Failure of the Einstein-Lorentz Spherical Wave Proof

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Einstein's transformation equations are believed to be mathematically correct in part due to the Spherical Wave Proof that Einstein offers in each of his derivations. Einstein asserts that if an electromagnetic wave is propagated as a Sphere in system K that the wave will also be represented as a Sphere in system K', where the values of the Sphere in K' are determined using the transformation equations. The proof asserts a one-to-one mapping between the points representing the Sphere in K and the points representing the Sphere in K'. Here we find that Einstein's proof shows that the transformed values conform to the general equation of a Sphere in K', but that his proof does not validate that all of the transformed points are part of the same Sphere in K'. We then show that the proof fails because the transformed K' values have different radiuses and represent points on multiple spheres in K', instead of on a single sphere.

1. Introduction

In 1904, Lorentz published his paper on Electrodynamics. [1] This paper was followed in 1905 by the publication of Einstein's paper on Special Relativity Theory (SRT). [2] Both papers provide similar transformation equations which assert that if an electromagnetic wave is propagated in one coordinate system, K, as a sphere that the transformed waveform will also be in the shape of a sphere in the second system, K'. In each of Einstein's papers, he uses this Spherical Wave Proof to establish the validity of his derivation and postulates. [2,3,4]

The author has identified several mathematical and conceptual problems with Einstein's derivation. [5,6,7] The author has also produced equations that have significantly less error in specific experiments than is obtained by using the SRT-based equations. [8,9] These findings of better equations and systemic problems with Lorentz's and Einstein's derivations suggest that the Spherical Wave Proof, offered in Einstein's derivations should fail. This paper reexamines the Spherical Wave Proof to reveal an oversight in Einstein's proof regarding the specific mathematical requirements of a sphere. As a result, this paper will show that the transformed points do not form a single sphere in the second system, K', which leads to the proof's failure.

The goal of Einstein's Spherical Wave Proof is to prove the relationship between the constancy of the speed of light and the Principle of Relativity. [2] It consists of three parts; 1) a claim that if an electromagnetic wave has a spherical shape in K that it also has a spherical shape in K', 2) a mathematical association, through the transformation equations, that relates the spherical equation for K with the spherical equation for K', and 3) an assertion that the mathematical association always succeeds. Einstein takes these three elements to conclude a spherical wave front in K' and establish the relationship. This paper will show that these three elements alone are not sufficient to reach this conclusion.

2. Definition of a Sphere

Since Einstein's proof is built upon the concept of a sphere, we need to begin with its definition:

> ***Definition:*** *A sphere is defined as the set of all points in three-dimensional Euclidean space that are located at a distance (the "radius") from a given point (the "center").* [10]

Translating this textual definition of a sphere into mathematical equations requires that two conditions are met. First, the values for all points on the sphere adhere to the equation

$$(x - x_0)^2 + (y - y_0)^2 + (z - z_0)^2 = R^2 \tag{1}$$

where the center point of the sphere is (x_0, y_0, z_0) and the radius is R. As illustrated in Fig. 1A, this equation confirms that a radius and a point are combined to produce an equation for a circle or sphere. Adherence to this spherical equation will be referred to as **Condition 1**.

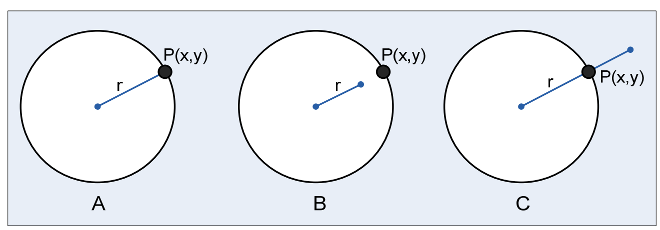

Fig. 1. Relationships between a point and a radius. A circle (2D) or a sphere (3D) is formed when the radius equals the distance of the point from the center. A valid circle or sphere exists when the values can be combined to create the equation of one circle or sphere, as given in Eq. (1) and illustrated in 1A. The points in 1B and 1C do not form a circle or sphere because their given radiuses do not equal the length of each point from the center.

Second, all points of the sphere must have the same radius, R. Mathematically, if **r** is the set of radius values, then all points on the sphere have the same radius when $|\mathbf{r}|=1$. This second condition, while strongly implied by Eq. (1), is often unvalidated because it is generally taken as given. As illustrated in Fig. 2, it is possible for multiple points to conform to Condition 1, but fail to form a sphere because the points are actually members of different spheres. Adherence to the requirement that the same radius is maintained for all points is referred to as **Condition 2**.

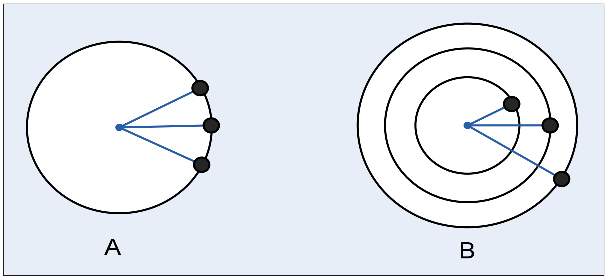

Fig. 2. Relationship of multiple points that correspond to the equation of a circle (2D) or sphere (3D). One valid circle or sphere exists when all of the points have the same radius, as given in 2A. Figure 2B illustrates individual points on multiple valid circles or spheres, but they do not combine to form a single circle or sphere.

3. Analysis of the Spherical Wave Proof

As illustrated in Fig. 3, the goal of Einstein's Spherical Wave Proof is to show that all points in the source circle (2D) or sphere (3D) map to a target circle or sphere. This goal is met when Conditions 1 and 2 are both satisfied for points on sphere K that are mapped to points on sphere K'. Einstein's Spherical Wave Proof is designed to produce a result consistent with Fig. 3.

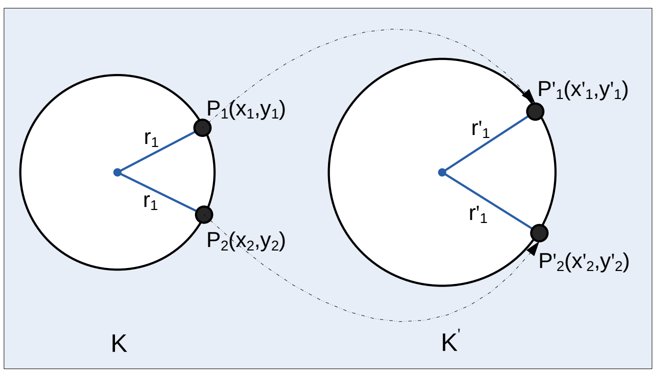

Fig. 3. Mapping between multiple points on a circle (2D) or sphere (3D) in K into multiple points on a circle or sphere in K'. Einstein's Spherical Wave Proof is designed to produce a result that is consistent with this diagram.

Einstein begins his proof with a spherical equation in K, with the center point at the Origin, such that

$$x^2 + y^2 + z^2 = R^2 \tag{2}$$

He states that the radius R is $R = ct$, resulting in the spherical equation for the K system as

$$x^2 + y^2 + z^2 = c^2 t^2 \tag{3}$$

All of the possible combinations of x, y, z, and t that will make this equation true for a given R can be found using the equations

$$\begin{aligned} x &= R\cos\theta\sin\phi \\ y &= R\sin\theta\sin\phi \\ z &= R\cos\phi \end{aligned} \tag{4}$$

where θ is an azimuth value, and ϕ is a polar value, with both having the domain $[0,2\pi]$. [10] Since the radius R is $R = ct$, the value for t is found using the equation

$$t = R / c \tag{5}$$

where c represents the speed of light. Equations (4) and (5) enable us to find the values (x, y, z, t) for any point on the sphere in K by varying θ and ϕ. All of the possible (x, y, z, t) values in K are then transformed into K' using the transformation equations

$$x' = \frac{x - vt}{\sqrt{1 - \frac{v^2}{c^2}}}, \quad y' = y, \quad z' = z, \quad t' = \frac{t - \frac{vx}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{6}$$

Einstein asserts that after a wave has been emitted from the Origin at time $t = t' = 0$ and has values (x, y, z, t), these transformed values (x', y', z', t') will adhere to the spherical equation for K',

$$x'^2 + y'^2 + z'^2 = c^2 t'^2 \tag{7}$$

where the radius R' has already been replaced by $R' = ct'$.

Independently, Eqs. (3) and (7) are valid for any arbitrary sphere. The Spherical Wave Proof requires that both equations remain true and represent valid spheres when they are constrained by Eqs. (6). Thus, the proof requires the following steps:

Step 1: A sphere is found in K that adheres to Eq. (3). The specific (x, y, z, t) values that make up this sphere can be found using Eqs. (4) and (5).

Step 2: For every (x, y, z, t) value on this sphere in K, use Eqs. (6) to produce their corresponding (x', y', z', t') values.

Step 3: Confirm that each transformed (x', y', z', t') value is a member of the same sphere in K'. This is accomplished when Conditions 1 and 2 are satisfied.

While Einstein's assertion is correct and every point on a sphere in K will produce values that adhere to Eq. (7), it does not prove the existence of a sphere in K'. In order to prove the existence of a sphere, we must show that both conditions have been satisfied: The transformed values must adhere to Eq. (7) for Condition 1 to be met and all of the points on the sphere must have the same radius from the center point for Condition 2 to be met. Einstein's proof has only shown that Condition 1 has been met in K'.

In order to show that Condition 2 has been met, we must show that for all values (x, y, z, t) that satisfy Eq. (3), that the radius R in K does not change. Concurrently, we must also show that the derived (x', y', z', t') values, produced using Eqs. (6) and satisfying Eq. (7), must maintain the same radius R' in K'. This can be validated using a Brute-Force technique. Tables I and II illustrate a case where a valid sphere is formed in K, but not in K'. While the values given in Table I satisfy both conditions and represent a sphere, the transformed values given in Table II only satisfy Condition 1. Because Condition 2 is not satisfied in K', the values do not combine to form a sphere.

Values in K					
x	y	z	t	c	R
1	0	0	3.33333E-09	300,000,000	1
0	1	0	3.33333E-09	300,000,000	1
0	0	1	3.33333E-09	300,000,000	1
-1	0	0	3.33333E-09	300,000,000	1
0	-1	0	3.33333E-09	300,000,000	1
0	0	-1	3.33333E-09	300,000,000	1

Table I. The values of a Unit-Sphere are points on the same sphere in K since they conform to Conditions 1 and 2.

Values in K' (v=100,000)					
x'	y'	z'	t'	c	R'
0.999667	0	0	3.33222E-09	300,000,000	0.999667
-0.000333	1	0	3.33333E-09	300,000,000	1
-0.000333	0	1	3.33333E-09	300,000,000	1
-1.000333	0	0	3.33444E-09	300,000,000	1.000333
-0.000333	-1	0	3.33333E-09	300,000,000	1
-0.000333	0	-1	3.33333E-09	300,000,000	1

Table II. While they conform to Condition 1, the transformed values (using Eqs. (6)) are not points on the same sphere in K' because they do not conform to Condition 2. (Note: When R' is shown as 1 in this Table, its value is actually $1+5.\overline{5}x10^{-8}$).

The results given in Tables I and II can be explained using derivatives that describe the behavior of R and R'. Using Spherical Coordinates, we can determine that Condition 2 is only satisfied when

$$\frac{dR}{d\theta}=0 \quad and \quad \frac{dR}{d\phi}=0 \tag{8}$$

in K, and when

$$\frac{dR'}{d\theta}=0 \quad and \quad \frac{dR'}{d\phi}=0 \tag{9}$$

in K'. We are given that $R=ct$, and through the use of Eqs. (4) and (5), we know that t is independent of the variables θ and ϕ. Thus, Condition 2, as specified by Eqs. (8), is satisfied for the K system. This explains why the radius R in Table I does not change. In the K' system, we are given $R'=ct'$. Since

$$t'=\frac{t-\frac{vx}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}} \tag{10}$$

and because we have already shown in Eqs. (4) that x is dependent on the variables θ and ϕ, we could instead show that

$$\frac{dR'}{dx}=0 \tag{11}$$

in order to satisfy Condition 2 for K'. However, here we find that

$$\frac{dR'}{dx}=\frac{dR'}{dt'}\frac{dt'}{dx}=-\left(\frac{v}{c}\right)/\sqrt{1-\frac{v^2}{c^2}} \tag{12}$$

This derivative explains the amount of change in R' observed in Table II. More importantly, it confirms that $|\boldsymbol{r}'|>1$, which means that Condition 2 cannot be satisfied for K' when $v>0$.

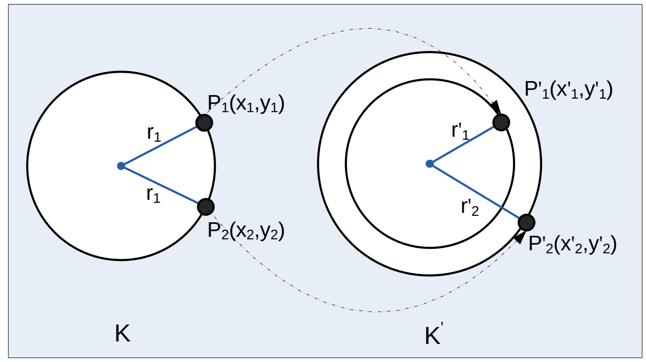

Fig. 4. The Einstein-Lorentz equations produce values that transform points from a source circle (2D) or sphere (3D) into multiple target circles or spheres. This occurs when Condition 1 is satisfied, but Condition 2 is not. The points in K' do not combine to form one circle or sphere.

As illustrated in Fig. 4, the Einstein-Lorentz transformations map values from a sphere in K onto multiple spheres in K'. This does not produce a single sphere in K' as illustrated in Fig. 1 and results in the failure of Einstein's Spherical Wave Proof.

4. Counter Arguments

One class of counter-arguments to the analysis presented in this paper is based on the assertion that aspects of relativity, such as simultaneity, length contraction, or time dilation, are already valid. Since this paper challenges the foundational proof of relativity, such counter-arguments are premature and create a circular argument, as in: *The proof for relativity is right because [some attribute of] relativity is right.* Logically, such counter-arguments that use aspects of relativity as a defense can only be rendered once the proof has been successfully completed.

A second class of counter-arguments asserts that Fig. 4 is the view for an observer in K, but that the view for an observer in K' is actually Fig. 1. This counter-argument essentially asserts that the first two equations in Section 4 of Einstein's 1905 paper are valid. [2] In that section, Einstein asserts that a sphere in one system will have an ellipsoid shape in the other, both centered at the Origin. Because (x,y,z,t) values in K are always associated with (x',y',z',t') values in K' using the transformation equations, Eqs. (6), we can use the same type of analysis presented herein to assess this claim and find that the second equation does not produce points with the same value, R. Specifically, the points (1,0,0) and (-1,0,0) produce $|\boldsymbol{r}|>1$ following the application of the transformation equations, which means that Einstein's assertion of $R\sqrt{1-v^2/c^2}$ along the X-axis is not always true. As a result, the assertion and counter-argument fail.

It is important to note that if Einstein's second equation in Section 4 is modified to shift the center of the transformed shape from (0,0,0) to $(-vt/\sqrt{1-v^2/c^2},0,0)$, one can perceive an ellipsoid in K. In fact, had a valid sphere in K' been formed from the application of Eqs. (6), its origin would have also been shifted by the same amount. This shift in the center of the transformed ellipsoid (and sphere) disagrees with Einstein's statements that the center of each is the origin, thus violating his first postulate. This also represents a failure of the counter-argument.

The third class of counter-arguments essentially disregards the association, established by Eqs. (6) (and by Step 2), that relates the specific (x, y, z, t) values in K to their specific transformed (x', y', z', t') values in K'. Alternatively, they disregard the need for Condition 2 to be met. Such arguments ignore the purpose of the proof.

5. Implications

The failure of the Spherical Wave Proof invalidates the theoretical conclusions of, and any alternative theory that derives from, Special Relativity Theory. Most important among these is General Relativity Theory (GRT). Einstein developed GRT to correct a shortcoming that limited SRT's applicability to uniform translatory motion. [11] His GRT derivation begins by assuming that a sphere in one system is related to an ellipsoid in the other. [11] We have shown that this fundamental assumption does not hold. The more interesting finding is that the mistreatment of the radius, when combined with this fundamental assumption (that enables Einstein to begin with a 4-dimensional space), leads to the conclusion of space-time curvature.

Begin with the radius, R', which is expressed in Eq. (7) as ct'. Both values, c and t', must be taken together to represent the radius. For clarity, we rewrite c as R'_c to represent the velocity component of R', and t' as $R'_{t'}$ to represent the time component of R'. Using these variables, Eq. (7) is rewritten as

$$x'^2 + y'^2 + z'^2 = R'^2_c R'^2_{t'} \tag{13}$$

to emphasize that both are components of the radius, or as

$$\sqrt{\frac{x'^2}{R'^2_{t'}} + \frac{y'^2}{R'^2_{t'}} + \frac{z'^2}{R'^2_{t'}}} = R'_c \tag{14}$$

in order to show the velocity component of the radius in isolation on the right-hand side. This equation can be rewritten without the emphasized radius notation as

$$\sqrt{\frac{x'^2}{t'^2} + \frac{y'^2}{t'^2} + \frac{z'^2}{t'^2}} = c \tag{15}$$

as is the case in Einstein's GRT derivation. [11] When compared to Eq. (14), it is difficult to identify the time radius component in Eq. (15), which leads to the mistreatment of the velocity radius component as if it were the complete radius for a 3-dimensional system. When the radius components are not recognized as appearing on both sides of the equation, the velocity radius component is mistreated as the complete radius, and a 4-dimensional space (which Einstein used to begin his derivation) is treated as a 3-dimensional space, an interpretation of space-time curvature results. GRT, like SRT, missed the requirement to satisfy Condition 2 and instead uses space-time curvature to explain $|\mathbf{r}'|>1$.

6. Conclusion

The goal of the Spherical Wave Proof is to show that the values (x, y, z, t) form a sphere and are associated, via the transformation equation, with the values (x', y', z', t'), which also form a sphere. This analysis has shown that values on a sphere in K produce points in K' that are on multiple spheres when they are associated with one another using Einstein's transformation equations. We can also show that the reverse is true; that if we begin with a sphere in K' and use the transformation equations to find values in K, that those transformed values will be on multiple spheres in K. Thus, we are able to conclude that Einstein's transformation equations do not associate a sphere in K with a sphere in K'.

We have shown that in Einstein's Spherical Wave Proof, the transformed points in K' all conform to the equation of a Sphere, but not necessarily to the same Sphere. Einstein's proof only shows that Condition 1 – that the points conform to the spherical equation - was satisfied in K'. However, Condition 2 - the requirement that a constant radius be maintained - is not satisfied in K' because the radius R' changes as x changes. This violates the definition of a sphere. Thus we can conclude that the waveform in K' is not spherical, which means that Einstein's Spherical Wave Proof fails. This failure of the Spherical Wave Proof invalidates any theoretical conclusions based on this assertion.

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