Reframing Special Relativity in Distance-Based Terms: A Testable Prediction on Aging and Decay

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Abstract

We propose a reformulation of Special Relativity in which time is not a fundamental dimension but a derived effect of movement through space. This hypothesis builds upon the foundational works of Einstein (1905) and Minkowski (1908) but challenges the assumption that time dilation represents a fundamental warping of time. Instead, we reinterpret time dilation as a function of velocity-dependent distortions in distance measurement, aligning with the principles of Lorentz transformations (Lorentz, 1904).

By reframing time dilation in purely spatial terms, we propose that biological aging and decay rates should correlate with spatial traversal rather than elapsed time. This idea is testable: if decay rates in high-velocity systems are measured relative to distance traveled rather than time elapsed, they should still match relativistic expectations.

Previous experiments, such as Rossi & Hall (1941) and Bailey et al. (1977), have confirmed relativistic time dilation by measuring muon decay rates at high velocities. However, these studies implicitly assumed time as the controlling variable. We propose an experiment using particle accelerators and high-speed biological samples to test whether decay rates can be fully described by spatial traversal alone, providing an alternative interpretation of relativity.

1. Introduction

1.1 The Problem with Time as a Fundamental Dimension

Traditional relativity, as formulated by Einstein (1905), treats time as an independent variable that dilates with motion.

However, time is never measured directly, it is inferred from movement (Bailey et al., 1977).

The idea that time “flows” has never been independently verified; we only observe motion-based effects that are interpreted as time dilation.

1.2 Core Hypothesis: Time is Not Fundamental, It’s a Measurement Effect

If time is merely a function of distance traveled, then relativistic time dilation should be explainable purely in terms of spatial transformations (Lorentz, 1904; Bell, 1987).

The twin paradox, where a traveling twin ages slower, should be reinterpreted as biological decay being affected by motion through space rather than a fundamental slowing of time (Barbour, 1999).

2. Reformulating Special Relativity Without Time

2.1 The Traditional Form of Time Dilation

The standard equation for time dilation in Special Relativity (Einstein, 1905):

$$t' = \frac{t}{\sqrt{1 - v^2/c^2}}$$

Where:

- t' is the dilated time (the time experienced by the moving observer).
- t is the proper time measured by an observer at rest.
- v is velocity.
- c is the speed of light.

2.2 Rewriting in Distance Terms

Since velocity is distance divided by time *($v=d/t$)* , we substitute *($t=d/v$):*

$$t' = \frac{d/v}{\sqrt{1 - v^2/c^2}}$$

which simplifies to:

$$d' = d \cdot \sqrt{1 - v^2/c^2}$$

Key Insight: Instead of "time slowing down," this suggests that velocity alters distance traversal measurements, meaning time dilation is just a distortion in how motion is perceived.

2.3 Length Contraction and the Unification of Time Dilation

Special Relativity also predicts length contraction (Lorentz, 1904):

$$L' = L \cdot \sqrt{1 - v^2/c^2}$$

If both effects come from the same transformation factor, this suggests that time dilation is simply the inverse of length contraction (Bell, 1987).

Conclusion: Time dilation and length contraction are actually the same phenomenon, just different perspectives of distance-based measurement distortions.

3. Testable Prediction: Aging & Decay as a Function of Distance Traversed

3.1 The Twin Paradox Reinterpreted

In standard relativity, a traveling twin ages slower due to time dilation (Bailey et al., 1977).

Our model predicts that biological aging and decay rates are not dependent on time at all, but instead on the total distance traveled relative to a stationary observer.

Instead of asking, "How much time has passed?", we should ask, "How much distance has been traversed?"

3.2 Experimental Hypothesis

New Prediction: If decay rates in high-velocity systems are measured as a function of distance traveled rather than time elapsed, they should still match relativistic expectations.

4. Proposed Experiment to Test the Hypothesis

4.1 Using Particle Accelerators to Measure Decay by Distance Traversed

Current Understanding:

Particles moving at relativistic speeds exhibit longer decay times, traditionally interpreted as time dilation (Rossi & Hall, 1941).

However, all previous measurements assumed time elapsed as the governing factor.

New Experimental Proposal:

Instead of measuring the decay of fast-moving particles over time, we should measure decay as a function of total spatial distance traveled.

If time is just a function of distance, then decay rates should correlate perfectly with distance traversed, regardless of time elapsed.

4.2 Biological Experiment: High-Speed Cellular Decay in Spaceflight

If this effect is not limited to particles but also applies to biological systems, then a high-speed biological sample (e.g., cell cultures in spaceflight) should exhibit:

Extended lifespan based on total distance traveled, not time.

Decay rates that match relativistic predictions but are calculable solely using distance.

If confirmed, this would provide direct biological evidence that time is just a measurement effect of motion.

5. Implications and Further Research

5.1 If Our Prediction is Confirmed

Time is not an independent dimension; it is a perception effect of spatial traversal.

All physics equations relying on time should be reformulated in purely distance-based terms.

The speed of light is not a velocity, it is the fundamental traversal rate of space itself (Smolin, 2013).

5.2 Future Research Directions

Reanalyzing General Relativity in this framework (Einstein, 1915).

Examining gravitational redshift as a distance measurement distortion.

Testing whether quantum mechanics contains hidden distance-based effects that appear time-dependent (Barbour, 1999).

6. Conclusion

We propose that time is not fundamental, but rather a measurement effect derived from spatial traversal.

We predict that decay rates, instead of being time-dependent, should be a function of distance traveled.

We outline an experimental method to test this using both particle physics and biological decay studies.

If validated, this theory could fundamentally change our understanding of relativity and time itself.

If confirmed, this could mark a paradigm shift in physics.

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