Experimental Values of Lorentz Transformations of Mass and Time

Measuring the Fitzgerald Contraction
Lorentz Transformation Thought Experiment
GPS Clock Calculations
Pound-Rebka Experiment
Triplet Paradox Experiment

The Lorentz transformation is a principle of measurement and not a theory. It is the calculation that is used to determine the changing values of mass and clock time intervals whenever acceleration and deceleration are measured. Contrary to popular belief, the Lorentz transformation is not a part Einstein's theories of relativity. While Einstein did incorporate the Lorentz transformation equations in his theories as a physical principle of measurement, it was not a structural part of the metaphysical assumptions made in either the special or general theories of relativity. The Lorentz transformation is based on Newtonian accelerometer measurements that Einstein used to interpret his metaphysical assumptions about the force and motion of both photons and gravity. The two basic unmeasured assumptions of Einstein's theories are the idea of a massless photon wave moving through spacetime for special relativity and the idea of equivalent inertial and gravitational motion for general relativity.

The Lorentz transformations of Mass, Time, and Space

The Lorentz transformation $m' = M/\sqrt{1-v^2/c^2}$ is a principle of measurement that is classed as a law of physics and not a theory. (A moving body's kinetic mass m' is equal to its rest energy/mass M divided by the square root of one minus 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. This equation calculates the changes in a body's mass that occur with measured changes in its momentum.

This equation is simply a different configuration of $e = mc^2$. The photon version of this equation is $e/m = cC$, the rest mass form is $e/m = CC$, and the kinetic energy form of the equation is $e/m = cc$. Energy and mass are always equal. As the momentum of a body is increased by acceleration, its energy/mass is increased by an equal amount. As the body approaches the speed of light, the measured value of its energy/mass increases requiring more and more kinetic energy to accelerate it faster. At the speed of light the body's energy/mass would become infinite. The Lorentz transformation for the energy/mass of the photon is $M/\sqrt{1-c^2/c^2} = e/m = cC = 1$.

The inverse of this equation $t' = T/\sqrt{1-v^2/c^2}$ ($t^2 = e/m$) calculates the length of a clock's time intervals as it slows down or speeds up in direct proportion to increases or decreases of the energy/mass of the clock's momentum vector relative to the Zero Momentum Frame of rest. When a clock is accelerated, its mass increases along with its energy and the length of its time intervals increase at the same rate. When a clock is decelerated, its energy/mass decreases to a minimum of $e/m = 1$ at rest and its time intervals grow shorter to a maximum rate of $T = 1.0$ where the clock is at absolute rest and has no momentum to dilate its intervals.

This change in the duration of clock intervals is simply an effect of mass changes in the clock's internal mechanism. As a clock's energy/mass (momentum) increases with increasing velocity, the angular momentum of its rotating and vibrating components remains at a constant value. It is this conservation of angular momentum that causes these components to slow their rotational motion and increase the intervals of time that they record. This process is reversed when the clock is decelerated to a decreased momentum and the lengths of its recorded intervals are decreased.

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 momentum velocity vector $p = mv$, but the universe contains only a single zero momentum Lorentz frame where $p = 0$, $v = 0$, $m' = 1$, $M = 1$, $t' = 1$ 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 intervals 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.

Measuring Mass Increase, Time Dilation and Length Contraction

When any body of mass, such as a clock, is accelerated to a high velocity its energy and mass are increased by equal measurable amounts according to '$m = M/\sqrt{1-v^2/c^2}$. This increase in energy is in no way apparent to the observer. There is no local experiment that can measure or even detect this energy. The only way that this energy can be identified is to use another quantity of energy to decelerate the observer and clock. The problem is, the observer has no way of knowing whether the energy is being used is for deceleration or acceleration. Energy cannot be measured separately from a unit of energy/mass $e/m = v^2/2$. Energy is the motion of mass. Energy is calculated from the measurement of momentum. Momentum is a real measured quantity of motion and energy is just the idea for how a quantity of momentum or angular momentum can be changed. The cannonball and cannon have equal momentum but the cannonball has much more energy.

While local observers can only observe relative changes in energy, they can use their clocks to observe absolute changes in momentum. As the momentum of the clock increases, its energy/mass increases. This extra momentum, added to the conserved angular momentum $I\omega = mvr$ of the clock's mechanism, reduces its rotational velocity and increases its time intervals. In order to conserve its angular momentum, all reciprocal, two-dimensional motions within each of a clock's atoms must slow down.

Clock "time dilation" is based on the relationship between momentum and angular momentum. All clocks are based on the conservation of angular momentum. This is true whether it is a mechanical Rolex, grandfather pendulum clock, the daily rotation of Earth, or a Cesium-33 GPS satellite clock.

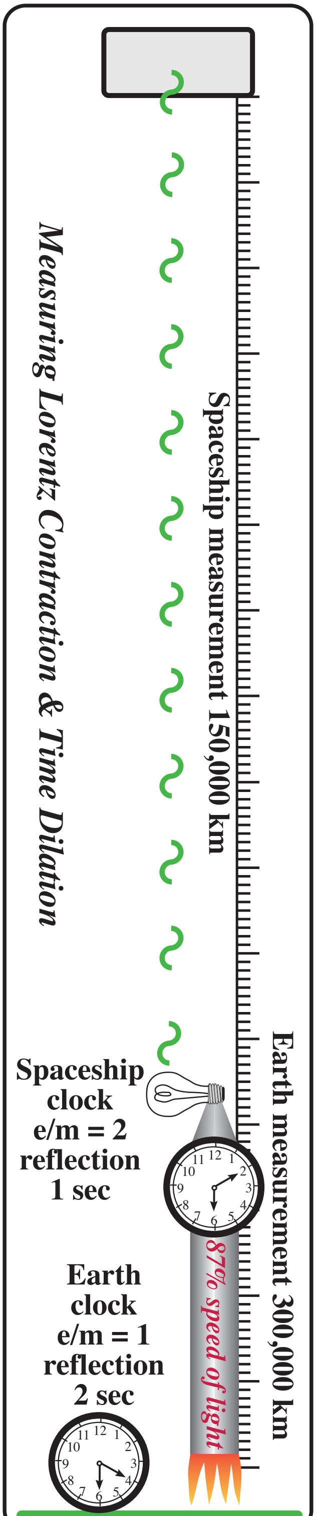
Changes in a clock's momentum have no effect on any of these clock intervals. A clock's rate can only be changed by changes in its angular momentum. Changing the radius of a Rolex balance wheel changes its angular momentum and recorded interval. Changing the length of a gravity clock's pendulum changes its angular momentum and interval. If Earth were to encounter a large cloud of water vapor that rained several feet of water into the oceans, it would increase Earth's mass but not its angular momentum. All of this new water would share the angular momentum of Earth's rotation. This does not change Earth's total conserved angular momentum because the new water did not bring new any angular momentum with it. In order to conserve angular momentum with the added water, the Earth would slow its rotation and the interval of a day would lengthen.

Slowing Earth's rotation by adding water to it is basically the same basic mechanism that causes time dilation in GPS satellite clocks. With atomic clocks, the angular momentum being conserved is $h/2\pi$ and there is no way to change it. When the atoms in an atomic clock are accelerated to a high momentum, the energy/mass associated with this momentum is added to the mass of the atoms within. In order to conserve their angular momentum with the addition of this "relativistic" mass, the atoms must slow their rates of vibration and rotation and lengthen the recorded intervals of the clock. Actual time does not change because time is just an idea used to describe the relationship between momentum and angular momentum. Momentum can only be measured as relative and angular momentum is always measured as absolute.

Measuring the Fitzgerald Contraction

The second order "length contraction" often associated with the Lorentz Transformations of mass and time is just a relativistic artifact of the measurement process and not an actual effect. Whether or not length contraction appears in an experimental measurement depends on the observer's choice of clocks and measuring rods. However, relative to the technicians onboard a rapidly moving spaceship, length contraction must be considered as real. If they were to send out an astronaut with a yard stick to measure the ship, they would find that it was still its original length in terms of Earth yards, but when the yardstick was brought back into the ship and measured with a laser it would be found to be only 18" long. Even if technicians know length contraction is not real relative to Earth measurements, they will still have to use this new shortened standard of length in all of their experimental measurements with lasers and clocks for the values to all come out right.

Lorentz Time Dilation and Length Contraction



To understand how time dilation and length contraction are actually measured, consider the following thought experiment. Two groups of technicians with atomic clocks are traveling in a space ship that accelerates from Earth to a velocity of 87% the speed of light. The first group will use laser photons to measure the changing length of the rod caused by Fitzgerald contraction and the second group will use laser photons to measure consecutive intervals of time.

Their measuring device is a mirror attached to the end of a very long rod that extends out 300,000 km in front of the spaceship. Photons are timed as they are emitted from the clock, reflect off the mirror, and return to the craft. When the spaceship left Earth, it took exactly two seconds for the photons to reflect from the mirror and return to the clock. The first group used the time of light travel as their definition of length and the second group used the distance light travels as their definition of time.

After the spaceship had accelerated to a high velocity, the first group notices that its take less and less clock time for the photons to return to the ship and they conclude that the rod must be contracting. The second group also observes the reflection time intervals getting shorter but they conclude that their clock used to time the photons must be slowing down.

When they finally reach 87% c, both groups agree that photons now only take 1 second to reflect and return while back on Earth they took two seconds. Since the speed of light could not change, either the clocks had slowed to one/half their rate or the pole had undergone a Lorentz contraction to one/half its Earth length. If the technicians were not expecting the otherwise undetectable Lorentz slowing of their clocks, it would be natural to assume that the length of the rod had contracted. If it were possible for observers to watch from Earth, they would see there was no length contraction and that it still takes two seconds Earth time for light to reflect back and forth. Length contraction is only apparent to observers who do not recognize the time dilation of their clock.

At a velocity of 87% c, the Lorentz transformation will double the mass of the ship, the technicians, and their clocks. With double their Earth mass, the clocks conserve their angular momentum by slowing their internal motion and doubling the length of their recorded time intervals compared to those intervals on Earth.

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 pair of clocks 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 further 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 ships approach and then are red shifted as they recede from one another. At the time interval when the two ships 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 ship’s average relative velocity is v = 1km/s.

At the point where the spaceships pass, it is easy for the technicians 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 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 = 1/2 c.

Lorentz Transformation Mass and Time Values for 1/2 c

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

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

Clock interval for 150,000 km/s -$t' = T/\sqrt{1-(150{,}000\ \text{km/s})^2/c^2}$ = 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 and v =150,001-- 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. 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.

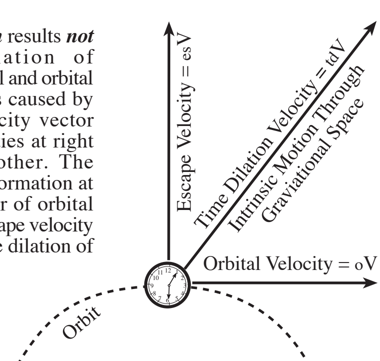
Two actual experiments that use the Lorentz transformation principle to calculate the mass and time differences between two Lorentz transformation frames are the GPS clock measurements and the Pound-Rebka measurements of gamma photon momentum.

Global Positioning System Clock Calculations and Adjustments

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 ${}_{es}V$ = 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.

Orbiting Atomic Clock Rate Equations

Orbital time dilation results ***not*** from a combination of gravitational potential and orbital motion. Rather, it is caused by the combined velocity vector (${}_{td}V$) of two velocities at right angles to one another. The Lorentz mass transformation at the combined vector of orbital velocity (${}_{o}V$) and escape velocity (${}_{es}V$) causes the time dilation of orbiting clocks,

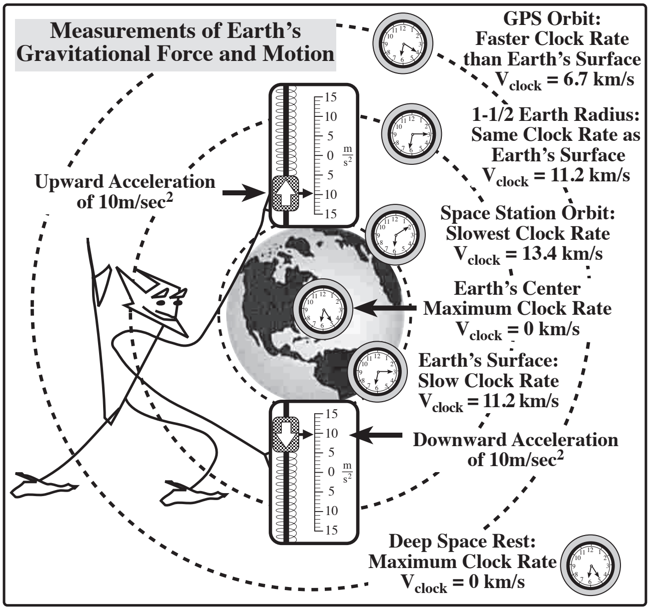


$${}_{td}V = \sqrt{{}_{es}V^2 + {}_{o}V^2}$$

Time dilation velocity (${}_{td}V$) of an orbit is equal to the square root of the sum of the escape velocity squared (${}_{es}V^2$) and the orbital velocity squared (${}_{o}V^2$).

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

A clock's kinetic time interval (T_k) is equal to its rest time interval (T_0) divided by the square root of one 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).



Both a satellite's orbital velocity and its upward escape/surface velocity play a role in the timing of satellite clocks. These two perpendicular velocities are combined into a single momentum vector to calculate the clock's Lorentz transformations of mass and time. The escape/surface velocity is calculated from the measured upward acceleration of mass and downward deceleration of time. Orbital velocity is measured relative to Earth's center.

GPS Time Dilation Equations

Newton Escape Velocity

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

Absolute Motion Time Dilation

$$T_k = \frac{T_0}{\sqrt{1 - \frac{V^2}{C^2}}}$$

Special Relativity Time Dilation

$$T_k = \frac{T_0}{\sqrt{1 - \frac{V^2}{C^2}}}$$

General Relativity Time Dilation

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

Absolute Motion Gravitational Time Dilation

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

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).

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 ($_oV^2$) divided by the speed of light squared (C^2).

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 measured 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.

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

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/surface velocities but they cannot be measured independently. It matters not whether you use calculated gravitational potentials or measured escape/surface 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 imaginary 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 are compared with the greater momentum and longer time interval at the bottom of the tower. The difference in gravitational escape/surface velocity between the top and bottom of the tower is is ${}_{es}V$ = .01974 m/s. During a photon's flight, Earth accelerates upward to a 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 change in relative velocity can be measured and verified with both accelerometers and photon Doppler shifts and is 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 clock intervals between the Lorentz velocity frames of the top ${}_{es}V$ = 11,189 m/s and bottom ${}_{es}V$ = 11,189.01974 m/s.

Pound-Rebka Experimental Values

Gravitational velocity at the top of tower -------------------11,189 m/s
Gravitational velocity at the bottom of tower -------------- 11,189.01974 m/s
Difference in velocity during photon travel time-----------.000000736 m/s
Mass of clock for relative velocity= 1.0000000000000000000000000000003 kg
Relative velocity interval--------- t'=1.0000000000000000000000000000003
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 escape/surface/velocity frames at the tower's top and bottom. The change in 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 either special or general relativity theories. 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. There is a more detailed explanation of the Pound-Rebka experiment at the end of this book

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 length in clock intervals of the outbound or inbound Lorentz velocities. If both legs of the journey are at the same measured 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 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.

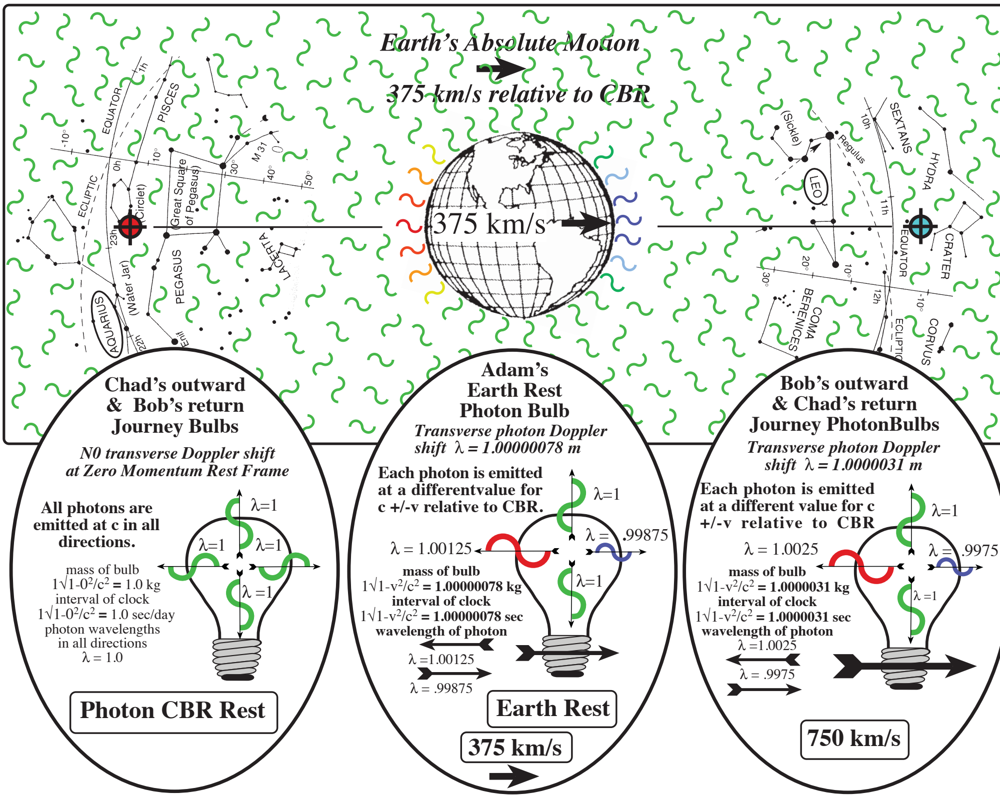
Chad accelerates to 375 km/s in the direction of Aquarius and then after one year he records the elapsed time on his clock, turns around and accelerates to 750 km/s back towards Earth. This also gives him a relative velocity with Earth of V = 375 km/s. Both triplets spend two years traveling at a velocity 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.

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



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 --------- $t' = T/\sqrt{1-375^2/c^2} = 1.000000781$

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 $m' = M/\sqrt{1-0^2/c^2} = 1$ kg. The ZMF is the measured preferred absolute rest frame of the Living-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 Doppler shifts 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. However, 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.

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.