

Qubit-Structured Spacetime: A Structural Origin for Gravity, Dark Energy, and Cosmic Architecture

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Abstract

This paper presents a structural model of the universe in which the fundamental substrate is a network of qubit-sized patches forming a nonlocal entanglement domain (E-domain). Local spacetime (S-domain) emerges as a coarse-grained description of this structure. Matter in the S-domain is anchored to extended “mats” in the E-domain, and tension within these mats encodes both gravity and dark energy. A central result is that force arises from gradients of tension at the boundaries of these mats, replacing both Newtonian action-at-a-distance and Einsteinian curvature with a unified structural mechanism.

Using a qubit-based natural unit system, Newton’s gravitational constant G is derived from the structural scale of the qubit network. This derivation does not assume $G = 1$; instead, G emerges from the qubit patch size. When expressed in SI units, the result matches the measured value $G \approx 6.674 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$. Since G is derived from first principles, it is not fundamental, rather structure is fundamental.

This framework naturally explains galactic rotation curves without dark matter, interprets the cosmic microwave background (CMB) as the thermal imprint of qubit-patch freeze-out, and identifies the cosmic web as the large-scale geometry of mat boundaries. The Big Bang is reinterpreted as a rapid phase transition in which the qubit-patch network crystallized into its present configuration. The theory is guided by two principles: simplicity and elegance.

Keywords: Entanglement, Spacetime, Galactic duality, Galactic rotation curves, Dark energy, Galactic mat, Qubit patches, Big Bang, Gravity, Gravitational constant.

Note to Readers of a Future Era: In every era, people try to understand what holds the universe together. Some look for complexity; others look for simplicity. This work belongs to the second tradition. It proposes that gravity and cosmic acceleration may arise from one underlying physical property: tension frozen into the fabric of the universe during its earliest moments.

If you are reading this long after it was written, the mathematics may look old-fashioned, and the assumptions may have been replaced by better theories. But the spirit behind it — the belief that nature prefers simple, unified explanations — will still be familiar. Every generation adds a piece to the story of the universe. This was one attempt to add ours.

1. Introduction

This work builds on the two-domain model [1, 2, 3, 4, 5] with separation of relativistic effects and entanglement effects in a galaxy. A subsequent work [6] used the two-domain model and proposed a conceptual framework in which both the gravitational constant G and the phenomenon commonly referred to as dark energy arise from a single physical mechanism of extended mats — formed during an early-universe phase transition.

This paper now considers an alternate formulation, based on qubit patches. The universe is proposed to be fundamentally structural. The basic constituents are qubit patches forming a globally entangled network (the E-domain). Spacetime (the S-domain) emerges from the coarse-grained behavior of this structure.

Matter corresponds to localized distortions of extended mats within the E-domain. Gravity, dark energy, and cosmic structure arise from the tension patterns of these mats, especially at their boundaries. Results show, as in the earlier paper, that G is derived, not fundamental.

Two principles guide this framework:

- Simplicity: the universe operates through minimal structural rules.
- Elegance: diverse phenomena arise from a unified mechanism.

It is noted that physics has progressed through two paradigms: Newton's action at a distance [7], and Einstein's curvature of spacetime [8].

This paper could be considered a third paradigm based on tension in stretched qubit mats.

2. Qubit Patches as Fundamental Units and the Derivation of G

Let the E-domain consist of discrete qubit-sized patches. Each patch has a characteristic structural length scale ℓ_q , time scale t_q , and mass scale m_q . These are not defined from G ; they are properties of the qubit network itself.

In standard physics, the Planck scales are defined by:

$$\ell_P = \sqrt{\frac{\hbar G}{c^3}}, t_P = \sqrt{\frac{\hbar G}{c^5}}, m_P = \sqrt{\frac{\hbar c}{G}}.$$

In this framework, the structural qubit scales are identified with the physical Planck scales:

$$\ell_q = \ell_P, t_q = t_P, m_q = m_P.$$

2.1 Deriving G from the Structural Length Scale

Start from the Planck length definition:

$$\ell_P = \sqrt{\frac{\hbar G}{c^3}}.$$

Square both sides:

$$\ell_P^2 = \frac{\hbar G}{c^3}.$$

Solve for G :

$$G = \frac{\ell_P^2 c^3}{\hbar}.$$

Substitute $\ell_P = \ell_q$:

$$G = \frac{\ell_q^2 c^3}{\hbar}.$$

Thus, once the structural qubit length ℓ_q is specified, the value of G is fixed.

2.2 Equivalent Derivations from Mass and Time

From the Planck mass:

$$G = \frac{\hbar c}{m_P^2} = \frac{\hbar c}{m_q^2}.$$

From the Planck time:

$$G = \frac{t_P^2 c^5}{\hbar} = \frac{t_q^2 c^5}{\hbar}.$$

2.3 Structural Consistency Conditions

For all three expressions to match, the qubit scales must satisfy:

$$t_q = \frac{\ell_q}{c}, m_q = \frac{\hbar}{\ell_q c}.$$

These are exactly the Planck relations, now understood as structural identities.

2.4 SI Numerical Value of G

Using the physical Planck length:

$$\ell_p \approx 1.616 \times 10^{-35} \text{ m},$$

and substituting into

$$G = \frac{\ell_p^2 c^3}{\hbar},$$

we obtain the standard SI value:

$$G \approx 6.674 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}.$$

Thus, G is not fundamental; it is a derived structural parameter determined by the qubit patch size ℓ_q .

3. The E/S Domain Framework

3.1 E-Domain Fields

Each qubit patch carries:

- entanglement density ρ_E
- tension τ_E

3.2 S-Domain Emergence

Coarse-graining over many patches yields the spacetime metric:

$$g_{\mu\nu} = F_{\mu\nu}(\rho_E, \tau_E).$$

The effective gravitational field equations in the S-domain are:

$$G_{\mu\nu} = 8\pi T_{\mu\nu} + \Lambda_{\text{eff}} g_{\mu\nu}.$$

Both terms arise from E-domain structure.

4. The Lagrangian of Structural Physics

The action is:

$$S = S_{\text{structure}} + S_{\text{matter}} + S_{\partial M}.$$

4.1 Structural Action

$$S_{\text{structure}} = \int (\alpha(\nabla\rho_E)^2 + \beta(\nabla\tau_E)^2 + \gamma\rho_E\tau_E) d^4x.$$

4.2 Matter Action

$$S_{\text{matter}} = \int \rho_m \tau_E d^4x.$$

4.3 Boundary Action (Origin of Force)

$$S_{\partial M} = \int_{\partial M} f(\tau_E) dA.$$

Variation yields:

$$F \propto -\nabla \tau_E \text{ at the boundary.}$$

This expresses the key insight: *Force arises from the boundaries of stretched mats.*

5. From Action at a Distance to Tension in Mats

Newton: bodies influence each other across space. Einstein: mass curves spacetime. Shaffer: matter deforms qubit mats; boundaries transmit tension.

Nothing acts across space. Nothing curves a manifold. Everything follows the tension landscape of the E-domain.

6. Nonlocality: Everything Knows Everything

The E-domain is globally entangled:

- interactions are fundamentally nonlocal
- every qubit patch is structurally connected to every other
- the S-domain inherits only a local shadow of this global structure

This explains CMB uniformity, cosmic web coherence, and large-scale stability [9, 10, 11, 12, 13, 14].

Relativity is not violated because it applies only to the emergent S-domain.

7. Gravity from Mat Deformation

A mass placed on a mat changes ρ_E and τ_E . This deformation induces curvature in the S-domain.

The force law arises from boundary tension:

$$F \propto -\nabla \tau_E.$$

Inverse-square behavior emerges from approximately spherical boundaries.

8. Dark Energy as Global Strain

Let the E-domain have uniform background tension:

$$\tau_E = \tau_0 + \delta\tau_E.$$

Then:

- local variations → gravity
- global strain → dark energy

$$\Lambda_{\text{eff}} \propto \tau_0.$$

Cosmic acceleration is structural relaxation.

9. Galactic Rotation Curves

Galactic mats have boundaries. Boundary tension produces constant centripetal force:

If τ_b is boundary tension:

$$v^2(r) \approx \tau_b.$$

Rotation curves flatten naturally. No dark matter is required.

10. The CMB as Structural Freeze-Out

The CMB is the thermal imprint of the qubit-patch network freezing during the Big Bang phase transition.

Before freeze-out: fluid entanglement. During freeze-out: qubit patches crystallize. After freeze-out: anisotropies become CMB temperature variations.

The CMB is a structural fossil.

11. The Cosmic Web as Mat Geometry

The cosmic web arises from:

- mats (sheets)
- boundaries (filaments)

- intersections (nodes)
- low-tension regions (voids)

Matter flows along tension gradients. No dark matter scaffolding is needed.

12. The Big Bang as a Phase Transition

The early universe was a hot entanglement fluid. Within minutes, it cooled and crystallized into qubit patches. All constants became structural properties of this frozen network.

This avoids singularities and unifies cosmic origins with structural physics.

13. Conclusions

This paper presents a structural cosmology in which:

- qubit patches are fundamental
- spacetime is emergent
- gravity is tension
- force arises from boundaries
- dark energy is global strain
- galactic rotation curves need no dark matter
- the CMB is a structural fossil
- the cosmic web is mat geometry
- the Big Bang is a phase transition
- G is derived, not fundamental

Everything follows from one principle: *Structure is fundamental.*

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