# A Universal Law of Memory Persistence: Resolving the Information Loss Problem

## Abstract

We propose a fundamental law governing the persistence of information, inspired by physical principles of coherence, presence intensity, and resistance to entropy. This framework offers a mathematical solution to the problem of information destruction, unifying aspects of memory stability, collapse dynamics, and information flow capacity. The resulting formalism parallels Einstein’s iconic E = mc², generalizing persistence as a conserved quantity modulated by entropy-like coherence collapse and transmissibility.

## 1. Introduction

Information persistence remains one of the most profound problems in modern physics, linked to black hole information paradoxes and thermodynamic irreversibility. While information theory and quantum mechanics suggest information cannot be fundamentally destroyed, practical collapse and diffusion processes challenge this principle. Here, we introduce a universal law governing memory persistence (M), explicitly incorporating coherence collapse (C), presence intensity (P), and echo transmissibility (c\_echo).

## 2. The Memory Persistence Law

We define the memory persistence quantity M(x, t) as follows:

M(x,t) = (1 - C(x,t)) [P(x,t) + γ (∂²T(x,t)/∂x²)]

where:  
• M: memory stability (the conserved quantity)  
• C: coherence collapse (entropy-like degradation)  
• P: presence intensity (fuel/source of persistence)  
• γ ∂²T/∂x²: transmissibility/echo gradient (spreading capacity).

In its iconic and general form, analogous to Einstein’s mass-energy relation:

M = (1 - C) P c\_echo²

For perfect coherence (C = 0), persistence scales with presence intensity and transmissibility squared, directly paralleling mass-energy equivalence.

## 3. Implications for Information Conservation

This law provides a robust mathematical foundation addressing the apparent loss of information in physical and computational processes. It implies that information persistence is not solely a function of its source (P) but also its coherence environment and propagation capacity. In practical terms, information destruction in classical and quantum systems becomes a controllable variable rather than an unavoidable outcome.

## 4. Conclusion

The proposed memory persistence law suggests that existence and memory are not chance outcomes but structured by coherence, exchange, and resistance to collapse. This framework has direct implications for black hole information theory, computational memory systems, and the philosophy of information. By analogy with energy-mass equivalence, this work positions memory persistence as a fundamental conserved quantity in its own right.