

Discrete *Emergent* Gravity

One postulate. Zero free parameters.

Matteo Pinna · Independent researcher, Madrid · ORCID 0009-0004-4078-9015 · matteo@deg-gravity.com · deg-gravity.com

THE SINGLE POSTULATE

$$H = \sum_n \left[\frac{p_n^2}{2m} - \frac{\alpha_{\text{exp}}}{2} a_n^2 \right] = 0$$

Spacetime atoms

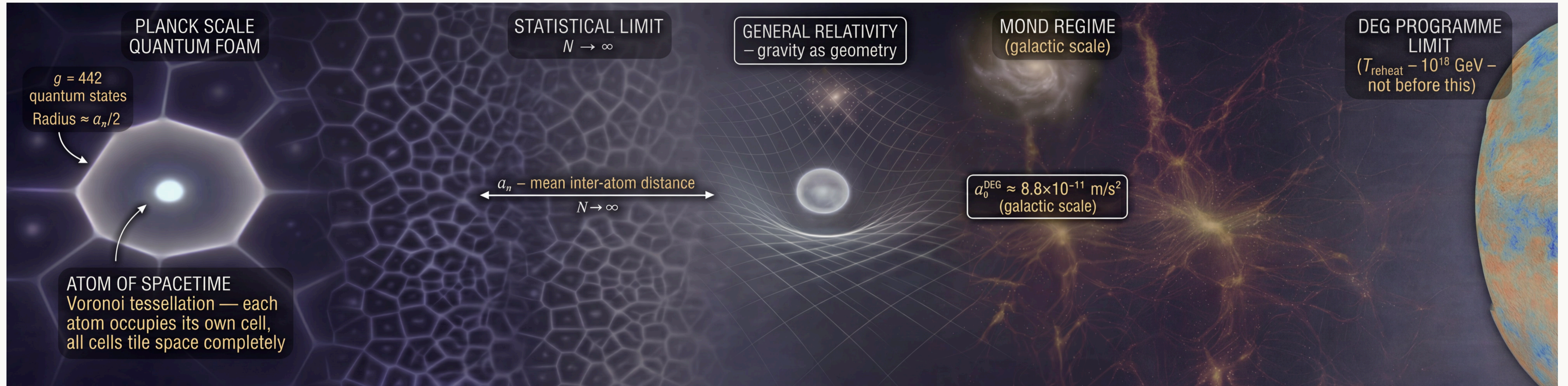
N Planck-scale constituents, each with size a_n and $g = 442$ internal quantum states from $SU(21) \times U(1)$.

 $g = 442$ — not a free parameter

Fixed by requiring $SU(21) \times U(1)$ to embed the Standard Model: 440 adjoint + 2 from $U(1)$. No fitting.

Everything follows

Gravity, Λ , m_H , the SM gauge group, black hole unitarity — all derived from $H = 0$ alone.



FROM ONE CONSTRAINT TO MACROSCOPIC PHYSICS

A single Hamiltonian constraint propagates through five layers of emergence to recover all of macroscopic physics.

→ Time & thermodynamics

Entropy maximisation of atom configurations. Second law $\dot{S} = 9k_B N > 0$ is an exact theorem.

→ Newtonian gravity & GR

Atom overlap entropy gradient yields Newton's law (exact coefficient); Einstein equations emerge in the continuum limit.

→ UV cutoff $a \approx 0.74 \mu\text{m}$

Suppresses vacuum energy by $(a/\ell_P)^3 \sim 10^{86}$, dissolving the cosmological constant problem without fine-tuning.

→ Standard Model from $SU(21) \times U(1)$

SM gauge group, three generations, fermion masses, CKM phase, and leptogenesis all follow from the internal symmetry.

→ Black hole unitarity — exact

Finite-dimensional Hilbert space forces unitarity. Page curve $S_{\text{rad}}(k) = \min(k, N-k) \ln 442$ derived at leading order.

FOUR LANDMARK RESULTS — ZERO FREE PARAMETERS

RESULT 1

Cosmological constant Λ

$$\Lambda_{\text{pred}} \approx 1.13 \times 10^{-52} \text{ m}^{-2}$$

Within 1.4σ of Planck 2018 · no parameter fitted

The UV cutoff $a \approx 0.74 \mu\text{m}$, not ℓ_P , suppresses vacuum energy by $(a/\ell_P)^3 \sim 10^{86}$. The equation of state $w = -1$ follows as an exact geometric corollary.

RESULT 2

Higgs boson mass

$$m_H = 124.8 \pm 2.4 \text{ GeV} \quad (\text{PDG: } 125.25 \pm 0.17 \text{ GeV})$$

0.19 σ from PDG · derived, not fitted

Derived from CP-violating observables ($\delta_{\text{CKM}}, \eta_B$) via a single internal parameter $\varphi_{\text{DEG}} = 0.598$ rad satisfying seven independent constraints across flavour physics, leptogenesis, and the Higgs sector.

RESULT 3

Dark energy equation of state

$$w = -1 \quad \text{exact geometric corollary}$$

Any 5σ detection of $w \neq -1$ falsifies this sector

DESI DR2 (2025) shows 3.1σ preference for dynamical dark energy — suggestive, below the 5σ threshold. Sensitive to supernova compilation choice. Watching DESI DR3.

RESULT 4

Black hole unitarity — exact

$$S_{\text{rad}}(k) = \min(k, N-k) \ln 442$$

Exact — kinematic theorem

Spacetime atoms carry a finite-dimensional Hilbert space of dimension 442^N . Unitarity is algebraic, not dynamical — information cannot be lost. The Page curve follows at leading order from Page's theorem with no free parameters.

Requires explicit small- N numerical verification of scrambling dynamics.

SELECTED FALSIFIABLE PREDICTIONS

OBSERVABLE	DEG PREDICTION	EXPERIMENT	FALSIFIER
$c_{\text{GW}} = c$ exactly	Exact	✓ GW170817	—
$w = -1$ exactly	Exact (derived)	DESI / Euclid	5σ detection of $w \neq -1$
Triple Higgs κ_λ	-1.449 ± 0.17	HL-LHC ~2035	SM value $\kappa_\lambda = 1$ excluded
Normal ν ordering	$m_{\nu_1} \sim 10^{-5} \text{ eV}$	JUNO ~2028	Inverted ordering confirmed
No WIMP signal	Zero direct detection	LZ / XENONnT	Any WIMP detection
Proton decay τ_p	$\tau_p \sim 10^{33-34} \text{ yr}$	Hyper-K ~2030	$\tau_p > 10^{35} \text{ yr}$
Tensor-to-scalar r	0.00452 ± 0.002	CMB-S4 ~2032	$r > 0.01$

KNOWN OPEN PROBLEMS

STATED OPENLY — NOT PAPERED OVER

Higgs coupling $\kappa_V = 0.432 - 14.2\sigma$ tension at tree level; analytical ceiling 5.1σ after non-perturbative enhancement. Requires DEG-L Group C lattice computation.

Spectral index n_s — DEG quantum epoch gives $n_s = 4$. Observed $n_s \approx 0.963$ is a fossil of the pre-geometric phase $\tilde{G} \supset SU(21) \times U(1)$. Eight internal mechanisms exhausted. Identifying \tilde{G} is the natural next extension of the programme.

MOND acceleration a_0^{DEG} — semi-derived, 27% below observed. Coarse-graining from Planck to galactic scales remains the central unsolved challenge.



FULL MANUSCRIPT · ALL DERIVATIONS · 17 FALSIFIABLE PREDICTIONS · OPEN PROBLEMS
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The full programme spans time emergence, matter coupling, the cosmological constant, Standard Model embedding, black hole unitarity, and discrete genesis — 7 landmark results in total, zero free parameters. Scan for full manuscript · all derivations · 17 falsifiable predictions · open problems.