Lorentz Transformations and the Twin Paradox

By James Carter

The Lorentz transformation m' = $M/\sqrt{1-v^2/c^2}$ *is a principle of measurement that can be classed as one of the laws of physics. (A moving body's kinetic mass m' is equal to its rest mass M divided by the square root of one minus the Lorentz velocity squared* v^2 *divided by the speed of light squared* c^2*). It comes into play whenever a body of mass undergoes measurable acceleration or deceleration.*

Lorentz Transformations of Mass to Energy

At the end of the 19th century Hendrik Lorentz predicted that a body's inertial mass would increase as it was accelerated to higher and higher velocities toward the speed of light. This increase in kinetic mass was proportional to the formula $\sqrt{1-v^2/c^2}$, while the relationship between a moving body's kinetic energy $e = mv^2/2$ and its increased kinetic mass was $m_K = e/c^2$.

What this transformation means is that when we accelerate an automobile to a high velocity, both the car and our body increase in mass in proportion to the kinetic energy from speeding down the highway. In this case, the change in mass is very small, but by comparison, the mass inherent in our kinetic energy begins to become significant when we consider the absolute velocity of 375 km/s that our bodies have relative to the zero momentum rest frame identified by the Cosmic Blackbody Radiation dipole anisotropy. This velocity gives a 100 kg person a kinetic energy of 1.8×10^{13} Joules and a kinetic mass increase of about 200 milligrams. This absolute velocity relative to zero momentum rest gives us each real kinetic energies that are about equal to the first atomic bomb that was exploded in New Mexico (10^{13} Joules) (see *Joules of the Universe*). This energy is completely hidden from us and could only be realized by the negative kinetic energy needed to slow us down to a stop. While this velocity might at first seem to be very fast, it is only about 1/1000th the speed of light. For our bodies to double in mass, we would have to travel in a spaceship at 87% the speed of light. At this velocity, our rest mass and kinetic mass would be equal and we would each have personal kinetic energies equal to about one million atomic bombs (10^{19} Joules).

The Lorentz transformation experiments listed below show that for every change in a body's velocity and energy there is complementary change in its mass. In an atomic explosion, about one gram of matter seems to change into the kinetic energy (10^{14} J) of moving bodies of mass and photons. The daughter atoms left over from fission have less mass than the original uranium atoms mostly due to the loss and subsequent decay of neutrons. The energy produced in the explosion consists of photons and decaying neutrons, as well as the kinetic energy of rapidly moving particles and atoms. Nowhere in this transformation is mass converted into energy. Mass and energy never change. The energy used to accelerate all of the particles in the explosion (heat) has created a Lorentz transformation in mass, meaning that their mass and energy remain constant before and after the explosion. In the same way, the mass of the matter converted into the energy of photons decreases by the same amount as the photons' mass $m = e/c^2$. This transformation of rest mass into the kinetic mass of energy is as common as lighting a match or kicking a football. It is just that in such cases, the energy is easy to measure but the mass change is too small to be detected. Mass and energy are two sides of the same coin and are always present in equal quantities and never separate.

Lorentz Transformation Thought Experiment
GPS Clock Calculations
Pound-Rebka Experiment
Twin Paradox Experiment

The Lorentz transformation equation calculates the changes in a body's mass that occur with measured changes in its momentum. The inverse of this equation $t' = T/\sqrt{1-v^2/c^2}$ calculates the length of a clock's time intervals as it slows down or speeds up in direct proportion to increases or decreases in a clock's momentum. When a clock is accelerated, its mass increases and its time intervals grow longer at the same rate. When a clock is decelerated, its mass decreases to a minimum of $m = 1$ and its time intervals grow shorter to a maximum rate of $t' = 1.0$ where the clock is at rest and has no momentum. This is where $v^2 = 0$, $m' = 1.0$, $M = 1.0$, $t' = 1.0$, and $T = 1.0$.

The Lorentz transformation is a measurement principle and not a theory. It is the calculation that we use to determine the changing values of mass and time whenever acceleration and deceleration are measured. While Einstein incorporated the Lorentz transformation in his theories as a principle of measurement, it is not a metaphysical assumption and is thus not a structural part of either the special and general theories of relativity. It is a Newtonian accelerometer measurement that is interpreted with the metaphysical assumptions of Einstein's theories.

Both $m' = M/\sqrt{1-v^2/c^2}$ and $t' = T/\sqrt{1-v^2/c^2}$ determine the inertial frame for each body of mass. There are an infinite number of inertial frames with different values for their Lorentz velocity v, but the universe contains only a single zero velocity Lorentz frame where $v = 0$, $m' = 1$, $M = 1$, $t' = 1$ and $T = 1$. All clocks with the same Lorentz velocity (v) have the same mass increase and increased clock intervals regardless of the direction of their motion. It is the absolute velocity of a clock's momentum vector that determines its mass value and time interval and not the relative velocity between any two bodies.

Two clocks can be moving side by side at v = x and have no relative velocity between them or they can be moving in opposite directions with a relative velocity of v = 2x. In both cases the values for their mass and time intervals will be the same.

Even though the relative motion between bodies in two moving frames has no effect on their mass and time, it is the only component of each body's Lorentz velocity vector that can be measured. The experimental process is unable to separate measured relative acceleration into its separate components of absolute acceleration and deceleration that produce changes in a clock's mass and time intervals. Their relative motion can tell us little to nothing about the interval lengths of two moving clocks. However, the measurement of the difference in their clock intervals can tell us something about the absolute components of the measured relative motion between them.

Lorentz Transformation Thought Experiment

Imagine two pairs of spacecraft containing Cesuim-133 clocks and technicians. Each pair of craft is separated by some distance and moving toward one another at a relative velocity of 1km/s. One of the first pair of crafts is at zero momentum rest with a velocity of v = 0 while the other is moving toward it at v = 1 km/s. The second pair are moving nearly side by side at v =150,000 km/s (1/2 c) and v = 150,001 km/s respectively. From their relative motion, we must conclude that each clock is moving along separate momentum vectors that are nearly identical. In each case, the technicians measure them to be moving toward one another with an average relative velocity of V = 1 km/s.

In the course of the experiment, the two crafts move closer together, pass, and then move farther apart. The purpose of the experiment is to acquire information about the true absolute motion of each clock. The technicians use Doppler shifted photons to monitor their changing relative motion as they pass. This relative motion measured with Doppler shifts is only valid for individual points in time. Photons are blue-shifted as the clocks approach and then are red shifted as they recede from one another. At the time interval when the two clocks pass, there are no Doppler shifts between them (except for relativistic shifts) indicating they have no relative motion. However, when all of the Doppler measurements are calculated together, it is determined that the two clock's average relative velocity is V = 1km/s.

At the point where the spaceships pass, it is easy for the experimenters to compare the difference in their clocks' intervals and determine a portion of their true momentum vector. If one clock is actually at rest with a mass and time interval of 1.0 and the other has an absolute velocity of v = 1km/s, then the mass and time interval of the moving clock would be m' & t'1.0000000000056. However, with one clock moving at 150,000 km/s and the other moving at 150,001 km/s, then the first clock would record intervals of 1.15470054 and the second clock's intervals would be 1.15470310. The difference in clock rates between a V = 1km/s relative velocity at rest and a V = 1 km/s relative velocity at ½ c is enormous. The clock interval increase for 1km/s at rest is more than 5 orders of magnitude smaller than the difference in intervals for V = 1km/s of relative motion between clocks moving at v = ½ c.

Lorentz Transformation Mass and Time Values for c

Mass of Clock at 1 km/s------------------------ $m' = M/\sqrt{1-v^2/c^2}$ = 1.0000000000056 kg

Clock interval for 1km/s --------------- $t' = T/\sqrt{1-(1\ km/s)^2/c^2}$ = 1.0000000000056

Mass of Clock at 150,000 km/s--------------------- $m' = M/\sqrt{1-v^2/c^2}$ = 1.15470054 kg

Mass of Clock at 150,001 km/s--------------------- $m' = M/\sqrt{1-v^2/c^2}$ = 1.15470310 kg

Clock interval for 150,001 km/s -----$t' = T/\sqrt{1-(150{,}001\ km/s)^2/c^2}$ = 1.15470310

Clock interval for 150,000 km/s -----$t' = T/\sqrt{1-(150{,}000\ km/s)^2/c^2}$ = 1.15470054

Difference in clock intervals of 150,001 km/s & 150,000 km/s ------.00000256

Difference in clock intervals of v = 0 km/s & v = 1 km/s--------------.0000000000056

Difference in mass increase for V = 1 between v = 1 km/s and v = 150,000 - 457,142

The Zero Velocity Lorentz Transformation Frame

The idea of a zero velocity Lorentz frame $t' = T/\sqrt{1-0^2/c^2}$ is a metaphysical principle for the mass and clock intervals of m', M, t', & T, all = 1.0. This zero velocity metaphysical frame is just a featureless void of empty three-dimensional space that can never be measured because it has no physical parameters. There are an infinite possible number of other Lorentz transformation frames that can be measured with clocks and accelerometers. Each frame has a different value for its momentum vector (p = mv) and a different time interval (t'/T) for its clock. These frames all share relative motion with the single zero velocity Lorentz clock frame with velocity v = 0, momentum p = mv = 0 mass m' = 1, M = 1, t' = 1.0 and T = 1.0. In all moving frames, mass and time intervals have equal Lorentz values of (m' = 1+) & (t' = 1+). Increasing the velocity of a clock increases its mass and momentum and the conservation of angular momentum in turn increases the length of its time intervals.

Two actual experiments that use the Lorentz transformation principle to calculate the mass and time differences between two Lorentz frames are the GPS clock measurements and the Pound-Rebka measurements of the momenta of gamma photons.

GPS Clock Calculations

In the GPS measurements, clock intervals between two different Lorentz velocity frames are calculated and measured. The first frame is the combined velocity vector of the rotational (orbital) velocity ($_o v$ = 448 m/s equator) at Earth's surface and the perpendicular upward gravitational escape/surface velocity of Earth's surface esv = $\sqrt{2gR_E}$ = 11,189 m/s. The Lorentz transformation velocity $v = \sqrt{_{es}v^2 + {_o}v^2}$ at Earth's equator is 11,198 m/s. The second frame is the combined vector of the GPS satellite's orbital velocity $_o v$ = 3868 m/s and the vertical upward gravitational escape velocity esv = 5471 m/s at its orbit. The Lorentz transformation velocity $v = \sqrt{_{es}v^2 + {_o}v^2}$ of the 24 GPS satellites is 6700 m/s. The relative velocity between the ground and the satellite is 11,198 – 5471 = 4498 m/s. While the relative velocity can be measured with photon Doppler shifts, this velocity is not used to calculate satellite clock adjustments. The measured value for clock adjustment is obtained by subtracting the calculated interval of the ground clocks momentum vector from the Lorentz velocity interval of the GPS clock.

Earth Clock and GPS Clock Experimental Values

Mass of 1kg clock at relative motion--------- $m' = M/\sqrt{1-v^2/c^2}$ = 1.000000000113 kg
Relative velocity interval------------------------ $t' = T/\sqrt{1- v^2/c^2}$ = 1.000000000113
Mass of Earth surface clock at 11.2 km/s---- $m' = M/\sqrt{1-v^2/c^2}$ = 1.000000000697 kg
Earth Clock's velocity interval --------- $t' = T/\sqrt{1- (11.2)^2/c^2}$ = 1.000000000697
Mass of 1 kg GPS clock at 6.7 km/s---------- $m' = M/\sqrt{1-v^2/c^2}$ = 1.000000000249 kg
GPS Clock's velocity interval ------------ $t' = T/\sqrt{1- (6.7)^2/c^2}$ = 1.000000000249
Interval adjustment needed to synchronize GPS clocks ----------- .000000000448

These different clock rates have nothing to do with relative motion. For example, the 24 satellites in the GPS constellation are all moving at many different relative velocities yet their clocks all remain synchronized because their frames all have the same Lorentz velocity. These calculations will not be correct if the zero velocity Lorentz rest frame is used for any of these frames. It is only used as a reference for a T = 1.0 clock interval at Earth's center.

These calculations are not made with the equations of General Relativity theory. General Relativity's calculations are based on the metaphysical assumption of undetectable gravitational potentials. These potentials are derived from measured gravitational accelerations and escape velocities but they cannot be measured independently. It matters not whether you use calculated gravitational potentials or measured escape velocities in your calculations. The results will come out the same either way because the calculated potentials are derived from measured velocities and accelerations. The metaphysical assumption of gravitational field potentials is not needed to calculate the correct GPS clock rates.

Pound-Rebka Calculations

In the Pound-Rebka measurements, the momentum and clock time interval at the top of the 22.5 m high Jefferson tower is compared with the greater momentum and longer time interval at the bottom of the tower. The difference in gravitational velocity between the top and bottom of the tower is the relative velocity of V = 7.36 x 10^{-7} m/s. This is the velocity that a falling body will attain in the time it takes for a gamma photon to travel 22.5 m. This Relative velocity can be measured and verified with both accelerometers and photon Doppler shifts but it is not used to calculate the momentum shifts measured in the Pound-Rebka gamma photons. The difference in clock intervals between the top and bottom is called gravitational red shift and is caused not by relative velocity but by the difference in the Lorentz velocity frames of v = 11,189 m/s and v = 11,189.000000736 m/s.

Pound-Rebka Experimental Values

Gravitational velocity at the top of tower ------------------11,189 m/s
Gravitational velocity at the bottom of tower -------------11,189.000000736 m/s
Mass of clock for relative velocity ----- = 1.000000000000000000000000000003kg
Relative velocity interval---------------- t'=1.000000000000000000000000000003
Mass of top clock ---------------------------- $m' = M/\sqrt{1-v^2/c^2}$ = 1.0000000006959459 kg
Mass of bottom clock ------------------------$m' = M/\sqrt{1-v^2/c^2}$ = 1.0000000006959484 kg
Bottom Lorentz velocity interval ----------- $t' = T/\sqrt{1-v^2/c^2}$ = 1.0000000006959484
Top Lorentz velocity interval ---------------- $t' = T/\sqrt{1-v^2/c^2}$ = 1.0000000006959459
Difference in time intervals between the top and bottom -------- .0000000000000025
Pound-Rebka measured momentum, wavelength & interval shifts ---- 2.5 x 10^{-15}

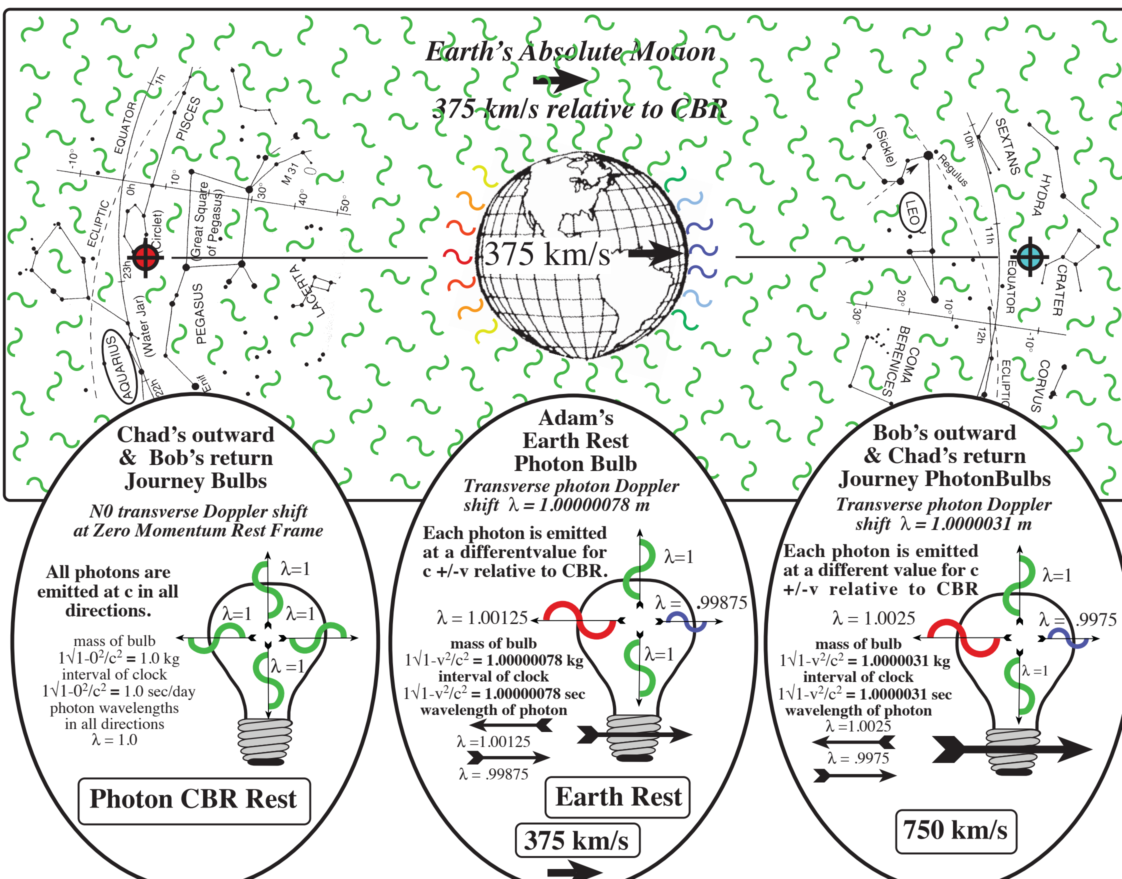
If we use a zero velocity Lorentz frame to calculate the momentum and time shifts in the gamma photons used in the experiment, we get a result that is 17 orders of magnitude smaller than the measured effect. In order to duplicate the measured values of 2.5 x 10^{-15} for photon momentum and time dilation, we must calculate the time dilation of the two Lorentz velocity frames at the tower's top and bottom. The relative velocity between frames is still the same but it is absolute velocity and not relative velocity that is used to make correct Lorentz frame calculations. The relative velocity of 7.36 x 10^{-7} m/s can be used to calculate photon Doppler shifts but the actual cause of the shifts is the difference in clock intervals.

Again, these calculations are not based on General Relativity. These results are derived completely from the measured parameters of gravitational force and motion. They have nothing to do with metaphysical assumptions about the relative motion between the undetectable potentials of gravitational fields.

Twin Paradox Experiment Calculations

There is a third type of Lorentz transformation experimental measurement that makes a comparison between not two but three or more Lorentz velocity frames. One example of this is the so called Twin Paradox experiment where one twin stays home in an assumed zero velocity Lorentz frame and the other goes on a long, high velocity, journey into space and back. When the astronaut twin returns home, he is younger than his brother due to the difference between the unchanging clock intervals of Earth's Lorentz rest frame and the increased clock intervals of the outbound or inbound Lorentz velocities. If both legs of the journey are at the same measured

Triplet's Journey in 2.7˚K Cosmic Blackbody Radiation Time



velocity, then the dilated clock time intervals will be the same for the back and forth portions of the trip.

The glaring problem with calculating the results of a twin paradox experiment is that the actual zero velocity Lorentz frame cannot be easily located and Earth's true Lorentz velocity frame cannot be located beyond comparing Earth's location with the motion of bodies in the universe in general and the Doppler shifts of 2.7˚K Cosmic Blackbody Radiation photons in particular.

In the zero velocity rest frame, all twin paradox experiments in any direction with equal velocity vectors will have the same clock intervals for each in each leg of the journeys. However, give Earth any arbitrary Lorentz velocity vector and the synchronous outward and inbound time intervals are lost to the difference in momentum vectors between Earth's velocity frame and the back and forth momentum vectors of the twin's spaceship. If the twin fired his rocket along the vector of Earth's Lorentz velocity, the difference in time dilation rates between outward and inbound trips would be at a maximum and if the twin traveled at a right angle to Earth's momentum vector, the difference in time dilation rates between legs would be at a minimum.

From this, it would be possible to measure the true magnitude and direction of Earth's Lorentz velocity frame by performing three different twin paradox experiments in three different perpendicular directions and then combining the results into a single velocity vector for Earth. The difference in time intervals between the two legs of each trip reveals Earth's Lorentz velocity along that vector. If two more twin experiments are preformed at right angles to the first, the different clock time intervals of each of the six legs can be combined to identify the true magnitude and direction of Earth's Lorentz momentum vector. Motions along x, y, and z vectors are combined into a single velocity vector. Thus, three perpendicular Twin Paradox experiments could be used to measure the true direction and magnitude of Earth's Lorentz velocity vector independently of the dipole anisotropy of 2.7˚K CBR photons.

The Triplet Paradox Experiment

In this thought experiment, there are identical triplets; Adam, Bob & Chad. Adam stays on Earth for two years and watches his clock. Bob uses his accelerometer to measure an acceleration to 375 km/s in the direction of the constellation Leo, maintains that velocity for one year and then records the time on his clock, turns around and accelerates to 750 km/s back towards Earth. This gives him a relative velocity with Earth of V = 375 km/s. Chad accelerates to 375 km/s in the direction of Aquarius and then after one year he records the elapsed time on his clock, turns around and accelerates to 750 km/s back towards Earth. This also gives him a relative velocity with Earth of V = 375 km/s. Both triplets spend two years traveling at velocity of V = 375 km/s relative to Earth.

If we use relativity's time dilation formula $t' = t/\sqrt{1-v^2/c^2}$ to calculate the clock rates for 375 km/s, we find the intervals of Bob's and Chad's clocks are t' = 1.000000781 versus Adam's zero velocity intervals of t' = 1.0. These measured values are only valid for the special situation where Earth is at rest in the zero momentum Lorentz frame. Common sense tells us that Earth cannot possibly be in the zero momentum frame. If nothing else, we can see Earth moving relative to the sun. Earth's true Lorentz velocity must remain unknown until the triplet paradox experiment has been completed. By measuring the difference in intervals between each leg of an astronaut's journey, it is possible to measure the magnitude of Earth's velocity along the vector of the twin's journey. Only if the two intervals are the same can we determine that Earth is at rest along that vector.

Now, if we use the formula to calculate Earth's values within a 375 km/s Lorentz frame with its vector between Leo and Aquarius, we get different intervals for all three clocks. Adam's Earth clock with an assumed interval of T = 1.0 is now calculated to have a Lorentz interval of t' = 1.000000781.

On Bob's trip toward Leo, he is actually traveling at 750 km/sec relative to the zero velocity Lorentz rest frame. This increases the momentum of his atomic clock and increases its interval to t' = 1.000003125. This is four times slower than Adam's slowed Earth clock. After one year, Bob turns around, marks his clock, and accelerates to 750 km/s toward Earth to obtain a relative velocity of 375 km/s. In actuality, this is all deceleration that brings Bob to the position of zero momentum rest. On Bob's "trip" back to Earth, he is actually sitting still while it is Earth that is traveling at 375km/s to meet him. With no momentum to slow his clock, Bob's clock is running faster than Adam's clock with a time interval of $t' = T/\sqrt{1- 0^2/c^2} = 1.0$. Bob can determine he is actually at v = 0 Lorentz rest by observing no dipole anisotropy in the temperature and momentum of the 2.7˚K CBR photons.

When Chad accelerates to 375 km/s in the opposite direction towards Aquarius, he is actually decelerating to a stop. This decreases his clock's momentum to zero and causes it to run at its maximum rate of $t' = T/\sqrt{1- 0^2/c^2} = 1.0$. He also will not be able to measure any dipole anisotropy in the momenta of 2.7˚K CBR photons. He sits at rest for one year while Earth moves away from him at v = 375 km/s. He then marks the time on his clock and accelerates to a momentum vector of v = 750 km/s towards Earth, giving him a relative velocity of V = 375 km/s. His clock will now have an interval of t' = 1.000003125 for his true Lorentz velocity of v = 750 km/s.

In these calculations, Bob and Chad spent half their journeys sitting at rest with clock intervals of t' = 1.0 and the other half moving at v = 750 km/s with clock intervals of t' = 1.000003125. The average momentum frame time dilation interval of the traveling triplets is t' = 1.000001562. Relative to Adam's unmeasured Earth clock's rate of t'

= 1.000000781, the traveling triplets will measure their average time dilations for both their trips to be t' = 1.000000781. By recording the elapsed time on their clocks when they turn around, Bob and Chad will be able to determine the correct clock time intervals for each leg of their journeys. This will allow the triplets to determine that the true motion of Earth is 375 km/s towards Leo without using the CBR dipole anisotropy as a reference.

While it is true that special relativity's twin paradox calculations for a zero velocity frame and the calculations for an arbitrarily moving Earth rest frame yield identical results for the total time dilation of Bob's and Chad's round trip journeys, they give greatly different results for the time intervals of individual legs of the triplet's journeys. When the triplets record the time intervals for each leg of their journeys they find that they are not equal even though they were careful to maintain a precise relative velocity of V = 375 km/s with Earth. This relative velocity can be measured and verified with both inertial navigation accelerometers and photon Doppler shifts between Earth and the spacecraft. The triplets can then use the measured differences in these two clock intervals to calculate the true value for Earth's velocity along their vector.

These results clearly show that the Living-Universe's zero velocity Lorentz frame is the only possible Preferred Frame and all of special relativity's arbitrary "rest" frames can be measured to be moving frames with unique momentum vectors. While special relativity theory is able to calculate the correct average time interval for two-way trips, it fails completely to give correct time intervals for individual one-way legs of the trips without incorporating Earth's true Lorentz momentum vector p = mv.

Triplet Paradox Experimental Values

Clock interval of Zero Velocity Frame -------$t' = T/\sqrt{1-0^2/c^2} = 1.0$
Lorentz mass of relative velocity --------- $m' = M/\sqrt{1-375^2/c^2} = 1.000000781$kg
Clock interval of relative velocity---- $t' = T/\sqrt{1-375\text{ km/s}^2/c^2} = 1.000000781$
Lorentz mass of fastest legs---------------- $m' = M/\sqrt{1-750^2/c^2} = 1.000003124$kg
Lorentz mass of stationary clocks------------ $m' = M/\sqrt{1-0^2/c^2} = 1.0$kg
Clock interval of fastest legs -----------------$t' = T/\sqrt{1-750^2/c^2} = 1.000003124$
Clock interval of stationary "legs" ------------ $t' = T/\sqrt{1-0^2/c^2} = 1.0$
Average clock interval of to and fro legs ------------------------ = 1.000001562
Increased mass of Earth at 375 km/s ----------------------------- = 1.000000781
Clock interval of Earth's 375 km/s Lorentz velocity frame---- = 1.000000781
Measured interval between Earth clock & Triplet's clock ------ = 1.000000781
Measured mass and time interval of Earth clock--------- m & t' = 1.0

The Zero Momentum Preferred Rest Frame

The measured time interval of 1.000000781 second, hour, year etc. tells us that Earth is moving at 375 km/s along the same x vector of the triplet's trips. The difference in time intervals between each leg of the triplet's trips determines the direction and magnitude of Earth's Lorentz velocity. There are three vectors of motion and this measurement only identifies Earth's momentum vector along its single x vector. Earth's true Lorentz xyx vector velocity must be at least v = 375 km/s but could be either much more or less along its y & z vectors. Earth could be moving up or down or sideways left or right faster or slower than it is moving along its x momentum vector.

In a triplet paradox experiment where Adam, Bob and Chad travel along the x, y, and z vectors, it would be possible to determine Earth's true Lorentz momentum vector relative to the Zero Momentum Frame $m' = M/\sqrt{1\text{-}02/c2} = 1$ kg. The ZMF is the measured preferred absolute rest frame of the universe and Special Relativity's calculations must be based on the ZMF in order to yield correct values for experimental measurements of the time intervals in individual legs in Twin Paradox experiments.

Not even the most dedicated relativity enthusiast can deny that the location of the Living-Universe's Zero Momentum Frame represents the preferred rest frame from which all accelerometer readings, Lorentz transformations, and photon interactions are ultimately calculated and measured. All photons move at exactly c within this frame and it is the only frame in which it is possible to make correct calculations for one-directional time dilations. It is also the only frame in which there are zero Doppler shifts in emitted and absorbed photons. While the very existence of the Doppler effect demands a common rest frame for photons, by their very nature, Doppler shifts can only be used to measure relative motion.

Some people who believe in intrinsic relative motion claim that only two-way relative motion time dilations can be measured. Accurate one-way measurements of mass and time dilations are made in both the GPS clock rate calculations and the Pound-Rebka momentum and photon measurements. Even true believers in aether frames will usually choose the ZMF as the location for their aether since it appears to be tied to the speed of light. They propose that all photons are measured to move at c relative to this zero velocity Lorentz aether. Some other aether people try to put their aether's rest frame at the same location as the 2.7˚K Cosmic Blackbody Radiation's Lorentz frame. Special relativity does not attempt to locate positions of rest for its metaphysical assumption of a 4-dimensional spacetime continuum field. It is a postulate of the theory that the parameter of absolute space can't be measured. The physical assumption of the ZMF calculates and measures the position and magnitude of Earth's momentum and establishes values for its mass, space, time, and gravitational force and motion.