East African Scholars Journal of Engineering and Computer Sciences

Abbreviated Key Title: East African Scholars J Eng Comput Sci

ISSN: 2617-4480 (Print) & ISSN: 2663-0346 (Online)

Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-6 | Issue-2 | Mar-2023 | DOI: 10.36349/easjecs.2023.v06i02.002

Review Article

The Failure of Both Einstein's Space-time Theory and His Equivalence Principle and Their Resolution by the Uniform Scaling Method

Robert J. Buenker[1*]

[1]Fachbereich C-Mathematik und Naturwissenschaften, Bergische Universität Wuppertal, Gaussstr. 20, D-42097 Wuppertal, Germany

Article History
Received: 18.02.2023
Accepted: 12.03.2023
Published: 23.03.2023

Journal homepage:
https://www.easpublisher.com

Quick Response Code

Abstract: The Lorentz transformation (LT) makes three predictions which are not consistent with one another: Lorentz-FitzGerald length contraction (FLC), time dilation (TD) and light-speed equality for observers in relative motion to one another. The LT also stands in violation of the Law of Causality because it fails to recognize that inertial clocks can never change their rate spontaneously. Einstein's light-speed postulate (LSP) is shown to be unviable by considering a case in which a light source passes by a stationary observer at the same time that it emits a light pulse in the same direction. It is found that, in contradiction to the LSP, that the classical velocity (Galilean) transformation (GVT) is applicable when two observers in relative motion deduce the speed of a light wave. The Newton-Voigt transformation (NVT) is consistent with the Law of Causality because it assumes space and time do not mix. The NVT is nonetheless consistent with the relativistic velocity transformation (RVT) and also with Einstein's mass-energy equivalence relation $E=mc^2$. The ratio Q of clock rates for two inertial rest frames S and S' is required input for the NVT. Experimental data obey the Universal Time-dilation Law (UTDL) which states that the measured time Δt obtained by a inertial clock for a given event is inversely proportional to $\gamma(v)= (1-v^2c^{-2})^{-0.5}v$, where v is the speed of the clock relative to a specific rest frame referred to as the objective rest frame ORS. The value of Q when the clock of the observer in at rest in S while that of another observer is at rest in the object's rest frame S' is obtained from the UTDL as the ratio γ(v')/γ(v). The Uniform Scaling method considers Q to be a conversion factor between the units of time in the two rest frames. It is found that the conversion factors for all other physical properties are integral multiples of Q. Kinetic scaling of the properties insures that the laws of physics are the same in each inertial frame, as required by the RP. It is also pointed out that Einstein's Equivalence Principle (EP) fails to deduce the experimental fact that the wavelength of light is invariant to changes in gravitational potential. The Universal Scaling method uses a set of conversion factors for the effects of gravity that is analogous to those for kinetic scaling.

Keywords: Uniform Scaling method, Lorentz transformation (LT), Newton-Voigt transformation (NVT), Time dilation (TD), Lorentz-FitzGerald length contraction (FLC), Einstein's Equivalence Principle.

I. INTRODUCTION

There are several straightforward proofs that show that the Lorentz Transformation (LT) is not internally consistent and is therefore unviable. Perhaps the simplest one to understand involves comparing the three predictions Einstein made [1] on its basis: FitzGerald-Lorentz length contraction (FLC), time dilation (TD), and the equality of measured light speeds for observers in two different rest frames. Added to this realization is the proof that his Equivalence Principle [2] leads to a false prediction of the variation of the lengths of objects with changes in their gravitational potential (Einstein's Elevator). Taken to together these observations make clear that an alternate version of relativity theory is required that, on the one hand, is still consistent with Einstein's historical contributions of the mass-energy equivalence relation ($E=mc^2$) and the relativistic velocity transformation (RVT), while on the

***Corresponding Author:** Robert J. Buenker

Fachbereich C-Mathematik und Naturwissenschaften, Bergische Universität Wuppertal, Gaussstr. 20, D-42097 Wuppertal, Germany

other removing the above imperfections in a logically transparent manner.

II. A Simple Puzzle to Unveil the LT's Space-time Contradictions

The LT was developed independently by Larmor [3] and Lorentz [4]. Its precursor was the Voigt transformation (VT) [5]. The latter was introduced in 1887 in reaction to the Michelson-Morley interferometry experiment [6] which indicated that the speed of light in free space has the same value for all observers regardless of their state of motion relative to the light source.

According to the LT (and the VT), therefore, if two observers are separating from each other by speed v along the common x-x' coordinate axis, the ratio of the distance traveled by a light pulse to the corresponding elapsed time is equal to c for both observers. This assumption translates into the following relationship between the measured distances (Δx and Δx') and the respective elapsed times (Δt and Δt') measured by the two observers:

$$\Delta x/\Delta t = \Delta x'/\Delta t' = c \quad (1)$$

In his landmark paper [1], Einstein deduced on the basis of the LT what have come to be known as FitzGerald-Lorentz length contraction (FLC) and time dilation (TD). The corresponding relationships are described by the following two equations [$\gamma(v) = (1-v^2c^{-2})^{-0.5}$]:

$$\Delta x' = \gamma(v)\,\Delta x \quad (2)$$

$$\Delta t' = \gamma(v)^{-1}\,\Delta t. \quad (3)$$

Derivations of both relationships may be found in Jackson's book on electrodynamics [7], as well as in Einstein's original work [1].

Consider the following example. In accord with eq. (1), assume that Δx'/Δt'=c and then compute the value of Δx/Δt using eqs. (2) and (3). The result is:

$$\Delta x/\Delta t = \gamma(v)^{-1}\Delta x'/\gamma(v)\,\Delta t' = \gamma(v)^{-2}\,\Delta x'/\Delta t' = \gamma(v)^{-2}c \neq c. \quad (4)$$

It is thus seen that the three eqs. (1-3) are not consistent with one another. The conclusion is therefore that the LT, on whose basis all three equations have been derived, is not a viable space-time transformation.

It is easy to see why there is a discrepancy. Consider the case of a measurement of the speed of light in a laboratory (S') which is moving at speed v along the x axis relative to another laboratory (S). The LT claims that the distance observed in S is *smaller* than in S' (length contraction), while at the same time the elapsed time measured in S is *larger* (time dilation) than in S', and yet the LT also claims that the measured value of the light speed, i.e. the ratio of distance traveled to elapsed time, from the vantage point of laboratory S is nevertheless the same as found in S'. Such a result is physically impossible to realize in practice.

Moreover, the FLC states that Δy' = Δy, i.e. when the light pulse moves in a perpendicular direction relative to that of the separation of S and S'. In that case, the observer in S must measure the light speed to be $\gamma(v)^{-1}c$, which again violates the LT condition that the light speed is equal to c for all observers, regardless of their state of motion relative to the light pulse.

III. Newtonian Simultaneity and the Newton-Voigt Transformation

It is standard practice to try and amend any theory which has been demonstrated to lead to false conclusions by eliminating the unsatisfactory features of the original while retaining consistency with the successful predictions of the theory. This must be done in a logically transparent manner, as opposed to making some purely *ad hoc* changes in the theory.

To this end in the case of the LT, it is useful to give careful consideration to space-time transformations which preceded it, starting with the classical or Galilean transformation (GT):

$$\Delta t' = \Delta t \quad (5a)$$

$$\Delta x' = \Delta x - v\,\Delta t \quad (5b)$$

$$\Delta y' = \Delta y \quad (5c)$$

$$\Delta z' = \Delta z. \quad (5d)$$

The notation used for the coordinates is the same as in Sect. II and v is assumed to be along the x.x' axis.

When it became of interest to assume that the speed of light is the same for all observers, Voigt [5] suggested that the GT be amended to accommodate this objective. His result (VT) is:

$$\Delta t' = \Delta t - vc^{-2}\Delta x \quad (6a)$$

$$\Delta x' = \Delta x - v\,\Delta t \quad (6b)$$

$$\Delta y' = \gamma^{-1}\,\Delta y \quad (6c)$$

$$\Delta z' = \gamma^{-1}\,\Delta z. \quad (6d)$$

The definition of γ is the same as given before in Sect. II.

A positive characteristic of this transformation is that it fulfills the desired condition of equal light speeds (c) for both observers in S and S'. The VT is physically problematic for another reason, however. This can be seen by forming the inverse transformation of the VT. For example, this leads to the equation: $\Delta y = \gamma\,\Delta y'$. This result is unacceptable from the vantage point of Galileo's Relativity Principle (RP), which requires that $\Delta y = \gamma^{-1}\Delta y'$. In other words, it must be expected that reversing the roles of the two observers can be achieved by interchanging their coordinates and changing the sign of v; this procedure will subsequently be referred to as Galilean Inversion.

In recognition of the both the successes and deficiencies of the VT, Larmor [3] and Lorentz [4] developed a different set of space-time equations which has come to be known as the Lorentz transformation (LT) given in eqs. (7a-d):

$\Delta t' = \gamma(\Delta t - vc^{-2}\Delta x) = \gamma\, \eta^{-1}\, \Delta t$ ……………(7a)

$\Delta x' = \gamma\, (\Delta x - v\Delta t)$ ……………………..….(7b)

$\Delta y' = \Delta y$ …………………………… ……(7c)

$\Delta z' = \Delta z.$ ………………… ……… ….. (7d)

Note that the quantity η is eq, (7b) is defined as $[(1\text{-}vc^{-2})\ \Delta x/\Delta t]^{-1}$. The inverse transformation is obtained by applying Galilean Inversion, so that problem with the VT is eliminated. As discussed in Sect. II, however, the LT is not internally consistent and is therefore also unacceptable as a physically viable component of relativity theory.

There is another problem with the LT, however; it is not compatible with the Law of Causality, i.e. no change in a physical process occurs without there being a definite cause for its occurrence. Recall that Newton's First Law of Kinetics (Law of Inertia) makes use of the Law of Causality because of its claim that the speed and direction of a moving object will not change unless it is acted upon by a unbalanced external force. If the object in question is a clock, the same argument leads to the conclusion that the latter's rate will not change spontaneously; under these circumstances the clock is said to be inertial. The LT makes use of two inertial clocks in its definition. As a consequence, one concludes on the basis of the Law of Causality that the ratio of the rates of these two clocks is also a constant. As a consequence, when the two clocks are used to measure the elapsed time of s given event, their respective measured values Δt' and Δt will always occur in the same proportion, i.e. $\Delta t' = \Delta t/Q$, where Q is the above ratio of the rates of the two clocks. This relationship will be referred to in the following as "Newtonian Simultaneity" in recognition of the fact that it rules out the possibility that events which are simultaneous for one observer ($\Delta t'=0$) will not also be simultaneous ($\Delta t=0$) for the other observer. The term "Newtonian" is included to call attention to the fact that Newton and his followers insisted that all events in the universe occur at the same time for each observer.

It is easy to see eq. (7a) is not consistent with Newtonian Simultaneity, and therefore also stands in violation of the Law of Causality. If $\Delta t=0$ in this equation and both v and Δx have non-zero values, Δt' will not be equal to zero, contrary to the $\Delta t' = \Delta t/Q$ relation required by the Law of Causality. As a consequence, it is advisable to obtain a different space-time transformation that is consistent with Newtonian Simultaneity. Lorentz [8] pointed out that there is a degree of freedom in the definition of the LT. Accordingly, the equal light-speed condition is maintained by multiplying each of its four equations with the same factor. Lorentz's conclusion is verified by comparing the respective equations of the VT in eqs. (6a-d) with those of the LT. The VT is obtained from the LT by multiplying each of the right-hand sides of eqs. (7a-d) by γ^{-1}. This degree if freedom can be used to define a different set of equations that is consistent with the condition of Newtonian Simultaneity by multiplying each of the right-hand sides of the LT equations by the factor η/γQ. The result is the Newton-Voigt transformation (NVT) given in eqs, (8a-d) below:

$\Delta t' = (\eta/\gamma Q)\ \gamma(\Delta t - vc^{-2}\Delta x) = (\eta/\gamma Q)\ \gamma\ \eta^{-1}\ \Delta t = \Delta t/Q$ ………….……… (8a)

$\Delta x' = (\eta/\gamma Q)\ \gamma\ (\Delta x - v\Delta t) = \eta\ (\Delta x - v\Delta t)/Q$ …………………….... (8b)

$\Delta y' = (\eta/\gamma Q)\ \Delta y$ ……………………… (8c)

$\Delta z' = (\eta/\gamma Q)\ \Delta z.$ …………………….… (8d)

The NVT has the Newtonian Simultaneity condition as its eq. (8a), so agreement for this relationship is obviously satisfied. The fact that it has been defined by using the Lorentz degree of freedom [8] proves that the equal light-speed condition is also fulfilled.

It is not so obvious that the inverse set of equations is consistent with the RP, however, Application of Galilean inversion leads to the following condition for satisfying the RP:

$\eta\eta' = \gamma^2 QQ'$ ……………………. (9)

This puts a condition on the values of Q and Q', namely QQ' =1, i.e. Q' in the inverse transformation must be the reciprocal of Q in the forward version, which is easily fulfilled. The proof [9] that $\eta\eta' = \gamma^2$ is shown below in eq. (10) in terms of the inverse quantities [note that $\eta' = (1+vc^{-2}\Delta x'/\Delta t')^{-1}$ is obtained by applying Galilean inversion to η]:

$(\eta\ \eta')^{-1} = (1\text{-}\ v\Delta x/c^2\Delta t)\ (1+\ v\Delta x'/c^2\Delta t') = (1\text{-}\ v\Delta x/c^2\Delta t)\ [1 + \eta\ v/c^2\ (\Delta x/\Delta t\ \text{-}v)] = 1\text{-}\ v\Delta x/c^2\Delta t\ \text{-}\ v^2/c^2 + v\Delta x/c^2\Delta t = 1\text{-}v^2/c^2 = \gamma^{-2}.$ …………….. (10)

Therefore, the NVT satisfies all three of the necessary conditions for a valid space-time transformation, unlike both the VT and LT.

The relativistic velocity transformation (RVT) is obtained from both the NVT and LT, as well as the VT, by dividing each spatial coordinate by the corresponding time coordinate; it can also be obtained\ from the VT in this way. The resulting set of equations is given below in eqs. (11a-c), whereby $u_x = \Delta x/\Delta t$, $u_x' = \Delta x'/\Delta t'$, etc., and the definitions of γ, η and η' are the same as used in deriving the identity in eq. (10):

$u_x' = (1\text{-}vc^{-2}u_x)^{-1}\ (u_x\text{-}v) = \eta\ (u_x\text{-}v)$ ……. (11a)

$u_y' = \gamma^{-1}(1\text{-}vc^{-2}u_x)^{-1}\ u_y = \eta\ \gamma^{-1}\ u_y$ …..….. (11b)

$u_z' = \gamma^{-1}(1\text{-}vc^{-2}u_x)^{-1}\ u_z = \eta\ \gamma^{-1}\ u_z.$ ………. (11c)

The RVT was first used successfully by von Laue [10] in 1907 to explain the experimental data (Fresnel-Fizeau light-damping) obtained for the speed of light in water under two different conditions, namely with water at rest, on the one hand, and with water flowing through the apparatus with speed v, on the other. It is also commonly used to determine the angular distribution of photons and neutrinos emitted by rapidly moving sources such as neutral pions and charged pions, as well as of electrons in circular accelerators [11]. The RVT is therefore an indispensable component of relativity theory.

It is important to note, however, that successful applications based on the RVT are not to be claimed as verifications of the LT, since the latter has been shown in Sect. II to be invalid. Instead, they can be viewed as verifications of the NVT of eqs. (8a-d), however, from which the RVT, as already stated above, can also be derived by appropriate division of its space and time variables.

IV. Uniform Scaling Method

In order to completely define the NVT, it is not only necessary to know the speed v between the two pertinent rest frames described in the equations, but also the value of the parameter Q which connects them. The latter value can be obtained by carrying out explicit timing measurements for the two clocks. For example, Hafele and Keating [12.13] placed atomic clocks on two airplanes which circumnavigated the earth in opposite directions. As a result of their study, the authors found that the rates of clocks decrease in direct proportion to $\gamma(v)$, where v is the speed of the clock relative to the earth's center of mass (ECM).

It is useful, therefore, to imagine that there is a hypothetic clock which is located at the ECM. To quantify the desired timing relationships, it is assumed that for a given portion of the flight, the elapsed time registered on the ECM clock is Δt_G. Based on the above information about the rates of the clocks in general, it can further be assumed that the elapsed time $\Delta t'$ on a given clock moving with speed v' relative to the ECM is therefore equal to $\Delta t_G/\gamma(v')$. In the same way, it can be assumed that a second clock moving with speed v relative to the ECM will register an elapsed time for the same portion of the flight to be $\Delta t_G/\gamma(v)$. By eliminating Δt_G in the latter two equations, one therefore comes to the conclusion:

$$\Delta t' \gamma(v') = \Delta t \gamma(v). \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

The latter equation can therefore be combined with the Newtonian Simultaneity in eq. (8a) of the NVT to obtain the following definition of the parameter Q as:

$$Q = \Delta t / \Delta t' = \gamma(v')/\gamma(v). \quad \ldots\ldots\ldots\ldots (13)$$

The experiments with gamma-radiation using high-speed rotors [14-16] are another important quantitative source of information about time dilation. The periods Δt of the radiation were found to increase with the respective distances R of the source and absorber from the rotor axis. A comparison of the timing results is given below as a function of the rotational speed ω:

$$\Delta t' \gamma(R'\omega). = \Delta t \gamma(R\omega). \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (14)$$

Since the speed v of a given clock is equal to $R\omega$, it is seen that this equation is completely equivalent to eq, (12). A major difference, however, is that the speeds of the clocks in this example are referenced to the rest frame of the laboratory, not that of the ECM. As a result, it is helpful to make another definition, namely the rest frame that serves as reference for the speeds of the clocks, namely as the objective rest system ORS. It can then be said that eq. (12) is true for both experiments provided the relevant ORS is implied in the determination of the clock speeds in each case.

For a typical example in which a decrease in the rate of a clock is caused by its acceleration due to application of an external force, eq. (12) is again made relevant by defining the ORS in this case to be the rest frame in which the force is applied. An example of this sort was given by Einstein [1] to demonstrate that when a clock in circular motion returns to its starting point, it will show less elapsed time than an identical clock left behind at the origin. He also gave another example [1] in which a clock at the Equator was predicted to have a slower rate than an identical counterpart located on the polar axis.

On this basis, it is justifiable to refer to eq. (12) as the Universal Time-dilation Law or UTDL. It is only valid when the speeds in the two γ (v) factors are taken relative to the appropriate ORS. It can also be used to compare the elapsed times of clocks with different ORS, for example, when the elapsed time for a given event measured on a satellite clock orbiting the moon is to be compared with the corresponding value obtained by a clock located on the earth's surface. In such a case, the UTDL simply needs to be applied twice, once for the comparison of the respective times measured on the earth and the moon, and the other for comparing the elapsed times registered on the moon and the satellite.

The Uniform Scaling method takes note of the homogeneity of the time dilation experimental results in the following way. It looks upon the parameter Q in the Newton Simultaneity relation as a *conversion factor* between the unit of time in the object's rest frame (S') and that of the observer in rest frame S. The elapsed time measurement $\Delta t'$ in the UTDL is converted over to the units employed in S by multiplication with Q to obtain the corresponding elapsed time Δt. When viewed in this way, one is led to conclude that the unit of speed/velocity must be the same in both rest frames, since the two observers agree that the speed of light in free space has the same value for both. In order for this to be true, however, it is necessary to assume that *the conversion factor for distances is also equal to Q;* only in this way can the ratio of the distance traveled by the light to the corresponding elapsed time be the same for both observers. Accordingly, the conversion factor for *relative speeds* in general is unity.

In this connection, it is also important to note that Bucherer showed that the inertial mass of electrons is proportional to γ (v) in experiments using crossed electric and magnetic fields [17]. This result had been predicted by Lewis and Tolman [18]. One can therefore deduce on this basis that the conversion factor for inertial mass also has a value of Q, i.e. the same as for time and distance. Since every other physical quantity can be expressed as a product of these three fundamental quantities (e.g. in the mks system of units), it therefore follows that the conversion factor for any other quantity must be an integral multiple of Q. All that is necessary to determine its conversion factor is knowledge of its composition in terms of inertial mass, time and distance.

For example, it has already been assumed that the unit of relative speed is $Q= 1=Q^0$. Any other value would be in violation of the RP because it would allow observers in different inertial frames to distinguish their respective states of motion based solely on a comparison of their measured values for the speed of any given object with the speed of light in free space. The conversion factor for energy can be deduced to also have a value of Q on the basis of Einstein's mass-energy equivalence relation $E=mc^2$, since the value for mc^2 is $Qx(Q^0)^2=Q$. The corresponding value for momentum p=mv is also equal to Q based on the product of the above two factors for m and v, i.e. $Q^1xQ^0 = Q$. The value for angular momentum (pr) is therefore equal to Q^2 since the latter is computed to be the product of their respective conversion factors (QxQ). The same conversion factor is therefore deduced for Planck's constant h since it has the unit of angular momentum (Js). More details about the values of other conversion factors are given elsewhere [19, 20].

It is important to note that the laws of physics are invariant to the application of the above conversion factors. It has already been shown above that this is the case for $E=mc^2$. Another such example is found in the Planck E=hν relation; frequency ν scales as Q^{-1}, i.e. the reciprocal of the factor for time, so the product with h scales as $Q^2Q^{-1}=Q$, the same as for energy E. Accordingly, it is possible to addend the RP as follows [21, 22]: The laws of physics are the same in every inertial system, *but the units in which they are expressed will generally vary from one system to another.* The success of the Uniform Scaling method as a whole indicates further that the conversion factors can be deduced on the basis of relative speeds on a continuous basis even when the object and observer are not inertial systems.

As a final remark about the Uniform Scaling method, it should be noted that it is possible to also fix the values of conversion factors for electromagnetic quantities such as electric and magnetic fields [23]. This can be done by taking advantage of ambiguities in the standard definitions. For example, Coulomb's Law simply requires that the value of e^2/ε_0 (e is the charge of an electron and ε_0 is the electric permittivity constant) be equal to the product of the force F on a pair of electric charges and the square of the distance separating them, i.e. as Fr^2. This can be accomplished, for example, by choosing the unit of electric charge to be Nm=J while at the same time taking the unit of ε_0 to be N. One must only take care that these values are used consistently in the definitions of other quantities such as the electric field **E**=**F**/q; in this case, E must have the unit of inverse distance (m^{-1}). The units for magnetic quantities can be deduced on the basis of the Maxwell relation for the magnetic permeability constant $\mu_0 = (c^2 \varepsilon_0)^{-1}$.

V. The Galilean Velocity Transformation and the Distance-reframing Procedure

The LT relies on Einstein's light-speed postulate (LSP) [24, 25]. It states that the speed of the light pulse has the same constant value of c for all observers *independent of their state of motion and that of the light* source. The LSP is clearly at odds with the classical velocity transformation (GT) given in eqs. (5a-d), however. It leads to the conclusion that two observers will obtain different values for the speed of an object, including a light wave, which is moving in the same direction as their separation velocity. To test the LSP, consider the following case in which a light source leaves a street corner with speed v at the same time that it emits a light pulse in the same direction. One can see that the LSP is an untenable assumption by calculating the respective distances separating the light pulse from each rest frame after a certain time T has elapsed. The value of this distance according to the LSP is seen *to be cT in each case.* But this is impossible, since the source and stationary observer *are no longer at the same position in space.* In arriving at this conclusion, it clearly does not matter how great T is, whether it is just a few milliseconds or many thousands of years. In summary, *Einstein's LSP is completely unrealistic.*

The latter procedure is referred to as *distance reframing*, i.e. taking a look at a particular relationship between two speeds and considering the situation after a certain time has elapsed. One can use the same procedure to demonstrate that the vector addition of velocities, which is generally referred to as the Galilean velocity transformation (GVT), leads to correct results even if one of the speeds is c. In terms of the previous example, one expects that the speed of the light pulse relative to the street corner is equal to v+c, not c as the LSP claims. One might argue that it is not necessarily true that one can just add speeds in the way described. The distance reframing procedure leads to the conclusion that the light source will travel a distance of vT relative to the street corner, while the light pulse moves a distance of cT relative to the light source. The rule that the total distance is equal to the sum of its parts is certainly applicable, however. One doesn't need Newton or Galileo to justify this statement; it is just a matter of arithmetic. The conclusion is that the total distance separating the light pulse from the street corner is therefore cT + vT = (c+v) T. By the ordinary definition of speed as the ratio of distance moved to elapsed time, the corresponding speed of the light pulse is equal to c+v, which is greater than c.

Nevertheless, the GVT cannot be used to describe the light-damping experiment [10], whereas von Laue showed in 1907 that the RVT does work in this case. This raises the question of when the GVT can be used and when RVT must be used in its place. There is a simple answer to this question. In the first example considered, the goal is to predict the difference in the measured speeds of the light waves *for two observers* who are in motion relative to one another. In the light-damping example, by contrast, only one observer is making the measurements. The goal in this case is to determine the speed of light in water under two different circumstances, namely when the water is flowing through the apparatus at speed v and when it is at rest instead. This distinction is easily made and thus gives a clear basis for deciding which of the two transformations should be used [26]. For example, in the case where an attempt is made to accelerate an electron to a speed greater than c, it is clear that the RVT must be used. In this experiment the speed of the electron is measured both before and after an electromagnetic force is applied; only one observer in the laboratory is required for this When one wishes to know the values of the speed of the light waves for two different observers in motion to one another, or for that matter for any other object in motion relative to both, the GVT must be used instead.

There is an historic example where the above distinction has not been applied. In 1727 Bradley made an important discovery about the relationship between the measured speed of light emitted by the sun and the relative speed of the telescope on earth relative to the sun. In arriving at his conclusion, Bradley used vector addition, i.e. the GVT, to compute the velocity of the light relative to the earth. In his 1905 paper, however, Einstein [1] amended Bradley's relation by adding the factor of γ (v) to the equation for determining the angle of emission. This change was made because Einstein insisted on using the RVT to obtain the desired relationship. Since the objective of the calculation involves two different observers which are in motion relative to one another (the earth and the sun), however, the GVT must be used instead [26], thereby eliminating the need for the additional γ (v) factor. Since the value of $\gamma(v)$ is on the order of 10^{-8}, it has not been possible to distinguish between the two formulas on a strictly experimental basis, however, but the theoretical principle is clear.

Another question raised by this discussion is how to use relativity theory to explain the null interference effect in the Michelson-Morley experiment [6]. The answer is again to eliminate Einstein's LSP because of its deficiencies described above, and replace it with a different version: The speed of light in free space relative to its source is always equal to c. One has to look upon the reflecting mirrors in the experiment as light sources in order to explain the lack of interference of the two light waves, but it seems entirely reasonable to do so. This version of the light-speed postulate is consistent with both the RVT and the NVT, and also with the assumption in Maxwell's theory that the speed of light in free space is the same in all inertial systems [27].

VI. Gravitational Scaling and Einstein's Equivalence Principle

There is an analogous scaling procedure for the effects of gravity [28]. One can began this investigation by combining Einstein's newly announced mass-energy equivalence relation [1] with Newton's classical gravitation theory. He assumed that an object of mass m has an energy value of $E=mc^2$. When it is raised a distance of h in a gravitation field with the local value of the acceleration due to gravity of g, its energy is increased by the amount of the potential energy value mgh, i.e. $E_h=mc^2+mgh$. He made a truly innovative advance [29] by assuming that an observer at the higher altitude does not notice this change of energy by reason of the fact that the unit of energy he employs is greater by a factor of $S=1+gh/c^2$. In other words, the observer at the lower potential can predict the energy value E_h obtained in his units by *converting* the original value of $E_l = mc^2$, which is the value measured by the local observer at the higher potential, to the unit of energy employed at his lower potential, i.e. $E_h=SE_l.=(1+gh/c^2)mc^2.=mc^2+mgh$. It can be seen that this approach is quite similar to that discussed in Sect. IV for kinetic scaling, only in this case the key parameter is S instead of Q.

Einstein went a step further, however. He proposed that no local experiment of any kind could distinguish between the effects of a gravitational field, on the one hand, and the effects of a uniform acceleration of the laboratory with respect to an inertial frame, on the other [29]. This assertion is known as the Equivalence Principle (EP). It is often expressed in the popular literature by the term *Einstein's Elevator*. He argued that if the observer's laboratory were accelerated upward *in a gravity-free field* to attain a speed of v=gh/c, the effect would be the same, i.e. the energy of the object at the upper level would be increased by a factor of $S=1+v/c=1+gh/c^2$. He based this conclusion on the Doppler effect, even though there is no such effect for energy, however. When applied to the frequency of light of light ν, the Doppler effect leads one to expect that the value would be increased by the same factor, i.e. to $S\nu = (1+v/c)\ \nu = \nu + (gh/c^2)\ \nu$. He made his famous prediction of the gravitational red shift on this basis [29]. The latter has been verified [30] by moving a clock to a position on a mountain and letting it stay there for a lengthy period of time before returning it to its original position. It was found that the clock gained time at the higher potential and by the amount predicted by Einstein. Similar agreement has been obtained in the Hafele-Keating experiment with circumnavigating clocks on airplanes [12, 13]. One could anticipate the change in frequency from the Planck relation E=hν [31], but this would require an additional assumption, namely that h is invariant to changes in gravitational potential, but Einstein did not mention Planck's relation [29] in his derivation.

As a further application of the EP, Einstein considered the effect the laboratory acceleration would have on the speed of light [29]. He predicted that the speed of light would increase by exactly the same factor as frequency, i.e. as $Sc = (1 + gh/c^2)\ c$. This prediction was tested in a terrestrial experiment carried out by Pound *et al*., [32, 33], and another stunning verification of the EP was reported as a result.

There is another property that has not received very much attention in this discussion, however, namely the wavelength of light. According to the EP, it is possible to obtain an accurate value for the change in wavelength with gravitational potential by sending the laboratory in which measurements are made upward in a gravity-region of space. The Doppler effect, which has been applied to demonstrate the ability of the EP in the prediction of light frequencies, leads to the conclusion that the wavelength of light will be *decreased* as a result of the upward motion of the laboratory. Yet, experimental data for light speed and frequency find that these two quantities are both changed by the same factor S when the light source is simply moved to a different gravitational potential (Sc and Sν). Therefore, the wavelength of light must be *invariant* to changes in the gravitational potential. Otherwise, the phase velocity of the light in free space, which is the product of the frequency and wavelength of the light, will not be equal to Sc. These two conclusions show without any doubt that the EP is unable to make a correct prediction in this instance, and is therefore *not a universally applicable principle.* It is simply not true that one cannot tell the difference between moving to a higher potential, on the one hand, and being elevated at speed gh/c upward toward the light source on the other. All that is required to disprove the EP is to measure the value of the wavelength of the light under both conditions. When the Doppler effect is applied, it is predicted that the wavelength λ will have a value of $S^{-1}\lambda_0$, whereas the necessity of satisfying the condition that the phase velocity be equal to the corresponding light speed in free space demands that the wavelength maintain the same value at all gravitational potentials, i.e. $\lambda = \lambda_0$.

It also should be noted that there is a second-order Doppler effect for frequencies. Thus, when the laboratory increases it speed relative to the light source, the value of the frequency changes by not only the v/c factor but also by γ (v) [34]. This is certainly a small effect for motion near the earth's surface, but it nonetheless has a definitively negative impact on the arguments in favor of the EP. It shows again that the upward motion of the laboratory leads to a different result than occurs by simply moving the light source to a higher potential.

There is clear experimental proof of the failure of the EP. It comes from the Hafele-Keating study of the rates of atomic clocks carried onboard circumnavigating airplanes [12, 13]. In order to satisfactorily account for the changes in the elapsed times of the clocks, it is necessary to make separate adjustments based on both the motion of the clocks and their position in the gravitational field of the earth. If the effects of motion and gravity were just two sides of the same coin, it would be unnecessary, and in fact counterproductive, to make both corrections.

The failure of the EP does not stand in the way of formulating a reliable version of the Uniform Scaling method that accounts for the effects of gravity on physical properties. Accordingly, the parameter S serves the same role as Q in kinetic scaling. The above experiments make clear what the conversion factors for energy, relative speed, frequency and wavelength are, namely S for the first three and unity (S^0) for distance. As before with kinetic scaling, one can deduce other conversion factors on the basis of their composition in terms of the three fundamental properties of inertial mass, time and distance. The conversion factor for inertial mass m is thus seen to be S^{-1}, the same as for time. This conclusion is based on the $E=mc^2$ relationship; since both E and c have factors of S, it follows that the conversion factor for inertial mass is equal to that of the E/c^2 ratio, namely $S/S^2=S^{-1}$.

The gravitational scale factor for linear momentum p =mv is $S^{-1}xS= S^0$ and the same holds true for angular momentum (l=mvr), as well as for Planck's constant h. The conversion factor of h is Q^2 (Sect. IV) for changes in the motion of the light source. This allows Planck's equation [31] to be satisfied in all rest frames since energy scales as Q and frequency as Q^{-1}. This state of affairs is another problem for applications of the EP, however, since the upward motion of the laboratory must be characterized by a change in the E/ν ratio, whereas it is invariant to simple elevation to a higher gravitational potential. More details about the conversion factors for gravitational scaling can be found in previous references [35, 36].

Finally, it should be noted that the scale factors for distance and speed must be altered for motion radial to the gravitational field. Schiff pointed this out [37] in connection with his computation of the angle by which the wave front of light waves is rotated during solar eclipses.

Einstein [38] had earlier pointed out the necessity for doing this in order to obtain an accurate value for this angle. Schiff was unable to explain the precession of the perihelion of planetary orbits in his work, however. It was shown later [39, 40] that this feature of planetary orbits can be explained by making an appropriate scaling of the local value of the acceleration due to gravity g. This conversion factor also helps to explain why g=0 for light waves, thereby causing photons to travel in a perfectly straight line as they pass by massive bodies [41]. This behavior was confirmed by Shapiro *et al*., [42, 43] in experiments with radar pulses passing close to Venus and Mercury. The evaluation of both of the above angles is accomplished with the same level of accuracy as with Einstein's General Theory of Relativity [44] but with a notably simplified computational procedure [37, 40].

VII. CONCLUSION

In his landmark paper [1] introducing the Special Theory of Relativity in 1905, Einstein makes two deductions based on the Lorentz transformation (LT) which clash with the underlying assumption of the equality of measured light speeds in rest frames moving with respect to one another. When an observer carries out a measurement of the light speed in his rest frame S', he obtains values for both the distance L' travelled by the light and the corresponding elapsed time T'. The LT asserts that an observer moving at speed v in rest frame S toward the observer in S' will find that his value L for the distance travelled by the light is smaller by as much as a factor of γ (v) because of FitzGerald length contraction (FLC); this value is the maximum contraction effect, with smaller contractions being recorded in other directions. His value based on the LT for the elapsed time will be greater by γ (v) in any case because of the effect of time dilation (TD). The combination of these two relationships leads unequivocally to the conclusion that the observers must disagree on their respective values of the light speed, contrary to the above assumption. This result is based solely on the claims/assumptions by the LT, and so there can be no question that it is incontrovertible. There is only one conclusion that can be made about the LT on this basis, namely that it is not a viable space-time transformation because of its lack of internal consistency.

In order to devise a suitable replacement for the LT, it is important to note that the original derivation ignores a basic fact about inertial, i.e. freely moving, clocks. According to the Law of Causality, the rate of such a clock will remain the same indefinitely. Newton's First Law of Motion operates on the same principle, namely that no change in the velocity of an object will occur until an unbalanced external force is applied to it. This characteristic of inertial clocks forces one to conclude that the elapsed times measured by two such clocks will always be found to be in the *same fixed ratio*: $\Delta t' = \Delta t/Q$, where Q is the ratio of the two constant rates. This relationship is referred to as Newtonian Simultaneity.

It is possible to combine Newtonian Simultaneity with the relativistic velocity transformation [(RVT shown in eqs. (11a-c)] to obtain a space-time transformation which satisfies both the requirements of Galileo's Relativity Principle (RP) and the equal light speed condition. The resulting set of equations is shown in eqs. (8a-d) and is referred to as the Newton-Voigt transformation (NVT). The value of Q needed for the complete definition of the NVT equations for any two inertial rest frames S and S' can be obtained from experimental TD tests. For this purpose, it is necessary to define a specific rest frame (ORS) relative to which the speeds v and v' of the two clocks are measured. The experimental data are found to satisfy the inverse proportionality relationship of eq. (12), which is referred to as the Universal Time-Dilation Law (UTDL).

A useful way to think about the parameter Q is as a conversion factor between the unit of time employed by the observer at rest in S' and that employed by his counterpart at rest in S. In other words, if an elapsed time $\Delta t'$ is measured in S', the corresponding value in the unit employed in the S frame is $\Delta t = Q\,\Delta t'$. It is easy to extend this procedure to other physical properties, starting with relative speeds. The invariance of the light speed indicates that the unit of speed is the same in both rest frames. At the same time, in order to maintain this relationship, it is necessary in an objective/logical world that the conversion factor of the respective units of distance must be exactly the same as for time, i.e. Q. Experiments with electrons accelerated in electromagnetic fields showed that their inertial mass increases by the same factor of γ (v) as for lifetimes and other elapsed times. Conversion factors for other quantities can be deduced on the basis of knowledge of their composition in terms of the three fundamental quantities: distance, inertial mass and time. The Uniform Scaling method is an extension of these relationships to all objects in the universe. Once one knows the value of Q for any pair of rest frames, it is assumed that it can be used to convert the local values of any property observed in S' to the corresponding value in S. It is a very attractive theory because it is ultimately based on only three integers, namely the exponents of Q for each of the fundamental quantities, namely 1, 1 and 1.

The Uniform Scaling method is perfectly consistent with Galileo's RP because it is found that application of the conversion factors always preserves the equations that represent physical laws, such as $E=mc^2$ and F=dp/dt. It also is found that the rolereversal of object and observer is accomplished with conversion factors which are the reciprocal of the original values; this is perfectly analogous to the case of conversion factors employed in everyday life.

One of the consequences of Einstein's SR is that it claims that the GVT cannot be used if the object is a light pulse. This position goes back the Einstein's version of the light speed postulate (LSP), namely that the speed of light is the same for all observers independent of their state of motion and that of the light source. An example has been presented in which a vehicle with a light source passes an observer standing on a street corner with speed v while at the same time emitting a light pulse in the same direction. According to the LSP, the speed of the light pulse relative to the source is the same as relative to the street corner. All one has to do to disprove this assertion is to consider how far the light pulse moves after a certain time T has elapsed. According the LSP, the light pulse is located at the same distance of cT relative to both the light source and the street corner. This is impossible, however, because the light source is no longer located at the street corner.

The same type of argument, referred to as "distance re-phrasing," can be applied to show that the GVT can be used to deduce the relative speed of the light pulse to the street corner. After time T has elapsed, the light pulse is separated from the source by a distance of cT, whereas the source has moved a distance of vT relative to the street corner. The total distance separating the light pulse from the street corner is obtained by summing the two partial distances, namely as vT+cT. By the definition of speed as the ratio of the distance travelled to the corresponding elapsed time, one therefore concludes that the speed of the light pulse relative to the street corner is c+v, exactly the same value as predicted by the GVT.

From this example, it is clear that the GVT can be used successfully to measure the respective speeds of an object relative to two observers in relative motion to one another.

It cannot be used in the light-damping experiment, however. For that purpose, von Laue showed that the RVT must be used instead. The distinction is clear. In the latter case, only *one observer* is involved; his measurements are simply made for two different conditions. In the former case, there are two observers making simultaneous measurements of the speed of a third object.

Bradley effectively used the GVT/vector addition to arrive at his conclusion about the aberration of starlight from the zenith. Einstein added a correction based on his belief that the RVT must be used instead, but in so doing he was ignoring the above distinction. Einstein also erred when he used the RVT to support his claim that light flashes on both ends of a moving train would not arrive at the same time for an observer on the train as for someone at rest on the station platform. His conclusion of remote non-simultaneity (RNS) also runs contrary to the Law of Causality and Newtonian Simultaneity.

Finallt, it is pointed out that Einstein's Equivalence Principle (EP) breaks down when attention is turned to the measurement of wavelengths, and also in the way Planck's constant h varies with acceleration of a light source. Nonetheless, his predictions about the gravitational red shift and the increase of light speed with gravitational potential play a very positive role in the Uniform Scaling methodology. A parameter S is defined which plays the same role as Q in deducing conversion factors for motion induced by kinetic acceleration. In this case, the gravitational conversion factors are integral multiples of S as opposed to integral multiples of Q in the former case. The key exponents of S are -1 for both inertial mass and time and 0 for distance.

Additional factors of S are required to compute trajectories of light waves and planets. It is especially important to scale the local acceleration of gravity for this purpose. As a consequence, it is found that light travels in a perfectly straight line as it passes by a heavy mass such as the sun. The observed angle of displacement of star images during solar eclipses is predicted from use of Huygens' Principle, in which case only the speeds of the light waves as a function of distance from the sun are required input. Result of equal accuracy are obtained using the Uniform Scaling method as are found by applying the much more complicating methodology of Einstein's Theory of General Relativity.

REFERENCES

1. Einstein. (1905). Zur Elektrodynamik bewegter Körper, *Ann Physik,* 322(10), 891-921.
2. Einstein. (1907). *Jahrb. Radioakt. u. Elektronik,* 4, 411.
3. Larmor, J. (1900). *Aether and Matter* (Cambridge University Press, London), pp. 173-177.
4. Pais, A. 1982). *'Subtle is the Lord …' The Science and the Life of Albert Einstein* (Oxford University Press. Oxford), p. 126.
5. Voigt, W. (1887). Ueber das Doppler'sche Princip, *Göttinger Nachrichten,* 7, 41-51.
6. Michelson, A. A., & Morley, E. W. (1887). ART. XXXVI.--On the Relative Motion of the Earth and the Luminiferous Ether. *American Journal of Science (1880-1910)*, *34*(203), 333.
7. Jackson, J. J. D. (1973). *Classical Electrodynamics* (John Wiley & Sons. New York), pp. 358-359.
8. Lorentz, H. A. (1904). Electromagnetic phenomena in a system moving with any velocity smaller than that of light, *Proceedings of the Royal Netherlands Academy of Arts and Sciences,* 6, 809-831;

Collected Papers, Vol. 5, Nijhoff ('s-Gravenhage, 1935-1939) p. 172.
9. Buenker, R. J. (2014). *Relativity Contradictions Unveiled: Kinematics, Gravity and Light Refraction (*Apeiron, Montreal), p. 201.
10. Laue, M. (1907). Die Mitführung des Lichtes durch bewegte Körper nach dem Relativitätsprinzip. *Annalen der Physik*, *328*(10), 989-990.
11. Sard, R. D. (1970). *Relativistic Mechanics* (W. A. Benjamin, New York), pp. 108-111.
12. Hafele, J. C., & Keating, R. E. (1972). Around-the-world atomic clocks: predicted relativistic time gains, *Science*, 177, 166-168.
13. Hafele, J. C., & Keating, R. E. (1972). Around-the-world atomic clocks: Observed relativistic time gains. *Science*, *177*(4044), 168-170.
14. Hay, H. J., Schiffer, J. P., Cranshaw, T. E., & Egelstaff, P. A. (1960). Measurement of the red shift in an accelerated system using the Mössbauer effect in Fe 57. *Physical Review Letters*, *4*(4), 165.
15. Kuendig, W. (1963). Measurement of the transverse Doppler effect in an accelerated system, *Phys. Rev,* 129, 2371-2375.
16. Champeney, D. C., Isaak, G. R., & Khan, A. M. (1963). Measurement of relativistic time dilatation using the Mössbauer effect, *Nature*, 198, 1186-1187.
17. Bucherer, H. (1908). *Phys Zeit*, 9, 755.
18. Lewis, G. N., & Tolman, R. C. (1909). LVII. The principle of relativity, and non-newtonian mechanics. *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, *18*(106), 510-523.
19. Buenker, R. J. (2014). *Relativity Contradictions Unveiled: Kinematics, Gravity and Light Refraction (*Apeiron, Montreal), p. 75.
20. Buenker, R. J. (2018). The relativity principle and the kinetic scaling of the units of energy, time and length, *Apeiron,* 20(4), 1-31.
21. Buenker, R. J. (2014). *Relativity Contradictions Unveiled: Kinematics, Gravity and Light Refraction (*Apeiron, Montreal), pp. 58-60.
22. Buenker, R. J. (2017). The universal time dilation law: objective variant of the Lorentz transformation, *BAOJ Physics*, 3(23), 1-6.
23. Buenker, R. J. (2014). *Relativity Contradictions Unveiled: Kinematics, Gravity and Light Refraction,* (Apeiron, Montreal), pp. 207-215.
24. Buenker, R. J. (2022). Proof That Einstein's Light Speed Postulate Is Untenable, *East Africa Scholars J Eng Comput.* Sci, 5(4), 51-52.
25. Buenker, R. J. (2022). Dissecting Einstein's Lightning-Strike Example, *East Africa Scholars J Eng Comput* Sci, 5(7), 85-91.
26. Buenker, R. J. (2019). Stellar aberration and light-speed constancy, *J Sci Discov,* 3(2), 1-15.
27. Reitz, J. R., & Milford, F. J. (1960). *Foundations of Electromagnetic Theory* (Addison-Wesley, Reading, Massachusetts), p. 52.
28. Buenker, R. J. (2008). Gravitational and kinetic scaling of physical units, *Apeiron*, 15, 382-413.
29. Pais, A. (1982). *'Subtle is the Lord …' The Science and the Life of Albert Einstein* (Oxford University Press. Oxford), pp. 181-182.
30. Netburn, D. (2018). *Washington Post*, Feb. 24, (2018).
31. Planck, M. (1901). Über das Gesetz der Energieverteilung im Normalspectrum, *Ann Physik* 309(3), 553-563.
32. Pound, R. V., & Rebka Jr, G. A. (1959). Resonant absorption of the 14.4-keV γ ray from 0.10-μsec Fe 57. *Physical Review Letters*, *3*(12), 554.
33. Pound, R. V., & Snider, J. L. (1965). Effect of gravity on gamma radiation. *Physical Review*, *140*(3B), B788-B804.
34. Sard, R. D. (1970). *Relativistic Mechanics* (W. A. Benjamin, New York), p. 318.
35. Buenker, R. J. (2008). Gravitational and kinetic scaling of physical units, *Apeiron*, 15, 382-413.
36. Buenker, R. J. (2014). *Relativity Contradictions Unveiled: Kinematics, Gravity and Light Refraction*, (Apeiron, Montreal), pp. 116-120.
37. Schiff, L. I. (1960). On Experimental Tests of the General Theory of Relativity, *American Journal of Physics*, 28, 340-343.
38. Einstein, A. (1911). Über den Einfluß der Schwerkraft auf die Ausbreitung des Lichtes. *Annalen der Physik*, *340*(10), 898-908.
39. Buenker, R. J. (2008). Extension of Schiff's gravitational scaling method to compute the precession of the perihelion of Mercury, *Apeiron*, 15, 509-532.
40. Buenker, R. J. (2021). The uniform scaling method for simplified accurate computation of the key tests of General Relativity. *ITS App Phys*, 4(2), 1-17.
41. Buenker, R. J. (2022). Compelling evidence that light travels in a perfectly straight line as it passes through a gravitational field, *Amer J Planetary Sci and Space Sci*, 1, 103, 1-8.
42. Shapiro, I. (1964). Fourth test of general relativity, *Phys Rev Letters*, 13, 789.
43. Shapiro, I. (1968). Fourth Test of General Relativity: Preliminary Results, *Phys Rev Letters*, 20, 1265-1269.
44. Einstein, A. (1916). "Die Grundlage der allgemeinen Relativitätstheorie, *Ann.Physik*, 354(7), 769-822.

Cite This Article: Robert J. Buenker (2023). The Failure of Both Einstein's Space-time Theory and His Equivalence Principle and Their Resolution by the Uniform Scaling Method. *East African Scholars J Eng Comput Sci*, *6*(2), 26-35.