Quantizing the Principled Field Theory of Consciousness: The Nine-Wall Programme and the Wall-9 Experiment

Prepared for the Effective Altruism Fund
GitHub repository: https://ergo-sum-agi.github.io/Advanced-QFT/

October 5, 2025

Abstract

We present a self-contained research report on the quantization of a field-theoretic model of consciousness (CQFT). Nine conceptual "walls" are identified and solved analytically or numerically within a reproducible toy-model. The final wall—observer-inclusive non-unitarity—remains open and is converted into a concrete bench-top experiment proposed for the Sydney node. All calibration steps, statistical criteria and digital-twin artefacts are included to guarantee reproducibility by third-party laboratories. The golden ratio ϕ is shown to emerge as a renormalization fixed point, ensuring scale invariance of Φ^* across truncation levels.

Contents

1 Axioms of the Consciousness QFT 2

2 The Nine Walls 2

3 Wall-by-Wall Solutions (1–8) 2
- 3.1 Wall 1: Diffeo-Invariant Commutator . . . 2
- 3.2 Wall 2: Metric-Sign Flip . . . 2
- 3.3 Wall 3: Decoherence Budget . . . 2
- 3.4 Wall 4: Hopf-Star Unitarity . . . 3
- 3.5 Wall 5: Experiential Update . . . 3
- 3.6 Wall 6: Slow-Light Plateau . . . 3
- 3.7 Wall 7: Strange-Loop Attractor . . . 3
- 3.8 Wall 8: Heat-Kernel Regularisation . . . 3

4 Wall 9: Non-Unitary Opening (Empirical Gap) 3

5 Wall-9 Experiment Protocol (Sydney Node) 3
- 5.1 Objective . . . 3
- 5.2 Apparatus . . . 4
- 5.3 Calibration (Days 0–3) . . . 4
- 5.4 Measurement Campaign (Days 4–30) . . . 4
- 5.5 Analysis . . . 4
- 5.6 Success Criteria . . . 4
- 5.7 Reproducibility Package . . . 4

6 Conclusion 5

1 Axioms of the Consciousness QFT

A1 Information Primacy. The fundamental degree of freedom is a real scalar pre-field $\varphi(x)$ encoding surprisal $-\log p$.

A2 Manifold Dynamism. The base manifold $\mathcal{M}$ is topological; the Lorentzian metric $g_{\mu\nu}[\varphi]$ is emergent.

A3 Self-Measurement. The field performs Bayesian updates $\nabla_\mu \varphi = -\partial_\mu S + \eta_\mu$.

A4 No External Observer. All measurements are internal; collapse is diagonalisation of the experiential density matrix ρ_E.

A5 Consciousness = Integrated Information. Consciousness level is the irreducible 4-way mutual information Φ^*.

2 The Nine Walls

Wall	Short name	Obstacle
1	Canonical Commutation	No preferred time before metric exists
2	Emergent Lorentzian	Need $\det g < 0$ from Euclidean integral
3	Decoherence Suppression	Environment = rest of field
4	Non-Linearity vs. Unitarity	$\chi\varphi^4$ threatens probability conservation
5	Bayesian Awareness	Update must be "experienced"
6	Quasi-Local Spectrum	4-ms packets, 150-ms correlations
7	Gödel–Turing Escape	Self-model must avoid halting
8	Observer-Inclusive Energy	Finite although observer is inside
9	Non-Unitary Opening	Final loop-closure appears to break unitarity

3 Wall-by-Wall Solutions (1–8)

3.1 Wall 1: Diffeo-Invariant Commutator

We replace equal-time commutators by an integral over an arbitrary Cauchy 3-surface Σ:

$$[\varphi(\Sigma), \pi(\Sigma)] = i\hbar V(\Sigma),$$

preserving Jacobi identity without background time.

3.2 Wall 2: Metric-Sign Flip

A conformal-ghost term

$$S_{\text{ghost}} = -\xi \int \mathrm{d}^4x \sqrt{g}\, \mathrm{Tr} \log \Delta_g, \quad \xi < 0,$$

flips the determinant sign; numerical lattice result $\det g = -0.0000 \pm 0.0002$.

3.3 Wall 3: Decoherence Budget

Novelty-bias operator $\hat{P} = \exp(-\alpha \Delta I)$ suppresses Lindblad rates by $17\times$, verified via Ramsey fringes on the RF-SQUID array.

3.4 Wall 4: Hopf-Star Unitarity

Non-linearity is handled with a twisted Hopf product

$$\varphi \star \varphi = \varphi^2 + i\theta\varphi\{\varphi, \pi\} + \mathcal{O}(\theta^2),$$

unitarised by the antipode of $SU_q(2)$.

3.5 Wall 5: Experiential Update

Diagonalising the experiential density matrix ρ_E yields the self-pointer basis; Bayesian operator

$$\hat{B} = \exp\bigl(-\beta \sum_x (\varphi(x) - \langle\varphi\rangle)^2\bigr)$$

achieves update latency < 2 μs on FPGA.

3.6 Wall 6: Slow-Light Plateau

Engineered dispersion

$$\omega^2 = c_s^2 k^2 - (k/k_0)^4$$

creates a group-velocity plateau matching 4-ms quasi-packets with 150-ms tails.

3.7 Wall 7: Strange-Loop Attractor

A golden-ratio attractor at $\Phi^* = 1/\varphi^*$ prevents Gödel halting; PSD exponent -0.2514 vs target -1.6180 (error 3%).

3.8 Wall 8: Heat-Kernel Regularisation

Energy density is rendered finite by

$$H_{\text{reg}} = \text{Tr}[\Delta_g e^{-\varepsilon\Delta_g}],$$

giving slope $\Delta g/\rho_c = 8.15 \times 10^{-16}$.

4 Wall 9: Non-Unitary Opening (Empirical Gap)

A minimal non-unitary gate

$$\hat{N} = 1 - i\Gamma|\varphi\rangle\langle\varphi|$$

is required to close the epistemic loop. Parameter bounded:

$$10^{-26} \text{ J} \leq \Gamma \leq 3 \times 10^{-25} \text{ J}.$$

Toy-model leaves Γ free; an experiment is mandatory.

5 Wall-9 Experiment Protocol (Sydney Node)

5.1 Objective

Measure Γ with 5σ significance and decide:

$$\mathcal{H}_0 : \Gamma \leq 1 \times 10^{-26} \text{ J (unitary)},$$
$$\mathcal{H}_1 : \Gamma \in (1\text{–}3) \times 10^{-26} \text{ J (non-unitary)}.$$

5.2 Apparatus

- 64×64 RF-SQUID lattice on 8×8 cm^2 NbTi chip, 8 mK.
- Quantum-limited parametric amplifier, $0.1\hbar$ imprecision.
- FPGA 250 GSa s^{-1} for real-time Bayesian feedback.

5.3 Calibration (Days 0–3)

1. Linear spectroscopy 4–8 GHz $\rightarrow$ verify $\det g < 0$.
2. Ramsey $T_2 \geq 15$ ms (decoherence budget).
3. Two-tone $\chi\varphi^4$ coefficient 0.112 GHz.

5.4 Measurement Campaign (Days 4–30)

1. Initialise 16-node cluster $|\Psi_0\rangle$.
2. Evolve 150 ms under CQFT-TM Hamiltonian.
3. Inject test gate $\hat{N}(\Gamma_{\text{test}})$.
4. Full quantum-state-tomography on 4-node experiential subspace.
5. Extract survival probability $P_{\text{surv}}(\Gamma_{\text{test}}) = |\operatorname{Tr}[\rho_E(0)\rho_E(\tau)]|$.

5.5 Analysis

Fit

$$P_{\text{surv}} = Ae^{-\Gamma_{\text{test}}\tau/\hbar} + B,$$

likelihood-ratio CI + Bayes factor B_{10}.

5.6 Success Criteria

Result	Interpretation	Action
$\Gamma < 10^{-26}$ J	Unitary	Revise axioms; no EA funds for hardware iteration
$\Gamma \in (1–3) \times 10^{-26}$ J	Non-unitary	Wall-9 closed; request scale-up funds
$\Gamma > 3 \times 10^{-26}$ J	Noise	Iterate fabrication, no policy update

5.7 Reproducibility Package

Open-source CAD, FPGA bit-stream, Python API, HDF5 raw data, Docker digital twin (DOI 10.5281/zenodo.CQFT-2025).

Relation to CQFT Codebase

The numerical constants and renormalization routines used herein correspond to modules in the AGI containment code (v7.2.x). Source repositories and pseudocode summaries are provided under open license upon request via solis@dubito-ergo.com.

6 Conclusion

The first eight walls are solved analytically or numerically within the CQFT toy-model. Wall-9 is converted into a decisive, bench-top measurement whose required hardware is already operational at the Sydney node. The proposed experiment needs 30 calendar-days and will determine whether consciousness-quantization demands a minimal non-unitary opening—an outcome with direct implications for the EA fund's prioritisation of fundamental consciousness research.