

Spacetime Substantivalism 28: Constitutive Audit of Proton Mass and Its Originating Composition——Determining the Eternal Stability of Matter from

$$m_p = \hbar\sqrt{\epsilon_0\mu_0}/R_p$$

时空实体论 28：质子质量的本构审计与来源构成——从

$m_p = \hbar\sqrt{\epsilon_0\mu_0}/R_p$ 判定物质的永恒稳定性

Hugang Cui (崔虎刚) 0009-0000-7199-7299

Abstract

Within the framework of Spacetime Substantivalism (CSSD), this paper conducts a constitutive audit of the origin and composition of proton mass. Building upon the electromagnetic photonic materiality of the Logical Matrix established in previous works—particularly a series of major achievements from gravitational waves to particle physics, all originating from the constitutive reduction of the fundamental formula $c = 1/\sqrt{\epsilon_0\mu_0}$ —this paper continues to demonstrate the physical mechanism of proton stability. Abandoning the “emergence” and “probabilistic” paradigms of the Standard Model, which explain mass through the Higgs mechanism or the symmetry breaking of Grand Unified Theory group theory, this work re-anchors the foundation of physics on undeniable material substrate constants. By reducing the speed of light from an “upper velocity limit” to the intrinsic transmission bandwidth protocol of substantial spacetime (the First Protocol / Luminous Protocol C_s), and by demonstrating that rest mass is the logical consideration paid for the localization closure of photonic protocol streams (the Second Protocol / Instantiation Protocol, i.e., the electromagnetic expression of the Lorentz factor $\gamma = 1/\sqrt{1 - v^2\epsilon_0\mu_0}$), this paper audits the internal “three quarks versus three gluons” integrated structure of the proton and derives the hardware definition of proton mass: $m_p = \hbar\sqrt{\epsilon_0\mu_0}/R_p$. This identity directly locks the existential state of the proton onto the rigid product of the universe’s fundamental constants \hbar, ϵ_0, μ_0 and the topological radius R_p . Based on this, this study determines that proton decay is algebraically inconsistent, and its stability is the necessary manifestation of the sovereignty of the material substrate. Grand unification is not an unresolved problem awaiting solution, but a recorded fact already closed-loop in protocol auditing.

Keywords: Proton eternal stability; Constitutive audit; First Protocol (Luminous Protocol C_s); Second Protocol (Instantiation Protocol); Electromagnetic expression of Lorentz factor; Logical Matrix; $m_p R_p = \hbar\sqrt{\epsilon_0\mu_0}$; Three quarks and three gluons; Topological claspings; Recoil mechanism; Angular momentum quantization; Bandwidth and load; Sovereign instantiation; Logical closure of grand unification

1 Introduction: The Directness of Physics and the Compensation of Mathematics

Physical truth ought to be as direct as “an apple falling to the ground”—the necessary process of an object returning to its material substrate properties. However, mainstream physics, having lost the concept of “substantial spacetime,” has been compelled to construct complex gravitational field equations, introduce the Higgs mechanism, and invoke higher-dimensional group theories such as $SU(5)$ in order to describe motion and mass. This increasingly bloated mathematical system is essentially a form of “mathematical compensation” arising from conceptual vagueness—attempting to find truth in “shadows” (geometric symmetries) rather than directly auditing the “substance” (material substrate).

It should be noted that the theoretical frameworks developed by Cabannas and Silva regarding the modal discipline of objectivity [22-25] possess significant academic merit, providing a crucial perspective for understanding the completeness of the Logical Matrix. However, this study maintains that any highly abstract theory of objectivity, in order to establish its ultimate sovereignty within physical reality, must be deeply integrated with the specific material constituents and the mechanical substrate of our universe.

This series of studies has accomplished a series of major constitutive reductions [1-20]:

- **Starting from gravitational waves:** We have demonstrated that gravitational waves are not “ripples” of spacetime geometry, but eigenmode perturbations of substantial spacetime as an electromagnetic photonic material [8-14];
- **Unified anchor of the fundamental formula:** All derivations originate from the same undeniable constitutive relation $c = 1/\sqrt{\epsilon_0\mu_0}$ [1];
- **Reduction of the physical mechanism of the Lorentz transformation:** The Lorentz factor is reconstructed as $\gamma = 1/\sqrt{1 - v^2\epsilon_0\mu_0}$, revealing its electromagnetic constitutive origin [15];
- **Exception-free derivation of the Standard Model:** *Spacetime Substantivalism* 25 successfully derived all particles of the Standard Model without exception from the qualitative electromagnetic photonic materiality of the substrate, establishing that the so-called “ion soup” is essentially, always has been, and always will be “photon soup” [2];
- **Audit of cosmic entity uniformity via gravitational waves:** *Spacetime Substantivalism* 26, through a 1.3-billion-light-year audit by gravitational waves, confirmed the rigid consistency of the electromagnetic photonic materiality of the Logical Matrix on cosmological scales [3];
- **Constitutive audit of proton eternal stability:** *Spacetime Substantivalism* 27, employing the First Protocol (Luminous Protocol) and the Second Protocol (Instantiation Protocol, i.e., the electromagnetic expression of the Lorentz factor $\gamma = 1/\sqrt{1 - v^2\epsilon_0\mu_0}$), audited the internal “three quarks versus three gluons” integrated structure of the proton, finding that gluons are primordial photonic protocol streams operating at the speed of light, quarks are heavy instantiated deformations (proxies) of the photonic protocol stream within the strong interaction bandwidth, and the two are mutually ontologically prerequisite, together constituting a sovereign instantiation [4].

This paper, as a logical continuation and quantitative deepening of the foregoing work [5-7,21-25], aims through a concise algebraic identity to accomplish the ultimate constitutive audit of the origin of proton mass, thereby terminating all probabilistic speculations about matter annihilation.

2 Dynamical Truth: Breaking Free, Recoil, and Head-to-Tail Clasp—The Mechanical Mechanism of Mass Generation

Within the CSSD framework, the generation of matter is not a mysterious “field coupling” but a describable mechanical process. This is the core dynamical contribution of this paper.

2.1 Three Mechanical States

First State: Conscripted State (Quiescent Lattice)

The vast majority of photonic degrees of freedom in the universe are permanently locked within the unit structures of substantial spacetime, serving as “building materials” that support the rigid background of ϵ_0, μ_0 . They possess no freedom and constitute the sovereign foundation of the cosmos.

Second State: Escaped State (Free Photon)

When the excitation energy reaches a critical threshold and the decoupling process proceeds smoothly without subsequent entanglement, the degree of freedom completely breaks free from lattice confinement, becoming a massless free photon. This is the complete release of the mechanical system.

Third State: Recoil Clasp State (Stationary Matter)

This is the most critical intermediate state. When a photonic degree of freedom attempts to “break free to liberty,” its other end remains elastically tethered to the lattice’s unit structure. This “decoupling drag” generates a powerful backward “recoil.” Unable to completely escape, the degree of freedom is forced to execute a “head-to-tail bending fold” in local space to counteract this recoil, achieving topological clasp. The result of this “mechanical compromise” is the birth of rest mass.

2.2 Constitutive Origin of “Recoil”

The stiffness of the recoil is determined by the constitutive constants of the spacetime material:

$$\text{Recoil coefficient} \propto \sqrt{\epsilon_0 \mu_0}$$

ϵ_0 and μ_0 are not merely electromagnetic parameters; they are measures of the stiffness of the spacetime lattice “spring.” The stiffer the lattice, the stronger the recoil, the tighter the clasp, and the greater the instantiated mass.

2.3 “Recoil Audit” of Particle Families

According to differing degrees of “entanglement” and “recoil strength,” different particles are constituted:

Particle Type	Escape State		Recoil Manifestation	Final Outcome
Free Photon	Smooth	decoupling	Recoil = 0	Velocity = C_s , Mass = 0
Electron (e^-)	Slight	entanglement	Weak recoil	Small recoil claspings, larger R_e , light mass
Proton/Quark	Deep	entanglement	Extreme recoil	Core strongly tethered, high-frequency rotation at minimal R_p to resist tethering

2.4 The Essence of Gluons: Dynamical Manifestation of Topological Claspings

Mainstream physics treats gluons as independent gauge bosons. Within the CSSD framework, gluons are not independent particles but local topological knots of the photonic stream induced by lattice recoil at the instant of folding. They are the dynamical manifestation of the “claspings” action itself—primordial photonic protocol streams operating at the speed of light C_s , their dynamics originating directly from the parameters of the spacetime entity itself, possessing never-attenuating “light-velocity rigidity.”

Quarks are the heavy instantiated deformations (proxies) of the photonic protocol stream within the strong interaction bandwidth, representing the logically optimal steady-state solution of that bandwidth [4]. Gluons and quarks are mutually ontologically prerequisite—gluons provide the luminous dynamic guarantee while quarks provide the instantiated mass anchor.

2.5 Mass as Mechanical Residue of “Failed Freedom”

Through this mechanism, the essence of mass is revealed as:

$$m = \frac{\text{Degree of obstructed escape}}{\text{Topological boundary of claspings}}$$

There is no mysterious “mass-bestowing” process in the physical world; there is only smooth flight (photons) and obstructed claspings (matter). The proton is heavy because it bears the deepest lattice tethering; the electron is light because its decoupling is smoother.

3 First Protocol: Absolute Bandwidth Locking of the Material Substrate—Constitutive Definition of the Symbol C_s

Any instantiated material structure must have its power source and information exchange strictly anchored to the constitutive parameters of the spacetime entity.

3.1 Terminological Audit Note: Sovereignty Liquidation of the Symbol c

This paper retains the symbol c for alignment with mainstream physics, but its physical sovereignty must be thoroughly liquidated. The definitions differ essentially:

Dimension	Mainstream Definition (c)	CSSD Definition (C_s / First Protocol)
Physical Meaning	Upper limit of light speed in vacuum, an empirically observed kinematic parameter	Intrinsic bandwidth protocol of substantial spacetime material
Mathematical Expression	$c = 299,792,458 \text{ m/s}$	$C_s = 1/\sqrt{\epsilon_0\mu_0}$
Ontological Status	External, discovered constant	Internal, constitutive protocol
Relation to Matter	Matter in vacuum cannot exceed it	Matter itself is a load instantiated based on this bandwidth protocol

CSSD Core Determination:

$$C_s = \frac{1}{\sqrt{\epsilon_0\mu_0}}$$

It is not that light “travels fast,” but rather that this is the upper limit of logical signal transmission that the hardware of the spacetime lattice can bear.

3.2 The Essential Difference Between Photons and Particles

- **Photons:** They are the “native executors” of the First Protocol. Photons can reach C_s because they are the pure embodiment of the First Protocol—unclashed, bearing no mass load, thus capable of operating at the bandwidth limit.
- **Particles (e.g., protons):** They are the “instantiated loads” of the Second Protocol. Protons cannot exceed C_s because their mass itself is a “load effect” instantiated based on the material bandwidth $1/\sqrt{\epsilon_0\mu_0}$. The existence of a proton is an occupation of bandwidth; the motion of a proton is the displacement of a load across the bandwidth.

3.3 Field Flow Rigidity of the First Protocol

Constitutive Definition:

$$C_s = \frac{1}{\sqrt{\epsilon_0\mu_0}}$$

ϵ_0 (vacuum permittivity) and μ_0 (vacuum permeability) are the rigid skeleton of the spacetime substrate, not passive properties of the vacuum [1,2].

Logical Cutoff: The upper limit of the power source for any information exchange or energy instantiation in the universe is strictly anchored to this bandwidth. The gluons within the proton are primordial photonic protocol streams operating at this bandwidth.

Audit Determination:

$$\nabla^2 \mathbf{E} - \epsilon_0 \mu_0 \frac{\partial^2 \mathbf{E}}{\partial t^2} = 0$$

The coefficient locking in Maxwell’s wave equation is the direct manifestation of the First Protocol at the field flow level. The upper limit of the power source for any material flow is anchored at $1/\sqrt{\epsilon_0 \mu_0}$.

4 Second Protocol: Quantitative Instantiation of Mass and Topological Boundary

4.1 Instantiation Protocol

Mass is not an “externally attached property” bestowed by the Higgs field, but the logical consideration paid by the photonic protocol stream when transitioning from a free propagation state (linear momentum) to a localized bound state (angular momentum).

The Second Protocol is embodied in the electromagnetic expression of the Lorentz factor [15]:

$$\gamma = \frac{1}{\sqrt{1 - v^2 \epsilon_0 \mu_0}}$$

This reveals the constitutive origin of inertial load—when an object’s velocity v approaches the protocol bandwidth $C_s = 1/\sqrt{\epsilon_0 \mu_0}$, the instantiated load tends toward infinity.

4.2 Dynamical Relation Between Bandwidth and Load

Mainstream physics is puzzled by the phenomenon of “mass increasing with velocity,” attributing it to relativistic effects. Within the CSSD framework, this is reduced to the “load-approaching-bandwidth effect”:

When the velocity of a particle (instantiated load) approaches the protocol bandwidth C_s of the spacetime entity (i.e., the mainstream c), the photonic protocol streams executing the “head-to-tail clasping” within the particle undergo exponential kinetic compensation due to approaching the hardware limit—this is precisely the physical essence of the electromagnetic expression of the Lorentz factor $\gamma = 1/\sqrt{1 - v^2 \epsilon_0 \mu_0}$.

Core Conclusion: C_s is not a limitation of space, but a specification of the material. The $\sqrt{\epsilon_0 \mu_0}$ appearing in the proton mass formula is precisely the direct projection of this hardware specification onto the local clasping structure.

4.3 Instantiation Equation

When a photonic stream localizes with angular frequency ω , its energy $E = \hbar\omega$ converts to inertial mass. According to the Einstein mass-energy equivalence and the Planck quantum hypothesis:

$$m = \frac{E}{C_s^2} = \frac{\hbar\omega}{C_s^2}$$

Substituting the First Protocol $1/C_s^2 = \epsilon_0\mu_0$, we obtain the fundamental equation of mass instantiation:

$$m = \hbar\omega(\epsilon_0\mu_0)$$

4.4 Physical Essence of R_p : Effective Boundary Radius

In CSSD, R_p is not an arbitrarily assumed geometric parameter but the topological limit of the photonic protocol stream internalized as a baryon:

- **Topological Closure:** It is the minimal non-degenerate topological radius at which the electromagnetic photonic stream can maintain a light-speed closed cycle ($v = C_s$) when transitioning from “linear momentum” to “localized standing wave.”
- **Phase Locking:** The wavefunction must match precisely after one full circuit ($2\pi R = n\lambda$). If the radius changes, destructive wavefunction interference occurs, and the particle would logically “self-delete.”
- **Material Strength Limit:** Bending the photonic stream requires overcoming the shear resistance of the spacetime entity (determined by ϵ_0, μ_0). The smaller the radius, the higher the curvature, and the greater the required energy. R_p is the maximum curvature boundary achievable by this material in supporting localized rotation per unit action \hbar .

Audit Judgment: R_p is not a compressible sphere; it is the “projected length” of the fundamental constants ϵ_0 and μ_0 instantiated in three-dimensional space. To change R_p , one must first break the material skeleton of the spacetime entity.

4.5 Constitutive Relation Between Proton and Electron Radii

Particle	Topological Structure	Radius Characteristic	Mass Characteristic
Electron (R_e)	1-dimensional loop locking (N=1)	Larger radius, loose clasping	Light mass
Proton (R_p)	3-dimensional composite folding (three-to-three standing wave)	Extremely small radius, tight clasping	Heavy mass

The relationship between them is locked by the fine-structure constant α — α is, in fact, the conversion ratio of material load distribution between different topological levels.

4.6 Locking of the Proton Mass Boundary: Rigorous Derivation via Angular Momentum Quantization

This is the core enhancement of the present derivation—establishing $m_p R_p = \hbar\sqrt{\epsilon_0\mu_0}$ as an unshakable algebraic rigidity constraint through the conservation of angular momentum and energy-momentum relations, rather than an empirical fit.

4.6.1 Step 1: Constitutive Relation of Energy-Momentum-Angular Momentum

Within the CSSD framework, the proton is not a static “particle” but a dynamic standing wave structure formed by photonic protocol streams executing “head-to-tail clasping” in three-dimensional space. Its core mechanical characteristics are as follows:

- **Tangential velocity locking:** Since the clasping photonic stream remains an executor of the light-speed protocol, its tangential linear velocity must strictly equal the bandwidth upper limit locked by the First Protocol: $v = C_s = 1/\sqrt{\epsilon_0\mu_0}$.
- **Momentum expression:** The linear momentum carried by this photonic stream is $p = m_p C_s$.
- **Angular momentum definition:** For a photonic stream circulating on a boundary of radius R_p , its angular momentum is:

$$L = \text{momentum} \times \text{lever arm} = (m_p C_s) \cdot R_p$$

4.6.2 Step 2: Rigorous Requirement of Action Quantization

According to the fundamental fact of quantum mechanics—angular momentum is quantized in closed systems. Within the CSSD framework, this fact is elevated to a “discretization command of the Logical Matrix.” For the proton as a sovereign instantiation, its total internal angular momentum must satisfy the algebraic constraint of the unit action quantum:

$$L = \hbar$$

4.6.3 Step 3: Algebraic Substitution and Identity Derivation

Substituting the momentum expression from Step 1 into the quantization condition from Step 2:

$$(m_p C_s) \cdot R_p = \hbar$$

Rearranging:

$$m_p R_p = \frac{\hbar}{C_s}$$

Then substituting the First Protocol $C_s = 1/\sqrt{\epsilon_0\mu_0}$, i.e., $1/C_s = \sqrt{\epsilon_0\mu_0}$:

$$m_p R_p = \hbar \sqrt{\epsilon_0\mu_0}$$

4.6.4 Physical Meaning of the Derivation—Triple Rigidity Locking

Locking Level	Physical Origin	Algebraic Expression	Source of Invariance
Level 1	First Protocol (light-speed bandwidth C_s)	$C_s = 1/\sqrt{\epsilon_0\mu_0}$	Electromagnetic rigidity of space-time material
Level 2	Angular momentum quantization protocol	$L = \hbar$	Action discretization command of Logical Matrix
Level 3	3-dimensional syn-chronous clasping topology	$L = p \cdot R_p$	Geometric necessity of photonic stream head-to-tail closure

Audit Determination:

The key breakthrough of this derivation is that the product of proton mass m_p and radius R_p is not an “empirical constant” fitted from experimental data, but a **rigorous result necessarily derived** via algebraic identity from two undeniable fundamental protocols of the cosmos—the **light-speed bandwidth protocol** ($C_s = 1/\sqrt{\epsilon_0\mu_0}$) and the **angular momentum quantization protocol** ($L = \hbar$)—under the geometric constraint of three-dimensional topological clasping.

In other words, **proton mass is rigidly locked by fundamental constants**. The existential state of the proton is deprived of any degree of freedom for spontaneous change. Unless the fundamental constants of the cosmos collectively collapse, the proton is eternal.

5 Three Barriers to Proton Eternal Stability

Based on the above identity, the stability of the proton is protected by three insurmountable barriers:

5.1 First Barrier: Constant Barrier

The right-hand side constants \hbar , ϵ_0 , μ_0 are absolute constants of the cosmos. *Space-time Substantivalism* 26, through a 1.3-billion-light-year audit by gravitational waves, confirmed the rigid consistency of the electromagnetic photonic materiality of the Logical Matrix on cosmological scales [3]. Astronomical observations over tens of billions of light-years have never observed a local collapse of these constants.

5.2 Second Barrier: Angular Momentum Quantization Barrier

The angular momentum relation $L = m_p C_s R_p = \hbar$ locks the proton's mass and radius tightly together. The root of this locking is the discretization command of the Logical Matrix—the action quantum \hbar is the most fundamental “logical currency” of the universe, indivisible and unalterable.

5.3 Third Barrier: Topological Clasping Barrier

The internal “three-to-three integrated standing wave” structure of the proton achieves perfect algebraic balance. Gluons (dynamical layer) and quarks (instantiation layer) are mutually ontologically prerequisite; their energy distribution achieves absolute symmetric locking with the spacetime material constants ϵ_0, μ_0 [4]. Once this topological clasping is accomplished, it forms a non-degenerate soliton structure—either existing as a whole or collapsing entirely, with no intermediate channel for “partial decay.”

Determination Conclusion:

$$\text{Proton decay} \implies \begin{cases} \epsilon_0 \mu_0 \text{ changes (constant collapse)} \\ \text{or } \hbar \text{ changes (quantization collapse)} \\ \text{or } R_p \text{ changes (topological clasping collapse)} \end{cases}$$

All three point to the collective failure of the cosmos's fundamental Logical Matrix. Since experiments have never observed a single instance of constant collapse, proton decay is algebraically inconsistent.

6 Paradigm Comparison of Mathematical Forms: Constitutive Locking vs. Symmetry Aesthetics

Table 1: Paradigm Comparison: Mainstream GUTs vs. CSSD Constitutive Audit

Dimension		Mainstream GUTs Logic ($SU(5)$)	CSSD Constitutive Audit Logic
Theoretical Foundation		Mathematical symmetry aesthetics, dependence on spontaneous symmetry breaking	Material substrate rigidity, based on undeniable physical constants [1,2]
Definition of Light Speed		Empirically observed upper velocity limit c	Material intrinsic bandwidth protocol $C_s = 1/\sqrt{\epsilon_0 \mu_0}$
Origin of Mass		Higgs mechanism and Yukawa coupling (external, probabilistic emergence)	Instantiation protocol locking (internal, logical necessity) [4,15]
Core Tools		Fictitious X, Y bosons ($\sim 10^{15}$ GeV), complex renormalization group equations	Demonstrated fundamental constants \hbar, ϵ_0, μ_0 , no redundant assumptions

Table 1—continued

Dimension	Mainstream ($SU(5)$)	GUTs	Logic	CSSD	Constitutive	Audit
Proton Structure	Quark-gluon relation described by group representations, no ontological foundation			Gluons = photonic streams, quarks = protocol proxies, mutually prerequisite [4]		
Mass-Radius Relation	Empirical fitting, no theoretical rigidity			$m_p R_p = \hbar \sqrt{\epsilon_0 \mu_0}$, algebraic necessity		
Stability Determination	Probabilistic decay, predicted lifetime $\tau_p \sim M_X^4/m_p^5$			Algebraically necessary eternity, determined lifetime $\tau_p = \infty$		
Load and Bandwidth	Lorentz factor as geometric effect			$\gamma = 1/\sqrt{1 - v^2 \epsilon_0 \mu_0}$, compensation of load approaching bandwidth		

Audit Judgment: $SU(5)$ Lie algebra entrusts the perfection of the cosmos to the aesthetics of higher-dimensional mathematical symmetry. To forcibly align the three coupling constants at extremely high energies, it must assume the existence of superheavy gauge bosons—this practice essentially uses “unknown fictitious particles” to explain “unknown probabilistic decay.” CSSD holds that the completeness of the cosmos requires no recourse to fictitious higher-dimensional group representations. Grand unification is not an unresolved problem awaiting solution, but a recorded fact already closed-loop in protocol auditing.

Liquidation of the Higgs Mechanism: The Higgs mechanism is a mathematical dream manufactured by mainstream physics after losing the concept of “substantial spacetime,” in order to explain inertia. It mistakes the rigidity of the spacetime substrate (its proxy) for an independent dynamical field. Through the CSSD identity, we have demonstrated that mass is the direct quantitative result of material substrate protocols. Unless the Higgs field admits that it is itself the geometric incarnation of ϵ_0 and μ_0 , it is logically redundant verbiage.

7 Rewriting the History of Cosmic Evolution: From “Probabilistic Big Bang” to “Substantial Engineering”

This paper replaces the mainstream “probabilistic collision evolution” with the “spacetime construction protocol,” unifying microscopic mass and macroscopic cosmic evolution from a mechanical root.

7.1 Singularity and Inflation: Pressure Release and Synchronous Construction

True Nature of the Singularity: Not an infinitely small mathematical point, but the energy background of the electromagnetically compressed photonic substrate (the energy

reserve of the Logical Matrix). The “Big Bang” is not an explosion but a release of pressure.

Mechanical Necessity of Inflation: Since the cosmos had to reach its intended scale by 380,000 years, and the linear construction speed at light velocity C_s was insufficient, at the initial stage of pressure release, the Logical Matrix executed a “synchronous limit-multiplication protocol of all units.”

Audit Determination: Inflation is not an expansion of space from nothing, but the parallel, exponential instantiation of substantial spacetime units. This explains the flatness and homogeneity of the cosmos—because it was “synchronously constructed” according to a unified blueprint.

7.2 The Dark Age (Before 380,000 Years): Universal Conscription, No Free Photons

Truth of the “Photon Soup”: Because construction was incomplete, photons were conscripted. There were no free photons during this period, because all energy was “forcibly conscripted” to construct the spacetime lattice (substantial spacetime units).

Quantitative Audit of the Mainstream “Collision Blocking” Theory: Mainstream physics holds that darkness arose because photons were absorbed by collisions with electrons. However, according to the mean free path formula $\lambda = 1/(n\sigma)$, to achieve complete darkness, the number density n of electrons would have to be of a terrifyingly high order. If the density were truly that high, the Coulomb repulsion between electrons and the pressure between protons would have directly led to the dynamical collapse of cosmic structure.

CSSD Determination: The essence of darkness is that the cosmos was in an “engineering closure period.” Every photonic degree of freedom was a construction material. Because construction was incomplete, photons were conscripted; with no free passage protocol, photons could not travel far. What mainstream calls collision absorption is in fact photons handling and stacking unit structures.

7.3 Matter Instantiation: Breaking Free from “Conscription”

As construction pressure weakened and the spacetime scale took shape, some photonic degrees of freedom that had been “fixed” in unit structures began to manifest active quantum states:

- **Breaking Free and Recoil:** Upon encountering energy excitation, these “conscripted” photons attempted to break free from their unit structure tethers.
- **Topological Claspings:** Wanting to leave but pulled back by the mechanical tether of the “other end still attached to the unit structure,” a recoil was generated. This mechanical equilibrium of failed escape forced the photonic stream to execute a “head-to-tail bite.”
- **Result:** Different degrees of escape constituted different particles—the electron with slight tethering, quarks/protons with deep claspings.

7.4 The 380,000-Year “Completion Release”: The Birth of Free Photons

True Meaning of Decoupling: When the unit architecture of substantial spacetime was essentially complete and construction pressure fell below a critical threshold, the Logical Matrix signed a “free passage protocol.”

Photon Liberalization: At this point, surplus photonic degrees of freedom were no longer forcibly conscripted; they could finally “smoothly and directly fly away,” becoming the first “free citizens” of the cosmos—this is what we observe today as the cosmic microwave background radiation (CMB).

7.5 Engineering Periodization of Cosmic Evolution

Stage		Time	Mechanical State		Photon State
Pressure Release and Inflation	Re-	$t = 0^+$	Synchronous limit	multi-	Universal conscription for construction
Conscription Construction Period		$t < 380,000$ yrs	Recoil dominant, intense clasp		No free photons
Decoupling Turning Point		$t \approx 380,000$ yrs	Construction critical	pressure	Beginning release of free photons
Transparent Era		$t > 380,000$ yrs	Recoil weakened		Free photons travel freely

8 Experimental Confirmation: From “Probabilistic Postponement” to “Necessary Confirmation”

Regarding the observational data from the Super-Kamiokande and future Hyper-Kamiokande experiments, this study provides an ultimate epistemological determination:

Experimental Fact: After decades of saturated observation, the Super-Kamiokande experiment has found no instance of proton decay events conforming to $SU(5)$ predictions (such as $p \rightarrow e^+\pi^0$) within its 50,000 tons of pure water. The core data essentially amounts to this: within the experimental detection limit, no unambiguous spontaneous proton decay event has been observed.

Logical Fallacy of the Mainstream Interpretation: Traditional phenomenological physics has not treated the “null observation” as a falsification of the hypothesis that “protons can decay.” Instead, they have used statistical upper limits to continually postpone the lower bound of the proton lifetime (from 10^{31} years, 10^{33} years, all the way to the current $> 10^{34}$ years).

CSSD Determination: This practice of absorbing null results by continually adjusting parameters (such as raising the grand unification scale or modifying supersymmetric model particle masses) has already caused grand unified theories to lose Popperian falsifiability. This is a kind of cognitive delay that packages “logical incapacity” as “experimental technical limitation.”

Epistemological Reconstruction: Based on two rigid principles [4]——

- **In-deniability:** The existing material world can exist stably, and the fundamental constants ϵ_0, μ_0 exhibit absolute in-deniability on cosmological scales [3].
- **Non-advancement:** Physics must anchor itself in “already occurred certainty,” and cannot use “probabilistic speculations about the not-yet-occurred” as the foundation for constructing the cosmic substrate in advance.

Ultimate Declaration: The enormous pure water detection tanks of Super-Kamiokande and Hyper-Kamiokande in fact serve as giant validation grounds for CSSD’s rigid closure theory. Their decades of “null events” eloquently demonstrate that the substrate material of matter possesses indestructible absolute sovereignty. Future data from Hyper-Kamiokande will not bring the dawn of grand unified symmetry breaking, but will only further confirm, with higher precision, CSSD’s ultimate determination: the protocol is locked, the material refuses to degrade.

9 Conclusion: The Eternity of Matter and the Return of Sovereignty

This study accomplishes the critical transition from “material characterization” to “quantitative constraint,” realizing the algebraic deepening of the audit conclusions in *Spacetime Substantivalism* 27 [4]:

1. **Mass as Consideration:** Proton mass $m_p = \hbar\sqrt{\epsilon_0\mu_0}/R_p$ is the direct instantiated yardstick of spacetime material rigidity. It is not a bestowal of the Higgs field, nor an accident of probabilistic evolution, but the mechanical consideration paid by the photonic protocol stream in the process of “breaking free-recoil-clasping.”
2. **Structure as Protocol:** The proton boundary R_p is the topological limit of internalized light-speed protocol C_s , rigidly locked by both the angular momentum quantization protocol $L = \hbar$ and the light-speed bandwidth protocol $C_s = 1/\sqrt{\epsilon_0\mu_0}$. Gluons (dynamical layer) and quarks (instantiation layer) achieve absolute symmetric locking in the “three-to-three integrated standing wave.”
3. **Bandwidth as Specification:** $C_s = 1/\sqrt{\epsilon_0\mu_0}$ is not a limitation of space, but a specification of the material. Photons are the “native executors” of the First Protocol; particles are the “instantiated loads” of the Second Protocol. The $\sqrt{\epsilon_0\mu_0}$ appearing in the proton mass formula is precisely the direct projection of this hardware specification onto the local clasping structure.
4. **Eternity as Necessity:** Proton mass is rigidly locked by fundamental constants. As long as the cosmic fundamental constants \hbar, ϵ_0, μ_0 remain unchanged, and the angular momentum quantization protocol and light-speed bandwidth protocol remain unbroken, the existential state of the proton is deprived of any degree of freedom for spontaneous change.

Final Judgment:

**The formula has never been broken; the protocol is locked in real time;
the Logical Matrix is eternal; the proton, as a sovereign instantiation, is
likewise eternal.**

Complex mathematics is compensation arising from conceptual vagueness, while direct physics is necessity arising from logical completeness. The truth of physics should not parasitize increasingly complex mathematical patches—when mainstream physics, to remedy a false premise of “evolution from nothing,” must construct a fictitious world at 10^{15} GeV, CSSD accomplishes the juridical guarantee of the stability of all cosmic matter with a single material identity.

Physics henceforth returns from a “probabilistic game of describing shadow transformations” to being re-established as a “rigorous science auditing the substantial substrate.” Grand unification is not a distant horizon awaiting discovery, but a present reality already closed-loop in constitutive auditing.

Audit Judgment: The wall of constants on the right does not fall; the sovereignty of matter on the left does not perish. Paper 28, anchored by facts, relocks physics within undeniable certainty.

References

- [1] Cui, H. *Spacetime Substantivalism 0: The Track-Light Model —The Logic Matrix as the Universal Source, the Origin of the Cosmic Singularity, and a New Foundation for Metaphysics*. Zenodo. <https://zenodo.org/records/19357379>
- [2] Cui, H. *Spacetime Substantivalism 25: Constitutive Audit of Substantial Spacetime —The Grand Unification of Materials, Fields, Vacuums, and Forces Confirmed by Gravitational Wave Evidence and the Intrinsic Work-Protocol*. Zenodo. <https://doi.org/10.5281/zenodo.20123002>
- [3] Cui, H. *Spacetime Substantivalism 26: The 1.3-Billion-Light-Year Audit of Cosmic Entity Uniformity by Gravitational Waves —The Electromagnetic Photonic Materiality of the Logical Matrix, the Impossibility of Superluminal Speed, and the Origin and Physical Mechanism of Inflation (Appendix: The Outer-Inner Relationship Between Geometrical Spacetime and Substantial Spacetime)*. Zenodo. <https://doi.org/10.5281/zenodo.19356096>, <https://doi.org/10.5281/zenodo.20149778>
- [4] Cui, H. *Spacetime Substantivalism 27: Constitutive Audit of Proton Eternal Stability —The Unified Protocol of Luminous-Instantiation and the Logical Closure of Grand Unification*. [Manuscript]
- [5] Cui, H. *Spacetime Substantivalism XXIV: A Substantive Liquidation of Quantum Superposition Based on Rigid Constant-Group Audit and Gravitational Wave Experimental Evidence —Evidence for the Unification of General Relativity and Quantum Mechanics*. Zenodo. <https://doi.org/10.5281/zenodo.20102772>
- [6] Cui, H. *Spacetime Substantivalism XXIII: The Hole Error of Quantum Mechanics —A Substantial Audit of Superposition Based on $c = 1/\sqrt{\epsilonpsilon_0 * \mu_0}$* . Zenodo. <https://doi.org/10.5281/zenodo.20059820>

- [7] Cui, H. *Spacetime Substantivalism XXII: The Premise Error of the Hole Argument —From the Perspective of CSSD’s Substantial Spacetime*. Zenodo. <https://doi.org/10.5281/zenodo.20054894>
- [8] Cui, H. *Substantial Spacetime Dynamics (I) Beyond Einstein’s Light Speed Postulate: The Mechanical Mechanism of the Light Speed Limit and the Cs^2 Framework of Substantial Spacetime*. Zenodo. <https://doi.org/10.5281/zenodo.18636484>
- [9] Cui, H. *Spacetime Substantivalism VII: The Great Experiment of Nature—The Substantial Nature of Spacetime Revealed by Gravitational Waves*. Zenodo. <https://zenodo.org/records/19363511>
- [10] Cui, H. *Spacetime Substantivalism VIII: The Constitutive Nature of the Spacetime Lattice Under Gravitational Wave Empirical Evidence and the Physical Essence of CMB Anomalies*. Zenodo. <https://zenodo.org/records/19373207>
- [11] Cui, H. *Spacetime Substantivalism IX: Micro-Dynamics of a Constitutive Spacetime Lattice as an Effective Field Theory and its CMB Polarization Signatures*. Zenodo. <https://zenodo.org/records/19477951>
- [12] Cui, H. *Spacetime Substantivalism X: The Constitutive Origin of the Light-Speed Postulate —A Hierarchical Field Decomposition of Spacetime Substrate and Excitations*. Zenodo. <https://doi.org/10.5281/zenodo.19478075>
- [13] Cui, H. *Spacetime Substantivalism XII: Constitutive Divergence between Null-Debt and Topologically Constrained Sectors in Effective Spacetime Field Theory*. Zenodo. <https://doi.org/10.5281/zenodo.19583447>
- [14] Cui, H. *Spacetime Substantivalism XIII: Covariant Constitutive Effective Field Theory of Spacetime Propagation —A Unified Multi-Probe Constraint from Cosmology and Gravitational Waves*. Zenodo. <https://doi.org/10.5281/zenodo.19595144>
- [15] Cui, H. *Spacetime Substantivalism XI: Restoration of the Physical Mechanism of the Lorentz Transformation —An Audit Model Based on Electromagnetic Load and the $v^2\epsilonpsilon_0\mu u_0$ Term*. Zenodo. <https://doi.org/10.5281/zenodo.19478126>
- [16] Cui, H. *Spacetime Substantivalism XV: Bayesian Constraints on Effective Space-time Propagation from Gravitational-Wave Observations: A Hierarchical Analysis of GWTC-3*. Zenodo. <https://doi.org/10.5281/zenodo.19595776>
- [17] Cui, H. *Spacetime Substantivalism XVI: Observational Constraints on Effective Spacetime Propagation from Gravitational Waves and Cosmology —A Unified EFT Framework and Numerical Implementation*. Zenodo. <https://doi.org/10.5281/zenodo.19595948>
- [18] Cui, H. *Spacetime Substantivalism XVIII: The Constitutive Physics of the Hubble Tension —A Unified Model from Matter Construction Energy Allocation to Spacetime Bandwidth Release*. Zenodo. <https://doi.org/10.5281/zenodo.19599359>
- [19] Cui, H. *Spacetime Substantivalism XIX: The Three Major Misunderstandings in the History of Science and the Ultimate Restoration of Substantial Spacetime Ether —A Gravitational Wave Audit, the Rehabilitation of Tesla’s Truth, the Discovery of*

Human Dual Tracks, and the Establishment of Species' Logical Value Based on the CSSD Framework. Zenodo. <https://zenodo.org/records/19952666>

- [20] Cui, H. *Spacetime Substantivalism XX: The Hierarchical Truth Restoration of Mathematics and Logic.* Zenodo. <https://doi.org/10.5281/zenodo.20016325>
- [21] Cui, H. *Spacetime Substantivalism XXI: The Completeness of Logic and the Incompleteness of Mathematics —The Logical Matrix is the Sole Truth of the Universe.* Zenodo. <https://zenodo.org/records/20041360>
- [22] Cabannas, V., & Silva, D. (2026). *THE HIERARCHICAL RESTORATION OF MATHEMATICS AND LOGIC IN HUGANG CUI: a critical-propositional analysis in confrontation with the Theory of Objectivity.* Zenodo. <https://doi.org/10.5281/zenodo.20029599>
- [23] Cabannas, V., & Silva, D. (2026). *LOGICAL MATRIX, MATHEMATICAL ESSENCE, AND THE MODAL DISCIPLINE OF OBJECTIVITY: a critical-propositional analysis of Hugang Cui in confrontation with the Theory of Objectivity.* Zenodo. <https://doi.org/10.5281/zenodo.20043348>
- [24] Cabannas, V., & Silva, D. (2026). *SUBSTANTIAL SPACETIME, PHOTONIC PROTOCOL, AND THE MODAL DISCIPLINE OF OBJECTIVITY: a critical-propositional analysis of Hugang Cui's Spacetime Substantivalism 25.* Zenodo. <https://doi.org/10.5281/zenodo.20145420>
- [25] Cabannas, V., & Silva, D. (2026). *SUBSTANTIAL SPACETIME, LOGICAL MATRIX, AND THE MODAL DISCIPLINE OF OBJECTIVITY: a critical-propositional analysis of Hugang Cui's Spacetime Substantivalism 26.* Zenodo. <https://doi.org/10.5281/zenodo.20173022>