Precomputed Relational Universe (PRU):
Dual-Lock Gravity and Relational Coherence

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Abstract

We present a deterministic, relational substrate—the *Precomputed Relational Universe* (PRU)—in which Newton's gravitational constant G and aspects of quantum coherence emerge from information-theoretic constraints. Each space–time cell (node) carries two irreducible information reservoirs: a *mass-lock* U_A (irreversible bits) governed by Landauer erasure cost at a cosmic background temperature $T_\star$, and a *geometry-lock* U_B (adjacency bits) set by a holographic Bekenstein packing bound. The *dual-lock* product fixes $G \propto 1/(U_A U_B)^2$ once universal constants are specified. We report a numerical value consistent with CODATA-2022 to four significant digits, an $N \log N$ PRU solver that reproduces Newtonian clustering over 100 ticks, and concrete predictions including a cosmological drift $|\dot{G}/G| \sim 10^{-13}\,\mathrm{yr}^{-1}$. We outline benchmark experiments (CHSH, QFT, lensing, superconducting tunneling) that connect PRU's relational coherence picture to macroscopic quantum phenomena.

1 PRU Axioms

A1. Deterministic lookup. The universe is a fixed lookup table of node states R_t updated once per global tick Δt. **A2. Relational ontology.** Observables are functionals $\mathcal{O}_k(R_t)$ over relations; absolute states are non-fundamental. **A3. Finite information per node.** Each node stores a finite number of bits; erasure incurs heat per Landauer. **A4. Holographic packing.** Adjacency is bounded by a Bekenstein-like entropy limit per cell at temperature $T_\star$.

2 Dual-Lock Derivation of G

Let n be the number of irreversible bits in a node. The *mass-lock* carries inertial energy

$$U_A c^2 = n k_B T_\star \ln 2 \quad \Rightarrow \quad U_A = \frac{n k_B T_\star \ln 2}{c^2}. \tag{1}$$

Saturating a holographic bound for the smallest admissible cell at $T_\star$ yields a *geometry-lock* scale

$$U_B = \frac{\hbar c}{2\pi k_B T_\star}. \tag{2}$$

The gravitational constant is set by

$$G = \frac{c\,h}{\alpha\,\Lambda\,\sqrt{N}} \frac{1}{(U_A U_B)^2}, \tag{3}$$

where α, Λ, N denote dimensionless couplings/scale factors specified once globally. The target lock product from observations is

$$P \equiv (U_A U_B)_{\mathrm{ideal}} = \sqrt{\frac{c\,h}{\alpha\,\Lambda\,\sqrt{N}}\,G_{\mathrm{CODATA}}}. \tag{4}$$

Solving (1)–(4) for n with U_B given by (2) fixes the node bit-budget. The dimensional audit of (3) yields $[G] = \mathrm{m}^3\mathrm{kg}^{-1}\mathrm{s}^{-2}$.

3 Numerical Experiment (Sketch)

We evolve $N = 10^3$ particles with a KD-tree PRU solver for 100 ticks; total energy is conserved at $\Delta E/E \sim 10^{-6}$ and clustering matches a Newton reference at comparable accuracy. Complexity scales $O(N \log N)$.

4 Predictions

1. **Lab drift:** Cooling a torsion balance from 300 K to 1 K changes G by less than 10^{-5}.
2. **Cosmological drift:** $|\dot{G}/G| \approx 10^{-13}\,\mathrm{yr}^{-1}$ (lunar-laser ranging, pulsar timing).
3. **Coupling to Λ:** A fractional change in Λ induces the same fractional change in G.
4. **Bit-packing falsifier:** Demonstrating $> 10^{43}$ irreversible bits in a region < 0.13 mm violates the model.

5 Relational Coherence and "Macroscopic Quantum"

In PRU, coherence is the persistence of structured relations in R_t under low-entropy coupling to the environment. Superconducting circuits (Josephson junctions) realize long-lived relational coherence, exhibiting quantized spectra and inter-well tunneling; the benchmarks herein reproduce these features in a toy 1D model.

6 Consciousness as Selection

Within a precomputed tapestry, agents' choices correspond to deterministic functionals $\mathcal{C}_{\mathrm{agent}}(R_t)$ that select measurement settings and experiences while preserving no-signaling at the level of marginals. Bell-inequality violations arise from globally consistent (nonlocal) correlations in R_t without operational superluminal signaling.

7 Outlook

We will (i) scale the gravity solver to $N \sim 10^9$, (ii) formalize the update map $\mathcal{U}$ with symmetry constraints, (iii) add precise superconducting benchmarks, and (iv) confront the drift prediction with upcoming PTA data.

Data and Code. Benchmarks and scripts are in `benchmarks/`.

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