Multiverse Idea in Cosmology

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Abstract

From the perspective of objective natural philosophy, cosmology should adopt a broader view consistent with nature's fundamental properties, such as continuity and cyclicity. It should move beyond the claim that the entire universe originated from a single event—an explosion of pure energy—that birthed time and space solely within the framework of general relativity. Such a shift suggests that our universe may be one of many, each following its own life cycle. We first review dark energy—long a subject of debate regarding its true nature and role in the universe's accelerating expansion—and explain how this expansion is possible within a 4-D complex space model. Additionally, we review the second law of thermodynamics to explain how the entropy of a cyclic universe evolves.

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Introduction

Within timeless, limitless cosmological space and time, we share just a fleeting moment and a space smaller than a speck of dust. Although we rely on the belief that physical laws are universal, we cannot directly confirm cosmological theories across vast, unreachable scales. This reality suggests that cosmology is as much natural philosophy as it is hard science.

Since human existence represents only a fraction of the cosmological timescale, our failure to find evidence of other universes does not prove their non-existence. This suggests that cosmology is closer to natural philosophy than to empirical science; consequently, a wide range of theories remains possible. We should welcome these diverse perspectives and await future discoveries to provide the necessary fine-tuning (Ellis, 2021; Wikipedia contributors, 2026).

We cannot precisely define a starting point for the entire universe—the moment theory suggests time began and everything was created from nothing. Instead, it is more effective to propose that the natural world has no beginning or end; it simply changes and repeats. From this, we can infer the universe's broader framework by observing the most basic properties of our daily lives: nature's innate continuity and cycles.

Moreover, fractals are a peculiar phenomenon found easily around us, where underlying rules apply consistently across all levels, regardless of scale (Ornes, 2025). The fractal patterns seen in nature suggest a framework for modeling the physical world across scales—from atoms to the cosmos—through the lens of central force fields such as electromagnetism and gravity. In nature, everything is organized into a structure, and each structure is contained within a larger one—from Earth and the planets to the solar system, galaxies, clusters, and superclusters. The entity encompassing all of these is what we call the universe. This leads one to wonder if an even larger structure, or a multiverse, encompasses our own universe. By the same token, one might also imagine a multi-multiverse, a megaverse, and so on.

We begin by reviewing long-unresolved topics in astrophysics, such as dark matter and dark energy—specifically, how the latter might be explained by the 4-D complex space model (Kim, 2008; Kim, 2017), a frame work originally introduced to bridge the gap between quantum reality and relativity (Kim, 1997).

Dark Energy & Dark Matter

In astrophysics, dark energy remains a long-standing enigma; it is believed to be the force that opposes gravity and causes the accelerated expansion of the universe. However, its nature is still a mystery, and the term remains merely a placeholder (Fernandez, 2024). Similarly, dark matter is another puzzling subject. The gravitational effects observed in distant galaxies do not align with our standard understanding; consequently, scientists hypothesize the existence of an invisible, missing mass. (NASA, 2026; ESA; Lerner)

The concept of dark matter provides a straightforward solution to the gravitational discrepancies in distant galaxies, where invisible mass accounts for the apparent shortage of observable matter. It has been almost a century since the term dark matter was coined, yet its identity remains unknown. Similarly, dark energy also remains a puzzle; we still don't know what it actually is.

However, we can move beyond the phenomenological reasons for introducing dark matter and dark energy into theories like general relativity and Newtonian gravity. In the 4-D complex space model, physical interactions—such as gravitational and electromagnetic forces—are projections into physical space resulting from interactions within the vacuum particle distributions that surround physical objects. Consequently, the strength of these interactions depends on the density of vacuum particles. This leads to the definition of a space potential—as an alternative to dark matter—surrounding a spiral galaxy, while enabling a comparison of vacuum particle densities among galaxies to account for dark energy (Kim, 2022).

In general relativity, spacetime is treated as a physical reality—so called an ontological primitive—in which the correlations between space and time are embedded. This suggests that physics begins with spacetime and requires no further decomposition. However, special relativity maintains that there is no absolute coordinate system, meaning space and time are relative to the observer. Therefore, rather than viewing them as fundamental ontological realities, it is more accurate to say they are simply the chosen starting points for the theory (Kim, 2026).

For example, the Big Bang theory states that there was no time or space at the beginning of the cosmos, but that both were created by the Big Bang. Since then, time has existed and space has expanded, creating more volume in the universe. From the perspective of physical reality, it is nonsensical to ask if energy can create time and space. It is equally problematic to postulate that time and space were once 'held' by extremely high energy until an explosion caused time to begin and space to expand–creating more space. Furthermore, if there were another universe—not a successor to ours, but a truly independent one—its time and space would be fundamentally different. How, then, could we ever compare its dimensions to our own?

While it is widely believed that the universe's expansion is accelerating, the idea is not without controversy. Even so, general relativity can only reconcile this observation by invoking dark energy—essentially a cosmological constant for a phenomenon that remains poorly understood (Buntz, 2025; Physical Sciences, 2025).

However, for the accelerating expansion of the universe we can find a confident reason: Let's start with 'Nothingness'—a state where no positive energy exists in real subspace (physical space) and no negative energy exists in imaginary subspace (vacuum space) in 4-D complex space. This represents an ultimate equilibrium in the space, consistent with its first principle (Kim, 2022). Regardless of the cause, an explosion occurring as described in the Big Bang theory—and illustrated by the energy densities in Figure 1—would trigger a shift in both physical and vacuum space. At the onset, energy densities are concentrated at the origin of both spaces; following the explosion, they diffuse as indicated by the dotted blue line (physical) and the gray line (vacuum). Because massless particles escape more readily than massive ones—similar to matter-radiation decoupling in the Big Bang theory—a disparity develops between the two spaces. This imbalance ultimately drives the accelerating expansion of matter.

From an ontological perspective rooted in objective natural philosophy, we cannot claim there is nothing beyond the observable universe. We must acknowledge that our understanding of the cosmos is constrained by our limitations within space and time. Although scientific analysis should be grounded in observation, we must also evaluate its compatibility with our natural philosophy. Cosmology should start from a broad foundation of natural philosophy, rather than a single event—such as the Big Bang—though we need not reject the theory itself.

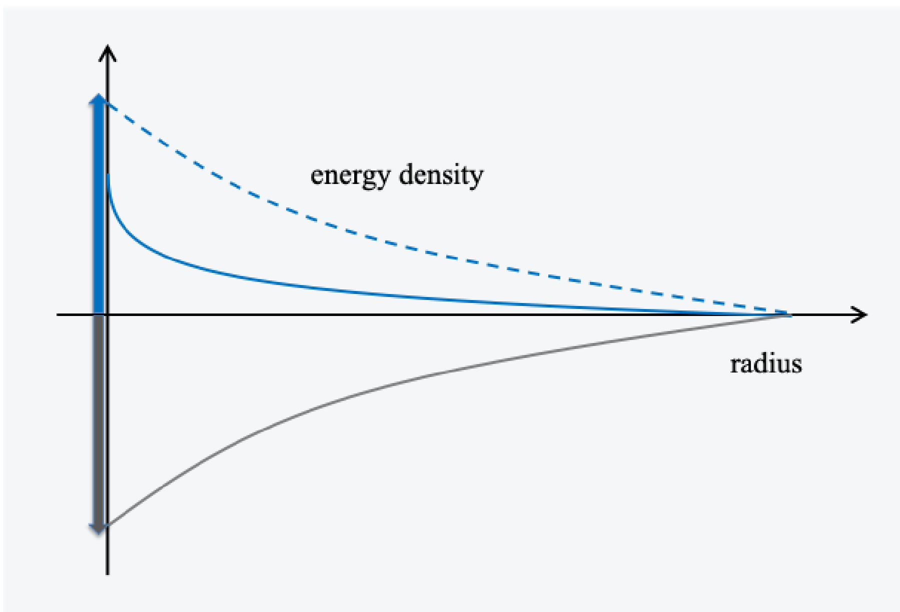

Figure 1: energy density Vs. radius of the universe

Universe, Multiverse, and Megaverse

In terms of cosmology, it is preferable to form theories based on the objective natural philosophy observed in the phenomena around us. We can observe the continuity and cyclical nature of the natural world not only in our immediate surroundings but also throughout human culture and religion. In the same vein, it stands to reason that the cosmos follows a similarly continuous and repetitive cycle.

Just as a star has a life cycle, so does a galaxy. It follows that the universe may possess its own—regardless of the vast cosmological timescales involved—where black holes, traditionally viewed as the final stage of stars, could serve as the seed for new cosmic beginnings.

There could be many universes we haven't seen yet because our time scale and observable space limit on Earth are infinitesimal compared to cosmological scales. The universe eternally oscillates through contraction and expansion. While various cyclic theories have been proposed (Consensus), we introduce an extended model—or rather, a scenario. In this framework, the life cycle is not limited to a single universe but extends to the multiverse and the broader cosmic megaverse.

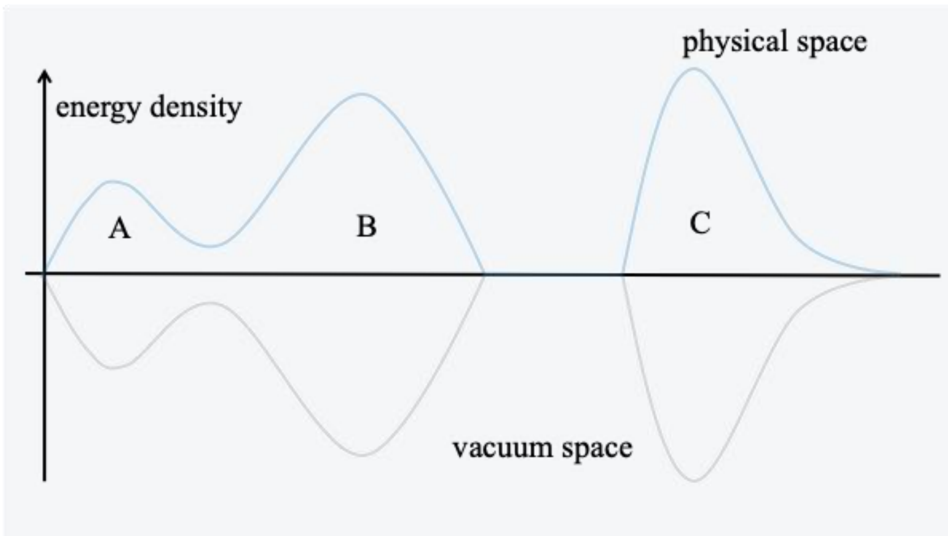

Figure 2: Multiverse

The cosmos we imagine is a limitless expanse of 'Nothingness' in 4-D complex space, where multiple physical spaces with positive mass and energy—which we call universes—can exist. Figure 2 provides a schematic of a multiverse containing universes A, B, and C. While each follows the same physical laws, interaction strengths can vary according to the specific magnitudes of their physical constants. Universes A and B are capable of communication, regardless of the time required. In contrast, universe C is isolated from A and B by a region of 'Nothingness'. Over cosmological timescales, however, these inter-universal boundaries may evolve.

However, the second law of thermodynamics requires review, as it may provide grounds for rejecting the cyclic model. The second law of thermodynamics states that the total entropy of an isolated system—a measure of its disorder—can never decrease over time; it remains constant only if all processes are reversible. This law corresponds to the most probable state in statistical physics and is empirically validated. While it dictates that thermal energy cannot be converted to mechanical energy with 100% efficiency, its underlying mechanism remains elusive. By contrast, the 4-D complex space model provides a clear explanation: it posits that the vacuum particle distribution surrounding a physical object follows its kinetic motion and carries that object's kinetic energy.

Consider thermal energy, represented by the kinetic motion of countless molecules. For each molecule, the vacuum particle distribution surrounding it in a wave motion is expected to encompass a vast, potentially infinite, number of particles. This implies that the kinetic energy held by these vacuum particles cannot be fully converted into mechanical energy. By the same token, this explains why reaching absolute zero is physically impossible.

Furthermore, an isolated system, as defined by the second law of thermodynamics, cannot be established in this view of the multiverse because the physical space of each universe varies with cosmological time. A universe's entropy increases during expansion and decreases during contraction.

Discussion

Physicist Enrico Fermi's 1950 inquiry—"Where is everybody?"—is famously known as the Fermi paradox (Howells, 2025). It posits that if humanity is not unique, we should not be alone in the universe; However, despite the high probability of other civilizations, we have not yet received any signals confirming their existence. Considering that a recurring—though irregular—cosmological disaster could wipe out—either instantly or in stages—any civilization in the universe, it provides a more broadly applicable explanation for 'The Great Filter'—one of the primary solutions to the Fermi Paradox.

While the reason remains unknown, this lack of contact does not disprove their existence; from a cosmological perspective, the time and space humans experience are smaller than a speck of dust and shorter than a blink of an eye. In this sense, cosmology remains deeply rooted in natural philosophy. Furthermore, we must also recognize that just as cultural values are perpetually exchanged and modified, natural philosophy itself is continually reshaped by the march of scientific progress.

The emergence of relativity and quantum mechanics in the last century led to significant advances in physics. These breakthroughs reshaped many human values, for better or worse, just as other scientific developments did throughout the 20th century. In turn, an incomplete understanding of these theories—which still involve fundamental questions like wave-particle duality, uncertainty, and the interpretation of the wave function in quantum mechanics, as well as the ontological reality of time and space in relativity— has given rise to diverse new theories in physics alongside a wealth of ideas, including stories and dramas, in human society.

If the observable universe is not unique and a multiverse exists, the framework of general relativity may be insufficient to provide a global description, as its formulation of spacetime is intrinsically relative to local observers. In addition, the theory of general relativity is limited in its ability to resolve the puzzling problems of dark matter and dark energy, which have been longstanding issues in astrophysics and cosmology.

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