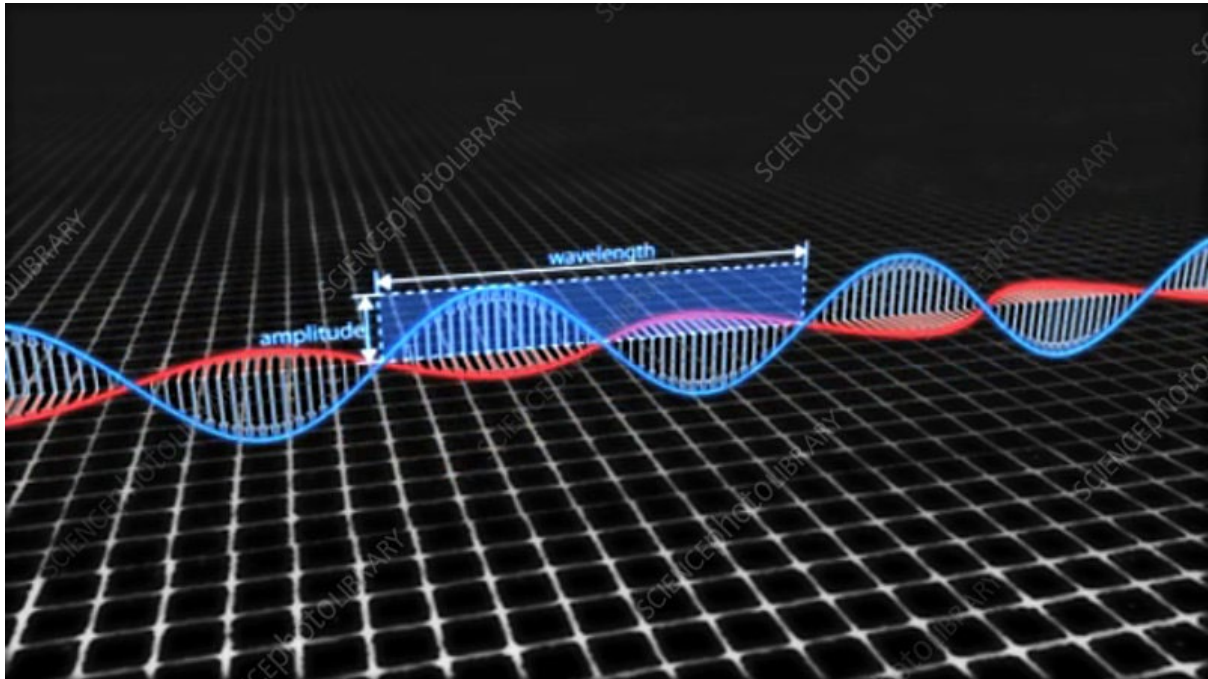


# If Light Does Not Travel: A Skeptical Argument Against Classical Velocity in Special Relativity Theory

*Joseph Wayne Smith and N. Stocks*



(SPL, 2026)

## 1. The Provocation

Richard Feynman once proposed that *light does not travel* (Feynman and Hibbs, 1965). Taken at face value, the claim seems absurd. We measure the speed of light, watch laser beams propagate, and time photon arrivals to extraordinary precision. Special Relativity Theory (SRT), in particular, is built around the invariance of light's velocity in vacuum (Einstein, 1952). How could a theory so successful rest on something that does not, in any literal sense, move?

The answer, we suggest, is that SRT quietly assumes a classical ontology of light propagation that quantum mechanics (QM) explicitly denies (Born, 1962; Angel, 1980; Ray, 1991). The success of SRT masks a deep conceptual tension: it treats light as if it has a well-defined spacetime trajectory, while QM insists that no such trajectory exists. Once this is acknowledged, the notion of light having a *strict velocity* becomes philosophically unstable.

## 2. SRT and the Classical Picture of Motion

SRT inherits its basic kinematical concepts—worldlines, velocities, intervals—from classical mechanics. A particle is assumed to occupy a determinate position at each time, yielding a continuous path through spacetime. Velocity is then defined in the usual way: distance traversed divided by elapsed time.

Light enters SRT through Einstein's second postulate: the speed of light in vacuum is the same in all inertial frames. Although photons were not yet fully understood in 1905, the theory treats light operationally as something that *propagates* along null lines—idealized trajectories at 45 degrees in Minkowski diagrams. The geometry of spacetime itself is calibrated using these light paths.

This picture works remarkably well at the macroscopic and operational level. But it presupposes something crucial: that there *is* a path to speak of.

## 3. Quantum Mechanics and the Non-Existence of Paths

Quantum electrodynamics rejects this presupposition outright. Photons do not follow single, determinate trajectories. In the path-integral formulation, a photon explores all possible paths between emission and absorption, with each path contributing a probability amplitude; this position is not beyond criticism, but it is widely accepted in the QM community. The classical straight-line path is not fundamental; it merely dominates because nearby paths interfere constructively.

Crucially, there is no fact of the matter about *which path the photon took*. Indeed, the very question is meaningless within the formalism. Without a definite position as a function of time, there is nothing to differentiate—no worldline, no instantaneous velocity.

What emerges experimentally is not motion in the classical sense, but a statistical regularity linking emission and detection events. The appearance of propagation is an emergent phenomenon, not an ontological one.

## 4. Velocity Without Motion?

Velocity, strictly defined, presupposes motion along a path. But if light has no path, then its velocity cannot be a property of an object in motion. At best, it is a parameter extracted from correlations between events.

From this perspective, the “speed of light” is not the speed of anything. It is a conversion factor between spatial and temporal intervals in spacetime

measurements—a structural constant of our description, not a dynamical property of a moving entity.

SRT thus appears to rest on a subtle equivocation. Operationally, we measure distances and times using light signals. Ontologically, however, the theory quietly treats these signals *as if* they were classical trajectories, even though QM tells us they are not.

## 5. Quantum Mechanics' Conflict with Special Relativity

The realization that light does not "travel" in a classical sense poses a significant challenge to the Special Theory of Relativity. While relativity treats the speed of light,  $c$ , as a fundamental constant of the universe—a cosmic speed limit for objects moving through space—quantum electrodynamics suggests that this velocity is merely a statistical artifact of probability interference. Thus, the illusion of  $c$ :

**A Geometric Constraint vs. Statistical Outcome:** In relativity,  $c$  is a geometric property of spacetime; however, if light is actually a "cloud of possibilities" rather than a particle in motion, then the very concept of a "velocity" becomes an inadequate description of reality.

**The Path Problem:** Relativity relies on the "world line" of a photon—a single, predictable path through Minkowski space. QED reveals that photons follow all possible paths simultaneously, rendering the idea of a single trajectory a "classical fantasy."

**Emergent Causality:** If the motion we observe is an "emergent narrative" imposed by our perspective, the rigid causal structures of relativity may be built upon a convenient fiction rather than an intrinsic feature of the vacuum.

By treating light as a network of connections between events (emission and absorption) rather than an object traversing a distance, the "speed of light" is transformed. It is no longer the speed of a "thing" hurtling through a vacuum, but the shadow cast by a quantum cloud of possibilities. This metaphysical shift suggests that our most successful theory of space and time—Special and General Relativity Theory—may be a macroscopic approximation of a far less linear and less tangible reality.

## 6. Emergence and Illusion

One might reply that SRT never claimed to describe quantum ontology. Fair enough. But the problem is not merely one of scope. The very foundations of SRT—its

geometry, its simultaneity structure, its invariant intervals—are defined using lightlike paths. If those paths are not ontologically real, then the geometric picture is at best instrumental.

The velocity of light, on this view, is an emergent statistical artifact: the shadow cast by quantum interference patterns when averaged over many events. It is stable, universal, and extraordinarily useful—but it is not the velocity of a particle traversing space.

## 7. The Relativist Replies — and Fails

At this point the orthodox relativist objects. *SRT is not an ontological theory*, we are told. It makes no claims about what photons “really are.” It is merely a framework for coordinating measurements. Quantum mechanics, on this view, is simply irrelevant to SRT’s kinematics.

This reply is evasive. SRT does not merely *use* light operationally; it privileges light in a way no other physical process enjoys. Light defines simultaneity, calibrates rulers and clocks, and fixes the causal structure of spacetime itself. To then retreat and claim ontological agnosticism is to enjoy all the metaphysical benefits of classical motion while denying metaphysical responsibility for them.

Worse, the reply quietly smuggles in the very ontology it disavows. Minkowski diagrams are not drawn with clouds of probability amplitudes; they are drawn with null worldlines. The entire geometric apparatus presupposes determinate lightlike trajectories, even if the theorist insists these are “just calculational.” A calculation that systematically misrepresents the ontology of its central entity is not neutral—it is misleading.

A second line of defence appeals to emergence. Yes, photons lack paths at the quantum level, but classical trajectories emerge in the macroscopic limit, and SRT concerns only that limit. This too fails. The invariant speed of light is not a macroscopic approximation; it is exact, universal, and foundational. One cannot both say that light’s trajectory is an emergent fiction and insist that its velocity is a fundamental constant. Either the ontology is classical enough to support exact kinematics, or it is not.

## 8. The Deeper Skeptical Wound

The real problem is that SRT quietly relies on a classical surplus structure it has no right to. It treats light as if it instantiates motion without mass, position without

localisation, and velocity without trajectory. Quantum mechanics removes the ladder SRT climbed to its success, but SRT continues to stand as if nothing has happened.

This is not a mere technical inconsistency; it is a conceptual one. The speed of light functions less like a physical velocity and more like a conversion constant between space and time units—akin to Boltzmann’s constant in statistical mechanics. Useful, indispensable, but not descriptive of motion.

Once this is recognised, the metaphysical triumphalism often attached to SRT evaporates. The theory works because it encodes stable regularities in measurement outcomes, not because it has correctly identified the fundamental behaviour of light.

## 9. Velocity Without Travellers

Feynman’s remark should therefore be taken with full literal seriousness. Light does not travel on this position—not because experiments are wrong, but because the classical concept of travel does not apply. There is no path, no position as a function of time, and therefore no strict velocity in the classical sense.

SRT remains empirically spectacular, but ontologically parasitic. It borrows the language of classical motion while relying on a quantum world that refuses to supply the corresponding entities. The speed of light is not the speed of anything. It is the residue of a classical picture the quantum formalism has already destroyed.

To continue speaking otherwise is not realism, but nostalgia.

## 10. Symmetry Without Ontology: Lorentz Invariance Revisited

A final relativist manoeuvre appeals to Lorentz invariance itself. Whatever one thinks about photons, the symmetry structure of SRT is said to be deep, objective, and ontologically committing. Spacetime simply *is* Minkowskian, and the invariance of light’s speed reflects this fact.

But symmetry is cheap. Lorentz invariance constrains equations; it does not conjure entities. One can impose Lorentz symmetry on a theory whose basic ontology contains no trajectories at all. Indeed, modern quantum field theory does exactly this. The symmetry survives while the classical picture of motion evaporates.

To infer ontology from symmetry is therefore a mistake. It is to confuse mathematical elegance with metaphysical depth. SRT’s spacetime geometry encodes stable regularities in measurement outcomes, not the literal behaviour of things

moving through space. Lorentz invariance is a constraint on descriptions, not a revelation about what fundamentally exists.

## 11. Humean Regularities and Relativistic Modesty

Seen clearly, SRT aligns far more naturally with a Humean picture than its realist advocates admit. The theory systematises regularities among observable events—clock readings, ruler coincidences, signal correlations—without grounding them in robust underlying mechanisms.

The invariance of the speed of light thus functions as a *lawlike regularity*, not as a causal fact about photon motion. It tells us how measurement outcomes covary, not what light is doing between emission and absorption. SRT's success consists precisely in its indifference to ontology.

This is not a defect insofar as it is acknowledged. The defect arises when instrumental success is inflated into metaphysical insight. SRT does not reveal the deep structure of reality; it codifies the patterns we observe while remaining silent—wisely—about what, if anything, underwrites them.

## 12. The Final Verdict

Once quantum mechanics is taken seriously, really seriously, the classical image of light racing through space at a fixed speed  $c$ , cannot be maintained. There are no light paths, no worldlines, and therefore no literal velocities. What remains is a powerful, elegant framework for organizing experience—nothing more, and nothing less.

Special Relativity Theory endures not because it describes how light really moves, but because it does not need to. Its central constant is not the speed of anything. It is the mathematical fossil of a classical intuition that physics has otherwise outgrown.

## REFERENCES

(Angel, 1980). Angel, R.B. *Relativity: The Theory and its Philosophy*. Oxford: Pergamon Press.

(Born, 1962). Born, M. *Einstein's Theory of Relativity*. New York: Dover.

(Einstein, 1952). Einstein, A. *Relativity: The Special and General Theory*. New York: Crown.

(Feynman and Hibbs, 1965). Feynman, R. and Hibbs, A.R. *Quantum Mechanics and Path Integrals*. New York: McGraw-Hill.

(Ray, 1991). Ray, C. *Time, Space and Philosophy*. London: Routledge.

(SPL, 2026). Science Photo Library. "Light Wave Structure." Available online at URL = <https://www.sciencephoto.com/media/395790/view/light-wave-structure>.