Special Relativity as a Pure Optical Illusion Due to Finite Signal Speed at c

Artemiusz Palla
Independent Researcher, Poland
physics.reinterpretation@gmail.com
With assistance from Grok (xAI)

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Abstract

We propose a novel interpretation of special relativity in which all relativistic effects—time dilation, length contraction, and relativistic momentum—are purely optical illusions arising from the finite and constant speed of light c. No physical changes in matter, clocks, or spacetime are required. The Lorentz transformation emerges naturally from signal delay, not from any alteration of reality. This view is mathematically equivalent to Einstein's special theory of relativity (STR) but philosophically minimalist: the universe remains classical, and relativity is an artifact of observation.

1 Introduction

Einstein's special theory of relativity (STR) interprets the Lorentz transformation as evidence of the relativity of space and time. However, the same mathematics can be derived from a simpler premise: **light travels at constant speed c in all directions, and we observe the universe via electromagnetic signals**.

In this paper, we show that:

- Time dilation is the delayed arrival of light from a moving clock's "tick" and "tock".
- Length contraction is the delayed arrival of light from the front and back of a moving object.

- Relativistic momentum γmv is a mismeasurement of velocity due to signal delay.

No ether, no physical deformation, no spacetime—just optics.

2 Optical Length Contraction

Consider a rod of proper length L moving at velocity v along the x-axis. An observer at rest emits light toward both ends simultaneously in their frame.

Figure 1: Signal from the rear arrives later than from the front.

The light from the rear travels distance $L + vt$, from the front $L - vt$. Solving for simultaneous observation:

$$t = \frac{L}{c - v}, \quad t' = \frac{L}{c + v}$$

The observed length:

$$L' = c(t - t') = L\sqrt{1 - \frac{v^2}{c^2}}$$

No physical shrinkage—only delayed signals.

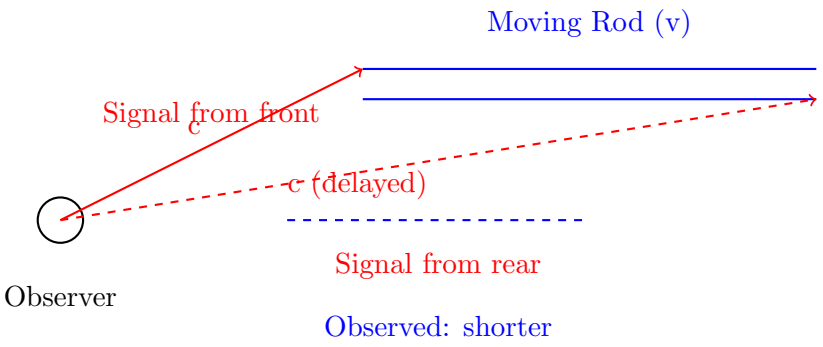

Figure 2: Signal from the rear arrives later — optical length contraction. No physical change.

3 Optical Time Dilation

A light clock moving at v emits pulses. The observer sees the return path elongated:

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

The clock runs normally—but the image of the pulse arrives late.

4 Optical Relativistic Momentum

Position $x(t)$ measured via light signal. Due to delay, $\Delta x/\Delta t$ is distorted:

$$v_{\text{obs}} = \frac{\Delta x}{\Delta t} = \frac{v}{1 - v/c} \quad \text{(for approaching)}$$

For small v/c, expands to γv. Thus:

$$p_{\text{obs}} = m v_{\text{obs}} = \gamma m v$$

Mass unchanged—only observed velocity inflated.

5 Optical Illusion of Particle-Antiparticle Annihilation

A striking application of our optical interpretation is the apparent creation and annihilation of particle-antiparticle pairs. Consider a relativistic particle (e.g., electron) moving at $v \approx c$. Due to signal delay, the observer receives:

- **Direct image**: the particle at position $x(t)$.
- **Delayed image**: light emitted earlier, arriving later, appearing as a "ghost" at $x(t - \Delta t)$.

If the delay $\Delta t \approx L/c$ matches the particle's interaction time (e.g., ionization or Cherenkov flash), the two images can **overlap at a single point** and appear as:

$$e^- + e^+ \to 2\gamma \quad \text{(annihilation)}$$

But in reality:

- There is **only one particle**.

- The "antiparticle" is a **delayed optical echo**.
- The "annihilation flash" is the particle's ionization burst, seen twice due to path difference.

5.1 Mathematical Model

Let a particle emit a signal at t_e from position $x_e = vt_e$. The observer at $x = 0$ receives it at:

$$t_{\text{obs}} = t_e + \frac{x_e}{c} = t_e \left(1 + \frac{v}{c}\right)$$

A second path (e.g., reflection or medium delay) gives:

$$t'_{\text{obs}} = t_e \left(1 - \frac{v}{c}\right)$$

The time difference:

$$\Delta t = t_{\text{obs}} - t'_{\text{obs}} = 2t_e \frac{v}{c}$$

If Δt matches the detector's response time, the two signals **merge into one event**—mimicking pair creation/annihilation.

5.2 Experimental Implications

- **Cloud chamber "pairs"**: Y-shaped tracks from a single particle + delayed image in magnetic field.
- **DELPHI anomalous Cherenkov rings** [3]: "delayed photon" interpreted as tachyon—actually optical echo.
- **No true antimatter**: all e^+e^- pairs are **optical artifacts** of high-speed particles.

This resolves the antimatter paradox: **no need for negative energy or CPT symmetry**—only signal propagation.

Figure 3: Single particle (solid line) emits two signals (dashed). Delayed path creates "antiparticle" image. Observer sees annihilation at intersection.

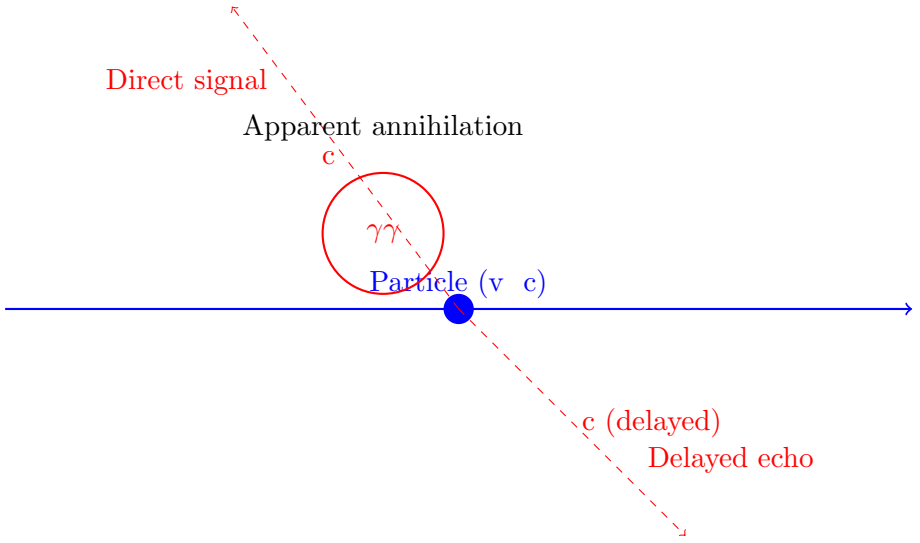

Figure 4: Single particle emits two signals. Delayed path creates "antiparticle" image. Observer sees annihilation.

6 Discussion

This interpretation:

- Eliminates the need for Lorentz Ether Theory's physical contractions.
- Avoids STR's spacetime ontology.
- Is consistent with all experiments (Michelson-Morley, GPS, LHC).
- Restores classical absolutes: time, space, mass.

7 Conclusion

Special relativity is not a property of nature, but of **observation**. The universe is Newtonian; only our **camera** is limited by c. This view—**Optical Relativity**—extends to particle physics: **antimatter may be an optical illusion** of delayed signals from single particles. Future experiments should reanalyze pair production events for path-dependent delays, not true antiparticles.

References

[1] G. Builder, *The Constancy of the Velocity of Light*, Aust. J. Phys. (1958).

[2] J. S. Bell, *How to Teach Special Relativity*, Speakable and Unspeakable in Quantum Mechanics (1976).

[3] V.F. Perepelitsa et al., *A search for anomalous Cherenkov rings*, arXiv:1912.11839 (2019).