Failure of the Relativistic Hypercone

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Einstein built relativity theory using two foundational shapes; the spherical wave and the hypercone. In 1922, he created the hypercone by defining l, or light-time, as $l = ct$. Conceptually and mathematically, Einstein used light-time l as a replacement for Time t in his derivation. Here we find that light-time l is actually a measure of Distance, not Time, because the result of a Velocity multiplied by a Time is always a Distance. Because Time and Distance cannot be used interchangeably, Einstein's mistreatment of light-time as both a Time and a Distance invalidates his hypercone concept and the resulting mathematical and theoretical conclusions. While a critical mistake, it also represents a cornerstone characteristic that permeates Relativity theory: The objectification of Time – or the treatment of Time as if it were a Distance. This objectification of Time, which is actually a measure of motion, has led to incorrect theoretical conclusions for over a century.

1. Introduction

Einstein's 1905 derivation fails because his Spherical Wave Proof is incorrectly interpreted as passing when, in fact, the transformed points do not form a spherical wave [1, 2, 3]. Because the transformed points do not form a valid sphere, his assertion that one is formed is false, invalidating his 1905 derivation [1,2]. This finding is difficult to detect because Einstein uses the equation

$$x'^2 + y'^2 + z'^2 = c^2 t'^2 \tag{1}$$

to determine if the transformed points form a sphere [1, 2, 3]. One can easily show that each of the transformed points will always satisfy this equation, enabling one to reach a conclusion that a spherical wave is formed [1, 2]. However, adherence to this equation, alone, is not sufficient to establish the existence of a spherical wave [1, 2]. A second requirement is that the radius, or the distance from the center of the spherical wave to each of the transformed points, as defined by $c^2 t'^2$, does not change [1]. This means that the use of Eq. (1) alone, without also confirming that the radius is the same for all points, leads to a false positive conclusion that the proof has passed, when it has failed [2]. Einstein did not test for this second requirement—that all points comprising the sphere have the same radius [1, 2].

Relativity theory proponents agree that the radius of each point of a spherical wave must measure the same distance from the origin. Rather than challenge the need for each radii to have the same measure, they instead defend Einstein's 1905 derivation by dismissing his statement that the transformed points form a spherical wave and suggest that the points form a hypercone, which is a conceptual shape Einstein uses in his 1922 derivation [4, 5, 6]. This paper examines Einstein's 1922 derivation where he establishes the hypercone as a key element of Relativity theory. We will show that Einstein makes significant conceptual and mathematical errors in his hypercone derivation that invalidates the derivation, the concept of the hypercone, and the resulting theoretical conclusions.

2. Discussion

In order to understand the nature of Einstein's mistake, we have to revisit the nature of mathematical *Types*, or *Units*. Many disciplines such as mathematics, computer science, chemistry, physics, and engineering, emphasize the importance of maintaining units as part of any derivation. In computer science, unit management is addressed using the term "Types." [7, 8, 9, 10] A Type is a category of data that helps ensure that variables do not get confused as part of a computation. Type mistakes have resulted in sensationalized media attention, such as when the Mars Climate Orbiter failed to achieve orbit and crashed into the Martian surface [11]. The cause was later found as a Type mismatch between Imperial units and Metric units [11].

There are two Type categories: Strongly Typed and Weakly Typed. Weakly Typed derivations use known implicit, stated explicit, or no Type conversions as part of the mathematical operations. As a result, such conversions are not guaranteed to behave as expected. Known implicit Weakly Typed conversions occur when the Types under consideration are similar. For example, as part of a derivation one can convert one meter into 100 centimeters without the need for an explicit math conversion. However, when an implicit Type conversion is not known and an explicit Type conversion is not given, Weakly Typed solutions will perform the mathematical operation with no type conversion and will produce erroneous results. For example, a Weakly Typed operation might incorrectly produce 27 as the answer to 3 feet multiplied by 9 yards (if an explicit conversion that associates yards and feet was not previously stated and an implicit conversion is not known). In a Weakly Typed system, this answer might be stated as 27 feet, 27 yards, or simply 27; all of which are incorrect.

Strongly Typed derivations, on the other hand, only use known implicit and stated explicit Type conversions. When a Type conversion is not possible (because it is not known or it is not previously stated), an error is produced and incorrect answers are not returned. For example, the result of 3 feet multiplied by 9 yards will be 9 square yards (when 3 feet is first converted to 1 yard), or it will be 81 square feet (when 9 yards is first converted to feet). A good Strongly Typed derivation will never yield 27 as the answer.

While identifying Type mistakes in engineering or computer science solutions is simplified by real-world problems that might be manifest, detecting Type mistakes in theoretical works is more challenging because they deal with concepts. A hypercone is an example of one such concept. Figure 1 is Einstein's illustration of a hypercone, which he uses to explain the geometry of Relativity theory [6]. While a hypercone may be one of the less familiar concepts from Relativity theory to the casual reader, one key characteristic is readily identified on his diagram; his use of l to represent the y-axis.

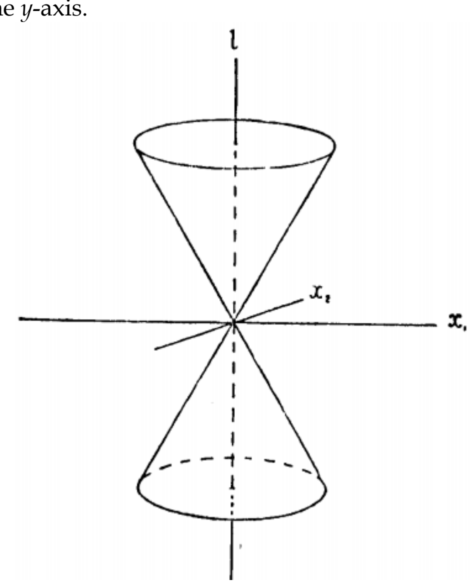

Fig. 1. Einstein's rendition of a hypercone as given in his manuscript **The Meaning of Relativity**. [6]

Einstein clearly defines the meaning of l, which establishes the meaning of the y-axis, when he says

> "*Before we analyze further the conditions which define the Lorentz transformation, we shall introduce the light-time, l = ct, in place of the time, t, in order that the constant c shall not enter explicitly into the formulas to be developed later.*" [6]

Thus, l, or the y-axis, represents Time. This conclusion that Einstein treats l as a type of Time is supported by statements like "*At the definite K time, l = 0…*" that occur later in his derivation [6].

While not obvious, Einstein has incorrectly associated l as a measure of Time when it is actually a measurement of Distance because it is the result of a Velocity, c, multiplied by Time t. To confirm this finding, we consider the accepted equation that defines the relationship between Distance, Velocity and Time,

$$\text{Distance} = \text{Velocity} \cdot \text{Time} \tag{2}$$

We must show that the result of the multiplication of Velocity by Time always results in Distance that is measured in units of distance (e.g., meters). The proof:

Define 1. $\text{Distance} = \text{Velocity} \cdot \text{Time}$,

and 2. $\text{Velocity} = \dfrac{\text{units of distance}}{\text{units of time}}$.

Since 3. $\text{Time} = \text{units of time}$

then 4. $\text{Distance} = \dfrac{\text{units of distance}}{\text{units of time}} * \text{units of time}$,

or simply 5. $\text{Distance} = \text{units of distance}$.

Thus we have established that Velocity multiplied by Time will always produce a Distance. Revisiting Einstein's first use of l: since c is a measure of Velocity and t is a measure of Time, l is a measure of Distance. Einstein's mistreatment of l as a measure of Time leads to incorrect conclusions about the behavior of Time. For example, he says

> "*A clock at rest at the origin $x_1 = 0$ of K, whose beats are characterized by $l = n$, will, when observed from K', have beats characterized by*
>
> $$l' = \frac{n}{\sqrt{1 - v^2}}$$
>
> *this follows from the second of [the equations] and shows that the clock goes slower than if it were at rest relatively to K'.*"*(emphasis added)* [6]

His statement only makes sense if light-time, l, were actually a measure of Time. But since it is a measure of Distance, this statement is incorrect and his conclusion is not supported. Notice that while a clock, which is used to measure Time, can run slower or faster, a ruler, which is used to measure Distance, does not share a similar concept. A ruler cannot run slower or faster. The variable l is a unit of Distance and would be measured by a ruler, while t is a unit of Time and would be measured by a clock. The two cannot be used interchangeably. It is this mistreatment of l as a measure of Time that enabled Einstein to incorrectly conclude a hypercone and develop his accompanying theoretical interpretations.

This conceptual and mathematical mistake is extremely subtle and hard to detect for two reasons. First, when c is mistreated as the scalar (or unTyped) value 299,792,458, l is misinterpreted as Time because t and l have the same units. Furthermore, when c is assumed to be the scalar value 299,792,458, it does not represent the Velocity of the speed of light since we would not know if Einstein meant to say 299,792,458 pounds, 299,792,458 miles, 299,792,458 kilometers, 299,792,458 meters, 299,792,458 seconds, 299,792,458 miles per day, or any other measure of 299,792,458. Since c is a specific Velocity, its units are known and its value is properly stated as "299,792,458 *meters per second.*" Thus, Einstein's substitution is invalid because when c is mistreated as a scalar it cannot be used to represent the speed of light. Second, Einstein's definition, *light-time*, contains the word "time" leading one to believe that l is a type of Time, obfuscating the fact that it is really a Distance.

This finding represents a critical point where Einstein makes an important philosophical error: the objectification of motion [12]. This objectification occurs when he conceptually treats Time as Distance. This dual treatment of light-time as both a Time and a Distance is a key characteristic that forms the foundation of Relativity theory. This objectification and simultaneous treatment of l as both a Time and a Distance has gone undetected and has led theoretical physics astray for over a century.

3. Conclusion

Motion in Relativity theory differs from motion in Classical Mechanics because of differences in space-time geometry. Relativity requires that Einstein's transformed points form a spherical wave or a hypercone. We have previously shown that Einstein's 1905 derivation fails because the transformed points do not form a spherical wave. Here we have shown that Einstein's derivation does not produce a hypercone because a key variable, *light-time*, is actually a measurement of Distance and not a measurement of Time. Since the speed of light, c, is a Velocity, and t is a Time, then l in the equation $l = ct$ is a Distance. This mistake in the hypercone derivation has gone undetected because the statement where Einstein defines *light-time*, appears to be a simple substitution for convenience. In fact, when one mistreats c as a constant scalar rather than as a constant Velocity, this substitution mistake will go undetected.

Einstein's subsequent use of light-time, which is a Distance, as if it were a Time invalidates his derivation. Thus, we have shown that Relativity theory cannot be derived using either of the two geographic shapes Einstein asserts are created. Correcting the problems identified in Einstein's derivations leads to moving system theories that, for several experiments, produce more accurate results than the equations associated with Relativity theory [13, 14, 15, 16, 17].

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