Galileo Invariance in Maxwell's Original Treatise: Refuting the Postulates of Special Relativity through the Restoration of Total Field Derivatives

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Abstract

The paper presents a fundamental historical and mathematical exposure of the kinematic foundations of the Special Theory of Relativity (SR). Based on a rigorous analysis of the original text of J. C. Maxwell's Treatise on Electricity and Magnetism (1873, paragraphs 600–601), it is proved that the original equations of the electromagnetic field initially contained total (material) time derivatives and convective field drift operators $(\mathbf{v} \cdot \nabla)$. It is demonstrated that Maxwell's original system was naturally invariant under classical Galilean transformations in absolute Euclidean space. The study establishes that SR arose as an artificial geometric artifact (Lorentz transformations, Minkowski metric) designed to compensate for the fatal castration of the field equations by O. Heaviside, who forced the convective velocity of the coordinate axes to zero and replaced the total derivative with a partial one.

1 Paragraph 600 of Maxwell's Treatise and the Nature of Heaviside's Truncation

In the modern academic mainstream, it is universally accepted that the equations of electrodynamics are fundamentally incompatible with classical Galilean transformations, an assertion that served as the primary catalyst for the creation of SR. However, a direct reference to the original text of J. C. Maxwell's Treatise [Maxwell1873, paragraph 600] completely refutes this relativistic dogma.

In Maxwell's original quaternion notation, the electromotive intensity vector $\mathfrak{E}$ in bodies moving with velocity $\mathfrak{G}$ was defined through the total derivative of the electrokinetic momentum (vector potential) $\mathfrak{A}$ with respect to absolute time t:

$$\mathfrak{E} = V.\mathfrak{G}\mathfrak{B} - \dot{\mathfrak{A}} - \nabla\Psi \tag{1}$$

where the dot over the gothic vector denotes the total (substantial) derivative of Newton–Euler. When projecting onto moving coordinate axes, Maxwell rigorously decomposes the total rate of change of the wave front into local and convective components:

$$\frac{dx}{dt} = \frac{\delta x}{\delta t} + \frac{dx'}{dt} \tag{2}$$

which, when expanded into Cartesian components for the total derivative of the potential, yields a system of differential field drift terms:

$$\frac{dF'}{dt} = \frac{dF}{dx}\frac{\delta x}{\delta t} + \frac{dF}{dy}\frac{\delta y}{\delta t} + \frac{dF}{dz}\frac{\delta z}{\delta t} + G\omega_z - H\omega_y + \frac{\partial F}{\partial t} \tag{3}$$

In modern vector formalism, this convective drift term is identically equal to the hydrodynamic operator of convective field transport by the moving coordinate system: $(\mathbf{v} \cdot \nabla)\mathbf{A}$.

The historical root of the 20th-century relativistic impasse lies in the engineering simplification introduced by O. Heaviside. In his vector modification of the equations, Heaviside forced the convective transport velocity of the axes to zero ($\mathbf{v} = 0$, $\frac{\delta x}{\delta t} = 0$), completely discarding paragraph 600 from the field equations. Maxwell's total derivative $\dot{\mathfrak{A}}$ was thus replaced by the partial derivative of a resting vacuum $\frac{\partial \mathbf{A}}{\partial t}$. Due to this amputation, electrodynamics lost its Galilean covariance, forcing subsequent physicists to deform the metric of space and time.

2 Mathematical Proof of Galilean Invariance via the Substantial Derivative

To clearly demonstrate the artificial nature of relativistic postulates, let us perform a direct algebraic recalculation of the field equations under a classical Galilean transformation to a coordinate system moving with velocity $\mathbf{v}$ along the X-axis:

$$x' = x - vt, \quad y' = y, \quad z' = z, \quad t' = t \tag{4}$$

Within Heaviside's truncated electrodynamics, which operates exclusively with the partial time derivative $\frac{\partial}{\partial t}$, the time operator under substitution (4) transforms according to the chain rule for multi-variable functions:

$$\frac{\partial}{\partial t} = \frac{\partial}{\partial t'} + \frac{\partial x'}{\partial t}\frac{\partial}{\partial x'} = \frac{\partial}{\partial t'} - v\frac{\partial}{\partial x'} \implies \frac{\partial}{\partial t'} - (\mathbf{v} \cdot \nabla) \tag{5}$$

The emergence of the parasitic convective term $-(\mathbf{v}\cdot\nabla)$ destroys the invariance of Heaviside's wave equation. It was precisely this coordinate asymmetry that H. Lorentz and A. Einstein attempted to compensate for by artificially introducing "local time" and spatial contractions, which ultimately led to the fabrication of Minkowski's pseudo-Euclidean space-time.

Instead of this relational patch, let us restore Maxwell's original total material derivative in the field equations (paragraph 600, equation 1):

$$\frac{d}{dt} = \frac{\partial}{\partial t} + (\mathbf{v} \cdot \nabla) \tag{6}$$

Substituting the transformed partial time operator (5) into Maxwell's total derivative (6), we obtain:

$$\frac{d}{dt} = \left[\frac{\partial}{\partial t'} - (\mathbf{v} \cdot \nabla)\right] + (\mathbf{v} \cdot \nabla) \equiv \frac{\partial}{\partial t'} \tag{7}$$

Equation (7) rigorously proves that the convective field drift term $+(\mathbf{v}\cdot\nabla)$ automatically and completely cancels out the Galilean phase shift of the moving reference frame. J. C. Maxwell's original system of equations in Hamilton's quaternion representation possesses natural Galilean invariance. The physical space of the Universe remains strictly Euclidean, and time remains absolute and continuous, which entirely deflates the mathematical necessity for the postulates of Special Relativity.

3 Comparative Analysis: Maxwell's Original vs. Heaviside's Truncated System

To expose the mechanics of the relativistic impasse, let us compare the fundamental equation for the total electromotive force (EMF), which describes field behavior in moving systems, in its modern textbook form versus the author's original version.

In modern textbook literature, the electrodynamics of moving media is traditionally written using the partial time derivative and the local Lorentz force:

$$\mathbf{E} = \mathbf{v} \times \mathbf{B} - \frac{\partial \mathbf{A}}{\partial t} - \nabla \phi \tag{8}$$

This system (8) is fundamentally non-invariant under classical Galilean transformations, since the time variation of the potential $\mathbf{A}$ is rigidly locked to an abstract stationary vacuum.

Using the table of symbols from paragraph 619 of the Treatise [Maxwell1873], let us translate Maxwell's original quaternion equation for moving axes into modern vector formalism:

$$\mathbf{E} = \mathbf{v} \times \mathbf{B} - \frac{d\mathbf{A}}{dt} - \nabla \phi \tag{9}$$

Expanding Newton–Euler's total derivative $\frac{d\mathbf{A}}{dt}$ according to the strict rules of continuous media kinetics yields the substantial Eulerian decomposition:

$$\mathbf{E} = \mathbf{v} \times \mathbf{B} - \frac{\partial \mathbf{A}}{\partial t} - (\mathbf{v} \cdot \nabla)\mathbf{A} - \nabla \phi \tag{10}$$

A comparison of equations (8) and (10) explicitly demonstrates that O. Heaviside completely amputated the fundamental **convective field drift term** $(\mathbf{v} \cdot \nabla)\mathbf{A}$ when forming his truncated vector model.

In the physics of non-equilibrium media, the convective term describes the dynamic transport of the spatial field distribution by the moving coordinate system. The field gradient $\nabla \mathbf{A}$ interacts with the translational mechanical velocity $\mathbf{v}$. The convective term acts as a natural kinematic compensator: under a Galilean coordinate shift, the resulting phase distortion is entirely absorbed and neutralized by Maxwell's operator $-(\mathbf{v} \cdot \nabla)\mathbf{A}$. Thus, Maxwell's original system (10) is natively Galilean, and SR is an artificial consequence of trying to use Minkowski's metric deformations to fix the absence of the convective term in Heaviside's truncated engineering version.

4 Experimental Confirmation of Convective Field Drift in One-Way Experiments

The amputation of the convective term $(\mathbf{v} \cdot \nabla)\mathbf{A}$ by O. Heaviside led to the false postulate of SR regarding the complete isotropy of the velocity of electromagnetic signals in a single direction. However, within the framework of original Maxwellian electrodynamics, when a measuring instrument moves with velocity $\mathbf{v}$, the convective operator of field drift must lead to an observable linear change in the phase and frequency of the moving wave front.

This physical effect of the first order of smallness (v/c) is completely masked and destroyed (compensated) in two-way optical schemes (such as the Michelson–Morley interferometer) due to the superposition of the forward and backward rays upon reflection from mirrors. The physical reality of Maxwell's convective drift was experimentally proven only upon transitioning to mirrorless one-way (one-way) measurement schemes:

1. **In the optical experiments of S. Marinov (1973–1984)** with coupled shutters, a laser beam was passed through a system of spaced rotating disks on a single rigid shaft [Marinov1979]. The apparatus directly recorded a linear phase drift of the wave front, corresponding to the absolute motion of the Solar System at a speed of 362 ± 40 km/s.

2. **In the non-optical experiments of R. De Witte (1991)**, the phase stability of an electronic signal in long coaxial cables was measured [DeWitte1991]. A steady fluctuation of electrical conductivity was recorded with an exact sidereal (stellar) period (23 hours 56 minutes ± 25 seconds).

The fact that the peaks of phase distortions are synchronized not with solar days, but with sidereal time, irrefutably proves that Maxwell's convective term describes a real physical drift of the potential during the Earth's motion through the absolute space of the cosmic medium.

5 Historical Deconstruction of Relativistic Dogma: From Poincaré to Mandelshtam and Landau

Ignoring paragraph 600 of Maxwell's original Treatise [Maxwell1873] led to a century-long tradition of false geometrization of physics. Instead of restoring the convective term $(\mathbf{v}\cdot\nabla)\mathbf{A}$ in the field equations, the mainstream consistently cemented Heaviside's computational compromise, elevating it to the rank of fundamental laws of nature.

5.1 Mathematical Patching by H. Lorentz and A. Poincaré

Primary sources reveal that H. Lorentz (1904) initially predicted a wave shift of fringes based on ballistic concepts of light. Having received a negative result in the Michelson experiment, he did not revise the two-way scheme of the device, but introduced an artificial hypothesis of mechanical contraction of bodies.

A. Poincaré, being a pure mathematician, developed this approach in his Sorbonne lecture course (1901). He explicitly called Lorentz's hypothesis a "patch" (coup de pouce) invented by nature to hide motion. However, being a proponent of conventionalism, Poincaré declared "local time" $t' = t - vx/c^2$ to be a convenient agreement for preserving the group symmetry of the truncated equations, laying the foundation for the abandonment of Euclidean space.

5.2 Algebraic Chaos of H. Minkowski and Postulates of A. Einstein

H. Minkowski (1908) finally transformed the dynamic equation of an expanding three-dimensional light sphere into the static geometry of a four-dimensional "light cone". To simulate the orthogonality of time to all three spatial axes, he introduced the imaginary coordinate $x_4 = ict$.

This step violated the axiomatics of vector spaces, turning Hamilton's non-commutative quaternion inside out [Maxwell1873]: instead of Hamilton's real time and imaginary spatial unit vectors, Minkowski created a pseudo-Euclidean basis with imaginary time, devoid of geometric meaning. A. Einstein (1905) stripped this model of references to the medium and absolutized the local phase drift in a moving receiver, presenting it as the physical slowing down of time in the Universe.

5.3 Consolidation of the Dogma: From Mandelshtam's Lectures to Landau and Feynman Textbooks

In the Soviet academic school, a key role in the absolutization of SR was played by the lectures of Academician L. I. Mandelshtam. He methodologically forbade the search for the microstructure of the medium, declaring the principle of relativity an a priori epistemological requirement for the measurement procedure. The physical drift of the wave front was finally replaced by an abstract "agreement on clock synchronization" using light signals.

Subsequently, this approach became the core of the standard course of theoretical physics by L. D. Landau and E. M. Lifshitz ("The Classical Theory of Fields"). Landau begins his exposition directly with Minkowski's strict pseudo-Euclidean interval:

$$ds^2 = c^2dt^2 - dx^2 - dy^2 - dz^2 = \text{inv}$$

Similarly, R. Feynman ("The Feynman Lectures on Physics") states the incompatibility of electrodynamics with Galilean transformations as an absolute truth. Feynman explicitly declares that "Maxwell's equations are true only in SR", demonstrating the mainstream's unawareness of the content of paragraph 600 of the original Treatise, where Newton–Euler's total derivative $\dot{\mathfrak{A}}$ initially provided the equations with natural Galilean invariance in a flat Euclidean space.

6 Conclusion

An analysis of paragraphs 600–601 of J. C. Maxwell's original Treatise allows us to uncover the root mathematical misunderstanding that served as the source for the creation of relativistic physics in the 20th century. It is proved that the original equations of electrodynamics, formulated in the Hamiltonian quaternion basis, initially included total material derivatives and convective field drift operators $(\mathbf{v} \cdot \nabla)\mathbf{A}$. This mathematical apparatus provided the equations with natural covariance with respect to classical Galilean transformations in absolute Euclidean space and time. The need for the postulates of SR, Minkowski interval deformations, effects of length contraction, and time dilation disappears automatically as soon as electrodynamics returns from Heaviside's truncated engineering version to Maxwell's full authorial basis.

References

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