A NEW PHYSICS THEORY

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This theory proposes a new interpretation of the universe. Its presentation requires a revision of the fundamentals of physics. This revision has a common theme around which all of the analysis is centered. The theme is the interaction of matter and electromagnetic radiation, which I will often refer to as *light*. The first step in developing this theme is to discuss the measurement of motion

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TWO ELEMENTS OF PHYSICAL ACTION

The successful search for unity in physics depends upon developing an analysis of the universe based firmly upon the two elements of physical action in the universe. These two elements are our only form of knowledge about all physical observations. Empirically, we observe all action as the motion of matter. The two elements of action are the two measurable types of motion of matter. These are velocity and change of velocity.

All of our empirical knowledge about the action of the universe should be expressible in simple to complex arrangements of these two elements of physical action. No matter how far removed an interpretation of action appears to be from an expression of these two basic elements, the interpretation is most exact when including only these two elements.

The use of the word particle has meaning because it relates to a foreknowledge of consistent, predictable measurements of change of velocity. We define gravity by a history of a variety of measurements of acceleration. The measurement of the decay of subatomic particles is a measurement of the time required for a velocity of separation to become detectable. The period of time spent waiting is measured by referencing it to the measure of motion of other particles. Motion and lack of motion are both measured with respect to motion.

Constant Velocity .

The first element of action is constant relative velocity. Constant velocity is constant speed in a constant direction as measured from a given reference frame. The measurement of constant velocity is defined as distance traveled per unit of time. Instantaneous velocity is the measurement of velocity at a point and is given by:

$$v = \frac{dx}{dt}$$

For constant velocity, the instantaneous velocity is the same constant value. While constant relative velocity is action, it is change of velocity that makes the universe possible. When there is only constant velocity, current theoretical physics does not feel it necessary to establish a cause of velocity.

Change of Velocity .

When there is a change in velocity, physics always looks for a physical cause. In general we define a cause of change in velocity as force. The particles of matter of the universe are all affected by force. Force results in predictable changes in their velocities. The particles of matter are also the sources of the causes of change in velocity. They are the sources of all force.

Theoretically, a change in the velocity of any particle of matter anywhere in the universe causes subsequent changes in the velocities of every other particle in existence. All of these resulting changes cause their own universal effects. Since material particles eventually interact with each other over any length of distance, the interactions of the particles of the universe can be considered as the dissemination of information. In other words, all matter communicates with all other matter in the universe.

The development of life and intelligence in the universe demonstrates that this dissemination of information must include more than just change of velocity. However, physics is the mechanical study of patterns of change of velocity. This new theory is also limited to this mechanical approach to interpreting the operation of the universe. Therefore, cause is defined as force and effect is defined as change of velocity.

Force is defined only by its effects. There is no evidence for a material substance nature for force. It is known that matter is affected by the presence and motion of all other matter and demonstrates this by changing its own velocity. Therefore, cause or force is the potential for matter to be in motion. Effect, change of velocity, is matter in motion.

This process of communication of force is predictable in its effects. We can describe its cause and effects by mathematical formulas. It is this predictability of changes in velocity upon which all of our laws of physics are derived. Our knowledge about this communication between particles of matter is knowledge of change. Our knowledge of

change is always knowledge of change of velocity. The instantaneous change in velocity is given by:

$$dv = d\left(\frac{dx}{dt}\right)$$

This change in velocity is given in its differential form because it is not yet measured with respect to another differential. For example, it is not yet properly a derivative with respect to time. The reason is that a change in velocity can be expressed as a function of either time or distance. My use of the word time actually represents duration. The word distance represents length. Neither true absolute time nor space is either of these. When a change in velocity is measured with respect to time it is called acceleration:

$$a_t = \frac{dv}{dt}$$

Newton used acceleration to arrive at his formula:

$$f = ma_t$$

This formula is interpreted as the definition of force as the cause of acceleration. It is a simple interpretation of a clear fundamental empirical observation. We observe that there are particles of matter and that they accelerate. However, the existence of the fundamental cause of the acceleration is known only by the measurement of changes of velocity of matter. The material nature of any force is empirically undetermined.

Physics defines unique fundamental sources of force such as gravitational and electrical. Although there are different definitions of origins of force, the knowledge that each of them can be represented by Newton's formula suggests a probable unity of origin for all. It is the appearance of the same mass, for any particular body of matter, in all applicable force equations, which is the empirically substantiated link.

It is a goal of physicists to find a theory that will establish the common origin for all force. This endeavor should take note of the success of Einstein's special theory of relativity in demonstrating a link between force and the propagation of light. His theory suggests strongly that the search for unity of force depends fundamentally upon first achieving a correct analysis of the nature of light. It is such an analysis, which forms the common basis for this new theory.

In order to perform this analysis of the nature of light, it is helpful to first examine a change in velocity from two perspectives. The first, as mentioned, is acceleration. Acceleration is the measure of a change of velocity with respect to time. Time is an intrinsic reference by which to measure all physical events. There is another intrinsic reference, which is itself clearly of a physical nature. It is distance. All action occurs across a distance and can be measured with respect to it.

Change of Velocity Per Unit Distance

A change in position is an integral part of all physical action. It can be fundamentally revealing to consider a change of velocity with respect to distance. In order to proceed toward a new analysis of the nature of light, I will sometimes make use of this method of measurement. The expression for a change of velocity with respect to distance is:

$$a_x = \frac{dv}{dx}$$

It is related to acceleration by:

$$a_x = \frac{a_t}{v}$$

Substituting differentials:

$$a_x = \frac{dv}{dx} = \frac{\frac{dv}{dt}}{\frac{dx}{dt}}$$

It is convenient to have a name for a change of velocity measured with respect to distance. I will call it *exceleration*. This is the only word I will coin. The name is chosen to reflect the use of the letter x to represent distance.

The use of exceleration will be demonstrated with the example of a freely falling body. It is described in Newtonian physics that a freely falling body, changing its velocity due to gravity, will achieve the same amount of acceleration regardless of the velocity of the body. It is also the custom to approximate the acceleration due to gravity as a constant for sufficiently short distances. Additionally it is common to observe a freely falling object by measuring its motion between two fixed points.

In order to make measurements of the change of velocity of the object as it passes between these two points, it is useful to measure the change in velocity over the distance involved instead of over the period of time involved. If the distance is a differential, i.e. infinitesimally small, quantity then the event measured is exceleration. The exceleration of a freely falling body will be used to develop formulas that will be helpful when discussing the behavior of light.

The body accelerates due to gravity as represented by the letter g. For this example g is considered a constant. Therefore, to a good approximation the body's exceleration is inversely proportional to its velocity:

$$a_x = \frac{g}{v}$$

This formula is useful for helping to define the properties of a freely falling body as measured between two points located along a line which passes through the center of the earth. One property defined in this manner is gravitational potential energy.

Energy of a Freely Falling Object

A clear empirically based understanding of energy is necessary for the development of a unified theory. The relationship between energy and the effect we call gravity is a phenomenon useful for analyzing energy. I will use the analysis of the energy of a freely falling body as a vehicle to introduce formulas that will later be used in an analysis of the properties of light.

The effect we call gravity is a natural empirical and theoretical starting point for analyzing the behavior of light. The existence of a fundamental connection between light and gravity has already been established by the theory of general relativity. A related proof offered in support of Einstein's theory is the Pound-Rebka experiment. This experiment uses the concept of a freely falling body to predict a change in the energy of light due to gravity.

In order to correctly understand the relationship between gravity and light, it is first necessary to examine the potential energy of gravity. It is known that a freely falling body experiences an increase in kinetic energy equal to its decrease in potential gravitational energy.

The change in kinetic energy between two positions of height can be expressed in terms of a corresponding decrease in potential energy by this relationship:

$$\frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2 = mgr_1 - mgr_2$$

For very small distances, I can substitute the differential expression:

$$r_1 - r_2 = dx$$

Simplifying the kinetic energy side, on the left, and substituting the distance dx into the potential energy side, on the right:

$$\frac{1}{2}m(v_2^2 - v_1^2) = mgdx$$

Factoring the kinetic energy side and substituting the general form of acceleration into the potential energy side:

$$\frac{1}{2}m(v_2 - v_1)(v_2 + v_1) = m\frac{dv}{dt}dx$$

For the very small distance dx, I can very closely approximate:

$$\frac{1}{2}(v_2 + v_1) = v_1$$

Substituting this into the equation above:

$$mv_1(v_2 - v_1) = m\frac{dv}{dt}dx$$

Rearranging differentials on the potential energy, right, side:

$$mv_1(v_2 - v_1) = m\frac{dx}{dt}dv$$

For a very small distance, I can approximate:

$$\frac{dx}{dt} = v_1$$

So for a very small distance:

$$mv_1(v_2 - v_1) = mv_1 dv$$

And the change in velocity also becomes a differential quantity:

$$v_2 - v_1 = dv$$

I make this substitution:

$$mv_1 dv = mv_1 dv$$

The differential changes in kinetic energy and potential energy are mathematically identical. It could then be said that for a freely falling object there is one general differential change in energy given by:

$$dE = mvdv$$

This general differential form of energy will be relied upon in a fundamental way in this new theory.

Momentum is also important. It can be expressed as:

$$P = mv$$

The differential energy equation given above can be used to solve for another expression of momentum:

$$P = mv = \frac{dE}{dv}$$

With this introductory analysis completed, I can proceed to analyze the nature and cause of relativity type effects. This new approach eventually leads to improved, clear, logical and interconnected general results embracing all of physics.

LIGHT AND RELATIVITY EFFECTS

The general theory of relativity established a connection between the behavior of light and all other physical phenomena. Space-time is predicted to be a part of every action of the universe. The cause of space-time is defined as the constant nature, in a vacuum, of the speed of light. The successes of the predictions of relativity theory demonstrate that in order to accurately define physics we must first accurately define light. Some primary properties of light are defined by the theory of relativity. That theory addresses the measurement of the speed of light. Therefore, I will first consider the measurement of the speed of light. I then use this new theory to explain light from a different perspective.

Measuring the Speed of Light .

The problem of the measurement of the speed of light, considered solved by relativity, can be simply introduced by considering a hypothetical problem in gravity free space. I will use two observers in proximity to each other with no relative velocity. Since there is no gravity, the only possible communication between these observers is by electromagnetic means. For convenience, I refer to electromagnetism as light.

One observer sends out a ray of light toward the second observer. The measurement of the speed of light passing between them may appear to be straightforward without logical complications. If a measuring rod is placed between the two observers, it appears reasonable to think either observer would measure the speed of light to be the known value commonly represented as C. There is some mystery, however, even in this very simple example.

What cannot be explained is how light is propagated, and what is the means by which the speed of light is regulated? It could be said there is nothing present to cause it to vary, but there is equally nothing present to cause it to not vary. This point becomes clearer when relative velocity is introduced into the problem. The correctness of relativity is not presupposed, so both time and space are considered to be symmetrical.

When there is a relative velocity between the two observers then the speed of light needs to be re-measured. There is reason to think the relative velocity may affect the measured speed of light. For example, if the two bodies are moving toward each other it is possible to wonder if the speed of the light passing by either of the observers would travel at the speed C plus their relative speed. However, this seemingly reasonable assumption is not a foregone conclusion. There is also a reasonable basis to expect the speed to be equal to C regardless of the relative velocity.

The idea of a changing speed of light due to relative velocity suggests the observer who emits the light retains control over that ray of light, while the second observer apparently does not have the ability to control it. There is no other potential source of control given. This idea requires the acceptance of multiple measured speeds of light equal to the same number of charged particles in the universe. The core of the problem is: There is implicit in this idea that the local environment has no control over the speeds of light from any number of external sources.

We have no current understanding of why light moves. It could easily be argued: If a particle controls the speed of its own light, then it should also have control over the speed of any light. We can wonder how a body has control over the light it emits, but no control over passing light physically indistinguishable from its own. The point is that there is no empirically demonstrated substance controlling the speed of light. Since the cause of this speed cannot be detected directly, then the motion of light must be determined empirically from the interaction of particles and photons. It cannot, at its level of origin, be logically deduced.

The achievement of the Michelson-Morely experiment was to very accurately demonstrate that there is no detectable variation in the speed of light as measured near the surface of the earth regardless of the relative velocity of the source. The earth's relative velocity within the solar system did not affect the speed of light. By achieving this result, the experiment confirmed the theoretical prediction of Maxwell's equations.

Maxwell's prediction was that the speed of light is a local phenomenon. The specific equation giving this prediction is:

$$C = \frac{1}{(\mu\varepsilon)^{\frac{1}{2}}}$$

Or for free space:

$$C = \frac{1}{(\mu_0\varepsilon_0)^{\frac{1}{2}}}$$

The prediction is: The speed of light depends only upon the local permeability and permittivity of the medium through which the light is passing.

The special theory of relativity agrees partly with this prediction when it accepts that the speed of light will always measure as a constant for an observer on the earth. However, it goes even further than this by extending the constant nature of the speed of light to apply beyond the local environment.

It is important to recognize that neither the Michelson-Morely experiment nor Maxwell's equation can be used as evidence to support this assumption. Each of them deals only with a local phenomenon. The special theory is not a local phenomenon. It maintains that the speed of light would measure as C over any distance. It needs to be demonstrated that the speed of light would always measure as the same constant, even over long distances, whether away from or near to matter.

Even if this prediction could be verified by placing a measuring rod across a long distance, it does not prove that the speed of light remained a constant. Any measuring rod that reaches between two points could be affected by the same environmental changes that affect the speed of light traveling between the same two points. If so, and if the changes in the length of the rod and the speed of light were proportional, then the rod would fail to help measure the change in the speed of light.

The only way to project measurements into other frames of references is to use some feature or features of the universe that can be demonstrated to be absolute constants. Relativity theory makes this claim for the speed of light; however, it is the success of relativity theory in making other predictions that is accepted as proof of the universal constant nature of the speed of light.

Interpreting Pound-Rebka .

In order to begin to demonstrate that relativity type effects, which definitely do exist, do not prove the constant nature of the speed of light, I will introduce gravity into an example problem. There are now two charged particles in proximity to each other. There exist both electromagnetic radiation and the force of gravity for each of the particles. The introduction of gravity allows me to include some general relativity effects in this analysis.

A major problem with the non-gravity example is that there is no way to give the traveling light roots. In other words, the light travels through an environment with no assumed substance. This implies the particles must control the speed of light from a distance by an unknown physical means. Special relativity gives the light roots by introducing the medium of space-time.

Since general relativity defines space-time as the real nature of gravity, then the introduction of gravity into my example gives light a physical medium, of theoretical origin, to move through. Gravity theoretically gives light universal roots. We can wonder what gives gravity roots. However, this circular question does not need to be answered

here. This simple hypothetical example is sufficient to use to begin analyzing relativity effects.

I begin the analysis by allowing gravity to serve, on a trial basis, as the roots or medium of control over the speed of light. This example problem I am using to explore the relationship between gravity and the behavior of light is, of course, not purely hypothetical. This is the kind of problem which the Pound-Rebka experiment was intended to help resolve.

The Pound-Rebka experiment did result in proof of a relationship between light and gravity. The experiment has been interpreted as a confirmation of the existence of space-time as predicted by relativity theory. Since the Pound-Rebka experiment was performed for the purpose of testing a prediction of the general theory of relativity, I will give some of that theory's background.

According to the theory of relativity the measurement of the speed of light in free space between any two bodies of matter will always be equal to C. Even before the advent of relativity theory, the work of H. Lorentz, analyzing the behavior of charged particles, used an analogous assumption on the atomic particle level. His assumption also produced a new theory.

Lorentz's use of this assumption led to the Lorentz transforms which predicted the variation of particle size and time. In a sense he invented particle-time as the predecessor of space-time. For Lorentz an electron could shrink in size in the direction of motion. His transforms are mathematical equations that do make predictions consistent with empirical evidence. Even though his equations were successful, his theory is not accepted as correct.

Einstein expanded the application of Lorentz's transforms from a description of particle size to a description of space, even to the whole universe. For Einstein it wasn't the size of the particle alone that was shrinking, but instead it was space itself and anything contained within it.

His expanded application of Lorentz's transforms provided a mathematical description of space-time. Einstein's use of the Lorentz transforms led to his pinnacle equation that is interpreted to equate mass with energy:

$$E = mC^2$$

Einstein then applied this energy equation to an analysis of the nature of photons. The application of this equation to photons led to the general theory of relativity.

It was understood photons have energy. The energy mass equation was interpreted early to predict light must then also have mass or at least could be assigned a property called *equivalent mass*. This conclusion implies that light should exhibit effects due to

gravity. In other words, gravity should cause effects upon light related to those experienced by freely falling matter.

This interpretation of the relativity mass term for photons had to be reconciled with Einstein's very first assumption about the universal constant nature of the speed of light. Einstein's initial postulate held that light in space couldn't be measured as having undergone acceleration. However, according to the predictions of the energy mass equation light must, because of its mass nature, exhibit effects consistent with having undergone acceleration.

Einstein showed that the deformations of space and time as predicted by the special theory could also account for the effects of gravity upon light. He predicted that an effect of space-time upon a photon approaching the earth would be to increase the energy of the photon. He showed that while space-time prevents the measurement of a physical acceleration of the speed of a photon, the photon's increase in energy is not masked from us. In other words, treating light as an object falling freely due to gravity, we should measure an increase in photon energy.

This increase should correspond to the known increase of kinetic energy that any freely falling body would achieve due to gravity. This is the effect that the Pound-Rebka experiment was intended to test. In the experiment a discrete particle of light, a photon, is sent vertically through the earth's gravity and is recaptured at a known distance in a manner that gives an accurate measure as to whether or not its energy has changed.

The result of the experiment showed the energy of the photon did change by the percentage predicted by general relativity. However, some caution must be exercised at this point. The interpretation of this result of the experiment has been made based upon other interpretations. The interpretation is chosen to be consistent with an accepted theoretical concept as well as with the empirical evidence. While the result did confirm the predicted percentage of energy change, it is important to keep in mind some of the things it could not do.

The Pound-Rebka experiment did not demonstrate a constant speed of light. It did not demonstrate the unification of space and time. It did not show space and time could be treated as a pliable substance. It did not do away with the action at a distance question. It did not demonstrate that the light suffered effects corresponding with a positive acceleration of light in the direction of the earth. This is an assumption based upon non-light evidence. It is possible light may actually slow down when nearing the earth, and the experiment alone cannot confirm or disprove this.

There is no direct empirical evidence as to the universal constant nature of the speed of light, because any such experiment falls short of the accuracy necessary to detect the magnitude of change expected. When light is treated as an object falling due to the acceleration caused by gravity, the expected increase in speed is very small for the distance used in the Pound-Rebka experiment.

If light did accelerate under these conditions, it would have increased, or possibly decreased, its speed by:

$$\Delta v_c = 7.35 x 10^{-7} \frac{meters}{sec}$$

This magnitude is very small when compared to the magnitude of the speed of light:

$$C = 2.998 x 10^8 \frac{meters}{sec}$$

This amount of change in the speed of light could exist, and we might not yet have verified it. If it does exist, then it could cause the result observed in the Pound-Rebka experiment.

The prediction of the Pound-Rebka experiment can be, and in practice is, arrived at by treating light as if it really did accelerate. If it wasn't for the prior existence of the theory of relativity, the result of the Pound-Rebka experiment could have been interpreted as evidence that light does accelerate as a function of distance from matter.

In fact, it remains possible to interpret the result as a refutation of the theory of relativity. The problem is that it could be interpreted as either for or against relativity. What it proved was that the energy of a photon will change as a function of gravity or, including another possibility, as a function of the cause of gravity.

There are, of course, many more successful predictions of relativity theory. Einstein's work has been very useful and cannot be dismissed by pure conjecture. On the other hand, if it is true then it should easily stand up against any challenge. Testing it should only make it more attractive. With relativity's success in mind, I ask: What can be inferred from the Pound-Rebka experiment if we do not depend upon the theory of relativity?

I pursue this line of inquiry fully realizing a simple answer will not suffice. If there is new truth to be learned from the experiment, then this truth should prove to be a key to the development of a theory more comprehensive and more successful than relativity. Also, the reason for the success of relativity theory needs to be explained.

Speed of Light .

The Pound-Rebka experiment result can be predicted by treating light as if it accelerates due to gravity. Therefore, I will allow for this possibility by representing the speed, and sometimes the velocity, of light as the variable v_c. The subscript c will be used to identify any variables pertaining to light. The single letter C will be used to represent the known measured speed of light.

The possibility for a change in the velocity of light due to gravity will be represented by:

$$\Delta v_c = g \Delta t$$

The value g represents the acceleration due to gravity. This acceleration is typically treated as a constant over the distance of *22.5* meters used in the Pound-Rebka experiment. If the distance is allowed to approach zero, then the expression approaches exactness and can be represented as:

$$dv_c = g\,dt$$

In this differential equation of the acceleration due to gravity I no longer need to approximate g as a constant. It assumes its true variable form. This is because the acceleration due to gravity g is defined as a differential expression. This equation applies to any infinitesimal point in the gravitational field. It can be solved for the change in velocity of light. I divide the equation by dt:

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

This equation says: The derivative of the speed of light with respect to time equals the acceleration due to gravity. This is a mathematical restatement of the initial assumption that light accelerates due to gravity.

The speed of light is assumed to vary with radial distance from the earth. It is useful, therefore, to reference its change of speed with respect to distance instead of time. To do this, I make use of:

$$v_c = \frac{dr}{dt}$$

This equation simply expresses the instantaneous speed of light as it travels along a straight path passing through the center of the earth.

In the Pound-Rebka experiment the distance changing is the radial distance with respect to the center of the earth. I want to reference the possible change in the speed of light to a differential quantity of this radial distance. In order to accomplish this I first solve for dt:

$$dt = \frac{dr}{v_c}$$

Now substituting this into the differential speed of light equation:

$$\frac{dv_c}{dr/v_c} = g$$

Solving for dv_c:

$$dv_c = g\frac{dr}{v_c}$$

The equation has been changed from a measurement with respect to time to an expression referenced to the distance involved. Multiplying by v_c:

$$v_c dv_c = gdr$$

It is known:

$$g = \frac{GM_E}{r^2}$$

The letter G represents the universal gravitational constant, and the expression M_E is the mass of the earth. Substituting this into the previous equation:

$$v_c dv_c = \frac{GM_E}{r^2}dr$$

Setting up the indicated integral:

$$\int_0^{v_c} v_c dv_c = \int_0^r \frac{GM_E}{r^2}dr$$

Performing the integration:

$$\frac{v_c^2}{2} = \frac{GM_E}{r} + k$$

Multiplying by two and retaining the letter k for the unknown constant:

$$v_c^2 = -2\frac{GM_E}{r} + k$$

Solving for k:

$$k = v_c^2 + 2\frac{GM_E}{r}$$

At the surface of the earth:

$$r = 6.378x10^6 \ meters$$

And:

$$v_c = 2.998x10^8 \ \frac{meters}{sec}$$

Substituting these values and solving for k:

$$k = 8.998x10^{16} \ \frac{meters^2}{sec^2} \cong C^2$$

Approximating this solution as equality and substituting for k:

$$v_c^2 = C^2 - 2\frac{GM_E}{r}$$

Taking the square root of both sides:

$$v_c = \left(C^2 - 2\frac{GM_E}{r}\right)^{\frac{1}{2}}$$

This equation describes the variation of the speed of light as evidenced by the Pound-Rebka experiment. It is not the most fundamental expression of the variation of the speed of light. It is a formula of first approximation based, in part, upon the results of the Pound-Rebka experiment. It can be seen from the formula that for any significant macroscopic distance the results predicted will be in agreement with the assertion that light accelerates due to gravity.

Acceleration Due To Gravity .

It is assumed for this analysis that light accelerates in the same manner as any falling object. The equation for the speed of light, as a function of distance from the earth, used g in its derivation. Falling objects of matter ideally accelerate at the rate of g. Since both light and matter are treated here as having the same magnitude of acceleration due to gravity, I can use this acceleration to derive an expression of the change of an object's velocity as a function of the change of light velocity. The definition of the acceleration due to gravity g for freely falling bodies of matter is:

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

Where the subscript p is used to denote particle or object velocity.

The acceleration of light is also assumed equal to g. The Pound-Rebka experiment does not make clear whether light has a positive or negative acceleration. For now I assume that it can be represented by a positive g. If this proves not to be the case then the sign can be changed later. So, the acceleration of light due to gravity is:

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

The equal left sides of these two equations allow me to set up the equality:

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

The relationship between a change in light velocity and a change in particle velocity is given here in a form that does not give much insight. In order to gain more information from it, I find it useful to change from an expression of acceleration to one of exceleration. The inconvenience with using acceleration is that for a given distance two objects moving at different speeds will have different values of dt.

So, for conditions similar to those of Pound-Rebka, the above equation should say:

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

The denominators are not the same expression for the circumstances of a measurement over a fixed distance. It will prove desirable to have equivalent differential values in the denominators. Pound-Rebka used a fixed distance as its standard for measurement of change of photon energy. This situation lends itself to the use of exceleration. In order to change the denominators to measures of distance I use:

$$dt_p = \frac{dx_p}{v_p}$$

And:

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

I substitute for each dt and now have differentials of distance in the denominators:

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

Even though I have given the denominators different subscripts in order to make their identities clear, for this example they are the same value. Both denominators are equivalent to dr the differential length of measurement of the radius of the earth.

A form of this equation will become useful later when discussing the properties of photons. For later convenience I use dx in place of dr. The expression dx represents an extremely small measurement of length. This form will be used to represent situations analogous to the current example. That is, it represents only those situations where the differential length in the denominators is the same. In these cases the formula is:

$$\frac{v_p dv_p}{dx} = \frac{v_c dv_c}{dx}$$

This formula and approximations of it will be useful for analyzing the effects of gravity in general. For the present example, both sides are still equal to g. For the right side of the equation, I can write:

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

I introduce a new variable to represent the exceleration of light:

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

The subscript x shows exceleration is defined with respect to distance. Substituting this into the equation above and rearranging:

$$g = a_{cx} v_c$$

This equation defines the acceleration due to gravity as the product of the exceleration of light multiplied by the velocity of light. Its simpler equivalent reflects my initial assumption of light accelerating at the rate of g. It is:

$$g = \frac{dv_c}{dt} = a_{ct}$$

Where, a_{ct} represents the acceleration of light due to gravity. The subscript t represents that acceleration is defined as a change of velocity with respect to time.

An important aspect of both of these equations is, until proven otherwise, they can be read both forward and backward with equal theoretical validity. This introduces the need to test for both possibilities. Each of the formulas, reading them forward, say that gravity causes the speed of light to change.

In reverse, they say: The acceleration due to gravity is caused by the change in the speed of light. In other words, if the speed of light is controlled by matter, then the effect we call gravity follows automatically without the introduction of a fundamental gravitational field.

Freely Falling Matter and Light .

I have derived a relationship between the change of velocity of light and the change of velocity of a freely falling body under the influence of the effect known as gravity. The equation expressing this relationship by use of exceleration is:

$$\frac{v_p dv_p}{dx} = \frac{v_c dv_c}{dx}$$

Multiplying by dx yields:

$$v_p dv_p = v_c dv_c$$

This form of the equation describes an equality that holds for measurements made between two points. In other words, the measurement of change of velocity is made over a given distance instead of over a given period of time. I am remaining consistent with the main ideas of the Pound-Rebka experiment.

The values of v_c and dv_c are fixed for any given location. This is a direct result of the assumption that the speed of light is a function of radial distance from matter according to the relationship:

$$v_c = \left(C^2 - 2\frac{GM_E}{r} \right)^{\frac{1}{2}}$$

While the speed and acceleration of light are fixed for a given distance r, the values of v_p and dv_p belonging to matter can vary. The reason dv_p can vary is because, I am considering a situation like the Pound-Rebka experiment. I am describing a value of dv_p that occurs within a given measure of distance and not a given measure of time.

In other words, as velocity is increased any object falling between two points will have a smaller increase in velocity between those two points. The reason is that the period of time for the object to pass the two points becomes less and less. Acceleration is based upon a constant unit of time. If the period of time varies then the change in velocity varies in a corresponding manner. Therefore, if the unit of time is decreased then the size of change in velocity will also decrease.

As a rule, I use exceleration when the dx values are equal and acceleration when the dt values are equal. Returning to the equation:

$$v_p dv_p = v_c dv_c$$

I solve for dv_p:

$$dv_p = \left(\frac{v_c}{v_p}\right) dv_c$$

At any point the values of v_c and dv_c are fixed. Therefore, dv_p is inversely proportional to v_p. This means: The faster the object is moving the less it is increasing its speed over a differential distance. It also says: If an object is moving at very nearly the speed of light the object still has a differential change in velocity approximately equal to that of light.

It has not been shown yet whether light should be treated as increasing or decreasing its speed as it approaches matter. Whichever is the case, the form of the equation should remain the same; only a sign would change. The predicted effects will confirm the correct choice.

Gravitational Energy .

The Pound-Rebka experiment showed the energy of light varies as a function of distance from matter due to gravity. The same is true for a freely falling body of matter. Therefore, I should be able to find a relationship between the energy of a falling body of matter and that of light. I will solve for this relationship over a vertical distance between two points. Therefore, I can use the equation:

$$v_p dv_p = v_c dv_c$$

Since I have not yet shown in what direction the acceleration of light is positive, it is possible this equation should have a negative sign in front of the right side. Whether the sign is given as positive or negative at this point, will not affect the form of the equation. The following analysis of the energy of light will produce more complex equations. If I choose the correct sign now then the equations developed will not have to be corrected later. It will become apparent that the speed of light slows as it approaches the earth.

With foreknowledge of the results and for the sake of giving the correct signs in the equations to follow, I choose to include a negative sign at this point. The justification will be given later. The equation becomes:

$$v_p dv_p = -v_c dv_c$$

Setting up the indicated integration equation:

$$\int_{v_{p1}}^{v_{p2}} v_p \, dv_p = -\int_{v_{c1}}^{v_{c2}} v_c \, dv_c$$

Performing the integration and multiplying by two yields:

$$v_{p1}^2 - v_{p2}^2 = -(v_{c1}^2 - v_{c2}^2 + k)$$

Zero change in v_p means zero change in v_c, therefore k is zero yielding:

$$v_{p1}^2 - v_{p2}^2 = -(v_{c1}^2 - v_{c2}^2)$$

This equation expresses the relationship between a change in the speed of a falling object and the corresponding change in the speed of light over the distance traveled. For the purpose of maintaining simplicity during this analysis, I set the initial speed of the object v_{p1} at zero. The equation for this special case becomes:

$$-v_{p2}^2 = -(v_{c1}^2 - v_{c2}^2)$$

Multiplying by *-1* and removing the subscript *2* from v_p yields:

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

Where the variable v_{c2} is the value of v_c closest to the earth.

For a body of matter dropped unhindered above the surface of the earth, the above equation gives the basic relationship of the speed it will achieve as a function of the speed of light at the point where it is released, and the speed of light at the point where the body's speed is measured. I choose to leave it in this squared form for now because I want to use it in an expression of energy.

This formula is my starting point for the analysis of relativity effects. The foundation for the introduction of these effects will now be given. I begin this part of the analysis by converting to the energies involved. I multiply both sides of the equation by *(1/2)m*:

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

The term on the left is the kinetic energy of the falling object. The two terms on the right also represent values of energy defined as functions of mass and the speed of light. When the theory is more fully developed, the true fundamental relationship expressed by this equation will become clear. For now I will provide a simple fundamental physical interpretation for the right side.