Substrate–Plexus Theory

Executive Summary

Theory of Everything

Dennis P. Wilkins

April 2026

Contents

Chapter 1

Introduction, Motivation and Organization

1.1 Introduction

Physicist John Archibald Wheeler proposed that, at the smallest scales, spacetime may not be smooth, but instead subject to continual microscopic fluctuation. In such a picture, geometry itself loses its classical meaning: connections appear and disappear, and the notion of a fixed point in space becomes ill-defined. While this idea provided an important conceptual shift, it still treats spacetime as the underlying object that fluctuates.

The present work departs from that assumption. In the Substrate–Plexus Theory (SPT), spacetime is not fundamental. Instead, it emerges as a large-scale, coarse-grained description of a deeper, pre-geometric substrate governed by stochastic renewal dynamics.

The central question is simple: what minimal underlying structure is required to reproduce the macroscopic universe we observe?

The answer proposed here is a substrate consisting only of continuously renewing microscopic pathways. These renewal pathways form, dissolve, and reconnect through stochastic processes. There is no predefined geometry, no intrinsic notion of distance, and no fundamental clock. The substrate is defined entirely by its renewal statistics and connectivity structure.

This idea parallels familiar examples from statistical physics. A digital image appears continuous when viewed at large scales, despite being composed of discrete pixels. A fluid behaves smoothly even though it consists of individual molecules. Quantities such as temperature and pressure are not fundamental objects, but emergent averages over microscopic degrees of freedom.

In the same way, spacetime, fields, and particles arise in SPT as effective descriptions of the collective behavior of renewal pathways. Structured, persistent patterns of connectivity—referred to as the plexus—emerge after coarse-graining and give rise to transport, interaction, and geometry.

From this minimal starting point, the framework reproduces the known structure of physical law. Classical mechanics emerges as the macroscopic limit of coherent transport. General relativity arises as the effective description of large-scale bias and connectivity gradients. Quantum field theory appears as the linearized dynamics of stabilized circulation modes within the plexus.

Importantly, this is not a reinterpretation layered on top of existing theories. The formal structures of general relativity and quantum field theory are derived as emergent consequences of the underlying renewal dynamics.

The framework also provides a unifying perspective on approaches to quantum gravity. Models such as string theory, loop quantum gravity, and causal dynamical triangulations can be understood

as different coarse-grained realizations of the same underlying substrate.

Finally, the theory makes concrete, testable predictions. Deviations from standard physics are expected near the limits of coherence and connectivity, providing falsifiable signatures that distinguish the model from purely philosophical constructs.

The goal of this work is to develop the Substrate–Plexus Theory systematically, beginning from its minimal assumptions and demonstrating how the full structure of modern physics emerges from a stochastic, pre-geometric substrate.

This work will present as a sequence of papers as we build from the basics to the universe, and along the way, we will answer the questions that are seldom asked. What is a particle or spin or charge? What is apace made of if it can be "bent"? (and many more).

1.2 Model Summary

What if the smooth spacetime we experience is just a large-scale average of something fundamentally stochastic underneath?

The logic is familiar from everyday physics. When you zoom far enough into any image, you see pixels. Zoom out, and those discrete dots become a continuous picture. Water behaves as a smooth fluid even though it is made of molecules. Temperature and pressure are not fundamental objects — they are statistical averages.

Spacetime may work the same way.

At the smallest scale, the model assumes only a constantly renewing network of microscopic connections — The SUBSTRATE. These connections form, dissolve, and reconnect randomly. There is no permanent geometry, no stable ruler, no intrinsic clock. Only rapid, stochastic restructuring.

If you lived at that scale, nothing would look continuous.

This substrate has one important primitive property and we will call it connectivity. It describes how those microscopic conections, let's call them renewal pathways join together. And it varies. Below a certan value, connections are unlikely to form and even unliklier to persist. But at some critical value, this connectivity can change all of those probabilities. And in this case, certain types of pathways are more likely to form and join together than others. This BIAS in formation probabilities will eventually lead to structure, spacetime, and all the laws of physics. But if we look at it at the substrate level, it isn't easily visible. There is way too much "noise" from the substrate still forming and disolving pathways the come and too quickly to participate.

But when we coarse-grain — averaging over enormous numbers of these renewal events — patterns begin to emerge. Some types of connections statistically reinforce each other. They rebuild in similar orientations again and again. Those persistent patterns survive longer than the surrounding noise.

When that happens, order appears.

This is exactly how many familiar systems behave. Below a critical temperature, spins align and a magnet forms. Below another threshold, electrons condense into a superconductor. In each case, a random microscopic system suddenly develops long-range structure.

The Substrate–Plexus Theory (SPT) proposes that something similar happened to the universe itself.

Roughly 13.8 billion years ago, the underlying substrate crossed a phase transition. Connectivity became dense enough that certain renewal patterns stopped flickering randomly and began renewing with a bias.

At the microscopic level: • pathways still renew • connections still flicker • structures still dissolve • alignments still fluctuate

BUT, when averaged over huge numbers, patterns are now recognizable as the "bias" prefers certain connectivity over others. And these averaged connections are what we recognize as networks. the basic networks are Electromagnetic, Weak, and Strong, and taken together, they give rise to what we call spacetime.

Distance finally becomes meaningful because connections average to a persistent answer. Time becomes meaningful because renewals acquire direction and memory. Geometry appears not because it was imposed, but because average correlations have locked in... and a metric emerges.

In this picture, spacetime did not "begin from nothing." Rather, the substrate entered an ordered phase. The measured age of the universe—13.8 billion years—is simply how long this ordered phase has lasted so far.

Particles fit naturally into this view as well. Instead of point objects moving through space, they are self-reinforcing circulations of connectivity — patterns that reconstruct themselves faster than random fluctuations can erase them. Their mass reflects how much bias is necessary to keep them intact; their charge is equivalent to the circulation itself.

So, Einstein and General Relativity remain exactly right: matter really does shape spacetime. But that curvature is not imposed on a smooth continuum — it emerges from the statistics of an underlying, constantly renewing substrate: Wheeler's quantum foam.

At everyday scales, all of this coarse-grains into the familiar equations of general relativity and quantum field theory. Those theories still work — just as fluid dynamics works without tracking molecules. They describe the emergent behavior, not the substrate. Zoom out far enough, and the jitter disappears. What remains looks continuous, curved, governed by Einstein's equations and quantum fields—because that's the only stable average left.

So the picture becomes surprisingly simple:

At the bottom: stochastic quantum foam. Zoom out: persistent connectivity networks. Zoom out further: spacetime and fields. Zoom out further: matter, stars, and us.

What we call "laws of physics" are the rules governing which patterns survive.

Spacetime is not the stage.

1.3 Organization

This body of work is presented in five books as follows:

- Book 1 Foundations,
- Book 2 Particles,
- Book 3 Modern Physics,
- Book 4 Cosmology,
- Book 5 etc,

Some of the new ideas require precision use of terminology, and where such is true, there is a Glossary in Appendix .

1.4 Executive Summary of the Substrate–Plexus Theory (SPT)

One-line version

Spacetime, particles, and all physical law emerge as coarse-grained statistical regularities of a pre-geometric stochastic substrate of continuously renewing microscopic connections.

The theory is developed across six books. Below is a book-by-book executive summary.

1.4.1 Book 1 — Foundations: The Birth of Spacetime

- The substrate is a stochastic ensemble of renewal pathways that continually form, dissolve, and reconnect — no geometry, metric, time, or objects exist at this level.
- Each pathway carries primitive attributes: segment scale label L, orientation Ω, harmonic excitation n, phase ϕ, chirality χ, dwell count τ_d, statistical weight σ, topological descriptor T.
- Single control parameter: connectivity λ.
- Stationary renewal measure $\pi(\omega)$ is uniquely fixed by maximum entropy + stationarity + symmetry.
- Phase transition at $\lambda_c \approx 1.0$: disordered regime $\rightarrow$ ordered spacetime phase via percolation + circulation condensation + bias lock-in.
- Bias $B(\mathbf{x})$ is the first departure from randomness and the seed of all structure.
- Three first-order plexuses emerge: EM (circulation-preserving), Weak (chirality-locked), Strong (non-abelian, confined).
- Gravity is strictly second-order bias response (quadratic in first-order bias fields).
- All fundamental constants (α, G, c, $\hbar$, Planck scales) are order parameters extracted from the stationary measure of the discrete renewal kernel.

1.4.2 Book 2 — Particles: Structure

- Particles are stable or metastable multi-plexus recursive knots — self-sustaining circulation structures.
- Charge = quantized net EM circulation (topological).
- Spin = topological phase property of circulation (4π periodicity).
- Mass = stored bias required to maintain multi-sector closure (Higgs-mediated).
- Electron: coupled EM + Weak circulation.
- Neutrino: minimal single Weak circulation (three families from mode excitations).
- Proton: four-sector knot $\{C_{\mathrm{EM}}, C^{+}_{\mathrm{Weak}}, C^{-}_{\mathrm{Weak}}, C_{\mathrm{Strong}}\}$.
- Neutron: opposing EM pair + same core (metastable, $\sim$880 s lifetime).
- Photon: counter-rotating EM circulation pair.
- All quantum numbers, conservation laws, and the three-generation limit emerge directly from circulation topology.

1.4.3 Book 3 — Physics

- Maxwell's equations emerge from EM-plexus bias transport and renewal conservation.
- QED: scattering = competition for finite renewal pathways; amplitudes = weighted sums over renewal histories.
- Feynman diagrams = coarse-grained renewal-history graphs; propagators = survival amplitudes of renewal random walks.
- Quantum mechanics: wavefunctions = renewal eigenpatterns; Schrödinger equation, Born rule, uncertainty all emerge from coarse-grained statistics.
- QFT and Standard Model Lagrangian derived from circulation compatibility and bias storage.
- Gravity = universal second-order bias response; black holes = connectivity phase breakdown.

1.4.4 Book 4 — Chemistry (in progress)

- Molecular bonding = coupled plexus eigenpatterns (EM + nuclear bias centers).
- Bond geometry and stability arise from bias minimization and circulation closure.
- Nuclear binding explained by plexus competition.

1.4.5 Book 5 — Cosmology (in progress)

- Big Bang = onset of persistent connectivity at λ_c.
- Dark matter = recursive infrared bias feedback (no new particle).
- Dark energy = residual vacuum bias + slow λ drift.
- Cosmic expansion, CMB, and structure formation emerge from plexus rescaling and bias amplification.

SPT Executive Summary

Substrate–Plexus Theory

Dennis P. Wilkins — April/May 2026
Status: Pre-submission working theory. Claims should be treated as draft physics requiring independent verification.

One-Line Version

Spacetime, particles, fields, forces, and physical law emerge as coarse-grained statistical regularities of a pre-geometric stochastic substrate of continuously renewing microscopic connections.

Core Thesis

Substrate–Plexus Theory replaces fundamental particles and fields with a deeper hierarchy:

$$\text{Connectivity} \to \text{Bias} \to \text{Plexus} \to \text{Circulation} \to \text{Stored Bias} \to \text{Particle/Mass}.$$

At the deepest level there is no space, no time, no metric, no force, no field, and no particle. There is only a stochastic renewal substrate: microscopic pathways form, dissolve, reconnect, and occasionally stabilize under coarse-graining. What we call spacetime is the ordered phase of this substrate. What we call particles are self-sustaining circulation knots within the emergent plexus networks.

1.5 Foundational Ontology

1.5.1 The Substrate

The substrate is a pre-geometric stochastic ensemble of renewal pathways. These pathways are not embedded in space; they are the precursor from which spatial relations later emerge.

Each renewal pathway carries primitive attributes:

$$\omega = \{L, \Omega, n, \phi, \chi, \tau_d, \sigma, T\},$$

where

- L: segment scale label, not geometric length,
- Ω: orientation marker,

- n: harmonic oscillator excitation number,
- ϕ: phase variable,
- χ: chirality marker, usually ± 1,
- τ_d: dwell or persistence count, not physical time,
- σ: statistical weighting parameter,
- T: topological descriptor.

A single control parameter, the connectivity λ, governs the transition from disordered renewal to persistent structure.

For $\lambda < \lambda_c$, no spacetime exists. For $\lambda > \lambda_c$, stable connectivity networks emerge and spacetime becomes meaningful. The critical threshold is modeled as a percolation-like transition with $\lambda_c \approx 1.0$.

1.5.2 Stationary Measure and Kernel

The stationary renewal measure is assumed to take the form

$$P(\omega) \propto e^{\lambda c(\omega)} M(\omega),$$

where $M(\omega)$ is constrained by maximum entropy, stationarity, and symmetry. In the leading reduced phase-chirality sector,

$$\pi(\phi, \chi) \propto 1 + a\chi \sin \phi,$$

with $a \approx 1.2$ in the discrete kernel realization.

The working discrete kernel uses:

- 48-site ring,
- 16 phase states,
- chirality $\chi = \pm 1$,
- Metropolis transitions preserving detailed balance,
- moves including phase exchange, circulation shift, chirality flip, and persistence.

Confirmed working outputs claimed from the current kernel include:

$$\alpha \approx \frac{1}{137.036},$$

Newton's G from second-order bias variance, and a proton mass estimate near 923 MeV at $L = 48$, extrapolating toward 938 MeV. Lepton masses, W/Z masses, and the full mass hierarchy remain active development rather than confirmed derivations.

1.6 Birth of Spacetime

The Big Bang is reinterpreted as the onset of persistent connectivity, not the creation of the substrate itself. The substrate is treated as pre-existing or eternal; the universe's measured age is the duration of the ordered phase.

At the critical connectivity threshold,

$$\lambda = \lambda_c,$$

three processes occur together:

1. percolation of renewal pathways,
2. condensation of circulation-preserving modes,
3. lock-in of statistical bias.

Distance emerges as a coarse-grained renewal cost between persistent regions. Time emerges as the accumulated ordering of irreversible reconstruction. The metric emerges from directional correlation statistics such as

$$C^{\mu\nu}(x) = \langle \Omega^\mu \Omega^\nu \rangle.$$

Lorentz invariance is not fundamental. It emerges from isotropic renewal statistics plus a finite renewal propagation speed.

1.7 Bias and Plexuses

1.7.1 Bias

Bias is the first departure from randomness:

$$B(x) = -\log\left[\frac{P(x)}{P_{\text{iso}}(x)}\right].$$

Bias is not a force, field, or potential. It is more primitive: a statistical preference in renewal-path formation. Fields arise only later as circulation-induced gradients in bias.

1.7.2 Plexuses

A plexus is a persistent, bias-dominated connectivity network. Plexuses are continuously reconstructed and spatially extended after spacetime emerges. They are not fields; fields are the observable gradients produced when circulations modify plexus bias.

Three first-order plexuses emerge.

Electromagnetic Plexus

Dominant attributes:

$$\Omega, \qquad \chi \text{ averaged}, \qquad \phi.$$

It supports circulation-preserving renewal modes. It is Abelian, massless, long-range, and corresponds to $U(1)$. Electric charge is quantized EM circulation.

Weak Plexus

Dominant attributes:

$$\chi, \qquad T/\sigma.$$

It supports chirality-locked renewal modes. It is parity-violating, short-range, and associated with $SU(2)$. Weak circulation is not strictly conserved in the same way EM circulation is, allowing decay and flavor-changing processes.

Strong Plexus

Dominant attributes:

$$T, \qquad \sigma,$$

with non-commuting closure constraints. It requires exactly three simultaneous closure constraints for stable baryonic structure. This gives confinement and maps to $SU(3)$. Color is interpreted as the phase state of a tri-constraint configuration, not as a literal subparticle.

1.8 Higgs and Mass

The Higgs is not treated as a fundamental plexus. It is the retarded response of the substrate to bias reconfiguration.

When a circulation structure changes, the substrate cannot instantly rebuild the corresponding bias pattern. The delayed adjustment is the Higgs response. The Higgs boson is a metastable excitation of this stored closure bias.

Mass is the stored bias cost required to maintain coherent multi-sector closure:

$$m \sim \text{stored closure bias.}$$

Inertia arises from the lag in substrate response when a circulation structure is forced to reconfigure relative to the surrounding plexus network.

1.9 Gravity

Gravity is not a first-order plexus. It is a universal second-order response of connectivity to the first-order bias fields:

$$B_G(x) = \kappa_0(\rho_c - \rho_0)^2 + \sum_{ij} \kappa_{ij} B_i(x) B_j(x).$$

Because it is quadratic in first-order bias, gravity is:

- universal, because all bias contributes;
- always attractive at leading order;
- weak, because it is second-order.

Gravitational transport is modeled by

$$\partial_t B_G = D_G(\lambda)\nabla^2 B_G + S_G,$$

with

$$D_G(\lambda) \propto (\lambda - \lambda_c)^\nu.$$

Near criticality, gravitational transport fails. Black holes are therefore interpreted as regions of connectivity transport breakdown, not singularities.

Dark energy is residual vacuum gravitational bias when gradients relax. Dark matter phenomenology is attributed to recursive feedback between B_G and the first-order plexuses rather than a new particle component.

1.10 Particles as Circulation Structures

Particles are stable or metastable self-sustaining circulation knots. They are not point particles.

General identifications:

- charge = net EM circulation,
- spin = topological phase property, with 4π periodicity for fermions,
- mass = stored bias required for closure,
- radiation = expelled retarded bias,
- virtual particles = transient, non-stabilized substrate configurations.

1.10.1 Electron

The electron is a coupled EM–Weak circulation structure. Its spin arises from 4π phase topology. Its magnetic moment arises from phase-wound EM circulation. Pauli exclusion arises because identical phase-wound circulation structures cannot occupy the same renewal pathways.

1.10.2 Neutrino

The neutrino is a minimal Weak-sector circulation:

$$\{C_{\text{Weak}}\}.$$

It has no net EM circulation and no Strong closure. Its near-zero mass reflects minimal Higgs response. The three neutrino families correspond to low-order mode excitations of the Weak eigenpattern. Oscillation is phase precession within the Weak circulation structure.

1.10.3 Proton

The proton is a multi-sector bundle:

$$B_p = \{C_{\text{EM}}, C^{+}_{\text{Weak}}, C^{-}_{\text{Weak}}, C_{\text{Strong}}\}.$$

The Strong sector provides tri-constraint closure. The EM circulation is a single net-positive circulation shaped by the Strong geometry. The Weak sector is internally balanced. The proton is stable because it is a deep minimum of multi-sector compatibility.

Partons in deep inelastic scattering are interpreted as resolution-dependent interaction domains, not literal constituent quarks.

1.10.4 Neutron

The neutron is

$$B_n = \{C^+_{\mathrm{EM}}, C^-_{\mathrm{EM}}, C^+_{\mathrm{Weak}}, C^-_{\mathrm{Weak}}, C_{\mathrm{Strong}}\}.$$

It has the same Strong core as the proton, but with opposing EM circulations and a more strained EM–Weak compatibility condition. It is metastable: Strong closure is robust, but weak-sector strain occasionally exceeds Higgs repair capacity, producing beta decay.

Bound-neutron stability is explained by nuclear binding lowering total stored bias, removing or suppressing the advantage of the free-neutron decay channel.

1.10.5 Photon

The photon is a counter-rotating EM circulation pair:

$$\{C^+_{\mathrm{EM}}, C^-_{\mathrm{EM}}\},$$

with zero net charge and no stored mass.

1.10.6 Gauge Bosons

Gauge bosons are expelled retarded bias from circulation reconfiguration:

- photon: EM retarded bias, propagates freely;
- gluon: Strong retarded bias, confined;
- W/Z: Weak retarded bias from chiral reconfiguration.

1.11 Emergent Physics Hierarchy

SPT organizes known physics as successive coarse-graining levels:

$$\text{Substrate} \to \text{Quantum Mechanics} \to \text{Quantum Field Theory} \to \text{Classical Physics}.$$

More explicitly:

1. **Coarse-grain 1: phase lock-in.** Persistent renewal eigenpatterns appear. This is quantum mechanics.
2. **Coarse-grain 2: mode occupation.** Variable occupation of coherent modes appears. This is quantum field theory.
3. **Coarse-grain 3: decoherence.** Stable macroscopic records appear. This is classical physics.

Quantum mechanics is not fundamental. Wavefunctions are coarse-grained encodings of renewal eigenpatterns. The Born rule, uncertainty principle, Hilbert space, and unitarity emerge from renewal statistics and environmental selection.

QFT is the variable occupation theory of coherent renewal modes. Creation and annihilation operators describe stabilization and dissolution of eigenpattern modes.

1.12 QED and Feynman Diagrams

Maxwell's equations emerge from EM-plexus bias transport and renewal conservation.

QED scattering is competition for finite renewal pathways. The transition amplitude is a weighted sum over renewal histories:

$$A_{i\to f} = \frac{1}{Z} \sum_{h \in \mathcal{H}_{i\to f}} W[h] e^{iS_h/\hbar_{\text{eff}}}.$$

Feynman diagrams are not fundamental. They are coarse-grained renewal-history graphs.

Propagators are survival amplitudes of renewal random walks:

$$G(p) = \frac{i}{p^2 - m^2 + i\epsilon}.$$

The path integral is interpreted literally: the substrate actually explores neighboring renewal paths through stochastic reconstruction. Classical paths dominate because they are stationary-phase, high-coherence renewal histories.

1.13 Standard Model Interpretation

The Standard Model is interpreted as the minimal coarse-grained compatibility structure of the three first-order plexuses:

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

- $U(1)$: single-component EM circulation,
- $SU(2)$: chirality-locked Weak circulation,
- $SU(3)$: tri-constraint Strong closure.

The Standard Model Lagrangian is not fundamental. It is the effective compatibility functional of coherent circulation modes.

Term mapping:

- kinetic terms = coherent bias propagation,
- gauge interaction terms = compatibility constraints under local phase transport,
- mass terms = Higgs-mediated closure cost,
- coupling constants = emergent transport coefficients,
- renormalization = scale-dependent renewal capacity.

1.14 Cosmology

The Big Bang is the onset of persistent connectivity. Inflation is replaced or reinterpreted as rapid ordering and bias lock-in, rather than superluminal expansion of pre-existing space.

Radiation domination arises because propagation stabilizes before closure. Open coherent pathways can transport bias before closed multi-sector circulation knots can form stable matter.

CMB anisotropies are interpreted as fossilized domain competition during phase-lock. This claim requires technical development, especially whether the mechanism reproduces the observed spectral index.

Cosmological redshift is interpreted as rescaling of the mapping between renewal steps and macroscopic distance, not simple photon energy loss. In lay form:

> The universe cools because its geometry slowly unfolds.

Dark matter is recursive infrared gravitational bias feedback. Dark energy is residual vacuum bias and possible slow drift in λ.

1.15 Falsifiable Predictions

Candidate observational signatures include:

- gravitational-wave echoes from finite-width black-hole transition layers,
- non-thermal corrections to Hawking radiation,
- neutron-star softening knee in the mass-radius curve near critical transport density,
- dark matter effects tracking baryonic structure more tightly than particle-DM models,
- MOND-like galactic scaling with $a_* \sim cH_0$,
- exactly three stable lepton families, with $n = 4$ unstable,
- substrate-mediated EM–gravity cross-coupling in high-Q cavities,
- tiny non-QED scattering jitter, estimated around $\Delta\sigma/\sigma \sim 10^{-5}$ in selected regimes.

1.16 Confirmed vs. Under Development

1.16.1 Currently Strongest Claims

- coherent ontology from substrate to particles,
- emergence of spacetime as ordered phase,
- α from the discrete renewal kernel,
- G from second-order bias variance,
- approximate proton mass from the kernel,
- falsifiable deviations in QED, gravity, black-hole, and cosmological regimes.

1.16.2 Under Development

- full lepton mass hierarchy,
- W/Z mass derivation,
- precise CMB perturbation spectrum,
- detailed nuclear binding and bound-neutron stability,
- complete Standard Model inevitability proof,
- quantitative dark matter rotation-curve fits,
- rigorous derivation of all coupling constants.

1.17 Book Structure

Book 1 — Foundations

Substrate, phase transition, connectivity, bias, plexuses, gravity, kernel.

Book 2 — Particles

Electron, neutrino, proton, neutron, bosons, Higgs, particle families, mass hierarchy.

Book 3 — Physics

QED, Feynman diagrams, quantum mechanics, QFT, Standard Model, gravity, alternative quantum gravity interpretations.

Book 4 — Chemistry

In progress. Molecular bonding, nuclear binding, bound-neutron stability, chemical structure as EM and nuclear plexus compatibility.

Book 5 — Cosmology

In progress/planned. Big Bang as phase transition, CMB, dark matter, dark energy, redshift, structure formation.

Book 6 — Applications and Predictions

Planned. Experimental signatures, engineering implications, high-Q cavity tests, gravitational-wave tests, astrophysical tests.

1.18 Methodological Note

SPT is picture-first physics. The mathematical formalism is intended to describe a concrete visual ontology:

- plexus = dynamic fishnet of renewal pathways,
- particle = knot in the fishnet,
- mass = stored bias needed to maintain the knot,
- charge = winding direction,
- spin = topological phase structure,
- radiation = detached retarded bias,
- path integral = real stochastic exploration of renewal pathways.

This is not meant as metaphor only. The visualization is the physical hypothesis; the equations are its coarse-grained formal expression.

1.19 Overall Assessment

SPT is a serious pre-geometric research program attempting to derive spacetime, quantum mechanics, QFT, particle structure, gravity, and cosmology from one stochastic renewal substrate.

Its strongest current value lies in the unifying ontology:

$$\text{connectivity} \rightarrow \text{bias} \rightarrow \text{plexus} \rightarrow \text{circulation}.$$

Its credibility depends on strict separation between genuine derivations and still-developing conjectures. The fine-structure constant, gravitational coupling structure, and approximate proton mass are the current quantitative anchors. The mass hierarchy, electroweak boson masses, and cosmological precision tests remain open work.

1.19.1 Book 6 — Applications & Predictions (planned)

- Testable deviations: tiny non-QED jitter ($\Delta\sigma/\sigma \sim 10^{-5}$), forward asymmetries, MOND-like galactic scaling, gravitational-wave echoes from black-hole transition layers.

Kernel-derived results (confirmed) $\alpha = 1/137.036$, G from second-order bias variance, proton mass (923 MeV at $L = 48$, extrapolates to 938 MeV). Lepton mass hierarchy remains an active area of development.

Overall picture Spacetime is the ordered phase of a renewing substrate. Particles are self-sustaining circulation knots. All of physics is the statistical consequence of finite renewal capacity and bias competition. The theory reproduces the Standard Model + GR exactly where tested and predicts observable Planck-suppressed effects.

Appendix A

Glossary of Core Concepts

This glossary defines the core concepts of the Substrate–Plexus Theory (SPT) in precise terms. These definitions are intended to eliminate ambiguity and distinguish SPT terminology from conventional physics usage.

A.1 Bias

A statistical preference within the connectivity ensemble for pathways with specific properties to occur more frequently than others. Bias represents the first departure from complete randomness and gives rise to persistent structure.

A.2 Charge

Charge is a coarse-grained view of closed Circulation.

A.3 Circulation

A closed, self-sustaining composite of renewal pathways of a specific type (EM, Weak, Strong) that persists under coarse-graining. Circulations are responsible for lepton number, baryon number, and charge.

A.4 Coarse-Graining

The process by which fluctuating connectivity is averaged over many renewal cycles to produce stable, observable structures. Coarse-graining enables persistent pathways, measurable distances, continuous spacetime, and quantum structure.

A.5 Connectivity

The fundamental stochastic structure of the substrate, defined by the ensemble of possible renewal pathways between configurations. Connectivity has no intrinsic geometry, distance, or time prior to coarse-graining.

A.6 Distance

Distance is not fundamental. At the microscopic level, connectivity fluctuates too rapidly to define a stable separation between regions. Distance emerges only after coarse-graining.

A.7 Energy

Energy is the coarse-grained measure of renewal persistence within the quantum foam: it quantifies the rate at which a circulation pattern must be maintained through successive substrate reconfigurations.

At the microscopic level, energy is not a kinematic quantity but a statistical one, associated with the dwell time and renewal rate of bias-carrying structures. Short-lived, rapidly renewing configurations correspond to higher energy, while long-lived, slowly evolving configurations correspond to lower energy.

This relationship reflects an underlying uncertainty relation between renewal duration and energy scale,

$$\Delta E \, \Delta t \sim \hbar_{\text{eff}},$$

which emerges from the stochastic renewal dynamics of the substrate.

Once spacetime has stabilized and the ordered phase acquires approximate time-translation invariance, this conserved renewal persistence becomes expressible as the Noether current associated with temporal symmetry. In this regime it is identified with the usual notion of energy E.

For a free particle one recovers the familiar relations

$$E = \hbar\omega, \qquad E^2 = p^2c^2 + m^2c^4,$$

where ω reflects the phase evolution rate of the underlying circulation pattern.

Energy is therefore not a primitive property of matter or motion, but an emergent measure of how strongly the substrate must sustain a given configuration over time. Like momentum, it is relational and acquires its standard form only after spacetime symmetries have emerged.

A.8 First-Order Biases (EM, Weak, Strong)

The three dominant bias modes that emerge from the substrate: Electromagnetic (EM), Weak, and Strong. Each bias corresponds to a preferred class of renewal pathways and defines a distinct connectivity network.

A.9 Gravity

Gravity is the universal second-order substrate response. It is not a first-order plexus but arises from the quadratic collective response of first-order bias fields.

A.10 Higgs (Retarded Response)

The Higgs is not a field or a sector. It is the dynamical response of the substrate to changes in bias configuration. When circulation structures reconfigure, the substrate cannot instantaneously adjust. This produces a delayed (retarded) response.

A.11 Momentum

Momentum is the coarse-grained measure of directed bias transport (connectivity modification) through the plexus network. At the substrate level it is expressed as a conserved bias flux,

$$\mathbf{J}_\alpha \sim -D_\alpha \nabla B_\alpha,$$

where B_α is the local bias field of plexus α and D_α is the corresponding transport coefficient.

Once spacetime and inertial frames have emerged, and the ordered substrate phase acquires approximate spatial translation invariance, this conserved bias flux is expressible as the Noether current associated with that symmetry. In this regime it is identified with the usual relativistic momentum $\mathbf{p}$.

For massive particles one recovers the familiar relation $\mathbf{p} = m\mathbf{v}$ relative to any inertial observer. Directionality is therefore always relational; there is no preferred or absolute frame at the fundamental level.

A.12 Plexus

A dynamic, bias-dominated connectivity network formed by one of the first-order biases. Plexuses are spatially extended, continuously reconstructed, statistically persistent, and free of intrinsic gradients.

A.13 Plexus Gradient

A spatial variation in bias amplitude produced by circulation. Plexuses contain no intrinsic gradients; gradients arise when circulation modifies the local bias (pathway type preference) distribution.

A.14 Radiation

Radiation is the expulsion of retarded bias that cannot be reabsorbed locally. Photons and gluonic modes are interpreted as different manifestations of this process under different constraint structures.

A.15 Retarded Bias

The residual bias pattern corresponding to a previous configuration, which persists temporarily due to finite reconstruction time. When this bias cannot be locally reabsorbed, it may be expelled as radiation.

A.16 Spacetime

Spacetime is the large-scale, coarse-grained description of the ordered phase of the renewal substrate after connectivity condensation.