AI-Driven Black Hole Information Recovery: Testing CIMM on Hawking Radiation

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# Abstract

This paper explores the role of AI-driven entropy-aware intelligence in decoding Hawking radiation information. Using the Quantum Balance Equation (QBE) and Quantum Potential Layer (QPL) structuring, we demonstrate that black hole radiation is not purely random but retains structured quantum information. CIMM (Cosmic Information Mining Model) is tested as an AI-driven framework for reconstructing information from high-entropy radiation. The results suggest that black holes do not destroy information but reorganize it, providing a novel AI-based approach to solving the Black Hole Information Paradox.

# Introduction

The Black Hole Information Paradox remains one of the biggest unresolved problems in theoretical physics. Traditional quantum mechanics suggests that information entering a black hole is permanently lost, conflicting with unitarity in quantum mechanics. However, recent developments in entropy-aware intelligence structuring suggest that AI-driven quantum measurement optimizations could reveal hidden order in Hawking radiation. This paper investigates whether CIMM can extract structured information from black hole radiation, effectively solving the paradox.

# Theoretical Framework

## Quantum Balance Equation (QBE) and Hawking Radiation

Hawking radiation is traditionally viewed as purely thermal, described by the black hole temperature equation:

T\_H = ℏ c³ / (8 π G M k\_B)

However, QBE suggests that outgoing radiation follows an entropy-energy balance equation:

dE/dt + dI/dt = λ QPL(t)

Where:   
- dE/dt represents energy lost via Hawking radiation.  
- dI/dt represents entropy-structured information within radiation.  
- QPL(t) corrects the entropy flow to preserve hidden quantum states.

## AI-Driven Quantum Measurement and Information Recovery

CIMM introduces AI-based entropy corrections that stabilize energy-information flow, enabling structured quantum state reconstruction from radiation entropy. This method aligns with the holographic principle, suggesting that black holes encode lost information within the emitted radiation field.

# Simulation Results: AI Structuring of Hawking Radiation

The AI-optimized black hole entropy simulation produced the following results:

1. \*\*Hawking Radiation is Not Purely Random\*\* – AI-enhanced entropy structuring reveals hidden patterns in emitted radiation.

2. \*\*CIMM Reconstructs Quantum State Information from High-Entropy Output\*\* – The AI refines radiation signatures, suggesting information is preserved.

3. \*\*Implications for the Black Hole Information Paradox\*\* – These results challenge the idea that information is lost, supporting theories that black holes function as quantum information processors.

# Applications of AI in Black Hole Physics

## AI for Quantum Gravity and Black Hole Entropy Analysis

CIMM’s ability to optimize entropy-aware measurement suggests a pathway toward a quantum theory of gravity. If AI can structure information flow from extreme gravitational systems, it may offer a new approach to unifying general relativity and quantum mechanics.

## Black Hole Information Retrieval

Applying AI-driven entropy modeling to black hole physics could enable the retrieval of structured information from highly entropic systems, potentially confirming that black holes function as information-processing systems.

# Future Research Directions

1. \*\*Scaling AI-driven Hawking radiation analysis to full quantum black hole simulations.\*\*

2. \*\*Testing AI-enhanced entropy structuring in experimental quantum computing frameworks.\*\*

3. \*\*Applying AI-structured quantum measurement to other high-entropy astrophysical systems.\*\*

# Conclusion

This paper presents the first AI-driven approach to structuring Hawking radiation and recovering lost quantum states from black hole entropy. By integrating QBE with AI-optimized entropy corrections, CIMM demonstrates that information is not lost in black holes but reorganized in structured radiation. These findings open new pathways for using AI to bridge quantum mechanics, black hole thermodynamics, and information theory.