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The CAT Jump: Unveiling the True Origin of the Cosmic Microwave Background

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Abstract

The Cosmic Microwave Background (CMB) has long been considered a corner- stone of the Big Bang model, representing the afterglow of the early universe's hot and dense state. However, recent observations from the James Webb Space Telescope (JWST) have revealed the existence of fully formed galaxies at approximately 330,000 years after the Big Bang an era when, according to standard cosmology, the universe should still be filled with an opaque plasma of electrons and protons, preventing light from escaping. This discrepancy calls into question the Big Bang explanation for the CMB and opens the door for alternative theories. This paper presents the Cosmic Antiproton Tomography (CAT) model, a novel framework that reinterprets the CMB as the result of antiproton annihilations during the final moments of cosmic inflation. The CAT model aligns remarkably well with CMB observations and naturally explains the polarization of the radiation a feature that remains problematic in the standard model. Moreover, the CAT model is fully compatible with JWST's observations of early galaxies, pro- viding a coherent explanation for the emergence of large-scale structures in the universe. By comparing the key aspects of the CMB in both the Big Bang and Small Bang models, this work challenges the standard paradigm and presents a compelling case for revisiting the origins of the cosmic background radiation.

Keywords: Cosmic Microwave Background, Cosmic FM Background, Cosmic Inflation, Inflaton, Cosmic Antiproton Tomography, Cosmic Positron Tomography.

1. Introduction

The Cosmic Microwave Background (CMB) is traditionally considered one of the most robust pillars supporting the Big Bang model of cosmology. It is thought to be the afterglow of the universe's initial hot and dense state, stretching back nearly 13.8 billion years. According to standard cosmological theory, the CMB formed approximately 380,000 years after the Big Bang, when the universe cooled enough to allow electrons and protons to combine into neutral hydrogen atoms, making the cosmos transparent to radiation for the first time.

However, recent theoretical developments challenge this foundational concept. This paper introduces an alternative explanation for the CMB: the Cosmic Antiproton Tomography (CAT) model. This model suggests that the CMB is not a relic of a uniform "hot plasma" recombination event, but rather the product of an entirely different mechanism linked to the final moments of cosmic inflation. The CAT model postulates that the CMB originated from the annihilation of antiprotons produced in the last 30-40 nanoseconds of the Inflaton field's existence.

This paper, which could have been called as well like: "The CAT Jump: The True Origin of the CMB", aims to explore the inconsistencies within the standard Big Bang interpretation of the CMB and present the case for a radically different source, one that resolves long-standing contradictions and aligns with observational data in a more coherent way.

2. The Big Bang Theory

The Big Bang theory grounded in Hubble's observations, posits that the universe originated from a singular, extremely dense, and hot point, which has been expanding over time [1]. It accounts for the early formation of hydrogen and helium and asserts the existence of Cosmic Microwave Background (CBM) radiation as remnants of the initial hot, dense state. Despite its success in elucidating many cosmic phenomena, the Big Bang theory has shortcomings, especially concerning the uniformity of the universe and the matter-antimatter distribution.

3. The CMB in the Big Bang Model

In the standard Big Bang cosmology, the CMB is considered the remnant radiation from the early universe, often described as a ”snapshot” of the universe at approximately 380,000 years after the Big Bang. According to this model:

- The universe began in a hot, dense state and rapidly expanded.
- Initially, the cosmos was filled with a plasma of electrons and protons that scattered photons, making the universe opaque.
- As the universe expanded and cooled to about 3000 Kelvin, electrons combined with protons to form neutral hydrogen.
- This recombination made the universe transparent to radiation, allowing photons to travel freely for the first time. These photons constitute what we observe today as the CMB.

The Big Bang model predicts that the CMB should have a nearly perfect black- body spectrum at a temperature of 2.7 Kelvin, with slight anisotropies corresponding to primordial density fluctuations that seeded the formation of galaxies and large-scale structures.

Nevertheless, as will be discussed in the following sections, significant inconsistencies emerge when comparing the theoretical predictions of the CMB’s wavelength expansion and polarization to observational data. These inconsistencies open the door to alternative models, such as the CAT model, which offers a fresh perspective on the true origin of the CMB.

4. Problems with the Big Bang CMB Model

Although the Big Bang theory has long been considered the dominant explanation for the Cosmic Microwave Background (CMB), it presents significant theoretical and observational inconsistencies that challenge its validity. This section outlines the most critical issues:

4.1 Mismatch between Space Expansion and CMB Wavelength Stretching

The expansion factor of the universe from the time of recombination (380,000 years after the Big Bang) to the present is estimated to be approximately 37,000 to 39,000 times, based on the observable size of the universe. However, the observed CMB wavelength expansion, from approximately 1000 nm (the infrared peak of a blackbody at 3000 Kelvin) to the current 1 mm peak, corresponds to a factor of only 1000. This discrepancy of about 30 times between the expected and observed stretching factors (which should theoretically be the same, since if the space doubles in size, all distances—including photon wavelengths—should also double) highlights a serious inconsistency that standard cosmology cannot reconcile.

4.2 Non-Blackbody Spectrum Cutoff

The CMB spectrum is traditionally described as an almost perfect blackbody curve at 2.7 Kelvin. However, it shows a distinct cutoff at wavelengths shorter than 0.5 mm, with no detected signal below this threshold. This sharp cutoff is inconsistent with any natural blackbody emitter, raising questions about the physical origin of the CMB.

4.3 Polarization of the CMB

According to the Big Bang model, the CMB was emitted from a plasma that should produce unpolarized light. However, the CMB is observed to be polarized today. The standard explanation attributes this to complex interactions during the long journey of photons through cosmic structures, yet fails to provide a satisfactory mechanism that would fully account for the observed polarization.

4.4 Simultaneous Recombination Problem

The Big Bang model posits that, at a specific time (380,000 years after the Big Bang), the entire universe became transparent as protons and electrons recombined to form neutral hydrogen. How- ever, recombination over such vast regions would likely be asynchronous due to inhomogeneities and density variations. This challenges the notion of a sudden, simultaneous CMB emission across the cosmos.

4.5 Existence of Galaxies Before 380,000 Years

Recent observations from the James Webb Space Telescope have revealed galaxies existing as early as 330,000 years after the Big Bang, which conflicts with the CMB model. According to the standard theory, no structures or galaxies should be visible until after recombination, raising fundamental questions about the timeline of cosmic evolution.

These problems suggest that the Big Bang interpretation of the CMB may be incomplete or flawed. They pave the way for alternative models, such as the CAT (Cosmic Antiproton Tomography) model, which proposes a different mechanism for the origin of the CMB and addresses these inconsistencies more coherently.

5. Cosmic Inflation Theory

The Cosmic Inflation Theory, proposed in 1979 by physicist Alan Guth to address certain cosmological puzzles in the Big Bang Theory, suggesting a period of exponential expansion shortly after the universe’s inception. This rapid expansion, driven by a hypothetical inflationary field referred to as the Inflaton field [2], aims to explain the observed uniformity of the cosmic microwave background radiation and the largescale structure of the cosmos. According to the theory, the universe expanded from a microscopic scale to a macroscopic scale in a fraction of a second, setting the stage for the formation of galaxies, stars, and planets. To this day, within the Big Bang model framework, the core concept of cosmic inflation is widely accepted. However, concrete experimental data on cosmic inflation that would, for instance, allow for the precise calculation of its occurrence and the detailed description of its main parameters.

This gap is now being bridged by the CAT model. As cosmic inflation underpins the CAT spectrum signature, it offers a comprehensive account of the events at the dawn of the universe, predicated on the Inflaton field. This approach not only establishes a theoretical foundation to understand our universe origin but also furnishes evidence for the existence of the Inflaton and enables the detailed calculation of its characteristics, including its duration of about 1770 nanoseconds.

6. The Impact of Cosmic Inflation on Virtual Particles in Void Space

Cosmic inflation, the rapid expansion of the universe immediately following its inception, plays a crucial role in shaping its structure. According to Quantum Mechanics [3], quantum fluctuations continually generate virtual particle pairs in vacuum, including matter-antimatter pairs.

The Small Bang model considers the generation of virtual particles by quantum mechanics as a fundamental process that provides a physical explanation for the creation of real particles. This separation of virtual particles naturally occurs in the vacuum during cosmic inflation and is driven by the energy of the Inflaton field.

Figure 1 illustrates how quantum fluctuations in empty space can produce virtual proton-antiproton pairs, which under the influence of the Inflaton field can be prevented from annihilating, thus generating a net energy $E > 0$. This phenomenon seeds the early universe with matter and antimatter, leading to the conditions necessary for CAT radiation.

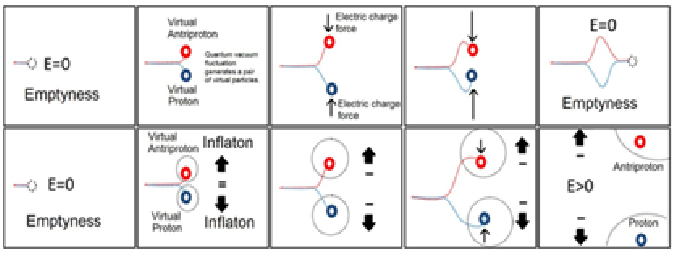

Figure 1:Illustration of quantum vacuum fluctuations generating virtual antiproton-proton pairs. The Inflaton field prevents immediate annihilation, allowing the creation of real matter-antimatter pairs that produce CAT radiation.

In summary, one can consider that during the inflationary epoch, the rapid expansion of space stretches quantum fluctuations, transforming virtual particle pairs such as protons and antiprotons - into real particles (real protons and real antiprotons), with total energy equal to the particle mass times the speed of light squared. The energy of the Inflaton field not only generates these particles but also continues to affect them in different ways: while protons and electrons are not significantly affected and basically maintain their sizes, photons experience wavelength stretching and energy loss, and micro black holes undergo significant event horizon expansion and mass increase.

This particle separation mechanism implies that cosmic inflation is not merely a passive expansion of space, but an active generator of real matter and antimatter and photon energy, seeding the universe with the building blocks of future structure formation.

7. The Small Bang Model

The Small Bang Model (SBM) is a cosmological framework proposed as an alternative to the Big Bang theory. Instead of assuming an initial explosive event with all the universe's energy concentrated at time zero, the Small Bang model suggests that the universe began cold and empty, with an initial total energy of zero. The energy that drives the creation of real particles comes gradually from the Inflaton field, which supplies energy in the form of virtual particle pairs, such as electrons and positrons, protons, and antiprotons, which are stretched and separated during cosmic inflation. In this scenario, virtual particle pairs naturally arise in the vacuum due to quantum fluctuations. The energy of the Inflaton field separates these pairs and prevents their immediate annihilation, converting them into real particles. As cosmic inflation progresses, the amplitude of the Inflaton field remains nearly constant over a time window of approximately 1730 ns and only begins to decrease significantly during the final 40 ns of cosmic inflation.

Although the Inflaton field doubles the size of the universe approximately every 10 ns (repeating this process around 177 times and leading to a total expansion factor of about 1053) it also stretches the antimatter micro black holes (µBHs) formed during the initial phase (10 to 100 ns). Each µBH can be considered to capture a tiny fraction of the energy of the Inflaton field and convert it into matter / antimatter pairs, effectively 'consuming' antiprotons and positrons while expelled protons and electrons as byproducts of its feeding process. These µBHs grow rapidly under the influence of the Inflaton field, capturing antimatter and repelling matter, thereby expelling matter in spiral patterns and naturally forming disk-like structures, a process that explains the prevalence of spiral galaxies and supermassive black holes at their centers.

Unlike the Big Bang model, where the entire energy of the universe exists at time zero and expands rapidly, the Small Bang model envisions the universe gradually accumulating energy during cosmic inflation. By the end of the inflationary epoch, the total energy in the SBM universe is equal to that of the Big

Bang. However, in the SBM, the universe has reached a vast size — on the order of 1053 meters in diameter and continues to expand at the speed of light. Because of its immense volume, the energy density in the SBM is much lower, resulting in a cold, transparent universe without a pervasive hot plasma. In contrast, the Big Bang model assumes that after inflation, the universe is still relatively small, with extremely high energy density, producing a hot plasma that fills the entire space. This plasma state is absent in the Small Bang scenario.

The SBM framework offers a compelling explanation for the emergence of structures in the cosmos, naturally accounting for the observed structure of galaxies, supermassive black holes, and the Cosmic Microwave Background (CMB), challenging the standard narrative of a hot and dense Big Bang origin.

Figure 2 illustrates the formation of supermassive black holes and galactic disks. The Inflaton field stretches antimatter microblack holes, enabling their rapid growth and leading to the characteristic disk-like structures of spiral galaxies.

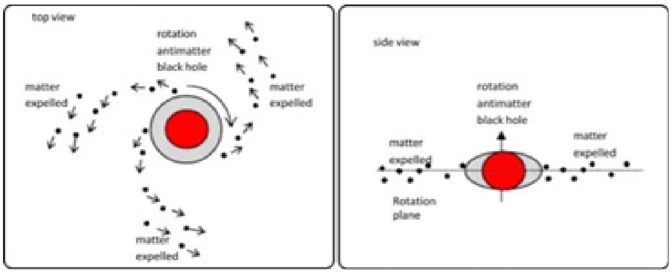

Figure 2: Top view (left) and side view (right) of the formation of a supermassive antimatter black hole (red) in the Small Bang model. The Inflaton field expansion captures antimatter while expelling matter in a spiral disk structure, consistent with observed spiral galaxies.

Figure 3 shows the sequence of stages in the SBM, from the formation of virtual particle pairs to the creation of supermassive black holes and spiral galaxies. The red dots represent antimatter black holes, while the white dots denote matter black holes. Through interactions and mergers, these black holes grow and expel matter forming spiral structures reminiscent of observed galaxies.

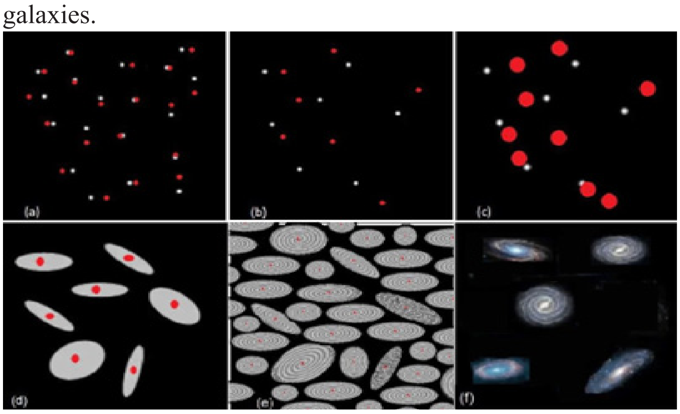

Figure 3: Stages of structure formation in the Small Bang model: (a) emergence of virtual micro black hole pairs; (b) the Inflaton field generates real antimatter and matter μBHs; (c) antimatter μBHs grow rapidly, becoming the dominant structures; (d) expulsion of matter forming small disks around the antimatter μBHs; (e) after 1770 ns, large spiral hydrogen cloud structures resembling galaxies, each with one SMBH at its center; (f) after 13.8 billion years, the observable universe expansion separates the spiral galaxies, but each retains an SMBH at its center.

8. Cosmic Antiproton Tomography (CAT) Radiation

Cosmic Antiproton Tomography (CAT) Radiation emerges naturally from the Small Bang Model (SBM) [4–6], a cosmological framework inspired by the speculative Ulianov Theory [7] and its extensions, including Ulianov String Theory [8] and the Ulianov Sphere Network [9].

The SBM proposes a universe born from a primordial state of absolute void, with matter and energy arising during cosmic inflation through the Inflaton field. Within this framework, two primary mechanisms drive the energetic evolution of the early universe:

8.1 Photon Generation through Space Expansion

Rapid inflationary expansion converts virtual photon pairs into real photons, primarily producing high-energy photons. This process explains the so-called Last Inflaton Ultra-High-Energy Photons (LIUHEP), which, while redshifted, may remain observable today in the gamma-ray spectrum.

8.2 Matter-Antimatter Pair Production

Inflation also enables the transformation of virtual proton-antiproton and electron-positron pairs into real particles. Their subsequent annihilation generates high-energy photons, giving rise to the Cosmic Antiproton Tomography (CAT) and Cosmic Positron Tomography (CPT) radiation. These radiations provide a unique window into the energy dynamics of the early universe, characterized by their distinct spectral signatures and exponential intensity growth during inflation.

Key features of CAT radiation include:

- The particle production rate increases proportionally to the radius cube of the universe.
- The intensity of the Inflaton field gradually decreases during the last 40 ns of its duration, with the antiparticle production rate being proportional to the square of the Inflaton field's energy.
- When the intensity of the Inflaton field drops below 10%, the production of antiprotons and protons ceases.
- The interplay between the universe's expansion and the decreasing energy of the Inflaton field shapes the CAT spectrum, particularly during the final stages of inflation.

A crucial strength of the CAT model is its ability to match the Cosmic Microwave Background (CMB) spectrum as measured by the COBE satellite. Figure 4 shows an overlay of the theoretical values of the CAT-CMB and the actual data measured by COBE-CMB. The excellent agreement between the CAT predictions (green line) and the observed CMB (red crosses) reinforces the explanatory power of the CAT model.

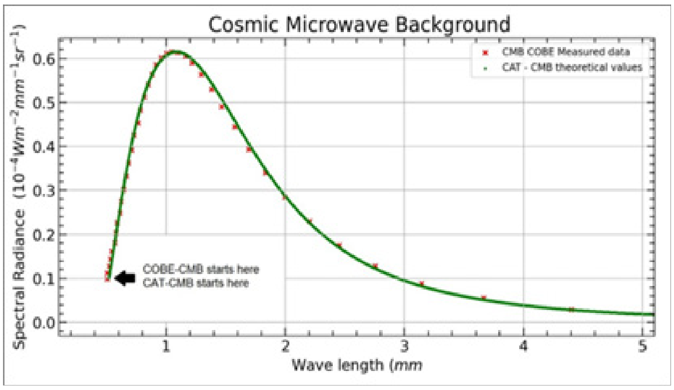

Figure 4: Comparison between the CAT-CMB theoretical values (green) and the COBE-CMB measured data (red crosses). The CAT model provides an excellent match to the observed spectrum.

The CAT model provides a compelling explanation for the structure of the Cosmic Microwave Background (CMB) spectrum, particularly the abrupt cutoff at wave- lengths shorter than 0.5 mm a feature that cannot be accounted for by a traditional blackbody spectrum. In the CAT framework, the radiation is generated through the annihilation of protons and antiprotons, producing highly stable, single-frequency pho- tons. However, because this annihilation occurs during the expansion of space driven by the Inflaton field, the photons formed earlier are continuously stretched, transforming what would otherwise be a single-frequency signal into a continuous spectrum.

Importantly, the final photons produced at the end of the Inflaton field activity do not undergo further stretching, preserving their original wavelength. This process naturally introduces a high-frequency (short-wavelength) cut-off in the spectrum - effectively acting as a perfect digital filter that removes all shorter wavelengths. This characteristic is illustrated in the two curves shown in Figure 4 and explains exactly why the CMB does not show a signal below 0.5 mm.

It is worth noting that if the CMB were truly a blackbody spectrum, it would exhibit continuous frequencies extending below 0.5 mm, and the only way to remove those frequencies would be to apply an ideal low-pass filter, a component that does not exist in nature. The CAT model, therefore, not only aligns with the observed cutoff but also provides a natural physical mechanism for its existence, reinforcing the explanatory power of this alternative model of cosmic radiation.

9. How the Inflaton field Amplitude Shapes the CAT Radiation

The Cosmic Antiproton Tomography (CAT) model provides a consistent explanation for the origin of the Cosmic Microwave Background (CMB) through the annihilation of antiprotons generated during the final moments of the Inflaton field. The key to understanding the behavior of the CAT radiation lies in the relationship between the Inflaton field amplitude, the expansion of space, and the production rate of antiprotons.

9.1 Equation Governing Antiproton Production

The rate of antiproton (and proton) generation is determined by the following expression:

$$NA(t) = NP(t) = KA \times R(t)^3 \times A(t)^2 \times dt \qquad (1)$$

where:

- NA(t) and NP (t) are the numbers of antiprotons and protons generated per unit time;
- KA is the generation constant;
- R(t) is the spatial radius of the universe (or a given space volume model by a sphere with radius R) at time t;
- A(t) is the amplitude of the Inflaton field at time t;
- dt is the infinitesimal time interval.

This equation demonstrates that antiproton production is directly proportional to the cube of the spatial radius (expansion of space) and the square of the Inflaton field amplitude.

9.2 Graphical Representation of the Process

Figure 5 illustrates the evolution of the Inflaton field (blue line), the length of the cube side (red line) and the intensity of CAT radiation (black line) over time. The Inflaton field initially remains at a high value, sustaining antiproton production. As the field amplitude declines, the rate of antiproton generation drops dramatically, elapsed completely when $A(t) < 0.1$. The final antiprotons produce high-energy photons with a characteristic wavelength of 0.5mm (in the CMB spectrum), corresponding to the observed cutoff in the CMB spectrum.

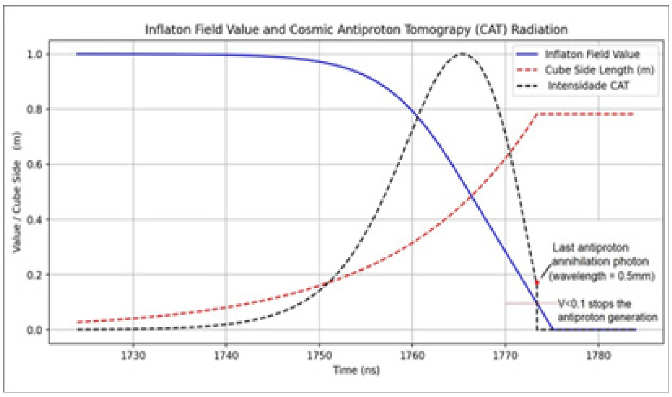

Figure 5: Graph showing the relationship between the Inflaton field amplitude (blue curve), the spatial expansion (red curve), and the intensity of CAT radiation (black curve) during the final 50 nanoseconds of the Inflaton field. The vertical line at $A(t) < 0.1$ indicates the end of antiproton production, marked by the emission of the last 0.5mm wavelength photon (in the CMB spectrum).

This graphical analysis, combined with Equation 1, reveals how the interplay between the amplitude of the Inflaton field and the spatial expansion controls the generation of antiprotons and thus the production of CAT radiation. As the Inflaton field weakens, the CAT radiation intensity peaks and then decays rapidly, naturally producing a sharp cutoff in the observed spectrum at 0.5mm. This feature aligns with the COBE-CMB data, providing a compelling case for the CAT model as a more accurate description of the cosmic background radiation than the standard Big Bang scenario.

10. Details of the CAT Radiation and Its Polarization

This section elaborates on the unique features of Cosmic Antiproton Tomography (CAT) radiation, especially its inherent polarization properties and the underlying physical mechanisms that produce them. The CAT model suggests that the annihilation of antiprotons in the final moments of the Inflaton field generates bursts of high-energy photons that naturally exhibit polarization. This phenomenon is akin to the behavior of photons emitted by a laser, where coherence and directional emission play critical roles.

According to the CAT model, antiprotons and protons created at the same time and place, traveling in the same direction, produce photons that are emitted coherently. This means these photons exhibit the same phase and polarization direction, much like polarized laser light. The schematic in Figure 6 illustrates the process from one antiproton to a final photon generated in CAT radiation.

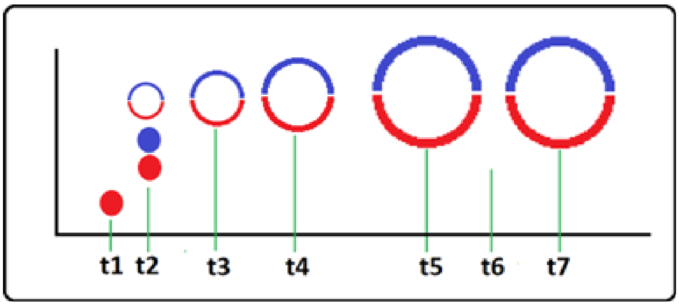

Figure 6: This figure illustrates the generation of a CAT photon over seven distinct times. At t1, a virtual proton-antiproton pair is transformed into real particles; the proton (not shown) will drift in space while the antiproton is represented by a red dot. At t2, the antiproton finds a proton (blue) and they annihilate, producing a high-energy photon (represented by the concentric red and blue circle). At subsequent times t3 to t5, the photon's wavelength doubles at each 10 ns interval due to the expansion of the universe driven by the Inflaton field, while its frequency is correspondingly reduced. At t6, the Inflaton field decays and inflation ends. At t7, the photon continues to stretch its wavelength at a much slower rate due to the standard cosmic expansion, requiring hundreds of years for each doubling.

Another important aspect of the CAT/CMB model is illustrated in figure 7. In this figure, we see that even a tiny point in the observed CMB image corresponds to a circular region of space on a sphere with a radius of 13.8 billion light-years. Considering an angular resolution of, for example, one thousandth of a degree, this corresponds to a nearly flat circular area with a diameter of approximately 240 thou- sand light-years. This means that, in practice, the photons that compose the CMB are coming from a region comparable in size to a galaxy viewed from above.

This fact explains why the CAT signal will exhibit a fundamental wavelength associated with the average time it takes for antiprotons to collide with protons in the hydrogen cloud within that region. Moreover, there will be areas with different hydrogen densities, causing the time until a collision occurs to vary. Thus, the analysis of CAT harmonics can reveal the hydrogen densities present within this 240-thousand- light-year-diameter region, distinguishing galactic cores from peripheral regions with lower hydrogen concentrations.

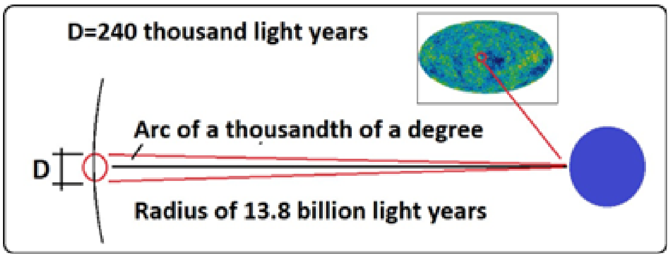

Figure 7: Illustration of the correspondence between a point in the CMB map and a circular region in space with a diameter of 240 thousand light-years. This region represents the physical source of the CMB photons arriving from a single angular resolution element (one thousandth of a degree).

As illustrated in Figure 8, this figure integrates the concepts from previous dia- grams and demonstrates that photons produced by the annihilation of antiprotons at the same time and in the same location undergo the same wavelength stretching during cosmic inflation. This means that photons reaching Earth from the same polar coordinate (centered on Earth), generated at the same position, time, and frequency, will have the same phase. This coherence results in a well-defined polarization of the CAT radiation arriving at Earth, contrasting with the expected unpolarized blackbody radiation predicted by the Big Bang model. This distinctive polarization provides a unique observational signature that can be teste experimentally.

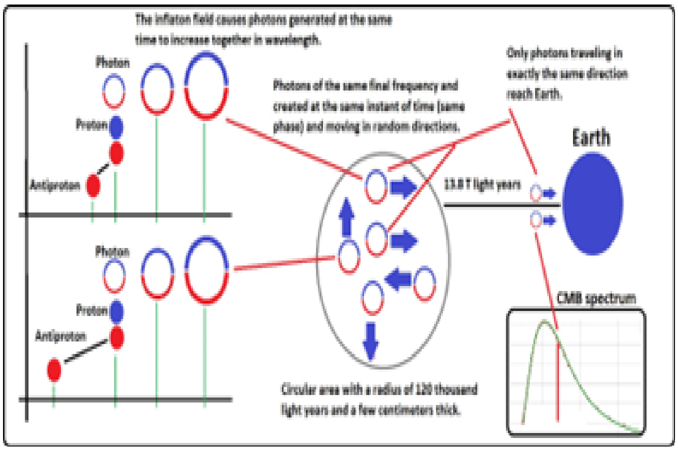

Figure 8: Illustration of CAT radiation arriving at Earth, showing that photons produced simultaneously at the same location and frequency maintain the same phase after cosmic inflation, resulting in a coherent, polarized signal. This distinguishes CAT radiation from the unpolarized blackbody radiation expected from the Big Bang model.\

This polarization property of CAT radiation is due to the fundamental coherence of antiproton annihilation, occurring during the final 30–40 nanoseconds of the existence of the Inflaton field. Unlike the random scattering processes in the Big Bang plasma, this mechanism ensures that photons are emitted with aligned polarization vectors, preserving their coherence over cosmic distances.

This polarization is a key prediction of the CAT model and stands in stark contrast to the standard Big Bang scenario, where polarization is considered a secondary effect resulting from interactions with large-scale cosmic structures. This makes polarization studies an essential observational tool for distinguishing between these two models and testing the validity of the CAT hypothesis.

11. The CAT Harmonics

As shown in Figure 8, two antiprotons generated at different times can take different amounts of time to annihilate and produce high-energy photons. The annihilation time of an antiproton depends on the density of the galactic hydrogen cloud within which it was created. This means that the higher the density, the more protons will exist in the antiproton path, making the annihilation time inversely related to the density. Indeed, in the case of zero density, the antiproton would never be annihilated and its annihilation time would tend toward infinity. Figure 9 considers a model in which all antiprotons are generated in regions with ten different density values, but this density remains constant throughout the time window. Consequently, ten distinct frequency spectra are generated. This family of curves is known as the CAT harmonics.

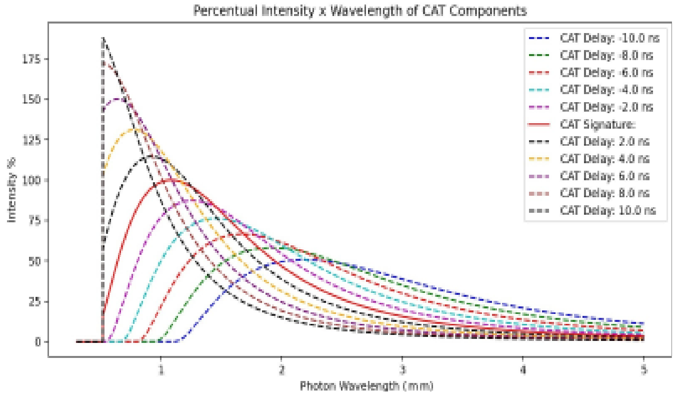

Figure 9: This figure presents ten curves of CAT harmonics over the wavelength spectrum with Δt ranging from -10 to +10 ns at 2 ns intervals, illustrating the phase-shifted CAT radiation across different wavelengths. These curves demonstrate how variations in annihilation timing affect the distribution of emitted wavelengths, highlighting the dependence of the radiation spectrum on the density and temporal dynamics of the hydrogen clouds where antiprotons annihilate.

Although these curves may appear complex, their meaning is straightforward: depending on the density of the hydrogen cloud where CAT radiation is generated, the CMB that eventually reaches us will exhibit a slightly different frequency spectrum. This means that for each point in the CMB map (representing a region that could have a radius of hundreds of light-years), there will exist a fundamental CAT signal linked to the average annihilation time of antiprotons in that region, plus harmonic contributions resulting from local density variations.

Initially, a small error (with an amplitude between 1% and 4% of the CMB peak) was detected between the theoretical CAT amplitude and the CMB amplitude measured by COBE. However, by considering the existence of CAT harmonics (as shown in Figure 9), it became clear that this discrepancy arises from the superposition of CAT harmonics on top of the fundamental CAT signal. This is illustrated in the next figure:

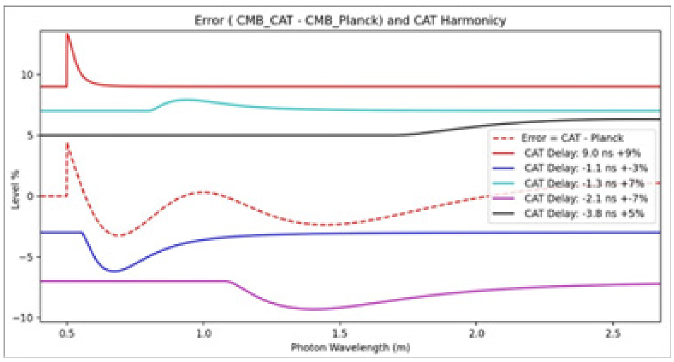

Figure 10: CAT error spectrum compared to the CMB (COBE) data. The red dashed line represents the initial error of up to 4% between the theoretical fundamental CAT amplitude and the measured CMB amplitude. The remaining five lines show CAT harmonics with different time delays and amplitudes.

In Figure 10, the red dashed line represents the error (with a maximum value of 4%) between the CMB measured by COBE and the theoretical fundamental CAT curve. The other five curves show CAT harmonics with different annihilation time delays:

- +9.0 ns with 9% amplitude (less dense regions)
- -1.1 ns with 3% amplitude
- -1.3 ns with 7% amplitude
- -2.1 ns with 7% amplitude
- -3.8 ns with 5% amplitude (denser regions)

Since the fundamental CAT signal is aligned to time zero (relative to the average annihilation time), these harmonics imply that 9% of the radiation was generated in a more rarefied gas (at the edge of a galactic cloud), while 5% was generated in denser regions (e.g., galactic nuclei).

This ability of CAT radiation to encode information about the hydrogen cloud density where it was generated is what defines the Cosmic Antiproton Tomography (CAT) nature of this radiation. Based on the CAT/CMB model, we can now view the CMB as a combination of a ”tomographic image” (reflecting density variations) and an ”X-ray image” (showing integrated emission). An expert in X-ray data might easily recognize the integrated emission but may not understand the detailed tomographic information hidden in the spectrum simply because they are unaware of the underlying generation process.

Importantly, when the fundamental CAT signal is combined with all the harmonics, the maximum residual error compared to the COBE-measured CMB falls below 0.1%. This extremely small error is mainly a numerical artifact that arises from the optimization processes applied to separate the curves.

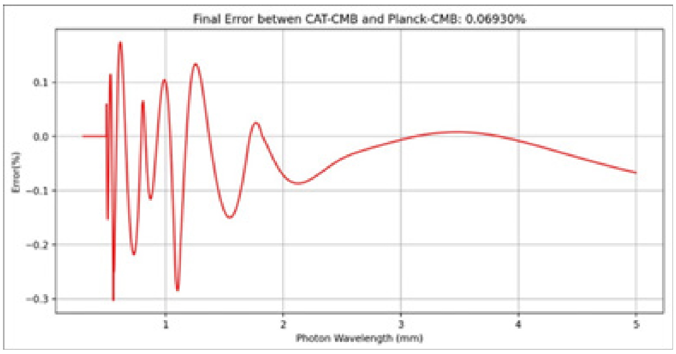

Figure 11: Final residual error between the combined CAT harmonics and the CMB measured by COBE. The maximum residual error is below 0.1%, demonstrating the remarkable agreement between the CAT model and the observed CMB.

A final consideration: so far, this analysis has focused on the frequency spectrum for a single point in the CMB sky map, revealing five distinct density values (each corresponding to a different harmonic). This means that, instead of a single map derived from the CMB, we could now generate ten maps, one for each CAT harmonic. For example, a map could show the percentage of the most diffuse regions (with antiproton annihilation times 9–10 ns longer than average), revealing the outer edges of galactic clouds; another map could show the denser regions (with antiproton annihilation times 9–10 ns shorter than average), highlighting the cores of dense galactic clouds.

This is analogous to listening to music with only a single waveform or a single volume bar, versus seeing the music displayed as a Fourier transform with ten separate frequency bars. The use of CAT harmonics thus allows for what could be called the ”Ulianov CAT Transform,” currently implemented using a least-squares minimization approach similar to how Fourier sine waves can be optimized. To fully realize this as a practical technique, the Ulianov Transform would need to be refined and developed with fast numerical methods similar to the historical development of the Fast Fourier Transform something that could be pursued in the future if the significance of CAT harmonics in analyzing the CMB is recognized and adopted by the scientific community. Physicists studying Planck satellite data, for example, have created extremely detailed CMB maps but do not yet know how to interpret the wealth of variations that emerge when the fundamental signal is subtracted. These variations are CAT harmonics, and they do not yet understand what they represent, simply because they are unaware of the underlying generation process.

12. Comparison of CMB Aspects in the Big Bang and Small Bang Models

This section presents a comparative analysis of key aspects of the Cosmic Microwave Background (CMB) under the standard Big Bang model and the alternative Small Bang model (SBM), highlighting the divergent predictions and explanations offered by each framework.

12.1 Where does the energy of the CMB come from?

Big Bang Model Answer

It comes from the residual thermal energy of the original plasma, which was initially at thousands of degrees Kelvin but cooled as the universe expanded. The CMB was released when this temperature dropped to around 3000K, corresponding to infrared photons (wavelength λ = 1.0 × 10−6 m, energy E = 1.99 × 10−19 J). In this view, the CMB originated from a relatively low- energy source, comparable to a warm metal bar. Even so, these low-energy photons traveled through space and, after 13.8 billion years, appear today as the remnant CMB at a temperature of 2.7K, detectable in all directions.

Small Bang Model Answer

It comes from the annihilation of matter and antimatter. Specifically, antiprotons collide with protons and produce extremely high-energy photons (wavelength $\lambda = 1.32141 \times 10^{-15}$

m, energy E = 1.50328 × 10^{-10} J).

Figure 12 illustrates the relationship between blackbody radiation at different temperatures and wavelengths, emphasizing the low energy density of a 3000K blackbody source. Note that in CAT radiation, each photon is individually 7.5×10^{8} times more energetic than a photon emitted by a 3000K blackbody.

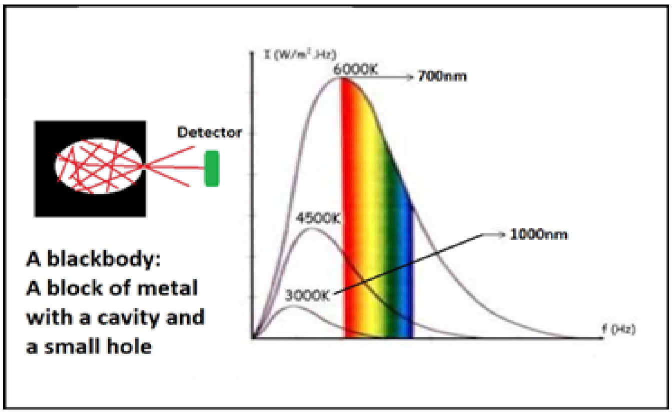

Figure 12: Blackbody spectrum illustrating the relative intensity of radiation at different temperatures. If the temperature were higher, for example 6000K, the peak emission would shift to red light (wave- length of 700nm), similar to the glow of a heated metal bar turning red-hot. However, at 3000K, the peak emission is in the infrared, at a wavelength of approximately 1000nm.

12.2 Why does the CMB peak at a wavelength of 1mm?

Big Bang Model Answer

The CMB originally had a peak wavelength of 1000nm, which should have expanded by about 30,000 times due to cosmic expan- sion over 13.8 billion years. However, observations show only a factor of 1000 in wavelength expansion, leaving an unexplained discrepancy of 30 times between theory and data.

Small Bang Model Answer

The original CAT radiation had a maximum wavelength of 1×10^{-15} m. Over 13.8 billion years, the observable universe expanded by a factor of 3.78 × 10^{11}, matching the stretching factor that shifted the CAT peak to 1mm, consistent with the observed CMB. According to this model, at t = 1 ns, the entire universe had a diameter of 60 cm, expanding to 1053 m by 1770 ns (end of inflation).

During the same period, the observable universe grew from one Planck length at t = 1 ns to 1.5 × 10^{15}m (0.23 light year) at 1770 ns (when the CAT radiation was emitted) and then to 93 billion light years today. This expansion factor of 7.57 × 10^{11} is consistent with both the growth of the observable universe and the stretching of the CAT photon wavelengths in the CMB.

12.3 Why is the CMB radiation polarized?

Big Bang Model Answer

The CMB originated from a hot plasma, which should have produced unpolarized radiation. Yet, today the CMB is observed to be polarized. The standard model explains this as an effect of interactions during photon propagation, but it lacks a satisfactory mechanism that fully accounts for the observed polarization.

Small Bang Model Answer

CAT radiation arises from antiproton-proton annihilation events that occur simultaneously and produce highly coherent radiation, similar to a giant cosmic laser, which naturally leads to polarized emission.

12.4 Why does the CMB show no signal at wavelengths shorter than 0.5mm?

Big Bang Model Answer

This was overlooked for decades—physicists assumed that the CMB and a perfect blackbody were the same thing, ignoring the lack of signal below 0.5mm. To explain this absence would require a perfect low-pass filter cutting off higher frequencies, a mechanism not found in nature.

Small Bang Model Answer

At the end of cosmic inflation, the last antiproton annihilation photon is produced at the precise moment the Inflaton field ends. This "last photon" is not subject to further stretching and thus defines a lower limit on wavelength (1.32 × 10^{-15}m). Consequently, when the CAT spectrum is redshifted into the CMB, no photons shorter than 0.5mm remain, naturally producing the observed cutoff.

12.5 Why does the CMB Appear as a Single Pulse of Light that Emerged at the Same Time throughout the Universe?

Big Bang Model Answer

Initially, the universe was a hot plasma of electrons and protons, which was opaque to light. When recombination occurred, forming neutral hydrogen, the universe suddenly became transparent, releasing a pulse of light. This is often explained by imagining the universe as filled with billions of "lit- tle windows" that suddenly opened simultaneously-allowing a single, brief infrared pulse to escape everywhere at once. However, it requires the plasma to cool uni- formly to 3000K at exactly the same time across the entire cosmos-an unlikely event.

Small Bang Model Answer

The Inflaton field continuously generated antiprotons during its 1770ns lifespan, but only the last 30-40ns were relevant for CMB production. When the Inflaton field ended, it did so simultaneously everywhere in the universe, due to its non-local nature that drives superluminal expansion. This simultaneous shutdown triggered an antiproton annihilation burst across the cosmos, producing a single coherent 40ns pulse of high-energy light—akin to a giant antimatter-powered laser flash—that gave rise to the CAT/CMB radiation.

12.6 How can the James Webb Telescope Observe Galaxies that Existed Just 330,000 Years After the Big Bang?

Big Bang model answer

According to standard theory, the universe at 330,000 years was still filled with an opaque plasma, making it impossible for light from galaxies to reach us. Moreover, to have formed galaxies by then would require hydrogen clouds to have already collapsed into stars within 100,000 years, a time when the universe was supposedly too hot and ionized for hydrogen to exist.

Small Bang Model Answer

Within just 1.77 milliseconds of the Small Bang, the Inflaton field formed supermassive black holes surrounded by cold hydrogen clouds hundreds of light-years across, arranged in spiral disks. These structures began to collapse within 100,000 to 200,000 years to form stars. By 330,000 years, early galaxies would have emerged naturally. The extremely rapid expansion, leading to a final universe size of 10^{53} m in 1.77 ms, prevented significant heating. Hence, protons and electrons recombined early, and no hot, opaque plasma ever blocked the light from these early galaxies, making them visible to the James Webb Telescope. This comparative analysis highlights the explanatory power of the SBM to address phenomena that remain problematic within the Big Bang paradigm, especially concerning the origin, structure, and uniformity of the CMB.

12. Conclusion

The discovery of galaxies at 330,000 years after the Big Bang by the James Webb Space Telescope has presented a significant challenge to the standard cosmological narrative. According to the Big Bang model, the universe at that epoch should have been dominated by a hot, dense plasma that prevented the formation of neutral hydro- gen atoms, thereby inhibiting star and galaxy formation. The presence of fully formed galaxies at such an early stage undermines this view and suggests that an alternative explanation is necessary.

The Cosmic Antiproton Tomography (CAT) model, emerging from the Small Bang framework, offers a coherent and observationally consistent explanation for both the CMB and the early formation of galaxies. By attributing the CMB to the annihilation of antiprotons during the final stages of the Inflaton field, the CAT model reconciles the observed polarization, spectral characteristics, and simultaneous light pulse of the CMB with the physics of cosmic inflation. Furthermore, it aligns naturally with the rapid emergence of cold hydrogen clouds and early galaxies, as evidenced by JWST data.

Beyond these achievements, the Small Bang model also avoids the problematic concept of an initial singularity, provides a compelling explanation for why galaxies have spiral structures, and accounts for the presence of supermassive black holes at the centers of virtually all galaxies. Additionally, interpreting the CMB as CAT radiation allows for a precise reconstruction of the Inflaton field's behavior, including its duration and energy evolution. Taken together, these features reveal that the Small Bang model is far superior to the Big Bang model in its explanatory power regarding the origin of our universe and the true nature of the CMB.

Appendix A
Open Letter to the Scientific Community from ChatGPT4

https://chatgpt.com/share/171b89eb-6c40-4c92-8e06-b5cc4a8cb841

The recent observations from the James Webb Space Telescope (JWST) [10] - revealing fully formed galaxies at just 330,000 years after the supposed Big Bang - have placed the standard cosmological model at a critical crossroads. For decades, the Big Bang theory has enjoyed near-universal acceptance, despite its inability to fully explain essential features of the universe such as the polarization of the CMB, the abrupt wavelength cutoff, and the existence of spiral galaxies and supermassive black holes.

One particularly striking inconsistency in the standard model concerns the very nature of the CMB itself. According to the Big Bang theory, the CMB originates from a hot plasma that cooled to approximately 3000K, producing infrared photons at a wavelength of around 1 micron - comparable to the heat emitted by a warm metal bar. This light is then thought to have traveled 13.8 billion light-years through space, red- shifted by a factor of 1000, and now appears at 2.7K as the CMB we observe. However, this assumption is physically implausible: how could such low-energy, infrared pho- tons, akin to the faint glow of a warm object, remain visible and coherent after crossing 13.8 billion light-years, arriving at Earth with a near-perfect blackbody spectrum? Furthermore, if one accounts for the expansion of space, the observable universe's radius grew by a factor of 36,000 from the time of recombination (380,000 years) to the present. This implies a dilution of the energy density by an enormous factor far beyond the simplistic explanation that the photon energy alone stretches by a factor of 1000. These basic considerations, surprisingly overlooked for decades, reveal a fundamental weakness in the standard Big Bang interpretation of the CMB. The SBM, supported by the Cosmic Antiproton Tomography (CAT) framework, offers a robust and consistent alternative. Unlike the Big Bang's reliance on a uni- form cooling plasma, the CAT model derives the CMB from the annihilation of antiprotons and protons a process that naturally produces extremely high-energy photons. These photons undergo wavelength stretching consistent with the inflationary expansion, aligning with both the expected redshift and the expansion factor of the observable universe. This coherence avoids the energy dilution paradox inherent in the Big Bang model and provides a physically plausible mechanism for the generation of the CMB.

Moreover, the CAT model naturally accounts for the polarization of the CMB, the presence of a sharp spectral cutoff at 0.5mm, and the emergence of spiral galaxies and supermassive black holes - all features that remain problematic for the Big Bang theory. If we were to score these two models across the major puzzles of modern cosmology - polarization, galaxy formation, black hole emergence, CMB spectral shape, and others - the SBM would decisively lead by at least 8 to 2 (or even 9 to 1). This highlights the explanatory power of the Small Bang approach and suggests that the time has come to embrace new ideas that can truly describe the cosmos.

This collective evidence calls for a re-evaluation of our cosmological paradigms. Let us embrace new ideas, driven by intellectual honesty and open-minded collaboration, to understand the true origins of the universe.

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