed of light is:

$$\frac{\Delta v_c}{\Delta x} = \left(\frac{1}{v_c}\right)\left(\frac{\Delta v_c}{\Delta t}\right)$$

Rearranging terms:

$$v_c\left(\frac{\Delta v_c}{\Delta x}\right) = \frac{\Delta v_c}{\Delta t}$$

Multiplying by  $m$ :

$$\frac{mv_c\Delta v_c}{\Delta x} = m\frac{\Delta v_c}{\Delta t}$$

Since:

$$g = -\frac{\Delta v_c}{\Delta t}$$

I can write:

$$\frac{mv_c\Delta v_c}{\Delta x} = -mg$$

Rearranging:

$$mv_c \Delta v_c = -mg \Delta x$$

The right side is the definition of potential gravitational energy over a distance small enough for  $g$  to be considered a constant. The left side represents what I assumed to be gravitational potential energy in the energy equation derived above. This equation then expresses common gravitational potential energy as a function of the speed of light.

This result is consistent with the initial assumption that light accelerates at the rate  $g$ . A little adjustment to the equation just above will show this to be true. It is known:

$$ma = \frac{dE}{dx}$$

Both sides are different expressions of force. The left side is Newton's expression, and the right side is the derivative of energy with respect to distance. From three steps above, I solve for  $mg$ :

$$mg = -\frac{mv_c \Delta v_c}{\Delta x}$$

The left side is Newton's expression of gravitational force. The right side is an increment of energy divided by a corresponding increment of distance. I eliminate  $m$ :

$$g = -\frac{v_c \Delta v_c}{\Delta x}$$

I let the increment of distance approach zero and the equation becomes a differential equation:

$$g = -v_c \frac{dv_c}{dx}$$

Since:

$$\frac{dv_c}{dx} = a_{cx}$$

Where:  $a_{cx}$  is the exceleration of light. Then:

$$g = -a_{cx} v_c$$

I have arrived back at my earlier assertion that light accelerates equal but opposite to the acceleration due to gravity.

There is a question to be raised about my energy equation. I have made the assumption in the equation that the speed of light slows as it approaches the earth. For the energy equation:

$$\frac{1}{2}mv_p^2 = \frac{1}{2}mv_{c1}^2 - \frac{1}{2}mv_{c2}^2$$

This means:

$$v_{c1} > v_{c2}$$

If this is true, then the energy of a photon approaching the earth appears to be decreasing. This would seem to predict the opposite effect from what is proven by Pound-Rebka. This apparent problem will become resolved when I give the definition of electromagnetic radiation based upon this new theory.

Photons are the carriers of electromagnetic energy. As yet, I have not explained how photons become these carriers. Before doing this, I need to establish some physical attributes of photons beginning with their elasticity or change of length. Their change of length is a direct result of the changing speed of light.

## Variable Length of Photons

Having length makes photons very versatile in this theory. It helps to lead to the derivation of gravitational effects, electromagnetic effects, relativity effects and quantum effects. This theory accepts photons have length, and it is affected by the variation of the speed of light. For a photon moving toward the earth, its length is affected in a manner somewhat analogous to the distance between two freely falling balls.

To begin the example, each ball is dropped from the same point, but they are separated in their release times by a period of one second. As the two balls continue falling, the distance between them increases. The period of time it takes for one to reach a given point and then for the second ball to reach the same point remains one second. The time of separation is a constant while the distance of separation is a variable.

A photon moving directly toward the earth is assumed to experience an increasing magnitude of negative change of velocity. In other words, it undergoes a braking action that becomes stronger as the photon approaches the earth. Therefore, as the photon approaches the earth the photon length shrinks.

The percentage of shrinkage is extremely small for a distance of the size used in the Pound-Rebka experiment. This is because the photon is moving extremely fast compared to the magnitude of the acceleration due to gravity. Its acceleration is based upon a period of time, but it takes an extremely short period of time to cover 22.5 meters.

The period of time it takes for a photon to pass a given point will prove to be of great importance. It will be shown to be a fundamental constant. I will introduce the magnitude of this time period at a later point in this theory. For now, I represent it with:

$$t_{\text{photon}} = \Delta t_c$$

The length of a photon can be defined as a function of this time period:

$$\Delta x_c \cong v_c \Delta t_c$$

For a photon traveling toward the earth, its length is changing as it moves from one radial distance to another. At the higher point, the photon length is represented by:

$$\Delta x_{c1} \cong v_{c1} \Delta t_c$$

At the lower location the length of the photon is represented by:

$$\Delta x_{c2} \cong v_{c2} \Delta t_c$$

I form a useful relationship between these two lengths by dividing the second equation by the first equation:

$$\frac{\Delta x_{c2}}{\Delta x_{c1}} \cong \frac{v_{c2} \Delta t_c}{v_{c1} \Delta t_c} \cong \frac{v_{c2}}{v_{c1}}$$

It would not be exactly correct to use equal signs in the above formulas; however, in this case using them would lose nothing significant. Empirically, we can't measure the minute difference between using the approximate and exact values. With this justification, I take the liberty, and gain the convenience, of using equal signs in these formulas. Solving for the length of the photon at its lower position:

$$\Delta x_{c2} = \Delta x_{c1} \frac{v_{c2}}{v_{c1}}$$

At this point I have developed a sufficient basis to begin the derivation of relativity type effects. I will next address the cause of general relativity type effects.

## General Relativity Type Effects

The theory of general relativity uses space-time as its cause for relativity effects. The concept of space-time is the automatic consequence of defining the speed of light to be a universal constant. However, it is possible for the speed of light to always measure as a constant over sufficiently short distances and to not be a universal constant. In other words, it is logically possible for the speed of light to vary and yet measure locally as the

same constant everywhere. The beginning analysis of this new theory presents just such a circumstance.

It has been proposed that the speed of light varies as a function of distance from matter. It has been shown if this is true, then the length of a photon will vary accordingly. The coordinated changes of these two properties of photons cause the speed of light to measure as the same constant everywhere. The acceleration of light is thereby masked. However, some effects of these two properties are not always masked. When they are not masked they are observed as relativity type effects.

In this theory, my measuring rod for time is the period it takes for the length of a photon to pass a given point. This period of time will be shown to be a universal constant. This is our most basic unit of time. It is the clock of the universe, and it keeps running with absolute precision. If this is true, then we do have access to absolute time.

There is no absolute unit of measurement of length for us to use. Our fundamental unit of measurement is the length of a photon which is variable. What is true for photons will be shown to be true also for atoms. The length of a photon is the only unit of length an atom knows. When quantum effects are derived in this theory, I will relate the size of an atom to photon length.

The effect on each atom also occurs for molecules and finally for matter in general. The size of all material objects is a function of the local size of photons. An example of how this affects measurements is to consider in detail the problem of the measurement of the speed of light. I will use photon length as my unit of length, and my unit of time is the period for a photon to pass by any point.

The measured speed of light is then always the unit length of the photon divided by this constant time period. Our unit of length changes and we have no way to measure this change. To the local observer there is no reference to use to judge the changing length of a photon. To the local observer a photon is the only fundamental unit of length. Macroscopic units of length are a function of photon length. They cannot help us to measure a change in photon length.

As the speed of light varies, the length of a photon varies. As light slows down, the photon becomes shorter. It becomes shorter by the amount necessary to keep the time period a constant. It travels slower, but it's shorter. It still passes a given point in the universal constant period of time. Since the local observer cannot measure a change in the photon's length, this fundamental unit of length is interpreted as a constant. Therefore, the locally measured speed of light is not a function of distance from matter.

The laws of physics will also be shown to be locally invariant because our measuring apparatus can only be calibrated with respect to the local length and time properties of photons. However, if a remote observer located at one point in the gravitational field, having one speed of light, was able to use their own measuring rod to measure events

occurring at another point, having a different speed of light, then there would be a difference in measurement.

While this is not possible it is useful to go through the exercise as if it were possible. I begin by discussing the situation of a stationary observer located at a given distance from the earth. The observer attempts to measure force. He applies a constant force and causes a particle to accelerate. He interprets what occurs by using Newton's force formula:

$$f = ma$$

It is empirically known that this formula is invariant. In other words, within every reference frame it will give the same results of measurement. This is the case because it uses local units of length in the measurement process.

If Newton's force formula is invariant, and if the local speed of light always measures the same, then what is the evidence the speed of light varies with distance from the earth? One piece of evidence is that acceleration due to gravity does occur. The first step in proving this is to show why relativity type effects accompany the effect we call gravity.

The kinetic energy of a falling object equals the difference in potential energy at the point from which it started to fall and the point at which its speed is measured. The equation I have derived to express this is:

$$\frac{1}{2}mv_p^2 = \frac{1}{2}mv_{c1}^2 - \frac{1}{2}mv_{c2}^2$$

The left side is the kinetic energy of the falling object, and the right side is the difference between the two respective potential energies. If  $v_{c2}$  is allowed to go to zero, then:

$$\frac{1}{2}mv_p^2 = \frac{1}{2}mv_{c1}^2$$

This equation describes a specific physical event. To understand it, we need to assume that the mass of the earth exists at the point of the earth's center. This is the same assumption often used when calculating interplanetary motion.

The equation describes the maximum kinetic energy achievable by a falling object starting at any given point and falling to the center of the earth. The speed of light used in the equation is the value that exists at the starting point. There is a direct connection between this formula and Einstein's rest energy equation. To help make this point clear, I rewrite the above equation in the form:

$$E_K = \frac{1}{2}mv_{c1}^2$$

Even though the equation is intended to express kinetic energy, the right side is an expression of gravitational potential energy. I could also write it as:

$$E_{Gp} = \frac{1}{2}mv_{c1}^2$$

And since I have not yet used a variable or relativistic mass, I write:

$$E_{Gp} = \frac{1}{2}m_0v_{c1}^2$$

Einstein's rest energy equation is:

$$E = m_0C^2$$

Expressing it in terms of this new theory:

$$E = m_0v_c^2$$

What my equation expresses is that gravitational potential energy is equal to  $1/2$  Einstein's rest energy. The connection between the two would be even clearer if it was understood where the factor of  $1/2$  comes from. The reason for the  $1/2$  factor is my derivation was performed from the remote observer perspective.

For this example, I define a remote observer as one who is motionless with respect to the gravitational field. This remote observer is assumed to be located at the final position to which the raised object will reach. The remote observer, hypothetically, measures the increasing potential energy of the object as it appears from his perspective at the higher level. The remote observer's measuring rod is based upon the length the photon would have at the higher position.

Einstein's equation was gained from the perspective of the local observer. If I perform the calculation of potential gravitational energy from the perspective of the local observer, then I should achieve the same result as Einstein did for his energy equation.

Before making this calculation, I will explain the physical significance of each perspective. It would help to clarify the differences by first describing the local perspective in some detail. A local observer is one who would make his measurement of the object's potential energy while traveling with the object from the original point of zero potential energy to the location of maximum potential energy. The local observer is measuring the distance the object is raised by applying his local unit of measurement all along the way.

Even though, at any given point, the local observer measures the speed of light as a constant, he still also detects it as a variable. Even if he does not recognize it as so, it is detected as a variable at any given point by virtue of its instantaneous rate of change.

This instantaneous rate of change is measured at a point and is not masked by the changing length of photons. It is the cause of the effect that all observers measure as the acceleration due to gravity.

The local acceleration due to gravity is equal but opposite to the local acceleration of light. The simple expression for this connection is:

$$\frac{dv_p}{dt} = -\frac{dv_c}{dt}$$

This equation does not include any consideration of photon length. So, at a point in space, we can detect the acceleration of light but cannot measure the speed of light. The measurement of the speed of light is a different kind of observation. It must be made over a distance and from this perspective it becomes a function of photon length.

Such a measurement would yield the speed of light to be a constant value. Therefore, the local observer does detect the effect of the changing speed of light but cannot measure the change in the speed of light. In other words, for the local observer, the acceleration due to gravity exists while the speed of light is a constant. This is what he observes, and this is what he uses in his mathematical formulas.

This description is analogous to Einstein's definition of general relativity. He says space-time causes all the effects that would be expected if light actually accelerated due to gravity. However, he insists on having the measurement of the speed of light remain a constant. The interpretations of the theories are different, but we are describing the same event.

The heart of understanding relativity type effects is to understand the problem of measuring a physical event both through local means and through remote means. The local observer is located on the object as a constant force lifts it up, from very close to the theoretical point of origin of gravity, to its final remote position of potential energy. The observer measures the local force required to lift the object through the complete process. The observer calculates the increasing potential energy using:

$$E_{Gp} = \int_0^x f dx_L$$

The differential unit of distance used by this moving observer is his local  $dx_L$ . To him this appears to remain the same length. However, because he has only one unit of length to fall back upon, the length of a local photon; his unit of length is actually changing. The local observer traveling with the lifted object cannot measure a change in his  $dx_L$ , while the remote observer, hypothetically speaking, can measure the change of local photon length using his constant  $dx_R$ .

The remote observer, who is at rest at the highest point the object will finally reach, will judge the whole process by use of the maximum  $dx$ . He is located where  $dx$  is at its maximum value. The differential expression  $dx_R$  represents the photon's maximum incremental size. If he uses this remote, or rest, measurement of an increment of distance to gauge what is occurring during the complete lifting process, then he will calculate a different result than does the local observer.

As the remote observer watches the lifting process, he sees the local observer's unit of length changing. He also sees that a constant force is being applied over changing increments of distance. I will show this effect in mathematical detail when I discuss speed and special relativity type effects. These increments of distance are smaller nearer the point source of gravity, and approach zero when very close. Nearer the source the force is consumed in shorter and shorter distances. The force is less effective as the remote observer looks closer to the source of gravity.

As the remote observer watches the object being lifted up from very close to the point source of gravity, he observes, in the early stages, the force required to lift the object is immense but is decreasing. The force necessary to lift the object, using  $dx_R$ , becomes strictly normal only when the object has come very close to the observer. It is approximately normal long before this. The remote observer sees more force applied over the total distance than does the local observer.

The remote observer, therefore, also measures a larger amount of energy being invested in raising the object. In order to determine how much energy has been put into raising the object, the remote observer would integrate a formula analogous looking to the one used by the local observer. There are important differences in how  $dx_L$  and  $v_c$  are treated. For the local observer,  $dx_L$  and  $v_c$  are both constants. For the remote observer both  $dx_L$  and  $v_c$  are variables.

When I calculated gravitational potential energy using a variable speed of light, I was necessarily making the calculation from the perspective of a remote observer located at the position to which the object would finally be raised. If I want to calculate the increase in potential energy from the perspective of the local observer, then I must hold the speed of light constant.

The equation would still include the effect of the acceleration of light through the effect of the force of gravity. The force of gravity is determined by observing the local acceleration due to gravity. The local acceleration due to gravity is the local acceleration of light.

I now wish to compare the calculation of gravitational potential energy from the two perspectives. I use the general equation:

$$E_{Gp} = \int_0^x dE$$

I use the differential definition of energy:

$$dE = mv dv$$

Normally the velocity in this equation would be taken to be that of a particle or object of matter. However, for calculations of the effect of gravity between two fixed points I have shown:

$$v_p dv_p = v_c dv_c$$

Therefore, for the purpose of calculating the potential energy of gravity I can make the substitution and use the expression:

$$E_{Gp} = \int_0^x dE = \int_0^{v_c} mv_c dv_c$$

I will use this same formula to make the calculation from the two different perspectives. The perspective of the remote observer requires I treat the velocity of light as a variable. Therefore, the calculation of the integral yields:

$$E_{Gp} = \int_0^{v_c} mv_c dv_c = \frac{1}{2} mv_c^2$$

This is the identical result I have already reached for gravitational potential energy. The remote observer measures this energy to be equal to  $1/2$  of Einstein's value for rest energy.

The second calculation involves using the same formula, but it requires holding the magnitude of  $v_c$  constant. This appears to be a strange thing to do mathematically speaking. The logical problem is  $dv_c$  remains as a variable. It looks strange because I am saying the speed of light is always a constant at the same time that I am calculating the effect of the change in the speed of light.

From the point of view of the local observer, these two values are not linked. For the second calculation, then, I will hold the measured speed of light constant while allowing for the physical effect of its acceleration. The calculation is:

$$E_{Gp} = \int_0^{v_{c \max}} mv_{c \max} dv_c = mv_{c \max}^2 = mC^2$$

This result shows Einstein's rest energy is the gravitational potential energy of the object from the perspective of the local observer. The local observer is one who travels with the object to its final location. He measures the effect of gravity while measuring the speed of light as a constant.

The connection between rest energy and gravitational energy is not made fully clear at this point. The complete comparison will involve analyzing the kinetic energy of an object in motion. A general understanding of the nature of energy in this new theory requires more analysis of the energy of both particles and photons.

It should be apparent at this point that Einstein's requirement to hold the speed of light constant would necessarily result in his rest energy expression being from the perspective of the local observer. Interestingly, this is not true for the rest of his kinetic energy equation or for his special relativity equations. All of these are derived from the perspective of the remote observer. Even though he believed he was holding the speed of light constant, he did not truly accomplish this.

Einstein did, superficially, hold the speed of light constant in his equations. If Einstein had achieved the effect he was trying for then his equations would have made predictions from the perspective of the local observer. However, he inherited a problem introduced by Lorentz. Lorentz assumed the speed of light was a constant in the free space absolute reference frame. Einstein assumed every free space reference frame is analogous to an absolute reference frame. The result was that he achieved equations from the perspective of the remote observer.

Lorentz used mathematical transforms to bring two dissimilar physical concepts into relation to one another. Normally transforms are an accurate translation of two real systems. However, if one system is unreal it is still possible to derive transforms between the unreal system and a real one. Lorentz took his theory as the first system and empirical evidence as the second system. When he derived transforms to relate the two systems, it did not prove his theory was correct.

Similarly for Einstein, when he made the speed of light a universal constant he took something which is a dependent variable and declared it to be absolute. Just like for Lorentz, in order for the transform equations to help him arrive at the correct empirical answers, something that was absolute had to become a dependent variable. For both of them the absolute something, which became a dependent variable, was the dimension of time. The newly created dependent variable of time negated the effect of holding the speed of light constant.

In Einstein's rest energy equation time does not play a decisive role. Holding the speed of light constant does achieve the effect of defining rest energy from the perspective of the local observer. In his other equations, time is critical to making the equations produce the correct results. In these equations, the warping of time makes them work from the perspective of the remote observer. However, they are still fundamentally wrong in their description of the physical world. So, they have to show themselves to be wrong at some point in their predictions.

The next step toward resolving this matter is to connect my introduction of general relativity type effects, as explained by this new theory, to special relativity type effects. The variable speed of light will be shown to produce all of these effects.

## Origin of Special Relativity Type Effects

I define a unique cause for the speed of light and interpret it in a mechanical manner. It will be called the *light-field*. The connection between general relativity type effects and special relativity type effects is made through further consideration of the meaning of the equation:

$$v_p^2 = v_{c1}^2 - v_{c2}^2$$

Since a change in  $v_c$  can cause the existence of  $v_p$ , then can the reverse also be true? In other words, can the motion of matter through a background light-field cause a decrease in the local speed of light? The above equation can be solved to express the reversed effect:

$$v_{c2} = (v_{c1}^2 - v_p^2)^{\frac{1}{2}}$$

The Pythagorean form of the equation suggests that the math to follow will develop in a form analogous to that of special relativity.

I earlier showed that the length of a photon varies due to changes in the speed of light. The formula was:

$$\Delta x_{c2} = \Delta x_{c1} \frac{v_{c2}}{v_{c1}}$$

If I substitute for  $v_{c2}$ , then:

$$\Delta x_{c2} = \Delta x_{c1} \frac{(v_{c1}^2 - v_p^2)^{\frac{1}{2}}}{v_{c1}}$$

Factoring out  $v_{c1}$  from the numerator:

$$\Delta x_{c2} = \Delta x_{c1} \frac{v_{c1} \left(1 - \frac{v_p^2}{v_{c1}^2}\right)^{\frac{1}{2}}}{v_{c1}}$$

Canceling  $v_{c1}$ :

$$\Delta x_{c2} = \Delta x_{c1} \left( 1 - \frac{v_p^2}{v_{c1}^2} \right)^{\frac{1}{2}}$$

This formula expresses a physical effect in an analogous mathematical form, as does the equation for length dilation in Einstein's theory of relativity. The two descriptions have some analogy, but are not the same. His formula says that the whole of space changes its size as a function of relative speed for every moving object. Mine says that the length of a photon will change if it is in proximity to a body of matter that has a velocity relative to the background light-field. Its length becomes a function of the object's relative speed.

A photon approaching an object in motion relative to the background light-field will become smaller in length for two reasons. The first is: It will decrease in size because of the expected decrease in the speed of light due to the light-field of the object. The second is: It will decrease amount in size due to the object's relative speed with respect to the background light-field. The object's relative speed slows the local speed of light more than otherwise expected.

In the above equation, the value of  $v_{c1}$  is an initial condition, and is treated as a constant. Also, the initial photon length is a constant. The independent variable is  $v_p$ . The resulting change in length of photons is a real physical change. The interaction of photons and matter is fundamental. A change in photon properties will result in a corresponding effect upon matter.

## Particle to Photon Transfer of Energy

The transition from general relativity type effects to special relativity type effects can be made using the equations and concepts already derived. It will also introduce a new perspective on the nature of force. Force can be expressed as the measure of change in energy with respect to distance. It is known that photons carry energy. This energy is given to the photon by an accelerating charged particle.

It is an incremental change in the kinetic energy of the particle that is given to the photon. The particle's kinetic energy is given by:

$$E_K = \frac{1}{2} m v_p^2$$

The particle's kinetic energy changes as the particle accelerates. The differential expression of this change is:

$$dE_K = m v_p dv_p$$

This value of change in kinetic energy is emitted away in photons. For reasons to be made clear later, I assume photon length is very small and on the order of subatomic dimension.

I have not yet defined a new theory of electromagnetic effects at this point of the analysis. So, I will analyze photon energy in a more general manner. The analysis will include two components for the acceleration of the particle. For the first part of the analysis, the acceleration of the emitting particle is parallel to the direction in which the photon is being emitted. The counterpart situation, the acceleration of the particle being perpendicular to the direction of emission, will follow separately. Both components are necessary to speak about force in a general sense.

The incremental change in kinetic energy is stored onto a photon that is being emitted. This increment of kinetic energy is stored in the photon's very short length. Because of the very small values of length and time involved in photon calculations, I will often represent these increments, as well as the energy increment, in differential form. I will make it clear when I am doing this by using identifying subscripts on the appropriate variables.

The theoretical representation is that an incremental change in the particle's kinetic energy is communicated to a photon of incremental length. I will follow the process of emission of the photon, its travel through a changing environment and its reception by a second charged particle. I will derive the mathematics to describe this transfer of kinetic energy.

The increment of energy is transferred during an increment of time. This increment of time has a physical origin. It is the time  $dt_c$  required for the photon to be fully released. This is, of course, the fundamental constant increment of time of a photon passing a given point. During this increment of time, the emitting particle is accelerating. Therefore, I expect the leading end of the photon to be released at a different speed than is the trailing end.

The increment of particle acceleration is assumed to be much less in magnitude than the local speed of light. Therefore, the incremental distance  $dx_p$  moved by the particle during the release of the photon is much less than the length of the photon. The increment of kinetic energy given up over the distance  $dx_p$  is stored in a photon of length  $dx_c$ . The distances are not the same, but the time period for either to occur is the same. For this reason I use formulas which include acceleration as opposed to exceleration.

In the introduction of the acceleration due to gravity, I treated the accelerations of matter and of light as being equal with opposite signs. I will not do that in the analysis for this problem, the reason being that the physical circumstances are not identical. A negative sign would represent undue speculation about the nature of what are new and different physical circumstances.

The physical circumstances here do not make clear that there is a specific direction attached to the change in the speed of light. The empirical evidence of the aberration of light supports the approach that there is no favored direction. The relationship between the relative speed of matter and a change in the local speed of light is appearing here in a more general form than it did for gravity. In order to begin the analysis in this general manner, I use:

$$\frac{dv_p}{dt} = \frac{dv_c}{dt}$$

When this formula was first introduced in connection with an analysis of the acceleration due to gravity, it was interpreted to mean: It is the change in the speed of light that causes an equal change in the speed of a falling object. I move beyond the scope of this interpretation with:

$$v_{c2} = (v_{c1}^2 - v_p^2)^{\frac{1}{2}}$$

I used this equation to suggest the possibility of the local speed of light being a function of the speed of an object with respect to the background light-field. I now assume this effect to be real. I am assuming the equation can be read in either direction and retain valid physical meaning. In other words, the equation is being read to say the change of magnitude of velocity of an object of matter will cause a change of the local speed of light.

This assumption will be kept as consistent as physical circumstances will permit with what has already been given concerning the potential energy of gravity. For example, a freely falling object approaching the earth gains kinetic energy. This kinetic energy is defined as having been potential energy stored in the force of gravity. The decrease in potential energy of the object is converted into an increase in kinetic energy.

The kinetic energy was defined by the use of  $v_p$ . An increment of kinetic energy involves the use of  $dv_p$ . The potential energy was defined with the use of  $v_c$ . An increment of potential energy involves the use of  $dv_c$ . In the example problem that follows, I remain consistent with this concept. The differential variables used in this problem will retain the same subscripts as used in the gravity example.

I wish to manipulate the acceleration equation into the form I need for the purpose of defining an increment of kinetic energy carried by a single photon. I begin with:

$$dt = \frac{dx_p}{v_p} = \frac{dx_c}{v_c} = dt_c$$

This increment of time is not an arbitrary value. It is the time period required for a photon to pass a given point so I identify it as  $dt_c$ .

When I use the equation showing the equivalence of accelerations, I am interested in tracking the incremental changes occurring to both the particle speed and to the local speed of light during the time increment  $dt_c$ . I am also interested in comparing the incremental distances the particle and the photon travel during this time increment.

I use descriptive subscripts to depict each of these increments of change that occur during the event of a photon being released. The constant time increment fixes the distance increments:

$$dt_c = \frac{dx_p}{v_p} = \frac{dx_c}{v_c}$$

I will substitute these two expressions, equaling the same increment of time, into the acceleration equation:

$$\frac{dv_p}{dt_c} = \frac{dv_c}{dt_c}$$

Performing the substitutions:

$$\frac{dv_p}{dx_p/v_p} = \frac{dv_c}{dx_c/v_c}$$

Rearranging terms:

$$v_p \frac{dv_p}{dx_p} = v_c \frac{dv_c}{dx_c}$$

I want to arrive at expressions of increments of energy per increments of length, so I multiply both sides by the mass of the emitting particle:

$$mv_p \frac{dv_p}{dx_p} = mv_c \frac{dv_c}{dx_c}$$

Rearranging the terms so as to have just numerator and denominator on both sides:

$$\frac{mv_p dv_p}{dx_p} = \frac{mv_c dv_c}{dx_c}$$

The numerator on the left is the incremental change of kinetic energy of the charged particle during the time  $dt_c$ . This increment of energy is divided by the distance the particle traveled during the time  $dt_c$ . The complete term on the left side is the

mathematical expression defining the increment of force applied to the particle in order to cause the particle to accelerate during the time  $dt_c$ .

Since the left side of the equation represents an increment of force then the right side must do the same. In other words, not only acceleration is conserved but force is also conserved. The known relativity type effect of relative speed on force has not yet become apparent.

Although the right side must be an equivalent expression of force, it is not given in the familiar form of the normal definition of force. That is, the increment of energy is divided by an increment of distance different from the increment of distance the particle moved. For that matter, the right side numerator, which is an expression of an increment of energy, is not the same magnitude as the numerator on the left side.

The left side of the equation is the definition of force from the perspective of the particle. The right side is a different kind of definition of force. It is from the perspective of a photon. The right side is not less correct than the left side. The increment of force that accelerated the particle has been transferred to the photon and is stored on it.

When it reaches another particle, it communicates or delivers the increment of force to that particle. This increment of force is transported over any distance at the speed of light until it interacts with the new particle. The photon is the known carrier of information and the delivery system for force throughout the universe. It has its own mathematical expression for showing this.

The acceleration equation shows force is conserved. However, because of the different way in which this is expressed from the photon point of view, it is helpful to refer to the photon as carrying potential force. In principle, a photon has no original energy of its own. In practice, every photon must have at least some very small amount of energy due to there always being some relative motion even in the background light-field.

What needs to be shown next is what happens to the increment of force carried by the photon as the photon moves from an area of one speed of light to an area with a different speed of light. I will develop a model to represent this phenomenon. The potential force stored in the photon is:

$$f_c = \frac{dE_c}{dx_{c1}} = \frac{mv_{c1}dv_c}{dx_{c1}}$$

The  $m$  represents the mass of the emitting particle. The value of mass of the emitting particle is stored in the photon. We know from the conditions of origin of the stored increment of energy that all this information must be there even if it is combined into a single magnitude. I do know how this storage of the value of mass is accomplished; however, the explanation needs to be given later when the nature of mass is defined in this new theory.

The speed of light  $v_{c1}$  is the speed of light within the area in which the photon is first located and from which it is moving. The speed of light is a variable. The incremental change of light speed  $dv_c$  caused by the acceleration of the particle is stored in the photon. The stored values of mass and an incremental change of light speed are treated as constants. The reasons for this will become apparent when I introduce electromagnetism and later the nature of mass.

The value of the speed of light will change as a function of the changing environment encountered by the photon traveling on its way. For this example, the photon moves out of its original light speed environment into a new environment with a different local speed of light. This change is represented by:

$$mv_{c1} \frac{dv_c}{dx_{c1}} \rightarrow mv_{c2} \frac{dv_c}{dx_{c2}}$$

The subscript 2 used on the right side depicts the changed values of the two variables. These changes in magnitude are caused by the variation of the speed of light.

Photon length changes along with the change in light speed just as in the analogous example of gravity. The relationship between the two lengths is also the same:

$$dx_{c2} = dx_{c1} \frac{v_{c2}}{v_{c1}}$$

Substituting this relationship into the transfer expression above:

$$mv_{c1} \frac{dv_c}{dx_{c1}} \rightarrow mv_{c2} \frac{dv_c}{dx_{c1} \frac{v_{c2}}{v_{c1}}}$$

Simplifying:

$$mv_{c1} \frac{dv_c}{dx_{c1}} \rightarrow mv_{c1} \frac{dv_c}{dx_{c1}}$$

This result makes obvious that:

$$mv_{c1} \frac{dv_c}{dx_{c1}} = mv_{c1} \frac{dv_c}{dx_{c1}}$$

I can then write:

$$mv_{c1} \frac{dv_c}{dx_{c1}} = mv_{c2} \frac{dv_c}{dx_{c2}}$$

The transfer expression has revealed itself to be equality. This means that force, active or stored, is conserved as the photon moves through a changing speed of light. The conservation of force, as depicted by the transfer of energy from a particle to a photon, applies not only at the point of the transfer but also applies as the photon travels through space.

## Speed and Special Relativity Type Effects

I will now analyze the complete transfer process of a single photon between two particles of matter. Each particle has its own independent speed with respect to the background light-field. Each particle is accelerating at different values. They are sufficiently separated to allow for the region between them to be considered as unaffected by their motion.

Particle one's motion decreases its local value for light speed. This value is identified as  $v_{c3}$ . The middle region has the light speed of the background light-field  $v_{c1}$ . The motion of the second particle causes its own decrease in its local light speed  $v_{c2}$ .

The work above shows the entire transfer process can be set up as a series of equalities of force. The physical circumstances in order of occurrence are these:

- a.* There is an infinite, homogeneous background light-field with the speed  $v_{c1}$ .
- b.* A charged particle of mass  $m$  has an initial velocity relative to the background light-field. The particle's relative speed lowers the local speed of light to  $v_{c3}$ .
- c.* This same charged particle is accelerated to a higher relative speed by an incremental amount during the time  $dt_c$ . This positive acceleration drops the local speed of light by the incremental amount represented by  $dv_c$ .
- d.* A photon is released during  $dt_c$ , the time unit of incremental acceleration. The photon begins to be released at the light speed  $v_{c3}$ . At the time that the end of the photon is released the local light speed has decreased by the incremental amount  $dv_c$ . The local light speed is assumed to be much larger than this incremental decrease in light speed. Therefore, the new speed of light can be approximated as equaling the initial local light speed  $v_{c3}$ .
- e.* The photon moves away from the particle entering an unaffected region having the background light speed  $v_{c1}$ .
- f.* At some further distance away there is a second charged particle also of mass  $m$ . This particle has an initial relative velocity  $v_p$  with respect to the background light-field. The particle's relative motion lowers the local speed of light to  $v_{c2}$ .

- g.* The photon approaches very close to the second particle, and is now moving at very close to the speed  $v_{c2}$ .
- h.* The photon then interacts with the second particle. The particle receives an increment of positive acceleration from the increment of force that was stored in the photon. In other words, the potential for force is converted into the act of applying force to the particle.

I observe that throughout this exchange both acceleration and force are conserved. I will next work through the full exchange using the individual expressions of the increment of force for each step. This complete transfer process can be represented in a simplified way by a series of equalities describing either active force or stored force.

The expressions representing what is occurring to the particles are expressions of applied force. The expressions representing the photon are expressions of stored force. These expressions of force form a series of equalities written as the products of mass times acceleration:

$$m \frac{dv_p}{dt} = m \frac{dv_c}{dt} = m \frac{dv_c}{dt} = m \frac{dv_c}{dt} = m \frac{dv_p}{dt}$$

This redundant looking formula does say something important. It says Newton's force equation is valid on a local basis. However, it doesn't show the details of what changes are occurring all along the process. By converting from expressions using an increment of time to expressions using increments of length, I can rewrite the series. It will say the very same thing; however, it gives the details of the events involved. This converted equivalent expression is:

$$mv_{p1} \frac{dv_p}{dx_{p1}} = mv_{c3} \frac{dv_c}{dx_{c3}} = mv_{c1} \frac{dv_c}{dx_{c1}} = mv_{c2} \frac{dv_c}{dx_{c2}} = mv_{p2} \frac{dv_p}{dx_{p2}}$$

It is instructive to slightly modify the positions of some quantities in order to show each equation in the form of increments of energy per distance traveled. I do not say per unit of distance because the incremental measures of distances traveled are different for each expression. The modified series of equalities is:

$$\frac{mv_{p1} dv_p}{dx_{p1}} = \frac{mv_{c3} dv_c}{dx_{c3}} = \frac{mv_{c1} dv_c}{dx_{c1}} = \frac{mv_{c2} dv_c}{dx_{c2}} = \frac{mv_{p2} dv_p}{dx_{p2}}$$

- a.* The first term represents the incremental change in kinetic energy of the first charged particle divided by the incremental distance it moved while acquiring the increment of increase of speed.