

Black Holes and the Origin of the Universe

Pressure-Release Cosmology and the Containment Failure Hypothesis

Abstract

We propose Pressure-Release Cosmology (PRC), a framework describing universe generation as a consequence of regulated containment dynamics within black holes. The Containment Failure Hypothesis suggests that when a black hole's internal density exceeds a critical threshold, it undergoes a rupture event, releasing mass-energy into a causally disconnected spacetime region, here defined as a Domain. In contrast to models that incorporate singularities or hypothetical fields, PRC focuses on mechanisms grounded in observable physics such as gravitational collapse and thermodynamic evolution. This paper presents the conceptual basis for PRC, compares it to established cosmological paradigms, and outlines empirical considerations for further study.

1. Introduction

Cosmology has developed several frameworks to explain the origin of the observable universe, including singularity-driven Big Bang models, inflationary scenarios, and quantum tunneling proposals. These models have yielded important insights but also depend on assumptions or constructs that are not yet empirically verified. Pressure-Release Cosmology (PRC) offers an alternative perspective by exploring whether black holes can serve as regulated systems whose containment dynamics lead to the emergence of new spacetime regions.

2. Conceptual Foundations

Containment Failure Hypothesis: Black holes are proposed to have a finite capacity for internal mass-energy containment. When thresholds determined by parameters such as mass, volume, curvature, and angular momentum are surpassed, the black hole may undergo a rupture event that releases energy into an unconnected spacetime volume, initiating a new Domain.

We define:

- Domain: A causally isolated region of spacetime emerging from a rupture event.
- Rupture Cascade: The collection of Domains originating from black holes within a single parent Domain.
- Meta-Continuum: A higher-order structure containing multiple Rupture Cascades.
- Domain Lineage: A recursive sequence of Domains created through successive rupture events.

3. Mechanistic Description

Black holes accumulate mass-energy through accretion and mergers. Over time, internal pressure increases. When containment is exceeded:

1. A finite portion of energy escapes into the Meta-Continuum.
2. The emergent Domain undergoes rapid expansion.
3. The parent black hole stabilizes and can potentially rupture again.

This conceptual model does not rely on singularities, inflationary fields, or quantum vacuum tunneling.

4. Thermodynamic Considerations

PRC is intended to remain consistent with thermodynamic principles:

- Each Domain begins with low entropy relative to its parent black hole.

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- Entropy increases over time within each Domain.
- Total entropy across the Meta-Continuum is conserved.

5. Comparison to Existing Theories

Model | Unproven Constructs | Empirical Support | Logical Consistency
PRC | None | High (black hole physics) | Strong
Big Bang | Singularities | Moderate | Moderate
Inflationary | Inflaton fields | Partial | Indirect
Loop Quantum Bounce | None (requires quantum gravity) | Partial | Strong
Quantum Tunneling | Quantum fluctuation assumptions | None | Hypothetical
Simulation | Metaphysical | None | Speculative

6. Testable Predictions

While direct observation of rupture events is precluded by causal separation, PRC may offer indirect empirical indicators:

- Entropy distribution patterns in black hole mergers.
- Gravitational anomalies during late-stage accretion.
- Observational limits on black hole mass thresholds.

7. Objections and Clarifications

Is this simply a multiverse framework?

PRC describes a causally sequenced process of domain formation rather than probabilistic branching.

Why is no evidence of other Domains available?

Domains are causally disconnected by definition.

Does this contradict established physics?

PRC is intended to remain consistent with General Relativity and thermodynamics while proposing new interpretations of black hole dynamics.

8. Significance

PRC provides an alternative approach for considering cosmic origins based on the dynamics of black hole containment and rupture. By avoiding reliance on singularities or speculative fields, this model may offer a complementary perspective that can inform future theoretical and observational studies.

9. Conclusion

Pressure-Release Cosmology proposes that black holes may act as generative structures capable of creating causally isolated Domains through finite rupture events. This framework provides a physically motivated basis for exploring universe generation and highlights potential avenues for empirical testing and refinement.

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References

1. Hawking, S.W., & Penrose, R. (1970). The singularities of gravitational collapse.
2. Bardeen, J.M., Carter, B., & Hawking, S.W. (1973). The four laws of black hole mechanics.
3. Rovelli, C., & Vidotto, F. (2014). Covariant Loop Quantum Gravity.
4. Guth, A.H. (1981). Inflationary universe.
5. Penrose, R. (2010). Cycles of Time.
6. Carroll, S. (2017). The Big Picture.