Time-Dilated Light

(A Constructive Theory of Relativity)

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Abstract: *Albert Einstein's* ***Principled*** *Special Theory of Relativity* [1] *states that a moving object will experience time running slower than a stationary object. I.e., it will experience* ***dilated*** *time. This has been confirmed many times with atomic clocks. If the speed of light is defined as 299,792 kilometers* ***per second****, the question then becomes:* ***Whose*** *second? The* ***Constructive*** *Theory of Relativity defined here shows that light emitted by a distant time-dilated object will arrive at the earth at 299,792 kilometers per* ***the object's*** *second,* ***not*** *per Earth second. Light from celestial objects does not arrive at any "universal speed of light," but arrives at widely varied velocities depending upon the emitting object's velocity through space and its proximity to any gravitational mass.*

A photon or wave of light is created when an electron orbiting the nucleus of an atom drops from a high energy orbit to a lower energy orbit. That creates an excess amount of energy. The excess energy can't just disappear, so it is emitted from the atom as a photon of light. The energy of the photon depends on the difference in energy between the two orbits of the electron.[2]

When light is emitted from the atom, it does not have to accelerate to the "speed of light." It is emitted **at** the speed of light. When the electron drops from its high orbit to its lower orbit, it supposedly does so **instantly**. However, the light that is emitted is emitted at a **finite** speed. The question then becomes: What is the speed of that specific photon of light?

The postulate defined here is: When a photon or wave of light is emitted from an atom, it is emitted at **the "speed of light" at the location of the atom that emitted the photon.** As stated previously, the photon does not have to accelerate up to the speed of light. It instantly goes from velocity zero to 299,792 kilometers per **local** second. [3] And, as Einstein's Theories of Relativity show, Time does **not** pass at a constant rate throughout the universe.

Emission Theory

Emission theory [4] is the thoroughly disproved theory that light emitted by an object will travel at the speed of light plus or minus the speed of the object. It was first proposed by Isaac Newton. In his “corpuscular theory,” Newton visualized light "corpuscles" being thrown off from hot bodies at a nominal speed of c with respect to the emitting object, and obeying the usual laws of Newtonian mechanics. If true, that would cause the light from a moving object that is coming straight toward the observer to travel at a velocity that is combined with the velocity of the distant emitter (c + v). Likewise, if the object was moving away from the observer, light would travel at a velocity where the object’s receding velocity is subtracted from the emitted speed of light (c – v).

Simple experiments have thoroughly proved this theory to be untrue. For example, it would require a moon orbiting around Mars, Jupiter or Saturn to appear to travel noticeably faster when moving toward an observer on Earth (c + v) than when it is at the opposite side of its orbit and moving away from the observer on Earth (c – v). That doesn’t happen.

Albert Einstein is supposed to have worked on his own emission theory before abandoning it in favor of the version of his Special Theory of Relativity that he published in 1905. Many years later R.S. Shankland reported Einstein as saying that Walter Ritz' emission theory had been "very bad" in places and that he himself had eventually discarded emission theory because he could think of no form of differential equations that described it, since it leads to the waves of light becoming "all mixed up".[5]

But, while light may not come to us in the way that was used to disprove Corpuscular/Emission Theory, it appears light still comes to us “all mixed up,” i.e. at different velocities.

Time Dilation due to Velocity

In his 1905 paper, “*On the Electrodynamics of Moving Bodies*,” Albert Einstein explained that Time will run slower for an object that ***is moving***, compared to a stationary object. For convenience, he used clocks to describe how movement (velocity) dilates (slows down) Time:

> If at the points A and B of K there are stationary clocks which, viewed in the stationary system, are synchronous; and if the clock at A is moved with the velocity v along the line AB to B, then on its arrival at B the two clocks no longer synchronize, but the clock moved from A to B lags behind the other which has remained at B by $\frac{1}{2}tv^2/c^2$ (up to magnitudes of fourth and higher order), t being the time occupied in the journey from A to B.

In other words, if you have two stationary clocks that are in sync and one is moved, the clock that was moved will show less time has passed than the clock that remained stationary.

Einstein then goes on to explain that a clock at the equator, where the earth is moving around its axis at about 1,000 miles per hour, will run slower than a clock at the North Pole, which is not really moving but just rotating in place once every 24 hours. While the paper doesn't explicitly say so, the implication is that every location between the equator and the North Pole will experience time moving at a slightly different rate. Time will run slower in Los Angeles than in San Francisco, and time in San Diego will run slower than time in Los Angeles. The differences are, of course, so tiny – fractions of a microsecond – that the differences would not only be unnoticed, they also would be extremely difficult to measure by our best instruments.

Unfortunately, Einstein's 1905 paper doesn't make clear exactly how Time Dilation works. What ***is*** "Time" if it can slow down? It certainly isn't just a "concept." Einstein doesn't say because it is a principle-based theory, not a constructed theory based on observations.

In my paper "What is Time?"[6] I explain that "Time is particle spin." While no one currently really knows exactly what "particle spin" is, it can be visualized as a regularly repeating phenomenon within the particles within atoms, which has the effect of generating or controlling local time. If the atom containing the particle is **stationary** in otherwise empty space, the result will be that time is generated at its maximum interval value. A "second" measured by that particle will be as short in duration as it is possible for a second to be. So, the speed of light will be 299,792 kilometers per the shortest possible second.

If some force causes the atom and its particles to move, the duration of a second for that atom will increase. Of course, atoms that are part of a larger body, such as a space ship, will all experience the same amount of time dilation when the space ship moves.

This means that, if some phenomenon occurs once per second in an "at rest" or "stationary" environment, it will also occur once per second in a moving environment – even though the length of a second will be different. Thus, if you are measuring the speed of light by bouncing the light off of mirrors in a laboratory on earth, you will find that the speed of light is 299,792 kilometers per second (kps). And if you perform the same experiment aboard a space ship that is traveling through space at very high velocities, you will also find that the speed of light is 299,792 kilometers per second. What must then be understood is that the reason this happens is because the length of a second is different at the locations of the two experiments.

Special Relativity

Most discussions of Time Dilation usually quickly turn into discussions about Relativity. The discussions stop being about what is ***actually*** happening and become discussions about what is ***perceived*** to be happening. There seems to be a popular misconception that if something is "relative," it isn't real, it is just what is *perceived*. In my paper "Time Dilation Re-visualized"[7] I explained that Time Dilation works independently from Relativity and needs to be understood independently before you can fully understand all of the relativistic aspects of Time itself. It must also be understood that when Einstein wrote the words "a universal constant—the velocity of light in empty space" in his 1905 paper, the "universe" he was writing about was a ***<u>hypothetical</u>*** universe he created in which there existed only two clocks. It appears that a great many people understand his phrase "universal constant" to apply to our massive universe where there are countless objects that can be considered to be "clocks" measuring the passage of time, and most such "clocks" do not tick at the same rate as clocks on Earth.

In his 1905 paper, Einstein also wrote:

> It is essential to have time defined by means of stationary clocks in the stationary system, and the time now defined being appropriate to the stationary system we call it "the time of the stationary system."

The "stationary system" he was writing about is that same hypothetical system with two clocks, and "stationary" simply means the two clocks are not changing their distance from one another.

Einstein also wrote:

> light is always propagated in empty space with a definite velocity c which is independent of the state of motion of the emitting body.

The statement above seems to relate to Isaac Newton's Corpuscular Emission Theory, but it could mean that light emitted from an object is emitted **instantly** and is thus not affected by the direction in which the object is moving. Light is emitted ahead of and behind the moving at the same speed.

Einstein also wrote,

> If we wish to describe the motion of a material point, we give the values of its co-ordinates as functions of the time. Now we must bear carefully in mind that a mathematical description of this kind has no physical meaning unless we are quite clear as to what we understand by "time."

He says Time must be defined as it occurs in a "stationary system." The problem is that a "stationary system" is also entirely hypothetical. No one can create such a system with current technology. This also aggravates the problem of viewing Time Dilation as being all about what is perceived instead of being about what actually happens.

When the speed of light is measured here on Earth as being 299,792 kps and it is also measured as traveling at 299,792 kps aboard a space ship moving at 50% of the speed of light, it should be clear that there is some **actual** difference in the length of a second, not just a **perceived** difference. If the crew of the space ship sends a beam of laser light toward the Earth, the laser light will travel at the speed of light as it is determined to be (and actually is) aboard the space ship. It will not somehow change speed when it exits the space ship. The light will arrive at the Earth traveling much slower than light is measured to travel from point to point on Earth.

Time Dilated Light

Therefore, we can use Einstein's formula for calculating Time Dilation[8] to calculate the difference in the speed of light emitted from a stationary object versus a moving object. If light is emitted from an object that is traveling at 10% of the speed of light (29,979.2 kps), one second at a stationary location (assume Earth is stationary) will be 1.0050377997499 seconds aboard that space ship. That means that the emitted light from the space ship will be traveling 292,792.458 kilometers in 1.0050377997499 seconds. And light traveling at that speed would be traveling at 298,289.675 kps when it reaches "stationary" Earth, or 1,502.78 kps ***slower*** than the speed of light is measured here on Earth.

If a stationary observer (or an observer on Earth) mistakenly assumes that **all** light is coming to him at 299,792.458 kilometers per **his** second, he may mistakenly assume the moving object in the previous paragraph is farther away than it really is. If the moving object is actually 298,289 kilometers away, he may mistakenly assume that it is 299,792 kilometers away if he somehow calculates it took one Earth second for the light from it to reach him, an error of 1,503 kilometers. In other words: Distant objects may be closer than they appear.

Another key point is that light coming from a distant object is affected by the speed of that object, but unlike classical Corpuscular/Emission Theory, the **direction** the object is moving has no effect on the light it emits. The only slowing effect comes from the magnitude of dilated time being experienced by the object.

Gravitational Time Dilation

Of course, light emitted by some massive object, like virtually any star in the visible universe, will also be affected by **gravitational** time dilation. This may result in a significantly larger error than would be caused only by velocity time dilation. Since the only difference is the specific *cause* of the dilation of time, and that cause will not affect the postulate that "light emitted from a time-dilated object will be correspondingly time dilated," there seems no need to provide here any examples of the slowing of light due to gravitational time dilation. The bigger the star, the larger the error will be whenever it is falsely assumed that light from it travels at 299,792 kilometers per the observer's second. Light from our Sun does not arrive at the Earth at the speed of light measured by equipment here on Earth. It travels at a *slower* speed.

Implications

What are the implications of this Theory of Time Dilated Light? While it does mean that the speed of light coming to us from distant stars is highly variable and is mostly coming slower than we assume, there can be no effect on any part of Einstein's theories, since, as far as

Relativity is concerned, both this Time Dilated Light Theory and Einstein's Theories of Relativity merely confirm that all Time is "local" and thus can and will be different in different locations.

Simultaneity

Time-Dilated Light certainly does not affect simultaneity. In his 1905 paper, Einstein explained:

> If at the point A of space there is a clock, an observer at A can determine the time values of events in the immediate proximity of A by finding the positions of the hands which are simultaneous with these events. If there is at the point B of space another clock in all respects resembling the one at A, it is possible for an observer at B to determine the time values of events in the immediate neighbourhood of B. But it is not possible without further assumption to compare, in respect of time, an event at A with an event at B. We have so far defined only an "A time" and a "B time." We have not defined a common "time" for A and B, for the latter cannot be defined at all unless we establish by definition that the "time" required by light to travel from A to B equals the "time" it requires to travel from B to A.

If time-dilated light travels from Point A to Point B at the same speed as it travels from point B to Point A, Time at those two points are synchronous, and the speed of light will be identical – because the length of a second was identical at both points.

Stellar Distances

The primary technique for calculating the distance to nearby stars is called "trigonometric parallax"[9] and is based on geometry, but it is only good for up to about 500 light-years. The principle behind this method is elegantly simple: Earth orbits the Sun at a known radius, and when the Earth is at opposite ends of its orbit it results in a star appearing in a slightly different positions against distant background stars, That difference in angles allow us to use simple trigonometry to calculate how far away it is. It is basic trigonometry: The base of the triangle is the distance between the earth in summer and the earth in winter, and the angles to the star from those locations provide the other two sides of the triangle and the distance to the star. Time Dilation is not a factor.

For stars that are farther away than 500 light-years, the angles are too small to use trigonometry, so astronomers use various techniques involving the brightness of the star to determine its distance. Such techniques also appear to be unaffected by time dilation. But they only work to distances of about 150,000 light years, or just beyond the borders of our Milky Way galaxy.

For measuring the distance to stars in other galaxies (the Large Magellanic Cloud is the nearest at 160,000 light-years away) astronomers must measure the magnitude of stars that vary a little in their brightness, called Cepheid Variables. Cepheid Variables are pulsating variable stars have a period over which they go from maximum brightness to minimum brightness and then back to maximum brightness. In addition, the star's variable period is directly related to its absolute magnitude (i.e., the greater its absolute magnitude, the longer its period), as discovered by Henrietta Leavitt (1868 - 1921). Since Cepheid variable stars are rather abundant in space, astronomers simply measure the star's period, determine its absolute magnitude and then, together with the relative magnitude that can also be measured, use mathematics to determine distance. Time-dilation does not appear to be a factor because the only time involved is the variation period as viewed from earth.

The Expanding Universe

Theories about the rate the universe is expanding around us do not come from changes in the measurements of distances to stars. Expansion theories primarily come from the calculated velocities of celestial objects as they move through the visible universe. Primarily, they come from the differences in the "red shift" of light for objects at different distances.

In 1929 Edwin Hubble, working at the Carnegie Observatories in Pasadena, California, measured the redshifts of a number of distant galaxies.[10] He also measured their relative distances by measuring the apparent brightness of the Cepheid class of variable stars in each galaxy. When he plotted redshift against relative distance, he found that the redshift of distant galaxies increased as a linear function of their distance. The only explanation for this observation was that the universe was expanding.

Unfortunately, red-shifting doesn't tell you **who** is moving. It just says the distance between the light emitter and the observer is increasing. In addition, equipment used to measure red-shifting is calibrated for Earth's speed of light, which means that such equipment cannot tell if the increase in wave length is the result of the velocity of the source or if it is due to the wave moving slower through the measuring equipment than the equipment was calibrated to assume.

Nevertheless, red-shifting of light is used to determine the velocity of an object as it moves away from the observer. If the light is "blue-shifted," that means the object is coming toward the observer. However, in a situation where neither object nor observer is stationary,[11] and both are moving, the rate of movement determined by red-shifting must be shared by both objects. Some of the movement belongs to the distant object moving away from Earth, and some of the movement is the Earth's movement away from the distant object.

The question then becomes: Are cosmologists and mathematicians taking into consideration the time-dilated light as described in this paper? If, due to time-dilation, light from a distant object is coming slower than they assume, then the distance to the emitting object is actually closer than they assume.

More importantly, if everything was moving faster when they universe was younger, when we were all closer to the spot where "The Big Bang" occurred, then light from distant objects would be coming at much slower speeds than is currently assumed. When we look back at an object as it existed 10 billion light years ago, that object would have been moving a lot faster away from the center of the Big Bang back then than it is today. So, if we attempt to calculate the rate of expansion for the universe, we first have to understand how fast a distant object was moving when the light was emitted. Plus, we have to consider the apparent fact that we here on Earth are not moving away from the source of the Big Bang at the same rate as the distant object emitting the light. Depending upon who you ask, we are either moving faster now or we were moving faster in the distant past.

Red shift calculations appear to use the "universal speed of light" based upon how the velocity of light is measured here on Earth.[12] If the light being measured is actually traveling slower (or faster) than assumed, the calculated recession speeds of distant galaxies will be incorrect.

Principle-based theories and Constructive Theories

When reading scientific papers which mention the speed of light, it often seems that there is "an elephant in the room," i.e., there is an obvious problem that everyone is aware of, but no one wants to talk about because it will generate heated arguments if you do.

"Einstein's relativity theory was presented as a PRINCIPLED, rather than a CONSTRUCTIVE, theory. A principled theory is one that begins with principles and then uses these principles to explain the phenomena; a constructive theory starts with the observations and culminates in theories that explain and reconcile those observations. Einstein's principled account began with the postulate that the laws of science should appear the same to all freely moving observers. In particular, all observers should measure the speed of light as the same regardless of how fast they are moving. Thus, there is no 'universal time' that all clocks measure; rather, everyone has his or her own personal time. If one person is moving with respect to another, their clocks will not agree. To an observer moving in one frame of reference with uniform velocity relative to a second frame of reference, the clock in the second frame will appear to move more slowly than his own clock."[13]

The Constructive theory that light does not travel at a fixed speed uses the same principles, but uses *observations* to come to a somewhat different conclusion. Principled theory says lengths and times must change for different inertial observers because the speed of light is constant. It does not explain how the speed of light changes time. The Constructive theory presented here explains how time changes the speed of light. And it explains how that conclusion can be tested. We have equipment today – such as atomic clocks – that Einstein didn't have.

It seems that many scientists know about the problem of Time Dilated Light, but since no one knows **how** to **measure** the speed of light coming from distant objects, they ignore the problem by just falsely assuming that all incoming light comes at the same speed officially measured on Earth.

The speed of light on Earth is measured by firing a photon a specific distance and timing how long it takes to get from the photon gun to the target. If you tried to use two clocks, one at the photon gun and another at the target, you would have serious problems getting the two clocks to be synchronous. So, they just use one clock. A time measurement is taken when a photon is fired a specific distance to a mirror, and then another measurement is taken when the photon bounces back to a target next to the photon gun which is connected to the same clock.

But how do you measure the speed of a photon coming from a distant star when you do not know the exact time at the location where the photon was emitted nor how far away the star really is? Answer: you just use the speed of light as it is measured here on earth and ignore the fact that it is not correct while hoping that it is not too wildly incorrect.

When a slower than "normal" beam of light reaches a red-shift detector, the detector will measure the wave length as being longer than it really is because it took longer than "normal" for the complete wave to arrive.

Many things about the nature of dark energy remain matters of speculation.[14] A 2003 article in Physics today titled "Supernovae, Dark Energy, and the Accelerating Universe"[15] by Saul Perlmutter indicates that the paper uses a universal standard for the "speed of light," a standard which I postulate does not exist. Moreover, since Perlmutter's paper uses supernovae as "standard candles," he appears to use objects whose gravitational time-dilated light could travel at velocities much slower than the Earth standard for "the speed of light," and he may or may not have taken into consideration the question of whether the light emitted from the atoms of an **exploding** star will be traveling at a different speed than light emitted from atoms in a normal star. Dark Energy seems to be based upon one false assumption piled atop another because the "elephant in the room" is being ignored.

Conclusion

Every atom in the universe is its own clock and measures time at its own rate. When it emits a photon or ray of light, it emits it at 299,292.458 kilometers per *the atom's* second. Thus, in this constructive theory, every photon or ray of light coming to Earth from space may be coming at a different speed. Any theory that depends upon a "universal fixed speed of light" contains a logical flaw. While light may be measured at 299,792.458 kilometers per second everywhere, such as at the top of a mountain and at the bottom of a mountain, a second is longer at the bottom of the mountain than at the top of the mountain.

There have been experiments which show that time speeds up as you move upward from the surface of the earth.[16] Measurements of the speed of light have also been done at various locations. At the 1983 Conference Generale des Poids et Mesures, the following SI (Systeme International) definition of the meter was adopted:

> *The metre is the length of the path travelled by light in vacuum during a time interval of 1/299,792,458 of a second.* [17]

This defines the speed of light in vacuum to be exactly 299,792.458 kps. Unfortunately it doesn't mention anything about inertial frames, but you can consider a measurement in an inertial frame to be implied. It is the speed of light at the location of the measurement.

And it is generally believed that the speed of light is **only** guaranteed to have a value of 299,792.458 kps in a vacuum when measured by someone situated right next to it.

A validation of this Constructive Time Dilated Light Theory simply needs someone to use atomic clocks to measure both the speed of light ***and*** the length of a second at some high location (example: Denver) and at some low location (example: New York City) to determine if the speed of light is "the same" in both locations. If it is, that is conclusive evidence that the speed of light actually ***different*** in the two locations, because it has been repeatedly proved that the atomic clocks will show that the length of a second was different.

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