



A Unified Mathematical Framework for the Fundamental Mechanism of Space-Time, Mass, Gravity, and Quantum Phenomena Derived from the Universal Law



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Abstract: This work has discovered the reasons behind the workings of our universe by identifying the missing link that our great scientists recognised and are still seeking. The work does not dismiss the work done until now to progress physics and cosmology to a level where modern day technology has been developed however, this work does ascertain that there is a deeper reason for matter to behave the way it does in our observable universe; motion of matter, gravitational forces, quantum behaviour, Dark matter, Dark Energy all have a single reason behind them which causes them to behave in a certain way which has become difficult for current human understanding to explain. This work is the child of multiple thought experiments that led to the discovery of a universal law that all matter, or groups of matter, follow. When this universal law was applied to every state of matter or group of matter, the mathematics behind the workings of the universe emerged naturally and logically. This research was conducted to elevate current human understanding of the workings of the universe and to provide reasons for many unexplained phenomena in our cosmos, like wave-particle duality, dark energy, dark matter, black holes, etc. [8]. The universal law, when represented in mathematical form and derived from current understanding of gravitational force, kinetic energy, rest mass energy, etc., explicitly gives rise to a larger scale mathematical representation which matches the observations made by humans, but couldn't explain them and had to develop new theoretical frameworks to be able to explain those observations [9]. The Universal law, however, links the classical gravity to higher-order forces present in our cosmos without needing a reason for bringing in unexplained dark matter/dark energy phenomena [2]. And accurately provides explanations and reasoning behind black holes and quantum behavior.

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I. INTRODUCTION

The basis of the mathematical formulation is three interpretations derived from the observation of the behaviour of matter in the cosmos; these three interpretations are logically linked to discover the universal law.

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These three observations in the cosmos are as follows:

- A. The space-time fabric tends to maintain its one 3-dimensional free form and constantly attempts to do that when any matter or system of matter interrupts it by virtue of its motion within this fabric.
- B. The motion of bodies in our cosmos has broken down the ultimate space-time fabric into childlike systems, which we define as universal systems, secondary/galactic systems, tertiary /stellar systems, planetary systems, quantum systems and man-made systems. All these systems have their own space-time fabric and matter; the space-time fabric they hold is a direct entrapment of their parents' space-time fabric, and hence parent-child systems are observed in the cosmos.
- C. No matter or group of matter is stationary in the cosmos unless it is bound to another larger body, which in turn is in motion through the space-time fabric of its parent system.

II. UNIVERSAL LAW OF MOTION

Every matter or a group of matter continues in a state of uniform motion in a straight line with an ultimate velocity unless an external unbalanced force acts upon it.

III. MATHEMATICAL INTERPRETATIONS OF THE UNIVERSAL LAW

The universal law framework is an extension of known theories to explain the workings of the universe, not a contradiction of known observations. It provides reasons and eliminates the need for dark matter and dark energy entities, which physicists have fixed to match the observed data. We will derive and prove here that the universe law framework is the only reason for the behaviour of our universe, the way it is observed and beyond.

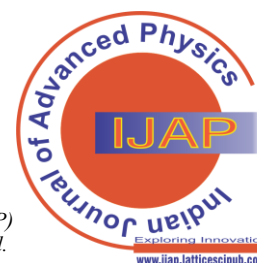
A. Energy Interpretation of the Universal Law

$$E_{total} = E_k + E_s \quad (1)$$

Were,

- a. E_k = realised kinetic energy
- b. E_s = stored energy due to constrained motion
- c. E_{total} = total intrinsic energy of the universal system

For universal systems, kinetic energy



$$\frac{1}{2}mv_*^2 = \frac{1}{2}mv^2 + \frac{1}{2}m(\Delta v)^2 \quad (2)$$

Cancelling the constants,

$$v_*^2 = v^2 + (\Delta v)^2 \quad (3)$$

From equation 2, we get

$$E_k = \frac{1}{2}mv^2 \quad (4)$$

$$E_s = \frac{1}{2}m(v_*^2 - v^2) \quad (5)$$

Substituting in equation 1

$$E_{total} = \frac{1}{2}mv^2 + \frac{1}{2}m(v_*^2 - v^2) \quad (6)$$

Solving,

$$E_{total} = \frac{1}{2}mv_*^2 \quad (7)$$

Were,

- a. v_* = intrinsic ultimate velocity of the universe
- b. v = observable (realised) velocity
- c. Δv = constrained or unfulfilled component of velocity
- d. m = mass of the universe

B. Ultimate Velocity Scale

The rest energy of any system is given by:

$$E = mc^2 \quad (8)$$

In the universal law framework this observed rest energy is same as the stored energy within any system, this energy is the mass that starts building inside any system due to constraint motion, It's a form of stored energy, all systems are in pursuit of ultimate velocity however the space-time fabric of their parent system constraint this motion and thus with this constraint the excess energy is stored as matter.

Consider the least constrained system in our universe, the photon:

$$E_s = mc^2 \quad (9)$$

Equate both equations 5 and 9:

$$\frac{1}{2}m(v_*^2 - v^2) = mc^2 \quad (10)$$

Cancel constant m and substitute the value of realised velocity v as c

$$\frac{1}{2}(v_*^2 - v^2) = c^2 \quad (11)$$

$$v_* = \sqrt{3}c \quad (12)$$

Were,

- a. c = speed of light in vacuum.

Universal system is in equilibrium and has maximum possible velocity so it doesn't have any constrained energy, as it has reached to a maximum possible velocity in ultimate space-time fabric and attained equilibrium, however the space-time fabric of the universal system does produce excessive constraints on systems inside of the universal system, which in turn produce matter to store the energy of the constrained motion.

C. Mass & Energy in Hierarchical Systems

From the law of conservation of energy, the total intrinsic energy of a parent system is equal to the sum of the total intrinsic energies of all its constituent child systems:

$$E_{total}^{(P)} = \sum_{i=1}^n E_{total}^{(Ci)} \quad (13)$$

Each child system comprises realised kinetic energy and stored energy arising from constrained motion. Thus, Equation (14) may be expressed as:

$$E_{total}^{(P)} = \sum_{i=1}^n (E_k^{(Ci)} + E_s^{(Ci)}) \quad (14)$$

Using the fundamental relations:

$$E_k^{(Ci)} = \frac{1}{2}m_i v_i^2 \quad (15)$$

$$E_s^{(Ci)} = \frac{1}{2}m_i(v_p^2 - v_i^2) \quad (16)$$

Substituting 16 and 17 into Equation 15:

$$E_{total}^{(P)} = \sum_{i=1}^n \left[\frac{1}{2}m_i v_i^2 + \frac{1}{2}m_i(v_p^2 - v_i^2) \right] \quad (17)$$

Simplifying:

$$E_{total}^{(P)} = \sum_{i=1}^n \frac{1}{2}m_i v_p^2 \quad (18)$$

$$E_{total}^{(P)} = \frac{1}{2}v_p^2 \sum_{i=1}^n m_i \quad (19)$$

For the parent system, using the same fundamental relation:

$$E_{total}^{(P)} = \frac{1}{2}M_P v_p^2 \quad (20)$$

Equating Equations (19) and (20):

$$\frac{1}{2}M_P v_p^2 = \frac{1}{2}v_p^2 \sum_{i=1}^n m_i \quad (21)$$

Cancelling the constant factor:

$$M_P = \sum_{i=1}^n m_i \quad (22)$$

Each subsystem possesses realised kinetic energy:

$$E_k^{(Ci)} = \frac{1}{2}m_i v_i^2 \quad (23)$$

Summing over all subsystems:

$$\sum_{i=1}^n E_k^{(Ci)} = \frac{1}{2} \sum_{i=1}^n m_i v_i^2 \quad (24)$$

For the parent system, treated as a single effective entity:

$$E_k^{(P)} = \frac{1}{2}M_P v_p^2 \quad (25)$$

To ensure consistency between subsystem and parent-level descriptions, the total realised kinetic energy must be preserved:

$$E_k^{(P)} = \sum_{i=1}^n E_k^{(Ci)} \quad (26)$$

Substituting Equations 24 and 25 in Equation 26:



$$\frac{1}{2} M_P v_P^2 = \frac{1}{2} \sum_{i=1}^n m_i v_i^2 \quad (27)$$

Cancelling the common factor:

$$M_P v_P^2 = \sum_{i=1}^n m_i v_i^2 \quad (28)$$

The limiting behaviour follows directly from the constraint relation:

$$v \rightarrow v_* \Rightarrow E_s \rightarrow 0, m \rightarrow 0 \quad (29)$$

Thus, in the limit of zero realised velocity:

$$E_k \rightarrow 0, E_s \rightarrow E_{total}, m \rightarrow \text{maximum} \quad (30)$$

Were,

- $E_{total}^{(P)}$ = total intrinsic energy of a parent system
- E_k = realised kinetic energy
- E_s = stored energy due to constraint
- m = mass of the system
- M_P = total mass of the parent system
- v_* = ultimate velocity of the primary system
- v_i = realised velocity of the i-th subsystem
- v_P = effective realised velocity of the parent system
- n = the number of subsystems
- P = parent system
- C_i = i-th child system

This denotes that any system distributes the energy within its child systems, and the total energy of the parent system and all the child systems is conserved and is dependent on the total kinetic energy of the parent system, which means it depends on the velocity the parent system could achieve in its parent system's space-time fabric.

D. Forces in Systems of Matter

The universal law framework predicts that mass is a consequence of the space-time fabric to maintain its free form and is the stored energy of any system to achieve the ultimate velocity.

In this framework, the space-time fabric of the local system, the propagation of force, the parent system motion, and the location of matter in the hierarchy of systems all affect the forces exerted on the mass of the matter.

The Universal law framework does not negate or contradict the research carried out so far; however, it extends it and provides the reasons for the workings of the universe.

We now attempt to derive the generalised gravitational force equation, which should be valid for all matter seen and unseen by humans and should satisfy all observational data.

E. Basis of Force Generation

Force arises from the spatial variation of stored constraint:

$$F \propto -\nabla E_s \quad (33)$$

Substituting from equation 16:

$$F \propto -\nabla \left[\frac{1}{2} m (V_p^2 - V^2) \right] \quad (34)$$

Since V_p is constant within a given hierarchy:

$$F \propto m \nabla (V^2) \quad (35)$$

Were,

- a. E_s = Stored constraint energy
- b. V = Realised velocity

- c. V_p = Parent system velocity
- d. F = Resultant force

i. Interpretations:

- Force is generated due to the spatial variation of realised velocity within a constrained system.
- Parent velocity defines the energy ceiling, but gradients arise from realised motion

F. Spatial Structure of Velocity Field

The Universal law framework establishes that spherical symmetry, a finite energy distribution, and continuity across the spatial domain govern the physical constraints on the velocity distribution.

Thus, the equations below naturally emerge from an understanding of the universal law and from maintaining physical consistency.

$$V^2(r) \propto \frac{1}{r} \quad (36)$$

$$V^2(r) \propto \text{constant} \quad (37)$$

$$V^2(r) \propto r^2 \quad (38)$$

i. Interpretation:

- a. $\frac{1}{r}$ = Localised influence of matter
- b. Constant = Uniform constraint from parent system
- c. r^2 = Large-scale amplification of constraint

These represent all possible equilibrium distributions under hierarchical constraint.

Combining all admissible contributions:

$$V^2 = \left(\frac{A}{r} + B \right) \left(1 + \left(\frac{r}{L} \right)^2 \right) \quad (39)$$

Identifying the physical parameters from equation 39

Local contribution:

$$A \propto kM(r) \quad (40)$$

Hierarchical contribution:

$$B \propto \frac{V_p^2}{1 + \beta} \quad (41)$$

ii. General Velocity Equation:

$$V^2 = \left(\frac{kM(r)}{r} + \frac{V_p^2}{1 + \beta} \right) \left(1 + \left(\frac{r}{L} \right)^2 \right) \quad (42)$$

Were,

- a. k = proportionality constant
- b. $M(r)$ = enclosed mass
- c. β = hierarchy-dependent suppression factor
- d. L = characteristic system scale

iii. Interpretation

- First Term: Local constraint induced by mass distribution
- Second Term: Parent system velocity constraint
- Third Factor: Scale-dependent transition across hierarchy

G. Derivation of Force Expression

The matter or system of matter is observed to be in three states: either bound to the parent matter and no motion is achieved, or in a stable orbit, or the last condition is escape, where it is no longer part of that system, hence considering the equilibrium motion.

$$F = m \frac{V^2}{r} \quad (43)$$

Substituting in equation 42:

$$F = m \left(\frac{1}{r} \right) \left(\frac{kM(r)}{r} + \frac{V_p^2}{1+\beta} \right) \left(1 + \left(\frac{r}{L} \right)^2 \right) \quad (44)$$

$$F = m \left[\frac{kM(r)}{r^2} + \frac{V_p^2}{(1+\beta)r} \right] \left(1 + \left(\frac{r}{L} \right)^2 \right) \quad (45)$$

i. Interpretation

- Force arises purely from velocity structure under constraint.
- No independent assumption of the gravitational law is required.
- Constraint distortion is missing and needs to be considered.

H. Constraint Distortion

Distortion of the constraint field is defined as the imbalance caused by motion in equilibrium, due to opposing forces between limiting motion and internal drive to achieve ultimate velocity.

This distortion potential also affects the total force exerted on any matter in any system.

Define Charge:

q

\equiv measure of constraint distortion due to motion imbalance 46

The distortion potential is given by:

$$\Phi_q \propto \frac{q}{r} \quad (47)$$

The interaction force is given by:

$$F_E \propto q_1 \nabla \Phi_2 \quad (48)$$

$$F_E \propto \frac{q_1 q_2}{r^2} \quad (49)$$

I. Hence, The Unified Force Expression Becomes

$$F = m \left[\frac{kM(r)}{r^2} + \frac{k_e q_1 q_2}{mr^2} + \frac{V_p^2}{(1+\beta)r} \right] \left(1 + \left(\frac{r}{L} \right)^2 \right) \quad (50)$$

Were,

- a. q_1, q_2 = charges
- b. k_e = electromagnetic constant

i. Interpretation:

- Constraint distortion introduces non-mass interaction
- The same framework naturally extends to electromagnetic behaviour

Were,

- a. q_1, q_2 = charges
- b. k_e = electromagnetic constant

J. Behaviour Across Systems

i. Planetary Systems (Local Constraint Dominance)

Condition:

$$\frac{kM(r)}{r} \gg \frac{V_p^2}{1+\beta}, r \ll L$$

From Equation 42:

$$V^2 \approx \frac{kM(r)}{r} \quad (51)$$

Substitute into equation 43:

$$F = \frac{kM(r)m}{r^2} \quad (52)$$

ii. Interpretation:

- Motion governed entirely by local constraint field
- Classical inverse-square law emerges naturally

iii. Atomic Systems (Constraint Distortion Dominance)

Condition:

$$q \neq 0, \text{ high constraint distortion}$$

From equation 50:

$$F \approx \frac{k_e q_1 q_2}{r^2} \quad (53)$$

iv. Interpretation

- Motion governed by the distortion of the constraint field
- Electromagnetic interaction emerges as a dominant effect

v. Galactic Systems (Hierarchical Constraint Dominance)

Condition:

$$\frac{V_p^2}{1+\beta} \gg \frac{kM(r)}{r}, r \ll L$$

From Equation 42:

$$V^2 \approx \frac{V_p^2}{1+\beta} \quad (54)$$

vi. Interpretation:

- Velocity becomes independent of radius
- Produces flat rotation curves observed in galaxies

vii. Cosmological Scale (Scale-Amplified Constraint)

Condition:

$$r \gg L$$

From equation 42:

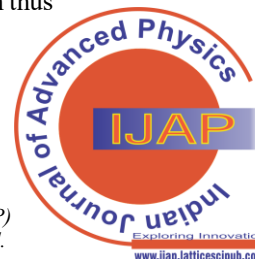
$$V^2 \approx \left(\frac{V_p^2}{1+\beta} \right) \left(\frac{r^2}{L^2} \right) \quad (55)$$

$$V \propto r \quad (56)$$

viii. Interpretation:

- Velocity increases linearly with distance
- Arises from scale amplification of the constraint field
- Corresponds to observed large-scale expansion behaviour

The generalised force equation thus establishes that:





- All forces are manifestations of constraint imbalance within any system.
- Differences in observed laws arise from the dominant contributing term for that system.
- System behaviour is completely determined by the spatial scale, hierarchy and degree of constraint distortion.

Hence, the final inference of this research is that the universal law provides reasons for the working of the universe without contradicting any known laws.

IV. VALIDATION ACROSS OBSERVED PHYSICAL REGIMES

This section summarises the consistency of the proposed framework with established physical observations by referencing previously derived relations. Each known law emerges as a limiting case of the generalised velocity and force expressions derived earlier.

Modern observational data, including gravitational wave detections, have confirmed the validity of gravitational behaviour across multiple regimes [6].

A. Classical Gravitational Behaviour

From equations 51 and 52 in the regime where the local constraint term dominates, the velocity reduces to inverse square gravitational behaviour.

i. Validation

- Recovers inverse-square gravitational behaviour.
- Consistent with Keplerian orbital dynamics [2].

The generalised Force equation naturally reduces to the known observed effects within our solar system.

B. Galactic Rotation Curves

From equation 54, when the hierarchical constraint term dominates:

$$V^2 \sim \frac{V_p^2}{1 + \beta} \quad (54)$$

i. Validation

- Predicts velocity independent of radius.
- Consistent with flat rotation curves [4].

The Milky Way galaxy's flat rotation curve is recovered, with minor adjustments to the shapes and geometry of the systems that need to be accounted for to achieve a precise match with the observations.

C. Cosmological Expansion

From equations 55 and 56, under large-scale amplification:

i. Validation

- Directly reproduces Hubble's law [1].
- No additional expansion term required.

Cosmic Expansion occurs due to the scale amplification of galactic systems as they attempt to achieve ultimate velocity. The condition for this is that the secondary systems should not be in equilibrium and locked in orbit around the universal gravitational parent in the centre of the universe. Cosmic Expansion is observationally consistent; however, its precise interpretation remains debated [7].

D. Gravitational Lensing (Photon Behaviour)

i. Framework Application

For photons: Velocity remains constant:

$$V = C$$

Interaction arises through local constraint equation 45, with effective inertia determined by energy:

$$m_{\text{eff}} = \frac{E}{C^2}$$

Thus, the governing force is:

$$F = m_{\text{eff}} \frac{kM}{r^2} \quad (57)$$

ii. Curvature of Trajectory

The force does not alter the magnitude of velocity but changes its direction. The curvature radius R satisfies:

$$\frac{C^2}{R} = \frac{kM}{r^2} \quad (58)$$

iii. Deflection Estimate

Integrating the curvature along the photon path gives:

$$\theta \propto \frac{kM}{C^2 b} \quad (59)$$

where b is the impact parameter.

iv. Constraint Dual Contribution

Within the present framework, the constraint field influences:

- Spatial trajectory (geometric curvature)
- Propagation structure of motion (effective path evolution)

These two contributions act simultaneously, effectively doubling the influence of curvature. Consequently:

$$\theta = \frac{4GM}{C^2 b} \quad (60)$$

v. Validation

- Matches observed light deflection near massive bodies [5].
- Consistent with measured solar lensing values

vi. Interpretation

Gravitational lensing arises from the combined effect of the velocity of the photon near ultimate velocity and the effects of the local system in which it is present, so in universal law terms, the constraints produced by local space-time fabric and the photon's tendency to shed all mass and achieve ultimate velocity give rise to the effect of curvature seen during gravitational lensing.

E. Atomic and Quantum Scaling

From the equilibrium condition equation 58:

$$\frac{kM}{r} \sim \frac{V_u^2}{1 + \beta} \quad (61)$$

Stable configurations exist only for discrete perturbations around this equilibrium, giving:

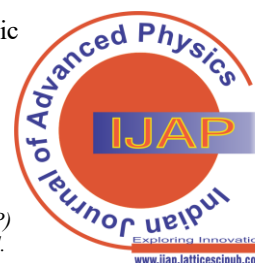
$$r_n \propto n^2, V_n \propto \frac{1}{n}, E_n \propto -\frac{1}{n^2} \quad (58, 59, 60)$$

i. Interpretation:

Quantisation arises from discrete stability conditions of the constraint field. Only specific ratios between local and hierarchical constraints produce stable orbits.

ii. Validation:

Matches observed atomic structure, including Bohr radius scaling, electron velocities, and energy levels.



F. Wave Particle Duality

The universal law framework further explains wave-particle duality as follows:

From the fundamental energy equation 4,

$$E_k = \frac{1}{2}mv^2 \quad (4)$$

The momentum of the system is:

$$p = mv \quad (62)$$

From experimentally established quantum behaviour, the wavelength associated with a moving system is given by [10]:

$$\lambda = \frac{h}{p} \quad (63)$$

Substituting equation 62 into equation 63:

$$\lambda = \frac{h}{mv} \quad (64)$$

From equation 4, the realised velocity can be expressed as:

$$v = \sqrt{\frac{2E_r}{m}} \quad (65)$$

Substituting equation (65) into equation (64):

$$\lambda = \frac{h}{m\sqrt{\frac{2E_r}{m}}} \quad (66)$$

Simplifying:

$$\lambda = \frac{h}{\sqrt{2mE_r}} \quad (67)$$

Were,

- a. E_r = Realised kinetic energy
- b. m = Mass of the system
- c. v = Realised velocity
- d. p = Momentum of the system
- e. λ = Wavelength associated with the system
- f. h = Planck's constant

i. *Interpretation:*

- Wavelength is inversely proportional to $\sqrt{mE_r}$
- Higher realised energy \rightarrow smaller wavelength \rightarrow particle-like behaviour.
- Lower realised energy \rightarrow larger wavelength \rightarrow wave-like behaviour.
- Small mass systems \rightarrow significant wavelength \rightarrow observable quantum effects.
- Large mass systems \rightarrow negligible wavelength \rightarrow classical particle behaviour.
- Wave-particle duality arises from energy distribution between realised motion and constraint.
- Charge modifies constraint distribution but does not create duality.
- Duality represents regime transition, not a contradiction.

G. Entangled Systems

From the previously established framework, the total intrinsic energy of a system is governed by the hierarchical constraint relation:

$$E = E_r + E_c \quad (68)$$

For two subsystems A and B originating from a common parent system, the total intrinsic energy is conserved:

$$E_{AB} = E_A + E_B = \text{constant} \quad (69)$$

From the constraint relation, the constrained energy of each subsystem is dependent on the shared parent constraint field:

$$E_c^A = E_c^B = f(C_p) \quad (70)$$

The realised energies satisfy:

$$E_r^A + E_r^B = \text{constant} \quad (71)$$

A perturbation in one subsystem leads to a corresponding redistribution [10]:

$$\Delta E_r^A = -\Delta E_r^B \quad (72)$$

Were,

- a. E = Total intrinsic energy
- b. E_r = Realised energy
- c. E_c = Constrained energy
- d. E_A, E_B = Intrinsic energies of subsystems A and B
- e. C_p = Constraint field of the parent system
- f. ΔE_r = Change in realised energy

i. *Interpretation*

- Entangled systems share a common parent constraint field.
- Entanglement represents constraint-level coupling across subsystems.
- Constrained energy is not localised but distributed across subsystems.
- A change in one subsystem leads to a correlated change in the other.
- Correlation arises from energy conservation within the shared system.
- No independent propagation between subsystems is required.
- Behaviour appears non-local due to shared constraint structure.
- Entanglement is a natural outcome of hierarchical energy coupling.
- Observed quantum correlations arise from constraint-linked systems.

H. Unified Validation Statement

Across all regimes, previously derived relations demonstrate that:

The universal law framework naturally explains all known phenomena without the need to introduce dark matter, dark energy, or other unknown phenomena in physics to match observations.

V. PREDICTIONS

A. β Hierarchical Influence Vs Local Constraint

From the general velocity relation (Eq. 42):

$$v^2 = \left(\frac{kM(r)}{r} + \frac{V_p^2}{1 + \beta} \right)$$

In the **galactic equilibrium regime**, the system stabilises when:





$$\frac{kM(r)}{r} \sim \frac{V_p^2}{1+\beta} \quad (73)$$

i. Rearranging

$$1+\beta \sim \frac{V_p^2 r}{kM(r)} \quad (74)$$

$$\beta \sim \frac{V_p^2 r}{kM(r)} - 1 \quad (75)$$

Where:

- V_p = parent system velocity (for galaxies $\rightarrow V_u = \sqrt{3}C$)
- $M(r)$ = enclosed galactic mass
- r = characteristic galactic radius

ii. Interpretation:

- β represents how strongly the parent (universal) constraint is suppressed by local mass distribution
- It is a dimensionless ratio of hierarchical influence vs local constraint

iii. Replace k with G (local consistency)

$$\beta \sim \frac{V_p^2 r}{GM(r)} \quad (76)$$

Where:

- V_p : parent system velocity (for galaxies $\rightarrow V_* = \sqrt{3}C$)
- $M(r)$: enclosed galactic mass
- r : characteristic galactic radius

iv. Physical Interpretation

$$\beta \sim \frac{\text{hierarchical energy scale}}{\text{local binding energy}}$$

β for Milky Way

Input Data

- $V_p = V_u = \sqrt{3}C \approx 5.2 \times 10^5$ km/s
- $M \approx 6 \times 10^{11} M_\odot$
- $r \approx 15$ kpc $\approx 4.6 \times 10^{20}$ m
- $G = 6.67 \times 10^{-11}$

Compute

Convert:

- $M \approx 1.2 \times 10^{42}$ kg
- $V_p^2 \approx 2.7 \times 10^{11} \text{ (km/s)}^2 = 2.7 \times 10^{17} \text{ (m/s)}^2$

$$\beta \sim \frac{(2.7 \times 10^{17})(4.6 \times 10^{20})}{(6.67 \times 10^{-11})(1.2 \times 10^{42})}$$

$$\beta \sim \frac{1.24 \times 10^{38}}{8.0 \times 10^{31}}$$

$$\beta \sim 1.5 \times 10^6$$

v. Result

$$\beta_{\text{Milky Way}} \sim 10^6 \quad (77)$$

Exact value of $\beta_{\text{Milky Way}}$ can be calculated by factoring the flat galaxy geometry.

B. Prediction 1: Scaling Of β Across Galaxies

From equation (65):

$$\beta \sim \frac{V_u^2 R}{GM}$$

i. Prediction:

- Smaller galaxies \rightarrow higher $\beta \rightarrow$ lower rotation velocity
- Larger galaxies \rightarrow lower $\beta \rightarrow$ higher rotation velocity

ii. Testable Outcome:

$$V^2 \sim \frac{V_u^2}{1+\beta} \quad (78)$$

Leads to:

$$V^4 \propto M \quad (79)$$

iii. Interpretation

This directly predicts the **Tully–Fisher relation** without dark matter [4].

C. Prediction 2: Nature of Black Holes

i. Framework Interpretation

Black holes are not singularities but Regions where local constraints fail to contain hierarchical motion, causing a rupture (tear) in the space-time fabric. They are defects in the space-time fabric where matter or systems of matter are left behind, and the parent system proceeds in its motion.

ii. Condition for Formation

From equation 62:

$$\frac{kM}{r} \rightarrow V_p^2 \quad (80)$$

iii. Prediction:

- At critical density:
 - local constraint = hierarchical constraint
- Beyond this:
 - The system cannot sustain a bounded structure
 - matter transitions into a higher hierarchy
- Black holes are ruptures in the space-time fabric, and it is predicted that every galaxy has a central black hole, which acts as a central parent that propagates the constrained field within the system's boundary.
- Similarly, it is predicted that the universal system also has a central black hole

D. Prediction 3: Maximum Velocity Limit

$$V \leq C$$

i. Explanation

- The universe moves at $V_* = \sqrt{3}C$
- Local systems constrained \rightarrow cannot exceed C
- The stored energy should reduce to zero for the true ultimate velocity to be achieved.

ii. Prediction

- No particle inside the universe exceeds the speed of light
- Speed limit emerges from hierarchical constraint, not the relativity postulate

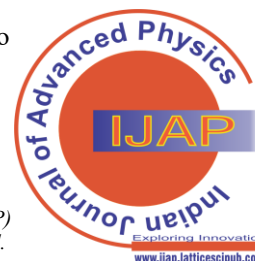
E. Prediction 4: Origin of Dark Energy

From equation 42:

$$V \propto r$$

i. Prediction

- Expansion is not due to external energy



- It is due to the scale amplification of the constraint field
- ii. *Observable Implication*
 - Hubble constant should depend on:

$$H_0 \sim \frac{v_*}{\sqrt{\beta}L} \quad (81)$$

F. Prediction 5: Quantum Stability Condition

From equation 62:

$$\frac{kM}{r} \sim \frac{V_*^2}{1 + \beta}$$

- i. *Prediction*
 - Stable atomic structures exist only at discrete radii
 - Ionisation occurs when constraint imbalance exceeds threshold

G. Prediction 6: Transition Between Regimes

- i. *Prediction*

Systems shift behaviour when:

$$\frac{kM}{r} \sim \frac{V_p^2}{1 + \beta}$$

- ii. *Observable Effects*
 - Transition from:
 - a. Newtonian \rightarrow flat curve
 - b. Bound \rightarrow expanding

H. Prediction 7: Photon Behaviour in Strong Fields

- i. *Prediction*
 - Light bending increases sharply near constraint breakdown regions
 - Near black holes:
 - a. deviation exceeds GR predictions
- ii. *Final Position*

The framework predicts:

- Galaxy rotation without dark matter
- Expansion without dark energy
- Black holes as constraint failures
- Quantum stability as equilibrium states
- Universal speed limit from hierarchy

VI. CONCLUSION

The universal law framework is the only reason for all the unanswered phenomena in our cosmos and in the quantum world. This framework successfully unites quantum and cosmology, potentially explaining all unanswered questions in physics and putting an end to the long-standing quest for a unification theory.

This work forms the foundation of this unification theory. It can be developed into a full-fledged mechanism in physics, combining all observational data and deriving the logical reasons for the observations.

The observational data already confirm that most galaxies have a central black hole [3]. This understanding is most aligned with the universal law framework, as black holes provide a unification with the higher parent system and serve as ports through which the space-time fabric dissolves and becomes non-existent.

Not being from a scientific background and not having any formal training in writing articles for journals, I accept there

might be errors in understanding and in the development of derivations; however, my motive is to let the real physicist or professionals take the baton and complete this work in a way that it truly becomes the basis of human understanding.

DECLARATION STATEMENT

As the article's author, I must verify the accuracy of the following information after aggregating input from all authors.

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- **Author's Contributions:** The authorship of this article is contributed solely by the author.

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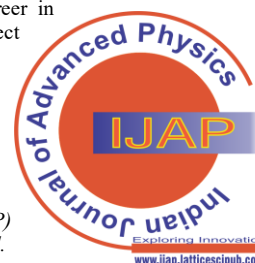
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