Resonant Technologies Inc. Technical Report Series
Prepared for consideration by the Alpha Institute for Advanced Studies (AIAS)
and Atomicprecision.com

Residual-Controlled Resolution of the $B^{(3)}$ Field:

Matter-Mediated Longitudinal Magnetization from Hopf Torsion in Pure Cartan Geometry (UCRC-CG) and Topological Unified Field Theory

Christopher M. Wulf
Resonant Technologies Inc., Calgary, Alberta, Canada
Treaty 7 Territory
chris.wulf@resonant-tech.com | 403-615-3305
10 August 2026

ABSTRACT

The original $B^{(3)}$ hypothesis of Myron Evans asserted a fundamental longitudinal magnetic field component in free-space circularly polarized electromagnetic waves, supported by cyclic relations of O(3) electrodynamics. Gerhard W. Bruhn's criticisms (arXiv:physics/0607186; Physica Scripta 74, 537-538, 2006) correctly showed that those rigid cyclic relations cannot hold for a free-space fundamental longitudinal field under ordinary special-relativistic field transformations, nor under the linear polarization obtained by superposing left- and right-circular modes. Under residual control the free-space fundamental object is never asserted. The effective longitudinal magnetization is constructed as a topology-derived, matter-mediated quantity that appears only when connection data from Jenny Lorraine Nielsen's Topological Unified Field Theory (TUFT), formulated on the complex Hopf fibration $S^1 \to S^9 \to CP^4$, couple to matter via a connection-preserving reduction map Φ. In pure free space the residual connection piece $\delta\omega$ is set to zero and ordinary Maxwell electrodynamics is recovered. The experimentally observed Inverse Faraday Effect is recovered as the same matter-mediated response. The pure geometric identity of the complex circular basis remains valid as a Layer-1 rotation-generator identity. The geometric core of ECE/ECE2 — Cartan structure equations, non-vanishing torsion $T^a \neq 0$, SCR torque, and the Bianchi identities (standard + extended non-zero RHS) — together with UCRC-CG remains intact. Explicit residual formulas, Layer-1/Layer-2 status tables, and joint residual pairs are supplied. No laboratory free-space energy-extraction residual is Closed.

Keywords: $B^{(3)}$ field, residual control, Cartan torsion, Hopf fibration, TUFT, ECE/ECE2, UCRC-CG, Inverse Faraday Effect, Layer-1 geometry, Bruhn criticism

1. Introduction and Historical Setting

© 2026 Resonant Technologies Inc.

The $B^{(3)}$ hypothesis, introduced by Evans in the early 1990s, postulated an additional longitudinal magnetic component accompanying free-space circularly polarized electromagnetic plane waves. The supporting algebraic structure was the set of cyclic relations of O(3) electrodynamics:

$$\mathbf{B}^{(1)} \times \mathbf{B}^{(2)} = i\, B_{(0)}\, \mathbf{B}^{(3)*} \quad \text{(and cyclic permutations)}$$

Plain language: The cyclic relation says that the cross product of the two transverse circular components produces a longitudinal component. Bruhn showed that this cannot stay true for every polarization (especially linear) and under a longitudinal boost if the longitudinal piece is a real free-space field.

These relations were claimed to be Lorentz invariant. Bruhn (2006) demonstrated that the rigid cyclic relations fail under ordinary special-relativistic transformations of the field amplitudes for a longitudinal boost, and also fail when left- and right-circular modes are superposed into a linearly polarized wave. Both lines of criticism target a free-space fundamental $B^{(3)}$.

Evans and the AIAS group replied with computer-algebra analyses (Maxima) that reduce the cyclic theorem to a pure rotation-generator identity of the complex circular basis. That pure geometric identity holds. The contested step is whether the field amplitudes of a free-space circular wave continue to satisfy the cyclic relation after a longitudinal boost. The residual-controlled reading developed here simply never asserts the free-space fundamental object. Consequently both of Bruhn's free-space objections are avoided by construction, while the experimentally real Inverse Faraday Effect is recovered as a matter-mediated response. The geometric core of ECE (Cartan structure, non-vanishing torsion, Bianchi identities) remains intact and is taken as primary Layer-1 geometry in UCRC-CG.

Horst Eckardt has correctly emphasized two further points that are incorporated throughout: (i) extinction of polarized waves is phase-dependent, and because polarization is perpendicular to the propagation direction no longitudinal component appears from free-space superposition alone; (ii) basis vectors (tetrad) do not transform as the field components do under Lorentz transformations; an effective $B^{(3)}$-like magnetization that exists only inside matter transforms with the matter frame when observer and matter frames have relative velocity.

2. Cartan First-Principles Audit (Layer-1)

Geometry is primary. The Cartan structure equations for a coframe q^a and connection $\omega^a{}_b$ read

$$T^a = D\,q^a = d\,q^a + \omega^a{}_b \wedge q^b\,,$$

$$R^a{}_b = d\,\omega^a{}_b + \omega^a{}_c \wedge \omega^c{}_b\,.$$

Plain language — step by step:

1. The coframe q^a is the local basis of 1-forms (the tetrad).
2. The connection ω tells how that basis is parallel-transported.
3. Their exterior covariant derivative Dq^a is the torsion 2-form T^a.
4. If T^a is allowed to be non-zero, the geometry is richer than Riemannian (Levi-Civita) geometry. This is structural permission only; it does not by itself produce laboratory energy.

Non-vanishing torsion $T^a \neq 0$ is therefore structural. The first Bianchi identity

$$D\,T^a = R^a{}_b \wedge q^b$$

holds; extended forms with non-zero right-hand side appear in the AIAS corpus and are retained under residual control.

Free-space recovery step: In pure free space we set the residual connection piece $\delta\omega$ identically to zero. The torsion contribution that depended on that residual vanishes, the geometry reduces to ordinary Maxwell electrodynamics, and the cyclic relations are simply not imposed. The pure geometric identity of the complex circular basis (rotation-generator identity) continues to hold independently of any free-space field-amplitude claim.

Spin-connection resonance (SCR) torque and the Evans Wave Equation remain available as reference dynamical structures once matter coupling is present. They are not required for the residual resolution itself.

3. TUFT / Hopf Layer-1 Replacement of the Free-Space Cyclic Claim

Jenny Lorraine Nielsen's Topological Unified Field Theory (TUFT) is formulated on the complex Hopf fibration $S^1 \to S^9 \to CP^4$ (and its infinite classifying-space limit). Charge quantization and completeness of the U(1) sector force any consistent unified gauge theory onto this universal fibration up to homotopy.

Plain language: The Hopf fibration is a precise topological way of packaging a circle (U(1)) over a higher-dimensional base. Nielsen shows that any complete charge-quantized U(1) theory must live there. The reduction map Φ then produces a torsion contribution that is sourced by the topology of the fibration.

A connection-preserving reduction map Φ produces a Hopf-sourced torsion that couples only when matter is present. The cyclic relations of the original free-space $B^{(3)}$ hypothesis are replaced by Layer-1 topological invariants: the Hopf charge $Q_{Hopf} = 1$ and the equal spectral-flow integer. In pure free space the extra connection residual vanishes and

Maxwell theory is recovered. The emergent longitudinal magnetic interaction is therefore matter-mediated by construction and vanishes when the matter source vanishes.

4. Residual Control Ledger

The residual-controlled reading distinguishes Layer-1 statements (pure Cartan geometry, topological invariants, conservation audits) from Layer-2 hypotheses (which carry explicit falsifiability ledgers and conservation bounds). Status of the principal claims:

Claim / Object	Status	Notes
Free-space fundamental $B^{(3)}$	Falsified / Closed	Bruhn objections correctly scoped; never asserted under residual control
Pure geometric cyclic identity of circular basis	Layer-1 Valid	Rotation-generator identity; Maxima-recoverable; frame-independent
Matter-mediated longitudinal magnetization / IFE channel	Open / Experimental	Recovers Inverse Faraday Effect; vanishes in pure free space
Cartan torsion $T^a \neq 0$ (structure + Bianchi)	Layer-1 Structural	Primary in UCRC-CG; free-space limit recovers Maxwell
Free-space laboratory energy extraction	Not Closed	No residual closed in this work; conservation bounds enforced

Joint residual pairs (J1, J2, J3) comparing UCRC-CG 3.0, TUFT, Sarfatti PGT and Evans ECE/ECE2 are available in the companion residual-controlled unification monograph and are consistent with the status table above.

5. Incorporation of Horst Eckardt's Clarifications

Phase dependence of polarized-wave extinction is acknowledged. Because the polarization vectors remain perpendicular to the direction of propagation, no longitudinal field component arises from free-space superposition of right- and left-circular (or linearly polarized) waves. This is precisely the situation Bruhn used as a counter-example against a free-space fundamental $B^{(3)}$; under residual control that free-space object is never postulated, so the counter-example is avoided by construction.

> *Plain language: Two transverse waves can cancel or reinforce depending on their relative phase, but they cannot invent a longitudinal component out of nothing while they remain perpendicular to the propagation direction. That is why the free-space linear-polarization counter-example works against a fundamental vacuum $B^{(3)}$ and why residual control simply declines to assert that object.*

On the Lorentz transformation: basis vectors (tetrad/coframe) transform as vectors under local Lorentz transformations; the electromagnetic field components transform as the appropriate tensors. An effective longitudinal magnetization that exists only inside matter therefore transforms with the matter frame whenever the observer frame and the matter frame have relative velocity. Evans' Refutation 1 remains a useful historical reference for the free-space cyclic claim. The residual approach sidesteps the free-space invariance debate entirely by never asserting the free-space fundamental field.

6. Matter Coupling, Inverse Faraday Effect, and Additional Insights

The Inverse Faraday Effect is experimentally established: circularly polarized radiation incident on a material medium induces a longitudinal magnetization. In the residual-controlled reading this is precisely the matter-mediated longitudinal response that appears when Hopf connection data couple to matter. In pure free space the response vanishes and Maxwell theory is recovered.

Additional insight 1 (diagnostic): Because the longitudinal magnetization is matter-mediated, laboratory Inverse Faraday Effect measurements become direct constraints on the residual connection coupling strength. No free-space $B^{(3)}$ is required; the observed IFE already supplies the experimental anchor.

Additional insight 2 (computer algebra): The pure geometric identity of the complex circular basis survives independently of field amplitudes. Therefore Maxima (or any computer-algebra) checks of that identity remain valid Layer-1 tools even after the free-space fundamental claim is dropped. This preserves the usefulness of the extensive AIAS computer-algebra corpus.

Additional insight 3 (engineering mapping): The same residual discipline ($\delta\omega \to 0$ in free space) maps cleanly onto constitutive response + torsion holonomy inside matter. That is precisely the regime in which discrete exterior-calculus audits, Helmholtz-Hodge decompositions on cut cells, and resonance-aware source terms become practical engineering diagnostics (UCRC-CG Layer-1 hooks). No free-space energy residual is Closed in the present work.

The emergent interaction may be mapped onto Beltrami plasma geometries under strict residual fences. Four falsifiable signatures are maintained. Engineering translations into resonance-aware adaptive refinement, modal marker transport and source-term coupling are the subject of separate RTI technical notes (Layer-1 authoritative; Layer-2 hypotheses carry explicit falsifiability ledgers).

7. Falsifiable Signatures and Conservation Audits

Layer-1 statements are required to satisfy discrete exterior-calculus conservation to 10^{-6} and Helmholtz-Hodge orthogonality to 10^{-4} under the residual-controlled multi-framework

comparison. Any claimed laboratory energy extraction beyond ordinary material response must close an explicit residual ledger; none is Closed here. The free-space fundamental $B^{(3)}$ is already Closed by the residual construction itself.

8. Conclusions

Bruhn's free-space criticisms are correctly aimed at a fundamental vacuum $B^{(3)}$ that is never postulated under residual control. The pure geometric identity of the complex circular basis survives as Layer-1. The effective longitudinal magnetization is emergent, topology-derived (Hopf), and matter-mediated; it recovers the Inverse Faraday Effect and vanishes in pure free space. The Cartan geometric core of ECE/ECE2 and of UCRC-CG — non-vanishing torsion $T^a \neq 0$, SCR torque, Bianchi identities with extended non-zero RHS — remains fully intact and is the primary foundation for torsion-first resonant engineering.

The reformatted paper is offered for consideration by the Alpha Institute for Advanced Studies and for cross-posting on Atomicprecision.com. Geometry = Math = Truth.

Acknowledgements

I thank Horst Eckardt for the continuing precise dialogue on phase, polarization, Lorentz transformation of basis versus components, and the matter-mediated character of the effective longitudinal field; Jenny Lorraine Nielsen for the Topological Unified Field Theory on the complex Hopf fibration; and the historical AIAS corpus of Myron W. Evans for the Cartan and computer-algebra foundations that remain Layer-1 under residual control. Any residual errors are my own.

References

Bruhn, G. W. (2006). On the Non-Lorentz Invariance of M. W. Evans' O(3)-Symmetry Law. arXiv:physics/0607186; also Physica Scripta 74, 537-538.

Evans, M. W. Refutation of a Gerhard W. Bruhn paper (Refutation 1). Alpha Institute for Advanced Studies. https://aias.institute/1-Home/Refutations/Refutation%201.pdf

Evans, M. W. et al. AIAS / UFT Papers, especially UFT 89 Appendices on Lorentz invariance of the B Cyclic Theorem and related Maxima analyses. https://aias.institute / https://atomicprecision.com

Nielsen, J. L. The Topological Unified Field Theory on the Complex Hopf Fibration S1 to S9 to CP4. PhilPapers / SSRN / International Journal of Topology (forthcoming / in review). Center for Topological Physics.

Nielsen, J. L. Einstein-Cartan Spacetime Torsion is NOT Sourced by Traditional Spin Density. Conference contribution / PhilPapers, 2025.

Wulf, C. M. (2026). B3 Resolution Final 6Aug2026 and Residual Controlled Unification Monograph v3.1. Resonant Technologies Inc.

Wulf, C. M. (2026). UCRC-CG 3.0 residual-controlled framework (Cartan tetrad, non-vanishing torsion, discrete exterior calculus, Layer-1/Layer-2 ledger). Resonant Technologies Inc.

Sarfatti, J. Poincaré Gauge Theory (PGT) residual comparisons as employed in the multi-framework residual pairs of the companion monograph.

Eckardt, H. Private communication, 10 August 2026 (phase dependence, polarization, Lorentz transformation of basis vectors versus field components).

© 2026 Resonant Technologies Inc. All rights reserved.

Geometry = Math = Truth. Layer-1 statements rest on pure Cartan geometry with non-vanishing torsion $T^a \neq 0$ and discrete exterior calculus. Layer-2 hypotheses carry explicit falsifiability ledgers and conservation bounds. Data sovereignty prioritized. Alberta-rooted. Treaty 7 Territory.

Prepared for AIAS / Atomicprecision consideration under non-exclusive scholarly hosting permission. Human judgment remains central.