Errata:

The Deleted Degrees of Freedom: A Case for Potential-Primary Electrodynamics

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Abstract. This document collects corrections, clarifications, and missing references identified in the first published version of "The Deleted Degrees of Freedom: A Case for Potential-Primary Electrodynamics" [1] since its publication on 19 March 2026. Twenty-four errata entries address: (1) incomplete physical reasoning regarding Faraday cage penetration and charge relaxation screening (E-001–E-005), including the withdrawal of the published field-level Faraday-cage prediction; (2) six missing historical lines spanning 1932–2017 that extend the paper's convergence record with stratified evidential weight (E-006); (3) the entirely absent Aharonov-Bohm Lagrangian framework (E-007); (4) an unresolved Belinfante-Rosenfeld question regarding scalar-gravitational coupling (E-008); (5) a third electromagnetic wave class not mentioned (E-009); (6) additional missing references, mechanisms, and a critical notational error (E-010–E-016); (7) an attribution error regarding Mead's superpotential (E-017); (8) algebraic and historical errors in the quaternion/differential-forms paragraph (E-018); (9) a historical completeness note on Whittaker's 1904 three-function construction (E-019); (10) two computationally verified corrections to the scalar-sector equations — a sign misprint in Eq. (1) whose repair restores the paper's $T = -cC$ reconciliation exactly (within the printed two-term sign family, under the stated potential normalization), and a prefactor slip in the S-trace equation (E-020–E-021); and (11) three corrections fixing the sign convention of the Stueckelberg Lagrangian: a sign correction to its scalar-sector term together with an explicit metric-signature statement (E-022), the withdrawal of the free-space scalar-wave entry (E-023), and an explicit source condition on the scalar-wave generation predictions (E-024). The corrections are of three kinds. Most tighten the physical reasoning or expand the convergence evidence; several repair attributions and algebra with no effect on the thesis; and three — E-001, E-023, and E-024 — narrow or withdraw published claims: the field-level Faraday-cage prediction, the free-space scalar-wave entry, and the unconditioned scalar-wave generation story. The two legs of the paper fare differently: the formal thesis — the Lorenz gauge removes the scalar sector — survives all twenty-four corrections; the field-level experimental program does not survive unchanged and is narrower after correction than as published. That split is why a correction ledger, rather than a retraction-and-replace, is the proportionate vehicle: the surviving thesis anchors the document, and each withdrawal is stated against it.

1 Charge Relaxation and Faraday Cage Penetration

The paper's treatment of Faraday cage penetration by scalar-longitudinal waves identifies only one of two independent shielding mechanisms in conductors. Five errata entries (E-001 through E-005) address this systematic oversimplification.

1.1 E-001: Faraday cage penetration claim omits charge relaxation screening

Severity: Substantive — incomplete physical reasoning

Section: 4.2 (Scalar-Longitudinal Waves)

Original text:

> *Because SLW carry a longitudinal E field and the scalar field C but no B field, they do not induce the eddy currents responsible for skin-effect attenuation. EED therefore predicts that SLW penetrate Faraday enclosures — a testable signature with no explanation in standard electrodynamics.*

Problem: The argument identifies only one of two independent shielding mechanisms in conductors. Faraday cages block electromagnetic signals via: (1) eddy currents (driven by changing **B**) — correctly identified as inapplicable to SLW; (2) charge relaxation (free electrons redistribute to cancel any applied **E** field, $\tau = \varepsilon_0/\sigma \approx 1.5 \times 10^{-19}$ s for copper, a quasi-static estimate valid at RF and below) — not addressed. The longitudinal **E**-field carried by an SLW would be screened by charge relaxation. The published field-level prediction therefore fails on standard conductor physics. What survives is narrower than the published text implied: the potentials themselves are not screened by either classical mechanism, but what the Aharonov-Bohm effect *establishes* is a gauge-invariant, topological loop phase for encircled flux — not local detectability of potentials. In the simply connected, field-free interior of a closed enclosure, **A** is locally pure gauge, and standard electrodynamics names no gauge-invariant in-enclosure observable for an incident wave's potential content.

Correction:

> SLW carry a longitudinal **E** field and the scalar field C but no **B** field. The eddy-current mechanism (driven by changing **B**) does not apply. However, a conductor also screens **E**-fields via charge relaxation (quasi-static bound $\tau = \varepsilon_0/\sigma \approx 1.5 \times 10^{-19}$ s for copper), which applies to the longitudinal **E**-field component. *The published prediction — SLW penetrate Faraday enclosures as "a testable signature with no explanation in standard electrodynamics" — is withdrawn at the field level.* What replaces it is strictly weaker and

> framework-internal: within EED/AB-framework electrodynamics, the potential and scalar sector is not screened by either classical mechanism, so *if* a gauge-invariant potential-sector observable exists inside a closed conducting enclosure, penetration of that sector would follow. Whether the framework's constitutive treatment of conducting matter supplies such an observable is an open question; this erratum states the penetration reading as a conjecture of the framework, not as a prediction. A dielectric shield (which lacks free charges for rapid charge relaxation) remains the cleaner experimental discriminator for the **E**-field component — itself partial, since a dielectric still screens by $1/\varepsilon_r$ with finite loss.

Note: This correction *withdraws* a published falsifiable prediction and replaces it with an explicitly open, framework-internal conjecture. It narrows the paper's empirical claims; the charge-relaxation physics that forces the withdrawal is standard and not in dispute.

1.2 E-002: Skin-effect immunity claim is narrowly correct but misleading

Severity: Moderate — correct in narrow sense, misleading in context

Section: 4.2 (Scalar-Longitudinal Waves)

Original text:

> *Both SLW and SW are immune to the skin effect, since they carry no B field. This is a testable, distinguishing prediction.*

Problem: The skin effect in its standard formulation is driven by **B**-field-induced eddy currents. SLW, carrying no **B**, are indeed immune to this specific mechanism. However, in context this claim implies that SLW are not attenuated by conductors at all, which is incorrect for the **E**-field component (see E-001).

Correction:

> SLW are immune to the skin effect (the **B**-field-induced eddy current mechanism), since they carry no **B** field. (The original sentence also named free-space scalar waves; that entry is withdrawn in E-023.) Note that conductors also screen **E**-fields via charge relaxation — a distinct mechanism that does apply to the longitudinal **E**-field of an SLW. The potential components (ϕ, $\mathbf{A}$) are not screened by either mechanism. This distinction — skin-effect immunity but not charge-relaxation immunity — becomes a testable, distinguishing prediction only once a gauge-invariant detection observable for the unscreened sector is specified; the published paper specifies none (see E-001).

1.3 E-003: VPT shield penetration description should distinguish potentials from fields

Severity: Minor — correct in substance, imprecise in framing

Section: 4.1 (Vector Potential Topology)

Original text:

> *The VPT penetrates conductive shields that block all conventional electromagnetic signals — voltage appears even when the secondary is enclosed in conducting material.*

Correction:

> State the VPT's reported shield penetration in gauge-invariant terms: the EMF around the enclosed secondary equals $-d\Phi_B/dt$ for the flux threading its circuit, however the secondary is enclosed. Describing that voltage as the action of an "unscreened $\mathbf{A}$" via $-\partial\mathbf{A}/\partial t$ is a gauge-dependent decomposition of $\mathbf{E}$ presented as a mechanism; standard electrodynamics does not support it as an additional channel. Within EED/AB-framework electrodynamics a potential-sector reading is admissible as an interpretation — labeled as such, not as the mechanism.

1.4 E-004: Engineering applications framing inherits E-001 oversimplification

Severity: Minor — correctly conditional but inherits flawed reasoning

Section: 5 (Engineering Implications)

Replace "Faraday-cage penetration" with "potential-sector penetration of Faraday enclosures" and note that receivers must be potential-sensitive.

1.5 E-005: "Faraday cage penetration" listed as classical observable without qualification

Severity: Minor — summary reference inherits E-001

Section: 6 (Discussion)

Replace "Faraday cage penetration" with "potential-sector penetration of conductive enclosures."

2 Convergence Table and Missing Frameworks

The paper's central convergence argument — that independent research programs arrived at the same scalar field — is significantly understated. Six historical lines are missing, and an entire parallel theoretical framework is absent.

2.1 E-006: Convergence table incomplete — 6 historical lines missing

Severity: Critical — directly undermines a central argument

Section: 4.3 (Four Independent Derivations), Table `tab:eed-convergence`
Source: Cross-reference with companion paper [1] + community feedback

Problem: The paper presents 4 derivations spanning 2003–2020 (from two research programs). The historical record contains at least ten documented lines of work on the scalar sector spanning 1932–2020; the six missing ones (1932–2017) are tabulated below. Two qualifications belong in the record: the added lines are NOT all mutually independent (Ohmura 1956 is the chronologically earliest of the related lines; Aharonov–Bohm 1963 is the conceptual root of the reduced-gauge program that Modanese develops — so these entries form a citation chronology rather than three independent derivations — and Reed and Hively [2] curate substantially the same list), and they are not of equal evidential weight (peer-reviewed derivations sit alongside non-refereed sources). The list is a floor, not a census; the most salient known omission is the 1932 Fock–Podolsky extended-Lagrangian line, left for a future revision rather than added here unverified:

Line	Year	Venue class	What it contributes
Fermi [3]	1932	Peer-reviewed (RMP)	Formal presence of the scalar sector in early QED, *eliminated* by the supplementary condition — a structural antecedent of the constrained treatment, not a derivation of a physical scalar
Ohmura [4]	1956	Peer-reviewed (PTP)	Extended field equations with the scalar, 47 years before Van Vlaenderen; chronologically the earliest of the related lines (predates AB 1963)
Aharonov & Bohm [5]	1963	Peer-reviewed (Phys. Rev.)	Further discussion of potentials; conceptual root of the reduced-gauge program Modanese develops (the paper cites only AB 1959)
Barrett [6]	1998	Non-mainstream journal	Toroid antenna as conditioner of gauge fields, 25 years before the Minotti–Modanese gauge-wave analysis (the paper cites only Barrett 2008)
Banduric [7]	2017	White paper	Quaternion route; three US patents. Primary source circulates in online copies with unstable date/version provenance; dated per its citation as Ref. [80] in Reed–Hively [2]; a 2014-dated variant also circulates and is not independently verifiable
Modanese [8]	2017	Peer-reviewed (MPLB)	AB-Lagrangian derivation of the same scalar; the modern development of the AB 1963 reduced-gauge line

Table 1: Missing historical lines, stratified by venue class. All absent from the published paper's Table 2.

Correction:

Replace the 4-line convergence table with the extended, *stratified* table: peer-reviewed derivations separated from non-refereed sources, the citation lineage acknowledged, and per source a statement of what was actually derived. The count claim reads: at least ten documented lines of work spanning 1932–2020 — fewer than ten mutually *independent* derivations once citation lineage is accounted for, and with Fermi 1932 counted as a structural antecedent of the *orthodox* constrained treatment rather than as a convergence line toward a physical scalar. Add all missing references to the bibliography.

2.2 E-007: Aharonov-Bohm Lagrangian framework entirely absent

Severity: Critical — omits a second theoretical framework, distinct from the Stueckelberg treatment

Section: 4.3 and throughout

Problem: The paper presents EED exclusively through the Stueckelberg framework. A second framework — the Aharonov-Bohm Lagrangian [8], the modern development of the AB 1963 reduced-gauge line — arrives at the same scalar field from reduced gauge invariance, and additionally predicts physics (gauge waves, non-locally-conserved current sources) that the Stueckelberg framework does not.

Correction:

> Add a paragraph in Section 4.3 noting that Modanese (2017) derived the same scalar field from the AB Lagrangian with reduced gauge invariance — the modern development of the AB 1963 reduced-gauge line within the chronology noted in E-006 (Ohmura 1956 earlier and independent). Note that this framework admits non-locally-conserved current as a source (a framework-internal hypothesis; see E-024) and on that hypothesis predicts additional wave modes (gauge waves) beyond SLW. Full treatment in the companion paper.

3 Open Physical Questions

3.1 E-008: Belinfante-Rosenfeld question not flagged as open

Severity: Critical — paper implies scalar-gravity connection that may not hold

Section: 4.7 (The Electromagnetic-Gravitational Bridge)

Problem: The paper states: "the gravitational potential Φ_g is related to the divergence of $\mathbf{A}$ — precisely the term that the Lorenz gauge eliminates." Community review identified that the Hilbert stress-energy tensor may lack the C^2 trace term — meaning the scalar field may carry energy without sourcing spacetime curvature.

Correction:

> Whether the scalar field C couples to gravity through the Hilbert stress-energy tensor — as opposed to carrying energy without sourcing spacetime curvature — is an open computation. The canonical (Noether) energy-momentum tensor contains a C^2 trace term, but the Hilbert tensor trace for the same Lagrangian contains C only as a divergence term, not a standalone

scalar density [9]. Whether the scalar-gravitational bridge is physical, formal, or framework-dependent remains an open question for the exact EED case ($\gamma = 1, m = 0$).

3.2 E-009: Third electromagnetic wave mode (gauge waves) not mentioned

Severity: Important — incomplete mode taxonomy

Section: 4.2 (Scalar-Longitudinal Waves)

Problem: The paper identifies two new wave types: SLW and SW. The Aharonov-Bohm framework [10] predicts, within that framework, a further class — gauge waves (g-waves): pure potential disturbances with $\mathbf{A} \neq 0$, $\mathbf{E} = \mathbf{B} = 0$, sourced by non-locally-conserved current (the framework-internal source hypothesis; see E-024). These are physically distinct from both SLW and the paper's "SW" (the latter withdrawn in E-023).

Correction:

> Add a forward reference noting that AB-framework electrodynamics predicts, conditional on its non-conserved-source hypothesis, an additional wave class (gauge waves) beyond what the Stueckelberg framework yields in vacuum; addressed in the companion paper.

4 Missing References and Mechanisms

4.1 E-010: Barrett 1998 toroid paper underrepresented

Severity: Important — missing specific prediction

Section: 4.1 (Vector Potential Topology); 5.6 (Toroidal Phase Factor Engineering)

The paper cites Barrett 2008 for the $U(1) \to SU(2)$ promotion principle but not the 1998 toroid antenna paper [6] that specifically predicted propagating phase factor waves with $\mathbf{E} = \mathbf{B} = 0$ from toroidal geometry — predating the Minotti–Modanese gauge-wave analysis [10] by 25 years.

4.2 E-011: Non-locally-conserved current case not discussed

Severity: Important — oversimplification hides quantum connection

Section: 4.2 (Scalar-Longitudinal Waves)

The paper derives $\Box C = \partial_\mu J^\mu$, then immediately restricts to $\partial_\mu J^\mu = 0$. The sourced case is hypothesized in the cited literature [8] to arise in quantum condensed-matter systems (Josephson junctions, tunneling currents, non-equilibrium superconductors) — a contested modeling assumption facing charge-conservation constraints, not an established laboratory fact (see E-024).

4.3 E-012: Charge conservation censorship mechanism absent

Severity: Important — framework-internal mechanism, previously omitted

Section: 6 (Discussion) or Limitations

Modanese [8] showed that even when $\partial_\mu J^\mu \neq 0$ locally, the observable $F_{\mu\nu}$ is generated by an effectively conserved source — a "censorship" mechanism. Within AB-framework electrodynamics this offers a candidate explanation for why the scalar sector would remain invisible to field-level measurements; it explains anything only if the framework is true.

4.4 E-013: Chester contribution uncredited

Severity: Minor — scholarly attribution

Section: Acknowledgments

David Chester (Quantum Gravity Research) identified the missing historical references (E-006), raised the Belinfante-Rosenfeld question (E-008), and flagged the sign error concern (E-016). Add to Acknowledgments in any revision.

4.5 E-014: Minotti-Modanese detector proposal absent

Severity: Minor — missing complementary experiment

Section: 4.2 or Limitations

Minotti and Modanese [11] proposed a concrete detector circuit for gauge waves based on non-conserved current dynamics. The paper mentions only Hively's SLW detection patent. Within AB-framework electrodynamics the two experiments test different physics and are complementary; both inherit the non-conserved-source condition of E-024.

4.6 E-015: Spirichev (2018) missing from convergence lines

Severity: Minor — additional convergence line

Section: 4.3 (convergence table)

Spirichev [12] decomposed the EMF tensor into antisymmetric and symmetric parts and derived field equations from both — an independent route to the symmetric tensor the paper identifies as deleted. Venue stratum, for the record: a viXra preprint, non-refereed — the same evidential-weight flag the E-006 table applies.

5 Notational Error

5.1 E-016: $T = -cC$ reconciliation fails as printed — root cause is the Eq. (1) sign misprint (E-020); the reconciliation itself is correct once Eq. (1) is fixed

Severity: Critical — resolved jointly with E-020

Section: 2.1 (Maxwell's Seventh Component)
Source: Community review + PM Jack [13]

Original text:

> *The two are related by $T = -cC$: they differ by a sign (opposite convention for which term carries the minus sign) and a factor of c (dimensional conversion between the two representations).*

Problem: As printed, the paper's Eq. (1) defines (setting $c = 1$ for clarity; at $c = 1$ the Gaussian/SI distinction of E-020 drops out):

$$T_{\text{printed}} = \nabla \cdot \mathbf{A} - \partial_t \phi$$
$$C = \nabla \cdot \mathbf{A} + \partial_t \phi$$

For these two expressions, $T = -C$ would require $\nabla \cdot \mathbf{A} = -\nabla \cdot \mathbf{A}$, which holds only under Coulomb gauge — so the reconciliation claim is false *of the printed equation*. A symbolic-algebra audit (see E-020) resolves the tension: the printed Eq. (1) carries a relative-sign misprint. With the corrected definition $T = -(1/c)\,\partial_t \phi - \nabla \cdot \mathbf{A}$ (both terms negative; $\mathbf{A}$ in Gaussian convention), the paper's reconciliation $T = -cC$ holds *exactly*, and both T and C vanish under the Lorenz condition — the two structural claims the paper makes about T are simultaneously satisfied by exactly this one sign variant, and by no other.

The attribution point stands independently of the sign question: PM Jack [13] is the origin of the T notation, not Maxwell's *Treatise*. Maxwell used T for kinetic energy (Vol. II, Part IV), never for a scalar field component. Dunning-Davies and Norman [14] re-derived T using PM Jack's non-commutative quaternion operators (*Journal of Modern Physics* — outside the mainstream-refereed stratum of the E-006 classification).

Correction:

Correct Eq. (1) per E-020 (the sign misprint is the root cause). With the corrected Eq. (1), the statement "the two are related by $T = -cC$" is retained as written — it is exact, with the factor c arising from Gaussian↔SI potential conventions. Clarify that T is PM Jack's notation (2003), not Maxwell's. Both scalars vanish under the Lorenz gauge; both become dynamical when the gauge is relaxed. Two scope statements attach to the exactness claim: it rides the stipulated potential normalization $\mathbf{A}_{\mathrm{G}} = c\,\mathbf{A}_{\mathrm{SI}}$ (E-020), and the uniqueness of the repairing variant is uniqueness *within the four sign variants of the printed two-term form* — the sweep adjudicates the misprint family, not every conceivable rewriting.

6 Attribution Error

6.1 E-017: "Superpotential χ" terminology misattributed to Mead 2000

Severity: Important — attribution error; underlying physics remains correct

Sections: 3.2 (Whittaker's Scalar Potentials and Mead's Superpotential) and 5 (Synthesis, observation 2)
Source: Community review on X (2026-04-11)

Original text:

> *"Mead [15] connected Whittaker's scalar potentials to quantum mechanics through the superpotential χ, defined by $\mathbf{A} = \nabla\chi$ and $\phi = \partial\chi/\partial t$. In a superconductor, the macroscopic quantum phase θ is directly proportional to the superpotential: $\chi = (\hbar/q)\theta$."*
>
> *Also: "Mead's identification [15] of the superpotential χ with the quantum phase θ (via $\chi = \hbar\theta/q$)" (Section 5, observation 2).*

Problem: Carver Mead's *Collective Electrodynamics* (MIT Press, 2000) works directly with the quantum phase θ of the collective electron wavefunction and the electromagnetic four-potential $(\phi, \mathbf{A})$; the term "superpotential" and a scalar field χ defined by $\mathbf{A} = \nabla\chi$ are, to the best of this review's checking, not Mead's — they entered through the DDoF paper's own packaging of his result. The central relation in Mead's formulation is a *gradient* relation between the vector potential and the phase gradient: $\mathbf{A} = (\hbar/q)\nabla\theta$ (in the superconducting ground state, within an appropriate gauge). The scalar equation $\chi = (\hbar/q)\theta$ is a *derived* statement that holds only when $\mathbf{A}$ is expressible as $\nabla\chi$ (a pure-gauge configuration) and only up to an additive constant.

The term "superpotential" in the DDoF paper conflates Whittaker's (1904) two scalar potentials F and G with Mead's (2000) quantum-phase formulation. These are distinct constructions. Whittaker's superpotentials are field-theoretic scalars that generate all components of $\mathbf{E}$ and $\mathbf{B}$ via second derivatives. Mead's θ is the macroscopic quantum phase of a superconducting condensate, related to $\mathbf{A}$ via a gradient relation, not a scalar proportionality.

Attributing the term "superpotential χ" to Mead is a terminological error, not a physical error: the underlying gradient relation $\mathbf{A} = (\hbar/q)\nabla\theta$ IS Mead's, and the conclusion that gauge freedom in classical EM corresponds to phase freedom in quantum mechanics IS the implication Mead draws. The paper overstates the formal equivalence by presenting a gradient relation as a scalar identity.

Correction:

> Replace both occurrences with the accurate framing: "Mead [15] showed that in the superconducting ground state the vector potential is directly related to the gradient of the collective quantum phase θ via $\mathbf{A} = (\hbar/q)\nabla\theta$. This makes gauge transformations $\mathbf{A} \to \mathbf{A} + \nabla\chi$ equivalent to shifts in the phase θ, so the classical gauge freedom of the vector potential IS the physical phase freedom of quantum mechanics. The term *superpotential* in this paper refers to Whittaker's (1904) construction, not Mead's; Mead does not use that term."
>
> Remove the scalar equation $\chi = (\hbar/q)\theta$ from the main text. Keep Whittaker's superpotentials and Mead's gradient relation as distinct, cross-referenced observations.
>
> This correction does not weaken the thesis. The Mead result is a key piece of evidence for potential primacy; the mis-packaging of Mead's gradient relation as a scalar identity was a presentation error, not a claim the paper depends on.

7 Algebraic and Historical Error

7.1 E-018: Quaternion dimensional scope, differential-forms equivalence, and formalism timeline all wrong

Severity: Important — three linked errors in one paragraph; underlying point about the 3D limitation of the cross product is correct

Section: 2.2 (The Limitations of the Replacement Formalism) [1]
Source: Community review on X (2026-04-11)

Original text:

> *"Gibbs and Heaviside's vector calculus relies on the cross product, which exists only in three dimensions. In four-dimensional spacetime, there is no unique perpendicular direction, and the cross product has no natural extension. The quaternion product that Maxwell used has no such limitation: it operates in any dimension because it encodes both symmetric (inner) and antisymmetric (outer) products simultaneously. The four-dimensional Heaviside-Gibbs formalism works only by importing the exterior algebra of differential forms — which is, mathematically, the quaternion structure under a different name."*

Problem: Three distinct errors:

(a) Quaternion dimensional scope. The quaternion algebra $\mathbb{H}$ is a four-dimensional division algebra (one scalar + three imaginary generators satisfying $i^2 = j^2 = k^2 = ijk = -1$). As a Clifford algebra, $\mathbb{H} \cong \mathrm{Cl}^+(3,0)$ — the even subalgebra of the 3D geometric algebra. Quaternions encode rotations of 3D space and do NOT generalize to arbitrary dimensions. The structure that does generalize — that works in any signature and any dimension — is *Clifford (geometric) algebra*, not quaternions. The claim that Maxwell's quaternion product "operates in any dimension" conflates quaternions with their generalization.

(b) Differential forms vs quaternions. Differential forms (exterior algebra on a cotangent space) and quaternions ($\mathrm{Cl}^+(3,0)$) are distinct algebraic structures. Both can be embedded as special cases of Clifford algebra in their respective settings, but they are not the same structure under different names. Differential forms use the wedge product on a dual space and naturally encode the antisymmetric part only; quaternions encode 3D rotations via a non-commutative product that combines scalar and bivector parts. Calling them "the quaternion structure under a different name" is a category error.

(c) Implicit historical timeline. The paragraph implies that the 4D formulation required importing differential forms. In fact, the 4D spacetime formulation came from Minkowski (1908) as an antisymmetric tensor $F^{\mu\nu}$, twenty-four years after Heaviside's 1884 reformulation. The single-equation geometric-algebra form $\nabla F = J$ came from Hestenes (*Space-Time Algebra*, 1966). Neither formalism was "imported" from differential forms in the sense implied.

Correction:

> Replace the paragraph with:
>
> "Gibbs and Heaviside's vector calculus relies on the cross product, which exists only in three dimensions. In four-dimensional spacetime there is no unique perpendicular direction and the cross product has no natural extension. Maxwell's quaternion formulation has the same limitation: quaternions form the even subalgebra of the 3D geometric algebra ($\mathrm{Cl}^+(3,0)$) and

encode 3D rotations, not arbitrary dimensions. The formalism that does generalize to spacetime is Clifford (geometric) algebra, in which Maxwell's four equations collapse to the single expression $\nabla F = J$ [16]. Minkowski's 1908 antisymmetric tensor $F^{\mu\nu}$ was the first spacetime-covariant recast of Maxwell's equations, twenty-four years after Heaviside. Hestenes introduced the compact geometric-algebra form in 1966. The 3D shortcut was paid for twice: once when Minkowski had to reformulate the equations tensorially, and again when the geometric structure had to be rediscovered in a third formalism."

The underlying point of the original paragraph — that Heaviside's vector calculus does not extend naturally to spacetime — is correct and survives the corrected framing. The three wrong sub-claims (quaternions in any dimension, differential forms as quaternions, implicit timeline) are removed.

8 Historical Completeness

8.1 E-019: Whittaker 1904 construction uses three scalar functions (F, G, ψ), not two

Severity: Minor — completeness note; underlying "two scalar potentials" result remains correct

Section: 4.7 (The Potential Hierarchy) [1]
Source: Community review on Jack Sarfatti mailing list (Chester, 2026-04-08)

Original text:

> *"Whittaker's 1904 paper extended this result to electrodynamics, showing that the complete electromagnetic field can be expressed through two scalar potential functions F and G."*

Problem: The paper presents Whittaker (1904) as a "two scalar potential" result, which matches both the paper's title ("On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions") and Whittaker's own statement of the result in § 1 of the original paper. However, Whittaker's construction in § 3 introduces *three* scalar functions of the electron coordinates:

$$
\begin{aligned}
F(x,y,z,t) &= \sum_e \frac{e}{4\pi} \sinh^{-1} \frac{\bar{z}' - z}{\{(\bar{x}' - x)^2 + (\bar{y}' - y)^2\}^{1/2}} \\
G(x,y,z,t) &= \sum_e \frac{e}{4\pi} \tan^{-1} \frac{\bar{y}' - y}{\bar{x}' - x} \\
\psi(x,y,z,t) &= \sum_e \frac{e}{4\pi} \log\{(\bar{x}' - x)^2 + (\bar{y}' - y)^2\}^{1/2}
\end{aligned}
$$

All three enter the construction. When Whittaker substitutes F, G, and ψ into the expressions for the components of dielectric displacement d_i and magnetic force h_i, the third function ψ drops out of the final field expressions [17, p. 370], which depend only on F and G. The two-potential result is correct as stated, but the construction's three-function origin and the automatic vanishing of the third function are not mentioned in the DDoF paper.

One possible modern reading — offered as an interpretive suggestion, not as an established equivalence — sees the three-function construction with one automatically vanishing member as a gauge-redundant scalar sector, structurally reminiscent of the Stueckelberg/EED scalar-longitudinal sector: two scalar modes that a final representation suppresses even though the intermediate construction contains them. Establishing that the two suppressions are the same operation on the same degree of freedom would require analysis this erratum does not attempt.

Correction:

> Revise the Whittaker paragraph in Section 4.7 to note Whittaker's three-function construction explicitly:
>
> "Whittaker's 1904 paper extended this result to electrodynamics. In § 3 of that paper Whittaker introduces three scalar functions (F, G, ψ) of the electron coordinates; when he substitutes them into the expressions for dielectric displacement and magnetic force, the third function drops out of the final field expressions, leaving the complete electromagnetic field expressed through the two scalar potentials F and G. The title of the paper refers to the final result. The construction itself passes through three. One possible modern reading — an interpretation, not Whittaker's claim — sees the automatically vanishing third function as a gauge-redundant scalar mode, structurally reminiscent of the scalar-longitudinal sector this paper identifies as deleted."

Note: The factual core of this entry is the three-function construction itself, which the published paper omits. The modern reading is interpretive and is not counted as convergence evidence.

9 Computationally Verified Corrections

The following two corrections were identified by a symbolic-algebra audit (SymPy; fully generic fields $\phi(\mathbf{x}, t)$, $\mathbf{A}(\mathbf{x}, t)$) of the paper's scalar-sector equations against the paper's own structural claims. The load-bearing algebra is displayed in the entries themselves — the complete four-variant sign sweep behind E-020, the one-line four-divergence evaluation behind E-021, and (in the next section) the Euler-Lagrange variation behind E-022 and the short field-equation arguments behind E-023 and E-024 — so each correction is checkable from this document alone, without recourse to any external artifact, and an independent symbolic-algebra audit reproduced the same results.

9.1 E-020: Sign misprint in Eq. (1): $+\nabla \cdot \mathbf{A}$ should read $-\nabla \cdot \mathbf{A}$

Severity: Critical — one-character correction; resolves E-016

Section: 2.1 (Maxwell's Seventh Component), Eq. (1)
Source: Symbolic-algebra audit (2026-07); sign concern originally raised in community review (see E-016)

Original text:

$$T = -\frac{1}{c}\frac{\partial \phi}{\partial t} + \nabla \cdot \mathbf{A}$$

Problem: The printed equation contradicts both structural claims the paper itself makes about T: (a) "The Lorenz gauge condition ... is precisely the statement $T = 0$" — under the Lorenz condition the printed expression evaluates to $-(2/c)\,\partial_t \phi \neq 0$; (b) "The two are related by $T = -cC$" — the printed expression differs from $-cC$ by $2\,\nabla \cdot \mathbf{A}_G$ (equivalently $2c\,\nabla \cdot \mathbf{A}_{SI}$). A sweep of all four relative-sign variants $T = s_1(1/c)\partial_t\phi + s_2\nabla \cdot \mathbf{A}_G$ gives, for the paper's two structural claims:

(s_1, s_2)	$T = -cC$?	Vanishes under Lorenz?
$(+, +)$	no ($T = +cC$)	yes
$(+, -)$	no	no
$(-, +)$ *(as printed)*	no	no
$(-, -)$	**yes, exactly**	**yes**

Exactly one variant satisfies both claims simultaneously: $s_1 = s_2 = -1$. With mismatched relative signs, the printed T is proportional to $\nabla \cdot \mathbf{A} - (1/c^2)\partial_t\phi$ (SI) — a genuinely different object that does *not* vanish in the Lorenz gauge, so the paper's central identification (the Lorenz gauge deletes T) would be algebraically false of its own Eq. (1).

Correction:

Eq. (1) should read

$$T = -\frac{1}{c}\frac{\partial \phi}{\partial t} - \nabla \cdot \mathbf{A}$$

(both terms negative; $\mathbf{A} = \mathbf{A}_G$, the Gaussian-convention vector potential implied by the equation's dimensional structure). With this correction, $T = -cC$ holds exactly — the factor c is the Gaussian↔SI potential conversion ($\mathbf{A}_G = c\,\mathbf{A}_{SI}$ with ϕ shared: a structural conversion of the potential normalization, not a full unit conversion) — and T vanishes under the Lorenz condition, as the paper claims. This is a relative-sign misprint, not a substance error: the reconciliation concept the paper asserts is verified correct.

Note: This correction *restores* the paper's central notational bridge. E-016's mathematical objection was an honest analysis of the misprinted equation; the misprint, not the reconciliation, was the error.

9.2 E-021: Prefactor slip in the S-trace equation: $(1/c)$ should read $(1/c^2)$

Severity: Moderate — c-bookkeeping; adjacent prose imprecise

Section: 2.2, Eq. `eq:S-trace`
Source: Symbolic-algebra audit (2026-07)

Original text:

$$S^{\mu}{}_{\mu} = \partial_{\mu} A^{\mu} = \frac{1}{c}\frac{\partial \phi}{\partial t} + \nabla \cdot \mathbf{A}$$

Problem: With the paper's own conventions — $A^{\mu} = (\phi/c, \mathbf{A})$ (SI) and $x^0 = ct$ — the four-divergence evaluates to $\partial_{\mu} A^{\mu} = \nabla \cdot \mathbf{A} + (1/c^2)\,\partial_t \phi$, which is exactly the paper's SI scalar field C. The printed $(1/c)$ is a prefactor slip within the same c-bookkeeping family as E-020. The adjacent prose — that the S-trace "is (up to sign) Maxwell's T component" — is also imprecise: with E-020 corrected, $S^{\mu}{}_{\mu} = C = -T/c$, i.e. the trace and T differ by a sign *and* a factor of c.

Correction:

Eq. `eq:S-trace` should read $S^{\mu}{}_{\mu} = \partial_{\mu} A^{\mu} = \dfrac{1}{c^2}\dfrac{\partial \phi}{\partial t} + \nabla \cdot \mathbf{A} = C$ (SI throughout this entry). Adjust the adjacent prose to: "which is the scalar field C itself; in the corrected notation of Eq. (1), $S^{\mu}{}_{\mu} = -T/c$ — the trace of the symmetric tensor and the seventh component T (PM Jack's notation, 2003; see E-016) differ by a sign and a factor of c."

10 Lagrangian Sign Convention

The three corrections in this section share one root cause: the published paper nowhere states its metric signature, and a sign error in its Stueckelberg Lagrangian survived undetected behind that omission. Throughout this errata document the metric signature is $(+,-,-,-)$, with $A^\mu = (\phi/c,\ \mathbf{A})$ in SI units — the conventions the published paper uses implicitly in every field equation it prints. The corrections below fix the one printed coefficient that is inconsistent with those field equations, add the missing signature statement, and make explicit two physical consequences of the field equations the paper itself derives. The same sign convention is adopted in the companion papers of this research program, so that every paper of the series states the same Lagrangian.

10.1 E-022: Sign of the scalar-sector term in the Stueckelberg Lagrangian: $+\gamma/2$ should read $-\gamma/2$

Severity: Critical — one-coefficient correction; every downstream field equation stands as printed

Section: 4 (The Deleted Physics), the Stueckelberg Lagrangian and its field equation in the scalar-longitudinal discussion
Source: Symbolic-algebra audit (2026-07), run independently against both sign variants; the missing-signature observation from the same review pass

Original text:

$$\mathcal{L} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} + \frac{\gamma}{2}(\partial_\mu A^\mu)^2 - \frac{1}{2}m^2 A_\mu A^\mu - J_\mu A^\mu$$

Problem: Under the signature $(+,-,-,-)$, the printed Lagrangian does not generate the paper's own printed field equations: varying the $+\gamma/2$ term produces the opposite sign on every γ-dependent term. The cleanest printed discriminator is the sourced wave equation: from the printed Lagrangian it comes out as $\Box C = -\partial_\mu J^\mu$ (at $\gamma = 1$), not the $\Box C = +\partial_\mu J^\mu$ the paper prints and uses; the modified Gauss and Ampère laws flip their C-terms correspondingly. A second symptom: at $\gamma = 1$ the printed term equals the covariant gauge-fixing term $-(1/2\xi)(\partial_\mu A^\mu)^2$ at $\xi = -1$, not at the Feynman–Stueckelberg point $\xi = 1$ — so the printed Lagrangian's $\gamma = 1$ theory is not the Stueckelberg theory the paper correctly describes in prose. The error stayed invisible because the free-field sector never discriminates: for conserved currents both sign variants give $\Box C = 0$, and every wave statement in the paper lives there.

Correction:

The Lagrangian should read

$$\mathcal{L} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} - \frac{\gamma}{2}(\partial_\mu A^\mu)^2 - \frac{1}{2}m^2 A_\mu A^\mu - J_\mu A^\mu$$

(scalar-sector coefficient negative; metric signature $(+,-,-,-)$, stated explicitly). The variation is short enough to display. With $C = \partial_\alpha A^\alpha$,

$$\frac{\partial\mathcal{L}}{\partial(\partial_\mu A_\nu)} = -F^{\mu\nu} - \gamma\,\eta^{\mu\nu}C, \qquad \frac{\partial\mathcal{L}}{\partial A_\nu} = -m^2 A^\nu - J^\nu,$$

so the Euler–Lagrange equation $\partial_\mu\big(\partial\mathcal{L}/\partial(\partial_\mu A_\nu)\big) - \partial\mathcal{L}/\partial A_\nu = 0$ gives

$$\partial_\nu F^{\nu\mu} + \gamma\,\partial^\mu C - m^2 A^\mu = J^\mu \qquad \big(F^{\mu\nu} = \partial^\mu A^\nu - \partial^\nu A^\mu\big),$$

the paper's field equation with every γ-dependent sign as printed. (The published equation writes the Maxwell term as $\partial_\nu F^{\mu\nu}$; the two layouts agree under the opposite — equally common — sign convention for F, which the paper, stating neither, uses implicitly. The physical content is fixed convention-independently by the $3+1$ laws below.) From here the chain is componentwise and elementary. At $m = 0$, in the paper's SI form, the time component is the modified Gauss law and the spatial components are the modified Ampère law,

$$\nabla\cdot\mathbf{E} + \gamma\,\frac{\partial C}{\partial t} = \frac{\rho}{\varepsilon_0}, \qquad \nabla\times\mathbf{B} - \frac{1}{c^2}\frac{\partial\mathbf{E}}{\partial t} - \gamma\,\nabla C = \mu_0\,\mathbf{J},$$

both exactly as the paper prints them; and the four-divergence of the field equation (using $\partial_\mu\partial_\nu F^{\mu\nu} = 0$) is the wave equation $\gamma\,\Box C = \partial_\mu J^\mu$. Every downstream equation therefore stands *as printed*: the field equation, the modified Gauss and Ampère laws, the wave equation $\Box C = \partial_\mu J^\mu$ (at $\gamma = 1$, $m = 0$), and the mode counting all follow from the corrected Lagrangian by the displayed chain. With the correction, $\gamma = 1$ is genuinely the Stueckelberg point ($\xi = 1$ in covariant-gauge language), as the paper's prose asserts. The one further prose occurrence of the term with a positive coefficient (the gauge-fixing discussion in the Stueckelberg-mechanism passage) reads correspondingly with the minus sign. The published paper should also gain, at first use of four-vector notation, the sentence: "Throughout, the metric signature is $(+,-,-,-)$." Its absence is part of how this error escaped both the writing and the first review pass.

10.2 E-023: Free-space scalar-wave (SW) entry withdrawn: the adopted framework excludes fieldless vacuum waves

Severity: Critical — withdraws a published claim

Section: 4 (The Deleted Physics), summary list of EED consequences in the scalar-longitudinal discussion
Source: Companion-paper review pass (2026-07); elementary consequence of the paper's own field equation

Original text:

> *EED predicts two new wave types: scalar-longitudinal waves (SLW), carrying both energy and momentum via a longitudinal* **E** *field plus the scalar field C; and free-space scalar waves (SW), carrying energy only.*

Problem: Within the framework the paper adopts ($\gamma = 1$, $m = 0$ Stueckelberg), a vacuum configuration with $\mathbf{E} = \mathbf{B} = 0$ forces $\partial^\mu C = 0$: setting $F_{\mu\nu} = 0$ and $J^\mu = 0$ in the field equation leaves $\gamma\, \partial^\mu C = 0$, so C is constant and nothing propagates. The conclusion is robust under either sign variant of E-022. A "free-space scalar wave carrying energy only" — no **E**, no **B**, a propagating C — is therefore not a solution of the theory this paper works in. The entry was imported from the extended-electrodynamics taxonomy of Reed and Hively [2], whose additional wave classes arise with sources or in media, not in source-free vacuum within the Stueckelberg framework. The paper's own mode counting says the same thing: it derives three propagating modes (two transverse, one scalar-longitudinal) and never had room for a second new vacuum class.

Correction:

> Strike the clause "and free-space scalar waves (SW), carrying energy only." The taxonomy reads: EED predicts one new propagating mode — scalar-longitudinal waves (SLW), carrying energy and momentum via a longitudinal **E** field plus the scalar field C. The corrected wording of E-002 adjusts correspondingly ("SLW are immune to the skin effect . . . "); references to SW elsewhere in the summary material are struck with it.
>
> This entry withdraws a published prediction; it does not strengthen the thesis. The three-mode structure that the paper's own dynamical analysis establishes is unaffected.

10.3 E-024: Scalar-wave generation and detection presuppose non-conserved current sources: condition now stated

Severity: Important — narrows a published prediction

Section: 4 (The Deleted Physics), experimental-signature discussion (Faraday-enclosure transmission, monopolar reception, $1/r^2$ attenuation)
Source: Companion-paper review pass (2026-07); consequence of the paper's own wave equation

Original text:

> *Preliminary experimental results reported by Hively (US Patent 9,306,527) — including SLW transmission through Faraday enclosures, reception by monopolar antennas, and $1/r^2$ free-space attenuation — are consistent with these predictions and cannot be explained by standard electrodynamics.*

Problem: The wave equation the paper derives, $\Box C = \partial_\mu J^\mu$, already contains the condition this erratum makes explicit. For any locally conserved four-current — which includes every ordinary antenna current — the source term vanishes identically, and the retarded solution with a quiescent past is $C \equiv 0$. A classical transmitter driven by conserved currents excites the transverse Maxwell sector only; it does not radiate into the scalar-longitudinal channel. The paper's experimental-signature discussion states no source condition, implying that ordinary transmitters suffice. They do not: each signature presupposes a source with $\partial_\mu J^\mu \neq 0$ at the emitter. Such sources are hypothesized in the Aharonov–Bohm-framework literature for quantum condensed-matter systems (see E-011), but that is a framework-internal hypothesis facing charge-conservation constraints — not an established laboratory fact.

Correction:

> Condition the experimental-signature discussion explicitly: generation and detection of the scalar-longitudinal sector presuppose a source with locally non-conserved current ($\partial_\mu J^\mu \neq 0$ at the emitter). Within Aharonov–Bohm-framework electrodynamics such sources are hypothesized in quantum condensed-matter systems (Josephson junctions, tunneling currents); no classical antenna current qualifies. Reported experimental signatures should accordingly be read as tests of the joint hypothesis — non-conserved source *and* scalar sector — not of the scalar sector alone.
>
> This entry narrows a published prediction. Combined with E-001 (the longitudinal **E**-field component of an incident wave is screened by charge relaxation), the paper's original field-level Faraday-cage claim is both withdrawn at the field level and conditioned at the source: what remains is a framework-internal conjecture requiring a non-conserved-current emitter and a potential-sensitive receiver.

Summary

Twenty-four errata entries in eleven categories:

Category	Entries	Severity	Effect on thesis
Charge relaxation	E-001–E-005	Substantive	Corrects; withdraws the field-level penetration prediction (E-001)
Convergence table	E-006	Critical	Extends, stratified ($4 \rightarrow 10$ documented lines, not all independent)
AB framework	E-007	Critical	Adds the second framework (lineage noted in E-006)
Open questions	E-008–E-009	Critical/Important	Clarifies (honest caveats)
Missing refs	E-010–E-015	Important/Minor	Adds references and mechanisms (framework-qualified where due)
Notation error	E-016	Critical	Resolved via E-020 (reconciliation restored)
Attribution error	E-017	Important	Corrects (no thesis impact)
Algebraic/historical error	E-018	Important	Corrects (no thesis impact)
Historical completeness	E-019	Minor	Completes the record (modern reading interpretive)
CAS-verified corrections	E-020–E-021	Critical/Moderate	Restores ($T = -cC$ exact; S-trace $= C$)
Lagrangian sign convention	E-022–E-024	Critical/Important	Corrects (E-022); narrows/retracts (E-023, E-024)

Table 2: Summary of errata by category.

The ledger is three-way. Most corrections tighten the physical reasoning or expand the convergence evidence; several repair attributions and algebra with no effect on the thesis; and three — E-001, E-023, and E-024 — withdraw or narrow published claims. The paper's central thesis — that the Lorenz gauge deletes physically meaningful degrees of freedom — survives all twenty-four corrections. Its experimental-signature claims do not survive unchanged: after E-001, E-023, and E-024, the scalar-sector detection story is a framework-internal conjecture with an explicit source condition, not the unconditional field-level prediction the paper published.

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References

[1] Paul Wilhelm. "The Deleted Degrees of Freedom: A Case for Potential-Primary Electrodynamics". In: (2026). https://advanced-rediscovery.com/research/deleted-degrees-of-freedom.

[2] Donald Reed and Lee M. Hively. "Implications of Gauge-Free Extended Electrodynamics". In: *Symmetry* 12.12 (2020), p. 2110. DOI: 10.3390/sym12122110.

[3] Enrico Fermi. "Quantum Theory of Radiation". In: *Reviews of Modern Physics* 4 (1932), pp. 87–132.

[4] T. Ohmura. "A New Formulation on the Electromagnetic Field". In: *Progress of Theoretical Physics* 16.6 (1956), pp. 684–685.

[5] Yakir Aharonov and David Bohm. "Further Discussion of the Role of Electromagnetic Potentials in the Quantum Theory". In: *Physical Review* 130.4 (1963), pp. 1625–1632.

[6] Terence W. Barrett. "The toroid antenna as a conditioner of electromagnetic fields into (low energy) gauge fields". In: *Speculations in Science and Technology* 21 (1998), pp. 291–320.

[7] Richard Banduric. *New Electrodynamics*. White paper, Displacement Field Technologies, Aurora, CO, 2017 — dated per its citation as Ref. [80] in Reed and Hively (2020); the document has also circulated with a 2014 date that is not independently verifiable. Three US patents (9,337,752; 10,084,395; 10,855,210). 2017.

[8] Giovanni Modanese. "Generalized Maxwell Equations and Charge Conservation Censorship". In: *Modern Physics Letters B* 31.6 (2017). arXiv:1609.00238, p. 1750052.

[9] Fernando Minotti and Giovanni Modanese. "A New Theory of Tensor-Scalar Gravity Coupled to Aharonov-Bohm Electrodynamics". In: *Modern Physics Letters A* 40.09n10 (2025). arXiv:2408.05230, p. 2550023.

[10] Fernando Minotti and Giovanni Modanese. "Gauge waves generation and detection in Aharonov–Bohm electrodynamics". In: *European Physical Journal C* 83 (2023). arXiv:2310.13968, p. 1086.

[11] Fernando Minotti and Giovanni Modanese. "Simple circuit and experimental proposal for the detection of gauge-waves". In: *Journal of Physics Communications* 8 (2024). arXiv:2403.10580, p. 055003.

[12] Yu. A. Spirichev. *On tensors and equations of the electromagnetic field*. viXra:1805.0425v3. 2018.

[13] Peter Michael Jack. *Physical Space as a Quaternion Structure, I: Maxwell Equations. A Brief Note*. arXiv:math-ph/0307038. 2003.

[14] Jeremy Dunning-Davies and R. Norman. "Deductions from the Quaternion Form of Maxwell's Electromagnetic Equations". In: *Journal of Modern Physics* 11 (2020), pp. 1361–1371.

[15] Carver A. Mead. *Collective Electrodynamics: Quantum Foundations of Electromagnetism*. Cambridge, MA: MIT Press, 2000.

[16] David Hestenes. *Space-Time Algebra*. New York: Gordon and Breach, 1966.

[17] Edmund T. Whittaker. "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions". In: *Proceedings of the London Mathematical Society* s2-1 (1904), pp. 367–372.