Experimental Refutation of Einstein's Symmetry Principle

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Abstract

A well-known prediction of the Lorentz transformation (LT) of Einstein's theory of Special Relativity (SR) is that when two observers exchange light signals, they will both measure a red shift (lowering in frequency). An experiment with gamma rays was reported by Hay et al. in 1960 in which an absorber is mounted at the rim of a high-speed centrifuge while the source is located near the rotor axis. There is general agreement that because of its acceleration, the clock attached to the absorber must be retarded relative to the gamma ray source. Despite the claim that this result is a confirmation of the Symmetry Principle, the fact remains that the slowing down of the absorber clock means that the frequency of the signals it receives from the source will be *greater* than the standard value, i.e. a *blue shift* will be observed because more waves are counted per second by virtue of the absorber clock's reduced rate. This experience therefore stands in direct contradiction of the Symmetry Principle. In addition, it is pointed out that the three space-time predictions of the LT (equal speeds of light, time dilation and FitzGerald length contraction) are incompatible with one another. An alternate theory is presented (Uniform Scaling method) which is in full agreement with the results of the ultra-centrifuge experiment and also avoids any incompatibility with regard to it space-time predictions.

Keywords: Uniform Scaling method, Lorentz transformation (LT), Einstein's Symmetry Principle, Equivalence Principle, Ultra-centrifuge experiment with gamma rays, time dilation, FitzGerald length contraction

I. Introduction

The prediction that clocks in motion run slower than their identical counterparts at rest was one of the great triumphs of Einstein's Theory of Special Relativity (SR) [1]. He concluded that a clock that returned to its starting point after moving in a circular path would have less elapse time than one left behind at the starting point. He also claimed that a clock at rest at the Equator runs slower than one near one the earth's Poles. It took more than 30 years before tests of this theory could be carried out experimentally. This was accomplished on the basis of measurements of the lifetimes of meta-stable particles as a function of their speed relative to the earth [2-6] and also by means of the Ives-Stilwell experiment with accelerated light sources [7-9]. In each case quantitative agreement with Einstein's predictions was obtained.

There was nonetheless one aspect of this general phenomenon (time dilation) which remains controversial to the present day. He claimed that the effect is symmetrical in nature (Einstein's Symmetry Principle). This concept is made plausible by the obvious fact that two observers in motion each think that it is the other who is moving. For example, Einstein predicted that two clocks in relative motion could be both be running slower than the other. The same should hold true for measurements of masses and the lengths of objects.

It became possible to make a definitive test of this prediction by employing the Mössbauer effect to carry out measurements of the frequencies of γ-rays emitted from a source mounted on a high-speed centrifuge. [10] Two other groups carried out similar investigations and came to the same conclusion [11-12]. They claimed that their results were consistent with Einstein's SR predictions of time dilation, but each found it necessary to invoke Einstein's Equivalence Principle enunciated in 1907 [13] to justify this conclusion. In the following discussion, attention will be turned to critically examining the arguments on which this theoretical approach is based.

II. Symmetry Characteristics of the Ultra-centrifuge Experiments

The purpose of the ultra-centrifuge experiment [10] was to investigate Einstein's time dilation prediction [1]. It was intended to supplement the earlier work of Ives and Stilwell [7] in which the properties of light emitted from an accelerated source were measured. In the latter case, the verification of time dilation was accomplished only indirectly by measuring the wavelength of the light [8,9]. It was necessary to take account of the Doppler effect, which is a non-relativistic effect. This was done by averaging the wavelengths of the radiation emitted with speed v in opposite directions relative to the laboratory. It was found [7-9] that the average wavelength λ based on the measured values recorded on the same photographic plate was equal to γ (v) $\lambda_0=(1-v^2c^{-2})^{-0.5}$ $\lambda_{0,}$ where λ_0 is the corresponding rest value. It was thereupon argued that this result is consistent with a frequency value ν which is less than the rest value ν_0 by a factor of γ because of the assumption that the speed of the light c has a value of λν, i.e. $\nu= \gamma^{-1}$ ν_0, in accord with the light-speed postulate of Einstein's SR [1].

It was clearly impossible to measure the value of the light frequency to sufficient accuracy to obtain a direct verification of time dilation. Hay et al. [10] made use of the Mössbauer effect to carry out accurate measurements of the frequency of γ -rays in order to overcome this uncertaintyy of the Ives-Stilwell study. There was another potential advantage of the ultra-centrifuge experiment, however, namely to eliminate any possible complication due to the conventional Doppler effect. This was because the direction of motion of the γ -ray absorber was always transverse to the radiation, thereby enabling a direct measurement of the transverse Doppler effect (TDE), which is a consequence of the expected time dilation of the γ-rays.

There is yet another novel aspect of the ultra-centrifuge study, namely it allows for a test of Einstein's Symmetry Principle of SR. In the Ives-Stilwell experiment [7-9], the source of the radiation is accelerated relative to the laboratory where the wavelength measurements were made. The γ-ray observer in the Hay et al. study was mounted on the rim of the rotor and was therefore moving at a higher speed relative to the laboratory than the source. According to the Symmetry Principle, the observer in the laboratory should find that the radiation from the light source is red-shifted, i.e. it has a smaller frequency than that measured in the rest frame of the source. In other words, the expectation from Einstein's Symmetry Principle [1] is that the radiation from a moving source is always red-shifted relative to the observer at rest.

The title of the Hay et, al paper [10] is "measurement of the red shift in an accelerated .."

In the second paragraph, however, the authors write that "the expected fractional shift is

$(R_1{}^2\text{-}R_2{}^2)\ \omega^2/c^2$=2,44x$10^{-20}\omega^2$." The authors do not say, however, what the direction of the shift is. In a later paper describing the same experimental procedure, Kündig [11] states that the fractional *energy* shift is $(E_A\text{-}E_S)/E_A = -\ R_A{}^2\omega^2/2c^2$. In his eq. (3), he states that $\Phi = -0.5R_A{}^2\omega^2 = \nu_S\ (1+ 2\Phi/c^2)^{0.5} \approx (1+ \Phi/c^2)$, so $(\nu_A\text{-}\nu_S)/\nu_A = -\ R_A{}^2\omega^2/2c^2$ as well. After his eq. (4), he then states that the clock which experiences acceleration is *retarded* compared to the clock at rest. This means in turn that the accelerated clock counts more waves per second than the source clock, i.e. experiences an *increase* of frequency/*blue shift* relative to what is emitted at the source, This conclusion is confirmed by Champeney et al. [12] by stating that $\Delta\nu/\nu = (v_a{}^2\text{-}v_s{}^2)/2c^2$ (where v =Rω in each case). In this case, ν_a refers to the frequency measured by the absorber clock; it is larger than the frequency emitted at the source, so a blue shift has been recorded. The results therefore stand in contradiction to the prediction of the Einstein's Symmetry Principle of SR and the Lorentz transformation (LT) [1].

Shortly after the results of Hay et al. were published [10], there appeared a paper by Sherwin [13] dealing with this subject. He pointed out the fact that, again in contradiction to the title of ref, [10], that "the result is completely unambiguous: One particular clock certainly runs fast, and the other certainly runs slow," i.e. a blue shift had indeed been observed in their experiment. Sherwin went further, however, to claim that this contradictory evidence did not necessarily prove that the SR Symmetry Principle was incorrect. He argued instead that the results might just mean that the expected symmetry should only occur when the clock to be used in the experiment was perfectly inertial, that is, not under the influence of some external force. This was clearly not the case in the ultra-centrifuge studies. It needs to be pointed out, however, that a truly inertial system is extremely rare in nature, so Sherwin's position effectively renders SR and the LT completely inapplicable in actual practice.

There are other indisputable proofs that the LT is invalid. In his classic book on electromagnetic theory [14], Jackson uses the LT to derive Einstein's time dilation (TD) phenomenon. Two rest frames are considered, one (S) in which the observer possesses a stationary clock and another (S') in which an inertial clock is moving at constant speed v relative to S. The lifetime of an object is measured using both clocks; the result is T for the stationary observer in S and T' for the other in S'. Consistent with SR, it is found that $T=\gamma(v)\ T'$. Jackson then gives an example of the measurement of the lifetime of some pi mesons, which confirms the above result ft time dilation in the S' rest frame. The same two observers then measure the length of an object which is also stationary in S'. The length of the object is measured to be L' by the observer in S', whereas the value obtained in S is L. Use of the LT then leads to the well-known relationship of FitzGerald length contraction (FLC) of SR, namely $L=L'/\gamma$, i.e. the object appears to be contracted to the stationary observer in S.

It is instructive to use the TD and FLC relationships to measure the speed of light of a source which is stationary in S'. The observer there finds, consistent with Einstein's light speed postulate of SR, that $L'/T'=c$. The observer in S measures the speed of the same light pulse by making use of the TD and FLC relationships. He therefore finds that $L/T= (L'/ \gamma)/\gamma T'=$

$\gamma^{-2} (L'/T') = \gamma^{-2}c$, i.e. that the light speed is not equal to c for the stationary observer in S, contrary to the LT expectation. This result by itself proves that the LT is invalid. Note that the argument does *not* rely on the results of measurements that could only be carried out in 1960. It is obvious from the theory itself that the LT is hopelessly flawed.

There is an interesting example from a textbook [15] which illustrates how the relationship between TD and the FLC has been misused. The authors consider the decay of muons with a half-life of $T_0=1{,}54\text{x}10^{-6}$ s moving with speed v in the direction of the earth. In accord with the TD relation given above, the value T of their half-life from the vantage point of an observer who is at rest on the earth's surface is γT_0 The muons are initially at a distance $L = \gamma(v)vT_0$ m above the earth's surface. After time $L/v = \gamma T_0$ has elapsed, only 50% of the muons arrive at the earth's surface (since the value of the half-life is γT_0). Next consider the same process from the vantage point on an observer co-moving with the muons. The half-life for him is T_0. The authors conclude on the basis of the FLC that the observer measures the distance to the earth's surface to be γ times *shorter* than his counterpart there, i.e. $L/ \gamma = vT_0$. As a result it is concluded that only half of the muons also arrive at the earth's surface from this vantage point, i.e. the same number as for the other observer. Everything is consistent since the two observers obviously must agree on the value of the fraction of surviving muons.

There is a problem with this analysis, however. The authors assume that the FLC determines the value of the distance to be *less* than for the co-moving observer than for the other, but this an incorrect deduction. The FLC claims instead that the distance appears *contracted to the observer on the earth's surface,* not the other way around. Therefore, since the latter finds that the distance is L, this must mean that the co-moving observer has measured the *larger* value of γL. As a consequence, the co-moving observer, who also travels with speed v, has measured an elapsed time of $\gamma L/v = \gamma^2 T_0$ for the duration of the flight to the earth's surface. Consequently, half of the muons were already gone after the time of T_0 had elapsed. The problem for the authors is the same as above with the light speed calculation. Instead of the FLC with $L=L'/\gamma$, the correct relation should be $L=\gamma L'$, i.e. *length expansion accompanies TD, not length contraction.*

Another inescapable difficulty with the LT is its violation of the Law of Causality [16,17]. An inertial clock cannot change its rate spontaneously, i.e. without the application of some unbalanced external force. The Law of Causality is the basis of Newton's First Law of Motion (Law of Inertia). The constancy of inertial clock rates can be seen to be a Corollary to his First Law. The space-time mixing of the LT equation $T' = \gamma (T - vc^{-2}L)$ stands in violation of the above rate invariance assertion. This is because it forces the conclusion that the ratio of the rates of any two inertial clocks (such as are assumed in the LT) *must itself be a constant*. As a result, when the clocks are used to measure the elapsed time of a given event, their values must always be in the same proportion, i.e. $T'=T/Q$, where Q is the value of the above ratio. The space–time mixing characteristic of the LT therefore stands in contradiction to the above requirement, thereby proving that the LT violates the Law of Causality. The proportionality relation $T'=T/Q$ is consistent with the conclusion that all processes occurring anywhere in the universe are simultaneous for all observers. The space-time mixing of the LT leads to the opposite conclusion, which is referred to as Remote Non-simultaneity (RNS). One is therefore left with the choice of either believing in the LT or in the Law of Causality.

Einstein's light-speed postulate (LSP) provides another clear example of the deficiency of the LT. It states that the speed of light is independent of the state of motion of both the observer and the light source. Consider the example of a light source moving with speed v relative to a stationary observer, however. According to the LSP, if a light pulse is emitted at the same time as the source passes the observer in the same direction, the speed of the light pulse relative to *both* the observer and the source must be equal to c, After time T has elapsed, the distance separating the light pulse from both is therefore cT. This is *impossible*, however, since the light source is no longer located at the same position as the observer [18,19]. This constitutes proof that neither the LSP nor the LT is viable.

The Equivalence Principle is not only irrelevant for understanding the results of the γ-ray experiment [10-12], it is also applied incorrectly. It is true that the rotor acceleration causes the frequency of the absorber to be reduced by a factor of γ ($R\omega$) and that this causes it to register higher frequencies that at the source. What is not true, however, is that the acceleration causes the energy/potential of the absorber to be lower than when located at the source. The mass of the absorber clearly increases with ω and so does the corresponding energy, which is therefore at a *higher gravitational potential*, not lower as assumed by proponents of the standard interpretation. The argument given by Kündig [11] is based on the first-order Doppler effect, but it assumes incorrectly that the ratio of E_a/ν_a is the same as E_s/ν_s. The unit of Planck's constant h [20] is the same as for angular momentum mvR, however, so the appropriate value is equal to $h_a = \gamma^2 h$ at the absorber. Thus, $E_a = \gamma E_s = (\gamma^2 h) \gamma^{-1} \nu_s = h_a \nu_a$, consistent with Planck's equation. Note that h has the same value at all gravitational potentials, as often assumed in Einstein's work [13, 21]. More discussion on this point will be given in Sect. IV.

One thing is perfectly clear, however. The formulas for the frequency shifts given in the three gamma ray studies [10-12] have one thing in common. They each contain a factor with a difference quantity of $(R_a - R_s)$. This means that interchanging the positions of the absorber and source on the rotor *necessarily reverses the direction of the shift* (blue to red or red to blue). Consequently, this state of affairs is unequivocal proof that Einstein's Symmetry Principle of SR is physically untenable. Moreover, it is proof that *the LT is not an acceptable space-time transformation.*

III. Uniform Scaling Method

The Uniform Scaling method [22] accounts for the errors in Einstein's SR in a very concise manner. It can be illustrated by means of the ultra-centrifuge experiment [10-12]. The ratio Q in the $T' = T/Q$ formula (referred to in the following as Newtonian Simultaneity) derived on the basis of the Law of Causality is a key parameter for the applications of the method. It is defined in general as the ratio of two γ (v) factors. The goal is to be able to convert the measured values in one rest frame (S') to the corresponding units employed in the rest frame of the observer. In the ultra-centrifuge example, S is the rest frame of the absorber and S' is the rest frame of the

γ-ray source. The parameter Q is defined to be equal to γ (v')/ γ (v), where v' is the speed of the S' rest frame relative to some definite reference and v is the corresponding speed of the observer relative to the same rest frame. The latter is referred to in general as the Objective Rest Frame (ORS) [23]. It is the laboratory in the ultra-centrifuge experiment, for example. In that case, Q= γ ($R_s\omega$)/ γ ($R_a\omega$) if the frequency measurements are made on the basis of the absorber.

The conversion factors for each physical property are integral multiples of Q. For example, the conversion factor for elapsed time/lifetimes is Q; the corresponding conversion factor for frequencies is Q^{-1}. Since the absorber is on the rim of the rotor in the ultra-centrifuge experiment, it is moving faster than the source relative to the laboratory and thus Q<1 from the vantage point of the absorber. The conversion factor for frequencies is therefore $Q^{-1} = \gamma (R_a\omega)/\gamma (R_s\omega) >1$; therefore a blue shift is expected on the basis of the absorber clock, in agreement with the experimental results [10-12]. Note that if the source is moved closer to the rim of the rotor, as was possible in the Champeney et al. version of the experiment.[12], the value of Q increases so that the fractional shift in frequencies decreases. This result is perfectly consistent with the experimental observations.

The Uniform Scaling method can be applied with relative ease to describe the results of the Ives-Stilwell experiment [7-9]. In this case the light source is moving, after appropriate averaging to eliminate the consequences of the first-order Doppler effect, with speed v in the tangential direction relative to the laboratory in which the photographic plate is located. The latter is the ORS, so Q=γ (v)/ γ (0)/= γ (v)>1, i.e. the photographic plate is at rest in the laboratory ORS.

The conversion factor for frequencies is Q^{-1}, so this means that the observed value in the laboratory (ν_{lab}) is γ (v) times less than the standard value (ν_0) observed at the light source. Therefore, a red shift is predicted from the vantage point of a stationary observer in the laboratory, as is *inferred* from the wavelength measurements recorded on the photographic plate, i.e. the fact that the average value λ of the wavelength there is γ (v) times larger than the standard value λ_0 observed in the rest frame of the source, i.e. $\lambda= \gamma (v) \lambda_0$.

The Uniform Scaling method can be applied to all physical properties, not just frequencies and lifetimes. The corresponding conversion factors are all integral multiples of the same parameter Q discussed above. A sample of the values of these exponents is given below in Table 1; a more exhaustive list is contained in Table 1 of ref. [22].

Table 1. Kinetic conversion factors for various physical properties. They are expressed as integral multiples of the parameter Q defined in the text.

Physical Property	Standard Unit	Power of Q
Time	s	1
Frequency	s^{-1}	- 1
Distance	m	1
Inertial Mass	kg	1
Relative Speed	ms^{-1}	0
Speed of Light	ms^{-1}	0
Energy	J	1
Momentum	$kgms^{-1}$	1
Angular Momentum	kgm^2s^{-1}	2
Planck's Constant h	kgm^2s^{-1}	2
Force	$kgms^{-2}$	0
Acceleration	ms^{-2}	-1

Note that the exponents for the fundamental properties of mass, distance and time are each equal to 1. The exponents for all other properties can be deduced from their composition in terms of the fundamental properties. For example, speed is defined as the ratio of distance travelled to the corresponding elapsed time; hence its exponent is computed to be the ratio of the values for distance and time: 0= 1/1. Energy is the product of mass and the square of speed; hence, its exponent is 1 = 1 + 0 +0. The exponent for angular momentum is determined on the basis of its composition of mass times speed times distance (mvr) to be 2, i.e. 2= 1+0+1.

The choice of 1 for length/distance is based on the fact discussed in Sect. II that the speed of light must be invariant to scaling; therefore, the conversion factor for distance must be the same as for time. This scaling takes care of the inconsistencies in SR that result from belief in the FLC. For example, in the example of Sect. II, the interpretation of the light speed experiment is corrected as follows: L'/T' =c =L/S = QL'/QT'=c. The discrepancy with the lifetimes of acceleration muons is also resolved with Uniform Scaling. In this case the observer co-moving with the muons finds that the distance to the earth must be γ (v) times smaller than for his counterpart on the earth's surface because his unit of distance is γ (v) times larger. The value of any property is inversely proportional to the unit employed to express it; this is a very useful principle that is universally applicable.

The experiments carried out with circumnavigating atomic clocks [24,25] provide another key example. In this case the ORS is the earth's center of mass (ECM). A clock flying in an easterly direction has a greater speed relative to the ORS than one left behind at the airport of origin. Therefore, from the latter's vantage point, Q>1. Consequently, it is expected that elapsed times measured with this clock will be Q times less than at the airport, and so it will return there with less time than is recorded on the airport clock. The clocks traveling in a westerly direction will have Q<1 so the opposite relationship is expected, in agreement with observation. These results were quite useful for the engineers who developed the Global Positioning navigation system [26]. Therefore, the everyday success of GPS throughout the world serves as a significant verification of Uniform Scaling as well as a contradiction to the Symmetry Principle of Einstein's SR.

In general, it should be noted that the conversion factors listed in Table 1 ensure that all laws of physics are satisfied in every rest frame. This is in perfect agreement with Galileo's Relativity Principle RP. An addendum to the RP is therefore appropriate [27]: *The laws of physics are the same in every inertial system, but the units in which they are expressed vary from one system to another.* The Uniform Scaling method is perfectly objective [28]. The only reason that two observers can legitimately disagree on the value of a physical property is because they employ different units to express their results. As a consequence, the method is easily extended to all rest frames for a given observer. The scaling parameter Q (2.3) for any two rest frames S_2 and S_3 can be deduced based on the corresponding values of a common rest frame S_1, namely as the ratio of

Q (1.3)/ Q (1.2) = Q (1.3)/Q (2,1). This relationship can be used to deduce the value of Q for a satellite orbiting the moon. It is obtained accordingly as the product of Q (earth, moon) and Q (moon, satellite).

IV. Gravitational Scaling

There is an analogous system for deducing conversion factors on the basis of the relative locations of the two rest frames in different gravitational potentials (gravitational scaling). Einstein [29] originated this procedure in 1907 with his prediction of the gravitational red shift [13] based on the Equivalence Principle. The basic procedure is illustrated by considering how the energy of an object changes with gravitational potential. The value of the energy E is computed on the basis of the $E=mc^2$ energy-mass relationship of SR [1]. When the object is raised by a distance h. its energy increases by mgh on the basis of Newton's classical gravitational theory (m is the object's inertial mass and g is the acceleration due to gravity at this location). The process can be described quantitatively by assuming that the observer at the same position as the object measures its energy E_P to be mc^2, whereas the corresponding value for the same object measured at the original potential by the stationary observer located there is $E_O = mc^2 + mgh$. Einstein made the crucial inference that the reason for this difference is that the unit of energy increases with gravitational procedure. Specifically, the value at the higher potential is larger by a factor of $S = 1+gh/c^2$; thus, $E_O = S\ E_P$.

The parameter S is seen to play the same role in gravitational scaling as Q does in the kinetic scaling procedure discussed in the previous section. The definition of S given above is only valid for small values of h, however. It can be brought to a more general form by considering how the energy varies when it is moved to an infinitely higher potential. This is done by integrating the changes over distance from R_p to infinity, i.e. $A_p = 1 + \int_{R_p}^{\infty} \frac{g dR}{c^2} = 1 + \frac{GM_s}{c^2 R_p}$,

($G = 6.67x10^{-11}\ Nm^2/kg^2$ is the Universal Gravitation Constant and M_s is the gravitational mass of the active source). If the observer is located at R_o, $S= A_o/A_p = (1+ GM_s/c^2R_o)/$ $(1+ GM_s/c^2R_p)$. Einstein used the Doppler effect [13, 29] to show that frequency ν varies in the same manner as energy. i.e. $\nu_o = S\ \nu_p$. When the object as located at the sun's chromosphere,

$S=2.122x10^{-6}$. Therefore, the frequency ν_P of an atomic line emanating from the sun is shifted to a lower value ν_O when received at the earth's surface (gravitational red shift).

The values of the gravitational conversion factors for other properties are given in Table 2. They are all integral multiples of S, similarly as those for kinetic scaling are always integral multiples of Q. Einstein derived the conversion factor of S for the speed of light based the Doppler effect [13.29]. He seems to have simply assumed that distance is invariant to changes in gravitational potential. In any event, this value of S^0 is in agreement with all experimental observations. The conversion factor for inertial mass m is deduced on the basis of the $E=mc^2$ relation. It must scale as S^{-1} in order for the latter to hold.

Table 2. Gravitational conversion factors for various physical properties. They are expressed as integral multiples of the parameter S defined in the text.

Physical Property	Standard Unit	Power of Q
Time	s	-1
Frequency	s^{-1}	1
Distance	m	0
Inertial Mass	kg	-1
Gravitational Mass	kg	0
Relative Speed	ms^{-1}	1
Speed of Light	ms^{-1}	1
Energy	J	1
Momentum	$kgms^{-1}$	0
Angular Momentum	kgm^2s^{-1}	0
Planck's Constant h	kgm^2s^{-1}	0
Force	$kgms^{-2}$	1
Acceleration	ms^{-2}	2

Acceleration g	ms^{-2}	2

The values of all conversion factors can be obtained with the knowledge of the composition of each property in terms of the fundamental quantities of mass, time and distance. For example, The exponent of S for energy) is obtained as the sum of the exponents for mass (-1) and double that for speed (1). i.e. 1 = -1+ 1+1. The exponent for angular momentum/Planck's constant is 0, i.e. -1 for mass, +1 for speed and 0 for distance. The exponent (1) for force F van be obtained in several ways, namely as the ratio of momentum to time [1=0-(-1)], or as the product of inertial mass and acceleration [1=-1+2]. Other examples may be found in refs. [22, 30].

The gravitational red shift has been discussed above. In that case the observer on the earth's surface is farther away from the sun as the atomic line located at the rim of the chromosphere, i.e. $r_O>r_P$, so $A_o<A_p$ and therefore S<1. Since the conversion factor for frequencies is S, $\nu_O<\nu_P$. When clocks are located on a mountain top for a long period of time, it is found that they have gained time relative to those left behind below [31]. In this case, $A_O>A_P$ since $r_O<r_P$ and so the value of the parameter S= A_O/A_P < 1. The conversion factor for time is S^{-1} (see Table 2) and so it has a value which is greater than 1 in this experiment; thus agreement with the time recorded on the clock located at higher altitude is obtained when its counterpart located below is speeded up by this factor.

The Pound-Snider-Rebka experiments [32,33] provide another interesting example that can be explained in a quite straight forward manner by the Uniform Scaling method. An x-ray source was mounted on the top of building and radiation was emitted toward the ground at a distance of h=22.5 m below. The gravitational source in this case is the ECM. The approximate definition of the gravitational scaling parameter can be employed with sufficient accuracy: $S= 1 + gh/c^2$. The x-ray radiation frequency ν_0 of the x-rays is received below with a value of $S\nu_0$. The difference is not due to a change in the absolute value of the frequency, but rather because of a difference in the unit of frequency at the two gravitational potentials. An interesting expect of the experiment is that the x-ray absorber performs with optimum efficiency when the value of the frequency is the same as for the emitter, i.e. ν_0. The experiment accounted for the increase in frequency to $S\nu_0$ received below by causing the absorber to move with variable speed v downward relative to the rest frame in which the radiation was received. The increase in frequency due to the Doppler effect is $(v/c)\nu_0$. Maximum efficiency of the absorber was therefore achieved by eliminating the effect of gravitation by means of this increase in frequency, i.e. by choosing the value of v so that $v/c = gh/c^2$. The value of g is 9.89 m/s^2, so the optimum value of v is estimated to be $gh/c = 7.42 \times 10^{-7}$ m/s on this basis. In the experiment, minimum transmission was obtained at this absorber velocity to an estimated precision of 0.8%.

In the Hafele-Keating circumnavigating atomic clock experiment [24,25], the airport clock is at a lower altitude and so $r_O < r_P$ and $A_O > A_P$ in this case. As a consequence, the conversion factor is $S>1$, so on this basis, the times measured on the clocks flying in either direction are greater than what is recorded on the airport clock. As discussed in Sect. III, however, there is also an effect due to the motion of the airplane clocks. The times on the airplane clocks need to be adjusted by a factor of Q/S in order to have them be equal to the corresponding values recorded on the airport clock.

V. Conclusion

Einstein's Symmetry Principle is based squarely on the Lorentz transformation (LT) of SR. Its application for the emission of light signals leads unequivocally to the conclusion that two observers in relative motion who are exchanging light signals will each find that the other's frequency is lower than his own. In other words, each will experience a *red shift* when he carries out such a measurement of the other's frequency of radiation. The experiments with γ-ray absorbers located at the rim of an ultra-centrifuge [10-12] provided a means of definitively testing this theoretical production, Their results show unequivocally that the clock attached to the absorber is retarded compared to the clock at rest. This means that the absorber clock counts more waves per second than the clock attached to the source, and therefore that the observer at the absorber registers a blue shift, in contradiction to what is predicted with Einstein's Symmetry Principle. Their results also show that reversing the positions of the source and absorber on the rotating rim causes the sign of the frequency shift to change from blue to red or *vice-versa.*

The authors of the three experimental papers [10-12] never use the term blue shift in the discussion of their results, however. Instead, they claim that what they have observed is a verification of the prediction of a gravitational red shift expected on the basis of the Equivalence Principle. This doesn't change the fact that their experiments have been carried out exclusively in a laboratory located on the earth's surface, so the equivalence between the forces of acceleration and gravity foreseen in their arguments may be at best totally irrelevant in the present context and at worst simply incorrect.

An obvious alternative to the classical arguments presented above is to apply logical principles without equivocation. The experimental results are clearly in violation of Einstein's Symmetry Principle and the LT on which it is firmly based. Support for this approach comes from the Law of Causality. Accordingly, one expects that the inertial clocks which are used in the definition of the LT will maintain their rates indefinitely as long as no unbalanced force is applied to them. This conclusion leads directly to another, namely that the ratio Q of the rates of any two such clocks must be constant over an indefinite period of time. As a result, one expects that the elapsed times Δt and $\Delta t'$ obtained when they are used for the same event will always occur in the same fixed ratio, namely $\Delta t' = \Delta t/Q$. This proportionality stands in conflict with the space-time mixing characteristic of the LT, thereby proving that the latter stands in direct contradiction to the Law of Causality.

One can also point to the obvious inconsistency of the LT because of its predictions of time dilation (TD), length contraction (FLC) and the equality of the speed of light measured by two observers in motion. Accordingly, if the speed of light is measured in rest frame S', the ratio of distance travelled L' and corresponding elapsed time T' is $L'/T'=c$, The corresponding ratio for the stationary observer in S' is thus seen to be $L/T=(L'/\gamma)/\gamma T'=\gamma^{-2}L'/T' = \gamma^{-2}c \neq c$. There is no way to bring all three of the LT predictions into a harmonious relationship with one another.

If, however, the FLC is replaced by the relation $L= \gamma L$, everything falls in place. The problem for SR is that this means that Einstein's Symmetry must be abandoned as well. Instead, one is left with a version of relativity which is perfectly objective. If your clock runs slower than mine, then my clock must be running faster than yours, regardless of our relative speed. Moreover, respective conversion factors must bear a reciprocal relationship to one another. If the conversion factor for measured times is Q for the S observer, then the reverse conversion factor must be $Q'=1/Q$ for the other in S'.

There is an analogous set of relationships for the effects of gravity on physical properties. Together they form the basis for the Uniform Scaling method. An attractive feature is that the conversion factors are based on a single parameter in each case, Q for kinetic scaling and S for gravitational, the values of each of which can be computed with a minimum of information regarding the relative speeds of the observers and their positions in the relevant gravitational field;

the latter speeds are measured relative a specific rest frame (ORS), not with respect to each other. The conversion factors themselves are always integral multiples of Q and S. The corresponding exponents for the fundamental quantities of mass, time and distance are 1, 1, 1 for Q and -1, -1 ad 0 for S. Knowledge of the composition of a given property in terms of these fundamental quantities is sufficient to deduce the corresponding conversion factor for each property. There are no known examples to date in which the results cannot be predicted in a straightforward manner by applying the Uniform Scaling method.

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