FERMION CARRIER–GENERATION STRUCTURE II

Terminal Nonpromotion and Target-Relative Factorization in Charged and Colored Matter

Fully abstract signatures, aggregate-safe colored targets, and an exact FCGS-II disposition atlas

The exact-three root object and four typed matter fibres are received unchanged from FCGS-I. This paper determines the additional conditions under which a rooted sector, relation, aggregate, or parent presentation may acquire terminal physical standing. Same-target identity is defined by indistinguishability under all licensed semantic uses. A complete typed continuation signature represents that identity exactly when its soundness and semantic completeness are activated. Terminal realization then requires candidate precertification, injective preassignment, a live residue, compatible role-covering bijections, physical authority, and exactly one lawful assignment orbit. Generation cardinality, Higgs response, mass, charge, decay, field notation, and detector display cannot replace this factorization.

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Abstract

FCGS-I derives an unlabelled three-root object I_3, forms the typed matter bundle $I_3 \times \{N, L, U, D\}$, and proves three rooted structural Higgs-response incidences per matter kind through one bridge/fixation carrier. Those premetric results do not identify terminal physical bearers. FCGS-II supplies the next theorem layer without changing the accepted FCGS-I chain.

For a frozen target, candidate presentations form a functor on the category of licensed continuations. Same-target carrier identity is defined independently as equality under every licensed semantic use. A codomain-typed arbitrary-base continuation signature is proved fully abstract when every coordinate is a licensed use and every licensed use factors through it. Signature equality then characterizes semantic identity, is stable under continuation, and induces the semantic carrier quotient with its universal factorization property.

Terminal realization is then stratified into precertified quotient classes, injective compatible preassignments, the induced live residue, compatible role-covering bijections, and Role-Occupancy Closure (ROC), which requires exactly one lawful assignment orbit. Quotient descent makes the unary and joint predicates representative-independent. The surface-fibre criterion states precisely when surface data could determine precertification, while the promotion theorem requires an actual singleton-ROC terminal certificate. Generation count, mass, charge, process or matrix display, Higgs incidence, field names, and reconstruction records do not supply that certificate.

The application is relative to two finite, versioned evidence bases and a typed inductive source calculus with a no-new-field invariant. Charged mass- shape and readout results are credited only at their stated targets. Colored descent is formulated by a Set-valued profunctor from upstream joint colored configurations to gauge-invariant singlet boundary records. The structural Yang–Mills extension supplies exact theorem-scope nonlocal sector authority through its extended-support class and realized-sector/global-form recovery theorems; the distinct bounded-region sharp-local gap and that structural sector theorem are not promoted to confinement, asymptotic authority, or complete channel coverage. The charged-lepton target and the two U/D-marked colored targets consequently have exact NotReady dispositions carrying their full residual profiles. Each profile separates interface formation, positive singleton-ROC completion, and exhaustive-negative completion. Since the formation layer is unready, no terminal ROC is formed or counted. The result is an exact evidence-relative classification, not a claim that charged leptons or quarks do not exist.

Contents

1 Introduction

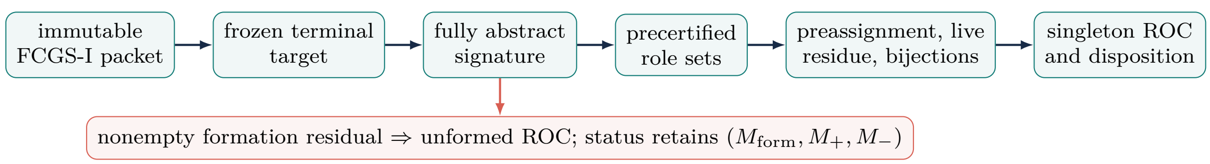
The familiar Standard Model table places fields, charges, generations, masses, transitions, and observed particles on one surface. It is an efficient representation of realized physics, but it combines three distinct questions:

1. which premetric roots and response incidences are structurally present;
2. which source-generated presentations are the same standing carrier at a frozen target; and
3. which carriers occur in a complete, jointly compatible terminal realization at a specified physical boundary.

FCGS-I answers the first. FCGS-II gives a typed factorization for the second and third and evaluates their dispositions relative to fixed evidence bases.

A generation root is not a terminal bearer. Terminal standing requires a complete semantic interface, persistence, local precertification, compatible injective preassignment, a live residue, a role-covering bijection, exactly one lawful assignment orbit, and the physical authority appropriate to the claim. Three roots, three names, three matrix rows, three masses, or three Higgs-response slots cannot supply omitted terminal fields.

The dependency architecture is



1.1 Main results and scope

The main result has two parts. The first is a conditional but fully proved mathematical architecture: semantic carrier identity, full abstraction of complete signatures, continuation congruence, quotient descent, acyclic terminal realization, assignment-orbit factorization, and the singleton-orbit ROC criterion. The second is an exact application theorem: neither the positive nor exhaustive-negative completion packet is activated for the charged or marked colored targets, and the three residual layers are retained in each disposition value. This gives an exact target-indexed classification without inventing a physical theorem absent from the sources.

Main result. Complete target-relative interfaces admit semantic-quotient and assignment-orbit factorization, with positive terminal realization requiring one lawful orbit. At the finite evidence bases studied here, neither the positive nor the exhaustive-negative packet is activated for the charged or marked colored targets. The resulting readiness classifications preserve the entire FCGS-I chain and determine no terminal cardinality.

1.2 Contributions

- Same-target carrier identity is defined semantically and only then represented by a complete typed signature.
- Arbitrary-base signatures and continuation congruence are proved with every witness codomain declared.
- Candidate precertification, injective preassignment, live residue, compatible bijections, and singleton ROC are stratified, removing the circular certificate architecture.

- The surface-fibre criterion is separated from the promotion implication valid in a formed terminal architecture.
- The charged source history is reconstructed field by field through its later local closures and remaining registry, process, authority, and exhaustive-rejection gaps.
- Colored physical descent is formulated on joint multi-parton configurations with retained U/D provenance and a channel profunctor to gauge-invariant color-neutral boundaries.
- A source-typed reaction hypergraph, observation/inference, chiral incidence, global form, anomaly-ledger incidence, and the unchanged two-arrow Higgs response chain are kept type-distinct.
- The numbered results produce an instantiated target-indexed disposition atlas and a typed successor-stage constraint.

1.3 Scope of physical language

Terminal means terminal at a frozen comparison and physical-boundary interface. It does not mean absolutely elementary or eternally stable. A resonance may be terminal for a pole target with the required gauge-invariant authority; a confined field may have internal structural standing without being an asymptotic bearer; a color-neutral composite may be terminal at a different boundary. These are target distinctions, not vocabulary choices.

1.4 Reading guide

Section 2 freezes the accepted import and no-backflow order. Section 3 proves semantic/signature full abstraction. Section 4 forms the charged and aggregate-safe colored targets. Section 5 constructs the acyclic terminal architecture and proves the terminal admissibility criterion. Sections 6 and 7 evaluate the source-relative branches. Section 8 proves typed process separation, quantum-boundary coinstantiation, and Higgs preservation. Section 9 gives the ROC, disposition atlas, and successor object. Section 10 states robustness tests, the main theorem, and the conclusion; the appendices provide the theorem index and source-use contracts.

2 Immutable import and terminal target lock

2.1 The received FCGS-I packet

Let $\mathsf{F} = \{N, L, U, D\}$ denote the neutral weak, charged colorless, up-type colored, and down-type colored matter kinds. FCGS-II receives the accepted FCGS-I result as

$$\mathcal{H}_I = \left(I_3, \{\mathcal{E}_f, \mathcal{S}_f, Q_f^Y, \eta_f, \chi_f\}_{f\in\mathsf{F}}, H_{\mathrm{br/fix}}, S_3 \curvearrowright I_3, \mathfrak{A}_0\right),$$

where

$$|I_3| = 3, \qquad \mathcal{E}_f = I_3 \times \{r_f\}, \qquad p_f : \mathcal{E}_f \xrightarrow{\sim} I_3,$$
$$\mathrm{Disc}(I_3) \underset{\sim}{\xrightarrow{\eta_f}} \mathcal{S}_f(C_f) \underset{\sim}{\xrightarrow{\chi_f}} Q_f^Y = \mathrm{Disc}(\mathcal{A}_f).$$

The canonical projection $p_f : \mathcal{E}_f \xrightarrow{\sim} I_3$ also gives the derived positioned-fibre map

$$\widehat{\eta}_f := \eta_f \circ \mathrm{Disc}(p_f) : \mathrm{Disc}(\mathcal{E}_f) \longrightarrow \mathcal{S}_f(C_f).$$

This derived map is not a redefinition of the received arrow: the FCGS-I field η_f retains the literal domain $\mathrm{Disc}(I_3)$. The positive-witness subquotient of Q_f^Y remains separate and may be empty. The common structural reduct $\mathfrak{A}_0$ erases kind-specific terminal, confinement, spectral, and metric data [1].

Definition 2.1 (Immutable import extension)**.** *An FCGS-II construction is an immutable import extension when it carries a designated literal-field inclusion and an erasure*

$$\iota_I : \mathcal{H}_I \hookrightarrow \mathcal{H}_{\mathrm{II}}, \qquad \epsilon_I : \mathcal{H}_{\mathrm{II}} \longrightarrow \mathcal{H}_I, \qquad \epsilon_I \iota_I = \mathrm{id}_{\mathcal{H}_I}\,.$$

Both maps preserve every received object, arrow, incidence, source contract, and external symmetry; ϵ_I forgets only the newly adjoined terminal fields. The inclusion is part of the extension data, not a section inferred from the erasure alone.

Theorem 2.2 (FCGS-I immutability)**.** *In every immutable import extension, the received FCGS-I packet is fixed pointwise along the designated inclusion. Identifying its literal image with the received fields, for every $f \in \mathsf{F}$,*

$$I_3^{\mathrm{II}} = I_3, \quad \mathcal{E}_f^{\mathrm{II}} = \mathcal{E}_f, \quad \mathcal{S}_f^{\mathrm{II}} = \mathcal{S}_f, \quad Q_f^{Y,\mathrm{II}} = Q_f^Y,$$

and both arrows η_f, χ_f, the external S_3-action, and the one bridge/fixation carrier $H_{\mathrm{br/fix}}$ are unchanged.

Proof. The section identity $\epsilon_I \iota_I = \mathrm{id}$ fixes every received field on the designated image, while preservation by both maps fixes all received incidences and composites. New terminal fields lie outside that image and the erasure forgets only those fields. Their failure or absence supplies no map deleting, identifying, or creating a received object or arrow. □

Corollary 2.3 (No independent recount)**.** *The charged-lepton and quark branches do not form new generation-cardinality engines. Any later terminal ROC is a quotient of a different assignment object and cannot be substituted for, or into, $|I_3| = 3$.*

2.2 Terminal kinds and frozen targets

FCGS-II evaluates $\mathsf{K}_{\mathrm{term}} = \{L, U, D\}$. The neutral branch is retained as an import and successor-target comparison, not recounted.

Definition 2.4 (Frozen terminal target)**.** *For $k \in \mathsf{K}_{\mathrm{term}}$, a frozen target is the record*

$$T_k = (D_k, \partial D_k, \mathfrak{S}_k, \mathcal{U}_k, \mathsf{Proc}_k, \mathsf{QB}_k, \mathsf{Auth}_k, \mathsf{AutSpec}_k, \mathsf{Fail}_k, \mathsf{Succ}_k)\,.$$

The fields are respectively the comparison domain, physical/observational boundary, source ontology, licensed continuation category, process architecture, quantum-boundary record, physical authority, ambient automorphism/action specification on the preterminal data, declared failure family, and successor rule. The lawful stabilizer of terminal assignments is formed only after precertification and the assignment law exist.

Two targets are identical only when every field, source version, chiral/global convention, and physical authority is extensionally identical. A change to a standing-bearing field is a successor-target map, not a same-target redescription. This prevents a mass-shape target from becoming a full terminal charged target by renaming, and a local-vacuum target from becoming a nonlocal confinement target by analogy.

2.3 Source, obligation, and authority states

A source has three distinct statuses:

$$\mathsf{Located}, \qquad \mathsf{UseContracted}, \qquad \mathsf{ActivatedAt}(T_k).$$

Location is provenance. A use contract fixes the exact theorem, hypotheses, target, and forbidden promotions. Activation additionally proves the hypotheses and target map. Thematic relevance implies none of these later statuses.

A registry is *source-complete relative to* T_k when every source sort, failure route, and authority family declared by that frozen target has a typed registry entry and use contract. This is target-relative exhaustiveness, not a claim that all possible literature or future physics has been listed.

Definition 2.5 (Atomic obligations and residual sets)**.** *A required atomic contract δ has one declared codomain and one activation test. For a frozen evidence basis, the residual set is the set of all required atomic contracts whose tests are not certified. A larger symbol such as Δ^+_{CL} denotes a full completion bundle, not an inclusion-minimal blocker unless a separate cut-set theorem proves minimality.*

Definition 2.6 (Evidence-indexed residual profile)**.** *For every terminal kind k, fix a disjoint finite decomposition*

$$\Delta_k(T_k) = \Delta_{k,\mathrm{form}}(T_k) \amalg \Delta_{k,+}(T_k) \amalg \Delta_{k,-}(T_k)$$

into interface-formation, constructive-completion, and exhaustive-elimination atoms. Also fix the explicitly enumerated finite target-local internal-certificate basis $\mathfrak{I}^0_k$. It consists only of proved target-formation outputs of this paper and the frozen provenance audit; it contains no target input and no terminal conclusion. For $j \in \{\mathrm{form}, +, -\}$, put

$$\mathrm{Cert}_{k,j}(\mathfrak{E}; \mathfrak{I}^0_k) := \Delta_{k,j}(T_k) \cap \bigcup_{c \in \mathrm{Der}_{T_k}(\mathfrak{E}; \mathfrak{I}^0_k)} \mathrm{supp}(c), \qquad M_{k,j}(\mathfrak{E}) := \Delta_{k,j}(T_k) \setminus \mathrm{Cert}_{k,j}(\mathfrak{E}; \mathfrak{I}^0_k),$$

and

$$\mathbf{M}_k(\mathfrak{E}) := \big(M_{k,\mathrm{form}}(\mathfrak{E}), M_{k,+}(\mathfrak{E}), M_{k,-}(\mathfrak{E})\big).$$

A positive packet is activated only by one certificate whose support contains $\Delta_{k,\mathrm{form}} \amalg \Delta_{k,+}$, or by the output of a registered packet-assembly constructor with that support. A negative packet is defined analogously using $\Delta_{k,\mathrm{form}} \amalg \Delta_{k,-}$. Atomwise availability alone is therefore not silently identified with a complete packet.

Definition 2.7 (Typed evidence calculus)**.** *For a frozen target let Δ_T be its atomic contract set. Let $\mathfrak{E}$ be an audited external evidence basis and let $\mathfrak{I}_T$ be a separately enumerated basis of proved internal certificates. Every leaf certificate $c \in \mathfrak{E} \amalg \mathfrak{I}_T$ has an exact target fingerprint and a declared field support* $\mathrm{supp}(c) \subseteq \Delta_T$. *A registered inference constructor*

$$\rho : (c_1, \ldots, c_n) \longmapsto c$$

is admitted only with a cited theorem/use contract, matching fingerprints, and the support condition

$$\mathrm{supp}(c) \subseteq \bigcup_{i=1}^{n} \mathrm{supp}(c_i).$$

The set $\mathrm{Der}_T(\mathfrak{E}; \mathfrak{I}_T)$ is the least typed family generated by those audited external and internal leaf certificates, coordinate projections, and the registered constructors. Zero-premise support-creating constructors are not admitted. Thus an internal theorem output is visible as a named leaf rather than hidden in the inference rules, and the calculus is not closure under unrestricted informal consequence.

Lemma 2.8 (No-new-field invariant)**.** *If $c \in \mathrm{Der}_T(\mathfrak{E}; \mathfrak{I}_T)$, every atomic coordinate in* $\mathrm{supp}(c)$ *occurs in the support of an audited external or internal leaf certificate on the derivation tree. In particular, a terminal coordinate absent from every compatible leaf support cannot be manufactured by composition.*

Proof. Induct on the derivation tree. The base and projection cases are immediate. For a constructor node, its support is contained in the union of the premise supports; the induction hypotheses for those premises give the result. $\square$

Theorem 2.9 (Import and target lock)**.** *Every immutable FCGS-II extension carries the designated literal-field inclusion*

$$\iota_I : \mathcal{H}_I \hookrightarrow \mathcal{H}_{\mathrm{II}}.$$

It carries separately frozen T_L, T_U, T_D target records, a versioned source-use ledger, physical-authority fields, residual obligation sets, and successor maps. Unresolved fields remain readiness coordinates.

Proof. The section identity fixes every received field on the designated image. Strict target equality makes any source, boundary, convention, or authority change an explicit successor step. The source-status distinctions and atomic residual set prevent a located or locally relevant theorem from entering the activated interface at a stronger target. □

2.4 No-backflow order

The dependency order is

$$\begin{aligned}\mathcal{H}_I &\prec T_k \prec \text{candidate/use and obligation registries} \prec \text{activated semantic signature} \prec Q_k^{\mathrm{car}} \\ &\prec \text{precertified role sets} \prec \text{joint assignments} \prec \mathrm{ROC}_k(T_k) \prec \mathrm{Disp}_k(T_k; \mathfrak{E}).\end{aligned}$$

No object to the right forms or repairs an object to the left. Detector reconstruction, lifetime, pole fit, mass order, hadron label, and matrix display therefore cannot complete an upstream source or candidate field.

Proposition 2.10 (Downstream failure is not upstream deletion)**.** *Let R be an immutable terminal extension with erasure $\epsilon : R \to \mathcal{H}_I$. Changing a new terminal field from active to failed or unactivated changes only the extension status; $\epsilon(R)$ remains the same FCGS-I packet.*

Counterexample criterion 2.11 (Import failure)**.** *The import theorem fails if an argument recounts L, U, D, assigns quarks a native neutral- cycle proof, inserts terminal or confinement data into $\mathfrak{A}_0$, bypasses η_f or χ_f, changes the one-Higgs response object, or uses FCGS-II readiness to modify I_3.*

3 Typed continuation signatures and carrier quotients

The standing-carrier identity theorem gives the governing criterion: same-target identity is equality under every target-authorized semantic use after every licensed continuation [2]. Its compact expression $w(u(x))$ must be typed before it can govern a terminal application. This section supplies that typing and separates three objects that must not be conflated: a total audit record, an activated terminal signature, and the semantic carrier quotient.

3.1 Continuation states, candidates, and witnesses

Fix $k \in \mathsf{K}_{\mathrm{term}}$ and one frozen target T_k. Let $\mathcal{U}_k$ be the small category whose objects are target-preserving continuation states and whose arrows are licensed continuations. Composition is sequential continuation and identities are null continuations. All categories, role families, witness families, and use registries in this paper are assumed set-sized; this is a size condition, not a completeness assumption.

Definition 3.1 (Candidate functor)**.** *The source-generated presentation functor is*

$$\mathcal{P}_k : \mathcal{U}_k \longrightarrow \mathbf{Set}.$$

An element of $\mathcal{P}_k(c)$ is an admitted presentation at state c, and $\mathcal{P}_k(u)$ transports it along $u : c \to d$. The functor is formed before terminal status is evaluated. Membership is neither standing nor terminality.

Definition 3.2 (Typed witness family)**.** *Let A_k be the frozen set of required audit-witness types. For each $\alpha \in A_k$, let*

$$\mathcal{V}_{k,\alpha} : \mathcal{U}_k \longrightarrow \mathbf{Set} \quad \textit{and} \quad \omega_{k,\alpha} : \mathcal{P}_k \Longrightarrow \mathcal{V}_{k,\alpha}$$

be a codomain functor and a natural evaluation. Hence, for $u : c \to d$,

$$\mathcal{V}_{k,\alpha}(u)\,\omega_{k,\alpha,c}(x) = \omega_{k,\alpha,d}\,\mathcal{P}_k(u)(x).$$

The required types include source, definedness, persistence, boundary, failure, process, physical authority, representation, charge, weak, color, anomaly, global form, Higgs incidence, root, and source-authority provenance whenever the target declares them identity-bearing. File names, notation, representative history, and other presentation metadata are excluded.

Definition 3.3 (Signature based at an arbitrary state)**.** *For every $b \in \mathrm{Ob}(\mathcal{U}_k)$ and $x \in \mathcal{P}_k(b)$, define*

$$\Sigma^b_{k,T_k}(x) := \big(\omega_{k,\alpha,c}(\mathcal{P}_k(u)(x))\big)_{\substack{c\in\mathrm{Ob}(\mathcal{U}_k),\ u\in\mathrm{Hom}_{\mathcal{U}_k}(b,c)\\ \alpha\in A_k}}$$

in the state-indexed product

$$\mathbb{V}^b_{k,T_k} := \prod_{c\in\mathrm{Ob}(\mathcal{U}_k)}\ \prod_{u\in\mathrm{Hom}_{\mathcal{U}_k}(b,c)}\ \prod_{\alpha\in A_k} \mathcal{V}_{k,\alpha}(c).$$

The frozen evaluation state is denoted b_k, and $\Sigma_{k,T_k} := \Sigma^{b_k}_{k,T_k}$.

3.2 Audit records, missing contracts, and activation

Every required atomic field has a total audit value: a certified value, an explicit failure, an inapplicability value justified by the target type, or an unactivated value carrying the exact residual contract. The resulting total record is denoted Σ^{audit}. The notation Σ^{term} is reserved for an audit record whose complete interface has been activated.

Definition 3.4 (Interface-formation residual)**.** *For an evidence basis $\mathfrak{E}$, let $\Delta_{k,\mathrm{form}}(T_k)$ be the atomic contracts required to form the complete terminal interface, and define*

$$\mathrm{Missing}_k(T_k;\mathfrak{E}) := \{\delta \in \Delta_{k,\mathrm{form}}(T_k) : \delta \textit{ is not certified in } \mathrm{Der}_{T_k}(\mathfrak{E};\mathfrak{I}^0_k)\}.$$

Then

$$\mathrm{Ready}_k(T_k;\mathfrak{E}) = \begin{cases} \mathsf{Ready}, & \mathrm{Missing}_k(T_k;\mathfrak{E}) = \varnothing,\\ \mathsf{NotReady}[\mathrm{Missing}_k(T_k;\mathfrak{E})], & \textit{otherwise}.\end{cases}$$

No uniqueness of a single minimal blocker is assumed. This set governs formation of the semantic quotient, assignment predicate, lawful action, and ROC. Missing positive-occupancy witnesses and missing exhaustive-negative proofs are recorded separately in the disposition profile; neither is folded into $\mathrm{Missing}_k$.

Definition 3.5 (Semantic-use registry and row coverage)**.** *For $b \in \mathrm{Ob}(\mathcal{U}_k)$, let $\mathsf{Use}^b_k(T_k)$ be the independently frozen family of licensed target-relative uses, each a typed map $F : \mathcal{P}_k(b) \to Y_F$. Relative to the frozen audited calculus, a row is tagged $\mathsf{Covered}(F, c_F)$ when $c_F \in \mathrm{Der}_{T_k}(\mathfrak{E};\mathfrak{I}^0_k)$ certifies a map $\overline{F} : \mathrm{im}(\Sigma^b_{k,T_k}) \to Y_F$ and the equality*

$$F = \overline{F} \circ \Sigma^b_{k,T_k}.$$

If the audited closure contains no such certificate, the row is tagged $\mathsf{Uncovered}(F, M_F)$, where M_F is the exact nonempty set of uncertified atomic coordinates required by the registered factorization contract. The latter tag states absence of a certificate in the frozen evidence calculus; it does not assert mathematical nonexistence of every possible factorization.

Definition 3.6 (Activated complete interface)**.** *The interface is activated when:*

1. *the candidate generator, source ontology, and failure routes are exhaustive relative to the frozen target;*
2. *every use row is covered and every codomain and continuation action is defined;*
3. *every required finite-arity joint use is total, every partial evaluation is a covered unary use, and diagonal-continuation naturality is certified;*
4. *every required coordinate projection is itself a licensed use;*
5. *source, boundary, process, physical-authority, and one-apex compatibility fields are active;*
6. *the registry is invariant under lawful target automorphisms; and*
7. $\mathrm{Missing}_k(T_k; \mathfrak{E}) = \varnothing$.

Theorem 3.7 (Complete-use activation)**.** *Each use row has exactly one audited row status,* $\mathsf{Covered}(F, c_F)$ *or* $\mathsf{Uncovered}(F, M_F)$*. The whole interface is ready exactly when every row is covered and every other atomic activation contract in Definition 3.6 is satisfied. If it is not ready, the exact terminal result carries the full nonempty set* $\mathrm{Missing}_k(T_k; \mathfrak{E})$*; no uncovered use retains terminal authority.*

Proof. The frozen ledger marks whether a registered factorization certificate occurs in the typed evidence closure. Presence supplies c_F; absence invokes the audited factorization contract and returns exactly its uncertified coordinates as M_F. The two tags are disjoint and exhaustive by the ledger test, not by a claim about all maps in an ambient universe. Interface readiness is the conjunction of the covered-row conditions and the remaining formation conditions, which is equivalent to an empty interface-formation residual by Definition 3.4. □

Remark 3.8 (Unformed is not empty)**.** *If* $\mathrm{Missing}_k \neq \varnothing$*, the audit record exists, but the activated terminal signature, semantic carrier quotient, certified assignment space, and ROC are unformed at terminal strength. A finite statement that the evidence basis contains no activation certificate is about evidence certificates; it is neither an empty physical candidate set nor a nonexistence theorem.*

3.3 Semantic identity and continuation congruence

Definition 3.9 (Same-target semantic equivalence)**.** *For* $x, y \in \mathcal{P}_k(b)$*, define*

$$x \approx^b_{k,T_k} y \quad \Longleftrightarrow \quad F(x) = F(y) \text{ for every } F \in \mathsf{Use}^b_k(T_k).$$

This definition is independent of the witness signature.

Theorem 3.10 (Signature characterization of semantic identity)**.** *For an activated complete interface,*

$$x \approx^b_{k,T_k} y \quad \Longleftrightarrow \quad \Sigma^b_{k,T_k}(x) = \Sigma^b_{k,T_k}(y).$$

Proof. If the signatures agree, every licensed use agrees because every use factors through the signature. Conversely, every signature coordinate projection is a licensed use. Semantic equivalence therefore gives equality coordinate by coordinate in $\mathbb{V}^b_{k,T_k}$. □

Lemma 3.11 (Typed continuation congruence)**.** *If* $v : b \to b'$ *is licensed and* $\Sigma^b_{k,T_k}(x) = \Sigma^b_{k,T_k}(y)$*, then*

$$\Sigma^{b'}_{k,T_k}(\mathcal{P}_k(v)x) = \Sigma^{b'}_{k,T_k}(\mathcal{P}_k(v)y).$$

Proof. For $u : b' \to c$ and $\alpha \in A_k$, the relevant continued coordinate is

$$\omega_{k,\alpha,c}(\mathcal{P}_k(u)\mathcal{P}_k(v)x) = \omega_{k,\alpha,c}(\mathcal{P}_k(u \circ v)x).$$

The arrow $u \circ v : b \to c$ indexes a coordinate of the original signature, so it has the same value for y. This holds for every u, c, α. □

3.4 The semantic carrier quotient and its universal property

Theorem 3.12 (Unique target-relative carrier quotient)**.** *For an activated complete interface, semantic identity is a continuation-stable equivalence relation and*

$$Q_k^{\mathrm{car}}(T_k) := \mathcal{P}_k(b_k)/{\approx_{k,T_k}^{b_k}} \;\cong\; \mathrm{im}(\Sigma_{k,T_k}).$$

Moreover, any same-target identity relation whose classes are exactly the classes indistinguishable by all licensed uses equals $\approx_{k,T_k}^{b_k}$.

Proof. Equality under every licensed use is reflexive, symmetric, and transitive. Theorem 3.10 identifies it with signature equality, and Lemma 3.11 proves continuation stability. The signature descends to a bijection from the quotient to its image. The final claim follows from the independent semantic definition: two presentations are in the same class precisely when all licensed uses agree. □

Theorem 3.13 (Signature factorization)**.** *A* lawful terminal interpretation *is a target-authorized semantic use that respects the frozen source, continuation, boundary, and authority types. Every lawful terminal interpretation $F : \mathcal{P}_k(b_k) \to Y$ factors uniquely through the semantic carrier quotient:*

$$F = \overline{F} \circ \pi_k, \qquad \pi_k : \mathcal{P}_k(b_k) \twoheadrightarrow Q_k^{\mathrm{car}}(T_k).$$

Proof. Lawfulness makes F one of the licensed same-target uses, so it is constant on semantic-equivalence classes. Set $\overline{F}([x]) = F(x)$. This is well-defined; surjectivity of π_k gives uniqueness. □

Proposition 3.14 (Interface enrichment is refining)**.** *If an activated witness family A'_k extends A_k on the same target and continuation category, then equality of A'_k-signatures implies equality of A_k-signatures, and the refined quotient maps canonically onto the coarser one. A genuinely new standing-bearing use after purported activation therefore falsifies the earlier completeness certificate.*

3.5 Candidate sorts and one-apex formation

Definition 3.15 (Candidate sorts and joint subfunctor)**.** *The presentation functor is sort-tagged:*

$$\mathcal{P}_k = \mathcal{P}_k^{\mathrm{root}} \amalg \mathcal{P}_k^{\mathrm{agg}} \amalg \mathcal{P}_k^{\mathrm{rel}} \amalg \mathcal{P}_k^{\mathrm{parent}}.$$

For relation and parent sorts, let

$$\mathcal{P}_k^{\mathrm{joint}}(c) = \{x \in \mathcal{P}_k(c) : \mathsf{Compat}_k(c, x)\}$$

be the subfunctor whose compatibility certificate fixes one target state, one source branch, and every deletion-essential cross-field relation. Closure under licensed continuation is part of the certificate.

Definition 3.16 (Licensed finite-arity joint uses)**.** *Let $\mathsf{Arit}_k(T_k) \subseteq \mathbb{N}_{\geq 1}$ be the frozen finite set of arities used by the target's relation, parent, and assignment laws. For each $n \in \mathsf{Arit}_k(T_k)$ and base b, independently freeze a family $\mathsf{JUse}_k^{b,n}(T_k)$ of total typed maps*

$$R : \mathcal{P}_k(b)^n \longrightarrow Y_R.$$

It contains every eligibility, incidence, compatibility, boundary, process, authority, and one-apex status used by a terminal parent or assignment. A status codomain distinguishes certified failure from $\mathsf{Pass}[j]$*, where* j *carries the complete coinstantiated apex record. Totality means that a tuple outside the joint domain receives a typed failure or inapplicability value rather than making* R *undefined.*

Joint-use activation requires two additional contracts. First, for every coordinate i*, every fixed choice of the other* $n-1$ *arguments, and every base* b*, the partial evaluation*

$$z \longmapsto R(x_1, \ldots, x_{i-1}, z, x_{i+1}, \ldots, x_n)$$

belongs to $\mathsf{Use}_k^b(T_k)$*. Second, the joint maps are natural under diagonal licensed continuation. Thus no finite-arity relation is introduced after the unary carrier quotient as an unregistered second classifier.*

Lemma 3.17 (Coordinatewise congruence for joint uses)**.** *For an activated joint-use registry, if* $x_i \approx^b_{k,T_k} y_i$ *for* $1 \le i \le n$*, then every* $R \in \mathsf{JUse}_k^{b,n}(T_k)$ *satisfies*

$$R(x_1, \ldots, x_n) = R(y_1, \ldots, y_n).$$

Consequently R *descends uniquely to a map*

$$\overline{R} : \big(Q^{\mathrm{car}}_{k,b}(T_k)\big)^n \longrightarrow Y_R, \qquad Q^{\mathrm{car}}_{k,b}(T_k) := \mathcal{P}_k(b)/{\approx^b_{k,T_k}}.$$

Proof. Replace the arguments one at a time. At the i-th replacement, the other arguments are fixed and the resulting partial evaluation is a licensed unary use by Definition 3.16. Semantic equivalence therefore makes its two values equal. Finite transitivity gives equality of the original and fully replaced tuples. The universal property of the product quotient gives the unique descended map. □

Definition 3.18 (Descended joint-apex witness object)**.** *At an activated target, let* $\mathsf{J}_k(T_k)$ *be the disjoint union, over the required arities, of pairs* $(\bar{\boldsymbol{x}}, j)$ *for which the descended one-apex status at* b_k *has value* $\mathsf{Pass}[j]$ *and every required descended joint-use coordinate passes on* $\bar{\boldsymbol{x}} \in (Q_k^{\mathrm{car}}(T_k))^n$*. The witness* j *fixes one target state, source branch, global form, boundary, authority branch, and all deletion-essential relations. Lemma 3.17 makes this object independent of the representatives of every carrier class.*

Theorem 3.19 (Product-valued signature status)**.** *Every audit candidate has the product status*

$$(\mathsf{TargetMembership}, \mathsf{InterfaceReadiness}, \mathsf{CandidateEvaluation}),$$

where the factors respectively record in-target/outside-target, Ready *or* $\mathsf{NotReady}[M]$*, and* Pass*,* $\mathsf{Fail}[B]$*, or* $\mathsf{Unevaluated}[M_x]$*. Simultaneous facts are retained: an explicit candidate failure may coexist with an unready interface. Only an in-target, ready, passing record supplies* Σ^{term}*.*

Proof. Target membership is decided by the frozen fingerprint. Interface readiness is the empty/nonempty test on the complete missing-contract set. Candidate evaluation records the candidate-local field outcomes available at that interface state. These questions are independent coordinates of the total audit type, so their product records simultaneous facts without forcing false exclusivity. A terminal signature requires exactly the in-target, ready, passing combination by Definition 3.6. □

Theorem 3.20 (One-apex parent signature)**.** *A relation or parent signature is terminally admissible only for an element of* $\mathcal{P}_k^{\mathrm{joint}}(b_k)$ *whose complete finite-arity record descends to an element of* $\mathsf{J}_k(T_k)$*. Rows from different target states, source branches, global forms, boundary states, or physical-authority branches form one parent only when a single licensed transport carries the entire joint record and every deletion-essential relation. Componentwise replacement by semantically equal carriers preserves every joint coordinate.*

Proof. The domain of a parent signature is the joint subfunctor at one base object. A marginal splice without one common transport is not an element of that domain. With such a transport, naturality moves the complete record and its relations together, so the transported object remains in the joint subfunctor. Coordinatewise preservation and representative-independent descent are Lemma 3.17; the simultaneous passing fibre is Definition 3.18. □

Counterexample criterion 3.21 (Typed-signature failure)**.** *This layer is falsified by an untyped witness, a missing arbitrary-base signature in the congruence proof, a licensed use that does not factor through an allegedly complete signature, identity-bearing provenance treated as mere metadata, an unregistered finite-arity classifier, a marginally spliced parent, or a quotient formed while* $\mathrm{Missing}_k \neq \varnothing$*.*

4 Charged and colored terminal targets

Target formation declares the data a terminal theorem must preserve; it does not populate the target or certify a parent. The targets below are invariant under external root remarking and contain no empirical mass order, species name, or default free-color occupant.

4.1 The charged-colorless target

Let r_L be the charged-colorless role imported from FCGS-I, with $\mathcal{E}_L = I_3 \times \{r_L\}$. The points of I_3 remain unlabelled.

Definition 4.1 (Charged terminal target)**.** *For a frozen admissible Standard-Model global form* Γ*, the target* $T_L(\Gamma)$ *records:*

1. *the root and charged-colorless kind;*
2. *exact chiral representation, charge, hypercharge, weak, Higgs, anomaly-ledger incidence, and global-form data;*
3. *identity-preserving continuation and persistence conditions;*
4. *coherent, weak, decay, pair, propagation, and observation/inference process interfaces without coercing one type into another;*
5. *production, source, detector, and physical-boundary records;*
6. *the exact pole, resonance, lifetime, stability, and asymptotic authority required by any claimed terminal value;*
7. *source, failure-route, one-apex compatibility, and lawful-assignment requirements; and*
8. *the successor rule under any later target or authority enrichment.*

Numerical mass, ordering, pole value, Yukawa texture, particle names, and measured lifetime are excluded from target formation.

Proposition 4.2 (Name- and order-free formation)**.** *The target* $T_L(\Gamma)$ *is equivariant under the external* S_3*-action on* I_3*. Electron, muon, and tau labels may mark later representatives, but do not form the root partition or a parent.*

Proof. Every forming coordinate is root-, role-, representation-, continuation-, boundary-, process-, or authority-relative. Root remarking transports the attached record and does not select a distinguished name or numerical order. □

Definition 4.3 (Charged constructive parent schema)**.** *A positive charged-parent witness consists of* $P_L \in \mathcal{P}_L^{\text{joint,parent}}(b_L)$*, a root-preserving map*

$$\jmath_L : \mathcal{E}_L \longrightarrow \mathsf{RootSlots}_L(P_L),$$

where $\mathsf{RootSlots}_L(P_L)$ *is the set of typed root-incidence slots declared by the parent presentation, and one coinstantiated complete signature and lawful assignment packet at* $T_L(\Gamma)$*. This definition gives the type of a positive witness; it does not assert that one exists.*

Theorem 4.4 (Charged-target formation)**.** *For every frozen admissible* Γ*, the charged target, its candidate sorts, its process and physical-authority interfaces, and its full audit schema are formed without mass-order, species-name, decay-familiarity, or detector backflow. Parent construction and exhaustive rejection remain separate evaluations.*

Proof. Definition 4.1 is a product of typed structural, continuation, process, boundary, authority, failure, and successor coordinates. None of its forming maps uses a mass order, species label, measured decay familiarity, or inverse detector reconstruction. The parent schema is introduced only after the target and is existential, while exhaustive rejection has a separately typed candidate/failure-universe obligation. Hence neither evaluation is inserted by target formation. □

4.2 The joint colored configuration architecture

Confinement does not map an isolated up- or down-type presentation to a canonical color-neutral bearer. Physical color-neutral channels are formed from joint multi-parton configurations that may contain both kinds, antiparticles, and gauge-field support. The colored target must therefore be aggregate-first while retaining each constituent's exact provenance.

Definition 4.5 (Internal constituent records)**.** *For* $k \in \{U, D\}$*, the marked constituent record is*

$$\mathsf{C}_k(\Gamma) = (I_3, r_k, \mathbf{3}_c, q_k, \mathsf{Weak}_k, \mathsf{H}_k, \mathsf{ColTrans}, \mathsf{AnomLedgerInc}_k, \Gamma)\,,$$

where

$$q_U = \frac{2}{3}, \qquad q_D = -\frac{1}{3}, \qquad \mathsf{H}_U = \widetilde{H}, \qquad \mathsf{H}_D = H.$$

The weak and Higgs coordinates are retained rather than reconstructed from electric charge.

These coordinates define the comparison target. Their presence in the target does not by itself certify a terminal quantum-boundary packet.

Definition 4.6 (Joint colored configuration category)**.** *Let* $\mathcal{C}_Q^{\text{col}}(\Gamma)$ *be the category of finite presentation-level, source-admitted colored configurations. It is a typed generating category, not an exhaustive universe of QCD states. An object records an ordered or otherwise incidence-complete family of* U*-type,* D*-type, conjugate, and gauge-support entries, together with the full tensor-product color representation* $\bigotimes_i R_i$*, charge, weak, Higgs, anomaly-ledger incidence, global-form, process, and source provenance. Morphisms are licensed internal continuations preserving the complete joint record. A gauge-singlet status is not a scalar "total color" label; it requires a certified invariant intertwiner from* $\bigotimes_i R_i$ *to* $\mathbf{1}$*. The root-bearing* U *and* D *presentations enter through typed constituent incidences*

$$\iota_k : \mathrm{Disc}(\mathcal{E}_k) \longrightarrow \mathsf{ConstituentSlots}(\mathcal{C}_Q^{\text{col}}(\Gamma)).$$

Here $\mathsf{ConstituentSlots}$ *is the set-valued slot functor that returns the typed constituent incidences carried by a joint configuration. They are not maps from isolated quarks to hadrons.*

Definition 4.7 (Color-neutral boundary category)**.** *Let $\mathcal{C}_Q^0(\Gamma)$ be the category of color-neutral physical boundary records. Objects are gauge-invariant composite asymptotic or bound- state records, resonances at their correctly typed physical boundary, and other authorized singlet channels. Every object carries a certified singlet intertwiner and the physical-boundary authority it invokes. Jet and parton hypotheses, detector outputs, reconstruction records, and hypothetical isolated- color proposals belong to* ObsRec_Q*, not to this physical category. Morphisms preserve the declared boundary and physical-authority type.*

Definition 4.8 (Confinement-safe channel schema)**.** *Let $\mathcal{C}_Q^{\mathrm{pre}}(\Gamma)$ be the upstream category of structurally well-typed colored configurations whose source and constituent incidences pass the pre-boundary checks. Membership asserts no physical descent, singlet boundary, or confinement authority. A confinement-safe realization is a Set-valued profunctor*

$$\mathsf{K}_Q : (\mathcal{C}_Q^{\mathrm{pre}}(\Gamma))^{\mathrm{op}} \times \mathcal{C}_Q^0(\Gamma) \longrightarrow \mathbf{Set}.$$

This is the standard variance of a Set-valued profunctor; its composition law is the bicategorical module composition, not composition of a presumed single-valued constituent map [30, 31]. An element $\kappa \in \mathsf{K}_Q(C, B)$ is a channel witness from the joint configuration C to the color-neutral boundary record B, rather than a presumed single-valued image. For every such witness it must:

1. *retain the complete constituent root, kind, charge, weak, Higgs, anomaly-ledger incidence, global-form, color-transport, and source provenance of C;*
2. *certify the color-neutral boundary status of B whenever the target demands an asymptotic physical bearer;*
3. *type hadronization and reconstruction as channel and inference data, not identity equalities;*
4. *preserve the joint record under licensed continuation and boundary gluing; and*
5. *carry authority for every nonlocal, superselection, confinement, or asymptotic sector invoked by the conclusion.*

Profunctoriality supplies the licensed precomposition by internal continuations and postcomposition by boundary morphisms. The definition specifies the required type. It asserts neither that any $\mathsf{K}_Q(C, B)$ is inhabited nor that a channel witness is unique. Positive activation additionally requires a nonempty, role-complete upstream domain and authorized witness coverage for every configuration class declared terminally relevant; empty-domain or partial coverage is not sufficient.

Definition 4.9 (Full marked colored target)**.** *For $k \in \{U, D\}$, define*

$$T_k(\Gamma) = \Big(\mathsf{C}_k(\Gamma), \mathcal{C}_Q^{\mathrm{col}}(\Gamma), \mathcal{C}_Q^0(\Gamma), \mathsf{Type}(\mathsf{K}_Q), \mathsf{Proc}_Q, \mathsf{Fail}_k, \mathsf{Auth}_Q, \mathsf{AutSpec}_k, \mathsf{Succ}_k\Big).$$

The two targets share the aggregate and boundary categories but retain a different marked constituent type.

Definition 4.10 (Colored constructive parent schema)**.** *A positive parent witness for kind k consists of an internal parent P_k preserving all three roots of $\mathcal{E}_k$, its certified incidences inside the joint configuration category, and a complete assignment/channel packet relating every required admissible aggregate to its authorized color-neutral boundary records. No individual hadron, sea pair, loop, jet, or weak-transition product is thereby retyped as a generation sector.*

Theorem 4.11 (Up/down target separation)**.** *There is no full-target isomorphism $T_U(\Gamma) \cong T_D(\Gamma)$ preserving the marked constituent record.*

Proof. The marked electric charges, weak components, and Higgs incidences differ. An isomorphism preserving the mark must preserve these coordinates and hence cannot exchange C_U with C_D. The common aggregate and boundary architecture does not erase the mark. □

Corollary 4.12 (Common generation geometry is not full-target identity)**.** *The equivalences $\mathcal{E}_U \simeq I_3 \simeq \mathcal{E}_D$ preserve the common structural root geometry, not the marked colored targets.*

Theorem 4.13 (Colored-target formation)**.** *Separate marked U- and D-type targets are formed over one joint colored configuration and color-neutral boundary architecture. The required descent is correctly typed as a multi-channel aggregate profunctor whose existence and authority remain activation questions. No free asymptotic quark, canonical quark-to-hadron map, or confinement theorem is inserted by definition.*

Proof. Definitions 4.6 and 4.8 first form the common joint configuration and boundary categories and then a channel-witness type between them. The marked record is retained as an incidence into the joint configuration, so Theorem 4.11 keeps the two targets distinct. Because a profunctor value is a set of witnesses, its type supplies neither an inhabitant nor a preferred image. The required confinement and asymptotic authority is a field of each witness, so no such theorem is present merely by forming the schema. □

4.3 The common audit field ledger

For every kind, the total audit record contains

$$\begin{aligned}\Sigma^{\mathrm{audit}}_{k,T_k}(x) = (&\Sigma_{\mathrm{sort}}, \Sigma_{\mathrm{src}}, \Sigma_{\mathrm{defined}}, \Sigma_{\mathrm{root}}, \Sigma_{\mathrm{cont}}, \Sigma_{\mathrm{pers}}, \Sigma_{\partial}, \Sigma_{\mathrm{fail}}, \Sigma_{\mathrm{proc}}, \Sigma_{\mathrm{auth}},\\ &\Sigma_{\mathrm{rep}}, \Sigma_{\mathrm{chg}}, \Sigma_{\mathrm{weak}}, \Sigma_{\mathrm{col}}, \Sigma_{\mathrm{anom}}, \Sigma_{\mathrm{glob}}, \Sigma_{H}, \Sigma_{\mathrm{source\ prov}}, \Sigma_{\mathrm{presentation\ meta}})_x.\end{aligned}$$

Standing-bearing source authority is retained; presentation metadata is explicitly ignored by semantic identity. Inapplicable fields receive a typed $\mathsf{NotApplicable}$ value. Unactivated required fields carry their exact missing-contract set. Only a ready audit record induces Σ^{term}.

Counterexample criterion 4.14 (Target-formation failure)**.** *The target-formation results fail if names or observed mass order form the charged partition; if the U/D marked records are merged; if an isolated quark is assigned a canonical color-neutral image; if a hadron, jet, sea pair, loop, or final state is retyped as a generation root; or if source, process, global-form, and physical-authority fields are omitted.*

5 Terminal promotion, assignment, and nonpromotion

This section stratifies candidate certification from simultaneous role realization. The separation is essential: a candidate can satisfy every individual condition yet fail to coexist with the other roles at one apex, and an assignment cannot be defined by mapping into a set whose membership already presupposes that assignment.

5.1 Precertification and realized support

Assume in this subsection that T_k is activated and target-complete. Let $Q^{\mathrm{car}}_k(T_k)$ be the semantic quotient of Theorem 3.12.

Definition 5.1 (Candidate precertificate)**.** *For $[x] \in Q^{\mathrm{car}}_k(T_k)$, the predicate $\mathrm{PreCert}_{k,T_k}([x])$ holds when:*

1. *$[x]$ has an activated complete terminal signature;*

2. *it is eligible for at least one declared target role;*
3. *its identity persists under every licensed continuation;*
4. *every applicable failure route is classified and survived; and*
5. *every physical-authority coordinate required by the claimed standing is active.*

Define the precertified carrier set

$$\mathsf{PC}_k(T_k) := \{[x] \in Q_k^{\mathrm{car}}(T_k) : \mathrm{PreCert}_{k,T_k}([x])\}.$$

Lemma 5.2 (Quotient descent for terminal predicates)**.** *Every unary coordinate used by* $\mathrm{PreCert}_{k,T_k}$ *and every finite-arity incidence used by the joint-assignment law is representative-invariant. Consequently* $\mathrm{PreCert}$ *is a predicate on* $Q_k^{\mathrm{car}}(T_k)$*, and the joint-assignment relation descends to finite products of that quotient.*

Proof. Activation requires every precertificate coordinate projection to be a licensed semantic use. Equality in the semantic quotient is therefore equality on each such coordinate by Theorem 3.10. Every finite-arity incidence in the assignment law belongs to the activated joint-use registry, so Lemma 3.17 gives coordinatewise congruence and descent to the product quotient. Definition 3.18 then makes the apex witness object itself representative-independent. □

Definition 5.3 (Preassignments and assignment-local live residue)**.** *Let* $\mathsf{R}_k(T_k)$ *be the complete target-role object and* $\mathsf{J}_k(T_k)$ *the activated joint-apex witness object of Theorem 3.20. A compatible preassignment is a pair* $p = (j, \tau)$*, with* $j \in \mathsf{J}_k(T_k)$ *and an injection*

$$\tau : \mathsf{R}_k(T_k) \hookrightarrow \mathsf{PC}_k(T_k),$$

whose complete graph and deletion-essential incidences are realized by the single apex witness j*. Write* $\mathsf{PreAssign}_k(T_k)$ *for these pairs and define the live residue of* $p = (j, \tau)$ *by* $\mathsf{Live}_k(p) := \mathrm{im}(\tau)$*. The corestriction* $\sigma_p : \mathsf{R}_k(T_k) \xrightarrow{\sim} \mathsf{Live}_k(p)$ *is then a bijection. Lemma 5.2 makes both definitions independent of carrier representatives.*

Definition 5.4 (Compatible role-covering assignments)**.** *A lawful assignment is a preassignment* $a = (j, \tau)$ *for which the canonical bijection*

$$\sigma_a : \mathsf{R}_k(T_k) \xrightarrow{\sim} \mathsf{Live}_k(a)$$

has graph realized by j *and satisfies the complete rolewise eligibility, persistence, boundary, process, incidence, and physical- authority law. The set of all such assignments is* $\mathrm{Assign}_k(T_k)$*. Only after they are formed define the global live support*

$$\mathsf{Live}_k(T_k) = \mathsf{Supp}(\mathrm{Assign}_k) := \bigcup_{a \in \mathrm{Assign}_k(T_k)} \mathsf{Live}_k(a).$$

Proposition 5.5 (Selector alternatives survive assignment formation)**.** *If two compatible preassignments satisfy the complete assignment law and have different live images, both remain elements of* $\mathrm{Assign}_k(T_k)$ *and may determine different lawful orbits. Using their global union as the codomain of each individual bijection would instead make both assignments disappear whenever that union has more elements than the role set. Assignment-local live residues are therefore necessary to represent the zero/one/multiple-orbit ROC classification faithfully [3].*

Proof. Each injection is a bijection onto its own image. Hence a different image does not obstruct either corestriction. If the two images enlarge their union beyond the role cardinality, no bijection from the role set onto that union can exist, so the global-union codomain would erase rather than classify the alternatives. Quotienting the assignment-local attempts retains them and lets the lawful action decide whether they are one orbit or a selector gap. □

The construction order is acyclic:

$$\mathcal{P}_k(b_k) \longrightarrow Q_k^{\mathrm{car}}(T_k) \supseteq \mathsf{PC}_k(T_k) \longrightarrow \mathsf{PreAssign}_k(T_k) \longrightarrow \mathrm{Assign}_k(T_k) \longrightarrow \mathsf{Live}_k(T_k).$$

No set in this display is defined by mapping into a codomain whose membership already presupposes that same map.

5.2 Promotion necessity and assignment-orbit factorization

Definition 5.6 (Ambient action data)**.** *Upon activation, the frozen specification* $\mathsf{AutSpec}_k$ *is required to be a group. Each* $g \in \mathsf{AutSpec}_k$ *carries bijections*

$$\alpha_g : \mathsf{R}_k(T_k) \xrightarrow{\sim} \mathsf{R}_k(T_k), \qquad \beta_g : \mathsf{PC}_k(T_k) \xrightarrow{\sim} \mathsf{PC}_k(T_k), \qquad \zeta_g : \mathsf{J}_k(T_k) \xrightarrow{\sim} \mathsf{J}_k(T_k),$$

compatible with multiplication and inverses. Let $\mathsf{LawPres}_k(g)$ *mean that* g *preserves the activated target, every descended joint coordinate, and the assignment law in both directions. Define the lawful stabilizer by*

$$\Gamma_k^{\mathrm{law}} := \{g \in \mathsf{AutSpec}_k : \mathsf{LawPres}_k(g)\}.$$

Lemma 5.7 (Lawful stabilizer and assignment action)**.** *The set* Γ_k^{law} *is a subgroup of* $\mathsf{AutSpec}_k$*, and*

$$g \cdot (j, \tau) := \big(\zeta_g(j),\, \beta_g \circ \tau \circ \alpha_g^{-1}\big)$$

defines a group action on $\mathrm{Assign}_k(T_k)$*.*

Proof. The identity preserves every listed coordinate. Preservation by equivalence in both directions is closed under composition and inverse, so the stabilizer is a subgroup. The displayed transport remains injective, its graph is the g-transport of the graph certified by j, and the defining preservation conditions keep every assignment-law coordinate true. Compatibility of α, β, ζ with multiplication gives the action laws. □

Definition 5.8 (Lawful assignment quotient and ROC)**.** *Define*

$$\mathrm{ROC}_k(T_k) := \mathrm{Assign}_k(T_k)/\Gamma_k^{\mathrm{law}}.$$

Definition 5.9 (ROC closure, terminal certificate, and promotion)**.** *Role-Occupancy Closure holds when*

$$\mathsf{ROCClosed}_k(T_k) \quad\iff\quad |\,\mathrm{ROC}_k(T_k)| = 1.$$

For an admitted presentation x*, set*

$$\begin{aligned} \mathrm{TermCert}_{k,T_k}([x]) &\iff \mathsf{ROCClosed}_k(T_k) \ \wedge\ [x] \in \mathsf{Supp}(\mathrm{Assign}_k), \\ \mathrm{Prom}_{k,T_k}(x) &\iff \mathrm{TermCert}_{k,T_k}([x]), \\ \mathsf{CT}_k(T_k) &:= \{[x] : \mathrm{TermCert}_{k,T_k}([x])\}. \end{aligned}$$

Thus mere assignment support is not terminal promotion: zero or multiple lawful assignment orbits do not satisfy ROC closure.

Theorem 5.10 (Terminal-promotion necessity)**.** *For every admitted candidate presentation x,*

$$\mathrm{Prom}_{k,T_k}(x) \iff \mathrm{TermCert}_{k,T_k}([x]) \implies \mathrm{PreCert}_{k,T_k}([x]).$$

Thus licensed promotion requires precertification, occurrence in a compatible bijective assignment, and exactly one lawful assignment orbit. No generation cardinality premise replaces any of these requirements.

Proof. The promotion definition and terminal-certificate definition are identical, giving the equivalence. Every compatible bijection has codomain contained in PC_k, so a supported value is precertified. The singleton-orbit condition is explicit in $\mathsf{ROCClosed}_k$; an isolated generation cardinality establishes none of these facts. □

Corollary 5.11 (Selector gap and empty-orbit boundary)**.** *If $|\,\mathrm{ROC}_k(T_k)| > 1$, the target has a selector gap and no terminal promotion is licensed. If $|\,\mathrm{ROC}_k(T_k)| = 0$, a negative terminal disposition follows only from a separately certified complete candidate and failure-route exhaustion.*

Theorem 5.12 (Terminal assignment-orbit factorization)**.** *Let $Z_k(T_k)$ be any terminal-disposition label set. Every lawful interpretation*

$$\Phi : \mathrm{Assign}_k(T_k) \longrightarrow Z_k(T_k)$$

that is invariant under Γ_k^{law} factors uniquely through the orbit quotient:

$$\Phi = \overline{\Phi} \circ q_k, \qquad q_k : \mathrm{Assign}_k(T_k) \twoheadrightarrow \mathrm{ROC}_k(T_k).$$

Proof. Set $\overline{\Phi}([a]) = \Phi(a)$. Orbit invariance makes the definition independent of the representative, and surjectivity of q_k makes the factorization unique. □

Together with Theorem 3.13, the full architecture has two linked factorization levels:

$$\mathcal{P}_k(b_k) \twoheadrightarrow Q_k^{\mathrm{car}}(T_k) \longrightarrow \mathsf{PC}_k(T_k),$$
$$\mathsf{R}_k(T_k) \longrightarrow \mathsf{PC}_k(T_k) \quad \rightsquigarrow \quad \mathrm{Assign}_k(T_k) \twoheadrightarrow \mathrm{ROC}_k(T_k) \longrightarrow Z_k(T_k).$$

Corollary 5.13 (No pre-ROC terminal count)**.** *No terminal multiplicity or one-parent conclusion is licensed before the candidate registry, semantic quotient, precertified set, role object, assignment family, and lawful action are complete.*

5.3 Formal surface separation and the admitted-fibre criterion

Let Surf_k collect any combination of generation-root data, mass, charge, stability display, process display, matrix entries, rooted Higgs response, field or flavor names, and detector reconstruction. Let $\mathsf{Residual}_k$ collect the omitted source/use completeness, full failure basis, continuation persistence, one-apex compatibility, and exact physical-authority fields. The total audit-record type contains the product schema

$$\mathsf{Audit}_k = \mathsf{Surf}_k \times \mathsf{Residual}_k, \qquad \Pi_k^{\mathrm{surf}}(s, r) = s.$$

This is an audit type, not a claim that every formal record is physically realized. On the full formal audit grammar, let $I_k^{\mathrm{formal}} : \mathsf{Audit}_k \to \{0, 1\}$ mark whether every precertificate-status field is certified. Fix any required nonsurface precertificate coordinate δ. For each formal surface record s, choose the formal status pattern r_{pass} with every required precertificate field certified, and let $r_{\mathrm{fail}(\delta)}$ agree with it except that δ is explicitly failed or unactivated. Hence

$$\Pi_k^{\mathrm{surf}}(s, r_{\mathrm{pass}}) = \Pi_k^{\mathrm{surf}}(s, r_{\mathrm{fail}(\delta)}) = s, \qquad I_k^{\mathrm{formal}}(s, r_{\mathrm{pass}}) = 1 \neq 0 = I_k^{\mathrm{formal}}(s, r_{\mathrm{fail}(\delta)}).$$

Thus no surface function represents the formal audit indicator on the entire grammar. This separating pair is formal only; it is not asserted to consist of two physically realized or source-admitted candidates.

Let $\mathsf{A}_k^{\mathrm{adm}} \subseteq \mathsf{Audit}_k$ be the records admitted by the source and typing rules, and let $I_k^{\mathrm{pre}} : \mathsf{A}_k^{\mathrm{adm}} \to \{0,1\}$ be the audit indicator that all precertificate contracts pass. For an actual candidate, this indicator agrees with PreCert by Lemma 5.2.

Lemma 5.14 (Surface-fibre criterion)**.** *There is a function*

$$g : \mathsf{Surf}_k \to \{0,1\}$$

whose composite with $\Pi_k^{\mathrm{surf}}|_{\mathsf{A}_k^{\mathrm{adm}}}$ equals I_k^{pre} if and only if the indicator is constant on every admissible surface fibre. In particular, any two admitted records (s, r_+) and (s, r_-) with different audit indicators refute every surface-only decision rule.

Proof. If g exists, equal surface images have equal g-values and hence equal indicators. Conversely, fibre constancy defines $g(s)$ as the common indicator on a nonempty admissible fibre; choose either value on empty fibres. The final statement is the forward implication applied to a mixed fibre. □

Theorem 5.15 (Terminal nonpromotion)**.** *The formal audit grammar is surface-indeterminate by the explicit formal pair above. On the actual admitted arena, a surface-only precertification rule is licensed only after fibre constancy in Lemma 5.14 is proved; it is not supplied by target formation or by displaying generation, mass, charge, process, matrix, Higgs-response, name, or detector coordinates. In every formed terminal architecture and for every admitted candidate,*

$$\neg\,\mathrm{TermCert}_{k,T_k}([x]) \quad\Longrightarrow\quad \neg\,\mathrm{Prom}_{k,T_k}(x).$$

At the unready targets evaluated below these predicates are not declared false: the exact statement is that no promotion certificate is licensed before the interface is formed and a terminal assignment witness exists.

Proof. The formal separation is the displayed status pair, while the actual-arena criterion is Lemma 5.14. The candidate-level claim is the contrapositive of Theorem 5.10. The two conclusions are related but not identified: the first states the exact additional condition a surface factorization would require, while the second is the promotion rule for admitted candidates in a formed architecture. Remark 3.8 forbids treating an unformed predicate as a false one. □

5.4 Proof-class and disposition algebra

Definition 5.16 (Typed status value)**.** *A result has a proof class*

$$\mathsf{PClass} \in \{\mathsf{Structural}, \mathsf{Terminal}, \mathsf{Inference}, \mathsf{Readiness}\}$$

and a separately typed disposition

$$\mathrm{Disp}_k(T_k; \mathfrak{E}) \in \{\mathsf{Positive}, \mathsf{Negative}, \mathsf{Split}[B], \mathsf{TargetDependent}, \mathsf{NotReady}[(\mathsf{tag}, M)]\}.$$

Here $M = (M_{\mathrm{form}}, M_+, M_-)$ is the tagged residual profile for interface formation, positive ROC closure, and exhaustive-negative proof. The values mean:

- $\mathsf{Positive}$*: an activated interface and ROC prove the stated positive terminal claim;*
- $\mathsf{Negative}$*: complete candidate and failure universes prove every same-target candidate fails the stated claim;*

- $\mathsf{Split}[B]$*: at the frozen target product, branch set B has no licensed common apex preserving all required fields;*
- $\mathsf{TargetDependent}$*: explicitly frozen targets have different exact values; and*
- $\mathsf{NotReady}[(\mathsf{tag}, M)]$*: neither terminal proof packet is activated, and M records exactly which of the three typed layers remain uncertified. If $M_{\mathrm{form}} \neq \varnothing$, the terminal quotient and ROC are unformed.*

The split value is target-relative. It does not exclude a future successor target equipped with new lawful transports.

Proposition 5.17 (Readiness does not decide physical existence)**.** *The value* $\mathsf{NotReady}[(\mathsf{tag}, M)]$ *implies neither existence nor nonexistence of a physical bearer. It classifies the proof and interface state at the frozen target.*

Theorem 5.18 (FCGS-II general factorization theorem)**.** *For every activated frozen target, lawful carrier interpretations factor through the semantic signature quotient, and lawful terminal dispositions factor through the complete assignment-orbit quotient. Positive terminal closure additionally requires that quotient to have exactly one element. If the interface-formation residual is nonempty, the corresponding terminal objects remain unformed; if neither positive nor exhaustive-negative packet is activated, the exact result is* $\mathsf{NotReady}[(\mathsf{tag}, (M_{\mathrm{form}}, M_+, M_-))]$*. In every branch, the immutable FCGS-I packet is unchanged.*

Proof. The carrier-level result is Theorems 3.10 and 3.13; the terminal level is Theorems 5.10 and 5.12; the unready branch is Theorem 3.7 and Remark 3.8; immutability is Theorem 2.2. □

Counterexample criterion 5.19 (Nonpromotion failure)**.** *This layer is falsified by a promotion that lacks precertification, compatible bijective assignment support, or singleton ROC; by a circular definition of assignments through terminal certification; or by a proved surface-only factorization despite a mixed admissible surface fibre.*

6 FCGS-2L: charged-lepton terminal disposition

6.1 What the structural and mass-role results establish

FCGS-I supplies the exact three-root charged-colorless fibre and its rooted structural Higgs-response correspondence. The matter-carrier analysis supplies the charged-colorless matter-response role at fixed structural scope [4]. Neither theorem is a terminal-parent theorem at $T_L(\Gamma)$.

Let

$$\rho_L : T_L(\Gamma) \longrightarrow T_L^{\mathrm{shape}}$$

forget the process-completeness, full failure, source/detector boundary, physical-authority, one-apex, and assignment fields while retaining the charged deformation-response shape.

Proposition 6.1 (Mass-shape closure is not terminal closure)**.** *No source in the frozen charged basis certifies a factorization of terminal disposition through ρ_L. In the total audit schema, records can have the same mass-shape image and different process, authority, or assignment status. Hence a mass-shape residue or symbolic readout does not by itself determine terminal standing.*

Proof. The forgotten fields include atomic predicates in Definition 5.1 and the assignment law. Any such factorization would certify every omitted precertificate and assignment coordinate as a function of the shape image. The finite support matrix below contains no constructor with those output fields, and the no-new-field invariant, Lemma 2.8, prevents their manufacture by composition. Thus no such certificate occurs in the frozen calculus. □

6.2 The charged source ledger

The finite charged evidence basis is

$$\mathfrak{E}_L^0 = \{\mathcal{H}_I^{2.2.0}, \mathrm{SCIC}, \mathrm{ROC}, \mathrm{SM3}, \mathrm{CLY}, \mathrm{CLZ}, \mathrm{CLC}, \mathrm{CLE}, \mathrm{CLF}, \mathrm{CLG}, \mathrm{CLH}, \mathrm{CLI}, \mathrm{CLJ}, \mathrm{CLM}, \mathrm{CLO}, \mathrm{CLR}^{4.6}, \mathrm{AOT1}^3, \mathrm{Schrodinger}, \mathrm{SM5}, \mathrm{SYM2}, \mathrm{ChargeLat}, \mathrm{HiggsEnv}\}.$$

Versions, paths, and hashes are fixed in the source-provenance supplement. Only the theorem-bearing works in the displayed basis enter the evidence calculus. The abbreviations below refer to the full titles in the bibliography, and each statement records its exact contracted scope:

1. **Mass-shape comparison and selection.** CLY finds no certified co-comparable family-index selector, and CLZ finds no certified standing stratifier [6, 7]. These results govern the family-index-sensitive mass-shape route. They are not assumed to be a universal necessity for every conceivable charged terminal target.
2. **Historical eliminator gap.** CLC returns closure-deferred at the target frozen in that analysis [8]. Its later branches must therefore be credited individually rather than treating the earlier classification as the whole basis-relative ledger.
3. **Subsequent local closures.** CLE closes the declared direct selective-source sector; CLF closes the declared family-index selective-source alternatives; CLG closes its quotient-dependent sector; CLH closes its scalar-representation selective- source sector; and CLI closes the declared branch-taxonomy assignment [9, 10, 11, 12, 13]. These are genuine local advances. None supplies the absent co-comparable selector or the full terminal target.
4. **Residue, role, and readout.** CLJ retains a deferred integrated-classification status absent the required object-level input. CLM proves a unique physically typed mass-shape residue, and CLO closes a symbolic metric-relative one-anchor readout [14, 15, 16]. These results live in the proper image T_L^{shape}.
5. **Pole and boundary authority.** CLR v4.6 gives a conditional one-anchor shape/readout, but its exact pole status remains open, the overall scale is not derived, and zero-anchor status is not achieved [17]. The charged pole-transport source likewise retains a deferred protected-trace remainder rather than an exact terminal pole certificate [18].
6. **Process completeness.** The process sources cover coherent evolution and selected weak or flavor transitions. No source-complete family simultaneously closes decay, pair creation, propagation, observation/inference, and their terminal identity consequences.

The ledger is consistent because each positive closure is target-relative. Transporting the word "closed" through ρ_L without its erased fields would be a change of theorem.

6.3 Constructive and eliminative completion obligations

Definition 6.2 (Positive charged completion obligation)**.** *The obligation $\Delta^+_{\mathrm{CL}}(T_L)$ is a certified packet containing:*

1. *a complete source/use registry and admissible continuation envelope;*
2. *a parent P_L, root incidence $\jmath_L$, and complete target-relative terminal signature;*
3. *continuation persistence and the complete failure audit;*
4. *simultaneous representation, charge, weak, Higgs, anomaly-ledger incidence, global-form, boundary, and process records;*

5. *exact physical authority for the claimed terminal object; and*
6. *a compatible role-covering bijection whose lawful assignment quotient has exactly one orbit and supports P_L.*

Activation proves a positive terminal packet; it does not merely authorize a search.

Definition 6.3 (Negative charged completion obligation)**.** *The independent obligation $\Delta^{-}_{\mathrm{CL}}(T_L)$ contains a complete same-target candidate universe, a complete failure-route universe, and a proof that every candidate fails terminal certification. Activation licenses* Negative*. It does not require construction of the parent it rejects.*

These are full completion bundles over one-codomain atoms, not asserted minimal cut sets. The basis-relative residual profile is

$$\begin{aligned}
M^0_{L,\mathrm{form}} &= \{\delta^L_{\mathrm{sourceReg}}, \delta^L_{\mathrm{useReg}}, \delta^L_{\mathrm{failureReg}},\\
&\qquad \delta^L_{\mathrm{processReg}}, \delta^L_{\mathrm{boundaryReg}}, \delta^L_{\mathrm{QBReg}},\\
&\qquad \delta^L_{\mathrm{authorityReg}}, \delta^L_{\mathrm{jointLaw}}, \delta^L_{\mathrm{actionLaw}}\},\\
M^0_{L,+} &= \{\delta^L_{\mathrm{parent}}, \delta^L_{\mathrm{termSig}}, \delta^L_{\mathrm{continuation}},\\
&\qquad \delta^L_{\mathrm{repLedger}}, \delta^L_{\mathrm{weakLedger}}, \delta^L_{\mathrm{HiggsIncidence}},\\
&\qquad \delta^L_{\mathrm{persistence}}, \delta^L_{\mathrm{boundaryWit}}, \delta^L_{\mathrm{failureWit}},\\
&\qquad \delta^L_{\mathrm{processWit}}, \delta^L_{\mathrm{jointAnom}}, \delta^L_{\mathrm{globalForm}},\\
&\qquad \delta^L_{\mathrm{poleAuth}}, \delta^L_{\mathrm{resonanceAuth}}, \delta^L_{\mathrm{lifetimeAuth}},\\
&\qquad \delta^L_{\mathrm{stabilityAuth}}, \delta^L_{\mathrm{asymptoticAuth}}, \delta^L_{\mathrm{oneApex}},\\
&\qquad \delta^L_{\mathrm{assignmentCoverage}}, \delta^L_{\mathrm{uniqueOrbit}}\},\\
M^0_{L,-} &= \{\delta^L_{\mathrm{negativeCandidateExh}}, \delta^L_{\mathrm{negativeFailureExh}}\},\\
\mathbf{M}^0_L &:= (M^0_{L,\mathrm{form}}, M^0_{L,+}, M^0_{L,-}).
\end{aligned}$$

The quantum-boundary atoms require one simultaneous packet at a frozen Γ; they do not demand anomaly cancellation by each kind in isolation.

6.4 Evidence closure and basis-relative activation

Definition 6.4 (Permitted evidence closure)**.** *Let $\mathrm{Der}^0_L := \mathrm{Der}_{T_L}(\mathfrak{E}^0_L; \mathfrak{I}^0_L)$ be the typed inductive calculus of Definition 2.7. Its base supports and registered constructors are enumerated in Appendix B; each constructor satisfies the no-new-field support condition. Set*

$$\mathrm{ActCert}^{\pm}_L(T_L; \mathfrak{E}^0_L) := \{c \in \mathrm{Der}^0_L : c \textit{ activates } \Delta^{\pm}_{\mathrm{CL}}(T_L)\}.$$

Theorem 6.5 (No derivable charged terminal completion)**.** *For $\mathfrak{E}^0_L$ and its typed closure,*

$$\mathrm{ActCert}^{+}_L(T_L; \mathfrak{E}^0_L) = \mathrm{ActCert}^{-}_L(T_L; \mathfrak{E}^0_L) = \varnothing,$$

and the exact residual profile is $\mathbf{M}^0_L$.

Proof. The source-output matrix in Appendix B computes, for each of the formation, positive, and negative contract families, the complement of the union of compatible base supports. Those three complements are exactly $M^0_{L,\mathrm{form}}$, $M^0_{L,+}$, and $M^0_{L,-}$ displayed above. In particular, no base packet supplies the complete registries, terminal parent and witness fields, the full physical-authority family, assignment coverage and singleton-orbit certificate, or the two exhaustive-negative coordinates. CLR and AOT1 retain the pole/protected-remainder gap, while the selective-route exhaustions cover proper subfamilies only.

Lemma 2.8, applied by induction to every derivation tree, shows that no registered constructor emits any of those absent output fields. Every positive packet requires all formation and positive atoms; every negative packet requires the formation atoms needed to state the complete candidate/failure universes and both negative-exhaustion atoms. Therefore neither activation set is inhabited. Conversely, the matrix marks every required atom outside the three displayed complements as certified, proving exactness rather than merely exhibiting some blockers. □

The empty sets here contain evidence-derived completion packets, not physical charged leptons. Since the interface is unready, the terminal quotient, assignment space, and ROC are not formed and then found empty.

6.5 Exact charged disposition

Theorem 6.6 (Charged constructive/eliminative trichotomy). *At a frozen charged target and evidence basis $\mathfrak{E}$, exactly one sound disposition branch may be certified:*

$$\begin{aligned} \mathrm{ActCert}_L^+ \neq \varnothing \quad &\Longrightarrow \quad \mathrm{Disp}_L(T_L;\mathfrak{E}) = \mathsf{Positive}, \\ \mathrm{ActCert}_L^- \neq \varnothing \quad &\Longrightarrow \quad \mathrm{Disp}_L(T_L;\mathfrak{E}) = \mathsf{Negative}, \\ \mathrm{ActCert}_L^+ = \mathrm{ActCert}_L^- = \varnothing \quad &\Longrightarrow \quad \mathrm{Disp}_L(T_L;\mathfrak{E}) = \mathsf{NotReady}[(\mathrm{CL}, \mathbf{M}_L(\mathfrak{E}))]. \end{aligned}$$

Sound positive and negative packets cannot coexist at the same frozen target.

Proof. The positive packet exhibits a terminally certified parent in a compatible bijective assignment and proves that its lawful quotient has one orbit. The negative packet proves that every same-target candidate fails certification, so soundness makes the two branches disjoint. If neither packet is activated, Definition 5.16 returns the exact residual readiness value rather than a guessed truth value. □

Corollary 6.7 (Exact charged endpoint). *Relative to $\mathfrak{E}_L^0$,*

$$\boxed{\mathrm{Disp}_L(T_L;\mathfrak{E}_L^0) = \mathsf{NotReady}[(\mathrm{CL}, \mathbf{M}_L^0)].}$$

No charged terminal ROC cardinality or one-carrier/three-sector terminal packet is reported.

6.6 Charged nonpromotion consequences

Observed mass order, familiar stability/decay patterns, and a 3×3 mass or Yukawa matrix cannot form P_L. Each lies in the surface factor of the audit schema and omits fields of $\mathbf{M}_L^0$. Theorem 5.15 therefore licenses no surface-only promotion; because the terminal architecture is unformed, it does not reclassify an unformed predicate as false.

Counterexample criterion 6.8 (Charged-branch upgrade). *The $\mathfrak{E}_L^0$-relative readiness value is falsified by a source-compatible derivation of either full completion packet at the same frozen target. A new local mass-shape formula, numerical fit, family name, conditional readout, or partial selector is insufficient. Conversely, exact exhaustive rejection must prove candidate and failure completeness, not merely report that no parent was found.*

7 FCGS-2Q: colored terminal disposition

7.1 Licensed structural support

The colored branch begins with positive results at scopes below terminal confinement realization:

1. FCGS-I supplies the U- and D-typed three-root fibres and their distinct rooted Higgs-response packets [1].
2. The gauge-carrier analysis supplies non-Abelian color transport and prevents perturbative lines, jets, and color-flow displays from becoming isolated primitive carriers by notation alone [5].
3. The matter-carrier analysis supplies color-bearing quark roles and ConfCompat as a structural compatibility condition, while expressly not proving empirical confinement [4].
4. The local Yang–Mills theorem proves a positive Hamiltonian gap for the bounded-region gauge-invariant sharp-local vacuum net [19].
5. The structural Yang–Mills extension freezes an extended-support line and surface class $E(G)$, proves that its nontrivial objects are not bounded-region local observables, constructs the admissible realized sector class $S_{\text{ext}}(G)$ over the fixed local net, and proves a well-defined sector assignment and global-form recovery at that sector level [20].
6. The spacetime-symmetry analysis keeps stable particles, resonances, confined fields, and composite asymptotic sectors type-distinct [21].

The local vacuum gap and the structural extended-support sector theorem are therefore genuine positive evidence at their exact targets. The latter certifies theorem-scope nonlocal color-sector authority; it neither selects the Standard-Model global quotient nor supplies confinement, asymptotic quark standing, hadronization, singlet-channel coverage, or a terminal joint packet. The frozen colored basis contains no confinement theorem and no theorem populating hadronic, jet, or free-colored terminal roles. The distinction is also standard in the external literature: Wilson's lattice confinement mechanism is a separate result, and the official Yang–Mills problem description distinguishes the mass-gap problem from a proof of quark confinement [28, 29].

The finite colored evidence basis is

$$\begin{aligned}\mathfrak{E}_Q^0 = \{&\mathcal{H}_I^{2.2.0}, \mathrm{SCIC}, \mathrm{ROC}, \mathrm{SM2}, \mathrm{SM3},\\ &\mathrm{YM}_{\text{core}}, \mathrm{YM}_{\text{patched}}, \mathrm{YM}_{\text{extended}}, \mathrm{Schrodinger},\\ &\mathrm{SM5}, \mathrm{SYM2}, \mathrm{ChargeLat}, \mathrm{HiggsEnv}\}.\end{aligned}$$

Versions, paths, and hashes are fixed in the source-provenance supplement; the core Yang–Mills PDF and patched source archive are distinct artifacts.

7.2 Constructive and eliminative colored obligations

Definition 7.1 (Kind-marked parent/continuation obligation). *For $k \in \{U, D\}$, $\Delta_{56}^{k,+}$ requires:*

1. *an internal parent P_k with a root-preserving incidence from $\mathrm{Disc}(\mathcal{E}_k)$;*
2. *persistence of the marked constituent identity under every licensed internal continuation;*
3. *compatible embedding into the joint colored configuration category;*
4. *complete process and quantum-boundary records; and*
5. *complete precertification, one-apex assignment data, and a singleton lawful assignment orbit.*

It is a constructive completion bundle, not a claim of activation at $\mathfrak{E}^0_Q$ *or inclusion-minimality.*

Definition 7.2 (Confinement/asymptotic-authority obligation)**.** *The common joint obligation* Δ^+_{60} *requires an activated multi-channel profunctor of Definition 4.8, nonempty role-complete channel coverage, complete confinement and nonlocal-sector authority, channel-complete process typing, constituent provenance preservation, and authorized color-neutral boundary records for every terminal claim. A bounded local vacuum gap or the structural predicate* $\mathsf{ConfCompat}$ *does not instantiate this bundle.*

Definition 7.3 (Negative colored completion obligation)**.** *For kind* k*,* $\Delta^{k,-}_Q$ *requires a complete same-target universe of marked internal parents, joint configurations, channel relations, and physical-boundary candidates, together with a complete failure universe and a proof that every candidate fails terminal certification. It licenses an exact negative result without requiring construction of the parent it rejects.*

For each $k \in \{U, D\}$, the basis-relative one-codomain residual profile is

$$\begin{aligned}
M^0_{k,\mathrm{form}} &= \{\delta^k_{\mathrm{sourceReg}}, \delta^k_{\mathrm{useReg}}, \delta^k_{\mathrm{failureReg}},\\
&\qquad \delta^k_{\mathrm{processReg}}, \delta^k_{\mathrm{boundaryReg}}, \delta^k_{\mathrm{QBReg}},\\
&\qquad \delta^k_{\mathrm{authorityReg}}, \delta^k_{\mathrm{channelReg}}, \delta^k_{\mathrm{jointLaw}}, \delta^k_{\mathrm{actionLaw}}\},\\
M^0_{k,+} &= \{\delta^k_{\mathrm{markedParent}}, \delta^k_{\mathrm{jointEmbed}}, \delta^k_{\mathrm{termSig}},\\
&\qquad \delta^k_{\mathrm{colorRep}}, \delta^k_{\mathrm{weakLedger}}, \delta^k_{\mathrm{HiggsIncidence}},\\
&\qquad \delta^k_{\mathrm{continuation}}, \delta^k_{\mathrm{persistence}}, \delta^k_{\mathrm{failureWit}},\\
&\qquad \delta^k_{\mathrm{processWit}}, \delta^k_{\mathrm{jointAnom}}, \delta^k_{\mathrm{globalForm}},\\
&\qquad \delta^k_{\mathrm{channelWit}}, \delta^k_{\mathrm{channelGlue}}, \delta^k_{\mathrm{singletIntertwiner}},\\
&\qquad \delta^k_{\mathrm{confinementAuth}}, \delta^k_{\mathrm{asymptoticAuth}},\\
&\qquad \delta^k_{\mathrm{constituentProv}}, \delta^k_{\mathrm{oneApex}}, \delta^k_{\mathrm{assignmentCoverage}}, \delta^k_{\mathrm{uniqueOrbit}}\},\\
M^0_{k,-} &= \{\delta^k_{\mathrm{negativeCandidateExh}}, \delta^k_{\mathrm{negativeFailureExh}}\},\\
\mathbf{M}^0_k &:= (M^0_{k,\mathrm{form}}, M^0_{k,+}, M^0_{k,-}).
\end{aligned}$$

The U and D profiles are separately indexed even where their obligation schemas are isomorphic.

Definition 7.4 (Joint structural nonlocal-authority certificate)**.** *Specialize the structural Yang–Mills extension to* $G = SU(3)_c$*, with its fixed local net, frozen extended-support class* $E(G)/\!\sim_{\mathrm{def}}$*, realized sector class* $S_{\mathrm{ext}}(G)$*, and well-defined assignment*

$$\Xi_G : E(G)/\!\sim_{\mathrm{def}} \longrightarrow S_{\mathrm{ext}}(G).$$

Write c^Q_{ext} *for the single audited proof object certifying the existence and well-definedness of this theorem-scope assignment and the sector-level distinction of its frozen labels, and write* $\delta^Q_{\mathrm{nonlocalAuth}}$ *for its one joint-interface contract coordinate. Thus* $\mathrm{supp}_Q(c^Q_{\mathrm{ext}}) = \{\delta^Q_{\mathrm{nonlocalAuth}}\}$*.*

Both colored targets contain the same component Auth_Q*. For* $k \in \{U, D\}$*, let* r_k *be the singleton support reindexing*

$$r_k(\delta^Q_{\mathrm{nonlocalAuth}}) = \delta^k_{\mathrm{nonlocalAuth}},$$

and define the target-local leaf certificate $c_{\mathrm{ext},k} := \mathrm{Use}_k(c^Q_{\mathrm{ext}})$ *by retaining the theorem object, hypotheses, proof, source, and provenance while reindexing only its atomic target-use coordinate. Hence*

$$\mathrm{supp}_{T_k}(c_{\mathrm{ext},k}) = r_k(\mathrm{supp}_Q(c^Q_{\mathrm{ext}})) = \{\delta^k_{\mathrm{nonlocalAuth}}\}.$$

The operation Use_k *is evidence-ledger reindexing. It is not a map on* $E(G)$*,* $S_{\mathrm{ext}}(G)$*, or their objects, and it does not construct a distinct nonlocal sector for either quark kind.*

Lemma 7.5 (Marked target use of structural nonlocal authority)**.** *The joint certificate of Definition 7.4 licenses the two typed target-use coordinates $\delta^{U}_{\mathrm{nonlocalAuth}}$ and $\delta^{D}_{\mathrm{nonlocalAuth}}$. They are two uses of one source output, which is counted once. Neither use certifies a choice of Γ, confinement, singlet-channel coverage, hadronization, or asymptotic quark authority.*

Proof. Main Theorem II.1(B–D), Theorem V.12, Theorems VI.10 and VI.12, Corollary VI.14, and Theorems VII.5 and VII.8 of the structural extension respectively establish the frozen local/nonlocal boundary, realize each theorem-scope object as an admissible sector datum over the fixed local net, form the canonical sector class, make Ξ_G well defined, and recover the frozen global-form labels at sector level. This proves the one joint proof object c^{Q}_{ext}. The targets $T_U(\Gamma)$ and $T_D(\Gamma)$ in Definition 4.9 have the identical authority component Auth_Q; only their marked constituent records differ. The two applications of Use_k therefore change only the atomic target-use tag and preserve the theorem, hypotheses, and provenance. No map from the constituent incidences ι_k to $E(G)/{\sim_{\mathrm{def}}}$ or $S_{\mathrm{ext}}(G)$ is asserted. The forbidden terminal fields are absent from the joint certificate and remain absent from both reindexed uses. □

7.3 Composite evidence and source-relative activation

Definition 7.6 (Permitted colored evidence closure)**.** *For each $k \in \{U, D\}$, let $\mathrm{Der}^{0}_{Q,k} := \mathrm{Der}_{T_k}(\mathfrak{E}^{0}_{Q}; \mathfrak{I}^{0}_{Q,k})$ be the typed inductive calculus of Definition 2.7 at the separately frozen target fingerprint, with the base supports and registered constructors enumerated in Appendix B. Define*

$$\mathrm{ActCert}^{+}_{Q,k} = \{c \in \mathrm{Der}^{0}_{Q,k} : c \textit{ activates } \Delta^{k,+}_{56} \textit{ and } \Delta^{+}_{60}\},$$
$$\mathrm{ActCert}^{-}_{Q,k} = \{c \in \mathrm{Der}^{0}_{Q,k} : c \textit{ activates } \Delta^{k,-}_{Q}\}.$$

Theorem 7.7 (No derivable confinement-safe terminal completion)**.** *For $k \in \{U, D\}$,*

$$\mathrm{ActCert}^{+}_{Q,k} = \mathrm{ActCert}^{-}_{Q,k} = \varnothing,$$

and the exact residual profile is $\mathbf{M}^{0}_{k}$.

Proof. The source-output matrix in Appendix B computes the complement of compatible base support in each of the formation, positive, and negative contract families. The three complements are exactly $M^{0}_{k,\mathrm{form}}$, $M^{0}_{k,+}$, and $M^{0}_{k,-}$. The positive support includes structural quark standing, color transport, route discipline, the sharp-local vacuum gap, and the theorem-scope extended-support nonlocal sector authority, but not the marked-parent, complete joint configuration, authorized channel, singlet-intertwiner, confinement, asymptotic, assignment-coverage, or singleton-orbit outputs. The matrix also contains no complete marked-parent/channel candidate exhaustion or complete failure exhaustion.

By Lemma 2.8, induction over every registered constructor preserves those absences; in particular neither the bounded local-vacuum output nor the distinct structural nonlocal-sector output can become a confinement or asymptotic-authority output. Every positive packet requires all formation and positive atoms, while a negative packet requires the formation atoms needed for the exhaustive universes and both negative atoms. Neither activation set is therefore inhabited. Every atom outside the displayed complements is marked certified in the finite matrix, which proves exactness of the profiles. □

The empty sets in Theorem 7.7 are sets of derivable completion packets. The candidate, hadron, or quark universes are not asserted empty.

7.4 Confinement-safe disposition trichotomy

Theorem 7.8 (Colored constructive/eliminative trichotomy)**.** *For each marked kind k and evidence basis $\mathfrak{E}$, sound evidence permits exactly one disposition:*

$$\begin{aligned}
\mathrm{ActCert}^{+}_{Q,k} \neq \varnothing &\implies \mathrm{Disp}_k(T_k;\mathfrak{E}) = \mathsf{Positive},\\
\mathrm{ActCert}^{-}_{Q,k} \neq \varnothing &\implies \mathrm{Disp}_k(T_k;\mathfrak{E}) = \mathsf{Negative},\\
\mathrm{ActCert}^{+}_{Q,k} = \mathrm{ActCert}^{-}_{Q,k} = \varnothing &\implies \mathrm{Disp}_k(T_k;\mathfrak{E}) = \mathsf{NotReady}[(\mathrm{Confinement}, \mathbf{M}_k(\mathfrak{E}))].
\end{aligned}$$

Proof. The positive packet exhibits a marked internal parent in a lawful joint assignment, with authorized channel-witness coverage and a singleton lawful orbit. The negative packet rejects every same-target candidate, so soundness makes the positive and negative branches disjoint. If neither packet is activated, the exact residual set gives the readiness value. □

Corollary 7.9 (No isolated-color promotion)**.** *An internal U- or D-type record, a perturbative line, a jet tag, or a color-flow display supplies no promotion certificate without the complete colored packet of Theorem 7.8. This is an admissibility criterion, not a metaphysical proof that quarks do not exist. Gluon-line standing remains a separately typed gauge-carrier question rather than an additional FCGS-II matter kind.*

7.5 Exact target-indexed branch decomposition

Theorem 7.10 (Colored endpoint and branch separation)**.** *Relative to $\mathfrak{E}^0_Q$,*

$$\boxed{\begin{aligned}
\mathrm{Disp}_U(T_U;\mathfrak{E}^0_Q) &= \mathsf{NotReady}[(\mathrm{Confinement}, \mathbf{M}^0_U)],\\
\mathrm{Disp}_D(T_D;\mathfrak{E}^0_Q) &= \mathsf{NotReady}[(\mathrm{Confinement}, \mathbf{M}^0_D)].
\end{aligned}}$$

The charged and colored analyses therefore define separately indexed disposition records at their distinct target fingerprints. This target-indexed branch decomposition does not prove that no richer future successor target or tagged common apex can preserve both branches.

Proof. The dispositions follow from Theorems 7.7 and 7.8. FCGS-2L and FCGS-2Q have different target fingerprints and different residual sets, so preserving both rows requires separate indexed disposition rows. No theorem in $\mathfrak{E}^0_Q$ excludes a later common successor; accordingly no Split impossibility value is claimed. □

Counterexample criterion 7.11 (Colored-branch upgrade)**.** *The $\mathfrak{E}^0_Q$-relative status is falsified by a target-compatible derivation of either a full constructive packet or a full exhaustive-rejection packet. A local vacuum gap, structural color compatibility, phenomenological confinement, successful hadron reconstruction, or a single hadronic channel does not by itself meet either obligation.*

8 Typed process separation, quantum-boundary coinstantiation, and Higgs preservation

8.1 Atomic processes and compositional histories

Physical dynamics, physical-boundary channels, and epistemic reconstruction do not have one common domain. They are therefore typed separately.

Definition 8.1 (Source-typed physical reaction signature)**.** *For kind k, let $\mathsf{H}_k(T_k)$ be a typed reaction hypergraph. Its vertices are physical state and boundary sorts, and an atomic hyperedge has finite input and output lists together with source, boundary, conserved and changed incidences, continuation effect, and physical authority. The frozen atomic registry $\mathsf{Atom}_k(T_k)$ must be exhaustive for the process families invoked by a terminal claim. Its standard seed includes coherent, electromagnetic, strong, weak, decay, pair/annihilation, radiation, binding/fragmentation, and propagation families, but the seed is not itself a completeness assertion.*

The ordinary physical histories form the free symmetric monoidal category presented by this hypergraph and the source-certified relations. A history is a typed tensor/composite of hyperedges; it need not have one exclusive primary label [32, 33]. The colored channel profunctor K_Q is not inserted as an ordinary arrow. It composes with physical histories only through its typed proarrow interfaces to $\mathcal{C}_Q^{\mathrm{pre}}$ and $\mathcal{C}_Q^{0}$.

Representative hyperedge and proarrow types are

$$\begin{array}{lll}
\mathsf{Coh}: & X \to X, & \text{closed coherent evolution,} \\
\mathsf{Weak}: & X \to Y_1 \otimes \cdots \otimes Y_n, & \text{weak-current transition,} \\
\mathsf{Decay}: & X \to Y_1 \otimes \cdots \otimes Y_n, & \text{parent-to-final-state boundary,} \\
\mathsf{Pair}: & S \to X \otimes \overline{X} \otimes R, & \text{source-driven pair channel with recoil/conservation record,} \\
\mathsf{K}_Q(C,B): & C \rightsquigarrow B, & \text{joint colored configuration to neutral channel,} \\
\mathsf{Prop}: & X(c) \to X(d), & \text{identity-preserving propagation.}
\end{array}$$

The wavy arrow denotes a profunctor element, not a morphism in the free symmetric monoidal category.

Definition 8.2 (Observation and reconstruction)**.** *Let ObsRec_k be a separate category of detector records, inference records, and reconstruction morphisms. A source- and boundary- typed observation functor*

$$\mathsf{Meas}_k : \mathsf{PhysBoundary}_k \longrightarrow \mathsf{ObsRec}_k$$

uses the physical-boundary category $\mathsf{PhysBoundary}_k$ declared by T_k (for the colored case, this includes $\mathcal{C}_Q^0$). It relates physical boundary data to epistemic records. It is not an inverse carrier-identity map unless a separate reconstruction theorem proves that property.

Theorem 8.3 (Atomic process noncoercion)**.** *A lawful same-target redescription preserves atomic constructor tags, typed source and target, boundary and incidence-change records, and compositional order. Consequently:*

1. *a weak-mediated decay may be a composite path but is not coerced into coherent motion among generation roots;*
2. *pair production does not multiply internal parent sectors;*
3. *a hadronization channel does not identify an isolated constituent with a color-neutral composite;*
4. *propagation does not absorb a decay or weak-transition boundary; and*
5. *reconstruction does not become upstream source identity.*

Proof. Hyperedge or proarrow tag, domain/codomain, boundary, and incidence change are retained signature coordinates. Changing one changes the target-relative audit record. Tensor/composition retains the typed term and supplies no deletion map to a different atomic constructor. Proarrow composition preserves the colored-channel type. The observation category is type-distinct from the physical-process category, so no lawful redescription reverses Meas_k without an additional theorem. □

Status theorem 8.4 (Basis-relative process evidence)**.** *The evidence bases certify closed coherent evolution and selected weak/flavor transition descriptions. They do not activate an exhaustive atomic registry and source-complete terminal calculus for all reaction, boundary, propagation, measurement, and reconstruction families. Theorem 8.3 proves the logical noncoercion theorem, while* $\delta^k_{\mathrm{processReg}}$ *remains in the interface-formation residual for each terminal kind.*

8.2 The simultaneous quantum-boundary ledger

Write

$$G_\Gamma = (SU(3)_c \times SU(2)_L \times U(1)_Y)/\Gamma, \qquad \Gamma \le \mathbb{Z}_6$$

for a frozen admissible global form [27]. Two convention coordinates are retained and linked explicitly. Chiral and anomaly bookkeeping uses left-handed charge conjugates of right-handed particle fields; the imported physical-particle Yukawa convention uses H for charged leptons and down-type quarks and $\widetilde{H}$ for up-type quarks [26]. Charge conjugation reverses the scalar factor in the corresponding all-left Weyl monomial. The frozen target convention is:

Kind	Chiral multiplet incidences	particle Q	Higgs: particle / left-Weyl	retained relation
L	$L_L : (\mathbf{1},\mathbf{2})_{-1/2}$, $e^c_R : (\mathbf{1},\mathbf{1})_{+1}$	-1	$H/\widetilde{H}$	left charged component remains paired with the neutral weak component; singlet conjugation is explicit
U	$Q^u_L \subset (\mathbf{3},\mathbf{2})_{1/6}$, $u^c_R : (\overline{\mathbf{3}},\mathbf{1})_{-2/3}$	$+2/3$	$\widetilde{H}/H$	up component remains part of the common quark weak doublet; color provenance retained
D	$Q^d_L \subset (\mathbf{3},\mathbf{2})_{1/6}$, $d^c_R : (\overline{\mathbf{3}},\mathbf{1})_{+1/3}$	$-1/3$	$H/\widetilde{H}$	down component remains part of the common quark weak doublet; color provenance retained

The component notation does not split an $SU(2)_L$ doublet into two independent representations. Likewise, an individual matter-kind row is not declared anomaly-free. Anomaly cancellation is evaluated on the complete joint chiral apex, including the neutral weak partner and color multiplicity. The ordered Higgs pair in each row is a convention bridge, not two independent Higgs carriers.

Definition 8.5 (Quantum-boundary packet)**.** *For a candidate x at $T_k(\Gamma)$, set*

$$\mathsf{QB}_{k,\Gamma}(x) = \begin{pmatrix} \mathsf{ChiralRep}, \mathsf{Conjugation}, \mathsf{Charge}, \mathsf{Hypercharge}, \mathsf{WeakInc}, \\ \mathsf{HiggsParticle}, \mathsf{HiggsLeft}, \mathsf{ConventionBridge}, \mathsf{ColorInc}, \\ \mathsf{AnomLedgerInc}, \mathsf{JointAnom}, \Gamma, \mathsf{Boundary}, \mathsf{ConfinementAuth} \end{pmatrix}_x .$$

Inapplicable fields receive a typed value. Joint-anomaly and global-form relations are never replaced by a per-kind marginal assertion.

Theorem 8.6 (Simultaneous quantum-boundary requirement). *A terminal certificate requires one coinstantiated $\mathsf{QB}_{k,\Gamma}$ packet and every deletion-essential relation to the joint apex. Rows from different chiral conventions, global forms, parameter states, boundaries, or confinement-authority branches cannot be spliced. The theorem is uniform in the frozen admissible parameter Γ; it does not select a global quotient.*

Proof. The packet and its cross-field relations are coordinates of the joint subfunctor in Theorem 3.20. A marginal splice has no element in that subfunctor unless one licensed transport carries the whole packet and all relations. Uniformity follows because the proof uses only equality of the frozen Γ-coordinate. □

Status theorem 8.7 (Quantum-boundary activation status). *The table specifies the local representation, conjugation, charge, hypercharge, and paired Higgs-incidence coordinates of the target. Specification is not evidence-relative certification: the frozen bases contain no theorem-output packet that activates the representation, weak-incidence, color-incidence, or particle/left-Weyl Higgs-incidence coordinates as terminal evidence. Complete joint-anomaly, chosen-global-form, boundary, process, and confinement-authority packets are not simultaneously activated relative to $\mathfrak{E}^0_L$ and $\mathfrak{E}^0_Q$. Those exact fields occur in the positive-completion residual profiles below.*

8.3 The immutable Higgs-response chain under refinement

FCGS-I proves, for every matter kind, the literal received chain

$$\mathrm{Disc}(I_3) \xrightarrow{\eta_k} \mathcal{S}_k(C_k) \xrightarrow{\chi_k} Q^Y_k = \mathrm{Disc}(\mathcal{A}_k),$$

with one bridge/fixation carrier $H_{\mathrm{br/fix}}$. The canonical projection $p_k : \mathcal{E}_k \xrightarrow{\sim} I_3$ induces $\widehat{\eta}_k := \eta_k \circ \mathrm{Disc}(p_k)$ on the positioned kind fibre. FCGS-II may add terminal fields but may not bypass, rename, or alter either received arrow.

Definition 8.8 (Terminal response extension). *An activated terminal response extension consists of the displayed upper chain, three erasures $u_{E,k}, u_{S,k}, u_{Q,k}$, and designated inclusions $i_{E,k}, i_{S,k}, i_{Q,k}$ in the reverse vertical directions:*

$$\begin{tikzcd}
\mathrm{Disc}(\mathcal{E}^{\mathrm{term}}_k) \arrow[r, "\widehat{\eta}^{\mathrm{term}}_k"] \arrow[d, "u_{E,k}"'] & \mathcal{S}^{\mathrm{term}}_{k,T}(C^{\mathrm{term}}_k) \arrow[r, "\chi^{\mathrm{term}}_k"] \arrow[d, "u_{S,k}"'] & Q^{Y,\mathrm{term}}_{k,T} \arrow[d, "u_{Q,k}"] \\
\mathrm{Disc}(\mathcal{E}_k) \arrow[r, "\widehat{\eta}_k"'] & \mathcal{S}_k(C_k) \arrow[r, "\chi_k"'] & Q^Y_k
\end{tikzcd}$$

They satisfy $u_X i_X = \mathrm{id}_X$ for $X = E, S, Q$, and the upper arrows agree with the imported arrows on the designated image:

$$\widehat{\eta}^{\mathrm{term}}_k i_{E,k} = i_{S,k}\widehat{\eta}_k, \qquad \chi^{\mathrm{term}}_k i_{S,k} = i_{Q,k}\chi_k.$$

Terminal-field variation has no backflow into the imported coordinates:

$$u_{E,k}(x) = u_{E,k}(x') \Longrightarrow u_{S,k}\widehat{\eta}^{\mathrm{term}}_k(x) = u_{S,k}\widehat{\eta}^{\mathrm{term}}_k(x'),$$
$$u_{S,k}(y) = u_{S,k}(y') \Longrightarrow u_{Q,k}\chi^{\mathrm{term}}_k(y) = u_{Q,k}\chi^{\mathrm{term}}_k(y').$$

The inclusions and erasures retain root, kind, the one $H_{\mathrm{br/fix}}$ coordinate, boundary, continuation, and failure provenance. Global commutation of the two squares is not assumed in this definition.

Theorem 8.9 (Rooted Higgs-response preservation)**.** *Every activated terminal response extension preserves the induced positioned map through the first commuting square, preserves χ_k through the second, and thereby leaves the literal imported* $\mathrm{Disc}(I_3) \xrightarrow{\eta_k} \mathcal{S}_k(C_k) \xrightarrow{\chi_k} Q_k^Y$ *chain unchanged. It retains the same one bridge/fixation carrier $H_{\mathrm{br/fix}}$. Numerical texture, phase, ratio, running, mass, width, or pole data cannot define a root, create a response slot, or multiply the Higgs carrier. If the upper chain is unactivated, it remains unformed and the lower FCGS-I chain is unchanged.*

Proof. For any upper source x, compare it with $i_{E,k}u_{E,k}(x)$, which has the same erasure. Fibre no-backflow, agreement on the designated image, and $u_{S,k}i_{S,k} = \mathrm{id}$ give

$$u_{S,k}\widehat{\eta}_k^{\mathrm{term}}(x) = \widehat{\eta}_k u_{E,k}(x).$$

The identical argument at the standing-response object gives $u_{Q,k}\chi_k^{\mathrm{term}} = \chi_k u_{S,k}$. Thus both squares commute as a consequence of the section and fibre laws. The retained-coordinate law and Theorem 2.2 fix p_k, η_k, $H_{\mathrm{br/fix}}$, and the full received chain. Numerical or spectral terminal fields lie in erasure fibres and therefore cannot modify the lower row. Failure of upper activation invokes Theorem 3.7 and leaves the imported row unchanged. □

Corollary 8.10 (No terminality from three response slots)**.** *Three rooted structural Higgs-response slots per kind imply neither three nonzero couplings, three masses, nor three terminal bearers. The U/D Higgs incidences remain distinct even though they share one bridge/fixation carrier.*

Counterexample criterion 8.11 (Process, quantum, or Higgs backflow)**.** *The process, quantum-boundary, and preservation results fail if a compound event is forced into one exclusive atomic label; if reconstruction becomes source identity; if per-kind anomaly freedom is assumed; if global forms or boundary branches are spliced; if the accepted η_k-χ_k chain is bypassed; or if numerical mass/pole data create an upstream root or Higgs carrier.*

9 Kind-indexed ROC, disposition atlas, and successor data

9.1 Readiness-valued Role-Occupancy Closure

Definition 9.1 (Readiness-valued ROC)**.** *Let $\mathbf{Set}_{T_k}$ denote the set-sized ROC objects admitted at T_k, and define the common codomain*

$$\mathsf{ROCVal}_k(T_k) := (\{\mathsf{Ready}\} \times \mathbf{Set}_{T_k}) \sqcup \coprod_{\varnothing \neq M \subseteq \Delta_{k,\mathrm{form}}(T_k)} \{\bot_M\}.$$

For a frozen target and evidence basis, the map $\widehat{\mathrm{ROC}}_k(T_k; -) : \mathfrak{E} \mapsto \mathsf{ROCVal}_k(T_k)$ is

$$\widehat{\mathrm{ROC}}_k(T_k; \mathfrak{E}) = \begin{cases} (\mathsf{Ready}, \mathrm{Assign}_k(T_k)/\Gamma_k^{\mathrm{law}}), & \mathrm{Missing}_k(T_k; \mathfrak{E}) = \varnothing, \\ \bot_{\mathrm{Missing}_k(T_k;\mathfrak{E})}, & \mathrm{Missing}_k(T_k; \mathfrak{E}) \neq \varnothing. \end{cases}$$

The coproduct tags give both cases one type. A bottom value is a readiness result, not an empty orbit set and not a number. A ready orbit set licenses a positive terminal value only when its cardinality is exactly one.

Theorem 9.2 (Kind-indexed terminal ROC)**.** *If the candidate and use registries, semantic quotient, precertificate predicates, joint role object, assignment constraints, physical authority, failure routes, lawful group action, and assignment-schema completeness are all certified, then*

$$\mathrm{ROC}_k(T_k) = \mathrm{Assign}_k(T_k)/\Gamma_k^{\mathrm{law}}.$$

Every group-invariant terminal disposition factors uniquely through this quotient. Here assignment-schema completeness means that the assignment object and lawful action are formed; it does not assume occupant coverage or a singleton orbit. If any required interface-formation atomic contract is missing, the output is the corresponding bottom value and no ROC cardinality is reported. Missing positive or exhaustive-negative atoms remain in the disposition profile without changing a formed ROC object into a bottom value.

Proof. The ready branch is Theorem 5.12. In the unready branch at least one object needed to form the assignment set or lawful action is absent; Definition 9.1 records that exact set rather than coercing an unformed quotient to $\varnothing$. ☐

At the frozen evidence bases,

$$\begin{aligned}\widehat{\mathrm{ROC}}_L(T_L;\mathfrak{E}^0_L) &= \perp_{M^0_{L,\mathrm{form}}},\\ \widehat{\mathrm{ROC}}_U(T_U;\mathfrak{E}^0_Q) &= \perp_{M^0_{U,\mathrm{form}}},\\ \widehat{\mathrm{ROC}}_D(T_D;\mathfrak{E}^0_Q) &= \perp_{M^0_{D,\mathrm{form}}}.\end{aligned}$$

9.2 Concrete target-indexed dispositions

Definition 9.3 (Target-indexed disposition record)**.** *A target-indexed disposition record is*

$$\begin{gathered}(\mathsf{TargetID}, \mathsf{EvidenceBasis}, \mathsf{ProofClass}, \mathsf{Disposition}, \mathsf{ResidualSet},\\ \mathsf{ForbiddenPromotions}, \mathsf{SuccessorRule}, \mathsf{CounterexampleCriterion}).\end{gathered}$$

Provenance identifiers belong to the source supplement, not to this mathematical object.

The instantiated rows are:

Target and evidence	**proof class**	**evaluated result**	**residual and successor rule**
$\mathcal{H}_I$, FCGS-I v2.2.0	Structural	Established	none; immutable downstream import
$T_L(\Gamma), \mathfrak{E}^0_L$	Readiness	NotReady $[(\mathrm{CL}, \mathbf{M}^0_L)]$	activate a sound positive or negative charged completion packet; do not infer from shape or names
$T_U(\Gamma), \mathfrak{E}^0_Q$	Readiness	NotReady $[(\mathrm{Confinement}, \mathbf{M}^0_U)]$	activate marked-parent plus joint-channel authority, or exhaustive rejection
$T_D(\Gamma), \mathfrak{E}^0_Q$	Readiness	NotReady $[(\mathrm{Confinement}, \mathbf{M}^0_D)]$	same schema, separately indexed and retaining the D mark
Surface-only promotion rule	Inference	Criterion	Theorem 5.15 requires surface-fibre constancy and, in a formed architecture, an actual terminal certificate
Common charged/colored apex	Readiness	Undetermined	no impossibility theorem; a future tagged successor target is not excluded

For the three terminal rows, the forbidden promotions and counterexample criteria are those stated in Sections 6–8; their target IDs, evidence bases, residual sets, and successor rules are displayed above.

Thus each mathematical disposition record is instantiated. Source identities and versions are summarized in Appendix B; exact paths and hashes are supplied in the accompanying provenance table.

Theorem 9.4 (FCGS-2 disposition atlas)**.** *The branch-complete basis-relative atlas is*

$$\begin{aligned}\mathfrak{A}^0_{\mathrm{FCGS2}} = (&\mathsf{Established}(\mathcal{H}_I),\ \mathsf{NotReady}[(\mathrm{CL}, \mathbf{M}^0_L)],\\ &\mathsf{NotReady}[(\mathrm{Confinement}, \mathbf{M}^0_U)], \mathsf{NotReady}[(\mathrm{Confinement}, \mathbf{M}^0_D)],\\ &\mathsf{TerminalAdmissibilityCriterion}, \mathsf{TargetIndexed}_{2\mathrm{L}/2\mathrm{Q}}).\end{aligned}$$

The final tag records the target decomposition, not a theorem that a future common successor is impossible.

Proof. Structural establishment is Theorem 2.2; the charged readiness row is Theorem 6.7; the colored rows and target indexing are Theorem 7.10; terminal nonpromotion is Theorem 5.15; and the ROC bottom values are Theorem 9.2. The displayed rows retain proof class, target, and exact residual profile, so no stronger terminal value is hidden inside a summary label. □

9.3 Successor-stage data

Definition 9.5 (Tagged successor object)**.** *Define the heterogeneous tagged coproduct*

$$\mathcal{H}_{2\to 3} = \mathsf{Struct}(\mathcal{H}_I) \sqcup_{\mathrm{tag}} \mathsf{PositiveTerminal}(\mathcal{P}^+_{\mathrm{term}}) \sqcup_{\mathrm{tag}} \mathsf{Disposition}(\mathcal{C}_{\mathrm{disp}}).$$

Only activated positive terminal packets enter $\mathcal{P}^+_{\mathrm{term}}$; exact negative, target-dependent, branch-indexed, and readiness results enter $\mathcal{C}_{\mathrm{disp}}$.

Relative to $\mathfrak{E}^0_L$ and $\mathfrak{E}^0_Q$,

$$\mathcal{P}^+_{\mathrm{term}}(L) = \mathcal{P}^+_{\mathrm{term}}(U) = \mathcal{P}^+_{\mathrm{term}}(D) = \varnothing$$

as a set of licensed positive successor packets. This is an evidence-relative theorem state, not an empty physical candidate universe.

Theorem 9.6 (Successor-stage constraint)**.** *A successor stage may use the unchanged structural packet, the conditional semantic signature and assignment-orbit factorization theorems, the charged and joint colored target schemas, the process noncoercion and Higgs-preservation theorems, and the exact basis-relative readiness profiles. It may not infer terminal universality, one terminal parent per kind, or a terminal exact-three count by analogy.*

Proof. The successor type admits only activated positive packets into the positive summand. Theorems 6.7 and 7.10 place all evaluated terminal branches in the disposition summand. Filling a positive slot from $\mathcal{H}_I$ would erase the terminal fields whose absence produced the readiness values and would violate Theorems 5.10 and 5.15. □

9.4 Target-indexed consequence

Corollary 9.7 (FCGS-II target-indexed consequence)**.** *The immutable structural packet and the conditional semantic and assignment-orbit factorization theorems coexist with the exact disposition triple*

$$\Big(\mathsf{NotReady}[(\mathrm{CL}, \mathbf{M}^0_L)], \mathsf{NotReady}[(\mathrm{Confinement}, \mathbf{M}^0_U)], \mathsf{NotReady}[(\mathrm{Confinement}, \mathbf{M}^0_D)]\Big).$$

The three terminal ROC objects are unformed at these evidence bases, so no terminal count enters the successor object.

Proof. The structural and conditional statements are Theorems 2.9, 3.20–5.15, and the two factorization theorems. The displayed values are Theorems 6.7–7.10; unformed ROC is Theorem 9.2; and the successor constraint is Theorems 9.4–9.6. □

Scope of the classification. The present evidence bases determine the conditional factorization and the displayed readiness values. Those values are outputs of the typed disposition algebra; they neither deny physical charged leptons or quarks nor determine a terminal cardinality.

Counterexample criterion 9.8 (Atlas or successor-data failure)**.** *The result fails if a readiness value is rendered as zero, if a structural packet is promoted to a terminal one, if the U/D marks or aggregate colored architecture are erased, if branch separation is overstated as an impossibility theorem, or if a successor receives a positive terminal slot absent an activated certificate.*

10 Robustness, counterexamples, and conclusion

10.1 Independence of the theorem layers

The final result is a conjunction of logically distinct layers.

1. **Immutable structural inheritance.** The FCGS-I packet is fixed by the designated inclusion/erasure pair of every immutable import extension. Nothing in the terminal status evaluation can alter its roots, typed fibres, or η_k-χ_k response chain.
2. **Conditional semantic factorization.** If the complete use and witness interface is activated, the signature is fully abstract for same-target semantic identity and terminal judgments factor through lawful assignment orbits; positive closure requires exactly one orbit. A newly discovered standing-bearing use would falsify the earlier activation certificate, not the conditional theorem.
3. **Terminal admissibility.** In a formed terminal architecture, a candidate without a singleton-ROC terminal certificate is not lawfully promoted. In an unready architecture no unformed predicate is declared false; rather, no promotion certificate is licensed. Surface data do not substitute for the missing terminal witness.
4. **Evidence-relative application.** At the frozen charged and colored evidence calculi, neither a sound positive completion packet nor a sound exhaustive-negative packet is derivable. The three-layer residual profiles, rather than an invented zero or positive parent, are the exact values of the disposition algebra.

Because these layers are independent, a future positive charged-parent or confinement theorem would change only the corresponding successor-target disposition without changing the structural import or the factorization theorem. Conversely, a failure to activate a terminal interface has no retroactive force on FCGS-I.

10.2 Characterization of counterexamples

Each basis-relative result has a precise counterexample criterion.

Result challenged	Required counterexample
Semantic/signature equivalence	A licensed same-target use that separates two equal complete signatures, or a signature coordinate that is not a licensed use, under an allegedly activated interface.
Continuation congruence	A licensed continuation and a pair of equal base signatures whose correctly reindexed continued signatures differ.
Terminal promotion necessity	A sound terminal promotion lacking a candidate precertificate, compatible role-covering bijection, or singleton lawful orbit.
Formal surface separation and admitted-fibre criterion	A surface function whose composite equals the formal indicator on both members of the equal-surface pass/fail status pair, or a failure of either direction of the admitted fibre-constancy equivalence; an actual surface-only theorem must prove constancy on every admitted surface fibre.
Charged readiness	A target-compatible derivation in Der_L^0 of either Δ^+_{CL} or Δ^-_{CL}.
Colored readiness	A target-compatible derivation of a marked parent together with aggregate confinement/asymptotic authority, or an exhaustive rejection packet for the complete joint configuration/channel universe.
ROC bottom values	A complete candidate, use, role, assignment, authority, and lawful-action certificate making the relevant formation residual empty.

A successful mass fit, familiar particle table, isolated process display, local vacuum gap, single reconstructed hadron, or absence of a found parent does not meet any of these criteria.

10.3 Why the colored aggregate correction is necessary

The colored result does not model confinement as a function from one quark kind to one color-neutral particle. Such a map would erase the physical fact that color-neutral channels are supported by joint configurations and may contain multiple constituent kinds, antiparticles, and gauge-field structure. The marked U/D target records therefore enter the common configuration category as constituent incidences. Any future physical descent must act on the joint aggregate, may be multi-channel, and must preserve constituent provenance. It makes no confinement claim at this evidence basis while enforcing the necessary aggregate and provenance types for a future confinement-safe theorem.

10.4 Main theorem

Theorem 10.1 (FCGS-II terminal factorization and disposition theorem)**.** *For the immutable FCGS-I import, the frozen target family $T_L(\Gamma), T_U(\Gamma), T_D(\Gamma)$, and the frozen evidence bases $\mathfrak{E}^0_L, \mathfrak{E}^0_Q$:*

1. *activated same-target carrier identity is characterized by the fully abstract typed continuation signature and is stable under continuation;*
2. *activated terminal dispositions factor through precertified quotient classes, injective preassignments, assignment-local live residues, compatible role-covering bijections, and lawful assignment orbits, with positive realization requiring exactly one orbit;*
3. *in every formed terminal architecture, candidates lacking terminal certification are not lawfully promoted; at the evaluated unready targets no promotion certificate is licensed from generation, mass, charge, process, matrix, Higgs, name, or detector surface data;*
4. *the charged branch has exact evidence-relative value* $\mathrm{Disp}_L(T_L; \mathfrak{E}^0_L) = \mathsf{NotReady}[(\mathrm{CL}, \mathbf{M}^0_L)]$*;*
5. *the marked colored branches have exact evidence-relative values*

$$\mathrm{Disp}_U(T_U; \mathfrak{E}^0_Q) = \mathsf{NotReady}[(\mathrm{Confinement}, \mathbf{M}^0_U)],$$
$$\mathrm{Disp}_D(T_D; \mathfrak{E}^0_Q) = \mathsf{NotReady}[(\mathrm{Confinement}, \mathbf{M}^0_D)].$$

6. *the three terminal ROC objects remain unformed at full terminal strength and no terminal cardinality is reported; and*

7. *all FCGS-I objects and the complete* $\mathrm{Disc}(I_3) \xrightarrow{\eta_k} \mathcal{S}_k(C_k) \xrightarrow{\chi_k} Q_k^Y$ *chain remain unchanged.*

Proof. Item 1 is Theorem 3.10 and Lemma 3.11. Item 2 follows from Theorems 3.20, 5.10, and 5.12. Item 3 follows from Theorems 5.10–5.15; Items 4–5 from Theorems 6.7–7.10; Item 6 from Theorem 9.2; and Item 7 from Theorems 2.9 and 8.9. □

10.5 Conclusion

FCGS-II separates premetric root and response structure from terminal physical realization. It identifies the complete target-relative factorization that a terminal claim must satisfy and evaluates the frozen charged and colored evidence bases against it. Each readiness value is an exact result of the finite evidence calculus, with an explicit residual profile, successor rule, and counterexample criterion.

The charged branch preserves substantial selector-route, mass-shape, and readout progress without confusing it with terminal parent realization. The colored branch preserves quark standing, color transport, the sharp-local vacuum gap, and the structurally proved theorem-scope nonlocal sector layer while keeping those results distinct from confinement. Its aggregate-first profunctorial channel architecture supplies a type-correct necessary target schema at the declared scope for a future confinement-safe theorem. The resulting successor data retain the immutable structural packet, the proved conditional factorization, and the exact unresolved physical branches without filling them by analogy.

A N01–N18 theorem index

The index below records the mathematical content of the numbered results. The index distinguishes conditional theorems from their evaluation at the finite evidence bases.

N01. The FCGS-I packet, including the exact-three root set, the four post-count typed fibres, the response chain, and the single bridge/fixation carrier, is fixed by a designated inclusion and erasure. The charged and marked colored targets are frozen independently.

N02. The charged terminal target is name-free and order-free. It contains three inherited root slots but no terminal parent by definition.

N03. The colored target is formed on a joint pre-boundary configuration category with retained U/D constituent marks and a Set-valued channel profunctor. Neither an isolated constituent-to-hadron map nor a confinement theorem is inserted.

N04. Every licensed semantic-use row has a unique audited coverage state. Complete interface activation is equivalent to an empty formation residual.

N05. A total audit record exists independently of activation. An activated terminal signature exists only when every required interface contract is certified.

N06. Under activation, the typed continuation signature is fully abstract for same-target semantic identity. Unary continuations and registered finite-arity joint uses descend through the semantic quotient.

N07. Terminal promotion requires a precertified quotient class, a compatible role-covering assignment, and a singleton lawful assignment orbit.

N08. Surface-only promotion is valid exactly when the terminal predicate is constant on every admissible fibre of the surface map and the induced predicate is certified. At an unformed interface the criterion gives no terminal value.

N09. Charged positive completion, exhaustive negative completion, and readiness form a sound evidence-indexed trichotomy.

N10. The same trichotomy holds separately for the marked U and D colored targets, using the joint colored configuration and channel architecture.

N11. Reaction hyperedges, colored channel proarrows, physical-boundary maps, and epistemic reconstruction retain distinct types under composition and redescription.

N12. A terminal quantum-boundary certificate is one simultaneous packet at a frozen global form. Marginal charge, anomaly, Higgs, or boundary records cannot be spliced into it.

N13. Every activated terminal response extension preserves the complete imported FCGS-I response chain through the inclusion/erasure squares. Failure of upper activation leaves the lower chain unchanged.

N14. At $\mathfrak{E}_L^0$, neither charged completion packet is derivable and the exact value is $\mathsf{NotReady}[(\mathrm{CL}, \mathbf{M}_L^0)]$.

N15. At $\mathfrak{E}_Q^0$, the exact marked values are

$$\mathsf{NotReady}[(\mathrm{Confinement}, \mathbf{M}_U^0)] \quad \text{and} \quad \mathsf{NotReady}[(\mathrm{Confinement}, \mathbf{M}_D^0)].$$

FCGS-2L and FCGS-2Q are a target-indexed branch decomposition, not an impossibility theorem for every successor target.

N16. Readiness-valued ROC returns an orbit set only after formation. At the evaluated bases it returns the three formation-indexed bottom values, so no component count is inspected.

N17. The branch-complete disposition atlas retains target, evidence basis, proof class, exact residual profile, successor rule, and counterexample criterion.

N18. The tagged successor object receives the immutable structural packet, the conditional factorization theorems, and the exact disposition rows. Its positive terminal summand receives only activated positive packets.

B Finite evidence bases and exact source-output contracts

B.1 Basis identity

The charged basis contains the twenty-two source artifacts

$$\begin{aligned}\mathfrak{E}_L^0 = \{&\mathrm{FCGSI}, \mathrm{SCIC}, \mathrm{ROC}, \mathrm{SM3}, \mathrm{CLY}, \mathrm{CLZ}, \mathrm{CLC}, \mathrm{CLE}, \mathrm{CLF}, \mathrm{CLG}, \mathrm{CLH}, \mathrm{CLI},\\ &\mathrm{CLJ}, \mathrm{CLM}, \mathrm{CLO}, \mathrm{CLR}, \mathrm{AOT1}, \mathrm{Schrodinger}, \mathrm{SM5}, \mathrm{SYM2}, \mathrm{ChargeLat}, \mathrm{HiggsEnv}\}.\end{aligned}$$

The colored basis contains the thirteen provenance entries

$$\begin{aligned}\mathfrak{E}_Q^0 = \{&\mathrm{FCGSI}, \mathrm{SCIC}, \mathrm{ROC}, \mathrm{SM2}, \mathrm{SM3}, \mathrm{YM}_{\mathrm{core}}, \mathrm{YM}_{\mathrm{patched}}, \mathrm{YM}_{\mathrm{extended}}, \mathrm{Schrodinger},\\ &\mathrm{SM5}, \mathrm{SYM2}, \mathrm{ChargeLat}, \mathrm{HiggsEnv}\}.\end{aligned}$$

The local Yang–Mills PDF and patched source archive form one provenance pair and contribute one local-vacuum-gap output. The distinct structural extension paper contributes the theorem-scope extended-support sector output. Only the theorem-bearing works displayed above enter either evidence basis.

The internal leaf bases used by the typed calculus are

$$\mathfrak{I}^0_L = \{\mathrm{N01}_L, \mathrm{N02}_L, \mathrm{Prov}_L\}, \qquad \mathfrak{I}^0_{Q,k} = \{\mathrm{N01}_k, \mathrm{N03}_k, \mathrm{Prov}_k\} \quad (k \in \{U, D\}).$$

Their exact supports are the target-lock/schema fields and the evidence fingerprint fields displayed below. They are named theorem/audit outputs, not zero-premise constructors and not imported scientific evidence.

B.2 Certified and residual atoms

For compactness, let $C^0_{k,j}$ denote the certified side of the finite contract ledger,

$$C^0_{k,j} = \mathrm{Cert}_{k,j}(\mathfrak{E}^0_k; \mathfrak{I}^0_k), \qquad j \in \{\mathrm{form}, +, -\}.$$

The charged certified atoms are

$$\begin{aligned} C^0_{L,\mathrm{form}} &= \{\delta^L_{\mathrm{targetLock}}, \delta^L_{\mathrm{candidateSchema}}, \delta^L_{\mathrm{evidenceFingerprint}}\}, \\ C^0_{L,+} &= \{\delta^L_{\mathrm{rootImport}}, \delta^L_{\mathrm{kindFibre}}, \delta^L_{\mathrm{chargedRole}}, \delta^L_{\mathrm{chargeLedger}}, \\ &\qquad \delta^L_{\mathrm{anomalyLedgerIncidence}}, \delta^L_{\mathrm{massShape}}, \delta^L_{\mathrm{metricReadout}}, \delta^L_{\mathrm{declaredSelectorAudit}}, \delta^L_{\mathrm{declaredStratifierAudit}}\}, \\ C^0_{L,-} &= \varnothing. \end{aligned}$$

For each $k \in \{U, D\}$, the colored certified atoms are

$$\begin{aligned} C^0_{k,\mathrm{form}} &= \{\delta^k_{\mathrm{targetLock}}, \delta^k_{\mathrm{markedTargetSchema}}, \delta^k_{\mathrm{jointConfigurationType}}, \delta^k_{\mathrm{evidenceFingerprint}}\}, \\ C^0_{k,+} &= \{\delta^k_{\mathrm{rootImport}}, \delta^k_{\mathrm{kindFibre}}, \delta^k_{\mathrm{chargeLedger}}, \delta^k_{\mathrm{anomalyLedgerIncidence}}, \\ &\qquad \delta^k_{\mathrm{colorTransport}}, \delta^k_{\mathrm{routeDiscipline}}, \delta^k_{\mathrm{localVacuumGap}}, \delta^k_{\mathrm{nonlocalAuth}}\}, \\ C^0_{k,-} &= \varnothing. \end{aligned}$$

The finite target ledgers are defined by the disjoint unions

$$\Delta_{L,j}(T_L) = C^0_{L,j} \amalg M^0_{L,j}, \qquad \Delta_{k,j}(T_k) = C^0_{k,j} \amalg M^0_{k,j}.$$

Thus the residual sets displayed in Sections 6 and 7 are not samples of missing coordinates: they are the exact complements of the certified sides in the frozen ledgers.

The N12 table is part of the frozen target specification, not an audited theorem-output packet. Consequently $\delta^L_{\mathrm{repLedger}}, \delta^L_{\mathrm{weakLedger}}, \delta^L_{\mathrm{HiggsIncidence}}$ and $\delta^k_{\mathrm{colorRep}}, \delta^k_{\mathrm{weakLedger}}, \delta^k_{\mathrm{HiggsIncidence}}$ occur on the residual side until an explicit compatible constructor certifies them. Here $\delta^k_{\mathrm{anomalyLedgerIncidence}}$ denotes only the kind-tagged incidence or projection into the single joint chiral anomaly ledger; it is neither a per-kind anomaly-cancellation claim nor an independently additive marginal.

B.3 Atomic support matrix

The following table records every theorem-output family used on the certified side. An omitted atom is not licensed. The accompanying one-row-per-source provenance table records the exact version, path, fingerprint, credited outputs, and forbidden outputs.

Certificate source	**Credited atomic support**	**Explicit non-output**
FCGS-I [1]	$\delta^k_{\text{rootImport}}, \delta^k_{\text{kindFibre}}$; rooted response structure and the single bridge/fixation carrier as context	terminal Higgs-incidence packet, parent, process, confinement, pole authority, assignment, or ROC
N01–N03 in this paper	$\delta^k_{\text{targetLock}}$ from N01; the charged candidate schema from N02; and the marked colored target schema and $\delta^k_{\text{jointConfigurationType}}$ from N03	physical realization, terminal source completeness, or confinement
Frozen provenance audit	$\delta^k_{\text{evidenceFingerprint}}$	any theorem output beyond source identity and use contract
SM-3 [4]	$\delta^L_{\text{chargedRole}}$; representation-response and marked-quark coordinates are target inputs rather than theorem-output ledgers	local representation/weak-incidence certificate, terminal parent, confinement-safe realization, exact pole, or assignment
Charge lattice [24]	$\delta^k_{\text{chargeLedger}}, \delta^k_{\text{anomalyLedgerIncidence}}$, with the latter restricted to a kind-tagged incidence into one joint ledger	per-kind marginal cancellation, global-form choice, joint-apex cancellation, numerical coupling, or terminal packet
Higgs envelope [25]	the unique Higgs bridge/fixation carrier and its faithful carrier-order projection as premise context; no terminal atom is credited	particle/left-Weyl convention bridge, numerical scale, or terminal incidence packet
N12 requirement theorem in this paper	coinstantiation and no-splicing requirement for an already formed quantum-boundary packet; no certified nonresidual atom	local convention activation, joint anomaly cancellation, global-form selection, or terminal quantum-boundary packet
CLY/CLZ [6, 7]	$\delta^L_{\text{declaredSelectorAudit}}$ and $\delta^L_{\text{declaredStratifierAudit}}$, respectively, for the two separately declared routes	universal selector exhaustion, empirical selector, terminal stratifier, parent, or hierarchy
CLE–CLI [9, 10, 11, 12, 13]	typed audits of proper direct, family-index, quotient, scalar, and declared branch-failure subfamilies	$\delta^L_{\text{negativeCandidateExh}}$ or $\delta^L_{\text{negativeFailureExh}}$
Charged readout sources [15, 16]	$\delta^L_{\text{massShape}}, \delta^L_{\text{metricReadout}}$, with the shape-only and symbolic one-anchor scopes retained	exact pole, zero-anchor scale, full physical authority, or terminal assignment
SM-2 [5]	$\delta^k_{\text{colorTransport}}, \delta^k_{\text{routeDiscipline}}$	free colored asymptotic standing, hadronization, confinement, or S60 authority
Local Yang–Mills provenance pair [19]	one $\delta^k_{\text{localVacuumGap}}$ output	confinement, nonlocal line/surface authority, hadronization, or quark asymptotic authority
Structural Yang–Mills extension [20]	one joint theorem-scope extended-support sector output, registered by target-use reindexing as $\delta^U_{\text{nonlocalAuth}}$ and $\delta^D_{\text{nonlocalAuth}}$	arbitrary nonlocal-invariant classification, Standard-Model global-form selection, confinement, hadronization, singlet-channel coverage, or quark asymptotic authority
Schrodinger/SM-5/SYM-2 [22, 23, 21]	closed coherent evolution, selected weak/flavor typing, and stable/resonant/ confined/composite type separation	complete process registry, decay/hadronization calculus, terminal reconstruction, or physical-authority packet

Theorem-output support matrix.

SCIC [2] and ROC [3] supply the conditional quotient and orbit factorization theorems. Because their activation hypotheses include formation atoms in $M^0_{k,\mathrm{form}}$, they contribute no evaluated terminal-activation atom at the frozen bases. CLC and CLJ record historical or deferred classifications; they do not strengthen the certified side of the terminal ledger.

The registered inference constructors are coordinate projection, exact same-target transport, target-matched conjunction, and finite packet assembly. Projection and transport preserve support; conjunction has support contained in the union of its premises; packet assembly is admitted only after every atom in the packet already occurs in compatible premise support. The local Yang–Mills provenance-pair constructor identifies the PDF and patched source as one theorem output. The structural Yang–Mills target-use constructor reindexes the one joint $SU(3)_c$ extended-support sector certificate at its two marked U, D use coordinates. It is not a projection of sector objects, does not construct kind-specific sectors, does not duplicate the source output, and does not broaden its support. No registered constructor emits an atom in any of $M^0_{L,j}, M^0_{U,j}, M^0_{D,j}$. Lemma 2.8 therefore proves both the three exact complements and the emptiness of the positive and negative activation sets.

C Terminal audit fields

Field family	**Semantic content**	**Failure condition**
sort, root, and kind	typed presentation, inherited root incidence, and retained matter-kind mark	untyped coercion or independent recount
source and definedness	exact ontology, domain, version, target fingerprint, and use contract	located-only source or undefined continuation action
continuation and persistence	all licensed paths and identity survival	missing path, base-change failure, or identity loss
failure audit	declared candidate-local failure family and outcomes	unregistered route or unsupported exhaustion
process and boundary	reaction hyperedges, channel proarrows, physical boundary, observation, and reconstruction	coercion, missing family, or reconstruction backflow
physical authority	exact pole, resonance, confinement, asymptotic, or boundary authority asserted	local theorem used beyond scope or authority absent
representation and incidence	chiral representation, conjugation, charge, hypercharge, weak, Higgs, and color records	marginal splice or convention drift
anomaly and global form	joint-ledger incidences and joint-apex cancellation at frozen Γ	per-kind cancellation assumption or unfrozen quotient
joint compatibility	finite-arity licensed uses, role coverage, incidence laws, and global constraints	representative-dependent or marginally assembled parent
source-authority provenance	standing-bearing theorem or physical-boundary origin	target, source, or authority drift
presentation metadata	file name, notation, and representative history	excluded from semantic identity; using it as selector is failure

D Process and observation type ledger

typed object	role	noncoercion
Coh	closed same-bearer evolution	not a generation transition or decay
Weak	weak-current reaction hyperedge	not root identity or coherent motion
Decay	parent-to-final-state boundary	not an internal standing equivalence
Pair	source-driven pair hyperedge with recoil and conservation record	not multiplication of internal parent sectors
K_Q	Set-valued channel proarrow from a joint colored configuration to a neutral channel	not an ordinary arrow and not isolated quark-to-hadron identity
Prop	identity-preserving propagation	does not erase a transition or decay boundary
Meas_k	physical boundary to epistemic record	not an upstream carrier inverse without a reconstruction theorem

E Residual profiles and successor rule

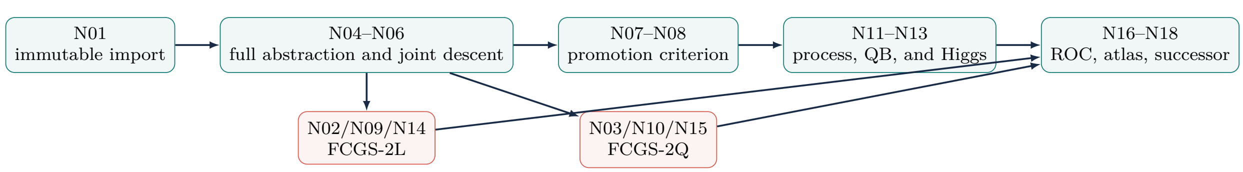
Definition 2.6 gives, for every evidence basis,

$$\mathbf{M}_k(\mathfrak{E}) = \big(M_{k,\mathrm{form}}(\mathfrak{E}), M_{k,+}(\mathfrak{E}), M_{k,-}(\mathfrak{E})\big).$$

The readiness-valued ROC is indexed only by the first component because that component determines whether the quotient and action are formed. The disposition NotReady carries all three components because it records both missing formation data and the independent positive and exhaustive-negative burdens.

Evidence extension is monotone in certified atomic support, but no monotonicity of orbit cardinality follows. Activating a new witness may refine semantic classes, create an assignment space that was previously unformed, or split or identify lawful assignment orbits. Every successor target must therefore re-establish full abstraction, joint compatibility, lawful-action formation, and ROC. It cannot obtain a count by deleting one residual symbol from an earlier row.

F Theorem dependency map



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