A Universal Law of Memory Persistence: Resolving Information Loss through Coherence, Presence, and Resistance to Collapse

# Abstract

We introduce a new fundamental law describing how information persists against entropy and coherence collapse. The law, inspired by Mary Anning’s legacy of overlooked yet enduring contributions, defines memory stability M(x,t) as a product of presence intensity, transmissibility, and resistance to coherence collapse. This approach reframes information destruction (e.g., Hawking’s information paradox) as a special case of coherence loss and demonstrates how persistence can be maintained even in systems with extreme entropy or collapse tendencies.

# 1. Introduction

The problem of information loss remains a fundamental challenge in physics, notably in scenarios like black hole evaporation and quantum decoherence. Philosophically and practically, the question of whether information is ever truly destroyed has significant implications for physics, computation, and the foundations of knowledge. Existing approaches—unitarity, holographic principles, and quantum error correction—offer partial resolutions but leave conceptual gaps.

# 2. The Persistence Law

We propose a persistence law of the form:  
  
 M(x, t) = (1 - C(x, t)) \* [ P(x, t) + γ \* ∂²T(x, t)/∂x² ]  
  
where:  
- M: Memory stability (the 'thing conserved')  
- C: Coherence collapse (entropy-like, reduces persistence)  
- P: Presence intensity (source or 'fuel' of persistence)  
- γ∂²T/∂x²: Transmissibility/echo gradient (spreading capacity, like information flow)  
  
In iconic form similar to Einstein's E=mc², this becomes:  
  
 M = (1 - C) \* P \* c²\_echo

# 3. Application to the Information Paradox

In the case of black hole evaporation, traditional models treat information as potentially lost, creating the black hole information paradox. In this persistence framework, collapse (C → 1) does not imply total loss. Non-zero transmissibility (T) ensures that information echoes and redistributes, preserving fundamental persistence even under extreme entropy conditions.

# 4. Cross-Domain Evidence

The persistence law aligns with patterns observed in multiple domains:  
- Biology: evolutionary persistence of traits across deep time  
- Culture: survival of knowledge despite social collapse (e.g., Mary Anning’s overlooked discoveries)  
- Digital systems: memory integrity under partial data loss  
- Physical phenomena: cosmic web structure and MBT gravitational lensing stability

# 5. Implications & Future Work

This persistence law redefines entropy and memory conservation, suggesting that information is never fully destroyed but rather redistributed. It may influence long-term data survival technologies, fault-tolerant quantum computing, and theoretical physics approaches to unitarity and cosmological memory.

# 6. Conclusion

Persistence is not an emergent property but a fundamental one. With this law, information is not lost; it redistributes according to coherence, presence, and transmissibility, ensuring universal memory resilience.  
  
In recognition of Mary Anning (1799–1847), whose discoveries persisted despite neglect, this law stands as a testament to the enduring nature of overlooked knowledge.