Relativity, Induction, and the Unknown Laws: A Skeptical Problem for Einstein's First Postulate of Special Relativity

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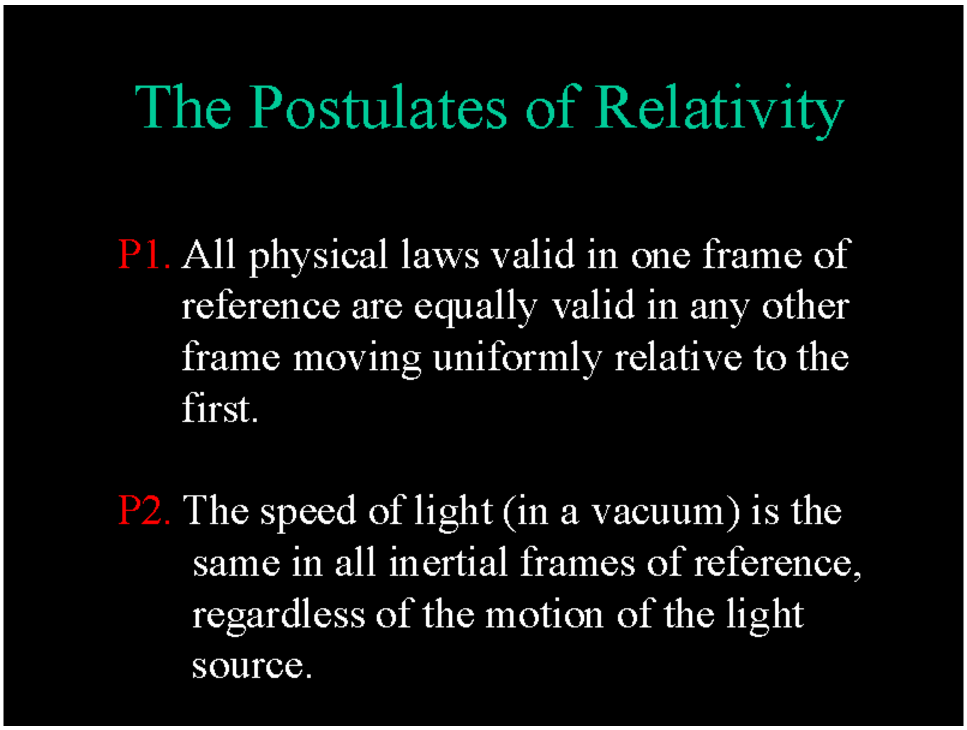

(Gardner, 2026)

1. Introduction

Einstein's first postulate of special relativity—that the laws of physics are identical in all inertial frames—is routinely presented as an empirically grounded principle (Einstein, 1905). In this essay, we argue that such a presentation is epistemologically indefensible. The postulate asserts a universal invariance over an open-ended and unknowable set of physical laws, thereby exceeding the limits of inductive justification in a manner more extreme than that identified by Hume (Hume, 1748/2000). Far from being inferred from experience, the principle functions as a methodological constraint on admissible laws, enforced retrospectively through reformulation and exclusion. Drawing on Humean skepticism and engaging with contemporary philosophy of science, we argue that the first postulate is neither known, proven, nor empirically warranted, but instead survives as a regulative principle sustained by symmetry commitments and post hoc success.

Special relativity emerges not as an inductive triumph, but rather as a case study in the replacement of epistemic justification with mathematical authority.

2. The Myth of Empirical Grounding

The first postulate of special relativity is often introduced with a rhetorical sleight-of-hand. Students are told that it merely generalizes Galileo's principle of relativity and codifies experimental facts. This is false.

Einstein's claim is not that some laws appear invariant under changes of inertial frame. It is that *all* laws of physics, without exception, are invariant under such transformations (Einstein, 1905). The scope of the claim is total, unrestricted, and modal. It applies equally to laws not yet discovered, not yet tested, and not yet conceivable.

No finite body of experimental evidence can possibly support such a claim. To present it as empirically motivated is therefore not merely misleading, but epistemically incoherent.

3. Induction Beyond its Breaking Point

Hume showed that induction cannot justify universal generalizations about unobserved cases (Hume, 1748/2000). The first postulate of special relativity goes further: it generalizes over *unknown theoretical entities*.

To infer that all physical laws are Lorentz-invariant, one would need: (i) knowledge of all physical laws, and (ii) independent confirmation that each respects frame invariance. Neither condition is remotely satisfied. Physics does not possess a closed set of laws, nor any principled reason to believe it ever will. Effective field theories, regime-dependence, and theory replacement are not anomalies; they are the norm (Norton, 2003).

Thus, the postulate does not merely rely on induction—it presupposes its success for domains in which induction cannot even get started.

4. The Unknown Laws Problem and Unconceived Alternatives

The decisive difficulty is this: the first postulate quantifies over laws that do not yet exist as epistemic objects. One cannot check invariance for laws that are unknown. One cannot even meaningfully assert invariance for laws that may overturn current ontology.

This problem resembles, but extends beyond, Stanford's problem of unconceived alternatives (Stanford, 2006). Stanford showed that the history of science is littered with empirically adequate theories later displaced by alternatives not even conceived at the time. Our argument is structurally similar but more focused: the first postulate claims to know properties of *future* fundamental laws—laws that might employ concepts, symmetries, or ontologies utterly alien to current physics.

The response that “future laws must respect Lorentz invariance” simply restates the postulate as a rule of admissibility. It does not justify it. It converts a factual claim about the world into a normative constraint on theory construction. This is not empirical physics. It is methodological legislation.

Yet this is precisely where defenders retreat: to the claim that Lorentz invariance functions not as an empirical discovery but as a *regulative principle*—a methodological commitment that structures research without asserting necessity. This retreat, however, does not resolve the skeptical challenge; it merely relocates it. We address this response in section 7.

5. Circularity and Theory Selection

The historical record reveals a troubling pattern: laws inconsistent with Lorentz invariance were not straightforwardly refuted by experiment. They were reformulated, restricted, or excluded from consideration.

Consider the early development of quantum field theory. Initial attempts at relativistic quantum electrodynamics encountered infinities and inconsistencies. Rather than entertaining Lorentz-violating alternatives as live possibilities, physicists took for granted that the correct theory must be Lorentz-invariant and renormalizable. The development of renormalization techniques enforced these constraints as prerequisites for theoretical acceptability (Brown, 2005; Schweber 1994).

More recently, consider quantum gravity phenomenology. When quantum gravity effects are explored at accessible energies, Lorentz-violating scenarios are indeed tested—but only as *parameterized deviations* from the standard model, using frameworks like the Standard-Model Extension (SME) (Kostelecký and Russell, 2011). These tests constrain possible violations to extraordinarily small levels. Yet the very structure of such tests assumes Lorentz invariance as the null hypothesis and background framework. Violations, when searched for, are perturbative corrections—not fundamental reconceptualizations of spacetime symmetry.

The circular structure of this reasoning is self-evident: (i) only Lorentz-invariant laws are taken seriously as candidate fundamental theories, (ii) all surviving fundamental theories are Lorentz-invariant. This is not discovery through elimination. It is selection by methodological fiat.

That this strategy has been empirically fruitful is undeniable. But empirical fruitfulness within a methodologically constrained space does not vindicate the constraint itself. It only shows that, among theories we have allowed ourselves to consider, some have worked well.

6. The Proper Skeptical Response

What, then, is the proper philosophical attitude to take toward the first postulate? We must distinguish carefully between what experience supports and what the principle asserts. The evidence supports *local, conditional invariances*—robust regularities within tested regimes, consistent with electromagnetism, particle physics at accessible energies, and null results in aether-drift experiments. These are genuine empirical achievements.

The theory asserts *global, necessary invariance*—extending without exception to all conceivable laws, including those at Planck scales, in regimes of quantum gravity, or in future fundamental theories employing concepts not yet formulated.

The step from one to the other is philosophical inflation, not empirical inference. We can accept the former—indeed, we should celebrate the extraordinary empirical success of relativistic physics—without committing to the latter.

This is the classical skeptical move, articulated by Sextus Empiricus: distinguish between what appears (the phenomena) and what is asserted about underlying necessity (Sextus Empiricus, 1996). We may use special relativity to navigate experimental domains without assenting to the metaphysical claim that nature must conform to its symmetry structure in all possible circumstances.

7. Regulative Principles and the Limits of Methodological Justification

The most sophisticated defense of the first postulate retreats from empirical claims to methodological ones. One might argue that Lorentz invariance functions as a *regulative ideal*—not a claim about what the world must be like, but a principle that structures inquiry and makes systematic knowledge possible (Friedman, 2001).

On this view, the first postulate is a *regulative principle* for modern physics: it defines the framework within which physical theories are formulated and assessed. It is neither true nor false in the ordinary empirical sense, but rather a precondition for the kind of unified, mathematically structured physics we practice.

This defense is more sophisticated than naive empiricism, but it does not escape the skeptical challenge. The problem is that *regulative principles themselves require justification*—and their justification cannot be merely pragmatic.

Consider this question: why adopt Lorentz invariance as a regulative principle rather than some alternative symmetry constraint? Why not Galilean invariance, or no global symmetry requirement at all? The standard answer is that Lorentz invariance has proven empirically superior. But this returns us to the original problem: the evidence supports it *in tested regimes*, not as an absolute methodological commitment for all future physics.

Moreover, treating the first postulate as regulative rather than empirical makes it *unfalsifiable by design*. If apparent violations emerge, they are reinterpreted as incomplete theories or approximations rather than genuine counterexamples. This is the very circularity diagnosed in Section 4, now elevated to a methodological principle.

Harvey Brown's dynamical interpretation of special relativity (Brown, 2005) attempts to ground Lorentz invariance in the contingent behavior of matter and fields rather than in spacetime geometry itself. This reverses the traditional explanatory order: Minkowski spacetime structure is demoted from a fundamental constraint to an emergent consequence of underlying dynamics. Brown argues this makes special relativity more empiricist—contingent on how matter actually behaves rather than a priori geometric necessity.

Yet even this sophisticated approach does not resolve our skeptical worry. Brown's account still treats Lorentz invariance as a *de facto* constraint on admissible fundamental theories: future theories must either exhibit Lorentz invariance dynamically (to match observations) or violate it in ways beyond current experimental reach. The dynamical interpretation relocates the source of invariance, but it does not eliminate the methodological filtering function we have criticized. Theories that would violate Lorentz symmetry in observable ways remain excluded—not by geometric fiat, but by empirical adequacy requirements that themselves presuppose our current experimental regime remains representative of deeper structure.

In short: whether framed as geometric necessity, regulative ideal, or dynamical constraint, the first postulate functions as a methodological filter on the space of admissible theories. And this filtering lacks the epistemic warrant its proponents assume. Success within the filtered space does not justify the filter itself.

8. Symmetry as Ersatz Epistemology

Modern physics increasingly treats symmetry as a surrogate for justification. Lorentz invariance is elevated from an observed regularity to what may be called a "sacred principle." This sanctifying elevation is rarely argued for; instead, it is merely assumed.

Symmetry is not observed in the way length or charge is observed. It is a property of mathematical representations of theories. When we say that electromagnetic theory is Lorentz-invariant, we mean that the Maxwell equations retain their form under Lorentz transformations. This is a fact about the mathematical structure of the theory, not a directly measured property of nature.

Of course, theories with certain symmetries make predictions that can be tested. And the experimental success of relativistic theories is impressive. But this success justifies using those theories in tested regimes—not treating their symmetry structures as metaphysically necessary constraints on all possible physics.

The danger is subtle: once symmetry principles become methodologically entrenched, physics risks prioritizing mathematical elegance over empirical openness. Theories are judged not primarily by how well they fit observations, but instead by whether they conform to preferred symmetry structures. This inverts the proper relationship between mathematics and empirical content.

9. What Would Warrant the First Postulate?

A critic might object: if no evidence could satisfy us, then isn't our skepticism unfalsifiable and therefore empty?

Not quite. We can specify what would constitute genuine warrant, even if such warrant is unlikely to be achieved, in three ways.

First, genuine warrant would require *closure*: a demonstration that physics has identified all fundamental laws, or at least operates within a framework where no conceptually revolutionary alternatives remain possible. This is extraordinarily implausible given the history of physics.

Second, genuine warrant might come from *a priori derivation*: showing that Lorentz invariance follows necessarily from more primitive principles of rationality, consistency, or the possibility of objective knowledge. Some have attempted such derivations (e.g., Mittelstaedt, 1980), but they invariably smuggle in substantive physical assumptions that themselves require empirical justification.

Third, pragmatic warrant might accumulate over time: if Lorentz invariance continues to structure successful theories across wider domains—including quantum gravity and cosmology—without exception, and if alternatives consistently fail, the methodological constraint gains inductive support. But this remains hostage to future developments and does not justify presenting the postulate as already established.

Our skepticism is not that genuine warrant is impossible in principle. It is that warrant sufficient to support the universal, modal claims of the first postulate has not been achieved—and likely cannot be achieved through ordinary empirical means.

10. Conclusion: Relativity Without Relativistic Dogma

Special relativity remains one of the most powerful calculational frameworks in modern physics. Nothing in this paper challenges its technical success or practical utility. What we challenge is the casual slide from success to certainty—the tendency to treat a successful methodology as a metaphysical discovery.

Einstein's first postulate is not known to be true. It is not inductively justified. It is not empirically grounded in any way that would support its universal, modal scope. It is a regulative principle that has proven remarkably useful within tested domains—but one that functions simultaneously as a methodological filter on what theories we take seriously.

To acknowledge this is not to undermine physics. It is to recognize the difference between (i) *well-confirmed regularities* and (ii) *necessary truths*—between using a principle to organize successful inquiry, and believing that nature must conform to it. Physics has never needed metaphysical guarantees to progress. It has only needed careful observation, mathematical creativity, and *epistemic humility*.

The proper philosophical attitude toward the first postulate is neither belief nor rejection, but self-disciplined skepticism: recognition of its empirical successes combined with awareness of the limits of our justification. This is not a weakness but a strength: the acknowledgment that our best theories remain human constructions, powerful but provisional, tested but not transcendent.

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