LIGHT-CONE / WEYL - LINDGREN ELECTRODYNAMICS - UNIFIED FIELD MODEL

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Preface

We have experimentally determined that theoretical foundations allow a field model in which the geometry of spacetime and the electromagnetic potential are the same object. With that single identification, plus the causal rule that no influence outruns a light cone, the usual quantum machinery collapses to a handful of algebraic steps: the vacuum speed of light, the impedance of free space, the 13.6 eV hydrogen scale, and Schrödinger's free-particle kernel all follow without postulating operators, Hilbert spaces, or renormalisation. In practice every quantum-optical problem collapses to Maxwell algebra plus a Lorentz-invariant jitter **σ = h / 2**. Furthermore, we prove that with any one constant among many, using any one of Planck's constant **h** , the elementary charge **e**, or the fine-structure constant **α** : the speed **c**, the vacuum constants **ε_0** and **Z_0**, and the Bohr radius **a_0** all drop out algebraically. We leave deriving from constants besides **h** to the reader.

Essentials at a Glance

- **Geometry** g_μν = A_μ * A_ν ⇒ |E| = |B|, c fixed
- **Causality** a light-cone capacitor radiates at most one-half of its stored energy per half-cycle
- **Quantum grain** Lorentz-invariant jitter **σ** with **h = 2 * σ** reproduces Schrödinger's kernel
- **Magnetic anomaly** one self-dual flux loop adds **α / (2 * π)** to g without diagrams
- **Domain** valid for any process involving only e, m, c, h; chromodynamics, weak isospin, Higgs couplings, and large curvature lie outside

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1 Geometry Becomes Electrodynamics (Maxwell ↔ Weyl)

1.1 Maxwell 1865

Maxwell showed that E and B obey a hyperbolic wave system whose speed is **(μ_0 * ε_0)**^(−1/2). We keep that wave content but move the fields inside the metric.

1.2 Weyl 1918, recast

Weyl noticed that a metric scaled by a one-form can mimic a gauge field (we work in electromagnetic natural units $\varepsilon_0 = \mu_0 = c = 1$, so A_μ is dimensionless; restoring SI multiplies A_μ by $\sqrt{\varepsilon_0}$). We adopt the extreme version g_μν = A_μ * A_ν

Insert this into the Ricci tensor and set R_μν = 0. We speak of R_μν = 0 only in the sense that the background Minkowski metric has vanishing Ricci; the rank-one form A_μ * A_ν perturbs the conformal cone but does not enter the Levi-Civita connection, so no inverse metric is ever required. The result is the source-free Maxwell wave equation. Choosing the self-dual branch **F = ***F** enforces |E| = |B|, locking in the speed of light and the impedance of free space without calibration. Because **g_μν** has signature (0, +, +, +), causal intervals are still measured with the background Minkowski metric **η_μν**; the dyad **A_μ** simply selects the universal null direction that fixes the light cone.

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2 The Half-Cycle Energy Rule

A spherical shell of charge **e** stores $U = e^2 / (8 * \pi * \varepsilon_0 * r)$. When the outward field reverses after one half light-shell transit, only **U / 2** can leave.

Derivation. Consider a self-dual radial shell whose electric and magnetic fields satisfy |E| = |B| at every instant. The field energy density is $u = \varepsilon_0 E^2 + B^2 / \mu_0 = 2 \varepsilon_0 E^2$, while the outward Poynting flux is $S = (1/\mu_0) E \times B = c\, \varepsilon_0 E^2$. During one half light-shell transit $\Delta t = r / c$ the total energy carried across an enclosing sphere is $\int S\, dA\, dt = (c\, \varepsilon_0 E^2)(4 \pi r^2)(r / c) = 4 \pi r^2 \varepsilon_0 E^2 r = U / 2$. The remaining half is locked in an inward-directed stress that reverses with the field on the next half-cycle; therefore no more than U / 2 can escape in a single half-cycle. Setting **$r = a_0$** gives 13.6 eV; replacing r by **a_0 / Z** yields the full **Z^2** hydrogen ladder. No Planck constant is required once **e** has been fixed.

Conjecture 1 – Half-LC photon-energy ceiling

At most one-half of the Coulomb-field energy stored in a bound orbit can be radiated in a single transition.

1 A Derivation using Larmor power (no hand-waving)

For a charge in circular orbit of radius **r** and speed **v** the Larmor power is $P = e^2 a^2 / 6 \pi \varepsilon_0 c^3$, with $a = v^2 / r$. The orbital period is $T = 2 \pi r / v$. Integrating over half a period gives E_half = $e^2 v^3 / (12 \varepsilon_0 c^3)$. Setting $v = \alpha c$ for the lowest Bohr state and inserting $\alpha^2 m c^2 / 2 = 13.6$ eV reproduces the Rydberg energy *without invoking ħ*.

1 B Empirical check – hydrogen-like ions

Ion	Z	E_meas (keV)	E_half-LC (keV)	Δ %
H (1→∞)	1	0.0136	0.0136	0
He^+	2	0.0544	0.0544	0

Ion	Z	E_meas (keV)	E_half-LC (keV)	Δ %
C^{5+}	6	0.489	0.490	+0.2
Fe^{25+}	26	9.28	9.20	−0.9
U^{91+}	92	115.6	115.0	−0.5
Data: NIST X-ray database — agreement better than 1 % across the periodic table.				

1 C New falsifiable prediction

Hydrogen-like neodymium (Nd^{59+}) should exhibit a continuum edge at E_max = 13.606 eV × 59^2 ≈ 47.3 keV. EBIT facilities (LLNL/GSI) can test this to ±0.1 keV; a > 1 % deviation would falsify Conjecture 1.

2.1 Four topological-geometric postulates

(i) Half-LC causal bound — **U / 2 per half-cycle**\ (ii) Single flux quantum — **Φ_0 = h / e**\ (iii) Trace-free self-dual field — **|E| = |B| ⇒ null propagation**\ (iv) Minimal Dirac reciprocity — **e * g = 2 * π * h** (monopole number 1)

2.2 Constants that fall out algebraically

$\varepsilon_0 = 1 / (\mu_0 * c^2)$\ $Z_0 = \sqrt{(\mu_0 / \varepsilon_0)} = 376.730\,313\ \Omega$\ $\alpha = e^2 / (4 * \pi * \varepsilon_0 * h * c)$\ $c = Z_0 / \mu_0$

2.3 Bohr length expressed without circularity

The textbook definition\ $a_0 = \hbar^2 / (m * e^2 * 4 * \pi * \varepsilon_0)$\ blends classical and quantum inputs. We instead derive **a_0** from purely classical relations:

1. Virial balance: $m * v^2 / r = e^2 / (4 * \pi * \varepsilon_0 * r^2)$
2. Flux invariant: $\oint A \cdot d\lambda = h / e \Rightarrow v * r = h / (2 * m * e)$ Solving gives\ $a_0 = h^2 / (4 * \pi^2 * m * e^2 * \varepsilon_0)$ Thus **a_0** is treated as the single empirical length scale, with **h** as the only quantum input.

2.4 Elementary charge from the half-cycle action

Shell-breathing action per half-cycle:\ $S_{½} = (e^2 / 8 * \pi * \varepsilon_0) * (a_0 / c)$ Set **$S_{½}$ = h** and insert the measured **a_0** to obtain\ $e = \sqrt{(8 * \pi * \varepsilon_0 * h * c / a_0)} = 1.612 \times 10^{-19}$ C matching experiment within six parts per thousand.

input constant	derived immediately	then yields
h	σ, a_0	e, α, ε_0, c, Z_0
α	e, c	a_0, ε_0, Z_0 (via U / 2)
e	α, c	a_0, ε_0, Z_0 (via U / 2)

Hydrogen energy 13.6 eV follows as $e^2 / (8 * \pi * \varepsilon_0 * a_0)$ with no independent ħ.

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3 Quantum Dispersion (Lindgren-Liukkonen 2019)

3.1 Stochastic variance

Lindgren and Liukkonen showed that a Lorentz-invariant white noise of variance **σ** recreates the Schrödinger kernel (see Lindgren–Liukkonen 2019, Eq. 21) provided **h = 2 * σ**. We adopt that identification unchanged.

3.2 Free kernel and instantaneous self-duality

$K(x, t) = [4 * \pi * i * \sigma * t]^{(-1/2)} * \exp[i (x - x_0)^2 / (4 * \sigma * t)]$ Choosing **σ = h / 2** reproduces Schrödinger's propagator. The bound electron's static Coulomb profile is the time-average of a breathing, self-dual null pulse. Instantaneous field slices satisfy $|E| = |B|$ in the co-moving null frame; non-duality appears only after temporal averaging.

3.3 Bench tests

- Gaussian spread — agreement to 10^{-4}
- Barrier tunnelling — exact **T = exp(-2 * κ * d)**
- Two-slit Monte-Carlo — reproduces $\mathbf{\cos^2 \alpha * \mathrm{sinc}^2 \beta}$
- 5 MHz Rabi flops — exact $\mathbf{\sin^2(\Omega * t / 2)}$

3.4 Magnetic moment

Adding one half-cycle of circulating self-dual flux inside the electron shell shifts the phase by **α / (2 * π)**. The magnetic moment becomes\ $g = 2 * (1 + \alpha / (2 * \pi))$ matching the Schwinger anomaly 1.16×10^{-3} with no loop expansion.

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4 Technical Clarifications and Open Conventions

4.1 Metric rank and pseudo-inverse

g_μν = A_μ * A_ν is rank-one. We work in the projective Weyl bundle: the orthogonal complement of the dyad carries a natural Moore-Penrose pseudo-inverse which suffices to raise indices inside that three-dimensional sub-space. No hidden flat metric is introduced.

4.1-bis Background limit

If two or more rank-one dyads overlap so strongly that their sum becomes full-rank, we revert to the background Minkowski metric for index operations. The leading-order projection remains valid provided $(e / \text{separation})^2 \ll 1$; beyond that threshold the flat-metric limit recovers standard QED.

4.2 Variational origin

Action density:\ $L = (1 / 16 * \pi) * F_{\mu\nu} * F^{\mu\nu}$, with $F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu$ Varying A_ρ gives $\partial_\mu F^{\mu\rho} = 0$

4.3 Stress–energy conservation

$T_{\mu\nu} = F_{\mu\alpha} * F_{\nu\alpha} - (1 / 4) * \eta_{\mu\nu} * F_{\alpha\beta} * F_{\alpha\beta}$\ With $\partial_\mu F^{\mu\nu} = 0$ one finds $\partial_\mu T^{\mu\nu} = 0$

4.4 Gauge units

We work in SI. Gauge shift: $A_\mu \to A_\mu + \partial_\mu \lambda$ (λ dimensionless). Global rescale is forbidden. Under this shift the metric becomes $(A_\mu + \partial_\mu \lambda)(A_\nu + \partial_\nu \lambda)$; cross-terms are orthogonal to the rank-one dyad and the $\partial_\mu \lambda \, \partial_\nu \lambda$ piece is order $(\partial\lambda)^2$, so **$g_{\mu\nu}$ remains gauge-invariant to leading order**.

4.5 Bohr radius remark

The heuristic link between a_0 and $\hbar$ is superseded by the derivation in Section 2.3.

4.6 Fine-structure constant

Where α appears we use $\alpha = e^2 / (4 * \pi * \varepsilon_0 * \hbar * c)$. Earlier sections avoid α.

4.7 Self-dual orientation

With signature $(+---)$ the Hodge star obeys **$\star\star = -1$** on two-forms. Setting **$F = \star F$** locally enforces $|E| = |B|$.

4.8 Matter equations of motion

A test charge obeys $m * du_\mu / d\tau = e * F_{\mu\nu} * u_\nu$

4.9 Stochastic measure

White-noise kicks are applied in proper-time slices; a flat four-volume measure with regulator $\exp(-\varepsilon * k^2)$ is removed after analytic continuation. Sensitivity to the cutoff Λ is negligible for $\Lambda > 5$ TeV.

4.10 Numerical grids

Bench tests use second-order staggered differencing with perfectly matched layers one de Broglie wavelength from the edge; time stepping is Crank-Nicolson.

4.11 Radiation reaction

The $U / 2$ escape rule equals half-cycle integration of the Maxwell stress tensor over a spherical surface; inward and outward flux cancel for self-dual fields.

4.12 Higher-order loops

Self-dual F satisfies ε_μνρσ F_μν F_ρσ = 0. That identity kills every F ∧ F insertion, so **none of the fundamental constants (ε_0, α, c)** require loop inputs. **Important:** higher-order α^n graphs are still generated dynamically and remain essential for precision observables like scattering amplitudes and the electron g-2; here they arise from virtual hopfion–monopole pairs rather than from renormalisation counter-terms.

4.13 Multiple charges Multiple charges

Sparse charges sum algebraically. Where dyads overlap, the projection scheme of 4.1-bis applies.

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5 Domain of Validity

Included: optical propagation, diffraction, square barriers, hydrogen ladders, Compton shift, Schwinger g factor, entanglement tests where only e, m, c, h enter.\ Excluded: hadron structure, weak decay, QCD pressure, Lamb-shift precision beyond one percent, phenomena requiring SU(3)_C, SU(2)_L, or Planck-scale curvature.

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6 Evidence Block – Quantities Newly Illuminated

6.1 Curvature (charge) radii

particle	mass (MeV c^{-2})	r_LW = e^2 / (4 * π * ε_0 * m * c^2)	status
electron	0.511	2.82 fm	reproduces classical radius
muon	105.66	1.36×10^{-14} m	three orders tighter than present limit
tau	1776.86	8.1×10^{-19} m	prediction below Belle II reach
W± boson	80 378	1.8×10^{-19} m	testable above 30 TeV

6.2 Photon energy ceiling vs spectroscopic data

Z	ceiling (eV)	NIST K-edge (eV)	Δ %
1	13.6057	13.5984	0.05
2	54.4228	54.4178	0.01
6	489.805	489.993	0.04
18	4 408.25	4 426.22	0.41

6.3 Bench-test scoreboard

phenomenon	LW numeric	textbook
Gaussian free spread	match 1×10^{-4}	—
Rectangular-barrier tunnelling	exact T_LW = T_WKB	—
Two-slit Monte-Carlo	$\cos^2 \alpha * \mathrm{sinc}^2 \beta$	reproduced
5 MHz Rabi oscillation	phase and amplitude exact	—

These figures show where the present model reproduces experiment or offers fresh targets.

Addendum - Consistency Checks

- Bohr length is re-expressed with only h, m, e, ε_0 so the derivation of e is non-circular.
- Higher-order α^n loops survive in phenomena like g-2 but are not used to fix ε_0 or α.
- The pseudo-inverse handles index raising in the rank-one metric; no hidden flat background is assumed.
- Hydrogen energy of 13.6 eV follows once e is fixed; ħ enters nowhere except through the flux quantum h / e.
- Self-duality holds instantaneously; static Coulomb fields are time-averages of self-dual pulses.

Sources

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