



The Break – Electroweak

Artist's Proof 16

Electroweak Unification

Electroweak unification, the Higgs, and the immeasurability of ϵ

****§1 — WHAT IS ESTABLISHED****

Before this paper, the corpus has derived:

SU(2) — from Axiom S. The two sectors give Z_2 . $Z_2 = \pi_1(\text{SO}(3))$ in $N = 3$ spatial dimensions (AP08). The double cover is $\text{SU}(2) \rightarrow \text{SO}(3)$ (AP11 §2).

This is the gauge group of the weak force.

One Z_2 , one classification, two descriptions. The sector involution σ is the unique non-trivial binary classification in the pre-state: paired vs unpaired. AP20 proves: the abstract structure IS the manifold (EH).

When this classification expresses itself on the manifold in $N = 3$, it IS $\pi_1(\text{SO}(3)) = Z_2$ — tensors vs spinors. AP11 proves the correspondence.

There is no connecting theorem needed between a “sector Z_2 ” and a “topological Z_2 .” They are the same classification described at two levels. The axioms already say it.

U(1)_Y — from the phase freedom of the complex Hilbert space (AP07 §3.3), expressed on the local manifold as the U(1)_Y connection B_μ (AP15 §3).

Before the break, this is U(1)_Y — the hypercharge gauge group. After the break, a specific combination of U(1)_Y and SU(2) survives as U(1)_{em}, whose connection is A_μ (see §3.1).

This is the gauge group of electromagnetism.

The fermion — the unpaired element ε , no σ -image, half-integer spin, the electron (AP09 §3.2).

The boson — paired elements, σ -image exists, integer spin, the photon (AP09 §3.1, AP15 §7).

$SU(2)$ and $U(1)_Y$ are both derived. They coexist in the pre-state. $SU(2)$ from the sector structure. $U(1)_Y$ from the phase structure. They are independent symmetries of the same Hilbert space.

Together they form $SU(2) \times U(1)_Y$. The electroweak symmetry group.

This paper derives what Axiom B does to it.

§2 — The Symmetry Before The Break

Before the break, the pre-state is perfectly symmetric.

You need to see what that symmetry looks like — all four generators, all four massless bosons — so you can feel what Axiom B does to it.

2.1 — The pre-state's full symmetry

The pre-state — the 1:1, before any record is written — has the full symmetry of the Hilbert space \mathcal{H} .

From Axiom S: two sectors, involution σ , Z_2 symmetry. On the manifold ($N = 3$, AP08), this lifts to $SU(2)$. $SU(2)$ acts on the pre-state by rotating between the two sectors.

It mixes \mathcal{L} and \mathcal{P} (Light and Dark — the two sectors of the record algebra, not cosmological dark matter/energy). Before the break, this mixing is exact. Both sectors are identical. Nothing distinguishes them.

You cannot tell \mathcal{L} from \mathcal{P} . They are perfect mirrors.

From AP07 §3.3: complex amplitudes. The phase of any amplitude can be rotated by $e^{i\theta}$. This is $U(1)_Y$ — the hypercharge phase rotation. It acts on the pre-state by shifting the global phase.

Before the break, this rotation is exact. No phase angle is preferred. All are equivalent. You cannot pick a preferred angle.

At the pre-state level this is the universal phase symmetry; field-specific hypercharge assignments and the detailed representation content are downstream of the sector/break coupling structure and are part of Gap E (§8).

The full internal symmetry of the pre-state is $SU(2) \times U(1)_Y$.

This symmetry has four generators. $SU(2)$ has three (the Pauli matrices, or equivalently, three independent rotations of the sector space). $U(1)_Y$ has one (the hypercharge phase rotation).

Four generators means four gauge bosons when the symmetry is expressed on the manifold: W^1, W^2, W^3 from $SU(2)$, and B from $U(1)_Y$. Before the break, all four are massless. The symmetry is exact.

2.2 – What “before the break” means

“Before the break” is not a moment in time. Time requires records (Axiom R). Before the break, there are no records. There is no time.

“Before the break” means: the structure of the pre-state, considered without Axiom B. Axioms S, R, and C give $SU(2) \times U(1)_Y$ on the manifold. Axiom B is what changes it.

§3 — The Break

This is the moment. One axiom. One element. And the electroweak symmetry shatters.

3.1 — Axiom B

Axiom B: one element $\varepsilon \in \mathcal{L}$ with no σ -image in \mathcal{P} . Valuation $v(\varepsilon) = 1$. The minimum viable splinter.

ε breaks the 1:1. Before ε , the two sectors are identical. After ε , they are not. ε lives in \mathcal{L} but not in \mathcal{P} . The sectors are no longer interchangeable.

The SU(2) symmetry — which rotates freely between the sectors — is broken.

But not all of it. The hypercharge phase freedom — U(1)_Y — is not broken by itself. However, three of the four original generators are broken (those that would rotate ε between sectors).

The surviving generator is the electromagnetic one: the unique linear combination of the original SU(2) and U(1)_Y generators that leaves the vacuum (the break background) invariant. On the manifold, this is U(1)_{em}.

(In Standard Model notation: pre-break SU(2) × U(1)_Y; unbroken U(1)_{em} generated by $Q = T_3 + Y/2$; photon A_μ is the massless mixture of W^3_μ and B_μ via θ_W .)

Axiom B breaks SU(2) × U(1)_Y down to U(1)_{em}.

You just watched electroweak symmetry breaking happen. One element. No potential. No fine-tuning. Axiom B.

Note on the surviving U(1)_{em}. The U(1) that survives the break is not the original U(1)_Y but a specific combination of U(1)_Y and one SU(2) generator.

This is a structural consequence of the breaking pattern: ε has no σ -image, so any generator that would rotate it between sectors is broken; the surviving generator is the unique combination that leaves the break background invariant.

On the manifold, this is the electromagnetic gauge symmetry whose connection is A_μ (AP15).

No Standard Model dynamics are assumed here: the axioms require that a unique $U(1)_{em}$ survives as the generator leaving the break background invariant; Standard Model notation is used only to label that survivor and its mixing.

The algebraic details of which combination survives — and consequently the value of the Weinberg angle θ_W — are downstream of the coupling structure (the relative strengths of the $SU(2)$ and $U(1)_Y$ couplings, g and g').

This is explicitly listed in Gap C (§8).

3.2 — The Higgs field is the break

ε is one object with two descriptions on the manifold.

As background condition: $v(\varepsilon) = 1$ everywhere. The break is present wherever the manifold exists. It fills the structure. Its ground state is nonzero — by construction, not by choice of potential.

If $v(\varepsilon) = 0$, the 1:1 is perfect, nothing distinguishes the sectors, there are no records, no time, no manifold, no physics. The nonzero ground state is the condition for existence.

This is the Higgs field — and if you have been paying attention, you already knew it had to exist: a scalar order parameter with a nonzero vacuum expectation value that breaks $SU(2) \times U(1)_Y$ to $U(1)_{em}$.

As localised excitation: the minimum ripple in the break. ε has no σ -image — it is unpaired — so it carries half-integer spin (AP11). It is fermionic. It is the electron.

The lightest mass the break can produce. The minimum viable splinter.

From outside the axioms, this looks like a type contradiction: ε appears to be both a scalar field (the Higgs) and a fermion (the electron). From within the axioms, it is the definition.

$1 = 1 + 1 \times \varepsilon$. The whole is whole AND the break is there. The background condition (scalar, everywhere, nonzero) and the localised excitation (fermionic, pointlike, quantised) are two faces of one element.

The Embedding Hypothesis (AP20) proves that the abstract algebraic structure IS the manifold — there is no gap between the algebraic description and the geometric one.

The two faces are not connected by a theorem; they are the same object read at two scales.

The identification is therefore direct. The Higgs field is ε as background condition. The electron is ε as localised excitation. The Higgs mechanism is Axiom B.

Empirically, $v \approx 246$ GeV sets the electroweak scale; in this architecture it is the scale at which the sector distinction (Axiom S) meets the one-element break (Axiom B) on the manifold.

The derivation of v from the axioms is a target of the open programme (Gap A/B, §8).

Debt statement: the dynamics of how the scalar background condition and the fermionic excitation relate at intermediate scales — the detailed mechanism by which one object presents two faces — is downstream of the mass spectrum (Gap E, §8) and the derivation of the self-coupling (Gap B, §8).

AP16 derives the pattern and the identification. The dynamical details are an open programme.

3.3 — What gets mass

Before the break, four massless gauge bosons. After the break:

Three generators of SU(2) are broken. Their corresponding gauge bosons acquire mass by coupling to ε . These become the W^+ , W^- , and Z^0 bosons. They are massive because SU(2) is broken.

The standard manifold expressions for the broken pattern give $m_W = gv/2$ and $m_Z = gv/(2\cos\theta_W)$.

AP16 derives the pattern and the mechanism; the numerical values of these masses depend on the coupling constants and the vacuum expectation value (Gap A, §8).

One generator — the specific combination of SU(2) and U(1)_Y generators that leaves ε invariant — remains unbroken. Its gauge boson remains massless. This is the photon.

The photon is massless because U(1)_{em} survives the break.

The electron acquires mass through the coupling of the fermionic excitation (ε as localised ripple) to the scalar order parameter (ε as background condition). This is the self-coupling of the break to itself.

In standard language, this is a Yukawa coupling — the coupling of a fermion to a scalar field.

Here both fermion and scalar are ε , so the electron's mass is the minimum such coupling: the lightest mass the break can produce.

Other fermion masses (muon, tau, quarks) arise from ε -compositions at higher energy scales. The derivation of the full mass spectrum from the axioms is the open programme of Gap E (§8).

§4 — The Higgs Boson And The Now

4.1 — The excitation of the break

The Higgs boson is the excitation of the Higgs field. A ripple in the break. At CERN in 2012, this excitation was observed at ~ 125 GeV.

Its properties were inferred from recorded decay products — pairs of photons, pairs of Z bosons, pairs of W bosons. Every observation was a record. A scar. A trace left by the break wobbling.

They did not measure the break in the act of breaking. They measured what it left behind. You can only ever measure what the break leaves behind.

This is not a limitation of instruments. This is the structure.

4.2 — The now actualises FROM the now

The break is ε . The electron is ε as localised excitation (§3.2). The electron is the now — the edge of the break that is still breaking (AP06 §10.5).

The now is structurally unmeasurable. Not because instruments are too slow. Because measurement IS the now turning into a record (AP07 §4). The moment you capture the now, it is gone. It is already past.

By the time you have a measurement, the now has moved on. The now is the act of measuring, not what gets measured.

ε actualises FROM the now. It produces records, masses, coupling constants, scars on the manifold. Everything measurable comes from it. But it itself — in the act of actualising — is never in the record.

It is always one step ahead of the last measurement. Always at the frontier.

The Higgs boson at 125 GeV is the record of ε wobbling. The electron at 0.511 MeV is the record of ε existing. The photon is the record of the connection fluctuating.

All of these are records. Scars. The black curve.

ε itself is the white space. Always present. Never captured. The thing that makes everything measurable, while being itself immeasurable in the act. Everything measurable comes from it. It itself is never measured.

It gives you everything by giving you nothing now.

This is the measurement structure as read by the axioms. The wave function collapses at measurement — the now writes a record — and the collapse itself is not in the wave function.

In the 420 Code, the observer is not in the Hilbert space. The now is not in the monoid. The break is not in the record. The record is what the break leaves behind.

The “god particle” was always a more accurate name than intended.

§5 – The Fine-Structure Constant

5.1 – What α_{em} is

Symbol note. In this section, e is the electron charge and ϵ_0 the vacuum permittivity – not ϵ the break. Context disambiguates throughout.

$$\alpha_{em} = e^2/(4\pi\epsilon_0\hbar c) \approx 1/137.036.$$

It is the coupling strength of the break to the connection. How strongly the electron (ϵ as localised excitation) interacts with the electromagnetic gauge field A_μ (AP15).

How much of the original unity leaks through at the point where the splinter meets the fabric it left.

It is one of the six faces of the multidimensional residual (AP06 §10.5). Paired with α/β (the substrate stiffnesses) in Pair 2. Constrained by c through the leakage (AP06 Theorem 3.1).

Chained to G through m_e through κ .

α_{em} is structurally determined. It is not a free parameter. The substrate stiffness $\Lambda_{sub} \approx 2.15 \times 10^{46}$ determines c . c constrains the leakage. The leakage is ϵ . ϵ is the electron.

The electron's coupling to the connection is α_{em} . One chain. One knob. The value follows from the structure.

5.2 – Why it cannot be derived from within

Two things must be distinguished. “Determined” means: the value is fixed by the structure; it is not a free parameter; it could not be otherwise.

“Derivable from within” means: there exists a finite chain of deductions from $\{S, B, R, C\}$ that terminates in $\alpha_{em} = [\text{number}]$. α_{em} is determined but not derivable from within.

You cannot derive the coupling of the now from inside the now. You can only measure it. Deriving is record-writing.

To derive α_{em} from within the argument would require writing a record of the now — but the now is precisely what exists before any record is written.

This is not a failure of the argument. It is a prediction.

The argument predicts that α_{em} is structurally determined but empirically known — the value is fixed by the axioms, there is no other value it could have, but the number itself can only be obtained by looking outward, at what the break left behind.

The value can be checked from outside via the fixed-point equation (AP24 §5.4–§5.5). The number can be checked. It cannot be proved from within.

Every other quantity treated in this dependency chain is derivable from {S, B, R, C}: the number of dimensions, the field equations, the Born rule, the uncertainty principle, the spin-statistics theorem, the gauge symmetries, the photon.

These are the structure looking at itself. You can derive them because they are inside the record. α_{em} is the structure looking outward.

5.3 — The formal status

The argument derives:

(i) α_{em} exists and is nonzero (AP15: ε couples to the connection; AP06 Theorem 3.1: leakage is nonzero for finite c).

(ii) α_{em} is not a free parameter (AP06 §10.5: six faces, three pairs, three constraint equations; §10.7: the constraint path $c \rightarrow \alpha_{em} \rightarrow \varepsilon \rightarrow G$).

(iii) $\alpha_{em} < 1$ (AP06 §2.4: for the physical value of c , α is less than unity; the coupling is sub-maximal).

(iv) α_{em} is paired with α/β in the six-face structure (AP06 §10.5, AP08 §5).

The argument does not derive:

(v) The numerical value $1/137.036$.

And the argument explains why it does not: the coupling of the now to its own field is the one quantity that requires measurement. It is the empirical face.

The full analysis of α_{em} 's structural status — including its necessary irrationality and unprovability from within — is in AP24.

KS-4 remains LIVE — HARD. Not because the argument has failed to close it. Because it is structurally the kind of thing that stays live.

It is the architecture's empirical contract: this is the number you check us against.

§6 — What Is Now Derived

Axiom S $\rightarrow Z_2 \rightarrow SU(2)$ (via $\pi_1(SO(3))$ in $N = 3$, AP08; double cover AP11) \rightarrow **weak gauge group.**

AP07 + AP15 \rightarrow complex amplitudes \rightarrow phase freedom $\rightarrow U(1)_Y \rightarrow$ **hypercharge gauge group.**

$SU(2) \times U(1)_Y$ \rightarrow the full internal symmetry of the pre-state on the manifold \rightarrow **electroweak symmetry group.**

Axiom B $\rightarrow \varepsilon \in \mathcal{L}$, no σ -image in $\mathcal{P} \rightarrow$ sectors no longer interchangeable $\rightarrow SU(2)$ broken $\rightarrow U(1)_{em}$ survives \rightarrow **$SU(2) \times U(1)_Y \rightarrow U(1)_{em}$. Electroweak symmetry breaking.**

The Higgs field = ε \rightarrow nonzero ground state ($v(\varepsilon) = 1$) \rightarrow **the break cannot be zero. The condition for existence.**

Three broken generators $\rightarrow W^+, W^-, Z^0$ acquire mass (coupling to ε) \rightarrow **massive weak bosons.**

One unbroken generator \rightarrow photon stays massless ($U(1)_{em}$ exact, Born rule exact) \rightarrow **massless photon. You hold the kill switches.**

Self-coupling of ε (Yukawa: fermionic excitation \times scalar order parameter) \rightarrow electron mass $m_e \rightarrow$ **minimum viable splinter.**

α_{em} = leakage at the electromagnetic face \rightarrow structurally determined, empirically known \rightarrow **the architecture's empirical contract (STRUCTURAL, not DERIVED — see §5).**

§7 — Kill Switches

New kill switches:

KS-32 [LIVE — EMPIRICAL] — Electroweak breaking mechanism. The derivation identifies Axiom B with the Higgs mechanism.

If a physical process is discovered that breaks $SU(2) \times U(1)_Y$ without a scalar field with nonzero vacuum expectation value — that is, if electroweak symmetry breaking occurs by a fundamentally different mechanism — the identification fails.

Status: LIVE — EMPIRICAL. The Higgs boson is observed at ~125 GeV. The mechanism is strongly supported by current data. Empirically supported; structurally aligned.

KS-33 [LIVE — EMPIRICAL] — Sector distinction = weak isospin. The derivation maps the two sectors (\mathcal{L}, \mathcal{P}) to the $SU(2)$ weak isospin doublet.

If the physical weak isospin structure requires more than two components, or if the sector structure does not faithfully map to isospin, the identification fails. Status: LIVE — EMPIRICAL.

The Standard Model's $SU(2)$ acts on left-handed doublets with exactly two components. Matches the two-sector structure. Empirically supported; structurally aligned.

KS-34 [LIVE — HARD] — Non-derivability of α_{em} . The paper claims α_{em} cannot be derived from within because it is the coupling of the now to its field.

If a closed-form derivation of $\alpha_{em} = 1/137.036\dots$ from $\{S, B, R, C\}$ is found, this claim is falsified. Status: LIVE — HARD.

This is the only kill switch in the corpus whose triggering would be a triumph rather than a disaster. Here is the weapon: derive α_{em} .

If someone derives α_{em} from the axioms, the architecture becomes stronger, not weaker. The claim would be wrong in the best possible way.

Existing kill switches affected:

KS-4 — $\alpha \approx 1/137$. AP16 reframes KS-4. The kill switch is not a gap in the derivation. It is the architecture's empirical face. α_{em} is the one number that connects the axioms to experiment.

If the measured value of α_{em} changes, or if the constraint chain (AP06 §10.7) is shown to permit multiple values, the architecture is falsified.

KS-4 remains LIVE — HARD, but its meaning has changed: it is not a problem to solve but a contract to honour. α_{em} is one of the most precisely measured constants in physics, known to better than a part per billion.

§8 — Open Gaps

Gap A: W and Z boson masses. The argument derives that three gauge bosons acquire mass and one stays massless.

It does not yet derive the specific values $m_W \approx 80.4 \text{ GeV}$, $m_Z \approx 91.2 \text{ GeV}$.

These depend on the coupling constants g and g' of $SU(2)$ and $U(1)_Y$, and the vacuum expectation value v . v is the energy scale of the break.

Derivation requires the detailed structure of ε at the electroweak scale. Depends on: Gap E (mass spectrum).

Gap B: The Higgs boson mass (~125 GeV). The mass of the Higgs excitation depends on the self-coupling of the break. $m_H = \sqrt{(2\lambda)v}$.

The self-coupling of ε — how strongly the break interacts with itself — is determined by the structure, but the value is not yet computed.

Depends on: Gap A (coupling constants), Gap E (mass spectrum), α_{em} constraint chain.

Gap C: The Weinberg angle θ_W . The mixing angle between $SU(2)$ and $U(1)_Y$ determines the relationship between W and Z masses and the electromagnetic coupling. $\sin^2\theta_W \approx 0.231$. This angle measures how $SU(2)$ and $U(1)_Y$ combine in the break.

Conjectural route: it may be derivable from the six-face structure — specifically, the angle between Pair 1 (gravity/quantum) and Pair 2 (stiffness/coupling) in AP06 §10.5. This is a target for future work.

Depends on: Gap A, detailed structure of the breaking pattern at the electroweak scale.

Gap D: EH. CLOSED. The Embedding Hypothesis was proved in AP20.

Gap E: The fermion mass spectrum. The electron mass m_e is derived as the self-coupling of the break — the minimum viable splinter.

Other fermion masses (muon, tau, quarks) arise from ε -compositions at higher energy scales. The derivation of the full mass spectrum from the axioms is an open programme.

Required for: Gap A (boson masses), Gap B (Higgs mass), computation of α_{em} via the fixed-point equation (AP24 §5.6).

§9 — Conclusion

What follows is synthesis language for the derived/structural chain above, not an additional theorem.

The electroweak symmetry $SU(2) \times U(1)_Y$ is the full internal symmetry of the pre-state on the manifold. $SU(2)$ from the sector structure (Axiom S). $U(1)_Y$ from the phase structure (AP07, AP15).

Axiom B breaks it. One element ε , no σ -image, minimum viable splinter. $SU(2) \times U(1)_Y \rightarrow U(1)_{em}$. The weak force carriers get mass. The photon stays massless. The Higgs field is the break.

The Higgs mechanism is Axiom B.

The Higgs boson — the excitation of the break, the record of ε wobbling — was observed at CERN. 125 GeV. A scar on the manifold. They measured what the break left behind.

But the break itself is the now. The now actualises from the now. It gives everything — every mass, every coupling, every record, every observation. It itself is immeasurable in the act. Not hidden.

Structurally unmeasurable. The instrument cannot turn on itself.

$\alpha_{em} = 1/137.036$ is the coupling of the break to the connection. The leakage at the electromagnetic face. Structurally determined. Empirically known. The architecture's contract with the world.

And the electron is the hinge. It is the break that breaks the electroweak symmetry. It is the source that sources the electromagnetic field.

It is the mass that sets the gravitational coupling $G = 2\kappa/m_e^2$. It is the leakage that makes boundaries imperfect (AP06 Theorem 3.1). It is the now that writes every record.

The electron is at both ends. At the bottom: the minimum splinter, the lightest break. At the top: Hawking radiation, the leakage from maximum curvature.

And at every scale between: coupling, writing records, paying the Landauer cost, advancing the frontier. You have been watching it do all of these things since AP06.

Everything is the electron, being the break, being the now. And now you have seen it break the electroweak symmetry, source the electromagnetic field, set the gravitational coupling, and write every record.

The axiom speaks. The algebra transcribes.

Conditional on: None. EH and QRA proved in AP20.

Depends on: AP06 (leakage, six faces, constraint chain), AP07 (complex amplitudes, Born rule, the now), AP08 ($N = 3, D = 4$), AP09 ($SU(2)$, fermion/boson), AP11 (spin, Z_2 correspondence), AP12 (\hbar), AP15 ($U(1)$, electromagnetic connection), The Lock (Edition 04).

New kill switches: KS-32 (electroweak mechanism), KS-33 (sector = isospin), KS-34 (non-derivability of α_{em} — HARD, triggering is a triumph).

What is established:

DERIVED: $SU(2) \times U(1)_Y$ electroweak symmetry. Electroweak breaking via Axiom B. Higgs field = ε (background condition). Massive W^+, W^-, Z^0 . Massless photon. Electron = ε (localised excitation). Electron mass as minimum Yukawa self-coupling.

STRUCTURAL: Higgs boson = excitation of the break. Immeasurability of the now. One Z_2 , one classification, two descriptions.

DERIVED/CONJECTURE: α_{em} as the empirical face — structurally determined, empirically known. Weinberg angle route via six-face structure.

Non-load-bearing: §4.2's interpretive language (the "god particle" framing and measurement-structure commentary). Load-bearing: the symmetry/break mapping (§§1–3), mass-pattern claims (§3.3), and kill switches (§7).

The structural facts described in §4.2 (the now's role, the break's immeasurability) are load-bearing consequences of the axioms; the specific poetic framing is not.

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