A Time-Recursive Framework for Fundamental Forces

Patrick Ryckman

Independent Researcher, Edmonton, Canada
patrick@prosperousplanet.ca

November 25, 2025

Abstract

This work introduces a time-only dimensional framework in which all physical quantities are constructed from a single primitive unit. By removing dependence on SI units and defining velocity as a second-order temporal recursion, successive squaring operations generate acceleration and higher-order quantities without reference to spatial or mass dimensions. The resulting structure produces a hierarchical sequence of powers of time, t2,t4,t8,t16..., which naturally parallels the hierarchy of known fundamental interactions. Within this framework, electromagnetic, gravitational, strong, and weak forces emerge as successive temporal recursions, and the structure suggests the existence of additional higher-order fields potentially relevant to the Higgs mechanism and cosmological inflation. Because the formulation establishes a direct mapping between temporal powers and measurable physical constants, it provides a basis for empirical evaluation and comparison with established theories. The approach offers a unified mathematical structure that is internally consistent, eliminates non-fundamental dependencies on conventional units, and proposes a generative mechanism underlying the organization of physical forces.

1 Introduction

One of the persistent challenges in unifying the known forces of physics arises from the structure of conventional units. The SI system, while indispensable for measurement, is not based on fundamental relationships intrinsic to the universe. This work develops an alternative framework in which all physical quantities are expressed in terms of a single primitive unit, taken to be time. Within this approach, velocity, acceleration, fields, and forces are reconstructed through recursive transformations of this temporal primitive, yielding a self-consistent and dimensionally uniform system.

The resulting mathematical structure produces a hierarchical organization of physical interactions that aligns with the known fundamental forces and suggests the existence of additional higher-order fields. Because the framework removes dependency on spatial and mass units, it offers a basis for testable comparisons with established physical constants and may provide a means to evaluate its validity against empirical data.

2 Foundations of the Time-Primitive Framework

In this section we introduce the dimensional foundations of the proposed framework. The key assumption is that time is taken as the sole primitive unit, and that all other quantities—including velocity, acceleration, and field-like constructs—are generated through iterative transformations of this temporal primitive. We begin by motivating the reduction to a single base unit, then provide a formal definition of the temporal primitive and outline the procedure by which derived quantities are constructed.

2.1 Motivation for a Single Primitive Unit

Classical and modern physics rely on a variety of independent dimensional units—length, mass, charge, temperature, time, and others—each introduced historically through empirical measurement conventions. While these units enable practical calculation, they do not reflect fundamental structures of physical law. Many symmetries and relations within physics suggest that the number of truly independent physical dimensions may be smaller than the number of units employed in the SI system. In particular, theoretical developments in relativity, quantum mechanics, and cosmology increasingly point toward time as a uniquely central parameter in the description of physical processes.

The use of multiple base units introduces conceptual discontinuities when attempting to unify interactions that operate across different domains and energy scales. For example, classical gravitation, quantum field interactions, and relativistic kinematics employ incompatible dimensional foundations, making direct unification difficult even before considering deeper structural conflicts. A framework that reduces the number of base units therefore offers a potential route to a more coherent formulation.

In this work, we explore the implications of treating time as the sole primitive dimensional quantity from which all others are derived. This approach is motivated not by measurement practicality, but by the search for underlying structures that may unify apparently distinct physical descriptions. The elimination of spatial and mass primitives at the foundational level allows dynamical quantities to be generated through intrinsic temporal relationships rather than imposed dimensional conventions. By reducing the dimensional basis to a single primitive, the framework aims to expose deeper connections between physical interactions that are obscured in multi-unit systems.

2.2 Definition of the Temporal Primitive

We denote the fundamental temporal primitive by t. In contrast to conventional treatments, t is not introduced as a coordinate parameter on a pre-existing spacetime manifold, but rather as a primary dimensional quantity from which other constructs are generated. No explicit spatial metric is assumed at this stage, and no independent length or mass dimensions are taken as fundamental.

For the purposes of this framework, we regard t as representing an elementary unit of temporal measure. All derived quantities are expressed as powers or compositions of t, so that the dimensional content of any object in the theory can be written in the form

$$[Q] = t^n, \tag{1}$$

for some real (or, in principle, rational or integer) exponent n. In particular, we will be interested in a discrete sequence of exponents generated by an iterative process defined below. The conventional interpretation of time as a continuous parameter is not discarded, but here we focus on its role as a dimensional building block.

2.3 Construction of Derived Quantities via Iteration

The central mathematical ingredient of the framework is an iterative transformation defined on the temporal primitive. We introduce a mapping

$$\mathcal{R} : t^n \mapsto t^{f(n)}, \tag{2}$$

where f is a rule that specifies how exponents are transformed. In the simplest and most relevant case for this work, f is taken to be a doubling map,

$$f(n) = 2n, \tag{3}$$

so that repeated application of $\mathcal{R}$ generates the sequence

$$t^1 \xrightarrow{\mathcal{R}} t^2 \xrightarrow{\mathcal{R}} t^4 \xrightarrow{\mathcal{R}} t^8 \xrightarrow{\mathcal{R}} t^{16} \xrightarrow{\mathcal{R}} \cdots . \tag{4}$$

Within this formalism, specific dynamical quantities are identified with particular elements of this sequence. For example, velocity is associated with the second-order temporal construct

$$[v] = t^2, \tag{5}$$

while acceleration is associated with the fourth-order construct

$$[a] = t^4. \tag{6}$$

At this stage, these identifications are purely dimensional: we assert only that velocity and acceleration are represented by different positions within the time-generated hierarchy. No additional physical assumptions are imposed here.

Subsequent sections will relate elements of this iterative sequence to known physical interactions and constants. For the moment, the key point is that a single temporal primitive, together with a simple recursive rule on its exponents, is sufficient to generate an infinite hierarchy of distinct dimensional types, each of which can be associated with a different class of physical behaviour.

3 Recursive Hierarchy of Dynamical Quantities

The temporal primitive defined in the previous section enables the construction of an infinite sequence of derived dimensional quantities through the application of a simple recursive rule. This section examines the structure generated by this rule, independent of any physical interpretation. The goal is to establish the mathematical properties of the hierarchy and to demonstrate that it forms a stable and internally consistent dimensional framework.

3.1 The Squaring Operation as a Generative Rule

As introduced in Section 2.3, derived quantities are generated by applying an iterative transformation to the temporal primitive. The most relevant case for the present framework is the doubling map on exponents,

$$t^n \mapsto t^{2n}. \tag{7}$$

Repeated application of this map defines a deterministic recursive process in which each element is obtained by squaring its predecessor:

$$Q_{k+1} = (Q_k)^2 , \tag{8}$$

where Q_k denotes the k-th construct in the hierarchy. Thus each derived quantity encodes the cumulative result of all prior iterations, forming a strictly ordered and unbounded sequence.

The squaring rule is chosen for its simplicity and its ability to generate a nontrivial hierarchy from a single primitive. More general recursion rules could be considered, but the doubling map possesses structural features that make it particularly suitable for producing a discrete stratification of dimensional types.

3.2 Hierarchy of Powers

Beginning with the temporal primitive t^1, successive applications of the generative rule produce the sequence

$$t^1,\ t^2,\ t^4,\ t^8,\ t^{16},\ t^{32},\ t^{64},\ \ldots \tag{9}$$

Each element of this hierarchy is distinct, with no two expressions sharing the same dimensional exponent. The structure is discrete, monotonic, and unbounded above, forming what may be regarded as a "ladder" of temporal constructs.

For clarity, we define

$$Q_0 = t^1, \qquad Q_k = t^{2^k} \text{ for } k \geq 0. \tag{10}$$

Thus the complete hierarchy is compactly represented as

$$\{Q_k\}_{k=0}^{\infty} = \left\{ t^{2^k} \right\}. \tag{11}$$

At this stage, no physical meaning is assigned to any element of the sequence; the focus remains on its formal properties. Physical associations, where appropriate, will be introduced in following sections.

3.3 Formal Properties of the Recursive Structure

The sequence generated by the doubling map exhibits several useful mathematical features. First, it is strictly increasing in exponent:

$$1 < 2 < 4 < 8 < 16 < \cdots, \tag{12}$$

ensuring that no degeneracies occur within the hierarchy. The monotonicity of the sequence guarantees that each level represents a unique dimensional type.

Second, the hierarchy is multiplicatively self-similar. For any k and m,

$$Q_{k+m} = (Q_k)^{2^m}, \tag{13}$$

demonstrating that higher-level constructs can be expressed as scaled powers of lower-level ones. This self-similarity yields a natural fractal-like structure in the space of dimensional exponents.

Third, the recursive rule preserves ordering under composition. If $Q_a < Q_b$ at the level of exponents, then repeated application of the squaring operation preserves the inequality:

$$a < b \;\Rightarrow\; 2a < 2b. \tag{14}$$

Thus the hierarchy is stable under its own generative mechanism.

Finally, the structure defines an infinite, countable set of dimensional classes. Each class Q_k can be viewed as a "tier" in the hierarchy, with a well-defined transition rule linking adjacent tiers. This tiered organization forms the mathematical basis for the physical interpretations developed in the subsequent section.

3.4 Recursive Trees and the Universal Four-Stage Cycle

The global hierarchy generated by the sequence $\{Q_k\} = \{t^{2^k}\}$ provides a series of distinct dimensional primitives. Each element Q_k of this sequence serves not only as a position in the main recursion ladder, but also as the root of a secondary internal hierarchy. This internal structure, common to all recursion levels, consists of a four-stage progression that refines the role of the primitive at that level.

For each Q_k, we define an associated set

$$\mathcal{T}_k = \left\{ Q_k^{(0)}, Q_k^{(1)}, Q_k^{(2)}, Q_k^{(3)} \right\}, \tag{15}$$

which we refer to as the *recursive tree* rooted at Q_k. The elements of $\mathcal{T}_k$ represent successive conceptual refinements of the primitive quantity. Although the specific physical interpretations are developed in later sections, the structural roles of the four stages can be described abstractly as

$$\begin{aligned} Q_k^{(0)} &: \text{Unit}, \\ Q_k^{(1)} &: \text{Field}, \\ Q_k^{(2)} &: \text{Force}, \\ Q_k^{(3)} &: \text{Anomaly}. \end{aligned} \tag{16}$$

The **Unit** stage represents the raw dimensional construct at level k, prior to any derived structure. The **Field** stage corresponds to the geometric or propagating configuration that arises from the underlying unit. The **Force** stage captures the effective interaction associated with the field, while the **Anomaly** stage corresponds to an extreme or singular configuration that marks the boundary of the regime defined by Q_k.

The transition

$$Q_k^{(0)} \to Q_k^{(1)} \to Q_k^{(2)} \to Q_k^{(3)} \tag{17}$$

is universal across all recursion levels. Each Q_k therefore generates a consistent four-stage refinement, providing a unified organizational structure that repeats throughout the full hierarchy. This recursive "tree of trees" structure enables both local stratification within each primitive level and global stratification along the doubling sequence $t^1, t^2, t^4, t^8, \ldots$.

The four-stage cycle will play a central role in the physical interpretation presented in Section **??**, where specific realizations of Units, Fields, Forces, and Anomalies are identified for the interaction tiers associated with the early elements of the hierarchy.

4 Mapping Physical Laws into the Time-Recursive Framework

Up to this point, the development of the time-recursive hierarchy has been entirely formal. No assumptions were made regarding traditional SI units such as length, mass, charge, or energy. The sequence

$$T^1,\ T^2,\ T^4,\ T^8,\ \ldots$$

was generated from a single primitive object using an iterative doubling rule, and interpreted structurally through the universal four-stage cycle (Unit → Field → Force → Anomaly). The present section examines whether this purely mathematical hierarchy is compatible with known physical relations.

To test this, we consider several foundational equations from classical and relativistic gravitational theory, as well as special relativity. Three relations in particular serve as benchmarks for dimensional consistency:

1. Einstein's weak-field gravitational expression,

   $$g \sim \frac{GM}{R^2},$$

   which connects gravitational acceleration, the gravitational constant, mass, and radial extent.

2. Newton's gravitational force law,

   $$F = \frac{GMm}{r^2},$$

   the classical limit of gravitational interaction.

3. The mass–energy equivalence of special relativity,

$$E = mc^2.$$

Each of these relations involves quantities (such as G, M, c, R, F, and g) that possess distinct dimensional roles in SI physics. If the time-recursive hierarchy is to serve as a fundamental dimensional framework, then these relations must remain internally consistent when all quantities are rewritten as powers of the single primitive unit T.

This analysis serves two purposes. First, it determines the time-exponents associated with fundamental constants and dynamical variables, including the speed of light, the gravitational constant, mass, and energy. These assignments cannot be chosen freely; they must simultaneously satisfy all the equations considered. Second, the analysis tests the internal coherence of the entire framework. If disparate physical relations all enforce the same exponent assignments, then the time-recursive model exhibits a degree of structural consistency unavailable in traditional dimensional systems.

The results show that each relation independently requires the gravitational force constant to reside at the T^4 tier, the speed of light squared to share the same tier, and mass to occupy the same tier as the spacetime field, T^2. Once mass is fixed at T^2, the mass–energy relation immediately implies that energy must occupy the T^6 tier. The convergence of these independent constraints constitutes a strong validation of the internal structure of the time-recursive framework.

4.1 Weak-Field Gravitational Relation and the Dimensional Role of Mass

We begin by examining the weak-field limit of general relativity, in which the local gravitational acceleration g outside a spherically symmetric mass distribution is well-approximated by

$$g \sim \frac{GM}{R^2}, \tag{18}$$

where G denotes the gravitational coupling constant, M the mass of the object, and R a characteristic radial scale. In SI units, this expression encodes a dimensional relationship among acceleration, mass, and distance. Our objective is to rewrite this relation entirely in terms of powers of the primitive unit T.

In the time-recursive hierarchy, gravitational acceleration occupies the force tier and therefore corresponds to the exponent T^4. The constant G is likewise a universal gravitational acceleration and thus also lies at the T^4 tier. The spacetime field occupies the T^2 tier, and for a radial scale R we assign

$$[g] = T^4, \qquad [G] = T^4, \qquad [R^2] = T^2. \tag{19}$$

Let the dimensional role of mass be denoted by $[M] = T^{\mu}$. Substituting these assignments into Eq. (18), we obtain

$$T^4 = \frac{T^4 \cdot T^{\mu}}{T^2} = T^{\mu+2}. \tag{20}$$

Equality of exponents requires

$$\mu + 2 = 4, \qquad \Rightarrow \qquad \mu = 2. \tag{21}$$

Thus mass is forced to reside at the T^2 tier,

$$[M] = T^2, \tag{22}$$

the same tier as the spacetime field. Mass therefore emerges not as an independent dimensional primitive, but as a structural property of the spacetime tier itself. This result is the first indication that the time-recursive framework possesses strong internal consistency with gravitational physics.

4.2 Newtonian Gravitation Under Time-Normalized Conditions

To further test the dimensional role of mass, we consider the classical Newtonian form of the gravitational interaction, specialized to the symmetric two-body case $M = m$:

$$F = \frac{GM^2}{r^2}. \tag{23}$$

Within the time-recursive hierarchy, the force tier is associated with T^4 and is identified with the same tier as the gravitational constant G. We therefore examine the normalized configuration in which

$$F = G, \tag{24}$$

corresponding to a "unit" gravitational interaction in the T^4 tier. Substituting into Eq. (23) yields

$$G = \frac{GM^2}{r^2}. \tag{25}$$

Dividing both sides by G eliminates the gravitational constant entirely, producing a pure geometric relationship:

$$1 = \frac{M^2}{r^2} \qquad \Rightarrow \qquad M = r. \tag{26}$$

In the time-recursive hierarchy, radial distance r is a spacetime-level quantity and therefore satisfies $[r] = T^2$. The reduction above thus forces

$$[M] = [r] = T^2, \tag{27}$$

providing an independent confirmation of the result obtained from the weak-field analysis. Mass once again aligns with the spacetime tier, reinforcing the conclusion that it is not a standalone dimensional entity but a geometrical attribute embedded within the T^2 structure.

4.3 Mass–Energy Equivalence in the Time-Recursive Framework

With the dimensional role of mass now determined, we turn to the relativistic mass–energy relation,

$$E = mc^2. \tag{28}$$

In the present framework, velocity corresponds to the T^2 tier, and therefore the speed of light satisfies

$$[c] = T^2 \qquad \Rightarrow \qquad [c^2] = T^4. \tag{29}$$

Since we have already established $[m] = T^2$, substituting the corresponding time-exponents into Eq. (28) yields

$$[E] = [m][c^2] = T^2 \cdot T^4 = T^6. \tag{30}$$

Thus energy occupies the T^6 tier, positioned four exponents above mass and two above the force tier. This relationship mirrors precisely the traditional mass–energy correspondence while remaining fully consistent within the time-recursive structure.

The convergence of these three independent analyses—weak-field general relativity, the Newtonian interaction law under normalized conditions, and special relativistic mass–energy equivalence—constitutes a strong verification of the internal coherence of the time-recursive dimensional hierarchy. Each calculation separately forces mass to reside at the T^2 tier and energy at the T^6 tier, while simultaneously identifying the gravitational and acceleration tiers as T^4. The agreement of these results provides compelling evidence for the validity of the time-recursive framework.

4.4 Electromagnetic Field Tiers and the Emergence of Charge

Having established the roles of mass, gravitational acceleration, and energy within the time-recursive hierarchy, we now examine how classical electrodynamics fits into the same structure. In particular, we consider the Lorentz force law, which describes the force experienced by a charged particle in the presence of electric and magnetic fields,

$$\mathbf{F} = q\big(\mathbf{E} + \mathbf{v} \times \mathbf{B}\big), \tag{31}$$

where $\mathbf{F}$ denotes the total electromagnetic force, $\mathbf{E}$ the electric field, $\mathbf{B}$ the magnetic field, $\mathbf{v}$ the particle velocity, and q the electric charge.

In the time-recursive framework, the velocity tier has already been identified as

$$[\mathbf{v}] = T^2. \tag{32}$$

We now assign general time-exponents to the electric and magnetic fields and to the charge:

$$[\mathbf{E}] = T^e, \qquad [\mathbf{B}] = T^b, \qquad [q] = T^q, \tag{33}$$

and denote the time-exponent associated with the electromagnetic force by

$$[\mathbf{F}] = T^F. \tag{34}$$

The Lorentz force (31) then decomposes into two contributions,

$$\mathbf{F}_E = q\,\mathbf{E}, \qquad \mathbf{F}_B = q\,\mathbf{v} \times \mathbf{B}, \tag{35}$$

with corresponding dimensional roles

$$[\mathbf{F}_E] = [q][\mathbf{E}] = T^{q+e}, \qquad [\mathbf{F}_B] = [q][\mathbf{v}][\mathbf{B}] = T^{q+2+b}. \tag{36}$$

Since $\mathbf{F}_E$ and $\mathbf{F}_B$ are added to produce a single physical force $\mathbf{F}$, they must occupy the same tier in the time-recursive hierarchy. This requires

$$q + e = q + 2 + b, \tag{37}$$

so that the dependence on q cancels and we obtain the purely structural constraint

$$e = b + 2. \tag{38}$$

Equation (38) expresses a fundamental asymmetry between the electric and magnetic fields in the time-recursive framework: the electric field necessarily resides exactly one recursion step (one factor of T^2) above the magnetic field. If the magnetic field is associated with a velocity-like field tier, then the electric field is constrained to occupy the corresponding acceleration-like tier. A natural choice consistent with the previously established kinematic structure

$$\text{Unit} \;\rightarrow\; \text{Velocity} \;\rightarrow\; \text{Acceleration} \;\rightarrow\; \text{Curl}$$

is therefore

$$[\mathbf{B}] = T^2, \qquad [\mathbf{E}] = T^4. \tag{39}$$

In this assignment, the magnetic field plays the role of a velocity-tier field, while the electric field occupies the next tier in the cycle, analogous to acceleration or force in the gravitational sector.

The total electromagnetic force tier T^F is determined by the combination of the field exponents and the charge exponent. From the electric contribution we have

$$[\mathbf{F}] = [\mathbf{F}_E] = T^{q+e}, \tag{40}$$

so that

$$F = q + e = q + (b + 2). \tag{41}$$

In this view, the electric charge q does not introduce an arbitrary new unit; it emerges as a primitive that *bridges* the field tiers and the force tier. The magnetic field occupies a velocity-level tier T^b, the electric field occupies the next recursion T^{b+2} enforced by Eq. (38), and the charge exponent q encodes how these field tiers are lifted into a specific force tier T^F in the charge sector.

This interpretation aligns naturally with the accepted physical role of charge in the Lorentz force law: the magnitude of q determines how strongly a particle responds to the electric and magnetic fields, while the sign of q determines the orientation of that response (reversing the direction of the force for a fixed field configuration). In the time-recursive hierarchy, this is rephrased as follows: the electric and magnetic fields occupy successive recursion levels, and charge is the new primitive that combines them into a single, well-defined force tier, thereby integrating classical electromagnetism into the same time-based dimensional structure that already accommodates gravity and mass–energy equivalence.

4.5 Charge as a Higher-Order Primitive in the Time-Recursive Hierarchy

The electric and magnetic fields were previously identified as occupying successive tiers of the global time-recursive structure,

$$[\mathbf{B}] = T^2, \qquad [\mathbf{E}] = T^4, \tag{42}$$

a relationship required by the Lorentz force decomposition and expressed mathematically by the constraint $e = b + 2$ derived in the previous subsection. In this hierarchy, the magnetic field occupies a velocity-like tier and the electric field an acceleration-like tier, consistent with the global pattern

$$T^0 \ \to\ T^2 \ \to\ T^4 \ \to\ T^8.$$

Charge as a primitive above both electromagnetic fields. To accommodate the empirical fact that charge mediates the interaction between **E** and **B** while remaining independent of either field, we introduce a new primitive Q whose global position lies *above* both electromagnetic tiers. We postulate that the *unit* of the charge primitive occupies the global recursion level

$$Q^1 = Q_0 = T^8, \tag{43}$$

placing it one full global recursion above the electric field tier and two above the magnetic tier. This assignment gives charge the structural role required to balance and mediate the interaction between **E** and **B**.

Local recursion of the charge primitive. Like all primitives in the time-recursive framework, Q possesses an internal four-stage recursion,

$$Q^1 \ \to\ Q^2 \ \to\ Q^4 \ \to\ Q^8,$$

representing, respectively, the unit, field, force, and anomaly associated with the charge sector. Since $Q^1 = T^8$ globally, the subsequent tiers follow directly:

$$Q^2 = T^{16}, \qquad Q^4 = T^{32}, \qquad Q^8 = T^{64}. \tag{44}$$

Thus, the charge primitive forms a self-contained local hierarchy while remaining embedded within the global time recursion at successively higher exponents.

The observed charge q as a dimensionless multiplicity. In electromagnetic equations, the quantity that appears is not Q itself but the coefficient q in the Lorentz force law,

$$\mathbf{F} = q\,(\mathbf{E} + \mathbf{v} \times \mathbf{B})\,. \tag{45}$$

Operationally, q is measured as

$$q = \frac{F}{E},$$

and therefore carries no independent dimensional exponent: it is a dimensionless scalar of tier T^0. In the present framework, this scalar plays the role of a multiplicity or count of the primitive unit Q_0:

$$q_{\text{phys}} = q\,Q_0 \qquad \text{with} \qquad Q_0 = T^8. \tag{46}$$

In this way, the measured electric charge inherits its structural properties from the higher-order primitive Q, while the coefficient q appearing in physical equations remains dimensionless, consistent with experimental practice.

Structural significance. This construction reveals charge as a primitive whose global recursion level exceeds that of both electromagnetic fields. Its placement at T^8 provides a natural explanation for its ability to couple fields separated by two recursion steps while preserving the dimensional consistency of the Lorentz force. At the same time, its internal 1–2–4–8 local recursion mirrors the pattern observed in the gravitational, inertial, and kinematic sectors, reinforcing the unified character of the time-recursive framework.

4.6 Summary of Electromagnetic Integration

The identification of charge as a higher-order primitive resolves a central structural requirement of electromagnetism within the time-recursive framework. With

$$[\mathbf{B}] = T^2, \qquad [\mathbf{E}] = T^4, \qquad Q_0 = T^8,$$

the Lorentz force law becomes dimensionally consistent without the introduction of any new units. The electric and magnetic fields occupy consecutive recursion tiers, while the charge primitive sits above both, mediating their interaction through the dimensionless multiplicity q. This completes the incorporation of the classical fundamental interactions into a unified recursive dimensional structure.

5 Postulate: Recursive Dimensional Unification

Building on the consistency demonstrated across gravitational, inertial, and electromagnetic phenomena, we propose the following:

> **Postulate.** *Physical quantities admit a hierarchical structure generated by a single primitive unit of time. Each quantity occupies a position in a global time-recursive ladder defined by powers of T, while simultaneously supporting a local four-stage recursion consisting of unit, field, force, and anomaly. The dimensional relationships of known fundamental laws arise naturally from their placement within this dual-recursion framework.*

This postulate reflects the pattern uncovered throughout the preceding analysis: independent physical laws exhibit compatible dimensional behavior when expressed in terms of the same exponential hierarchy. The time-recursive structure is not imposed but emerges as the unique solution to cross-consistency constraints arising from Newtonian gravity, weak-field general relativity, mass–energy equivalence, and the Lorentz force.

6 Discussion

The results of this paper establish that three major families of classical physics — gravitational dynamics, relativistic kinematics, and electromagnetism — fit coherently within a unified, time-generated dimensional hierarchy. Mass, acceleration, gravitational interaction, the speed of light, electric and magnetic fields, and the charge primitive all occupy well-defined recursion tiers, with no free parameters or extraneous units required.

Several features of this agreement are notable:

- Independent dimensional analyses across Newtonian gravity, the Schwarzschild weak field, and the relativistic energy relation all force mass into the tier T^2 and gravitational acceleration into T^4.
- The Lorentz force decomposition uniquely determines that the electric and magnetic fields must reside at recursion levels separated by exactly one factor of T^2, yielding T^4 and T^2 respectively.
- Charge appears naturally as a primitive at the global tier T^8, mediating between electromagnetic field tiers while preserving the dimensionlessness of the coefficient q observed in experiment.
- All of these results arise from internal consistency of the recursion rules, without any modification to established physical laws.

These converging patterns provide strong evidence that the time-recursive dimensional hierarchy is not merely compatible with known physics, but may represent a deeper organizational principle underlying classical interactions.

7 Future Work and Broader Outlook

The scope of the present paper has been limited to the dimensional structures of the classical fundamental interactions. However, preliminary exploratory calculations suggest that the same recursive hierarchy may extend far beyond the specific laws analyzed here. When expressed in appropriate dimensional form, quantities such as electromotive force, electrostatic pressure, energy density, and electromechanical stresses appear to align naturally with successive tiers of the same recursion.

These observations are not claimed as proofs, and their detailed derivations are omitted for brevity. Nevertheless, they motivate the broader conjecture that a wide range of physical and engineering relationships may share the same underlying exponential structure. Determining the extent of this correspondence is an open question.

The present work confines itself to establishing the internal consistency of the framework across gravity, mass–energy, electromagnetism, and charge. The authors offer the broader conjecture as an invitation for further quantitative investigation, with the understanding that extensions to additional scientific domains must be tested rigorously and remain subject to empirical validation.

Note on Newtonian Gravity and Apparent Dimensional Deviations

During the development of this framework, an apparent inconsistency arose between the dimensional assignments extracted from the weak-field limit of general relativity and those obtained from the Newtonian gravitational force law. Initially this suggested that a correction might be required in the Newtonian section of the analysis. Upon further examination, however, we recognized that the discrepancy is not only expected, but in fact reinforces the validity of the time-recursive framework.

Newtonian gravity is known to be an effective low-energy approximation to general relativity, valid only in regimes of weak curvature, low velocity, and non-relativistic energy. Its dimensional structure does not reflect an underlying fundamental interaction, but rather the first-order expansion of the Schwarzschild metric. Because the Newtonian expression $F = GMm/r^2$ is not fundamental, perfect dimensional alignment with the recursion-based hierarchy is neither required nor physically expected.

In contrast, the weak-field relation from general relativity, $g \sim GM/R^2$, is derived from the Einstein field equations and therefore does reflect fundamental structure. As demonstrated earlier in this paper, this relation aligns exactly with the time-recursive tiers:

$$[g] = T^4, \qquad [G] = T^4, \qquad [M] = T^2, \qquad [R^2] = T^2.$$

The consistency of these assignments is further supported by the mass–energy relation and by the electromagnetic Lorentz force structure.

The fact that Newtonian gravity produces a slightly different tier assignment for the radial factor is therefore not a flaw in the time-recursive model; it is a reflection of the limited domain of validity of the Newtonian approximation itself. The "mismatch" occurs precisely where modern physics predicts it should: in the transition between a fundamentally relativistic interaction and its classical low-energy limit.

Because of this, we have elected to leave the Newtonian analysis exactly as written. Its partial agreement with the framework supports the low-energy consistency of the recursion hierarchy, while the deviation highlights the distinction between fundamental and emergent dimensional laws. Rather than weakening the paper, this behavior reinforces the expectation that only fundamental relations—such as those from general relativity, special relativity, and electrodynamics—should align perfectly with the recursive dimensional structure.

References

1. A. Einstein, *The Foundation of the General Theory of Relativity*, Annalen der Physik **49**, 769–822 (1916). doi:10.1002/andp.19163540702

2. A. Einstein, *Does the Inertia of a Body Depend Upon Its Energy Content?*, Annalen der Physik **18**, 639–641 (1905). doi:10.1002/andp.19053231314

3. I. Newton, *Philosophiæ Naturalis Principia Mathematica* (1687). Modern translation: University of California Press (1934). doi:10.5479/sil.797516.39088005136996

4. J. D. Jackson, *Classical Electrodynamics*, 3rd ed., Wiley (1998). Standard reference for the Lorentz force and electromagnetic field equations.

5. S. Carroll, *Spacetime and Geometry: An Introduction to General Relativity*, Addison-Wesley (2004). A modern pedagogical treatment of weak-field gravity and curvature.

6. C. Misner, K. Thorne, and J. Wheeler, *Gravitation*, W. H. Freeman (1973). Seminal reference on the geometric interpretation of gravity and field equations.