Pulse Theory of Everything (Pulse ToE): A Unified Scaling Framework

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We propose the Pulse Theory of Everything (Pulse ToE), a scale-invariant framework that unifies classical gravity and quantum phenomena through dimensional scaling laws. The theory introduces two fundamental parameters: the scaling exponent α and the effective dimensionality β, which govern physical quantities across regimes. Modified Planck units are derived using system-specific characteristic speeds, enabling a master scaling equation valid from sub-Planckian to cosmic scales. Applications include cosmology (dark energy), quantum gravity (singularity resolution), condensed matter (low-dimensional materials), and biophysics (protein folding). The framework predicts measurable deviations in gravitational coupling constants and energy density, offering experimental validation pathways.

I. INTRODUCTION

Modern physics struggles to reconcile quantum mechanics, which governs microscopic phenomena, with general relativity, which describes cosmological scales. Existing unification approaches, such as string theory [1], loop quantum gravity [2], and holographic duality [3], often rely on high-dimensional or background-dependent models with limited testable predictions. The Pulse Theory of Everything (Pulse ToE) introduces a scale-invariant framework based on dimensional scaling laws, connecting physical systems through recursive oscillations of fundamental quantities (mass, time, charge, etc.) across all scales, governed by system-specific parameters.

II. THEORETICAL FOUNDATIONS

A. Dimensional Index β

The effective dimensionality β reflects the physical context:

- $\beta = 4$: Standard spacetime (3 spatial + 1 temporal dimension).
- $\beta > 4$: Inflationary or multiverse regimes (e.g., compactified string dimensions).
- $\beta < 4$: Low-dimensional systems (e.g., 2D materials, membranes).

B. Scaling Exponent α

The scaling exponent α governs the power-law behavior of physical observables:

$$\alpha = \begin{cases} 1 & \text{Quantum (low-dimensional systems)} \\ 2 & \text{Classical (Einstein gravity)} \\ 3 & \text{Unified field regime} \end{cases} \tag{1}$$

C. Dimensional Duality and Scaling Symmetry

Pulse ToE exhibits symmetry under dual dimensional mappings:

$$8D \leftrightarrow 0D, \quad 5D \leftrightarrow 3D, \tag{2}$$

with unification at $\beta = 4$.

III. MODIFIED PLANCK UNITS

System-specific Planck units are defined using a characteristic velocity v_c:

$$m'_p = \sqrt{\frac{v_c \hbar}{G_\beta}}, \tag{3}$$

$$E'_p = \sqrt{\frac{v_c^5 \hbar}{G_\beta}}, \tag{4}$$

$$l'_p = \sqrt{\frac{\hbar G_\beta}{v_c^3}}, \tag{5}$$

$$t'_p = \sqrt{\frac{\hbar G_\beta}{v_c^5}}, \tag{6}$$

where $v_c = c$ at cosmic scales and $v_c < c$ for condensed systems.

IV. UNIFIED EQUATIONS

A. Master Scaling Equation

The central relationship connecting system variables across scales is:

$$F(\alpha, \beta, X) = X'_p \left(\frac{P_X}{X'_p}\right)^{\pm\left(\frac{\alpha+2}{\alpha}\right)^{\pm(\beta-4)}}, \tag{7}$$

where P_X is the characteristic radius or time, and X'_p is the modified Planck unit for physical quantity X.

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B. Derived Composite Quantities

Energy density:

$$\rho = \frac{F(\alpha, \beta, E)}{\frac{4}{3}\pi F(\alpha, \beta, l)^3}, \tag{8}$$

Force:

$$F = \frac{F(\alpha, \beta, E)}{F(\alpha, \beta, l)}, \tag{9}$$

Field strength:

$$\varepsilon = \frac{F}{F(\alpha, \beta, q)}. \tag{10}$$

V. INFINITE RADIUS AND SINGULARITIES

Pulse ToE reinterprets cosmological singularities, such as the Big Bang, as an infinite-radius spatial manifold undergoing homogeneous collapse to a Planck-scale state at every point, followed by expansion. This leverages the scale-invariant master equation and dimensional scaling parameters.

A. Theoretical Basis

In standard cosmology, the Big Bang singularity occurs as the scale factor $a(t) \to 0$, leading to infinite energy density. Pulse ToE describes this as a flat ($\beta = 4$) Friedmann-Lemaître-Robertson-Walker (FLRW) universe with zero curvature ($k = 0$) collapsing homogeneously to a Planck-scale state, followed by expansion consistent with the cosmological principle.

B. Mathematical Formulation

The dynamics are described by:

$$F(\alpha, \beta, l) = l'_p \left(\frac{t}{t'_p}\right)^{\pm\left(\frac{\alpha+2}{\alpha}\right)^{\pm(\beta-4)}}, \tag{11}$$

where $l'_p = \sqrt{\frac{\hbar G_\beta}{v_c^3}}$, $t'_p = \sqrt{\frac{\hbar G_\beta}{v_c^5}}$, and $v_c = c$ for cosmological scales. For $\beta = 4$ and $\alpha = 3$, the scale factor evolves as:

$$r(t) = l_p \left(\frac{t}{t_p}\right)^{\pm\frac{5}{3}}, \tag{12}$$

with a negative exponent ($-\frac{5}{3}$) for collapse as $t \to 0^+$ and a positive exponent ($+\frac{5}{3}$) for post-singularity expansion.

C. Quantum Gravity and Singularity Resolution

Pulse ToE resolves singularities using modified Planck units and quantum scaling effects, avoiding true singularities via a quantum bounce, analogous to loop quantum cosmology [2]. The wave function of the universe follows a modified Wheeler-DeWitt-like equation:

$$\left[-\frac{\hbar^2}{2}\frac{\partial^2}{\partial r^2} + V(r, \phi)\right]\psi(r, \phi) = 0, \tag{13}$$

where ϕ is a scalar field driving collapse.

D. Cosmological Implications

The collapse-expansion cycle predicts:

- Time-varying constants due to scaling of G_β.
- Dark energy emerging from unified regime scaling.
- Multiverse dynamics for $\beta > 4$.

E. Testable Predictions

The model predicts:

- Variations in G_β detectable via astrophysical observations.
- Quantum fluctuation signatures in the cosmic microwave background.
- Scaling behaviors testable through gravitational wave experiments.

VI. SCALING REGIMES

The scaling behavior of physical quantities is summarized in Table I.

TABLE I. Scaling regimes and exponents for $\beta = 4$.

Regime	α	Scaling Law	Example ($\beta = 4$)
Quantum	1	$\pm 3^{\pm(\beta-4)}$	$+3^0 = +1$
Classical	2	$\pm 2^{\pm(\beta-4)}$	$-2^0 = -1$
Unified	3	$\pm\left(\frac{5}{3}\right)^{\pm(\beta-4)}$	$\pm\left(\frac{5}{3}\right)^0 = \pm\frac{5}{3}$

VII. APPLICATIONS

A. Cosmology

- Time-varying constants due to α, β transitions.
- Dark energy as an emergent scaling effect.

B. Quantum Gravity

- Singularity resolution via regularized Planck units.
- Quantum fluctuations linked to early-universe inflation.

C. Condensed Matter

- Dimensional crossover in 2D materials.
- Explanation of phenomena like the quantum Hall effect.

D. Biophysics

- Scaling models for protein folding.
- Neural dynamics in low-dimensional frameworks.

VIII. DERIVATION OF UNIFIED SCALING

A. Mass-Energy and Spacetime Unification

Starting from Einstein's mass-energy equivalence:

$$E = mc^2, \quad c = \frac{R}{t}, \tag{14}$$

we obtain:

$$Et^2 = R^2 m. \tag{15}$$

B. Pairs of Equations for E and M

Various expressions for E and M yield consistent relations, e.g.:

- Pair 1: $E = \frac{h}{t}$, $M = \frac{h}{c^2 t}$, yielding $t = \frac{R}{c}$.
- Pair 4: $E = \frac{h}{t}$, $M = \frac{c^3 t}{G}$, yielding $R = \sqrt{\frac{Gh}{c^3}}$.

C. Recursive Spacetime Scaling

From unified equations:

$$t = R^2\sqrt{\frac{c}{Gh}} \implies R = \left(\frac{Ght^2}{c}\right)^{1/4}, \tag{16}$$

$$t = \frac{c^2 R^3}{Gh} \implies R = \left(\frac{Ght}{c^2}\right)^{1/3}. \tag{17}$$

Combining yields:

$$R = \left(Ght^3\right)^{1/5}. \tag{18}$$

D. Recursive Structure

After n iterations:

$$R = \left(\frac{Gh}{c^3}\right)^{\frac{1-3^{-n}}{2}} \left(\frac{Ght}{c^2}\right)^{3^{-n-1}}. \tag{19}$$

E. Mass Derivation

Equating $R = \left(\frac{Ght}{c^2}\right)^{1/3}$ with the Schwarzschild radius $R = \frac{2GM}{c^2}$:

$$M = \left(\frac{c^4 ht}{(2G)^2}\right)^{1/3}. \tag{20}$$

Recursively:

$$M = \left(\frac{ch}{2G}\right)^{\frac{1-3^{-n}}{2}} \left(\frac{c^3 hR}{(2G)^2}\right)^{3^{-n-1}}. \tag{21}$$

F. Final Scaling Law

The master scaling law for any physical quantity X is:

$$F(\alpha, \beta, X) = X'_p \left(\frac{P_X}{X'_p}\right)^{\pm\left(\frac{\alpha+2}{\alpha}\right)^{\pm(\beta-4)}}, \tag{22}$$

where the exponent $\frac{\alpha+2}{\alpha}$ emerges from dimensional consistency.

IX. DISCUSSION

Pulse ToE aligns with scale-invariant approaches like the renormalization group [4] and string compactification. It offers testable predictions, including variations in G_β and scaling laws in 2D materials. Future work includes simulations of $F(\alpha, \beta, X)$ and experimental tests via gravitational wave detectors and low-dimensional systems.

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