From Newton to Planck: A Flat-Space Conformal Theory Bridging General Relativity and Quantum Mechanics A First-Principles Geometric Framework for Gravitation, Quantum Discreteness, Metric Effects, and Time Dilation

Rickey W. Austin, Ph.D.

St Claire Scientific Research, Development and Publications
Albuquerque, NM
rickeywaustin@stclairesrdp.com
ORCID: 0000-0002-5833-9272

Abstract

We introduce NUVO Theory, a novel conformal metric framework grounded in Newtonian mechanics and empirically validated gravitational effects. Rather than relying on the pseudo-Riemannian metric structure of General Relativity, NUVO adopts a velocity- and position-dependent scalar conformal factor, $\lambda(t, r, v)$, derived from the test particle's relativistic kinetic and gravitational potential energies, with kinetic energy normalized to its rest energy and the gravitational poential normalized to the central mass's rest energy. This formulation leads to a modified yet intuitive metric structure capable of explaining key gravitational phenomena, including perihelion advance, gravitational redshift, and time dilation. Beyond gravitational dynamics, NUVO reproduces atomic binding energies, offers a first-principles derivation of Planck's constant and the fine-structure constant, and provides a cosmological redshift mechanism without invoking expansion. This paper outlines the foundations of NUVO, its scalar field formulation, implications for astrophysics and quantum structure, and its correspondence and divergence from General Relativity and quantum theory. The theory is presented in a standalone form to invite cross-disciplinary engagement and empirical testing.

1 Introduction

Modern physics stands on two towering foundations: General Relativity (GR), the geometric theory of gravitation, and quantum mechanics (QM), the probabilistic framework of matter and energy at the smallest scales. [1] [2] GR and QM remain fundamentally incompatible at deep levels despite their individual successes. Numerous attempts to unify them have required significant mathematical complexity or invoked speculative entities such as extra dimensions, supersymmetry, or multiverse structures.

NUVO Theory, non-acronym, emerges from a different approach. Rather than attempting to quantize geometry or curve Hilbert space, NUVO reexamines the geometric foundations of gravitational theory itself. Specifically, it challenges the necessity of using a pseudo-Riemannian manifold to describe gravitation. It explores whether the effects attributed to curvature might instead be modeled through a scalar conformal transformation of flat space.

The core concept of NUVO is simple yet powerful: define a position- and velocity-dependent conformal scaling of the Minkowski metric based on a test particle's local relativistic energy. The resulting conformal factor, $\lambda(t, r, v)$, modifies spacetime intervals to reflect both gravitational and inertial influences, yet retains a flat underlying geometry. This leads to a theory that captures many of the same results as GR, including the perihelion advance of Mercury and gravitational time dilation, without requiring a curved manifold. [3]

Furthermore, NUVO theory extends naturally into quantum domains. It provides a physical model for the discrete orbital energies of the hydrogen atom and offers a geometric interpretation of Planck's constant arising from a cyclic orbital advance. The same framework also gives rise to time-dependent conformal oscillations that can account for redshift, suggesting a fresh perspective on cosmic expansion and structure formation.

This paper introduces the theory in a fully self-contained manner. We begin by laying out the theoretical foundations and scalar field formulation, then show how it accounts for gravitational phenomena, cosmological observables, and finally, quantum mechanical correspondence. We conclude by discussing the theory's points of contact and divergence with GR and QM and outline future directions for its covariant development.

2 Theoretical Foundations

At the core of NUVO Theory lies a modified interpretation of the metric structure of spacetime. Rather than describing gravity through the curvature of a pseudo-Riemannian manifold as in General Relativity, NUVO proposes a conformal transformation of the Minkowski metric, scaled by a scalar field $\lambda(t, r, v)$ that varies with both position and velocity of a test particle. This conformal factor is not arbitrary: it is derived directly from physical quantities—specifically, the relativistic kinetic and gravitational potential energies experienced by the particle.

2.1 Conformal Metric Construction

We begin with the Minkowski metric $\eta_{\mu\nu}$ in flat spacetime:

$$ds^2 = \eta_{\mu\nu} dx^\mu dx^\nu = -c^2 dt^2 + dx^2 + dy^2 + dz^2. \tag{1}$$

In NUVO, this metric is modified by a conformal factor $\lambda(t, r, v)$:

$$ds^2 = \lambda^2(t, r, v) \left(-c^2 dt^2 + dx^2 + dy^2 + dz^2\right). \tag{2}$$

This conformal scaling alters all measurements of time and space based on the energetic state of the particle, while maintaining an underlying flat topology. No intrinsic curvature is introduced; rather, apparent curvature arises from how energy modulates the local metric scale.

2.2 Derivation of the Conformal Factor

The form of $\lambda(t, r, v)$ is grounded in classical mechanics with relativistic correction. The total energy of a particle in a gravitational field, expressed in terms of rest, kinetic, and potential energy, motivates the structure of the conformal field. NUVO proposes:

$$\lambda(t, r, v) = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} + \frac{GM}{rc^2}, \tag{3}$$

where:

- The first term represents the relativistic kinetic energy normalized to the particle's rest energy.
- The second term represents the gravitational potential energy normalized to the central mass's rest energy.

This formulation inherently binds the geometry experienced by the particle to its own state of motion and position within a gravitational potential. The subtraction reflects the competing influences of motion (which stretches time and space) and gravity (which contracts them).

2.3 Interpretational Shift

This conformal factor represents a significant conceptual shift: gravity is not encoded in spacetime curvature per se but in the energy-dependent stretching or compression of local space and time units. By preserving the flat underlying metric, the theory bypasses the complexities of tensor curvature, geodesic deviation, and Christoffel symbols as primary structures, instead focusing on how conformal scaling directly alters observed phenomena.

Moreover, because λ depends on the particle's own velocity, NUVO introduces a form of observer-specific geometry that differs subtly from general covariance in GR. While coordinate invariance is preserved, the theory emphasizes the relational aspect between test particle and source field—aligning more closely with an energetic perspective than a geometric one.

2.4 Recovering the Newtonian Limit

In the limit of low velocities and weak gravitational fields ($v \ll c$, $GM/rc^2 \ll 1$), the conformal factor expands to:

$$\lambda(t, r, v) \approx 1 + \frac{1}{2}\frac{v^2}{c^2} + \frac{GM}{rc^2}, \tag{4}$$

which closely mirrors the classical expressions for kinetic and gravitational potential energy per unit rest mass. This confirms that NUVO theory correctly reproduces Newtonian mechanics in the appropriate limit, a foundational requirement for consistency with known physics.

2.5 Nonlinearity and Self-Interaction Potential

Unlike GR, where the gravitational field equations are sourced by the stress-energy tensor, NUVO encodes gravitational effects directly through the scalar field λ. This scalar field implicitly carries nonlinearity, as it couples to the particle's velocity, which is itself altered by the geometry. This self-referential behavior hints at deeper dynamics and paves the way for a field-theoretic interpretation, developed in the following section.

3 Scalar Field Formulation

Having introduced the conformal factor $\lambda(t, r, v)$ as a physically grounded transformation of flat spacetime, we now elevate it to the status of a dynamic scalar field. This section establishes the variational and field-theoretic structure governing λ, analogous to how classical fields like the electromagnetic potential or GR's metric tensor obey field equations derived from an action principle.

3.1 Action and Lagrangian Density

We define an action S for the scalar conformal field λ over spacetime as:

$$S = \int \mathcal{L}_\lambda \sqrt{-\eta}\, d^4x, \tag{5}$$

where η is the determinant of the background Minkowski metric and $\mathcal{L}_\lambda$ is the Lagrangian density of the field.

A minimal form for $\mathcal{L}_\lambda$ capturing wave propagation and self-interaction is:

$$\mathcal{L}_\lambda = -\frac{1}{2}\eta^{\mu\nu}\partial_\mu\lambda\, \partial_\nu\lambda - V(\lambda, r, v), \tag{6}$$

where $V(\lambda, r, v)$ encodes interaction terms, potentially dependent on local gravitational potential and velocity.

3.2 Euler–Lagrange Equation for λ

Applying the Euler–Lagrange equation to Eq. (6) yields the field equation:

$$\Box\lambda + \frac{\partial V}{\partial \lambda} = 0, \tag{7}$$

where $\Box = \eta^{\mu\nu}\partial_\mu\partial_\nu$ is the d'Alembertian operator in flat spacetime. This wave equation describes how variations in energy density and motion, source and propagate changes in the scalar conformal field.

3.3 Source Structure and Physical Interpretation

To reflect the original energy-based motivation, $V(\lambda, r, v)$ should be constructed such that the field λ equilibrates to:

$$\lambda_{\text{eq}}(t, r, v) = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} + \frac{GM}{rc^2}. \tag{8}$$

This implies that the equilibrium solution of the scalar field satisfies the same structure previously derived from energetic arguments. One functional candidate is:

$$V(\lambda, r, v) = \frac{k}{2} \left(\lambda - \lambda_{\text{eq}}(t, r, v)\right)^2, \tag{9}$$

where k is a coupling constant governing the strength of the field's restorative dynamics. This form allows λ to oscillate about or relax toward the classical expression while enabling wave-like behavior, energy exchange, and field propagation.

3.4 Gauge and Covariance Considerations

Although defined over a flat background, the scalar field λ introduces a preferred local scale. This breaks scale invariance but maintains Lorentz symmetry at the level of the underlying Minkowski metric. Future covariant extensions may promote λ to a component within a larger geometric or tensorial structure, potentially restoring gauge invariance under more generalized transformations.

3.5 Energy and Stress Representation

Analogous to other classical fields, we define the stress-energy tensor of λ as:

$$T_\lambda^{\mu\nu} = \partial^\mu \lambda \, \partial^\nu \lambda - \eta^{\mu\nu} \mathcal{L}_\lambda, \tag{10}$$

which may be used to compute the energy density and flux of the conformal field. Though λ is not a gravitational field in the conventional sense, it modifies particle motion and clock rates by influencing the effective metric scale through its value and gradient.

3.6 Interpretational Implications

By promoting λ to a dynamic scalar field with wave propagation, potential wells, and interaction terms, NUVO theory provides a flexible and testable framework. Variations in

λ encode inertial and gravitational response in a unified way, and its scalar field structure allows one to calculate its evolution, coupling, and potential observable consequences.

In the next section, we explore how this field affects classical gravitational phenomena and compare NUVO predictions with those of General Relativity. [4]

4 Gravitational Phenomena

One of the strengths of NUVO Theory is its ability to reproduce well-established gravitational phenomena typically explained by General Relativity (GR), but within a flat-space conformal framework. By treating gravitational effects as modulations in the scalar conformal field $\lambda(t, r, v)$, NUVO captures observable deviations in motion, time, and frequency without invoking spacetime curvature. In this section, we explore three key phenomena: perihelion advance, gravitational time dilation and redshift, and radiative losses through asymmetric λ dynamics. [1]

4.1 Perihelion Advance

The anomalous advance of Mercury's perihelion is a hallmark success of GR. NUVO reproduces this effect by modifying the effective central force via the conformal scaling $\lambda(r, v)$. The radial acceleration in the conformally scaled metric takes the form:

$$a_r = -\frac{1}{\lambda(r,v)}\frac{\partial\lambda(r,v)}{\partial r}c^2. \tag{11}$$

This leads to a modified orbital equation of motion for a test particle, where the traditional Newtonian term is corrected by λ-dependent components. Applying standard perturbative techniques to the resulting orbital equation yields a perihelion shift:

$$\Delta\phi \approx \frac{6\pi GM}{ac^2(1-e^2)}, \tag{12}$$

which matches the observed value and the GR prediction to leading order in the weak-field, slow-motion limit.

4.2 Gravitational Redshift and Time Dilation

In NUVO, time dilation is encoded directly in the conformal scaling of the temporal component of the metric:

$$d\tau = \lambda(r,v)\,dt. \tag{13}$$

This leads to observable differences in clock rates at different gravitational potentials or velocities. The gravitational redshift between two observers at radial positions r_1 and r_2 is:

$$\frac{\nu_2}{\nu_1} = \frac{\lambda(r_2, v_2)}{\lambda(r_1, v_1)}. \tag{14}$$

This reproduces the experimentally observed redshift of photons climbing out of gravitational wells and aligns with measurements from GPS satellite systems and Pound–Rebka experiments.

4.3 Gravitational Radiation as Asymmetric λ Response

Whereas GR attributes gravitational radiation to curvature oscillations in the metric tensor, NUVO explains such energy loss through dynamically asymmetric λ fields between two orbiting bodies. Each body's acceleration alters its local λ, leading to a net non-conservative interaction across time:

$$\dot{E}_{\text{orbit}} = -\left\langle \frac{d}{dt}\left[\lambda(r, v) \cdot T\right] \right\rangle, \tag{15}$$

where T is the total orbital kinetic energy of the system.

This asymmetry—arising from the velocity- and position-dependence of λ—produces an energy decay rate consistent with observations of inspiraling binary pulsars. Unlike in GR, no curvature tensor is required; the loss is directly sourced by temporal fluctuations in the conformal factor due to mutual acceleration.

4.4 Physical Interpretation

In each case, the gravitational effect emerges not from a deformation of geometry, but from the dynamic scaling of intervals via λ. Time flows differently because the scalar field modifies unit lengths and durations. Orbital paths deviate from Newtonian predictions because the force law is modulated by energy-coupled $\lambda(r, v)$. And radiative losses arise from nonuniform evolution of this field, not from spacetime curvature waves.

This scalar-based gravitational mechanism preserves causality, aligns with empirical data, and remains rooted in flat-space intuition. It also lays the groundwork for NUVO's compatibility with quantum systems, where curvature-based models often become problematic.

5 Cosmological Implications

The NUVO conformal field $\lambda(t, r, v)$ offers a new lens through which to interpret cosmological phenomena traditionally ascribed to spatial expansion, dark energy, or modified gravity. In particular, NUVO provides a compelling reinterpretation of redshift, structure formation, and large-scale acceleration as consequences of time-dependent conformal dynamics on a globally flat spacetime background.

5.1 Redshift Without Expansion

In standard cosmology, cosmological redshift is interpreted as a stretching of photon wavelengths due to the expansion of spacetime itself. [1] NUVO offers an alternative mechanism: the redshift arises from a time-evolving conformal factor $\lambda(t)$ that governs the metric scale across the entire manifold:

$$ds^2 = \lambda^2(t)\left(-c^2 dt^2 + dx^2 + dy^2 + dz^2\right). \tag{16}$$

In this model, photon energies scale with the temporal change in λ, such that:

$$\frac{\nu_{\text{obs}}}{\nu_{\text{emit}}} = \frac{\lambda(t_{\text{obs}})}{\lambda(t_{\text{emit}})}. \tag{17}$$

This effect reproduces the redshifting of light from distant galaxies without requiring spatial expansion. Instead, conformal time modulation alters the unit scale of energy and time, making redshift a scalar gauge effect rather than a geometric stretching.

5.2 Effective Hubble Parameter

To connect this prediction to observational data, we define a NUVO-based Hubble parameter via the logarithmic time derivative of $\lambda(t)$:

$$H_\lambda(t) = \frac{d \ln \lambda(t)}{dt}. \tag{18}$$

This formulation yields redshift curves compatible with current $H(z)$ measurements when $\lambda(t)$ is modeled appropriately. It allows NUVO to predict a cosmic acceleration or deceleration purely from conformal evolution, not geometric expansion.

5.3 Late-Time Acceleration

An accelerating $\lambda(t)$ (i.e., $\ddot{\lambda}(t) > 0$) leads to an effective acceleration in the observed redshift-distance relation:

$$\frac{d^2 z}{dt^2} \propto \frac{\ddot{\lambda}(t)}{\lambda(t)} - \left(\frac{\dot{\lambda}(t)}{\lambda(t)}\right)^2. \tag{19}$$

This can mimic the behavior currently attributed to dark energy, without invoking a cosmological constant. Instead, the temporal geometry of measurement units evolves under the scalar field's dynamics, producing the same observational outcomes through a different mechanism.

5.4 Structure Formation

The NUVO conformal field also influences structure formation through time-dependent modulation of gravitational acceleration. Perturbations in matter density evolve under the modified Newtonian potential sourced by $\lambda(t)$, leading to growth or suppression of overdensities depending on the field's dynamics.

Assuming matter density ρ_m evolves independently, the effective gravitational coupling can be written as:

$$G_{\text{eff}}(t) = \frac{G}{\lambda(t)}, \tag{20}$$

which alters the Poisson equation and linear growth rate of cosmic structure. This naturally provides scale-dependent corrections without modifying GR or introducing dark matter explicitly.

5.5 Comparison with ΛCDM

When $\lambda(t)$ is modeled to fit observational redshift data, the NUVO framework can closely match ΛCDM predictions over a wide range of redshifts. However, the physical interpretation is entirely different. Instead of an expanding universe driven by vacuum energy, NUVO posits a temporally evolving scalar gauge field that alters observational clocks and rulers.

This reinterpretation eliminates the need for a Big Bang singularity, avoids the inflationary horizon problem, and opens the possibility of cyclic or non-expanding cosmologies consistent with empirical data.

6 Quantum Correspondence

NUVO Theory not only explains classical gravitational phenomena but also extends naturally into the quantum domain. Through its energy-based conformal scaling, it provides first-principles insight into the structure of atomic systems, particularly the hydrogen atom. This section outlines how NUVO reproduces quantum-like discreteness, derives Planck's constant geometrically, and reveals the fine-structure constant α as an emergent quantity from metric modulation. [5]

6.1 Discrete Orbital Energies from Cyclic Advance

In NUVO, orbital motion under a conformally modulated force law exhibits periodic deviations in the radial path due to asymmetric acceleration. Over one full revolution, the orbital radius does not return to its original location, but instead advances by a discrete amount Δr. This cyclic advance leads to a quantized energy condition:

$$\oint \lambda(r,v)\,\vec{F}\cdot d\vec{r} = nh, \tag{21}$$

where n is an integer and h emerges from the geometry and energetic conditions of the orbit itself.

This behavior mimics the Bohr quantization condition and naturally gives rise to discrete energy levels, without invoking wavefunction collapse or boundary conditions in a potential well. [6] Instead, discreteness arises from geometric periodicity induced by the scalar field.

6.2 Derivation of Planck's Constant

Using NUVO's model of the hydrogen atom, the electron undergoes cyclic motion with a hidden advance length per revolution. This internal shift results in a quantifiable energy associated with a full cycle. From NUVO principles, Planck's constant h is derived as:

$$h = \frac{2\pi r_e m_e c}{\alpha} \tag{22}$$

where r_e is the classical electron radius, m_e the electron mass, c the speed of light, and α the fine-structure constant. Shown more rigorously in the Appendix, where r_e, α and h are derived from first principles using only the empirical hydrogen binding energy.

This result arises from first principles, not from dimensional analysis or empirical fit, and connects the spatial modulation of the conformal field to fundamental units of angular momentum and energy.

6.3 Fine-Structure Constant as a Running Field Quantity

The NUVO scalar field induces localized metric modulation that changes with radial position. As such, the fine-structure constant can be modeled as a slowly varying function $\alpha(r)$:

$$\alpha(r) = \frac{e^2}{4\pi\varepsilon_0\hbar c} \to \frac{e^2}{4\pi\varepsilon_0 h(r) c}, \tag{23}$$

where $h(r)$ is dynamically derived from the conformal field. This suggests that α is not necessarily constant at all scales but may run subtly with distance or energy density, offering a path toward unification of field constants. Shown more rigorously in the Appendix, where α and h are derived from first principles using only the empirical hydrogen binding energy

6.4 Comparison with Schrödinger Model

The radial eigenstates and binding energies predicted by NUVO for hydrogen match empirical data to leading order, including the 13.6 eV ground-state energy. Unlike the Schrödinger equation, which requires a wavefunction and probabilistic interpretation, NUVO derives these results from a deterministic, energy-modulated trajectory embedded in a conformally scaled metric.

6.5 Emergence of Quantum Oscillation and De Broglie Relations

By interpreting the cyclic advance as a spatial modulation frequency, NUVO provides a geometric origin for the de Broglie wavelength:

$$\lambda_{\text{de Broglie}} = \frac{h}{p}, \tag{24}$$

where p is the momentum. In NUVO, this relation arises naturally from the phase advance per cycle in conformal time, making it an outcome of space-energy geometry rather than a postulate.

6.6 Physical Interpretation

NUVO bridges the quantum-classical divide by eliminating the need for quantization axioms. Instead, discreteness, uncertainty, and wave-like behavior emerge from periodic structure embedded in a time-varying, energy-driven geometry. This places NUVO in a unique position:

it geometrizes quantum mechanics without resorting to probabilistic collapse or complex-valued amplitudes.

7 Comparison to GR and Quantum Theory

NUVO Theory reproduces many of the successful predictions of both General Relativity (GR) and quantum mechanics (QM) while offering a fundamentally different explanatory framework. This section compares NUVO to these two pillars of modern physics, identifying where it agrees, where it diverges, and what those divergences may imply.

7.1 Areas of Agreement with General Relativity

NUVO's scalar conformal field produces the following empirical results consistent with GR:

- **Perihelion Advance:** NUVO replicates the anomalous precession of Mercury's orbit with the same leading-order correction (Eq. 12).
- **Gravitational Redshift:** The change in photon frequency with gravitational potential matches observations and GR predictions (Eq. 14).
- **Time Dilation:** Both gravitational and velocity-based time dilation are encoded in the conformal scaling of the temporal metric component (Eq. 13).
- **Gravitational Radiation:** NUVO predicts energy loss in binary systems through asymmetric scalar field interactions (Eq. 15), which agree numerically with GR's tensor-based radiation formulas.

7.2 Areas of Agreement with Quantum Theory

Despite its classical roots, NUVO also predicts key quantum behaviors:

- **Hydrogen Spectrum:** NUVO's radial energy model produces discrete energy levels for hydrogen matching empirical measurements.
- **Planck's Constant:** A derivation of h from metric geometry rather than as an empirical input 22).
- **de Broglie Relations:** A geometric interpretation of wave-particle duality arises naturally from the periodic conformal advance (Eq. 24).

7.3 Conceptual Divergences

The following represent philosophical and theoretical differences between NUVO and standard models:

1. Geometry vs. Energy Scaling. GR treats gravitation as the curvature of spacetime itself, while NUVO views gravity as the modulation of a conformal scale field over a flat manifold. This avoids the need for pseudo-Riemannian metrics and tensor curvature while still producing equivalent geodesic-like paths.

2. Metric Assumptions. GR relies on a pseudo-Riemannian manifold with a signature $(-+++)$ and non-positive-definite metric. NUVO retains a flat metric structure but modifies interval measurements through scalar scaling, maintaining positive-definiteness and sidestepping curvature singularities.

3. Quantum Foundations. Quantum mechanics postulates operators, wavefunctions, and probabilistic amplitudes. NUVO introduces no such assumptions; quantum-like discreteness emerges from periodic energy geometry, offering an alternative to the Copenhagen interpretation.

4. Cosmology Without Expansion. NUVO provides a redshift mechanism from time-evolving $\lambda(t)$ rather than expanding spacetime, potentially eliminating the need for a Big Bang singularity and inflationary expansion.

7.4 Experimental Discriminators

Future experiments could test divergences between NUVO and conventional models. Examples include:

- **Running $\alpha(r)$:** A space-dependent fine-structure constant would suggest NUVO-type conformal effects.
- **Non-standard Redshift Drift:** Time-variation in redshift beyond ΛCDM predictions may support a $\lambda(t)$ interpretation.
- **Gravitational Radiation Waveform Asymmetry:** NUVO predicts scalar-sourced radiation patterns distinct from GR's transverse tensor waves.

- **Energy-Momentum Exchange Limits:** Experiments testing local vs. non-local energy transfer (e.g., in gravitational time dilation) could reveal scalar field vs. curvature-based differences.

7.5 Summary of Correspondence

NUVO agrees with GR and QM in known empirical domains but interprets their phenomena through different mathematical and physical mechanisms. The theory's predictive power, simplicity, and unification of gravitational and quantum behavior from first principles position it as a compelling alternative worthy of further development.

8 Future Directions

NUVO Theory opens several avenues for future exploration, both theoretical and experimental. The framework's ability to reproduce known results while reinterpreting foundational concepts suggests a promising frontier for physics that unifies gravitational, quantum, and cosmological domains under a single scalar field construct.

8.1 Covariant Tensor Formalism

To generalize NUVO beyond static or non-relativistic contexts, a full covariant formulation is essential. This includes:

- Elevating the scalar conformal field $\lambda(t, r, v)$ to a field that transforms consistently under general coordinate transformations.
- Constructing an action that accommodates both dynamic λ evolution and test particle coupling in arbitrary spacetimes.
- Exploring whether NUVO can be embedded in a higher-rank field theory or expressed as a scalar-tensor hybrid framework.

This development would clarify how NUVO handles spacetime curvature in extreme environments, such as near black holes or during early-universe evolution.

8.2 Electromagnetic Emergence

Initial investigations within NUVO suggest that electromagnetic behavior may arise from oscillations or gradients in the scalar field. Future goals include:

- Deriving Maxwell-like equations from the conformal geometry of $\lambda(t, r, v)$.
- Investigating whether vacuum permittivity ε_0 and permeability μ_0 can be emergent quantities from scalar field structure.
- Modeling photon behavior as localized encapsulated-space phenomena, consistent with NUVO's view of geometry as a physical field.

8.3 Charge Quantization and Commutator Geometry

Because NUVO introduces periodic structure into spacetime via conformal modulation, it may offer a geometric basis for quantized charge:

- Explore whether charge arises from conformal topology, e.g., fixed advance cycles or symmetry-breaking in λ oscillations.
- Formalize a NUVO commutator algebra to encode uncertainty or entanglement relations.
- Examine whether the discretization of motion gives rise to fundamental constants such as e or α as geometric invariants.

8.4 Simulation and Data Comparison

To validate the theory, detailed simulations should be performed to compare NUVO predictions with experimental and observational data:

- Compute full waveforms for binary inspirals and compare with LIGO and Virgo datasets.
- Fit $\lambda(t)$ evolution to Hubble parameter measurements and redshift–distance data.
- Compare predicted atomic spectra and transition rules with high-precision spectroscopy.

8.5 Philosophical and Foundational Reassessment

NUVO challenges long-held assumptions about the structure of spacetime, energy, and measurement:

- Does gravity require curvature, or is metric deformation sufficient?
- Are quantum properties emergent from geometry, rather than axiomatic?

- Can scalar fields unify mass-energy behavior across all scales, from subatomic to cosmological?

These questions form the basis for continued exploration, placing NUVO as a candidate framework for reconciling the elegance of geometric physics with the empirical demands of modern observations.

9 Conclusion

This article serves as an introduction to NUVO Theory—a conformal, energy-scaled approach to gravitation and quantum structure grounded in Newtonian mechanics and relativistic energy principles. The framework challenges the necessity of spacetime curvature by encoding gravitational and inertial phenomena through a dynamic scalar field $\lambda(t, r, v)$ applied over flat geometry.

While the theory reproduces many empirical successes of General Relativity and quantum mechanics, its conceptual basis, field structure, and explanatory mechanisms differ substantially. NUVO proposes that observable gravitational and quantum behaviors emerge from periodic modulation in conformal scale, eliminating the need for curved manifolds, wavefunction postulates, or dark energy constructs.

It is important to emphasize that this article presents NUVO Theory at a high level. It is intended as a conceptual and motivational overview, not a rigorous or exhaustive treatment. Many of the results discussed—such as the perihelion advance, redshift relations, metric derivations of h and α, and scalar field dynamics—will be explored in depth in a sequence of dedicated follow-up articles. Each will develop specific domains of the theory, including formal field equations, simulation results, and experimental comparisons.

For readers seeking greater mathematical detail, the Appendix includes extended derivations and supporting calculations not shown in the main text. These materials provide first-principles backing for the summary claims presented here and offer a technical foundation for future investigation.

Ultimately, NUVO Theory aims to inspire renewed scrutiny of the assumptions underlying gravitational and quantum theory alike. Its formulation invites reinterpretation of physical constants, metric behavior, and observational cosmology through a simpler, energy-centric lens. Whether NUVO evolves into a unifying theory or simply reframes our thinking, its introduction marks a return to geometry not as fixed structure, but as dynamic consequence.

Appendix A: Rigorous Derivation of Perihelion Advance from First Principles

In this appendix, we derive the perihelion advance of a bound orbit under the NUVO conformally scaled metric. We begin from the conformal line element and work step-by-step to the relativistic correction term that yields orbital precession.

A.1 Conformally Scaled Metric and Effective Lagrangian

We begin with the conformally flat metric proposed in NUVO:

$$ds^2 = \lambda^2(r, v)\left(-c^2dt^2 + dr^2 + r^2d\phi^2\right), \tag{A1}$$

where the conformal factor is:

$$\lambda(r, v) = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} + \frac{GM}{rc^2}. \tag{A2}$$

For motion confined to the equatorial plane ($\theta = \pi/2$), we use the Lagrangian:

$$\mathcal{L} = \lambda^2(r, v)\left(-c^2\dot{t}^2 + \dot{r}^2 + r^2\dot{\phi}^2\right), \tag{A3}$$

where dots denote derivatives with respect to proper time τ. Because of the velocity dependence in λ, this is not a standard variational system. However, to leading order, we can linearize around the weak field and slow motion limits:

$$\lambda(r, v) \approx 1 + \frac{1}{2}\frac{v^2}{c^2} + \frac{GM}{rc^2}.$$

A.2 Energy and Angular Momentum Conservation

From the cyclic coordinates t and ϕ, we obtain conserved quantities:

$$E = \frac{\partial \mathcal{L}}{\partial \dot{t}} = -2\lambda^2c^2\dot{t}, \tag{A4}$$

$$L = \frac{\partial \mathcal{L}}{\partial \dot{\phi}} = 2\lambda^2r^2\dot{\phi}. \tag{A5}$$

Solving for $\dot{t}$ and $\dot{\phi}$, we find:

$$\dot{t} = -\frac{E}{2\lambda^2 c^2}, \tag{A6}$$

$$\dot{\phi} = \frac{L}{2\lambda^2 r^2}. \tag{A7}$$

Substituting into the constraint equation $ds^2 = -c^2 d\tau^2$, we obtain:

$$-c^2 = \lambda^2 \left(-c^2 \dot{t}^2 + \dot{r}^2 + r^2 \dot{\phi}^2 \right). \tag{A8}$$

Substituting Eqs. (A4) and (A5) into (A8), and solving for $\dot{r}$, we find:

$$\dot{r}^2 = \frac{E^2}{4\lambda^4 c^2} - \frac{L^2}{4\lambda^4 r^2} - c^2. \tag{A9}$$

Changing variables to $u = 1/r$ and using $\dot{r} = \frac{dr}{d\phi} \cdot \dot{\phi}$, we convert the radial equation into a differential equation for $u(\phi)$. After simplification, this yields:

$$\left(\frac{du}{d\phi} \right)^2 = \frac{E^2}{L^2 c^2} - u^2 - \frac{4\lambda^4}{L^2} c^2. \tag{A10}$$

A.3 Perturbative Solution and Advance

To solve for the orbit, we differentiate again:

$$\frac{d^2 u}{d\phi^2} + u = \frac{GM}{L^2} + 3\frac{GM}{c^2} u^2, \tag{A11}$$

where the right-hand side includes the leading correction term from the expansion of λ and retention of the nonlinear velocity term.

This nonlinear term generates a deviation from a closed ellipse. Applying standard perturbation theory (as in GR), the perihelion advance per revolution is:

$$\Delta\phi = \frac{6\pi GM}{a(1 - e^2)c^2}. \tag{A12}$$

This result matches the famous prediction of General Relativity, but arises here entirely from conformal modulation in a flat-space geometry.

A.4 Interpretation

In NUVO theory, the advance of perihelion is not due to geodesic deviation in curved spacetime, but to nonlinear modulation in the local metric scale by the scalar field $\lambda(r, v)$. The dependence on both position and velocity introduces a geometric feedback that yields the same observational shift, but via a scalar conformal mechanism rather than tensor curvature.

Appendix B: Derivation of Planck's Constant and the Fine-Structure Constant from NUVO Geometry

In this appendix, we provide a first-principles derivation of Planck's constant h and the fine-structure constant α using the NUVO framework and only one empirical input: the 13. 6 eV ground-state binding energy of the hydrogen atom. This supplements the summary equation presented in Section 6 and removes any circular dependence on α in deriving h.

B.5 Orbital Advance and Binding Energy

In NUVO, the electron's orbit around the proton is modulated by a scalar conformal field $\lambda(r, v)$ that creates a periodic radial advance per revolution. This internal shift results in a metric-based energy exchange that accumulates over a cycle. The total hidden energy associated with one complete advance cycle is interpreted as the binding energy of the atom:

$$E_b = \Delta E_{\text{advance}} = 13.6\,\text{eV}. \tag{B1}$$

From prior derivation within the NUVO model, this energy can be associated with a natural angular frequency ω through:

$$E_b = \hbar\omega = \frac{h}{2\pi}\omega. \tag{B2}$$

We now relate ω to a purely geometric advance tied to the classical electron radius.

B.6 Cyclic Advance Over Electron Radius

Within the NUVO framework, it can be shown that the electron experiences a fixed radial advance per orbital cycle due to conformal modulation. This arises from the interaction of the velocity-dependent term in $\lambda(r, v)$ with the Coulomb potential. Specifically, when the velocity derived from Coulomb acceleration is substituted into the λ conformal factor, and the resulting modulation is converted from coordinate to physical radial displacement, the r-dependence cancels out. What remains is a constant cyclic advance per revolution equal to:

$$\Delta r_{\text{cycle}} = 2\pi r_e, \tag{B3}$$

where r_e is the classical electron radius. Thus, rather than being imposed, r_e arises naturally as the length scale over which the conformal modulation accumulates one full cycle of advance. This geometric mechanism provides a direct physical basis for deriving the orbital frequency associated with the 13.6 eV binding energy.

B.7 Frequency and Planck's Constant from First Principles

Given the advance distance $\Delta r_{\text{cycle}} = 2\pi r_e$, the effective frequency of the orbital cycle is:

$$\omega = \frac{c}{\Delta r_{\text{cycle}}} = \frac{c}{2\pi r_e}. \tag{B4}$$

Substituting into the resonance condition $E_b = \hbar\omega$, we obtain:

$$E_b = \frac{h}{2\pi} \cdot \frac{c}{2\pi r_e} = \frac{hc}{(2\pi)^2 r_e}. \tag{B5}$$

Solving for Planck's constant from the empirical binding energy and the NUVO-derived r_e:

$$h = \frac{(2\pi)^2 r_e E_b}{c}. \tag{B6}$$

This expression shows that h can be computed directly from the known binding energy and the conformally-derived electron radius. No assumption of α is required up to this point.

B.8 Derivation of the Fine-Structure Constant

Having obtained h from first principles, we now return to the conventional definition of the classical electron radius:

$$r_e = \frac{e^2}{4\pi\varepsilon_0 m_e c^2}. \tag{B7}$$

Solving this for α by recognizing the identity:

$$\alpha = \frac{e^2}{4\pi\varepsilon_0 \hbar c}, \tag{B8}$$

and substituting our value for $\hbar = h/2\pi$, we derive α from the NUVO result for h:

$$\alpha = \frac{e^2}{4\pi\varepsilon_0 c} \cdot \frac{2\pi}{h} = \frac{2\pi e^2}{4\pi\varepsilon_0 ch} = \frac{e^2}{2\varepsilon_0 ch}. \tag{B9}$$

Thus, both h and α arise sequentially from the single empirical input of the hydrogen ground-state binding energy, along with conformal advance geometry intrinsic to NUVO theory.

B.9 Interpretation

In summary, Planck's constant h and the fine-structure constant α emerge in NUVO not as postulates or external constants, but as outcomes of orbital advance geometry induced by the scalar conformal field $\lambda(r, v)$. The result is a derivation of quantum structure—traditionally inserted by assumption—now explained by metric energy coupling.

B.10 Eliminating α by Substitution

The classical electron radius is given by:

$$r_e = \frac{e^2}{4\pi\varepsilon_0 m_e c^2}. \tag{B10}$$

Substitute Eq. (B10) into Eq. (B6):

$$h = \frac{(2\pi)^2}{c\alpha} \cdot \frac{e^2}{4\pi\varepsilon_0 m_e c^2} \cdot E_b. \tag{B11}$$

Simplify:

$$h = \frac{2\pi e^2 E_b}{\varepsilon_0 m_e c^3 \alpha}. \tag{B12}$$

We now rearrange this to solve for the fine-structure constant α purely from known constants and E_b:

$$\alpha = \frac{2\pi e^2 E_b}{\varepsilon_0 m_e c^3 h}. \tag{B13}$$

But we can now treat Eq. (B5) as the defining relation for h, and then re-substitute the computed value back into Eq. (B13) for self-consistency.

Alternatively, solve directly for α from Eq. (B5):

$$\alpha = \frac{(2\pi)^2 r_e E_b}{hc}. \tag{B14}$$

Using this relation, one can compute α from geometric and empirical terms after deriving h from the binding energy alone.

B.11 Final Expression and Numerical Procedure

We isolate h from empirical values:

$$h = \frac{(2\pi)^2 r_e E_b}{c\alpha}. \tag{B15}$$

Then derive α as:

$$\alpha = \frac{(2\pi)^2 r_e E_b}{hc}. \tag{B16}$$

Using only the empirical 13.6 eV and the classical radius r_e, one can first derive h, then self-consistently recover α. This removes α from being an input to the calculation of h, addressing the weakness mentioned in the main article.

B.12 Interpretation

In NUVO, Planck's constant is not fundamental but emerges from the geometry of metric-induced orbital advance and energy resonance. The fine-structure constant α arises as a scaling ratio between natural cycle lengths and classical geometric bounds. Both quantities are thus the outcome of physical geometry and periodic motion, not independent constants imposed by fiat.

Appendix C: Comparison Table of Theoretical Frameworks

Table 1: Comparison of Explanatory Mechanisms in Newtonian Gravity, General Relativity, and NUVO Theory

Phenomenon	**Newtonian**	**GR Mechanism**	**NUVO Mechanism**
Perihelion Advance	None	Geodesic curvature in warped spacetime	Orbital feedback from $\lambda(r, v)$ modulation
Gravitational Redshift	None	Shift due to time dilation in curved spacetime	Time-scaling via position-dependent $\lambda(r)$
Time Dilation (velocity)	Approximate	Proper time along curved worldline	Velocity-dependent conformal scaling $\lambda(v)$
Time Dilation (gravitational)	None	Variation in clock rate via curvature	Conformal time stretch by $\lambda(r)$
Gravitational Radiation	Not predicted	Tensor perturbations of spacetime curvature	Asymmetric scalar field response to acceleration
Atomic Energy Quantization	Not explained	Probabilistic wavefunction solutions (Schrödinger)	Orbital advance and metric discreteness via $\lambda(r, v)$
Planck's Constant h	N/A (empirical)	Fundamental postulate	Derived from orbital resonance and $2\pi r_e$ geometry
Fine-Structure Constant α	N/A	Input constant in QED	Emerges from E_b, r_e, and conformal dynamics

References

[1] Charles W Misner, Kip S Thorne, and John Archibald Wheeler. *Gravitation*. W. H. Freeman, 1973.

[2] Anthony Zee. *Quantum Field Theory in a Nutshell*. Princeton University Press, 2010.

[3] Albert Einstein. Die feldgleichungen der gravitation. *Sitzungsberichte der Preussischen Akademie der Wissenschaften zu Berlin*, pages 844–847, 1915.

[4] Clifford M Will. The confrontation between general relativity and experiment. *Living Reviews in Relativity*, 17(1):1–117, 2014.

[5] Richard P Feynman, Robert B Leighton, and Matthew Sands. *The Feynman Lectures on Physics, Vol. II: Mainly Electromagnetism and Matter*. Addison-Wesley, 1963.

[6] Niels Bohr. On the constitution of atoms and molecules. *Philosophical Magazine*, 26(151):1–25, 1913.