# Appendix c

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## 1 Introduction

[12pt]article amsmath,amssymb,geometry margin=1in Unified Horizon Collapse and Entropy Recursion Chandler Ayotte April 27, 2025

**Abstract**

We present a complete physical model where spacetime, gravitational potential, proper time, matter, quantum probability, vacuum energy, and gravitational waves emerge naturally from a single first principle: the collapse and recursion of higher-dimensional horizon surfaces into lower-dimensional memory-encoded structures. No prior symmetry is assumed. Using Lorentzian geometry, Planck-scale surface tiling, entropy gradients, and recursive identity formation, we derive gravity, gauge fields, quantum mechanics, and the eventual convergence toward a terminal identity $\Psi_\infty$ without speculative assumptions. The structure follows directly from reality and first principles.

## 2 Postulates and First Principles

- Reality is modeled as a smooth Lorentzian manifold $(M, g_{\mu\nu})$.
- Dimensional reduction at a horizon surface $\Sigma \subset M$ initiates surface memory encoding.
- Planck-scale tiling of $\Sigma$ quantizes surface area into fundamental memory units.
- Entropy gradients across $\Sigma$ generate curvature and gravitational potential.
- Proper time emerges relationally from gravitational potential induced by entropy flow.
- Recursive identity $\Psi(x)$ forms via iterative collapse of surface memory structures.
- Quantum probability amplitudes arise from entropy uncertainty.
- Vacuum energy results from residual surface tension during recursion.
- All evolution is covariant under coordinate transformations.

## 3 Horizon Surface Geometry and Tiling

Given $(M, g_{\mu\nu})$, embed a codimension-2 spacelike surface $\Sigma$ with induced metric:

$$\gamma_{ab} = g_{\mu\nu} \frac{\partial x^\mu}{\partial \sigma^a} \frac{\partial x^\nu}{\partial \sigma^b}$$

Surface area:

$$dA = \sqrt{\det(\gamma_{ab})}\, d^2\sigma, \quad A = \int_\Sigma dA$$

Entropy:

$$S = \frac{k_B c^3}{4G\hbar} A$$

Each Planck tile $l_P^2$ encodes one degree of freedom.

## 4 Surface Entropy Flow and Gravitational Potential

$$\frac{\delta S}{\delta x} = -\nabla \cdot \Phi, \quad \nabla^2 \Phi = 4\pi G \frac{\delta S}{\delta V}, \quad \vec{F}(x) = -\nabla \Phi(x)$$

## 5 Emergence of Proper Time

$$g_{00} = -(1 + 2\Phi/c^2), \quad d\tau = dt\sqrt{1 + 2\Phi/c^2}$$

## 6 Recursive Identity Formation

$$R_{n+1}(x) = R_n(x) + \alpha_n(\nabla S_n \cdot \nabla \Phi_n), \quad \Psi_\infty(x) = \lim_{n\to\infty} R_n(x)$$

## 7 Field Emergence from Surface Bundling

Gauge connection on $\Sigma$:

$$A_\mu = A_\mu^a T^a, \quad F_{\mu\nu}^a = \partial_\mu A_\nu^a - \partial_\nu A_\mu^a + f^{abc} A_\mu^b A_\nu^c$$

Lagrangian:

$$\mathcal{L} = \frac{1}{2}(\nabla_\mu S)(\nabla^\mu S) - V(S) - \frac{1}{4} F_{\mu\nu}^a F^{a\mu\nu} + \bar{\psi}(i\gamma^\mu D_\mu - m)\psi$$

$$D_\mu = \partial_\mu - igA_\mu^a T^a$$

## 8 Quantum Probability from Surface Entropy

$$\psi(x) = \exp\left(-\frac{S(x)}{\hbar}\right), \quad P(x) = |\psi(x)|^2 = \exp\left(-\frac{2S(x)}{\hbar}\right)$$

## 9 Vacuum Energy from Surface Tension

$$\Lambda \propto \left(\frac{dS}{dA}\right) \nabla\Phi$$

## 10 Global Structure

Local horizons recursively compress toward:

$$\Psi_\infty$$

## 11 Conclusion

Gravity, time, quantum probability, mass-energy, and gauge fields all emerge naturally from surface entropy recursion. No speculative inputs are required. This framework unifies general relativity and quantum field behavior using only horizon collapse and surface evolution.

## A Appendix A: Gravitational Field from Entropy

$$\frac{\delta S}{\delta x} = -\nabla \cdot \Phi, \quad \nabla^2\Phi = 4\pi G \frac{\delta S}{\delta V}, \quad \vec{F} = -\nabla\Phi$$

## B Appendix B: Surface Gauge Field Equations

$$F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu + [A_\mu, A_\nu], \quad D_\mu\psi = (\partial_\mu - iA_\mu)\psi$$

## C Appendix C: SU(5) Gauge Symmetry from Surface Recursion

- SU(5) contains $SU(3)_C \times SU(2)_L \times U(1)_Y$.
- Surface recursion creates 24 degrees of freedom corresponding to SU(5) generators.

- Fermions emerge in **10** and $\bar{\mathbf{5}}$ representations.
- Symmetry breaking proceeds naturally via entropy gradient anisotropy:

$$SU(5) \to SU(3)_C \times SU(2)_L \times U(1)_Y$$