# *The Dual Effects of Both Gravity and Absolute Motion on the Rate of Clocks*

James Carter, Absolute Motion Institute, 29500 Green River Gorge Rd, Enumclaw
WA 98022 www.circlon-theory.com    circlon@yahoo.com

The photons the 2.7˚ Cosmic Background Radiation can provide and absolute rest frame in which all photons move at exactly C, as well as a frame in which all clocks run at the same rate. Time is usually thought of either as a separate entity that either exists independently from mass and space or as an integral part of an entity called space-time. Although many different kinds of clocks have been devised for measuring the passage of time, a careful look at them reveals that there are, in fact, two different arrows of time that are quite distinct from one another and can even be said to flow at different rates. It is shown that every clock records that passage of either inertial time or gravitational time. Several experiments demonstrate that the rates of inertial clocks are effected by both changes in motion and changes in gravity. Thought experiments are presented to show that the effects on the rate of clocks from both changes in motion and changes in gravity are caused by changes in the mass of the clock. The conclusion is reached that the gravitational interaction is the closest thing there is to a real time-like entity and the idea of "time itself"is nothing more than a metaphysical idea that is used to quantify different types of motion.

**The Relativity Postulates**

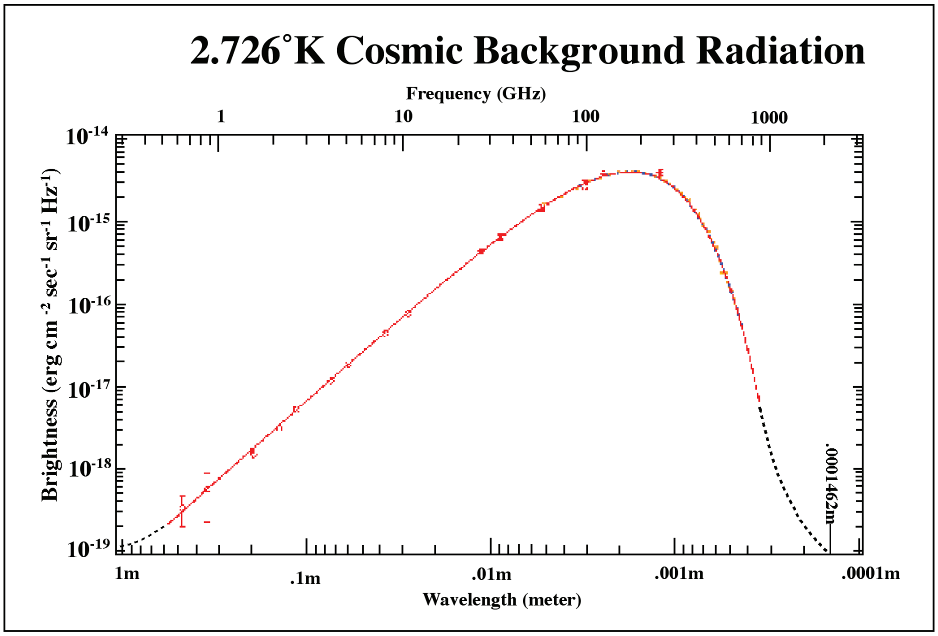
Despite the fact that Einstein's theory of Special Relativity is accepted with an almost religious fervor by the whole scientific establishment there is little if any experimental evidence that can be used to conclusively verify its validity.

The theory of Special Relativity begins with two fundamental assumptions or postulates as Einstein called them.

The first is that the laws of natures are the same for every observer in every inertial reference frame. This is usually interpreted to mean that motion is relative and there is, in principle, no preferred inertial reference frame that can be identified as absolute rest for all photons and particles of matter. This postulate is primarily derived from the Doppler effect that can only identify relative motion. Just because absolute motion is difficult to identify in practice does not mean that it does not exist in principle.

The second postulate is that the speed of light is always the same regardless of the motion of either the source or observer. This idea means that all motion is relative except for the motions of photons that are all the same and absolute relative to each other. Not only does each photon move at exactly C but all photons move relative to the same inertial reference frame of *photon rest*.

Both of these postulates are metaphysical in nature. They are paradoxical and non-intuitive conditions imposed on the interpretation of physical measurements. Such statements might properly appear as the final conclusions of a physical theory but they have no place as initial assumptions. All of the experimental evidence that has been offered as proof of relativity is only valid when interpreted through the filter of these postulates. It is far easier to interpret these same experiments within a more intuitive and non-metaphysical absolute reference frame. There is really no experimental evidence that positively confirms the need for the concept of intrinsic relative motion. All of the experimental measurements used for the verification of relativity from the old Michelson-Morley experiments to the present day GPS clock calibrations, can just as easily used to identify a position of absolute rest for the universe and support the *Principle of Absolute Motion*.




**The Nature of the Photon**

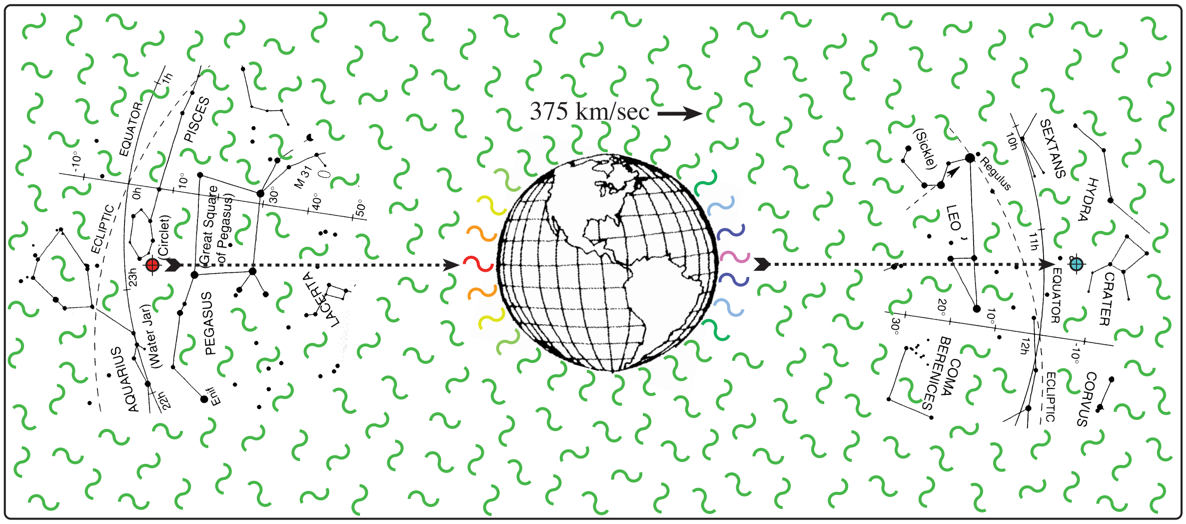
Experimental physics is essentially constructed upon the *nature* of the photon. Likewise, in theoretical physics the fundamental element in the construction of physical theory should be the *concept* of the photon. Physics begins and ends with the reality of the photon. Everything we know of in the universe, that can be observed and measured, can be explained in terms of the interaction of the appropriate photons. In fact, in order to read this page, you must engage in a complicated manipulation of a narrow band of photons. The nature of the photon is an absolute set of parameters and the concept of the photon is an arbitrary set of attributes used to explain its nature. In the theory of Special Relativity the concept of the photon was inserted almost as an afterthought. It was initially a mere mathematical construct used to explain the photoelectric effect and its attributes were selected to make it compatible with both the classical wave theory of light and the preestablished postulates of Special Relativity. Even before the nature of the photon was well understood the assumption was made that it was a massless particle and then this concept was used to interpret all experimental data.

If we construct a concept of the photon based solely on the vast amount of experimental data establishing its nature, rather than trying to pour it in a preconceived mold, we find we have a photon that is quite different from the one generated by Special Relativity and adopted by Quantum Mechanics. This new photon has rest mass and provides the universe with a preferred absolute inertial reference frame relative to which all photons move at C and time is absolute.

**A Case for Absolute Motion**

The primary experimental example of this ultimate photon rest frame is the vast number of photons that make up the 2.7˚ Cosmic Background Radiation. These photons make up well over 90% of all the photons in the universe and they are distributed in a virtually perfect blackbody spectrum for a temperature of 2.726˚ Kelvin. Careful measurement of this spectrum reveals a dipole anisotropy that shows a slightly higher temperature in the direction of the constellation of Leo and a correspondingly lower temperature in the opposite direction near the constellation of Aquarius. If we view these temperature differences as blue and red Doppler shifts, then it becomes apparent that we (the solar system) are moving with absolute motion in the direction of Leo at a velocity of about 375 km/sec. Since the rotation of the Milky Way galaxy moves our

*The 2.7˚ CBR Dipole Anisotropy*




*The Earth is in Absolute Motion relative to the 2.7˚ Cosmic Background Radiation*

solar system in a somewhat opposite direction to this motion, the actual motion of the Milky Way relative to the 2.7˚ CBR is about 600 km/sec or 2/1000 the speed of light. Since most of the photons in the universe are 2.7˚CBR photons, it would seem quite unlikely that the other photons produced by stars and by us here on earth could move at C within different reference frames.

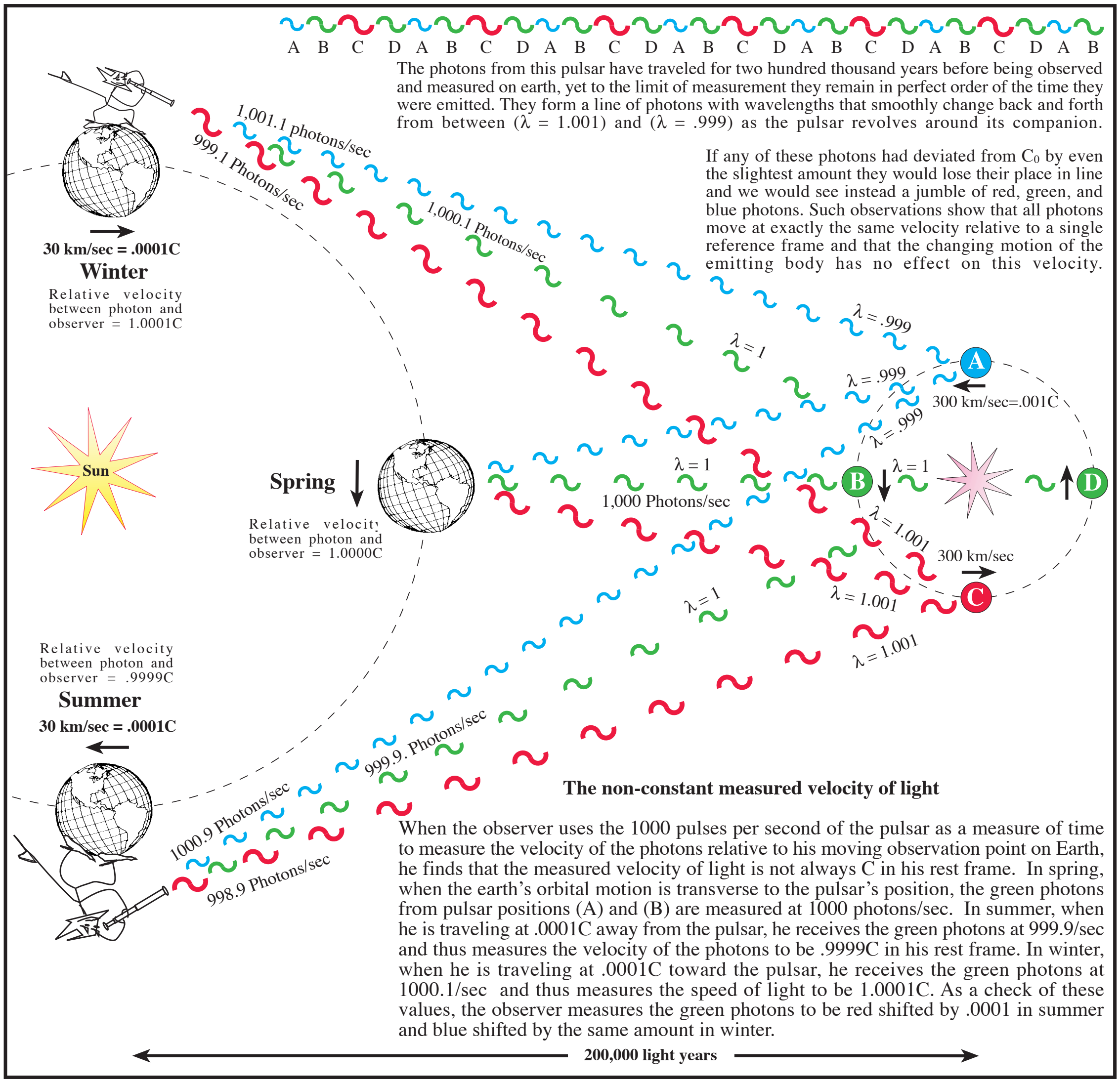
Both their extremely even directional distribution and their precise blackbody curve should convince anyone that they are all moving at exactly C relative to one another within the same inertial reference frame. If these photons were not all moving at exactly the same velocity, they would quickly lose their nearly perfect black body distribution curve.

There would seem to be little doubt that if we were to accelerate (actually decelerate) a space probe to a velocity of 375 km/sec in the direction of Aquarius, it would reach a position of absolute rest where the microwave background would be exactly the same temperature in all directions. I am sure that photons emitted at the probe would be observed back on the earth to be red shifted by an increase in wavelength and a decrease in energy of .00125. Likewise, photons emitted from the earth would be observed at the probe also to be red shifted by the same amount. Since both these sets of photons are measured to have the same wavelength of 1.00125, is it possible they have the same intrinsic wavelengths as they pass each other while traveling through space? The relative motion of Special Relativity tells us that these photons can have no intrinsic wavelength until they are measured. At the very least Special Relativity claims that we can not know to what degree each of these two sets of photons are red shifted. This, of course, is not true because if the observers on earth measure the 2.7˚ CBR coming from the direction of the space probe they see that this radiation is also red-shifted by 1.00125 when compared with 2.7˚ CBR photons coming at right angles to the direction of the probe. On the other hand, an observer on the probe would see photons emitted from earth to have a red-shift of 1.00125 but no shift at all in the 2.7˚ CBR photons coming from any direction.

The only possible explanation of these shifts is that the photons emitted from the probe have an intrinsic wavelength of 1.00000 and are then Doppler shifted to 1.00125 by the earth's absolute motion away from them. The photons emitted from earth are actually Doppler shifted by the earth's motion to 1.00125 when emitted and then measured at the probe to have this actual intrinsic wavelength.

The Doppler effect allows us to very accurately measure the relative motion between a source and observer but by its very nature it does not allow us to determine the absolute motion of either. For example, the Doppler effect allows us to determine the precise amount that a source and observer are moving relative to one another but there is no way to tell whether the photons are Doppler shifted when emitted from the source, when they are absorbed at the observer or, as is most likely, they are Doppler shifted in both cases.

**Binary Pulsar Observations**




However, this fact does not allow us to conclude that the absolute motion of photons does not exist. In fact, the very nature of the Doppler shift of photons almost requires that an absolute position of rest must exist for photons and that all photons move at C.

Photons provide the ultimate example of absolute motion since the evidence virtually proves that all photons move at exactly C within the same inertial reference frame that can be called "photon rest". If you believe in Special Relativity then you are forced to conclude that photons have no intrinsic wavelengths as they travel through space and that until they are measured there is no difference between a gamma-ray photon and a visible light photon. For example, an observer traveling in a spaceship at a velocity of .999999 C from the earth to Alpha Centuari would experience Doppler shifts of about Z = 1000. Gamma-ray photons coming from earth would be measured aboard the ship to be visible light and visible light photons from Alpha Centuari would be measured as Gamma-ray photons. The temperature of the 2.7˚ CBR in the direction of Alpha Centauri would be 2700˚K and appear as visible light. A Photon must have an intrinsic wavelength as it travels at C through space. That photon is then Doppler shifted to some other wavelength by the absolute motion of an observer.

**Binary Pulsars**

The observation of binary pulsars offers perhaps the most convincing experimental evidence that photons move at exactly C within the same reference frame. A binary pulsar emits rapid bursts of X-ray photons at very regular intervals as it revolves around a companion star. When photons from a pulsar are carefully measured, it is found that when the revolving pulsar is moving toward the earth they are blue shifted and when the pulsar is moving away from earth the photons are red shifted. Even though the pulsar may be a hundred thousand light years from earth, the photons remain perfectly lined up in their order of emission. They are observed as repeating sequences of first red shifted photons and then blue shifted photons. If the changing motion of the revolving pulsar had any effect on the photons' velocity of C, then the photons could never have remained in their sequence of emission a hundred thousand years. If any of these photons moved even slightly faster or slower than C, then they would be observed as a jumbled up mixture of red and blue shifted photons.

These observations of binary pulsars are frequently offered as proofs of Special Relativity and the constancy of the speed of light. However, while they prove quite conclusively that all photons always move at C relative to each other within a common inertial reference frame, they also demonstrate that photons almost never move at C relative to either source or observer. A typical orbital velocity for a binary pulsar can be .001C. This means that the red shifted photons are moving at 1.001C relative to the pulsar and the blue shifted photons are emitted at a relative velocity of only .999C. The very fact that the velocities of both the pulsar and the earth can change while the velocity of the photons cannot, means that the relative velocity between a photon and either its source or observer can be less than and greater than C.

When I presented this paper at the 2008 NPA meeting in Albuquerque, MN, an objection was made by one of the participants who is an advocate of Walter Ritz's emission theory of light. This theory proposes that photons are always emitted at C relative to their source. The statement was made that the photons could have been emitted at different velocities from the pulsar and were then absorbed and re-emitted by gas molecules in the vicinity of the pulsar. One problem with this idea is that molecules of even a cold gas can have individual velocities of hundreds of meters per second. This would mean the individual photons would still have different velocities as they traveled to earth. On a journey of 200,000 light years a difference in velocity between two photons of only one meter per second would mean a difference in travel time of over forty years. All photons must travel at exactly C or the pulsar's precise red and blue shifted pulses would be blurred into a steady signal.

**The Compton Effect**

The Compton Effect is the primary reason that the X-ray photons from the pulsar could not have been absorbed and re-emitted on their way to earth. In 1923 by Arthur Compton discovered that the dynamics of a collision between a photon and electron is virtually identical to the dynamics involved in the collision between any two bodies of mass such as billiard balls. At the time, there was still a good deal of debate as to whether light traveled as a wave within an electromagnetic field or whether it existed as individual and independent particles. The Compton effect offered convincing proof for the latter.

When visible light photons are absorbed and re-emitter by electrons within an atom, their wavelengths remain virtually unchanged. However, when photons of much greater energy and shorter wavelengths such as X-rays are scattered by electrons, they lose energy and momentum and can be deflected in any direction. In an encounter with an at rest electron, a photon will increase its wavelength by an amount between zero at 0˚ deflection and $4.8526 x 10^{-12}$m at 180˚ deflection. The value of this increase is constant for a given angle and is independent of the wavelength of the photon being deflected. For a visible light photon with a wavelength of $4.8510^{-7}$ m this represents a maximum increase of only 1/100,000λ. However, an X-ray photon that has a wavelength the same as the Bohr radius,($\lambda = 5.29x10^{-11}$m) would increase its wavelength by about 1/10λ, and a photon that has the same mass as an electron ($\lambda = 2.426 \times 10^{-12}$m) would triple in wavelength in a 180° reflection from an electron.

With even only a minor amount of Compton scattering, a pulsar's X-ray bursts would be blurred beyond recognition. For example, visible starlight can pass through the earth's atmosphere with only minor blurring, however, X-rays are scattered so completely that almost none ever reach the earth's surface.

**The Lorentz Transformation**

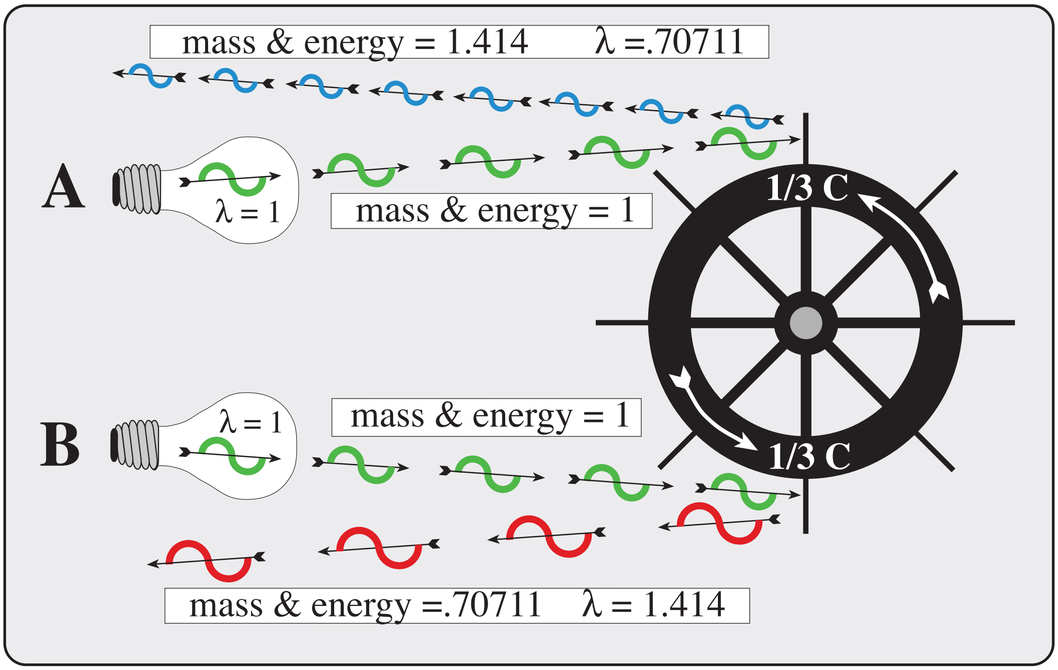
The Lorentz Transformation refers to the increase in a body's mass when it is accelerated and the decrease in its mass when it is decelerated. The reason for this mass transformation is the conservation of energy and mass that is represented by the formula $E=MC^2$. Anytime a body's energy is changed its mass is also changed. When a body is heated, its energy is increased and its mass is thus also increased according to $E=MC^2$. This mass increase is, of course, too small to be measured by conventional means but it is there. In the process used to heat the body, mass was converted into the energy used to increase the internal motions of the body and raise its temperature. For example, when we strike a match, mass is converted into energy. Some of this mass is carried away by the photons produced and some goes into the increased molecular velocities of the atoms involved. Again, these mass transformation are too small to be measured.

Special Relativity requires that photons have no mass. I believe that this metaphysical assumption is what is primarily wrong about Special Relativity. The idea of the massless photon is not really supported by experiment. Experiments show that photons carry both momentum (mv) and angular momentum (mvr) and without mass, these two parameters require new and somewhat counter-intuitive definitions. The idea of the massless photon is not a conclusion reached by the examination of experiments, rather it is a metaphysical assumption that is always given as a precondition for interpreting the results of photon experiments.

In the rest of this discussion, I am assuming that photons have mass according to their momentum divided by the speed of light (M=p/C). However, the essential arguments being made here are the same whether or not you believe photons to have mass. For example, when a positron and an electron come into contact with one another, they combine and then very quickly split into two photons. Each of these photons has the same mass as an electron (eM) or if you prefer, each has an energy of ($E = eMC^2$). In either case, when one of these photons is absorbed by another body, that body's mass will be increased by one electron mass. Either both mass and energy remain separate and constant or mass can be converted into energy and energy into mass and it is mass-energy that remains constant. I prefer to think that the electron and positron have physical structures that are rapidly spinning in opposite directions and it is this spin that contains the energy for the photons that are produced when the electron and positron annihilate. Mass remains constant in the process by which a positron and electron annihilate into photons.

Half of the photon's kinetic energy is contained in its linear motion at C ($E=MC^2/2$) and the other half of the photon's energy is rotational kinetic energy contained in its spin ($E=Iw^2/2$). This dual energy of the photon is somewhat similar to a spinning rifle bullet in which the rotational energy of its spin is equal to the energy of its linear motion. If we consider the electron and positron to be inert chunks of mass without any internal rotational kinetic energy, then where do the photons get their angular momentum and spin? Likewise, if photons are massless and electrons and positrons do have internal energy, then where does this energy go since all of the photon's energy can be accounted for by the total conversion of the particles' mass to the photons' energy?

## Photon Flywheel




**The Mass of Photons**

As an example of how the change in a body's kinetic energy must also change its mass, consider a thought experiment in which a flywheel has evenly space mirrors attached to its outer surface like the fins of a paddle-wheel. The wheel is made of an exceedingly strong imaginary material and is spun exceeding fast so the mirrors are moving at a velocity of 1/3 C.

Two lasers, **A** and **B**, shoot photons at the mirrors on opposite sides of the wheel so that the mirrors are moving at 1/3C toward the photons from laser **A** and at 1/3C away from the photons from laser **B**. These photons, are all emitted from the lasers with a wavelength, energy and mass of exactly one, and all move at exactly C relative the same inertial rest frame common to all photons. These photons all reflect from the mirrors at the same velocity C that they had before striking the mirror. The velocity of the mirrors has no effect on the photons' velocity but it does change their wavelength, energy and mass.

The photons from laser **A** are blue-shifted to a wavelength of .70711 as they reflect from the approaching mirror, and their energy and mass are increased to 1.414. In this process, the velocity of the spinning wheel is slowed as mass and energy are transferred to the reflecting photons.

The photons from laser **B** are red-shifted as they reflect from the receding mirror to a wavelength of 1.414 and an energy and mass of .70711. In this case, the velocity of the wheel increases as mass and energy are transferred from the photons to the wheel. In both of these examples, momentum is conserved and both mass and energy remain separate and constant.

If we attempt to explain this experiment in terms of massless photons then the conservation of mass is lost. The photons from laser **A** take energy away from the wheel and decrease its mass. Laser **B** photons transfer energy to the wheel and increase its mass. In both cases, energy remains constant but mass either vanishes into or appears from nowhere. How can mass and energy be equivalent if energy remains constant but mass does not? If energy has mass how can photons not have mass?

**The Mass of Clocks**

Another example of absolute motion vs relative motion is the above mentioned space probe decelerated to a position of rest within the Cosmic Background Radiation. As it was decelerated by 375 km/sec to a position of photon rest, the Lorentz Transformation would decrease its mass by .0000008. This small change in mass might be very difficult to detect were it not for the effect that it has on the internal components of clocks. In order to conserve angular momentum the spinning or vibrating components of clocks must change their rates of motion in response to changes in mass. An atomic clock onboard this probe should increase its rate of ticking by .0000008 relative to an identical clock on earth. Special Relativity would predict that its rate would slow by .0000008 as it was accelerated from its rest frame on earth to 375 km/sec. Either way, it would seem certain that if the clock was then accelerated back to the earth's frame, it would run at the same rate as the earth clock. If the clock slowed when accelerated away from the earth and then speeded up when accelerated back toward the earth, what is the mechanism by which the atoms in the clock know that they must slow down during the first acceleration and then speed up during the second identical acceleration? The only answer to this question must be that clocks run at a maximum rate when they are at the position of absolute photon rest and far away from any gravitating bodies. Clocks then slow their rates when they are accelerated relative to photon rest or come under the influence of a gravitating body.

**Gravitational Motion**

Just as the rates of clocks are affected by absolute motion they are also equally affected by gravitational motion. General Relativity predicts that clocks will slow their rates relative to their at rest rate in response to the earth's gravitational field. This slowing is proportional to the gravitational potential at the clock's location. A clock at the Dead Sea will run slower than one on Mt Everest. Gravitational Potential is a metaphysical quantity that cannot be measured directly. In order to determine the amount by which it will slow clocks, Gravitational Potential must be converted into the velocity known as escape velocity. Escape velocity for the earth is the upward velocity that a body will need to attain in order to escape the earth's gravity from a particular location in its gravitational field. Looking at it another way, it is the velocity that a body will attain falling from deep space to the earth's surface. The earth's escape velocity of the at sea level is about 11,179 m/sec. To visualize this in terms of General Relativity, we might say that curving gravitational space is being sucked into the earth's surface at the rate of 11,179 m/sec.

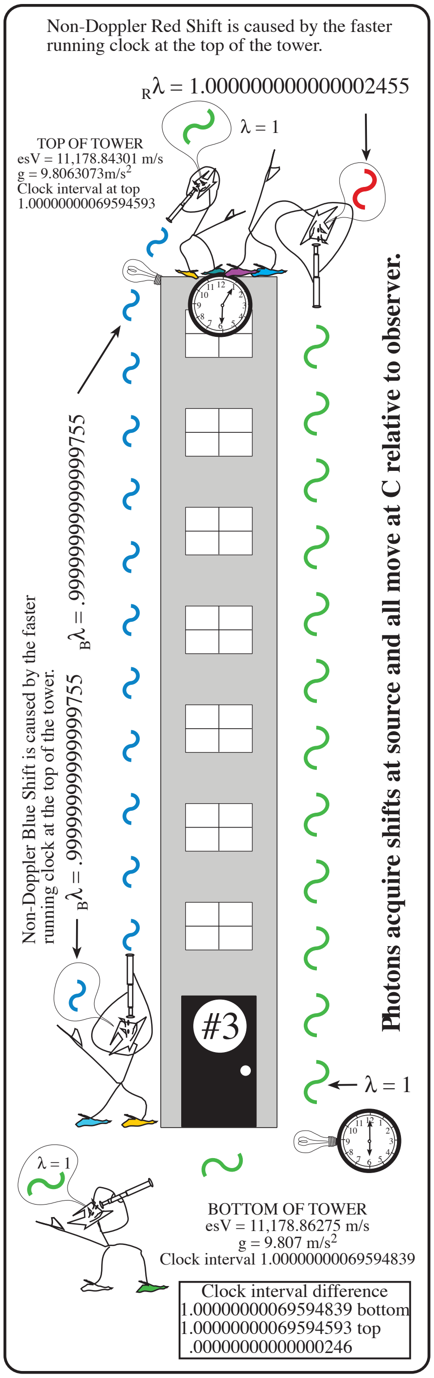
**Gravitational Expansion**

Even though General Relativity makes very accurate predictions for the effects of gravity on clocks, I prefer to view gravity from the opposite point of view. Rather than being caused by dynamically curving space-time, I believe that gravity results from the curving and expansion of matter or mass-time. This eliminates the need for the Equivalence Principle because stationary falling bodies are impacted by the earth's surface as it accelerates upward. In this theory of Gravitational Expansion, the gravitational constant is characterized as an outward surface velocity for matter rather than as an acceleration or force. The rate that a body falls to earth is determined by the difference in the upward surface velocities (escape velocity) between the earth's surface and the point above from where the body is dropped.

There is no room here to describe the various aspects of the Principle of Gravitational Expansion other than to say that in some ways it is almost a mirror image of General Relativity. Both theories are based on opposite interpretations of the equivalence principle and whereas General Relativity describes gravity as the changing geometry of space-time, Gravitational Expansion views gravity as the changing geometry of mass-time. Even though both General Relativity and Gravitational Expansion theories predict exactly the same values for gravitational clock slowing, the mechanisms by which the slowing occurs are quite different. These predictions for gravitational clock slowing have been verified by the following experiments.

**The Pound-Rebka Experiment**

The Pound-Rebka Experiment is quite complex in its technical details but in principle it is very simple. Photons of a precisely determined wavelength were emitted at the top and bottom of the 22.5-meter-high Jefferson Tower on the Harvard campus. When the photons from the top of the tower were measured at the




bottom, their wavelengths were decreased (blueshifted) by a small amount; and when photons from the bottom were measured at the top, their wavelengths were increased (redshifted) by the same amount.

In this explanation of the Pound-Rebka experiment, it is proposed that gravity causes clocks (as well as all other physical processes) at the bottom of the tower to run slower than clocks at the top. This causes the emitter at the bottom to take more time to produce a photon and thus increase its wavelength by 2.5 x $10^{-15}$. The faster clock at the top of the tower makes the emitter produce its photons in shorter time intervals and with shorter wavelengths.

Both General Relativity Theory and the Principle of Gravitational Expansion predict that atomic clocks tick faster at high altitudes than they do at sea level by the same amount. The difference in the two theories is that the Principle of Gravitational Expansion shows the difference in clock rates to be a simple Lorentz Transformation time dilation. The mechanism by which clocks run slower at the bottom of the tower is the increased mass caused by the higher escape velocity (V = 11,178.86275 m/s). The lower escape velocity (V = 11,178.84301 m/s) at the top of the tower makes the internal parts of the clock have less mass and the clock runs faster by a proportionate amount. The amounts that the clock rates change can be calculated from the standard time dilation formula of Special Relativity ($t = 1/\sqrt{1-V^2/C^2}$).

When a photon that is measured to have a wavelength of (λ = 1) is produced at the bottom of the tower it will still have a wavelength of (λ = 1) when it reaches the top. However, because the observer's clock at the top of the tower runs slightly faster, he will measure the photon's wavelength to be increased by 2.5 x $10^{-15}$. Also the faster clock at the top of the tower makes the emitter produce its photons with shorter wavelengths but the observer at the top measures them to have wavelengths of (λ = 1) because of his faster clock. The observer at the bottom measures the shorter wavelength photons from the top at their correct shortened wavelength. The photons do not change their intrinsic wavelength as they travel from one gravitational potential to another.

The conclusion that must be reached here is that the results of the Pound-Rebka experiment are caused by the effects of absolute

$$ {}_{m}T = \frac{{}_{R}T}{\sqrt{1-\frac{V^2}{C^2}}} $$

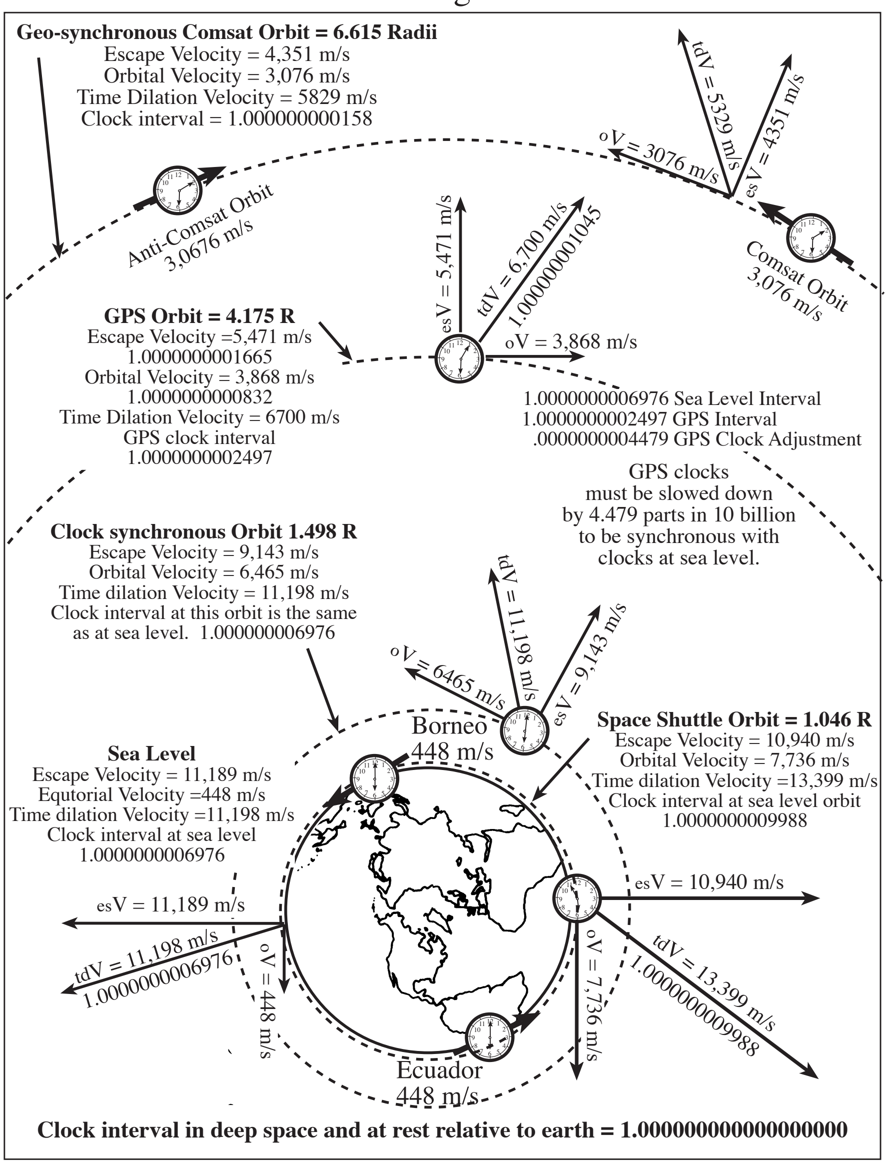
The clock interval for a velocity of 11,178.86275 m/s at the bottom is----------1.00000000069594839
The shorter clock interval for a velocity of 11,178.84301 m/s at the top is------1.00000000069594593
The difference in clock intervals between the top and bottom of the tower is----.00000000000000246
This almost exactly the red and blue shifts of 2.5 x$10^{-15}$ measured by in the Pound-Rebka experiment.

motion and not by relative motion. The difference in relative velocity between the top and the bottom of the tower is .01974 m/s, This velocity is not nearly enough to cause the changes in mass needed for the experiment's results. However, this same velocity difference is the precise amount needed for the Pound-Rebka measurements when it is the difference between the velocities of 11,178.86275 m/s and 11,178.84301 m/s. A difference of .01974 m/s between any two other velocities would not produce the Pound-Rebka results.

**Orbiting GPS Clocks**

The changing rate of clocks caused by changes in both velocity and gravity are well documented and have been determined to a high degree of accuracy. Measuring the rates of orbiting atomic clocks is a highly developed science necessitated by the need to maintain the accuracy of the atomic clocks in the constellation of satellites of the Global Positioning System (GPS). These clocks in many different satellites must be designed to run as synchronously as possible with clocks on the earth's surface. This is difficult because a clock's rate is influenced by the kinetic time dilation caused by both its orbital velocity and the gravitational escape velocity at the orbit's distance from the earth's center. Since these two velocities are at right angles to one another it is necessary to calculate the velocity vector of their combined velocities to determine the

Orbiting Clocks




**Absolute Motion Gravitational Time Dilation**

$$T_k = \frac{T_0}{\sqrt{1- \frac{{}_{es}V^2 + {}_{o}V^2}{C^2}}}$$

The duration of an interval of Kinetic Time ($T_k$) measured by a clock experiencing gravitational acceleration is equal to the duration of an interval of Inertial Time ($T_0$) measured by a clock at rest in deep space divided by the square root of one (√1) minus the escape velocity squared (${}_{es}V^2$) plus the orbital velocity squared (${}_{o}V^2$) divided by the speed of light squared ($C^2$).

**General Relativity Time Dilation**

$$T_g = \frac{T_0}{\sqrt{1- \frac{2GM}{RC^2}}}$$

**Newton Escape Velocity**

$${}_{es}V = \sqrt{\frac{2GM}{R}}$$

Escape velocity (${}_{es}V$) is equal to the square root of two times the gravitational constant (G) times the mass of the earth (M) divided by the distance to the earth's center (R).

absolute velocity responsible for the clock rate.

The clocks in the lowest orbits like the standard Space Shuttle orbit (1.046 radii) run the slowest because both their orbital velocities and escape velocities are greater than those of the higher orbits. Clocks speed up as they are placed in higher and higher orbits because they must be decelerated to both lower orbital velocities and lower escape velocities.

Clocks in an orbit of 1.498 radii run at the same rate as clocks at sea level because the combined time dilation effects of their orbital velocity and escape velocity are the same as those of the sea level escape velocity and the equatorial rotational velocity. Clocks at the poles run at almost exactly the same rate as clocks at the equator because the rotation of the earth causes the equator to bulge out. The greater gravity and escape velocity at the poles is balanced by the equator's lesser gravity and escape velocity combined with its rotational velocity.

GPS satellites are placed in orbits of 4.175 earth radii so that they will circle the earth exactly twice each day. In order to synchronize the clocks in the GPS constellation, technicians must first synchronize the cesium clocks to be put in orbit with a cesium clock on Earth. They must then calculate the increased rate at which the GPS clocks will run when they are placed in their desired orbits. This increased rate of GPS clocks is caused by the combined clock altering effects of the satellite's orbital velocity and its escape velocity. The clock slowing effect at the GPS orbit is more than one-third less than it is at sea level. As a result, the GPS technicians must calibrate the orbiting clocks to record time at a slower rate than the sea level clocks by 4.479 parts in ten billion. Then when these clocks are put into orbit they will speed up to the same rate as the clocks at sea level. In this way, all clocks in the system will run at the same rate and maintain the single simultaneous reference time necessary for the proper operation of the system.

Geosynchronous communications satellites (Comsat) are placed above the equator in west to east orbits of 6.615 radii. In this orbit, a satellite revolves around the earth once every 24 hours and thus maintains a constant position above some point on the equator. The slowing effect on clocks in Comsat orbits is about 4.4 times less than it is on clocks at sea level.

When the Global Positioning System was first proposed, a number of Special Relativity enthusiasts said that it would never work because Special Relativity predicts that clocks moving relative to one another run at different rates. They were of course wrong and the clocks in the GPS satellites all run at the same rate even though they are all moving relative to one another at constantly changing velocities. If motion is relative and not absolute, how do you explain that 24 GPS clocks, all moving in different directions, are able to keep the same time? If you do believe in relative motion how do you predict which clocks runs fast and which clocks runs slow?

**The Absolute Motion of Cesium**

One really good proof for the existence of absolute motion is the nature of the Cesium-133 atom. The radiation patterns and internal vibrations of all elements could be used to make some form of atomic clock. However, for a number of technical reasons, Cesium-133 is the atom of choice for building extremely accurate atomic clocks. All Cesium-133 atoms oscillate at a frequency of 9,192,631,770 cycles per second. In fact, these oscillations can be measured so accurately that the standard for defining the second has become 9,192,631,770 oscillations of a Cesium-133 atom.

The standard theories of nuclear synthesis require that elements lighter than nickle be assembled in the interior of stars and that the atomic nuclei heavier than iron be formed during nova and supernova explosions. Most Cesium-133 is formed either by the capture of a neutron by Cesium-132 or by the electron capture or positron emission of a Barium-133 nucleus. These atomic transitions usually occur within the extremely hot and rapidly moving gasses of gigantic stellar explosions. All Cesium atoms were formed at greatly varying velocities while traveling in every conceivable direction and each within its own unique reference frame.

Experiments with Cesium clocks show that their rates of oscillation changes slightly when they are either moved from one reference frame to another or from one gravitational potential to another. However, when we make a clock, we take several billion Cesium-133 atoms that have been accelerated and decelerated from various parts of the universe and bring them all together to our clock factory on the earth's surface. Despite the fact that each of these cesium atoms had to change its rate of oscillation as it was moved from its place of origin to the clock factory, all of these Cesium atoms now oscillate at the same frequency of 9,192,631,770 cycles per second. If all Cesium atoms, as well as all other matter did not move relative to the same common position of absolute rest, then how is it possible that all Cesium atoms in the same rest frame all vibrate at the same rate?

**The Duality of Time**

Time does not have a real physical existence like matter or even the void of space that has a negative existence. Time is merely an idea used to quantify the motion of matter through the void. The idea of time is a dichotomy between metaphysical time and physical time. *Metaphysical time* is the perception of time as a continuous flow that is without interval and is thus immeasurable. It is the comprehension of motion and therefore of time's passage. Once time becomes quantified into intervals by the cyclical motion of a clock it becomes *Physical time*.

Physical time does not have a single homogenous flow but rather is measured as two distinct and unrelated phenomena that are measured with two completely different kinds of clocks. The two separate types of time flow that we cut into equal intervals with our clocks are ***gravitational time***, that is derived from the constancy of a gravitational acceleration and ***inertial time*** that is derived from the constancy of momentum (mv) or angular momentum (mvr) of a body in motion, either in a straight line or rotating about an axis.

Inertial time can be measured by the daily rotation of the earth on its axis or by the vibration of atoms in an atomic clock. Gravitational time can be measured by the yearly revolution of the earth around the sun or by the swing of a grandfather clock's pendulum. The ability of a particular clock to measure the effects of one type of time is dependent on its ability to be isolated from the effects of the other type of time. Physical time is the concept used to generalize these two opposite time flows into the idea of a single one-dimensional temporal motion. Inertial time and gravitational time are the quantitative intervals measured by clocks and metaphysical time is the qualitative and dimensionless ideal principle common to both.

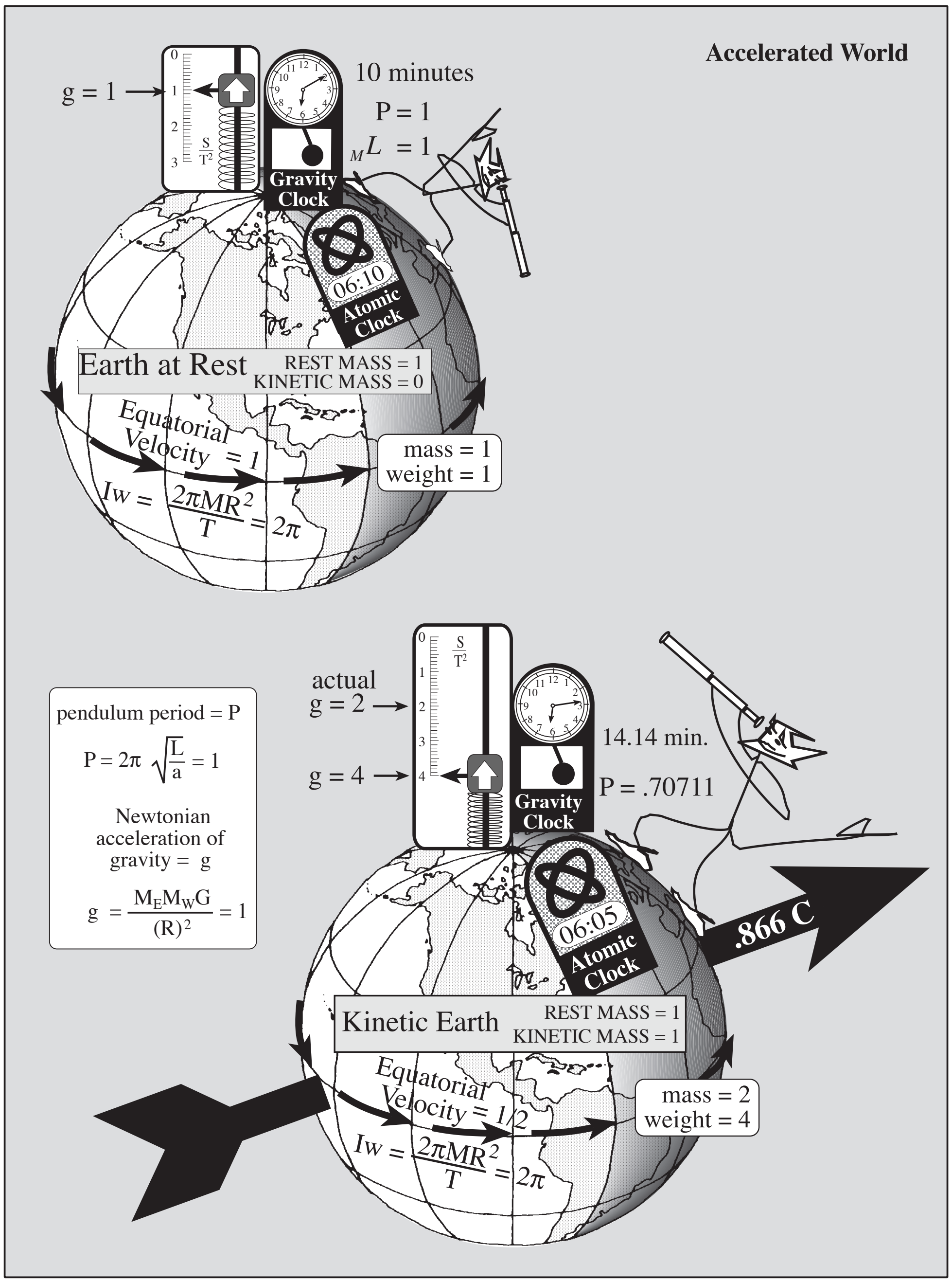
Clocks do not measure time directly; they monitor the relationship between mass and space. Time's existence can only be established and quantified by the measurement of these two parameters. Since time cannot be measured independently of mass and space, any change in the values of mass and space will cause the values of the intervals recorded by clocks to be transformed as well.

**Inertial Clocks vs Gravitational Clocks**

Only two different kinds of clocks are used to measure time (T): inertial clocks and gravitational clocks. Each of these clocks measures a different relationship between mass (M) and its motion through space (S). Gravitational clocks measure the constant force of gravity ($F=MS/T^2$) and inertial clocks measure the constancy of momentum (MS/T) or angular momentum (Iw = MSR/T). Inertial clocks divide the constant inertial motion of a body into intervals and derive their standard of time from the conservation of momentum and angular momentum. Gravitational clocks measure the inertial forces produced when a body's motion is constantly changed by gravity and derive their standard of time from the constancy of this force. Inertial time units are the cycles produced by a rotating body such as the earth or vibrating body like the atoms in an atomic clock and gravitational time units are the cycles produced by the constant acceleration of gravity such as the swinging of a pendulum or the revolving of the earth around the sun. The accuracy of both clocks depends on an unchanging relationship between mass and space.

The history of time keeping is a steady parade of ingenious devices, all of which are either gravity clocks or inertial clocks. Ever since humans first developed the idea of time and began devising clocks to measure and record its passage, they have used both gravity and inertial clocks. Hourglasses, water clocks, and pendulum clocks are examples of gravity clocks. The daily rotation of the earth, an electronic digital clock, that records the rapid cyclical motion of groups of atoms, and a pocket watch, that measures the cyclical motion of a balanced weight, are three examples of inertial clocks. For about three hundred years after it was invented the pendulum gravity clock was the most accurate of clocks, but recently the electronic inertial clock has far exceeded it in accuracy.

These two kinds of clocks can never be combined because each measures a different quantity, and these two quantities are mutually exclusive. For example, the inertial clock provided by the Earth's rotation would not be affected by a sudden change in the Earth's acceleration of gravity, but would be slowed down by an increase in the earth's mass. A pendulum clock would be speeded up by an increase in gravitational acceleration but would not be affected by the addition of mass to its pendulum. In fact it can be said that



gravitational time and inertial time are opposites that flow in different directions. The accuracy of any clock depends on isolating the kind of time being measured from the kind not being measured.

These two kinds of time show their opposite natures when we consider the transformations that occur to timekeeping devices when they are accelerated to extremely high velocities. When mass is accelerated, these two measures of time diverge from one another. As their absolute motion is increased, gravitational clocks run faster and inertial clocks run slower. These diverging time flows are not even symmetrical in that gravitational clocks increase at a rate that is the square root of the rate by which inertial clocks slow down.

**Accelerated World**

To understand how these two measures of time diverge from one another with the transformation of mass, we will perform a thought experiment in which the spinning Earth is an example of an inertial clock and Earth's acceleration of gravity is an example of a gravitational clock. Earth makes one revolution on its axis every day while a clock's pendulum swings back and forth a certain number of times each day.

In our thought experiment, an accelerometer is placed vertically at the North Pole to measure the gravitational acceleration and a pendulum clock is placed beside it to record gravitational time. An inertial atomic clock registers time based on the cyclical inertial motions of atoms contained within it. Both clocks are synchronized and register the passage of time identically.

For the second part of our thought experiment we will imagine that another Earth replica called Kinetic Earth with a mass the same as Earth has been accelerated to a velocity of 86.6% the speed of light. This is a very difficult task and requires $4 \times 10^{41}$ joules of kinetic energy, that is equal to the sun's total output for 10,000,000 years! At this velocity, a body's kinetic mass is exactly equal to its rest mass so that the total mass of the Kinetic Earth replica is twice that of the Earth at rest..

On the Kinetic Earth, the acceleration of gravity has doubled, the gravity pendulum clock is running 1.414 times faster than on the Earth at Rest and the accelerometer shows four times as much acceleration. This is because the accelerometer's movable weight has doubled in mass and now exerts four times as much force on the spring with the doubling of the earth's gravity.

The Kinetic Earth is rotating on its axis at one half the speed of the Earth at Rest. The inertial atomic clock has also slowed to one half of the rate it had on the Earth at Rest. This slowing is caused by the same inertial process that slowed the Kinetic Earth's rotation. This atomic clock slows as its atoms conserve angular momentum (Iw = mvr) as their masses increase with their velocity. As the linear velocity of a rotating body is increased, its equatorial velocity is reduced according to the formula: (V = Iw/mr). The atomic clock mistakenly shows that the day is still 24 hours long. However, the observer on Earth at Rest sees Kinetic Earth rotating only every 48 hours.

The internal body clock of the observer on Kinetic Earth has slowed to one half of its rest rate along with the atomic clock, and to him, the days seem to pass at their normal 24 hour rate, but he sees his gravity clock running at 2.28 times the rate of the inertial clocks. When he looks back at the Earth at Rest, he sees that it is rotating in just twelve hours. The observer's weight has increased from a value of one on the Earth at Rest to a value of four on the Kinetic Earth because his mass, as well as the force of gravity, have both doubled.

With the Kinetic Earth accelerated to 86.6% the speed of light, the values for the equatorial velocities of both it and the particles of its matter would be reduced to one half of their values at rest. It is this effect that is responsible for the so called concept of Relativistic Time Dilation whereby an observer in motion experiences the passage of inertial time at a slower rate than an observer at rest. If we are to establish a universal standard for time it must be gravitational time and not inertial time. Even though a pendulum clock changes its rate in response to changes in motion, the actual time flow of the gravitational interaction remains constant.

**Conclusions**

In conclusion, it can be seen that the photons the 2.7˚ CBR provide and absolute rest frame in which all photons move at exactly C. In addition the virtually perfect blackbody spectrum of these photons provides an absolute point of reference to establish a universal standard for the motion induced slowing of clocks. At any point in space where the temperature of the 2.7˚ CBR is the same in all directions, all inertial clocks will run at a maximum rate and all gravitational clocks will run at a minimum rate. Any acceleration in any direction from this point will decrease the rates of inertial clocks and increase the rate of gravitational clocks.

The observation of binary pulsars provides a seemingly substantial proof that all photons emitted from a rapidly moving source move through space at exactly C.

Even though the Standard Model of Physics views the photon as a "massless" particle, this idea is used as a fundamental assumption of the theory and is not really required by any experimental results. The simplest and most basic interpretation of photon experiments would indicate that photons have a mass of $M=E/C^2$.

The Pound-Rebka experiment provides a method of measuring the extremely small differences in inertial clock dilation rate between two gravitational potentials. There are several different explanations of the Pound-Rebka effect but, to me, the different clock rates between the top and the bottom of the tower seem to be the best explanation. An even more dramatic example of both gravitational and motion induced clock dilation is the calibration performed on the clocks of the Global Positioning System (GPS). The combined vectors of a satellite's, gravitational and orbital motions must both be included to determine the rate of an orbiting clock.

A careful examination of clocks in general reveals that are two different kinds of clocks that measure two different arrows of time. One type of clock that measures inertial time and the other that measures gravitational time. The thought experiment involving a replica of the earth moving at 87% C shows that these two different time flows diverge from one another when clocks are accelerated to high velocities.

The final conclusion to be made is that time is not a real physical quantity like mass or space but merely the relationship between these two parameters. Time is nothing more than an idea that we use to quantify the motion of matter and photons relative to space. Motion is a real physical phenomena and time is merely an intellectual tool used to measure and evaluate the various kinds of motion. Clocks do not measure time. They simply record certain kinds of either repetitive or constant motion.