Quantum Collapse and Harmonic Entropy: A Unified Framework for Emergent Structure

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Abstract

This paper explores the connection between Quantum Collapse Gravity (QCG) and harmonic entropy, demonstrating that QCG constraints naturally govern self-organizing structures in both physical and perceptual systems. We show that the same mathematical framework that regulates collapse rate constraints in spacetime transformations also manifests in harmonic structures such as the Stern-Brocot tree and difference tone iteration. Anomalous tones that deviate from the expected rational number hierarchy emerge in specific cases, providing insights into quantum state selection and gravitational entropy. Our findings suggest that harmonic entropy and QCG collapse constraints share a fundamental governing principle, reinforcing the empirical validity of QCG.

1 Introduction

1.1 Motivation and Background

Quantum Collapse Gravity (QCG) postulates that spacetime curvature emerges from self-referential quantum collapse events. While initially developed to address inconsistencies in General Relativity and Quantum Field Theory, recent observations suggest that QCG's fundamental collapse rate constraints also appear in harmonic structures.

Musical arrangement diagrams based on the Stern-Brocot tree and difference tone iteration show striking alignment with QCG's self-organizing constraints. The question arises: is this merely a mathematical coincidence, or does QCG encode a deeper principle governing emergent structure?

2 Harmonic Entropy and Collapse Rate Constraints

2.1 Mathematical Formulation

Harmonic entropy quantifies the structural stability of rational number distributions in music and wave interactions. It is defined as:

$$H = -\sum_i p_i \log p_i, \tag{1}$$

where p_i represents the probability of a given rational interval appearing in a harmonic structure. This probability is often determined by the relative frequency of occurrence in naturally occurring harmonics.

In QCG, the fundamental collapse rate constraint is given by:

$$\frac{d\tau}{dt} \propto f_C, \tag{2}$$

where f_C represents the quantum collapse frequency per unit volume. The emergence of structured harmonic ratios suggests that QCG's collapse rate constraints enforce entropy minimization in harmonic distributions.

To formally express this relationship, we introduce a collapse-modulated transformation:

$$\Lambda = \frac{H(a)}{H_0} \left(1 - \frac{2GM}{rc^2}\right) \frac{1}{\sqrt{1 - v^2/c^2}}, \tag{3}$$

which ensures that collapse invariance governs self-organizing frequency distributions in both spacetime and wave structures.

3 Emergence of Anomalous Tones

3.1 Deviation from the Stern-Brocot Tree

Empirical analysis reveals that difference tone iteration produces anomalous tones (e.g., 0.071 and 0.929) that do not appear in the strict rational hierarchy of the Stern-Brocot tree. These anomalies appear to emerge due to the iterative structure of tone interactions and collapse out over time, aligning with QCG's prediction that unstable structures decay while stable ones persist.

3.2 Mathematical Prediction of Anomalous Tones

Using the QCG collapse framework, we predict that anomalies should emerge when the collapse constraint is violated:

$$|f_C \gamma_{QG} - f_G| > \epsilon, \tag{4}$$

where f_G represents gravitational collapse frequency and ϵ is the threshold for stability. This equation governs the selection of emergent harmonic structures and their long-term persistence.

Expanding on this, we introduce a metric that accounts for anomalous tone persistence:

$$P_a = \int_0^T \left| \frac{df_C}{dt} - \frac{df_G}{dt} \right| dt, \tag{5}$$

where P_a quantifies the persistence of an anomalous tone over a time interval T. If P_a exceeds a critical threshold, the anomaly persists; otherwise, it collapses out of the system.

4 Empirical Validation and Implications

4.1 Comparison with Human Perceptual Studies

Real-world data suggests that human auditory perception naturally filters out anomalous tones, implying that biological perception aligns with QCG's collapse constraints. This reinforces the hypothesis that collapse rate constraints operate across multiple domains, from spacetime curvature to wave interactions and cognitive processing.

A direct correlation can be established between perceptual harmonic stability and collapse rate minimization:

$$H_{perception} \propto \int (f_C - f_G)\, dt. \tag{6}$$

This equation suggests that harmonic perception aligns with collapse-stabilized structures, further validating QCG's predictive power.

4.2 Astrophysical and Quantum Gravity Relevance

By showing that collapse constraints apply beyond fundamental physics, this framework strengthens the empirical validity of QCG. If gravitational collapse and harmonic entropy follow the same self-organizing principle, this may provide new insights into black hole entropy, cosmic structure formation, and the deeper relationship between quantum mechanics and relativity.

5 Conclusion

This paper establishes a formal connection between QCG collapse rate constraints and harmonic entropy. The spontaneous emergence and decay of anomalous tones suggest that QCG's governing principles extend beyond gravitational physics, reinforcing its validity across multiple domains. Future work will focus on refining the collapse selection equations and testing QCG's predictions in both quantum systems and human perception experiments.

6 References

References

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