Laws as Bygone Glory

Toward a Context-Sensitive Physics

J. Konstapel, Leiden, 25-7-2026

A synthesis essay and personal framework — a way of reading a century of physics, mathematics, and philosophy as pointing toward one conclusion: that what we call "laws of nature" are not eternal truths but context-bound regularities, and that the deepest context of all is a vacuum that is fractal to its core.

I. The Forgotten Context

Science begins with observation. Every experiment, every measurement, every equation rests ultimately on an observation made by someone, somewhere, under particular physical conditions. There is no observation without an observer, and there is no observer without a physical environment.

This statement appears trivial. Yet modern physics has quietly set it aside. The remarkable success of mathematical physics encouraged a shift in status: equations that originally summarized particular observations, taken under particular circumstances, came to be treated as descriptions of reality itself. What began as local regularities came to be read as universal necessities. Whether that shift was warranted, or only convenient, is the question this essay returns to.

In 1887, Michelson and Morley attempted to detect the Earth's motion through the "luminiferous ether" and found no measurable effect. Hendrik Lorentz was the last major physicist who still attempted to explain the measurement by referring to the observer's physical environment rather than treating the observer as an abstract coordinate: objects moving through the ether contract along their direction of motion, so what an observer measures depends on that observer's physical relationship to the surrounding medium. The ether itself, however, was never given an independently measurable property beyond the one effect it was invoked to explain — density, composition, and structure were left unspecified.

In 1905, Einstein no longer required a physical medium as part of the fundamental description, and treated the constancy of the speed of light as a postulate holding for every observer, in every environment, without exception. From that point, the observer's physical context — where they stood, what surrounded them, what medium they moved through — dropped out of the fundamental description of light and motion, replaced by a coordinate label with no physical content of its own.

The decisive abstraction was therefore not the Lorentz transformation itself. It was the abstraction of the observer. A physical observer embedded in a particular environment became an ideal observer whose physical surroundings no longer entered the theory. Context disappeared, while the mathematical relation remained.

A parallel narrowing took place in the mathematics used to describe electromagnetism. Maxwell's original equations, developed with the aid of quaternions, retained a structure — scalar and vector bound together — that carried more relational information than the field equations that eventually replaced it. Oliver Heaviside reformulated Maxwell's twenty equations as four vector equations, a simplification that became the standard teaching form after a public debate with Tait in the pages of Nature. What that simplification set aside went largely unexamined for a century, until physicists such as Peter Rowlands began deliberately reconstructing the algebraic structure it had removed.

Both developments share the same methodological move: replacing physically structured descriptions with mathematically invariant ones. In one case the observer lost its physical environment; in the other, the field lost part of its algebraic structure. Different problems, the same direction of abstraction — a direction that, across the physics of this period, ran consistently from context toward invariance: absolute space, the ether, and preferred physical frames were each, in turn, set aside in favor of formulations built from idealized, context-free observers. Whether anything of value was lost in that exchange — not error, but an unexamined cost — is the question this essay is built to reopen, not to settle by assumption in either direction.

II. What the Vacuum Already Told Us: Sakharov and Volovik

Andrei Sakharov's 1967 theory of induced gravity reopened a door the Lorentz-to-Einstein handoff had closed. Sakharov proposed that gravity is not a fundamental force at all, but a macroscopic byproduct of quantum field fluctuations in the vacuum. Newton's constant G falls out of the calculation not as an input but as an output, determined by which quantum fields happen to populate the vacuum and how they respond to curvature. Change the field content, and G changes with it. Gravity is not imposed on spacetime from outside; it is a local property of the medium.

Grigory Volovik extended this into a full research program: Superfluid Vacuum Theory. The vacuum behaves as a quantum liquid — modeled on the superfluid phase of Helium-3. Lorentz invariance itself turns out, in Volovik's framework, to be an emergent, low-energy property of this underlying fluid. Push toward higher energy, closer to the fluid's own microscopic scale, and Lorentz invariance stops holding. What looked like an eternal law is a local habit of a medium in a particular regime — precisely the kind of specific, mechanistic account Lorentz's own ether never became.

III. Matter as Structure: Williamson, van der Mark, and Rowlands

If gravity dissolves into a medium property, the particles inside that medium cannot be exempt. In 1997, Williamson and van der Mark proposed that the electron is not a point particle but a photon confined into a toroidal structure by two rotations per wavelength — reproducing spin, relativistic mass corrections, and the electron's characteristic internal oscillation. What looks like an elementary, structureless particle turns out to be a self-organizing pattern of light — a knot, not a point.

Peter Rowlands' nilpotent quantum mechanics goes further, deriving mass, charge, spin, and the Dirac equation from a self-referential algebraic process — explicitly recovering the richer, quaternion-adjacent structure Heaviside discarded. Both programs share the same spirit as Sakharov and Volovik: what looks like a fixed, external law is an emergent consequence of a deeper, self-organizing process.

IV. The Ungraspable: Spencer-Brown, Kauffman, and the Tao

Every account so far still risks the same trap that caught Lorentz: reaching for a placeholder — a medium, a substrate — and treating it as if naming it were the same as understanding it. Louis Kauffman's work, following George Spencer-Brown's Laws of Form, refuses that trap from the start.

Spencer-Brown begins with nothing but a single instruction: draw a distinction. Not a particle, not a field, not a spacetime — only the primitive act of separating an inside from an outside. Kauffman shows that when such a distinction is allowed to re-enter itself — to refer back to its own act of distinguishing — it generates oscillation, and oscillation generates the recursive structures (iterants, eigenforms) from which stable form can arise. An eigenform is a solution to $X = F(X)$: a thing that is produced by its own process of being observed, rather than a fixed object waiting to be found.

This is where Kauffman reaches for the Tao Te Ching's opening image: the Tao that can be named is not the eternal Tao. What is most fundamental is not capturable as a static object or a fixed postulate — it can only be pointed at through the process that keeps generating it. This is not vagueness in the sense Lorentz's ether was vague — an empty placeholder nobody could specify. It is a different kind of precision: the recognition that the ground of things is a process, not a thing, and that trying to freeze it into a named substance (an ether, a postulate, a particle) is exactly the move that produces false eternal laws in the first place.

This gives the present framework something Lorentz's ether never had and Einstein's postulate never wanted: a foundation that is rigorous without being static — self-generating structure in place of either a vague medium or a bare axiom.

V. The Fractal Vacuum

Pulling these threads together: if particles are windings (Williamson–van der Mark), and if the ground of things is recursive, self-referential process rather than a fixed substance (Spencer-Brown/Kauffman), then there is no principled reason for the winding to stop at one level. A winding built from a self-referential process should, at smaller scale, be built from the same kind of process again — windings within windings, the identical recursive act repeating at every scale it touches.

This is the core of the present thesis: physical laws are context-dependent, and the context is the vacuum itself — a fractal medium, beginning at the smallest conceivable scale and repeating its own generative structure upward, through particles, through fields, through the effective geometry that Sakharov and Volovik showed is itself only a local, emergent habit of that same medium. What we call “the universe” is, on this reading, extremely simple in its essence: one recursive act of distinction, applied to itself without end, whose accumulated windings-within-windings are what we mistake for separate laws governing separate domains.

VI. Conclusion

The twentieth century progressively replaced physical context with mathematical invariance. The resulting theories proved extraordinarily successful, but success does not by itself establish universality. Sakharov and Volovik show, a century later and independent of one another, that a medium-based account of gravity and relativity is not only possible but rigorously workable. Williamson, van der Mark, and Rowlands show the same for matter itself. And Kauffman, reaching back through Spencer-Brown to the Tao, supplies what the earlier medium-based attempts lacked: a way to ground all of this in something that does not need to be named as a fixed substance to be real — only followed as a process that keeps producing itself, at every scale, fractally, all the way down. If the vacuum possesses structure, then what we call physical laws may themselves be emergent regularities of that structure rather than timeless constraints imposed upon it.

Laws, on this reading, were never the eternal truth waiting to be found. They are the visible residue of one recursive, self-generating process, mistaken for something fixed and final. A bygone glory, not because nature ever possessed immutable laws, but because we gradually mistook context-independent descriptions for context-independent reality.

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