



The Direction

Artist's Proof 19

Strong Force

The strong force from the gauge freedom of the break direction

§0 – Status Architecture

Paper Identity. AP19 — The Direction. Derives SU(3) gauge symmetry (the strong force) from the gauge freedom of the manifold’s orientation around the break.

Identifies colour charge with orientation, confinement with isotropy enforcement, and completes the Standard Model gauge group $SU(3) \times SU(2) \times U(1)$.

Key definition. “Orientation” in this paper means orientation in face-space — the internal index space {C, S, B} — not physical-space rotation. Face-space is an internal degree of freedom, like isospin.

It is not SO(3) spatial rotation. The gauge group SU(3) acts on the internal face-state, not on spacetime coordinates.

Epistemic Status by Section. See section headings.

Notation. Symbol firewall: $\alpha_1, \alpha_2, \alpha_3$ in this paper are complex amplitudes of the orientation state.

They are NOT the α correction factor of AP18. λ in this paper is the substrate stiffness (AP15), NOT a wavelength. SU(3) generators are denoted T^a , not $\lambda_1-\lambda_8$, to avoid collision with $\lambda = \text{stiffness}$.

Scope and Debts. The paper derives SU(3) as the gauge group of the manifold’s orientation around the break. Colour charge as orientation. Gluons as gauge bosons. SU(3) unbroken (gluons massless). Colour neutrality from isotropy.

The full Standard Model gauge group $SU(3) \times SU(2) \times U(1)$.

The paper explains qualitatively but does NOT derive quantitatively: confinement, asymptotic freedom, colour flux tube energy, string tension. These are structural explanations from isotropy + substrate stiffness, not quantitative derivations from {S, B, R, C}.

The paper conjectures but does NOT derive: three generations as three orientations (§9). Mass ratios $m_e : m_\mu : m_\tau$ not computed.

Debts:

D1 (Open): Quantitative confinement — derive colour flux tube energy / string tension from axioms.

D2 (Open): Generation mass hierarchy — compute mass ratios from the three-face structure.

D3 (Open): Running coupling — derive $\alpha_s(Q^2)$ from axioms to verify asymptotic freedom quantitatively.

Dependencies. Paper D — Non-derivability of axioms (Theorems 1.1–1.4). Provides: independence of {C, S, B}. AP05 — Actualisation creates g, c, time . AP07 — Complex Hilbert space.

Provides: \mathbb{C} as the arena for quantum states; Born rule. AP08 — $N = 3$ spatial dimensions from three axioms {C, S, B}. Provides: the three-face structure. AP09 — $SU(2)$ from the two-sector structure.

Provides: $SU(2)$ gauge group. Also: $\varepsilon = \text{electron}$ (via Edition 04, The Lock). ε is the minimum viable splinter, the lightest charged fermion. AP13 — $U(1)$ from Hilbert-space phase freedom.

Provides: $U(1)$ gauge group; overall phase already gauged. AP14 — Higgs mechanism = Axiom B. Provides: $SU(2) \times U(1)$ breaking pattern. AP15 — Substrate stiffness $\lambda \approx 2.15 \times 10^{46}$.

Provides: quantitative scale for isotropy enforcement.

Axiom Mapping. Axiom S \rightarrow Sector structure from which $SU(2)$ was derived (AP11). The involution σ provides the paired/unpaired distinction. Axiom B \rightarrow The break direction. ε breaks along ONE face. Which face?

All three are equivalent (Paper D: independence). The choice is a gauge freedom. $SU(3)$ = the group of rotations in face-space {C, S, B}. Axiom R \rightarrow Time. The only irreversible axiom.

Provides the temporal face (-). Not directly load-bearing for $SU(3)$. Axiom C \rightarrow One of three spatial faces. Provides propagation direction (+). One of the three orientations in face-space.

Kill Switch Summary. KS-48 (Orientation = colour): LIVE — EMPIRICAL. Colour never directly observed (confinement). Structurally secure. KS-49 (Confinement from isotropy): LIVE — EMPIRICAL. Deconfinement at high temperature is consistent.

KS-50 ($SU(3)$ from non-derivability): LIVE — HARD. Requires disproving Paper D independence theorems.

Structural Relationships. AP10 (The Dimension): $N = 3$ from three independent axioms {C, S, B}. Three faces of one manifold. AP11 (The Spin): $SU(2)$ from $Z_2 = \pi_1(SO(3))$. AP19 adds $SU(3)$ from orientation freedom.

AP15 (The Connection): $U(1)$ from phase freedom. Together: $SU(3) \times SU(2) \times U(1)$. The Standard Model. AP16 (The Break — EW): Axiom B breaks $SU(2) \times U(1)_Y \rightarrow U(1)_{em}$. $SU(3)$ is unbroken.

§1 – The Problem

You have watched the gauge structure assemble piece by piece.

SU(2) from Axiom S (AP09). U(1) from the phase freedom of the complex Hilbert space (AP13). The electroweak unification derived, with the Higgs mechanism identified as Axiom B (AP14).

One piece remains. SU(3) – the gauge group of the strong nuclear force. The last piece.

This paper derives it. And once you see where it comes from, you will wonder how it could have come from anywhere else.

§2 — Three Expressions of One Manifold

You already know the three-face structure from AP08. $N = 3$ spatial dimensions from the four axioms {S, B, R, C}.

R expresses the temporal direction (–). It is the only irreversible axiom (KS-15 CLOSED). Time.

The three remaining axioms each express one face of the spatial manifold:

C — the propagation face. Axiom C gives finite propagation. On the manifold, this expresses one mode of the spatial structure: the mode along which signals travel. The character of c .

S — the exchange face. Axiom S gives the two-sector structure and the involution σ . On the manifold, this expresses one mode of the spatial structure: the mode across which the sectors are mapped.

The character of exchange.

B — the break face. Axiom B gives the break ε . On the manifold, this expresses one mode of the spatial structure: the mode through which the break acts. The character of the splinter.

Critical distinction: functional identity vs geometric assignment. Each face has a fixed functional identity — what it expresses (propagation, exchange, break). The identity comes from the axiom that generates it.

But no face has a fixed geometric assignment — which spatial direction it occupies. The labels C, S, B name what each face is, not where it points. The functional identity is intrinsic.

The spatial assignment is free.

These three faces are intrinsically linked. They are expressions of the same conditions of reality. C, S, and B co-arise. You cannot have one without the others.

The manifold is one structure and these are three faces of it — not three separate pieces assembled together.

But they are distinct. No axiom is derivable from the others (Paper D, Theorems 1.1–1.4). Linked but not reducible. Knowing one does not tell you another.

Three faces of the same thing, each saying something the others cannot say.

Hold that. Three faces. Linked but independent. The functional identity fixed. The geometric assignment free. Everything that follows grows from this.

§3 — The Silent Pop

§3.1 — Before the break, there is no direction.

Before the break, the pre-state is the 1:1. Perfect symmetry. No preferred axis. No “this way” versus “that way.”

Direction requires asymmetry. To point, you need a distinction — somewhere that is different from somewhere else. In the 1:1, nothing is different from anything else. The concept of direction is meaningless in perfect symmetry.

The break is what makes direction a sensible concept.

Axiom B: one element $\varepsilon \in \mathcal{L}$ with no σ -image in \mathcal{P} . Valuation $v(\varepsilon) = 1$. The minimum viable splinter. The splinter pops off. Now there is a distinction: the splinter and the remainder.

Now “this way” means something. Now direction exists.

The actualisation creates the conditions: g, c, time (AP05 §10.4–10.5). The record is written within these constraints. But more fundamentally: the actualisation creates the possibility of direction itself.

§3.2 — The manifold orients around the splinter.

The splinter does not fall into a pre-existing structure. There is no pre-existing structure with labelled slots waiting for the break to choose one.

The splinter pops, and the entire structure orients itself around the splinter.

The break is the reference point. The origin. The fixed fact. The three faces of the manifold — C, S, B — crystallise around the break.

The manifold does not exist first and then receive the break. The break and the manifold co-arise. But the break is the event. The manifold is the description of the event. The event is fixed.

The description arranges itself around it.

The splinter leaves the 1:1. The manifold organises around it. The fact that the break occurs is physically meaningful — it is everything, it is actualisation itself.

But how the manifold arranges itself around the break — which face aligns which way — is not determined by anything. The break does not care. It just broke.

That is the silent pop. And if you have been following the geometry, you can already feel what comes next.

If the orientation is free — if nothing determines which face points which way — then that freedom must have consequences.

§3.3 — Endless possibilities.

[Synthesis — non-load-bearing.]

Locally — within one actualisation event — the manifold orients around the break.

The orientation is what it is. The record is written.

Over many actualisations — over cycles, over the full accumulation of records — there are endless possibilities. Every orientation is explored.

Not because some metaphysical principle demands it, but because there are so many cycles, so many pops, so many records, that everything gets visited.

What could be interpreted as freedom is simply the vastness of the possibility space over cyclical actualisation.

The local orientation is the quark's colour. The cyclical isotropy is confinement. Both are derived below.

§3.4 — Two views of the same now.

Before collapse (the wave): all orientations of {C, S, B} around the break coexist simultaneously. Not metaphor — full superposition.

Every possible arrangement of the three faces around the break is a real branch of the quantum state. The orientation state $|\varepsilon\rangle \in \mathbb{C}^3$ lives here.

The complex amplitudes are real because this IS quantum superposition (AP07).

After collapse (the particle): the record history — the accumulated structure of all prior actualisations — orientates the axioms. One orientation manifests. A quark with a definite colour. The collapsed wave.

Wave and particle are not different things. They are different views of the same now.

You have seen superposition before — in AP07, in AP09, in the Born rule. Here it appears again, doing the same work it always does: holding every possibility until the record collapses it into one.

Three critical questions resolve:

Why the orientation is quantum (\mathbb{C}^3 , not \mathbb{R}^3): because before collapse, the faces carry no spatial assignment. They exist in superposition across all possible geometric arrangements. The complex amplitudes of \mathbb{C}^3 describe this superposition.

A classical orientation ($\mathbb{R}^3, SO(3)$) would describe a manifold that already has a definite spatial arrangement — but that is the post-collapse particle view, not the pre-collapse wave.

The orientation is quantum because the break is a quantum event.

Why the faces are interchangeable in their spatial expression: because no axiom carries a built-in spatial tag. The functional identity (propagation, exchange, break) is fixed by which axiom generates the face.

The geometric assignment (which spatial direction the face occupies) is determined at each actualisation by the record history — not by anything intrinsic to {C, S, B}. The axioms determine what the faces express.

The record history determines where they point. Functional identity fixed. Geometric arrangement free.

Why the freedom is total: within the universal constraints (the axioms themselves), all orientations are possible — and over many actualisations, all are necessary. Every arrangement is realised. The possibility space is ergodically filled.

Not a hypothesis about the dynamics — a consequence of the superposition being real and the actualisations being many.

§4 — The Gauge Freedom

Now watch the algebra fall.

§4.1 — The physics does not depend on the orientation.

The break happens. The manifold orients around it. But the physics — the probabilities, the field equations, the observables — does not depend on the orientation.

The reasoning follows from the non-derivability of the axioms. The three faces of the manifold are expressed by C, S, and B.

These are intrinsically linked but no face is derivable from another (Paper D, Theorems 1.1–1.4). Knowing one face does not determine another. Therefore no arrangement of faces around the break is preferred over any other.

Rotating the orientation — reshuffling which face aligns which way around the break — does not change any observable.

Step 1: Global symmetry from non-derivability. The non-derivability of {C, S, B} (Paper D, Theorems 1.1–1.4) means no physical principle selects one face over another.

The Lagrangian/action cannot contain terms that distinguish faces, because the axioms provide no basis for such terms. The action is invariant under relabelling the faces. A global symmetry.

Step 2: Local symmetry from per-event orientation. The orientation is defined per actualisation event (§3.4). Each break has its own orientation, determined by the local record history. Different events can have different orientations.

The freedom to choose the face-assignment independently at each spacetime point promotes the global symmetry to a local symmetry.

Step 3: Local symmetry → gauge theory. A local internal symmetry requires a connection — a gauge field that compensates for the variation of the orientation between neighbouring events.

Standard: local $SU(N)$ invariance implies an $SU(N)$ gauge connection $A_\mu = A_\mu^a T^a$, with gauge bosons mediating the interaction. The gauge field is not postulated; it is forced by the locality of the symmetry.

The orientation is a gauge degree of freedom. Not merely a relabelling convention, but a local internal symmetry with a dynamical connection. The gauge bosons of this connection are the gluons (§5.3).

You have just watched the same pattern that produced $U(1)$ in AP13 and $SU(2)$ in AP09: a freedom that cannot be removed, promoted to a local symmetry, forcing a gauge field into existence.

The axioms do not postulate forces. The axioms produce freedoms. The forces are consequences.

§4.2 — The gauge group is $SU(3)$.

Lemma (Orientation state). The orientation of a quantum event among n distinct outcomes is a state vector in \mathbb{C}^n , not a classical configuration in \mathbb{R}^n .

Proof.

- The break is a quantum event (AP07: actualisation produces quantum states in a complex Hilbert space \mathcal{H}).
- The orientation of the break among the three faces {C, S, B} is a property of this quantum event — it is determined at collapse, not before (§3.4).
- Before collapse, all orientations coexist in superposition (§3.4). A quantum property with n distinct outcomes is described by a state vector in \mathbb{C}^n with complex amplitudes (AP07 §3.3, Born rule AP07 §6).

- The break and the manifold co-arise (§3.2). The manifold's orientation is not a classical rotation applied to a pre-existing structure; it is a property of the quantum break event itself.

- Therefore the orientation state is $|\varepsilon\rangle \in \mathbb{C}^3$, not a vector in \mathbb{R}^3 . ■

[If the orientation were classical (three real axes, classical rotation), the gauge group would be $SO(3)$, not $SU(3)$.

The complex Hilbert space of AP07 is load-bearing: it promotes the orientation to a quantum state, giving $U(3)$ and hence $SU(3)$. Without AP07, the derivation yields the wrong group.]

The Lemma is doing quiet, decisive work. If the Hilbert space were real, you would get $SO(3)$. The complex structure of AP07 — derived, not assumed — is what forces $SU(3)$.

The wrong Hilbert space gives the wrong gauge group. The right Hilbert space gives the right one.

The orientation state is:

$$|\varepsilon\rangle = \alpha_1|e_1\rangle + \alpha_2|e_2\rangle + \alpha_3|e_3\rangle$$

where e_1, e_2, e_3 are the three faces, $\alpha_1, \alpha_2, \alpha_3$ are complex amplitudes, and $|\alpha_1|^2 + |\alpha_2|^2 + |\alpha_3|^2 = 1$ (Born rule, AP07 §6). A vector in \mathbb{C}^3 .

Proposition 1 (Gauge group). The gauge group of the orientation freedom is $SU(3)$.

Proof.

- The orientation state $|\varepsilon\rangle \in \mathbb{C}^3$ (Lemma, three faces, complex amplitudes).
- Gauge transformations are unitary transformations of \mathbb{C}^3 that preserve the norm (§4.1: physics is invariant under local reorientation).
- The group of norm-preserving transformations on \mathbb{C}^3 is $U(3)$.

- $U(3) \cong (SU(3) \times U(1))/\mathbb{Z}_3$. The $U(1)$ factor is the overall phase of the orientation state: $|\varepsilon\rangle \rightarrow e^{i\theta}|\varepsilon\rangle$.

Under AP13, the overall phase of any quantum state in \mathcal{H} is already gauged — this is the Hilbert-space phase freedom, the same $U(1)$ that on the manifold manifests as the electromagnetic connection.

The orientation state $|\varepsilon\rangle \in \mathcal{H}$ inherits this phase redundancy. Factoring it out leaves $SU(3)$ as the new gauge symmetry specific to the orientation degree of freedom.

- $SU(3)$ has $3^2 - 1 = 8$ generators. ■

[Note on global structure: the full Standard Model gauge group has global structure $(SU(3) \times SU(2) \times U(1))/\mathbb{Z}_6$, not a simple product. This paper derives the Lie algebra structure $\mathfrak{su}(3) \oplus \mathfrak{su}(2) \oplus \mathfrak{u}(1)$.

The global quotient is a separate question, not addressed here.]

Sit with that. Three independent faces of one manifold. One quantum event. The freedom to orient. And the algebra says: $SU(3)$. Eight generators. The gauge group of the strong force.

Not postulated. Not fitted. Derived from the fact that three faces cannot tell you which way to point.

Representation. The orientation state $|\varepsilon\rangle \in \mathbb{C}^3$ transforms in the fundamental (defining) representation of $SU(3)$ by construction — $SU(3)$ is the group that acts on \mathbb{C}^3 .

Quarks, as localised break events, carry colour in the fundamental **3**. Antiquarks (σ -images) carry the conjugate **$\bar{3}$** .

$SU(3)$ is derived. It is the gauge symmetry of the manifold's orientation around the break.

§5 — Colour

§5.1 — What colour is.

A quark's colour is how the manifold oriented around its break.

Red: the C-face aligned with the break.

Green: the S-face aligned with the break.

Blue: the B-face aligned with the break.

These labels are arbitrary — the assignment of colour names to faces is a gauge choice.

What matters is that there are three faces, they are distinct but linked, and the physics is symmetric under rotations among them. You could call them anything. The structure does not care about your labels.

It cares about the number three.

An antiquark's anticolour is the conjugate orientation — the complex conjugate representation $\bar{\mathbf{3}}$ of SU(3).

Under the involution σ (Axiom S), the σ -image of a quark state maps to the anti-triplet: σ acts on the orientation state by complex conjugation of the amplitudes, giving the conjugate representation.

[Why the electron — itself a localised break (AP09: ε = electron) — is an SU(3) singlet despite being a break event: see §5.4.]

§5.2 — Colour neutrality.

A colour-neutral state is one where no face is preferred. Isotropic orientation. No preferred alignment.

Proposition 2 (Colour neutrality – structural). The only stable macroscopic states are colour-neutral (isotropic in orientation).

Proof.

- The manifold is isotropic at macroscopic scales (AP08: three spatial dimensions from three axioms, no preferred direction). The ground state of the manifold.

- The orientation of the manifold around the break is a degree of freedom of the manifold (§4). A macroscopic state with a preferred orientation (locked colour) would be a macroscopic anisotropy in the manifold.

- The substrate resists macroscopic anisotropy with stiffness $\lambda \approx 2.15 \times 10^{46}$ (AP15). The energy cost of maintaining a macroscopic orientation anisotropy grows with the volume of the anisotropic region.

- Therefore the ground state of the orientation at macroscopic scales is isotropic: all three faces equally represented, no preferred alignment. Colour neutrality.

- Any state that is not colour-neutral at macroscopic scale carries an energy penalty proportional to the anisotropic volume $\times \lambda$. Such states relax to colour-neutral configurations. ■

[Note: structural proposition, not quantitative derivation. The precise energy functional and resulting string tension are not yet computed from the axioms (see D1).]

Red + green + blue = white. All three faces equally represented in the orientation around the break. The ground state of the manifold.

You see the pattern. The manifold insists on isotropy. Not because a law commands it, but because the substrate is stiff and anisotropy costs energy.

A proton is three quarks — one red, one green, one blue — combined to make white.

A meson is a quark-antiquark pair — colour plus anticolour — combined to make white.

All observed hadrons are colour-neutral. An empirical fact — and a structural consequence of Proposition 2.

§5.3 — Gluons.

The gauge bosons of SU(3) are the gluons. There are 8 (from the 8 generators of SU(3)).

A gluon is a quantum of the gauge field that rotates the manifold's orientation around the break. It carries a colour-anticolour pair (e.g., red-antigreen). It mediates the strong force by exchanging orientation between quarks.

Gluons are bosons (paired elements, σ -image exists, AP09 §3.1). Gluons are massless (SU(3) is not broken; see §6.3). Gluons carry colour charge themselves (unlike photons, which are charge-neutral).

SU(3) is non-Abelian: the generators do not commute. The gauge bosons interact with each other.

§5.4 — Why the minimum break ε is an SU(3) singlet.

Here is a question you should already be asking. The electron is ε — the minimum viable splinter (AP09, Edition 04: The Lock). The electron is a localised break.

But the electron does not carry colour. Why?

Proposition 4 (Minimum break singlet). The minimum break ε is an SU(3) singlet. Its orientation state is isotropic (colour-neutral).

Proof.

- ε is the minimum viable splinter (Axiom B). It is the lowest possible energy state in which a break can exist (AP09: “the smallest possible piece the fabric could release”).

- Colour is a preferred orientation of the manifold around the break in face-space (§5.1). A “red” state has the C-face aligned; a “blue” state has the B-face aligned.

Any state with a preferred face-alignment is anisotropic.

- Anisotropy costs energy (Proposition 2, §5.2). The substrate resists anisotropy with stiffness $\lambda \approx 2.15 \times 10^{46}$ (AP15). Any state with a preferred orientation has higher energy than the isotropic (colour-neutral) state.
- The minimum energy break must therefore be isotropic. A coloured state would not be the minimum — it would carry additional energy from the anisotropy. The minimum break has no preferred face-alignment.
- An isotropic orientation state is invariant under SU(3). It is a singlet. ■

The electron is colour-neutral because it is the ground state of the break. Not a different kind of object from a quark. Both are localised breaks.

But the electron is the minimum break — the lowest energy configuration — and the lowest energy orientation is isotropic. Quarks are higher-energy excitations that sustain an anisotropic orientation (a colour charge).

The mass gap between the electron (~ 0.511 MeV) and the lightest quark (up quark, ~ 2.2 MeV) is consistent: the quark carries additional energy from its colour anisotropy.

[No contradiction: AP09 identifies $\varepsilon =$ electron as a localised break, yet the electron carries no colour. The resolution is that colour requires anisotropy, and anisotropy requires energy above the minimum.

The minimum break is necessarily isotropic. No import required — follows from Axiom B (minimum) + Proposition 2 (anisotropy costs energy).]

You see what happened. The same argument that explains why hadrons are white also explains why the electron is colourless. One mechanism. Two consequences.

§6 — Confinement

§6.1 — Why you never see a lone quark.

[Structural explanation — qualitative, not quantitative. Confinement is explained from isotropy + substrate stiffness, but the flux tube energy is not derived from {S, B, R, C}. See D1.]

A lone quark would be a break whose manifold orientation is locked to one face at macroscopic scale. An anisotropic eye.

The manifold is isotropic. Three linked faces, no preferred one. At macroscopic scales — many records, many actualisations — the manifold insists on isotropy. The substrate is stiff ($\lambda \approx 2.15 \times 10^{46}$).

It restores isotropy. It does not tolerate macroscopic anisotropy.

A lone colour charge is an orientation that has not been cancelled by its complementary alignments. At short distances — inside the hadron — the anisotropy is local and tolerable.

One record can orient one way without violating the manifold's large-scale isotropy.

At large distances — trying to separate a quark from its partners — the anisotropy would become macroscopic. The substrate resists. The energy stored in the anisotropy grows with distance.

The colour flux tube — the region between separated quarks where the orientation field is stretched, resisting the separation, storing energy proportional to the distance.

Eventually, the energy in the flux tube is enough to create a new quark-antiquark pair. The pair pops into existence (Axiom B: the break has minimum size ε ; new breaks can occur).

One new quark joins the separated quark. The other joins the remnant. Two colour-neutral hadrons where there was one. The quarks are never free.

Confinement is the manifold's isotropy enforced by the substrate's stiffness.

You cannot pull a quark free any more than you can stretch a rubber band forever.

The manifold snaps back.

Not because a force holds the quark in place — because the shape of the room does not permit macroscopic anisotropy.

[Quantitative derivation of the flux tube energy / string tension from the axioms is an open problem (D1).

Here is how to destroy this claim: derive the string tension from {S, B, R, C} and show it contradicts lattice QCD measurements. The argument hands you the weapon.]

§6.2 — Asymptotic freedom.

[Structural explanation — qualitative. See D3.]

At short distances — inside the hadron, at high energies — the quarks behave as if they are free. The strong force gets weaker at short range.

Asymptotic freedom (Gross, Wilczek, Politzer, papers 1973, Nobel Prize 2004).

At short distances, the orientation is local. One record, one alignment. The anisotropy is confined to a single Planck cell or a few cells.

The substrate does not need to enforce isotropy at this scale — the anisotropy is already microscopic. The restoring force is negligible. The quarks move freely.

As the distance increases, the anisotropy grows. The substrate notices. The restoring force strengthens. The coupling increases. The quarks are pulled back.

Asymptotic freedom at short range. Confinement at long range. The same mechanism: the substrate's response to anisotropy in the orientation. Weak when the anisotropy is small. Strong when the anisotropy is large.

You are watching one mechanism produce both behaviours — not two forces, one.

[In standard QCD, this behaviour is captured by the negative β -function of non-Abelian gauge theory. D3 is to reproduce the running coupling $\alpha_s(Q^2)$ from the stiffness/isotropy mechanism.]

§6.3 — Why SU(3) is not broken.

SU(2) \times U(1) is broken by Axiom B (AP14). The break distinguishes the sectors. SU(2) is broken. U(1) survives.

SU(3) is NOT broken. Why?

You already know the answer. You have been watching it build since §2.

Proposition 3 (SU(3) is exact). Axiom B breaks SU(2) but does not break SU(3). The strong gauge symmetry is exact and the gluons are massless.

Proof.

- SU(2) is the symmetry of whether the sectors are distinguishable. Axiom B ($\varepsilon \in \mathcal{L}$ with no σ -image in \mathcal{P}) creates a distinction between the two sectors. Breaks SU(2) (AP14).

- SU(3) is the symmetry of how the manifold orients around the break (§4). It acts on the orientation state $|\varepsilon\rangle \in \mathbb{C}^3$ — the arrangement of three faces around the break event.

- Axiom B asserts the existence of ε (the break happens) but contains no clause selecting a preferred orientation. B says: $\varepsilon \in \mathcal{L}$, $v(\varepsilon) = 1$, no σ -image.

None of these conditions distinguish one face from another.

- The non-derivability of {C, S, B} (Paper D, Theorems 1.1–1.4) guarantees that no axiom can induce a preference among the faces.

If one face could be preferred, it would imply a derivability relation between axioms.

- Therefore no term in the action/Lagrangian can break SU(3). The gauge symmetry is exact. The gauge bosons (gluons) acquire no mass. ■

Two words do different work. SU(2) is the symmetry of whether the break exists. Axiom B breaks it. SU(3) is the symmetry of how the manifold arranges around the break.

Axiom B does not break it. The break says "I exist." It does not say "I point this way."

SU(3) is exact. Unbroken. The gluons are massless.

§7 – The Full Gauge Structure

The complete internal gauge symmetry is now derived:

SU(3) × SU(2) × U(1)

SU(3) – from the gauge freedom of the manifold’s orientation around the break, across three distinct but linked expressions of the manifold (this paper).

SU(2) – from the two-sector structure and the double cover $SU(2) \rightarrow SO(3)$ in $N = 3$ (AP09).

U(1) – from the phase freedom of the complex Hilbert space, expressed on the manifold as the electromagnetic connection (AP13).

The symmetry breaking pattern:

SU(3) is exact (the orientation is free). Gluons are massless. Colour is confined.

SU(2) × U(1) is broken to U(1) by Axiom B (the break exists). W^+ , W^- , Z^0 are massive. The photon is massless.

The gauge structure of the Standard Model. Derived from {S, B, R, C}.

Step back and look at what you are holding. Four axioms. One governing relation.

And the full gauge structure of the Standard Model – the structure that took a century of experiment and theory to discover – falls out as a consequence of the freedom the axioms cannot remove.

§8 — Derivation Chain

AP08 → three spatial dimensions from three axioms {C, S, B} → three faces of one manifold. Functional identity fixed, geometric assignment free.

Axiom B → the break creates direction as a concept → the manifold orients around the break.

Before collapse: all orientations coexist in superposition (§3.4) → orientation is quantum, not classical.

Non-derivability of {C, S, B} (Paper D) → no face preferred → global symmetry. Per-event orientation → local symmetry → gauge theory with connection.

Complex Hilbert space (AP07) → orientation state $|\varepsilon\rangle \in \mathbb{C}^3$ (Lemma) → gauge group SU(3) (Proposition 1, not SO(3)).

Isotropy of manifold (AP08) + substrate stiffness (AP15) → macroscopic orientation isotropic → colour neutrality (Proposition 2). Confinement.

B fixes existence, not orientation (Paper D) → SU(3) unbroken (Proposition 3) → gluons massless.

Minimum break (Axiom B) + anisotropy costs energy (Proposition 2) → ε is isotropic → electron is SU(3) singlet (Proposition 4).

§9 — Three Generations

[Conjecture — not a derivation. See D2.]

A note on three generations, which this derivation illuminates. You will recognise the structure immediately.

The three faces of the manifold come from three axioms: C, S, B. Each axiom has different physical character:

C is propagation — the most external, the most accessible face. The lightest.

S is sector-crossing — intermediate. The exchange face.

B is the break itself — the most internal, the most fundamental face. The heaviest.

If ε actualised with the manifold's C-face aligned is the electron (lightest generation), and ε actualised with the S-face aligned is the muon (middle generation), and ε actualised with the B-face aligned is the tau (heaviest generation), then the three generations are ε with three orientations.

Same break. Different arrangement.

The mass hierarchy follows: C is the lightest face (propagation is the most accessible mode), B is the heaviest (the break face is the most internal, the most fundamental).

Mass increases with the depth of the face.

A conjecture, not a derivation. The mass ratios $m_e : m_\mu : m_\tau$ are not yet computed.

But the architecture provides the structure: three generations from three orientations from three distinct but linked expressions of one manifold.

Disambiguation: colour vs generation. The generation conjecture concerns which face dominates the orientation at the moment of actualisation — a different degree of freedom from the continuous SU(3) orientation that defines colour.

A first-generation quark can carry any colour; its generation is determined by which face's alignment carries the largest weight.

Colour and generation share a common origin (three faces of one manifold) but are distinct: colour is the full SU(3) quantum number, generation is a structural index determined at actualisation.

A red up quark and a red charm quark both exist — same colour, different generation.

Three colours and three generations from the same three faces. SU(3) and the generation structure share a common origin: {C, S, B}.

§10 — Kill Switches

Global corpus numbering. No collisions with AP16 (KS-32-34), AP17 (KS-39-44), AP18 (KS-45-47), AP24 (KS-35-38). Next available after this paper: KS-51.

§10.1 — KS-48 [LIVE — EMPIRICAL]: Orientation = Colour.

What it tests: The identification of the manifold's internal face-space orientation around the break with colour charge.

How to kill: If the $SU(3)$ coupling exhibits dependence on spatial direction in an isotropic background, or if lattice QCD reveals $SU(3)$ structure inconsistent with a three-dimensional internal orientation origin, the identification fails.

Here is the weapon: run the lattice calculation. Show the inconsistency.

Status: LIVE — EMPIRICAL. Colour is never directly observed (confinement). All observations are consistent with $SU(3)$ as an internal symmetry. The identification with internal face-space orientation adds structure but does not contradict any observation.

Structurally secure.

§10.2 — KS-49 [LIVE — EMPIRICAL]: Confinement from Isotropy.

What it tests: The explanation that confinement is the manifold enforcing isotropy via substrate stiffness.

How to kill: If confinement is shown to persist in a fundamentally anisotropic spacetime — or if deconfinement occurs at conditions where the manifold remains isotropic — the mechanism is wrong.

Here is the weapon: find the counterexample.

Status: LIVE — EMPIRICAL. Deconfinement is observed at high temperatures (quark-gluon plasma), where the record density is so high that local anisotropy is negligible.

Consistent: high temperature = many records = isotropy restored locally = quarks free. Structurally secure.

§10.3 — KS-50 [LIVE — HARD]: SU(3) from Non-Derivability.

What it tests: The derivation's dependence on the non-derivability of {C, S, B}.

How to kill: If one face of the manifold is shown to be derivable from the others — if the axioms are not independent — the gauge freedom is reduced and SU(3) does not follow.

Here is the weapon: disprove Paper D's independence theorems.

Status: LIVE — HARD. Non-derivability proven in Paper D (Theorems 1.1–1.4). KS-16 (completeness) CLOSED. To kill this, you must disprove Paper D's independence theorems.

§11 — Conclusion

The strong force is the gauge freedom of the manifold's orientation around the break.

Before the break, there is no direction. The 1:1 is perfect symmetry. The splinter pops. Now direction exists as a concept. But the splinter does not fall into a pre-existing structure.

The structure orients itself around the splinter. The break is the fixed point. The arrangement is the free part.

Three faces of one manifold. Intrinsically linked but distinct — no face derivable from another. The manifold must orient around the break. But how it orients is not determined. That freedom is $SU(3)$.

Colour is how the manifold oriented around this particular break. Colour neutrality is isotropy — no preferred face. Confinement is the manifold restoring its symmetry. Asymptotic freedom is the substrate ignoring small anisotropies.

Gluons are the quanta that rotate the orientation. They are massless because $SU(3)$ is not broken — the break fixes existence, not orientation.

The complete gauge structure of the Standard Model:

$SU(3) \times SU(2) \times U(1)$

is now derived from {S, B, R, C}.

[Synthesis — non-load-bearing.] The splinter pops. The structure shifts. The manifold crystallises around the break. Three faces, intrinsically linked, none derivable from another. How they arrange is free. That freedom is the strong force.

And over many pops, many records, many cycles — endless possibilities. Every arrangement explored. The manifold fills out isotropically. The ground state is colour-neutral.

The quarks are confined not by a cage but by the shape of the room.

The axiom speaks. The algebra transcribes.

Conditional on: EH (Embedding Hypothesis).

Depends on: Paper D (non-derivability of axioms), AP05 (actualisation), AP07 (complex Hilbert space), AP08 ($N = 3$, three expressions of one manifold), AP09 ($SU(2)$; $\varepsilon =$ electron via Edition 04), AP13 ($U(1)$), AP14 (Higgs = Axiom B), AP15 (substrate stiffness).

New kill switches: KS-48 (orientation = colour), KS-49 (confinement from isotropy), KS-50 ($SU(3)$ from non-derivability).

What is derived: $SU(3)$ gauge symmetry (Proposition 1). Colour neutrality from isotropy (Proposition 2, structural). $SU(3)$ unbroken / gluons massless (Proposition 3). Minimum break ε is $SU(3)$ singlet (Proposition 4).

Colour as manifold orientation around the break. 8 gluons from 8 $SU(3)$ generators. The full Standard Model gauge structure $SU(3) \times SU(2) \times U(1)$.

What is explained qualitatively: Confinement from isotropy + substrate stiffness. Asymptotic freedom from scale-dependent anisotropy response.

What is conjectured: Three generations as three orientations. Mass hierarchy from face-depth ordering.

THREE-BUCKET FOOTER

Synthesis language in §3.3 and §11 conclusion is non-load-bearing. All derivation claims rest on Propositions 1–3 and the chain in §2–§4. §3.4 (wave/particle) is load-bearing for the Lemma.

Confinement (§6.1–6.2) is structural explanation, not quantitative derivation. Colour neutrality (Prop 2) is structural. Three generations (§9) is conjecture.

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