Quantum Memory Framework: Quantitative Analysis and Hypothesis

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Abstract

This appendix presents a quantitative model for the proposed Quantum Memory (QM) framework — a unified informational field embedded in spacetime that archives, transfers, and re-expresses data from all living systems. The mathematical formulations herein are intended as scaffolding for future experimental validation, linking the theory to established models in quantum information science and thermodynamics. While speculative, the goal is to formalize QM as a testable architecture compatible with known physics.

1. Framework Overview

Quantum Memory (QM) is conceptualized as a distributed informational substrate within spacetime, in which data from all quantum systems is conserved. Rather than existing as discrete storage, QM behaves as a dynamic archive in constant flux — a *quantum informational field* that both records and transmits the state of living and physical systems.

Let the memory field be denoted as $\mathcal{M}(x,t)$, parameterized over spacetime coordinates (x,t). Each localized system S_i contributes information via a state function $\psi_i(t)$ with probability amplitude α_i.

$$\mathcal{M}(x,t) = \sum_{i=1}^{N} \alpha_i \psi_i(x,t) \tag{1}$$

Here, $\mathcal{M}$ represents the collective informational field, aggregating contributions from all quantum systems.

2. Information Transfer and Imprint Model

We model the transfer of informational states between living entities and the QM field as an imprint–retrieval cycle.

2.1. Imprint Phase

At the quantum scale, data imprinting can be represented as a controlled rotation between a system qubit and a memory qubit:

$$U_{imprint} = \mathrm{CR}_y(\theta) \tag{2}$$

where $\mathrm{CR}_y(\theta)$ denotes a controlled rotation about the Y-axis by angle θ. This process aligns with the *Quantum Memory Matrix* experiments (Neukart et al., 2024), where imprint fidelity demonstrates partial state transfer from a field qubit to a storage qubit.

2.2. Retrieval Phase

Retrieval occurs through a controlled-SWAP operation:

$$U_{retrieve} = \mathrm{CSWAP}(\phi) \tag{3}$$

ensuring unitarity and reversibility. The total transformation is given by:

$$U_{QM} = U_{retrieve} U_{imprint} \tag{4}$$

where U_{QM} preserves quantum coherence across both field and memory qubits.

3. Entropy and Information Conservation

To satisfy the conservation of information principle:

$$\Delta I_{total} = \Delta I_{system} + \Delta I_{\mathcal{M}} = 0 \tag{5}$$

indicating that as informational entropy increases in any subsystem, a complementary decrease occurs within $\mathcal{M}$, maintaining global equilibrium.

4. Energetic Boundary of the Archive

We propose that $\mathcal{M}$ operates at or near the Planck energy boundary E_P:

$$E_P = \sqrt{\frac{\hbar c^5}{G}} \tag{6}$$

suggesting the archive functions as a non-local, low-entropy domain sustained by quantum coherence within spacetime foam.

5. Photonic Mediation Hypothesis

Photons are proposed as carriers of imprint and retrieval interactions between $\mathcal{M}$ and observable systems. The photon flux density Φ couples with informational exchange rate Γ as:

$$\Gamma = k\,\Phi\,\Delta S \tag{7}$$

where k is a proportionality constant and ΔS represents the system's change in entropy. This relation ties QM activity directly to energy transfer observable in decay and biophotonic emissions.

6. Implications for Consciousness

If neural microstructures (e.g., microtubules, per Penrose–Hameroff Orch-OR) engage in photonic quantum coherence, they may act as bidirectional nodes between $\mathcal{M}$ and biological cognition:

$$C(t) = f(\mathcal{M}(x,t), \psi_{neural}(t)) \tag{8}$$

with $C(t)$ representing emergent conscious experience as a coupled state function.

7. Experimental Outlook

Future tests may include:

1. Correlation of gamma-wave bursts in terminal EEG with photonic emission spectra.
2. Laboratory replication of imprint–retrieval dynamics using qubit arrays.
3. Study of entropy gradients in biological decay processes and their radiative output.

8. Conclusion

The Quantum Memory framework proposes that spacetime itself acts as an informational archive. Through reversible quantum processes, all states are preserved beyond physical dissolution. Life and death become transfers, not terminations, of data. Testing these principles will require integration across neuroscience, quantum computing, and cosmology — but the mathematics now provide a map worth following.

References

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