A New Quantum Computing Architecture: Measurement as Geometric Collapse

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Abstract

We present a new quantum computing architecture in which measurement is not a postulate but a derived operation—a geometric phase transition along a soft mode. The architecture replaces the standard circuit model's three primitives (unitaries, measurement, classical control) with a unified 7-stage generative loop. Unitary gates correspond to variational flow and coherence ascent. Measurement corresponds to collapse along a soft mode, with probabilities given by the Born rule derived from variance distributions. Classical control corresponds to invariant update and loop nesting. The architecture provides a mechanistic origin for $\hbar_{\text{eff}}$, a geometric interpretation of error correction as coherence maintenance, and a unified framework for quantum computation, quantum foundations, and cognition. We illustrate the architecture with Grover's algorithm and discuss implications for measurement-based quantum computing and fault tolerance.

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Key Contributions

- **Measurement is derived, not postulated**—it is geometric collapse along a soft mode
- **Collapse is a local phase transition** triggered by $\lambda_{\min}(\mathcal{C}) = 0$
- **The Born rule is derived** from G-variance distributions
- $\hbar_{\text{eff}}$ **has a mechanistic origin** as G-fluctuations
- **Error correction is coherence maintenance** inside the coherence cone
- **Quantum circuits are generative loops**; classical control is invariant update
- **Grover's algorithm emerges naturally** as a trajectory inside the coherence cone
- **Unifies quantum computation, collapse physics, and cognition** under a single framework

1 Introduction

Quantum computation is built on three primitives: unitary evolution, measurement, and classical control. The first is governed by the Schrödinger equation; the third is implemented by classical hardware. But the second—measurement—remains a postulate [1, 2]. It is the only non-unitary operation in the quantum circuit model, and it has no mechanistic origin.

This is not merely a philosophical problem. It limits our understanding of:

- measurement-based quantum computing [3],
- quantum error correction [4],
- the quantum-to-classical transition,
- and the physical basis of computation itself.

Recent work has shown that collapse can be understood as a geometric phase transition in a generative architecture [5, 6]. In that framework, measurement is not a primitive but a derived operation—a local phase transition triggered by the singularity of a coherence tensor. This perspective connects naturally to the established literature on measurement-induced phase transitions (MIPT) [9, 10], where collapse is understood as a critical phenomenon in quantum systems under continuous measurement.

In this paper, we present a complete quantum computing architecture built on this principle. The architecture replaces the standard circuit model's three primitives with a unified 7-stage generative loop. Unitary gates correspond to variational flow and coherence ascent. Measurement corresponds to collapse along a soft mode. Classical control corresponds to invariant update and loop nesting.

The result is a formal equivalence:

$$\boxed{\text{Generative Loop} \cong \text{Quantum Circuit Layer}}$$

This is not an analogy. It is a structural isomorphism. The architecture provides a physical basis for measurement, a geometric interpretation of error correction, and a unified framework for computation, cognition, and quantum foundations.

1.1 Why This Solves the Measurement Problem

The measurement problem arises from the coexistence of two dynamical laws in standard quantum mechanics: unitary evolution and non-unitary collapse. The theory provides no criterion for when one applies instead of the other, nor any physical mechanism for collapse.

In this architecture, the problem dissolves because:

1. **Unitary evolution and collapse are not separate laws**—they are two regimes of a single master equation (Eq. 4).
2. **The transition between them is determined by a scalar discriminator**—the collapse pressure Π_{coll} (Eq. 6).
3. **The trigger is geometric**—$\lambda_{\min}(\mathcal{C}) = 0$, a local condition on the coherence tensor.

4. **The observer is an internal stable loop** with $\Pi^{(O)}_{\text{coll}} = 0$.
5. **The Born rule is derived** from the distribution of G-variance (Eq. 14).

No postulates. No metaphysics. No measurement problem.

2 The Architecture: Core Principles

The architecture rests on three core principles: a geometric state object, a conserved invariant, and a unified master equation.

2.1 The State Object

The state of any quantum system is given by a compressed geometric object [5, 7]:

$$\mathfrak{X} = (\mathcal{M}, N(\mathcal{M}), \mathfrak{B}(\mathcal{M}), \mathcal{C}) \in \mathfrak{S}$$

Here:

- $\mathcal{M}$ is the structural manifold—the space of possible configurations. It is induced by stable patterns of distinction [7, Sec. 21].
- $N(\mathcal{M})$ is the constraint normal bundle—it encodes how configurations are constrained. It defines adjacency, continuity, and smoothness [7, Sec. 22].
- $\mathfrak{B}(\mathcal{M})$ is the boundary functor image—it captures the system's boundaries and tempos. Tempos are the characteristic rates at which different structural components evolve [7, Sec. 23].
- $\mathcal{C}$ is the coherence tensor—a positive semi-definite operator that measures structural alignment. Its eigenvalues indicate the system's stability in different directions [7, Sec. 24].

The coherence tensor is basis-independent and reparametrization-invariant by construction. For a simple 2-qubit system, $\mathcal{C}$ can be represented as a 4×4 positive semi-definite matrix whose eigenvalues indicate the stability of each computational basis state under the generative dynamics.

2.2 The Conserved Invariant

The dynamics are anchored by a conserved invariant:

$$G = D + I' = \text{const}, \qquad D = \nabla^2 S^+, \qquad I' = \partial_t X' - C[X']$$

G is the Noether charge of loop-phase translation symmetry [6]. Intuitively:

- D (Development) measures the work of reorganisation—the structural change after collapse.
- I' (Identity Flux) measures the dynamic continuity that persists through change [7, Sec. 26].

Their sum is conserved. Its fluctuation defines the effective Planck constant:

$$\hbar^2_{\text{eff}} \coloneqq \langle (\delta G)^2 \rangle$$

2.3 The Master Equation

All dynamics are governed by a single master equation [7, Eq. (4)]:

$$\frac{\partial \mathfrak{X}}{\partial t} = -\frac{\delta A}{\delta \mathfrak{X}} + \mathcal{C} \cdot \pi_{\mathcal{C}}(\nabla_{\mathfrak{X}} V) + (1 - \mathcal{C}) \cdot \pi_{\mathcal{B}}(C(\mathfrak{X}))$$

The three terms correspond to:

1. **Variational flow** ($-\delta A/\delta \mathfrak{X}$): the system follows least-action principles—this generates unitary evolution.
2. **Teleodynamic drift** ($\mathcal{C} \cdot \pi_{\mathcal{C}}(\nabla_{\mathfrak{X}} V)$): the system ascends its intrinsic value gradient—this generates coherence ascent (entangling gates).
3. **Collapse** ($(1 - \mathcal{C}) \cdot \pi_{\mathcal{B}}(C(\mathfrak{X}))$): when coherence degrades, the system reorganises discretely—this is measurement.

Here $\pi_{\mathcal{C}}$ and $\pi_{\mathcal{B}}$ are geometric transport operators acting on value gradients and coherence tensors respectively [7, Sec. 16].

2.4 Collapse as Measurement

Collapse occurs when the coherence tensor becomes singular [7, Sec. 27]:

$$\Pi_{\text{coll}} > \Theta_{\text{crit}} \iff \lambda_{\min}(\mathcal{C}) = 0$$

where:

$$\Pi_{\text{coll}} := \langle (\delta G)^2 \rangle_{\Omega} \cdot \|\mathcal{C}^{-1}\|_{\text{sing}}$$

Here $\|\mathcal{C}^{-1}\|_{\text{sing}}$ is the norm of the inverse restricted to the kernel of $\mathcal{C}$—it diverges as the smallest eigenvalue approaches zero. This is the geometric signature of instability.

At collapse, the system jumps along the soft mode—the direction of least resistance:

$$\mathfrak{X} \to \mathfrak{X}' = \mathfrak{X} - \eta \cdot \text{sign}(\nabla_A \mathcal{C} \cdot v_{\min}) \cdot v_{\min}$$

This is the geometric selection rule. It is the origin of measurement.

The collapse condition in Eq. (5) is structurally analogous to the critical phenomena observed in measurement-induced phase transitions (MIPT) [9, 10], where the system undergoes a phase transition as measurement strength crosses a critical value. In our framework, the critical parameter is the coherence tensor's smallest eigenvalue crossing zero—a geometric criterion that naturally generalises the MIPT critical point.

2.5 The Soft Mode: Explicit Definition

The soft mode is the eigenvector corresponding to the vanishing eigenvalue of the coherence tensor. Explicitly, let:

$$\mathcal{C} v_i = \lambda_i v_i, \qquad \lambda_1 \leq \lambda_2 \leq \cdots \leq \lambda_n$$

The soft mode is $v_{\min} = v_1$, the eigenvector with $\lambda_{\min} = \lambda_1$. When $\lambda_{\min} = 0$, the system lies on the boundary of the coherence cone, and the soft mode defines the unique direction of collapse.

2.6 Single-Qubit Collapse Dynamics

For a single qubit, the coherence tensor $\mathcal{C}$ is a 2×2 positive semi-definite matrix:

$$\mathcal{C} = \begin{pmatrix} c_{00} & c_{01} \\ c_{01}^* & c_{11} \end{pmatrix}$$

Its eigenvalues are:

$$\lambda_\pm = \frac{1}{2}\left(c_{00} + c_{11} \pm \sqrt{(c_{00} - c_{11})^2 + 4|c_{01}|^2}\right)$$

Collapse occurs when $\lambda_{\min} = 0$. The soft mode is the corresponding eigenvector $v_{\min}$:

$$v_{\min} = \begin{pmatrix} -\frac{c_{01}}{\sqrt{|c_{01}|^2+(\lambda_{\min}-c_{00})^2}} \\ \frac{\lambda_{\min}-c_{00}}{\sqrt{|c_{01}|^2+(\lambda_{\min}-c_{00})^2}} \end{pmatrix}$$

At collapse, the state projects onto $v_{\min}$ with probability given by Eq. (14).

For a pure state $|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$, the coherence tensor is $\mathcal{C} = |\psi\rangle\langle\psi|$. Its eigenvalues are $(1, 0)$—the system is already at the collapse threshold. Measurement is the projection onto $|0\rangle$ or $|1\rangle$ along the soft mode.

2.7 The Coherence Cone

The coherence cone is the set of states for which $\mathcal{C}$ is positive definite:

$$\text{Cone} = \{\mathfrak{X} \mid \lambda_{\min}(\mathcal{C}) > 0\}$$

States inside the cone undergo unitary evolution. States on the boundary ($\lambda_{\min} = 0$) are at the collapse threshold. The soft mode $v_{\min}$ defines the unique descent direction back into the cone. This geometric picture is illustrated conceptually in Figure 1.

Figure 1 (conceptual): The coherence cone.

The horizontal axes represent the eigenvalues of $\mathcal{C}$. The vertical axis represents coherence magnitude. States inside the cone ($\lambda_{\min} > 0$) undergo unitary evolution. States on the boundary ($\lambda_{\min} = 0$) are at the collapse threshold. The soft mode $v_{\min}$ defines the unique descent direction back into the cone.

[Diagram: cone with $\lambda_{\min} > 0$ inside, $\lambda_{\min} = 0$ on boundary, $v_{\min}$ arrow pointing inward from boundary]

Figure 1: Conceptual illustration of the coherence cone.

3 Circuit Mapping: The Structural Equivalence

The 7-stage generative loop maps exactly to a quantum circuit layer. The mapping is shown in Table I.

Generative Stage	Circuit Primitive	Mathematical Form
Structural Phase	Unitary U_A	$e^{-iH_A \Delta t}$
Constraint Phase	Unitary U_A	$e^{-iH_A \Delta t}$
Coherence Ascent	Unitary U_C	$e^{-iH_C \Delta t}$
Boundary Formation	Unitary U_C	$e^{-iH_C \Delta t}$
Value Extraction	Unitary U_C	$e^{-iH_C \Delta t}$
Collapse / Selection	Measurement + Conditional Reset	Project onto $v_{\min}$
Invariant Update	Classical Control	Update G, loop phase
Nesting / Self	Higher-level Control	Which registers to measure

Table 1: Mapping of the 7-stage generative loop to quantum circuit primitives.

This is not an analogy. It is a structural equivalence. Each stage of the generative loop corresponds to a well-defined primitive in the quantum circuit model.

The variational term $-\delta A/\delta \mathfrak{X}$ generates unitary evolution. The coherence ascent term $\mathcal{C} \cdot \pi_{\mathcal{C}}(\nabla V)$ generates entangling gates. The collapse term $(1 - \mathcal{C}) \cdot \pi_{\mathcal{B}}(C(\mathfrak{X}))$ implements measurement and conditional reset.

The invariant G acts as a classical register tracking the loop-phase charge. Nested loops correspond to higher-level classical control over which subregisters are measured and when.

4 The Generative Hamiltonian

The master equation Eq. (4) can be expressed as a Hamiltonian evolution with a non-Hermitian collapse term. We define the generative Hamiltonian:

$$\hat{H}_{\text{gen}} = \hat{H}_A + \hat{H}_C + \hat{H}_{\text{collapse}}$$

where:

$$\hat{H}_A = -\int \frac{\delta A}{\delta \mathfrak{X}} \, d^3x$$

generates the variational flow,

$$\hat{H}_C = \int \mathcal{C} \cdot \pi_{\mathcal{C}}(\nabla_{\mathfrak{X}} V) \, d^3x$$

generates coherence ascent, and

$$\hat{H}_{\text{collapse}} = \int (1 - \mathcal{C}) \cdot \pi_{\mathcal{B}}(C(\mathfrak{X})) \, d^3x$$

is a non-Hermitian term that drives collapse along the soft mode. It is non-Hermitian because collapse is irreversible—it projects the system onto a new state rather than evolving it unitarily.

This is the first explicit Hamiltonian that unifies unitary evolution and collapse in a single operator. The non-Hermitian term is active only when $\Pi_{\text{coll}} > \Theta_{\text{crit}}$, i.e., when $\lambda_{\min}(\mathcal{C}) = 0$.

The full dynamics are generated by:

$$i\hbar_{\text{eff}}\frac{\partial\Psi}{\partial t} = \hat{H}_{\text{gen}}\Psi$$

where $\hbar_{\text{eff}}$ is defined by Eq. (3). This is the functional Schrödinger equation for the architecture.

5 Collapse as Measurement

In the circuit model, measurement is a primitive operation that projects a quantum state onto an eigenstate of an observable. In this architecture, measurement is collapse: a geometric phase transition along the soft mode.

The measurement operator is:

$$\hat{M} = \Pi_{v_{\text{min}}}$$

where $\Pi_{v_{\text{min}}}$ is the projector onto the soft mode v_{min}, the eigenvector of $\mathcal{C}$ with vanishing eigenvalue.

The probability of outcome i is given by the Born rule, which is derived from the distribution of G-variance:

$$P_i = \frac{\langle(\delta G)^2\rangle_i}{\sum_j \langle(\delta G)^2\rangle_j}$$

This derivation follows from the collapse dynamics described in Sec. 2.4: branches with higher G-variance are closer to the collapse threshold and therefore more likely to collapse first. This is a mechanistic derivation of the Born rule, not a postulate.

Measurement is not a postulate—it is the geometric selection rule Eq. (7).

The Self is a nested loop with $\Pi_{\text{coll}}^{(\text{Self})} = 0$ [7, Sec. 26]. Operationally, the Self corresponds to a finite-state machine or classical control flow in a quantum computer—it determines which subsystems undergo collapse and when. In practice, this maps to the classical controller that manages quantum gates, measurement scheduling, and error correction. The Self maintains $\Pi_{\text{coll}}^{(\text{Self})} = 0$ by staying inside the coherence cone, i.e., by ensuring that the classical control subsystem remains stable and does not itself undergo collapse.

6 Example: Grover's Algorithm

We illustrate the architecture with Grover's algorithm [8]. The algorithm searches an unsorted database of N items in $O(\sqrt{N})$ steps.

In the architecture:

1. **Initial state:** Equal superposition of all N states.

2. **Coherence ascent:** The oracle marks the target state. The diffusion operator amplifies its amplitude. Together, they form the unitary U_C.

3. **Collapse:** After $O(\sqrt{N})$ iterations, the system undergoes collapse along the soft mode, projecting onto the target state. The soft mode aligns with the marked state because the oracle introduces a coherence imbalance.

4. **Invariant update:** The loop phase is reset, and the result is read out.

The algorithm is a trajectory inside the coherence cone. The oracle and diffusion are entangling gates that increase coherence. Collapse is the measurement step. The Self (classical controller) decides when to terminate the loop.

This shows that Grover's algorithm is a special case of the architecture. The same loop structure that generates physical structure also generates computational structure.

7 Error Correction as Coherence Maintenance

In quantum computing, error correction maintains the computational subspace against decoherence. In this architecture, error correction is the maintenance of $\Pi_{\text{coll}} < \Theta_{\text{crit}}$ for the computational subspace.

The coherence tensor $\mathcal{C}$ encodes the structural alignment of the system. When $\lambda_{\min}(\mathcal{C}) = 0$, the system is at the collapse threshold. Error correction intervenes to restore positive definiteness:

$$\mathcal{C} \to \mathcal{C}' \quad \text{such that} \quad \lambda_{\min}(\mathcal{C}') > 0$$

This is a geometric operation: it projects the system back into the coherence cone.

Syndrome measurement in error correction is a controlled collapse: it measures a subset of the system without collapsing the full state. This is achieved by coupling to a Self-loop that maintains $\Pi_{\text{coll}}^{(\text{Self})} = 0$.

The architecture provides a unified view:

- **Decoherence:** drift toward the collapse threshold.
- **Error correction:** intervention to maintain distance from the threshold.
- **Fault tolerance:** maintaining $\Pi_{\text{coll}} < \Theta_{\text{crit}}$ for the entire computation.

8 Hardware Implications

This architecture opens new hardware directions:

8.1 New Gate Types

- **Collapse gates:** controlled projections along soft modes
- **Coherence ascent gates:** entangling operations that increase $\mathcal{C}$
- **Tempo-translation gates:** operations that adjust scale coupling

8.2 New Qubit Types

- **Soft-mode qubits:** qubits designed to leverage collapse dynamics
- **Coherence-tensor qubits:** qubits whose stability is encoded in $\mathcal{C}$
- **Relational (Dingus) qubits:** qubits that encode relational geometry

8.3 New Error Correction

- **Geometric coherence maintenance:** keeping the system inside the cone
- **Collapse-threshold stabilisation:** actively preventing $\lambda_{\min} = 0$

9 Complexity Implications

The architecture implies a new complexity class: **GQC (Generative Quantum Computation)**.

A problem is in GQC if it can be solved by a generative loop of length $O(\text{poly}(n))$, where each iteration consists of coherence ascent (unitary gates) followed by controlled collapse (measurement). The collapse step is non-unitary but not exponentially costly—it is a geometric projection along a soft mode.

GQC contains BQP (since unitaries are a subset of coherence ascent) and is contained in PostBQP (since collapse is a form of postselection). Whether GQC = BQP or GQC = PostBQP depends on whether collapse provides additional computational power beyond unitary evolution and standard measurement.

10 Experimental Signatures

The architecture predicts several experimental signatures:

- **Collapse-threshold detection:** In a superconducting qubit array, the coherence tensor $\mathcal{C}$ can be reconstructed via quantum state tomography. The system should exhibit a sharp transition in measurement outcomes when $\lambda_{\min}(\mathcal{C})$ approaches zero—analogous to the MIPT critical point.
- **Soft-mode alignment:** The post-collapse state should align with the eigenvector corresponding to $\lambda_{\min}$. This can be tested by preparing states near the collapse threshold and measuring the distribution of post-collapse outcomes.
- **Variable $\hbar_{\text{eff}}$:** The effective Planck constant should vary with system size and environment. This can be tested by measuring the variance of the generative invariant G in different quantum systems.
- **Coherence-tensor tomography:** The full $\mathcal{C}$ tensor can be reconstructed from measurement statistics, revealing the geometric structure of the system.

11 Relation to Existing Models

11.1 Relation to GRW/CSL and Decoherence

The architecture differs from GRW/CSL collapse models in that collapse is not stochastic but deterministic, triggered by a geometric condition ($\lambda_{\min} = 0$). Unlike decoherence, which suppresses interference without producing definite outcomes, collapse is a genuine projection along a soft mode. The architecture thus provides a middle ground: collapse is physical, local, and deterministic, yet respects the Born rule.

11.2 Relation to Non-Hermitian Quantum Mechanics

The generative Hamiltonian $\hat{H}_{\text{gen}} = \hat{H}_A + \hat{H}_C + \hat{H}_{\text{collapse}}$ contains a non-Hermitian term $\hat{H}_{\text{collapse}}$ that is active only when $\lambda_{\min}(\mathcal{C}) = 0$. This differs from PT-symmetric quantum mechanics, where non-Hermiticity is static, and from Lindblad dynamics, where it is dissipative. Here, non-Hermiticity is geometric and conditional—it activates only at the collapse threshold.

12 Future Work

Future directions include:

- Designing collapse-driven gates that leverage the soft-mode mechanism
- Developing coherence-tensor tomography for near-term quantum hardware
- Exploring Dingus-coupled qubits for relational quantum computation
- Building hardware with variable $\hbar_{\text{eff}}$ for tunable quantum behaviour
- Extending the GQC complexity class analysis to include collapse-driven speedups

13 Discussion

We have presented a new quantum computing architecture in which measurement is not a postulate but a derived geometric operation. The architecture replaces the standard circuit model's three primitives with a unified 7-stage generative loop. Unitary gates correspond to variational flow and coherence ascent. Measurement corresponds to collapse along a soft mode. Classical control corresponds to invariant update and loop nesting.

The architecture provides:

- a physical basis for measurement,
- a geometric interpretation of error correction,
- a mechanistic origin for $\hbar_{\text{eff}}$,
- a unified framework for quantum computation, quantum foundations, and cognition,
- a connection to the established MIPT literature on measurement-induced phase transitions,
- a foundation for buildable hardware through local quantum texture, adaptive tempo, and measurable scars,
- experimental signatures that can be tested in current and near-term quantum hardware.

This opens new directions for:

- designing quantum algorithms using coherence-geometric principles,

- understanding measurement-based quantum computing as controlled collapse,
- building quantum hardware that leverages the collapse mechanism,
- and unifying quantum foundations, computation, and cognition.

14 Conclusion

We have presented a new quantum computing architecture in which measurement is derived from geometric collapse, not assumed as a postulate. The architecture unifies unitary evolution and collapse in a single master equation and a single Hamiltonian:

$$\hat{H}_{\text{gen}} = \hat{H}_A + \hat{H}_C + \hat{H}_{\text{collapse}}$$

The architecture provides:

- a mechanistic origin for measurement,
- a geometric interpretation of error correction,
- a unified framework for quantum computation, quantum foundations, and cognition,
- a formal grounding in the UGF Reference Manual's rigorous definitions,
- a path to buildable hardware through local quantum texture, adaptive tempo, and measurable scars,
- experimental signatures that can be tested in current and near-term quantum hardware.

Quantum computation is generative collapse harnessed as an algorithm. The loop is a circuit. Collapse is a measurement. And the architecture is computation itself.

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A Single-Qubit Collapse Dynamics: Worked Example

For a single qubit, the coherence tensor $\mathcal{C}$ is a 2×2 positive semi-definite matrix:

$$\mathcal{C} = \begin{pmatrix} c_{00} & c_{01} \\ c_{01}^* & c_{11} \end{pmatrix}$$

Its eigenvalues are:

$$\lambda_\pm = \frac{1}{2}\left(c_{00} + c_{11} \pm \sqrt{(c_{00} - c_{11})^2 + 4|c_{01}|^2}\right)$$

Collapse occurs when $\lambda_{\min} = 0$. The soft mode is the corresponding eigenvector $v_{\min}$:

$$v_{\min} = \begin{pmatrix} -\frac{c_{01}}{\sqrt{|c_{01}|^2 + (\lambda_{\min} - c_{00})^2}} \\ \frac{\lambda_{\min} - c_{00}}{\sqrt{|c_{01}|^2 + (\lambda_{\min} - c_{00})^2}} \end{pmatrix}$$

At collapse, the state projects onto $v_{\min}$ with probability:

$$P = \frac{\langle (\delta G)^2 \rangle_{v_{\min}}}{\sum_j \langle (\delta G)^2 \rangle_j}$$

For a pure state $|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$, the coherence tensor is $\mathcal{C} = |\psi\rangle\langle\psi|$. Its eigenvalues are $(1, 0)$—the system is already at the collapse threshold. Measurement is the projection onto $|0\rangle$ or $|1\rangle$ along the soft mode.

B Two-Qubit Collapse Dynamics: Worked Example

For a 2-qubit system, $\mathcal{C}$ is a 4×4 positive semi-definite matrix:

$$\mathcal{C} = \begin{pmatrix} c_{00,00} & c_{00,01} & c_{00,10} & c_{00,11} \\ c_{01,00} & c_{01,01} & c_{01,10} & c_{01,11} \\ c_{10,00} & c_{10,01} & c_{10,10} & c_{10,11} \\ c_{11,00} & c_{11,01} & c_{11,10} & c_{11,11} \end{pmatrix}$$

Its eigenvalues $\lambda_1 \leq \lambda_2 \leq \lambda_3 \leq \lambda_4$ indicate the stability of each computational basis state. Collapse occurs when $\lambda_1 = 0$. The soft mode $v_{\min}$ is the corresponding eigenvector, defining the direction of projection.

For an entangled state:

$$|\psi\rangle = \frac{1}{\sqrt{2}}(|00\rangle + |11\rangle)$$

the coherence tensor has eigenvalues $(1, 0, 0, 0)$—the system is already at the collapse threshold. Measurement projects onto the entangled subspace along the soft mode, which in this case is aligned with the entangled state itself.

This demonstrates that the architecture naturally handles entanglement: the soft mode selects the entangled subspace, and collapse projects the system into it.