100 Questions About Scalar-Longitudinal Waves — Part 4: Open Questions

What we don’t know. What needs to happen. Where this connects to the rest of physics. The final 25.

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Three parts covered the foundations, the evidence, and the engineering. This final part is about the edges. The places where the theory meets its limits. The experiments that would settle the debate. And the connections that, if they hold, change how we think about physics at a fundamental level.

⬅️ Previous: 25 questions about the engineering design space opened by potential primacy.

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76. Can EED be quantized?

Open question. The massive Stueckelberg theory ($m > 0$) is known to be renormalizable and unitary. Whether the massless EED limit ($m \to 0$, $\gamma = 1$) preserves these properties is not demonstrated. Specifically: is the scalar-longitudinal sector ghost-free at the quantum level? The classical predictions (SL propagation, modified Poynting vector) stand independently of the answer. But a complete theoretical foundation requires it.

77. What about negative-norm states?

In Gupta-Bleuler quantization, the scalar photon mode has negative norm. Standard QED handles this by restricting to a physical subspace where negative-norm states decouple (Ward identities guarantee this). If the SL sector is promoted to physical status, the question is whether negative-norm contamination occurs. Goto (1967) showed that non-Hermitian field operators with a Hermitian Hamiltonian produce a positive-definite Hilbert space with no ghosts. The negative norms are an artifact of insisting on Hermitian field operators, not a physical constraint.

78. Do the deleted degrees of freedom persist in QFT?

Yes. In Lorentz-gauge quantization, A_μ carries four polarization states: two transverse, one longitudinal, one scalar. Standard QED declares the longitudinal and scalar modes “unphysical” through the subsidiary condition. But Goto (1967) showed they persist as independent dynamical variables in an equivalent formulation with identical S-matrix. The “deleted” modes were never absent from quantum electrodynamics. They were declared invisible.

79. What’s the connection to the Higgs mechanism?

The Higgs mechanism gives gauge bosons mass through spontaneous symmetry breaking. The massive W and Z bosons acquire longitudinal polarizations that massless gauge bosons don’t have. The Stueckelberg mechanism does something analogous without spontaneous symmetry breaking: it restores gauge invariance to a massive theory via a compensating scalar field. EED ($\gamma = 1$, $m = 0$) borrows the Lagrangian structure but not the interpretation. The connection is structural: both mechanisms promote longitudinal modes to physical status.

80. Does the paper’s argument extend to non-Abelian gauge theories?

The paper’s U(1) thesis (gauge convention hides longitudinal/scalar DoF) may generalize to SU(3) and the Standard Model. In the electroweak sector, the Higgs promotes longitudinal modes via symmetry breaking. EED promotes them via Stueckelberg without mass. If the pattern generalizes, “deleted degrees of freedom” becomes a statement about gauge theory foundations, not just electrodynamics. This is the deepest theoretical extension and would require its own paper.

Subscribed

81. What is the Wheeler-Feynman absorber condition?

The theory requires the universe to be a "perfect absorber": all emitted radiation is eventually absorbed by the totality of matter. This is a cosmological boundary condition. In a matter-dominated Friedmann universe, the condition is satisfied. In a radiation-dominated or de Sitter universe, it may fail. The theory's predictions depend on cosmological model. This couples its electromagnetic content to the large-scale structure of the universe in a way standard EM does not.

82. Is the transactional interpretation of QM testable?

Cramer's interpretation reproduces all standard QM predictions (it must, since $P = \psi\psi^*$ is the same equation). The interpretive difference (transactions vs collapse) doesn't produce different experimental outcomes in standard scenarios. Potentially testable in quantum eraser experiments where the timing of "confirmation" can be manipulated. The interpretation is consistent with the formalism, not required by it.

83. What about the Woodward effect?

Woodward predicted transient mass fluctuations from time-varying energy content, mediated by the scalar gravitational potential. NASA funded experimental programs. Thrust measurements at micro-Newton levels were reported. The effect is contested: systematic errors (thermal expansion, EM interference, center-of-mass shifts) are hard to exclude at that scale. The derivation depends on Sciama's formulation of Mach's principle, which is one of several competing implementations. Include as theoretical possibility, not established result.

84. Could galaxy rotation curves be related?

One of the most speculative connections from launch week: the Aczél bounded composition framework, which predicts that Lorenz gauge is a linearization valid mid-range but failing at boundaries. The same mathematical structure applied to gravity yields $v_{scalar} = c/\cosh(\rho)$ deviating from c in strong fields. A collaborator has fitted 130 SPARC galaxies with zero per-galaxy free parameters using this framework. If the mapping holds, “dark matter” could be the gravitational analog of deleted EM degrees of freedom. Under review. Not established.

85. What is the Sagnac effect connection?

Multiple commenters noted during launch week that the Sagnac effect (path-dependent phase in rotating frames) has the same structural argument as Aharonov-Bohm but in a rotating reference frame. The paper doesn’t cover it. It should, in a future revision. Same class of evidence: topological phase depending on potentials rather than fields.

Leave a comment

86. How does Maxwell’s original dielectric treatment relate to N3LM?

A commenter pointed out (with the original Maxwell 1873 text, paragraph 66) that the N3LM violation in the paper’s Section 4.5 is specific to the Grassmann/Lorentz point-particle picture. In Maxwell’s continuous dielectric treatment, the medium’s stress tensor closes the momentum balance locally. The scalar field C in EED plays the same role: a stress carrier that restores momentum balance without requiring a material medium. The paper should acknowledge this distinction more explicitly.

87. What would falsify the EED predictions?

If a clean discriminator experiment (VPT source, Faraday cage, monopolar receiver, distance sweep) produces all three null results (no penetration, no monopolar selectivity, 1/r attenuation), the scalar-longitudinal propagation prediction is falsified. The underlying Stueckelberg Lagrangian and potential primacy (AB effect, superconductors) survive, but the specific prediction of a propagating SL mode would be disconfirmed.

88. What would confirm it beyond doubt?

Independent replication by at least two groups using the three-test discriminator protocol with different VPT geometries, published in peer-reviewed journals with full methodology. Plus a COMSOL simulation using the Stueckelberg Lagrangian ($\gamma = 1$) reproducing the predicted field patterns. Theory, simulation, and experiment aligned across independent teams.

89. Why hasn't this been published in a mainstream journal?

The individual components (Stueckelberg, AB, London equation, Proca) are mainstream and published. The synthesis, which connects these components into a single argument about deleted degrees of freedom, is what the paper offers. Pre-print publication on the author's own site + Zenodo + Academia.edu is the current stage. Peer review submission is a decision about timing and venue, not about the physics.

90. What distinguishes this from Evans' O(3) electrodynamics?

Trovon de Carvalho and Rodrigues (2006) demonstrated that Evans' AIAS program rests on elementary group-theoretic errors (confusing U(1) with O(2), inverting the SU(2)/SO(3) covering relation), a fictitious B(3) field refuted by experiment, and fundamental misunderstandings of gauge theory. The EED framework derives from the Stueckelberg Lagrangian, is supported by Woodside's uniqueness theorems, and has been arrived at independently by four groups. The programs share terminology. They share nothing else.

91. What is the connection to fiber bundles?

In modern differential geometry, gauge theories are connections on principal fiber bundles. The gauge potential A_μ is the connection form. The field tensor $F_{\mu\nu}$ is the curvature. Holonomy (the AB phase) is a property of the connection that the curvature cannot determine on multiply connected spaces. The fiber bundle formulation makes the information loss from gauge fixing geometrically precise: projecting from connection to curvature loses the global, topological content.

92. What role does Berry phase play?

Berry (1984) showed that quantum systems traversing a closed path in parameter space acquire a geometric phase determined by the connection (potential configuration), not the curvature (field). Phase engineering via Berry phase is already used in topological quantum computing concepts. The potential-primary perspective generalizes this: engineering the connection engineers the phase evolution.

93. Could the SL mode explain ball lightning?

Speculative. Ball lightning is an unsolved problem in atmospheric physics. The SL mode's properties (propagation without ≣, energy containment via the scalar channel, topological stability from multiply connected potential configurations) are suggestive. But "suggestive" is not "explanatory." Ball lightning needs a containment mechanism, an energy source, and a formation pathway. The SL mode could contribute to the first two. The third remains open.

94. What about the connection to consciousness?

The paper does not make this connection. The transactional interpretation (ψ^* as advanced wave) and Cramer's "handshake" model have been extended by others into consciousness territory (Stapp, Penrose-Hameroff). These extensions are outside the paper's scope. The paper's argument is about physics: what was deleted, what's recovered, what's testable. Consciousness connections are interesting but not the claim.

95. Is there a connection to superluminal signaling?

No. The SL mode propagates at c. The AB effect is non-local but cannot transmit information faster than light (the phase is measurable only statistically). The Wheeler-Feynman advanced waves are consistent with causality when the absorber condition holds. Nothing in the paper's argument violates special relativity or enables faster-than-light communication.

96. What are the implications for quantum computing?

Topological quantum computing already exploits non-Abelian phase factors and topological protection. The potential-primary perspective extends this: if the gauge group can be promoted from U(1) to SU(2) via toroidal topology (Barrett 2008), new non-Abelian operations become accessible. This is theoretical. But topological quantum computing is itself a field built on theoretical predictions about topological phases of matter.

97. What experiment would you do first if you had funding?

The COMSOL simulation. Custom PDE module implementing the Stueckelberg Lagrangian with $\gamma = 1$. VPT geometry. Predict the field patterns including C. Compare against standard Maxwell solver output (which zeros C by construction). The predicted difference, if it exists, defines the experimental signatures. Simulation before hardware. The simulation paper alone is publishable.

98. How many people are working on this?

Small community. Van Vlaenderen, Hively, Reed are the primary EED theorists. Barrett works on topological extensions. The Stueckelberg/Proca literature is broader (particle physics mainstream). The synthesis, connecting these threads into a unified argument about deleted degrees of freedom, is what my paper attempts. Launch week showed there are 15+ technical peers engaging at the math level and several hundred following the broader argument. The community is small but growing.

99. What's the most important thing the paper gets wrong?

Fair question. The N3LM discussion (Section 4.5) doesn't adequately distinguish between the point-particle Grassmann picture and Maxwell's continuous dielectric treatment. A commenter caught this during launch week. The paper's argument is correct for the Grassmann/Lorentz framework but incomplete without acknowledging that Maxwell's own treatment closes the momentum balance via the medium's stress tensor. The scalar field C does the same job without a material medium, but the paper should say this explicitly. Future revision.

100. What happens next?

Three things need to happen. First: a COMSOL simulation with relaxed Lorenz gauge and VPT geometry, producing predicted signatures that standard Maxwell solvers can't reproduce. Second: a bench-scale discriminator experiment confirming the predicted signatures. Third: independent replication by a different team. Theory exists. Evidence is suggestive. The experiment that closes the loop is the single most important next step. Everything else follows from it.

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100 questions. 4 parts. Foundations, evidence, engineering, open questions. If you've read all four, you know more about the scalar-longitudinal sector than most physicists. The full technical case, with the tensor decomposition, the Stueckelberg Lagrangian, and all eight lines of evidence, is in one place.

https://advanced-rediscovery.com/research/deleted-degrees-of-freedom

If you've read all 100 questions and want one document that takes you from theory to bench — the three-test discriminator, the experiment design, the FAQ, the reading list — **The EED Playbook** is that document. Built for engineers who want to test the prediction themselves. Paid subscribers get the PDF.