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Antimatter and the Possibility of a Parallel Universe: Exploring the Genesis and Existence of an Antimatter Universe

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Abstract
Antimatter, the oppositely charged counterpart of matter, has been extensively studied in physics. Although matter and antimatter were produced in roughly equal amounts during the Big Bang, our observable universe appears dominated by matter. This paper investigates the possibility of a separate, spatially and temporally mirrored antimatter universe. This study employs CPT symmetry and gamma-ray observations to assess the plausibility of such a universe existing beyond our observable limits, offering insights into fundamental symmetries and cosmic evolution.
Keywords: *Antimatter; Parallel universe; CPT symmetry; Gamma-ray observations.*

Introduction

Antimatter and matter are counterparts, sharing the same structure but with opposite charges. Matter consists of electrons, protons, and neutrons, while antimatter is composed of positrons, antiprotons, and antineutrons. When matter and antimatter collide, their masses annihilate, releasing energy in the form of radiation. Matter and antimatter particles are always produced as pairs.

The Big Bang generated roughly equal amounts of matter and antimatter. This should have resulted in complete annihilation, producing pure energy, yet our observable universe is overwhelmingly dominated by matter. It is possible that, in a manner analogous to the formation of our universe from matter remnants, the leftover antimatter coalesced into a separate, spatially and temporally mirrored antimatter universe.

This principle is demonstrated by the CPT Symmetry (Charge, Parity, and Time reversal), which states that the fundamental laws of physics remain unchanged if three transformations are applied simultaneously:

Charge conjugation (C): replacing all particles with their oppositely charged antiparticles.

Parity inversion (P): flipping the system into its mirror image.

Time reversal (T): reversing the direction of time.

If a process still behaves identically under all three transformations, it satisfies CPT invariance, a cornerstone of quantum field theory and modern particle physics. If Charge, Parity, and Time are reversed, the fabric of space-time has been mirrored, which mirrors relativity itself.

Today, CP violation — deviations from perfect charge-parity symmetry — has been observed in certain particles, such as K-mesons (kaons). However, there has not been an observation of all three conditions being violated at the same instance. Also, if CP violations occur in our universe, symmetry and relativity imply they could also manifest in its CPT-reflected counterpart, maintaining overall balance while producing locally asymmetric conditions

If CPT Symmetry is applied to the entire universe, there is a possibility, that to preserve the symmetry, another universe exists with opposite charges, mirror image, and inverse time. Hence, this universe would directly tie up in the idea of an antimatter, opposite coordinate, inverse time universe, which is our research topic.

Theory

The interaction between matter and antimatter results in complete mass–energy conversion, producing high-energy electromagnetic radiation, typically in the form of gamma rays. The total energy released from matter–antimatter annihilation is given by $E=2mc^2$, where m is the mass of each particle. To investigate such interactions observationally, data from the Fermi Gamma-ray Space Telescope can be analysed. Regions exhibiting anomalously high gamma-ray flux may suggest the presence of antimatter or zones of matter–antimatter annihilation, potentially revealing deeper cosmic symmetries. Furthermore, the slight matter excess attributed to baryogenesis in our observable universe could correspond to an excess of antimatter in a mirror universe, consistent with the predictions of CPT symmetry. Hence, the observation of Gamma Rays can significantly alter our current Standard Model of the Universe.

Gamma-ray observatories such as the Fermi Gamma-ray Space Telescope, HESS (High Energy Stereoscopic System), MAGIC (Major Atmospheric Gamma Imaging Cherenkov telescopes), and VERITAS (Very Energetic Radiation Imaging Telescope Array System) provide us with readings that will help validate this theory.

Particle accelerators demonstrate that when extremely high energy densities are achieved—by concentrating large amounts of energy in very small regions—energy can transform into matter and antimatter pairs in nearly equal proportions. On a much larger scale, this same process governed the early universe during the Big Bang, when the extreme temperature and density allowed continuous creation and annihilation of particle–antiparticle pairs. This can conclude that equal amounts of matter and antimatter had been generated.

Methodology And Data

Gamma-ray observations provide a unique window into high-energy astrophysical phenomena. Data from the H.E.S.S. Gamma-Ray Burst (GRB) catalogue were analysed to identify regions exhibiting elevated gamma-ray flux. The right ascension (RA) and declination (Dec) coordinates of recorded GRBs, up to the most recent year, were projected onto a Cartesian plane using an equidistant mapping for visual representation.

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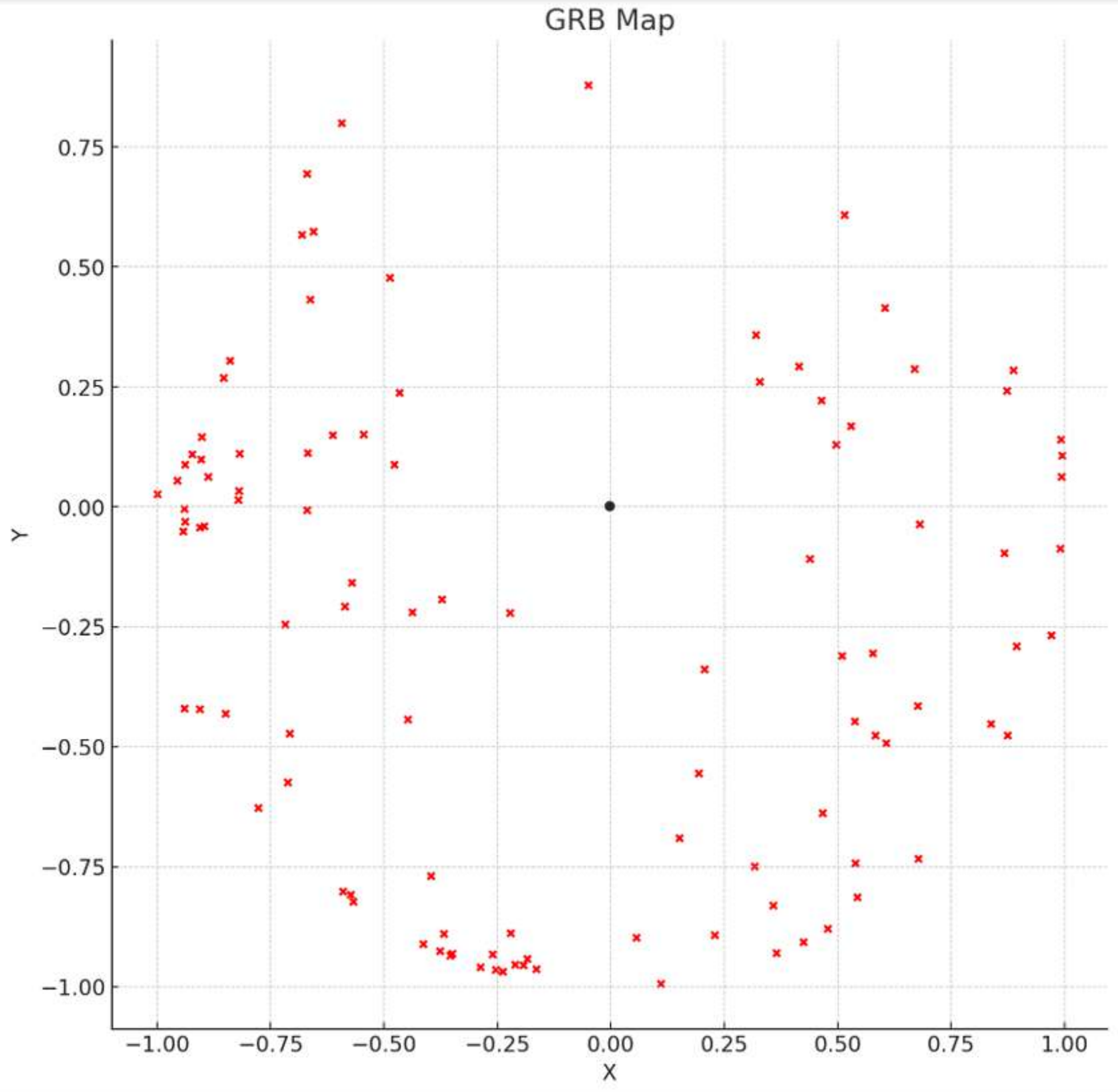

Results And Analysis

Preliminary visualization of gamma-ray bursts (GRBs) suggests an increased event density in certain distant regions relative to those nearer the observer. While conventional astrophysical explanations—such as supernovae or neutron star mergers—likely account for most observations, a speculative scenario is considered in which some elevated gamma-ray events might originate from rare matter–antimatter annihilations.

If this were the case, it could hint at the existence of a CPT-symmetric antimatter universe, wherein regions of antimatter coexist with matter and exert gravitational influence. This framework does not claim confirmation but rather provides a conceptual basis for further exploration, highlighting how anomalies in high-energy astrophysical data could, in principle, be consistent with a mirrored-universe hypothesis.

Although highly speculative, this approach may facilitate the conceptualization of a unified universe–anti universe model. Thought experiments such as this highlight the value of using

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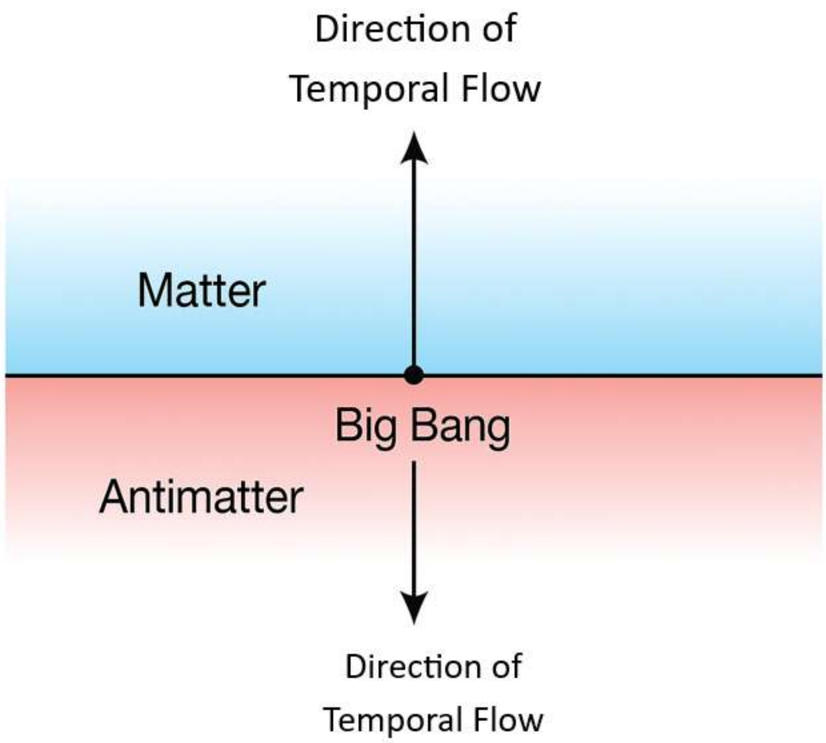
existing observational data to propose hypotheses that could, with future tools and measurements, be investigated more rigorously. This represents the "what if" stage of research, where creative reasoning and careful theoretical grounding are the primary contributions.

In this model, the universe is represented as a two-dimensional plane divided along a central axis corresponding to the Big Bang. The **upper half** of the plane represents our observable, matter-dominated universe, where particles follow conventional charges, spatial orientation, and forward temporal progression. The **lower half** depicts a mirrored antimatter universe, with particles of opposite charge, spatial coordinates reflected across the central axis, and temporal progression reversed, consistent with CPT symmetry.

The central axis serves as the origin of expansion for both universes, with arrows indicating outward progression of matter and antimatter regions. Gradients or intensity can encode properties such as gamma-ray flux or matter density, highlighting areas of matter–antimatter interactions or anomalies. Colour coding (blue for matter, red for antimatter) reinforces the mirror-symmetry concept.

This lateral-symmetry plane provides a simplified yet intuitive visualization of a CPT-symmetric universe. It enables conceptual exploration of interactions, spatial distributions, and energy phenomena within a framework where matter and antimatter coexist in mirrored halves of a unified space-time plane.



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Conclusion

In conclusion, a CPT-symmetric antimatter universe presents a compelling, if speculative, lens through which to view the matter-dominated cosmos. By linking theoretical symmetry principles with gamma-ray observations, this study hints that even subtle anomalies in high-energy astrophysical data could point to a mirrored universe. While definitive evidence remains out of reach, the possibility challenges us to rethink our cosmic perspective and explore the universe's hidden symmetries.

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