A Quantum Entanglement Perspective of the Big Bang: A Symmetric Universe-Anti-Universe Model

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Abstract

This paper introduces a novel hypothesis that reinterprets the Big Bang as a **quantum entanglement event** connecting two symmetric universes: our observable, matter-dominated universe and a mirrored anti-universe where antimatter dominates and time flows in reverse. This theory provides a unified explanation for unresolved cosmological challenges, including the **matter-antimatter imbalance**, the **arrow of time**, and the **nature of dark matter**. Furthermore, it offers explanations for anomalies in the **Cosmic Microwave Background (CMB)**, such as the **Cold Spot**, large-scale asymmetries, and power suppression at large scales. By integrating quantum entanglement, symmetry principles, and modern cosmology, this framework reshapes our understanding of the universe's origins, evolution, and structure, while providing predictions that align with observational data and offer new pathways for testing. This extended work explores further implications of the theory on unsolved challenges in the current cosmological models.

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1. Introduction

The Standard Model of cosmology successfully explains much of the observable universe but leaves key questions unanswered:

1. **Matter-Antimatter Imbalance**: Why is our universe dominated by matter when theory predicts equal creation of matter and antimatter?
2. **The Arrow of Time**: Why does time flow in a single direction, despite time-symmetric physical laws?
3. **Dark Matter**: What is the nature of dark matter, which accounts for ~27% of the universe's mass-energy but remains invisible and unexplained?
4. **CMB Anomalies**: Why do we observe large-scale asymmetries, such as the **Cold Spot** and the **Axis of Evil**, in the otherwise homogeneous CMB?
5. **The Nature of Spacetime**: Can quantum mechanics and general relativity be reconciled to describe the early universe?

In this paper, I propose that the Big Bang represents not the origin of everything but a **symmetry-breaking quantum entanglement event** that created two universes: our forward-time, matter-dominated universe and a reverse-time, antimatter-dominated anti-universe. These universes remain entangled, influencing each other subtly but detectably. This hypothesis aligns with **CPT**

symmetry, quantum mechanics, and modern observations, offering solutions to these challenges while reshaping the foundational framework of cosmology.

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2. Theoretical Framework

2.1. CPT Symmetry and Quantum Entanglement

CPT symmetry states that the laws of physics remain unchanged when **Charge (C)**, **Parity (P)**, and **Time (T)** are reversed. If the universe adheres to CPT symmetry, then for a matter-dominated, forward-time universe (ours), there must exist an antimatter-dominated, backward-time anti-universe.

- The **Big Bang** is reinterpreted as the moment this **quantum symmetry broke**, entangling two universes.
- Quantum entanglement provides a mechanism for information exchange and subtle correlations between the two universes, even across a temporal divide.

2.2. Emergence of Time and Symmetry-Breaking

The concept of **time** arises naturally from this symmetry-breaking process. While we experience time flowing forward (increasing entropy), the anti-universe experiences time flowing backward, aligned with its decreasing entropy.

- **Dual-Time Framework**: Both universes preserve the overall balance of entropy and time directionality, creating a larger symmetric whole.
- This resolves the **arrow of time** paradox while preserving the time-reversible laws of physics at a fundamental level.

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3. Implications for Cosmological Mysteries

3.1. Resolving the Matter-Antimatter Imbalance

In our universe, the dominance of matter over antimatter violates expectations from the Standard Model. However:

- The anti-universe, dominated by antimatter, restores the **global balance** of matter and antimatter across the two universes.
- This symmetry-breaking would have produced the slight imbalance needed to create our observable universe while entangling antimatter in the anti-universe.

3.2. Dark Matter as a Quantum Gravitational Signature

Dark matter remains one of the most mysterious components of the universe. In this theory:

- Dark matter may represent **gravitational interactions** or **quantum remnants** of the anti-universe. Mirror particles or entangled states from the anti-universe would interact gravitationally with matter in our universe.
- Unlike Weakly Interacting Massive Particles (WIMPs) or axions, which are hypothesized to interact weakly or via hypothetical scalar fields, mirror particles would exist as **non-local quantum states**. These states would not interact via known forces (like electromagnetic or weak interactions) but would leave detectable gravitational signatures.
- This interpretation positions dark matter as an emergent property of entanglement rather than a particle limited to our universe alone.

Predictions for testing:

- Gravitational lensing anomalies could reveal hints of entangled mirror particles.
- Indirect detection experiments might observe non-local correlations consistent with quantum entanglement across universes.
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- This would explain why dark matter exerts gravitational influence but does not interact via electromagnetic forces.

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3.3. CMB Anomalies as Entanglement Imprints

The Cosmic Microwave Background (CMB) provides a snapshot of the early universe. Several unexplained features could arise naturally in this entangled model:

1. **Cold Spot**: A region of unexpectedly low temperature could represent a quantum shadow or gravitational imprint of the anti-universe.
2. **Large-Scale Asymmetries**: Entanglement between universes may induce correlations that manifest as anisotropies like the **Axis of Evil**.
3. **Suppressed Power**: Power suppression at large scales aligns with predictions of symmetry-breaking quantum states influencing early cosmology.

To detect these anomalies in greater detail, current and upcoming observational tools include:

- The **Planck satellite** and upcoming missions like **CMB-S4** and **LiteBIRD** for high-precision polarization and temperature mapping.
- **James Webb Space Telescope (JWST)** and **Euclid** for gravitational lensing studies that may indirectly confirm anomalies linked to quantum imprints.
- **South Pole Telescope (SPT)** and **Atacama Cosmology Telescope (ACT)** for improved small-scale measurements that can provide finer details of CMB anisotropies.

By improving data resolution and mapping polarization patterns, these tools can validate whether observed anomalies are consistent with the predicted quantum entanglement imprints of a symmetric anti-universe. The Cosmic Microwave Background (CMB) provides a snapshot of the early universe. Several unexplained features could arise naturally in this entangled model:

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Future CMB studies:

- Analyzing CMB **polarization** and **anisotropy** with greater precision may detect these entanglement imprints.

3.4. Testing the Theory Through Observations

This theory makes testable predictions:

1. **CMB Observations**: High-precision measurements of large-scale anisotropies and polarization patterns, using tools such as the **Planck satellite**, **LiteBIRD**, or the upcoming **CMB-S4 experiment**, may reveal imprints of entanglement.
2. **Dark Matter Correlations**: Advanced gravitational lensing studies using observatories like the **James Webb Space Telescope (JWST)** and dark matter mapping projects could uncover quantum signatures from mirror particles.
3. **Gravitational Waves**: Next-generation observatories, including **LISA (Laser Interferometer Space Antenna)** and **Einstein Telescope**, may detect gravitational wave anomalies caused by entanglement effects between universes.

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2. **Dark Matter Correlations**: Advanced gravitational lensing and dark matter mapping techniques could uncover quantum signatures from mirror particles.
3. **Gravitational Waves**: Entanglement effects might produce gravitational wave anomalies detectable by next-generation observatories.

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4. Broader Implications for Physics

This theory offers a framework for reconciling quantum mechanics and cosmology:

- **Quantum Gravity**: Entanglement between universes may hint at a quantum gravitational structure underlying spacetime, aligning with approaches like loop quantum gravity or holographic duality, where spacetime emerges from entanglement.
- **Multiverse Connections**: While multiverse theories such as eternal inflation or string theory postulate disconnected bubble universes, this model introduces **entanglement** as a dynamic link, creating subtle correlations between universes that influence observable physics.
- **CPT Symmetry and Quantum Mechanics**: Unlike classical multiverse models, this framework adheres to fundamental symmetries like CPT invariance, ensuring a balanced, symmetric whole across matter-antimatter and forward-reverse time universes.
- **Origin of Time and Space**: Time and space emerge as entangled properties rather than pre-existing absolutes, similar to how time arises in thermodynamic models or emergent gravity frameworks.

By uniting elements of quantum gravity, multiverse theories, and cosmological symmetry, this theory provides a testable bridge between current models, offering new insights into the foundational structure of reality.**
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- **Quantum Gravity**: Entanglement between universes may hint at a quantum gravitational structure underlying spacetime.
- **Multiverse Connections**: The anti-universe may represent one of many entangled universes, providing a pathway for understanding the multiverse.
- **Origin of Time and Space**: Time and space are emergent properties of entangled systems, not pre-existing absolutes.

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5. Conclusion

I propose that the Big Bang is a quantum entanglement event that produced two symmetric universes: our matter-dominated, forward-time universe and a mirrored antimatter-dominated, reverse-time anti-universe. This theory elegantly resolves key cosmological mysteries, including the matter-antimatter imbalance, the arrow of time, dark matter, and CMB anomalies.

Specific observational signatures that would confirm or falsify this theory include:

- **CMB Anomalies**: High-precision mapping of CMB anisotropies and polarization patterns could reveal imprints consistent with quantum entanglement.
- **Gravitational Wave Anomalies**: Detection of gravitational wave signals from next-generation observatories, such as **LISA** or the **Einstein Telescope**, may provide evidence of entangled universes.
- **Dark Matter Correlations**: Gravitational lensing studies and dark matter mapping projects using observatories like **JWST** and **Euclid** could uncover non-local quantum signatures linked to the anti-universe.

By integrating quantum entanglement, symmetry principles, and modern observational data, this framework offers a testable, unified explanation for the origins and structure of the cosmos. It sets the stage for future advancements in cosmology, offering new tools to explore the fundamental nature of our universe and its symmetric counterpart.
I propose that the Big Bang is a quantum entanglement event that produced two symmetric universes: our matter-dominated, forward-time universe and a mirrored antimatter-dominated, reverse-time anti-universe. This theory elegantly resolves key cosmological mysteries, including the matter-antimatter imbalance, the arrow of time, dark matter, and CMB anomalies. By integrating quantum entanglement, symmetry principles, and modern observational data, this framework offers a testable, unified explanation for the origins and structure of the cosmos, paving the way for future advancements in cosmology and physics.

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