T-Consciousness
Cosmology
A Collection of Novel Theories in the Field of Cosmology

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Originator: Mohammad Ali Taheri

Space Viscosity and Fundamental Constants

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The First Scientific Journal in
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Special Issue

T-Consciousness Cosmology

Space Viscosity and Fundamental Constants

Important Point: A documentary concerning the topics addressed in this issue, titled:

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Preface

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Introduction

Unveiling the Cosmos

The vast expanse of the cosmos, a celestial ocean teeming with constellations and swirling galaxies, has ignited an unquenchable spark of curiosity within humanity since the dawn of time. This eagerness to understand the universe in which we live has continually driven humankind to uncover the secrets of the cosmos. This endeavor is evident in ancient civilizations that charted constellations, as well as in modern astronomers who peer into the farthest reaches of space. Throughout history, pioneering astronomers like Galileo and Copernicus paved the way for a more tangible understanding of the universe. Eventually, modern cosmology, equipped with powerful telescopes and advanced detectors, has revolutionized our understanding of the universe as a whole, offering a framework for the origin, evolution, and ultimate fate of the universe.

From Philosophy to Physics Theories and Observations

The mysterious enigma of the cosmos has been and continues to be a pretense for the clash of ideas, inspiration, and countless arguments throughout human history. For tens of thousands of years, the configuration of stars in the sky has captivated our attention and inspired the creation of constellations from which myths and fictional stories were born, followed by philosophical inquiries essentially defining the philosophy of nature. Subsequently, the introduction of mathematics to simplify these philosophical concepts has opened up the world of physics to humanity. Persistent efforts and the accumulation of unanswered questions have not only compelled humans to observe and monitor the cosmos on larger scales with the advancement of technology but also aimed to interpret and analyze its components. This has been achieved through the processing of numerous mathematical models and the formulation of various theories, which sometimes align and sometimes contradict.

However, despite technical and technological advancements, the definition of the cosmos has been obscured in countless equations, calculations, models, and physics theories, with no clear and powerful unified interpretation provided thus far. Humanity remains at a loss in answering the questions: What is the cosmos? Why does it exist, and where is it headed? This is where the power of intuition and perception from a holistic viewpoint becomes essential for understanding and grasping the philosophy of the why and how of the cosmos. From this perspective, T-Consciousness Cosmology has attempted to unravel the complexities of conventional cosmology and provide a complete, clear, and unified interpretation of the cosmos through new theories. Additionally, this viewpoint addresses all concepts and the nature of what transpires in the cosmos, including Cosmic Information, Cosmic Mind, Cosmic T-Consciousness, and also various forms of Cosmic Life. These topics, however, do not entirely conform to the limited framework of currently accepted theories in physics and cosmology.

The Conventional Cosmological Perspective and Common Theories

Big Bang: The universe originated from an ultra-dense and hot point.

With the advancement of scientific research, the Big Bang theory was eventually established as the dominant cosmological model for the origin of the universe. This theory posits that the cosmos began nearly 13.8 billion years ago from an infinitesimal point with incredibly high density and temperature, known as the singularity. This singularity rapidly expanded and cooled in a fraction of a second, initiating the process of element formation and subsequently the formation of celestial bodies, ultimately leading to the cosmos we observe today.

From the perspective of cosmologists, the Big Bang theory is strongly supported by several key observations. One such observation is the discovery of the Cosmic Microwave Background (CMB). This radiation is considered a faint echo of the early universe, permeating the entire cosmos. In other words, its uniformity across the sky aligns with the predictions of a hot, dense origin of the universe. Additionally, the observed abundance of light elements such as hydrogen and helium in the universe also corresponds with the nuclear synthesis predicted to have occurred following the Big Bang.

Standard Model of Cosmology: A Framework for Cosmic Evolution

Building on the Big Bang theory, the standard model of cosmology (Lambda-CDM) provides another perspective on the universe's initial moments and its evolution, from the formation of fundamental particles to the creation of large structures like galaxies and galaxy clusters. This model incorporates the theory of inflation, a period of rapid exponential expansion believed to have occurred shortly after the Big Bang. The theory addresses the observed uniformity in the large-scale universe and theoretically resolves some of the problems with the Big Bang model. Additionally, the model relies on the existence of dark matter and dark energy, which are considered enigmatic components of the universe. Although invisible, dark matter influences the motion of galaxies and clusters through its gravitational pull. On the other hand, dark energy is believed to be responsible for the currently accelerated expansion of the universe.

Unanswered Questions and Ongoing Explorations

Despite the successes achieved in cosmology, the Big Bang theory and the standard model still face challenges. Questions about how the universe was born, the process of its evolution to its current form, the nature and geometric shape of the cosmos, its ultimate fate, the characteristics of dark matter and dark energy, and the possibility of other universes – along with countless unanswered questions – continue to drive ongoing research. Furthermore, alternative cosmological models such as the steady-state model, etc., are being examined to ensure a comprehensive understanding of the origin and evolution of the universe.

T-Consciousness Cosmology: A New Perspective on the Universe

Through its novel approach, T-Consciousness Cosmology comprises a collection of theories that examine and analyze topics such as the origin of the universe, its nature, the manner of its evolution, its fate, and hundreds of other theories.

As the name suggests, this viewpoint introduces a unique consciousness known as T-Consciousness. It posits that the universe, in addition to matter and energy, contains another element called T-Consciousness, which differs from definitions previously offered in the history of science or philosophy. From this perspective, it is argued that both matter and energy themselves arise from T-Consciousness.

Furthermore, T-Consciousness Cosmology articulates that the cosmos generally consists of two parts: frequency-based (~) and non-frequency-based (-):

The frequency-based part of the cosmos describes behavior that is periodic and non-linear, characterized by amplitude and wavelength, such that it has a non-continuous effect on the cosmos (i.e. all known types of waves and ordinary matter).

In contrast, the non-frequency-based part of the cosmos describes non-periodic and linear behavior, where the amplitude and wavelength are zero, and its effects in the cosmos are linear and continuous.

In this regard, for example, it can be said that space, gravity, and time themselves do not have a frequency effect and have a sustained effect on everything. Even if, for a moment, one of these, like gravity, were to exhibit a periodic effect, the entire cosmos would disintegrate. However, it is worth noting that the result of this influence is the emergence of particles (ordinary matter), which exhibit periodic and frequency-based behaviors. Similarly, if time itself were to have a periodic effect, the cosmos would likewise collapse in the same way, despite the fact that we have a periodic method of measurement for time (tick tock of a clock). Therefore, from this perspective, for the most part, the known physical aspect of the cosmos is periodic and frequency-based.

An important point to note is that the linearity of the impact of space, gravity, time, dark matter, and dark energy refers to the inherent influence of these factors in the universe, not the outcome of their effects.

Consequently, the frequency-based part (~) of the cosmos includes matter and energy, and the non-frequency, non-pulsing part (-) of the cosmos consists of two sections:

A- A section that in conventional cosmology is referred to with different definitions, such as spacetime, dark energy, and dark matter.

B- T-Consciousness, information, mind, life, dark life energy, etc., are parts that do not have specific definitions and are not mentioned in conventional cosmology. While from the viewpoint of T-Consciousness Cosmology, they constitute the main part of the cosmos.

Important Note: In T-Consciousness Cosmology, instead of the concept of "space-time," the term "space, gravity-time" is used, in which gravity and time are always proportionally intertwined and inseparable. In fact, the effect of gravity-time is considered as two sides of the same coin. Moreover, considering that if space did not exist, the cosmos would certainly not exist either. Therefore, from this perspective, space is considered a fundamental element of the cosmos, while it is neither matter nor energy. This means the nature of space, as one of the main components of the cosmos, is non-pulsing. This concept also applies to dark energy and dark matter, which this perspective identifies as functions of space itself.

Therefore, T-Consciousness Cosmology states that the structure of the components of the cosmos, such as dark energy and dark matter, is not composed of particles. Additionally, because of its non-pulsing nature, gravity is inherently a non-frequency element. Thus, generally, gravity is also not composed of particles (such as the hypothetical graviton particles in conventional science).

Regarding the non-pulsing nature of gravity or space, it can be noted that physics calculations show that celestial bodies with significant mass or acceleration can disturb spacetime in such a way that it appears as if gravitational waves propagate in all directions. In other words, conventional cosmology predicts that although they differ from each other, gravitational waves resulting from the spinning of neutron stars, the collision of black holes, and supernova explosions can be analyzed. However, T-Consciousness Cosmology defines what is commonly referred to as gravitational waves in physics simply as the squeezing and stretching of space due to the changing behavior of massive bodies in proximity to one another. Therefore, the changes in gravitational behavior caused by massive bodies only lead to the contraction and expansion of space. In simpler terms, gravity has a linear impact on the structure of space, not a wave-like one.

Like gravity, time exerts its influence in a linear fashion on the cosmos and its components, in tandem with gravity. If gravity were zero, time would also be zero. Conversely, if gravity approached infinity, time would similarly become infinite. It is also essential to mention that the type of timekeeping invented by humans (i.e. the ticking of a clock) is completely arbitrary, as time does not have a frequency or pulsing nature.

Consequently, T-Consciousness Cosmology uses "space, gravity-time" instead of the well-known term "spacetime."

The Origin and Fate of the Universe

Existing models in conventional cosmology have not yet provided a widely accepted theory about what existed before the Big Bang or how the various forms of matter and energy known today came into being at the initial moment of the explosion. This issue remains shrouded in ambiguity for cosmologists. In this context, T-Consciousness Cosmology, by introducing a new model named the ‘Spherical Cosmos Model,’ not only addresses the origin or how the initial seed of the cosmos came into existence, but also acknowledges the expansion of the cosmos and introduces a shell made of TAM (Taheri Absolute Matter), that isolates the cosmos. This model proposes a different foundational mechanism compared to conventional inflationary models and introduces a new concept called ‘Space Rebound’ to explain the increase in the volume of the cosmos. In fact, the theories of this viewpoint support each other in the understanding of the structure of the universe as a whole system, making simple predictions about the behavior of the cosmos. Moreover, T-Consciousness Cosmology, by addressing the nature of dark matter and dark energy and their functions, determines the cause of the cosmic expansion and its ultimate fate. Additionally, in line with the Spherical Cosmos Model (SCM), a new theory about another stage of the lifecycle of the cosmos, referred to as its ‘Reversion,’ is also proposed.

The Nature of the Building Blocks of the Cosmos

T-Consciousness Cosmology, in addition to addressing the general behavior of the cosmos, also explores the formation and function of its components, introducing new types of matter. According to the Spherical Cosmos Model, there is no contradiction between the formation mechanism of fundamental particles and the initial point of the cosmos (Big Bang). However, in the standard model of cosmology, which includes the theory of inflation and is based on general relativity and the standard model of fundamental particles, there is a clear contradiction known as the singularity at the birth of the universe and the formation of matter. Specifically, the singularity, a consequence of general relativity, is an obstacle that is inconsistent with the formation of fundamental particles in the initial moments of the cosmos's birth.

Overall, it can be stated that T-Consciousness Cosmology offers a unique view of the cosmos by altering the perspective of the observer. From this shifted viewpoint, the cosmos is perceived as a grand system endowed with distinct identity, personality, and behavior. This system not only follows a specific trajectory to fulfill a special purpose but also demonstrates a high level of intelligence.

The Multiverse from a New Perspective

T-Consciousness Cosmology asserts that the cosmos in which we currently live follows a sequential principle (Consecutive Cosmos) and has its own lifecycle. It is one of countless homogeneous or heterogeneous universes, each with its own unique characteristics and behaviors (laws of physics).

Additionally, from this viewpoint, the fundamental constants of physics change according to different cosmic epochs and locations. For example, gravity-time will range from infinity at the beginning of the cosmic lifecycle to zero at the terminal edge of the cosmos (the ultimate stage of space rebound).

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Space Viscosity and Fundamental Constants

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Abstract

Fundamental constants in physics, such as the speed of light and the gravitational constant, are usually considered to be constant over time and space. This means that their value does not change with the expansion of the universe. Constants determine all the properties and behaviors of the cosmos, and any change in them would lead to the formation of a universe with new physical characteristics. The constants of physics in an expanding universe have always been a research challenge. In this context, some models suggest these constants may vary over time due to changes in the conditions of the cosmos; however, these theories have not yet been widely accepted by the scientific community. Fundamental forces in the universe are interactions that govern the behavior of matter and energy at the most elementary level. For example, the gravitational field, which follows the universal constant of gravity, clearly demonstrates its effect on large cosmic structures. According to the theory of general relativity, gravity is the result of distortions in space-time created by mass and energy. Moreover, gravity interacts with a specific type of matter in the universe known as dark matter. In fact, from the perspective of cosmologists, it is believed that this type of matter consists of hypothetical fundamental particles that do not emit electromagnetic radiation, such as light, and can be detected through their gravitational effects on visible matter and the large-scale structure of the universe. In conventional cosmology, dark energy can also be considered as a cosmological constant, is fundamentally a characteristic of space itself, which possesses a constant negative pressure and, contrary to gravity, causes the universe to expand at an accelerating rate. Dark energy is a dynamic quantity that can vary over time and space. However, T-Consciousness Cosmology posits that space has viscosity, and does not consider it constant. In other words, this viewpoint sees gravity as a result of the contraction of space (space viscosity) caused by the mass of light matter (ordinary matter). Additionally, this perspective introduces different types of dark matter (solid-like, liquid-like, gas-like), stating that dark matter is representative of high levels of space viscosity that envelopes massive objects or galaxies. Consequently, dark matter corresponds to high space viscosity and dark energy to low space viscosity. Moreover, both dark matter and dark energy not only possess gravitational properties but also act as the glue that holds massive cosmic objects and structures together. Due to the positive pressure it exerts within the isolated spherical cosmos, dark energy is recognized as one of the factors that drive cosmic expansion, effectively counteracting gravity. T-Consciousness Cosmology introduces a viscosity coefficient of space, ranging from infinity in the Cosmic Black Hole to zero at the Terminal Edge of the Cosmos (the final stage of space Rebound). Furthermore, this perspective argues that the speed of light varies in different viscosities of space, such that in areas of high viscosity, light's frequency increases and its wavelength decreases, slowing down the speed of light, and the opposite occurs in areas of low viscosity. Consequently, the speed of light is not constant throughout the cosmos due to the variability of space viscosity. The speed of light increases significantly higher than its currently calculated speed as the cosmos approaches its final stage of Rebound. It's important to note that while the notion of variable light speed is present in mainstream science, the approach taken by T-Consciousness Cosmology is distinctively different from these theories.

Keywords: Fundamental Constants, Cosmic Constant, Variable Space Viscosity, Variable Speed of Light, Gravitational Effect of Dark Energy, Positive Pressure of Dark Energy, Space Viscosity Coefficient, Solid-Like Dark Matter, Liquid-Like Dark Matter, Gas-Like Dark Matter

Introduction

This special issue introduces another segment of the novel hypotheses in T-Consciousness Cosmology: space viscosity and the Principle of Change. It analyzes and examines the unique viewpoints of this intellectual discipline in comparison with established principles in conventional cosmology. This issue also presents different interpretations from T-Consciousness Cosmology regarding dark energy, dark matter, space viscosity, and fundamental constants like the speed of light and gravity, comparing these with prevailing definitions in conventional physics.

The introductory section provides an overview of fundamental constants, dark energy, and dark matter from the perspective of conventional physics, laying the groundwork to introduce the distinct perspectives of T-Consciousness Cosmology on these concepts. The subsequent section outlines definitions of viscosity from the realm of conventional science, highlighting its significance across various disciplines, including conventional cosmology. The discussion then expands to explore the novel hypothesis on space viscosity and compares it with the concepts established in conventional cosmology. Thereafter, the Principle of Change, alongside the fundamental constants of the speed of light and gravity, are examined and compared through the lenses of conventional and T-Consciousness Cosmology. In the final part of this special issue, the fate of the cosmos from the perspective of T-Consciousness Cosmology is discussed, highlighting similarities or differences with one of the established scenarios proposed in conventional cosmology.

Fundamental Constants and Interactions in Physics

Fundamental constants in physics are quantities that, according to most scientists, currently possess a universal nature. They are considered constant throughout the entire universe and do not change over time. These constants enable the description and prediction of physical phenomena and serve as parameters for maintaining dimensional consistency in physical equations. Additionally, they reveal certain fundamental aspects of nature that are independent of human conventions or measurements.[1,2] some examples of these fundamental constants include:

1- The speed of light in a vacuum (*c*): the maximum speed at which any particle or electromagnetic signal can travel in a vacuum, and its precise value is 299,792,458 m/s.[3-5]

2- Newton's gravitational constant (*G*): the proportionality constant that links the gravitational force between two bodies. According to the principles of classical mechanics, it is the force that is expressed as the product of two masses and the square of the distance between them, with an approximate value of $6.674\times10^{\text{^}-11}$ m^3 kg^{-1} s^{-2}.[5-7]

3- Planck's constant (*h*): the quanta or the smallest possible amounts of energy for a photon of light. This constant relates the energy and frequency of the photon to each other, with an exact value of 6.62607015×10^{-34} J Hz^{-1}.[3,4]

4- Planck length (l_p): The smallest unit of measurement for length, which is approximately equal to 1.616255 x 10^{-35}m.[5,7]

5- Planck Time (t_p): This is the time it takes for light to travel one Planck length in a vacuum. In other words, Planck time is the shortest duration that can be meaningfully measured in physics. Its approximate value is 5.391×10^{-44} s.[5,8]

Fundamental constants are not only embodied by physical concepts but also determine all the characteristics of the universe. If these constants had different values in the current universe, a new world with new physical properties would emerge. Combining fundamental constants allows for the derivation of other physical quantities. For example, if three fundamental constants, such as the speed of light in a vacuum (*C*), Planck's constant (*h*), and the universal gravitational constant (*G*) are combined, Planck time can be derived according to the following formula: [5,8]

$$tp = \frac{lp}{c} = \frac{\hbar}{m_p c} = \sqrt{\frac{\hbar G}{c}} = 5.391247(60)\times10^{-44}\ [s]$$

In the above equation, m_p is the Planck mass and $\hbar$ which is Planck's constant (reduced Planck constant) divided by 2π.

Fundamental interactions in physics also consist of a series of actions and reactions that determine how matter and energy behave. Among these interactions are the strong nuclear force, the weak nuclear force, electromagnetism, and gravity. In nature, each of these fundamental interactions has a different extent, magnitude, strength, and general role. For example, gravity clearly manifests its effects at macro scales, whereas at subatomic scales (and in comparison with the strong and weak nuclear forces) it has a minor impact.[9]

Among the above-mentioned fundamental interactions, gravity was presented by Newton in 1687 as the Universal Law of Gravitation in the book "Mathematical Principles of Natural Philosophy." This law describes the gravitational interaction between bodies in space and also accurately predicts the orbital motion of most planets.[10] According to this law, bodies always exert a force on each other that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them (Figure 1). The Universal Law of Gravitation in its present form also includes the gravitational constant (G).[11,12]

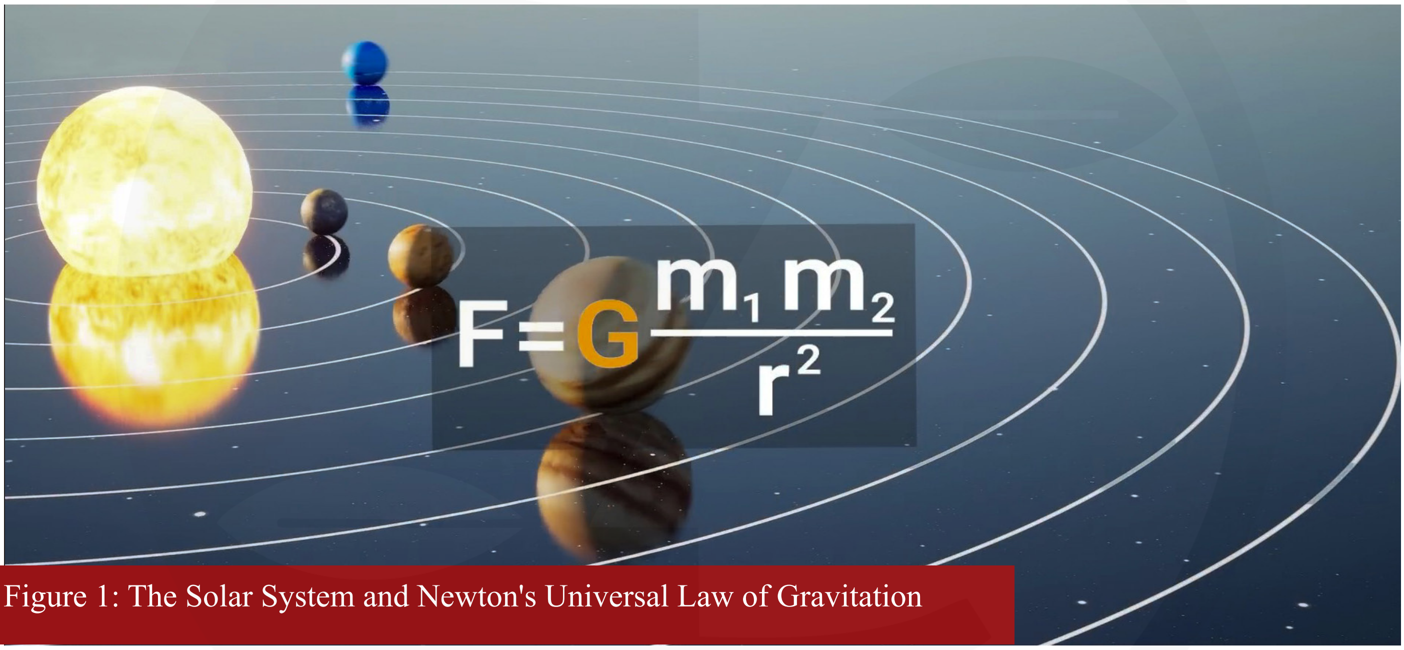


Figure 1: The Solar System and Newton's Universal Law of Gravitation

Gravity and Space-Time: From Classical Mechanics to the Theory of Relativity

In addition to introducing gravity, as mentioned in the previous section, Newton presented a unique perspective on important concepts such as space, time, force, and motion,[11,13] and despite being over 300 years old, these principles still hold significant importance and are considered foundational to classical mechanics for describing motion. For instance, the placement of satellites and spacecraft into Earth's orbit or the orbit of other planets is based on Newton's laws of motion. These laws also accurately predict many physical events, such as lunar and solar eclipses.[10]

In physics, the concept of an event is attributed to the simplest physical phenomenon that occurs at a specific point in space and at a certain time.[14] The spatial and temporal positions of any event are defined relative to an inertial reference frame[15] from which an observer witnesses an occurrence. In classical mechanics, the location of the reference frame is described using Euclidean geometry and the well-known three-dimensional Cartesian coordinate system, and the temporal position is expressed by assigning a specific time to the reference frame. Additionally, an observer can either be stationary or moving at a uniform speed and no acceleration while observing an event.[16] Since, in Newton's view, space and time are considered as two absolute and distinct concepts, the location and time of an event are independent of the observer's velocity (the reference frame's speed). In other words, different observers, regardless of their positions, measure the spatial and temporal positions of an event the same way, and no reference frame has preference over another.[13,11-17] This principle is also true for the spatial distances and time intervals between two events observed from different reference frames.

Newton's view, which considers space and time as absolute and independent of each other in calculations related to ordinary speeds, is practical; however, it fails at speeds comparable to the speed of light. For instance, the famous Maxwell equations that describe how electric and magnetic fields move at speed *c* in a vacuum are incompatible with the absolute space and time in Newtonian mechanics.[15,16]

Afterward, the German mathematician Hermann Minkowski successfully reformulated Maxwell's equations by conceptualizing space and time as interconnected within a four-dimensional continuum, and integrating the familiar three dimensions of space with the dimension of time. This resolved the inconsistencies of these equations with existing models (Lorentz transformations).[18-20] (Figure 2)

The Minkowski spacetime model also accurately describes Einstein's special relativity, in which the curvature of spacetime can be neglected, since the spacetime bedrock in this geometric model (special relativity) is considered flat. However, under conditions of spacetime curvature and the gravity resulting from this curvature, as addressed in Einstein's general relativity, the Minkowski spacetime model is generally not effective and is only locally and approximately applicable.[21-24]

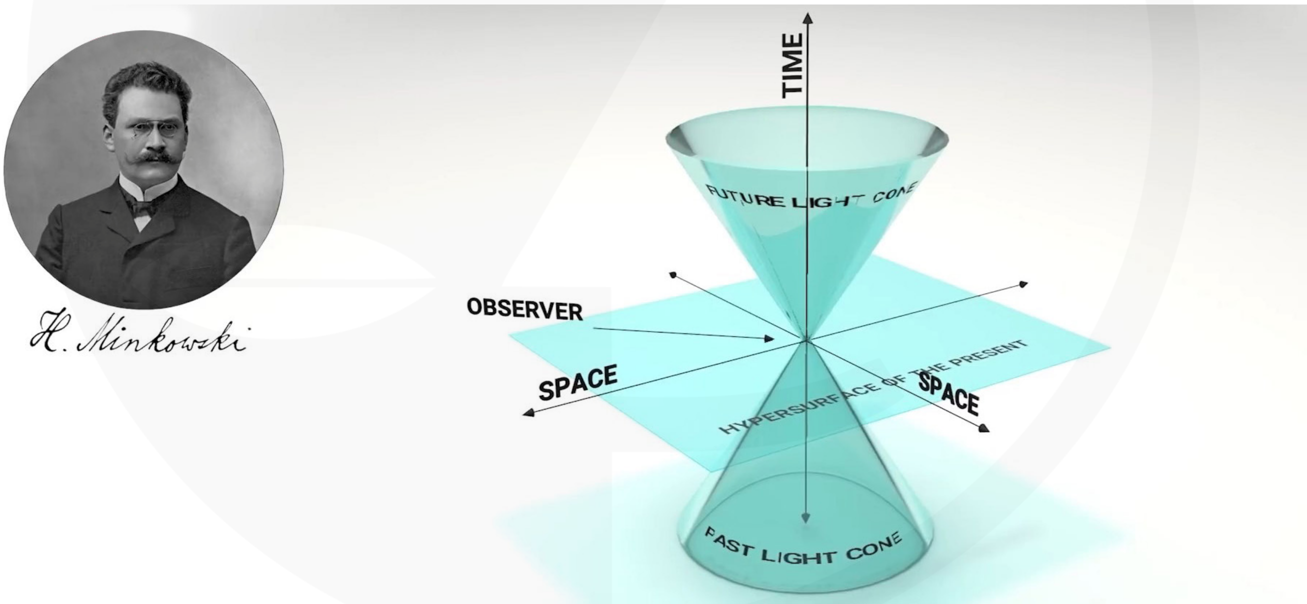
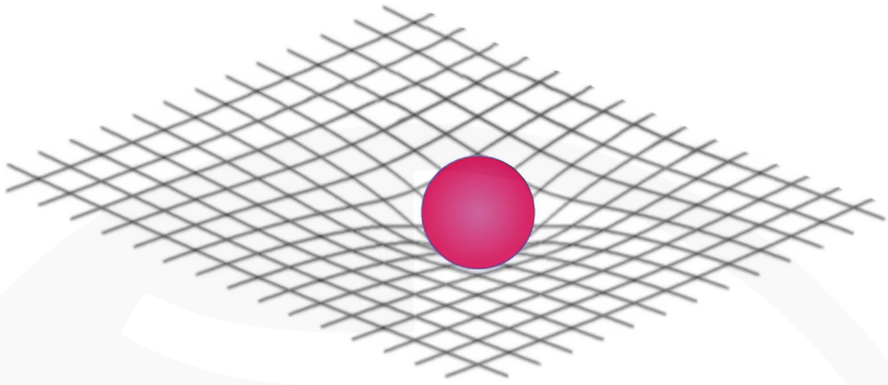


Figure 2: A portrait of Hermann Minkowski and his four-dimensional spacetime model. Credits for the 4D space-time: K. Aainsqatsi, CC BY-SA 3.0

Contrary to Newton's perspective, which regards gravity as a mutual force between objects, in Einstein's General Relativity, gravity is a geometric function and a result of the curvature of space-time. This curvature, in turn, arises from the uneven distribution of mass and energy.[22,23] Einstein's General Relativity is defined by the following field equation:[14,25]

$$G_{\mu v} + \Lambda g_{\mu v} = \frac{8\pi G}{C^4} T_{\mu v}$$

In this equation, $G_{\mu\nu}$ is the Einstein tensor Λ, is the cosmological constant, $g_{\mu\nu}$ is the metric tensor, and $T_{\mu\nu}$ is the stress-energy tensor. Additionally, as observed, Newton's universal gravitational constant G is also employed in the field equations related to this theory as a proportionality constant, which will be discussed more in the upcoming sections of this special issue. (Figure 3)



$$G_{\mu\nu}+\Lambda g_{\mu\nu}=\frac{8\pi G}{c^4}T_{\mu\nu}$$

Figure 3: An abstract image depicting the curvature of space-time due to mass distribution, Einstein's general relativity field equation, and its dependence on the universal gravitational constant *G*.

After briefly mentioning the fundamental constants and the concepts of space, time, and gravity, we can now explore them through the lens of **T-Consciousness Cosmology**. As mentioned in the introduction of this special issue, this novel discipline, by proposing new hypotheses, offers different definitions of fundamental constants in physics, such as the speed of light in a vacuum, gravity, space, time, and their effects on the dynamics of the universe. These definitions differ from the latest theories accepted in mainstream science and open a new perspective on understanding the mechanisms of the universe. However, before we can delve into the impact of these fundamental constants on the behavior of the cosmos and examine the important concepts of space and time from the perspective of T-Consciousness Cosmology, it is first necessary to explain two important topics cosmologists face: dark energy and dark matter.

Dark Energy and Dark Matter from the Perspective of Conventional Cosmology

Dark Energy

In the late 1990s, a group of scientists using observations made by the Hubble Space Telescope (Figure 4) of very distant supernovae, discovered that the universe is expanding at an accelerating rate.[26-28] This finding was astonishing and unexpected for the astronomical and cosmological community because, given the gravity existing among cosmic entities, the initial objective of these observations was to find a rate at which the expansion of the universe would be slowing down. The scientists attributed this unexpected observation of the accelerating expansion of the universe to a hypothetical and unknown type of energy called dark energy, which acts against gravity and has been incorporated into the standard model of cosmology.[29]

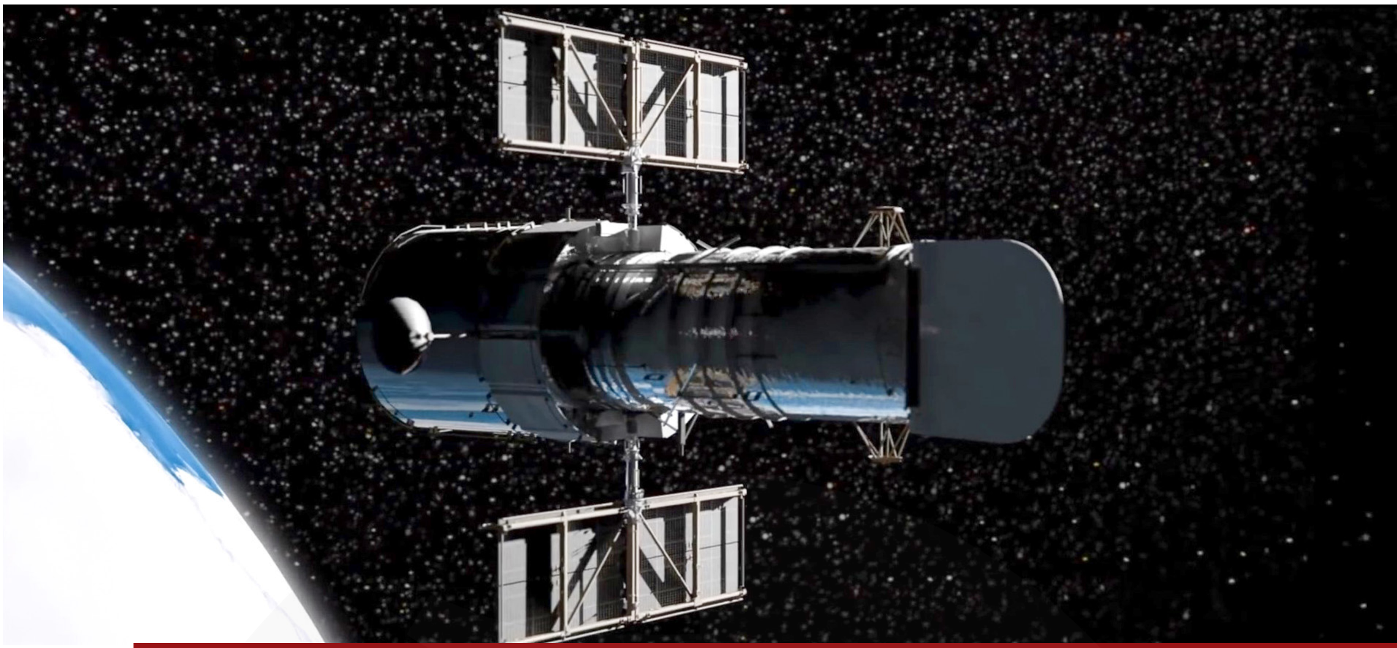


Figure 4: Hubble Space Telescope

Based on statistical calculations, dark energy constitutes about 68% of the total energy in the universe.[30-32] Although the nature of this type of energy remains unclear, various models have provided different definitions to describe it,[33,34] of which the most important ones are briefly mentioned below:

1- In the standard model of cosmology, dark energy is equated with the cosmological constant (Λ), which Einstein introduced in 1917 based on the idea that the positions of celestial bodies in the universe are maintained by an unknown force, incorporating it into his field equations of general relativity.[35] This constant is very small (approximately 10^{-52} square meters[31]), possesses a constant negative pressure, and is an inherent property of space. Furthermore, similar to the function attributed to dark energy, this constant can also have anti-gravity properties.

What does "the intrinsic property of space" mean? If a non-zero and a constant energy (mass) density are attributed to the empty space (vacuum), under the condition that the mass density of the universe drops below the vacuum energy density, the vacuum can behave repulsive to gravity; hence, stretching the space-time curvature and increasing the rate at which masses are separated from each other, or in the other words, causing the accelerated expansion of the universe.[36] This is why the dark energy (in addition that it is equivalent to the cosmological constant), is also known as the vacuum energy. (Figure 5)

2- In some models, dark energy is defined as a new form of a fundamental scalar field that pervades the universe and leads to its accelerated expansion; that is, a dynamical quantity that, unlike the cosmological constant (Λ), can change over time and space. This type of fundamental field is termed quintessence.[37-39]

3- Dark energy could also be equivalent to hypothetical particles known as tachyons, which move faster than the speed of light.[40] In cosmological models based on these hypothetical particles, the accelerated expansion of the universe is fitted with dark energy originating from tachyons.

4- In another category of models, dark energy is considered to be a exotic fluid (known as Chaplygin gas), which, due to its negative pressure, acts as a factor for the accelerated expansion of the universe. One of the motivations for proposing such models has been to address the fine-tuning problems associated with scalar fields previously used to describe dark energy.[41,42]

5- In order to resolve the tensions between the parameters used in the standard cosmological model due to increased precision in calculations, dark energy has been considered a dynamical fluid that interacts with dark matter.[43,44]

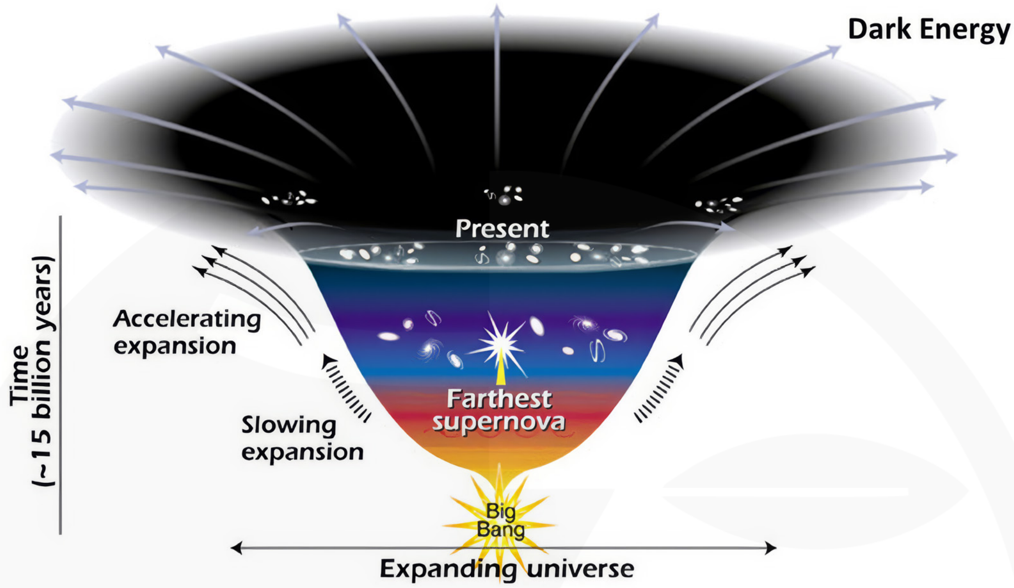


Figure 5: Accelerated expansion of the universe in the current cosmic epoch and dark energy as the driving force behind it which is indicated by gray vectors.

Credits: Anne Field, public domain

Dark Matter

Dark matter is an elusive form of matter that, in the standard model of cosmology (ΛCDM), accounts for about 26% of the mass-energy content of the universe.[30-32] Unlike ordinary matter known in the cosmos (visible matter), dark matter does not interact with light (electromagnetic waves) in any form, which is why it is referred to as "dark." In other words, dark matter neither emits nor absorbs light.[45]

Fritz Zwicky, a Swiss astronomer, was one of the first to infer the existence of dark matter.[46] In 1933, he observed that galaxies within the Coma Cluster were moving faster than expected based on calculations. Such that these galaxies should have dispersed much earlier than the time of observation. Additionally, the visible mass observed in this cluster and the gravitational force it generated were far too small to prevent the galaxies from drifting apart. Therefore, Zwicky concluded that there must be some amount of "invisible mass" or what is known as "dark matter" present that holds the galaxies together within the cluster (Figure 6).[46]

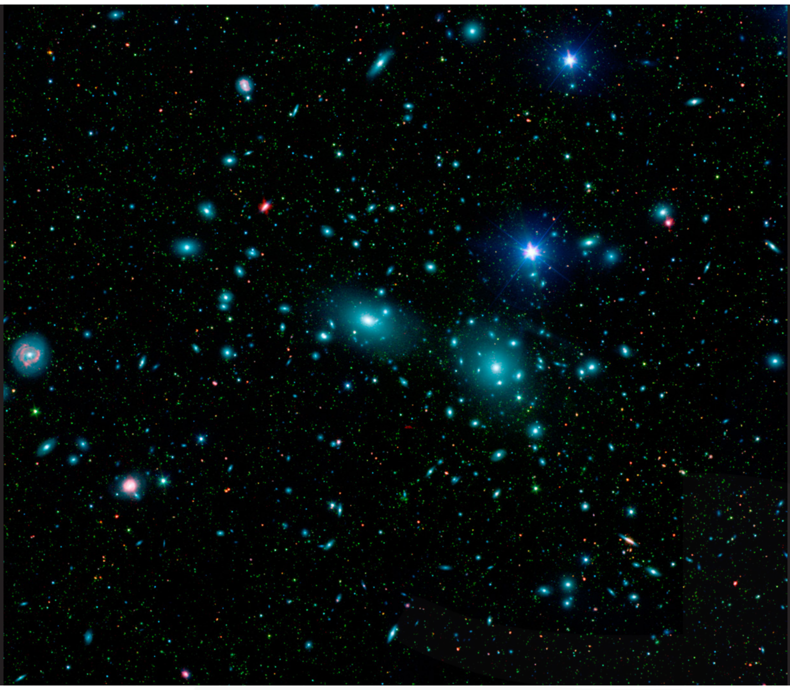


Figure 6: The Coma Galaxy Cluster, which is known to contain around a thousand galaxies so far.

Credits: NASA / JPL-Caltech / L. Jenkins (GSFC), public domain

Zwicky's idea was not widely accepted until the 1970s. During this period, numerous astronomers, including Vera Rubin, Vera Rubin and Kent Ford conducted studies on the rotation curves of galaxies and their velocities and found that the results did not align with Newton's laws of motion. Contrary to expectations, the rotational speeds of galaxies do not decrease with distance from the center but remain approximately constant. Therefore, they concluded that the mass in the halo region of galaxies must be greater than what can be observed with light (Figure 7).[47,48]

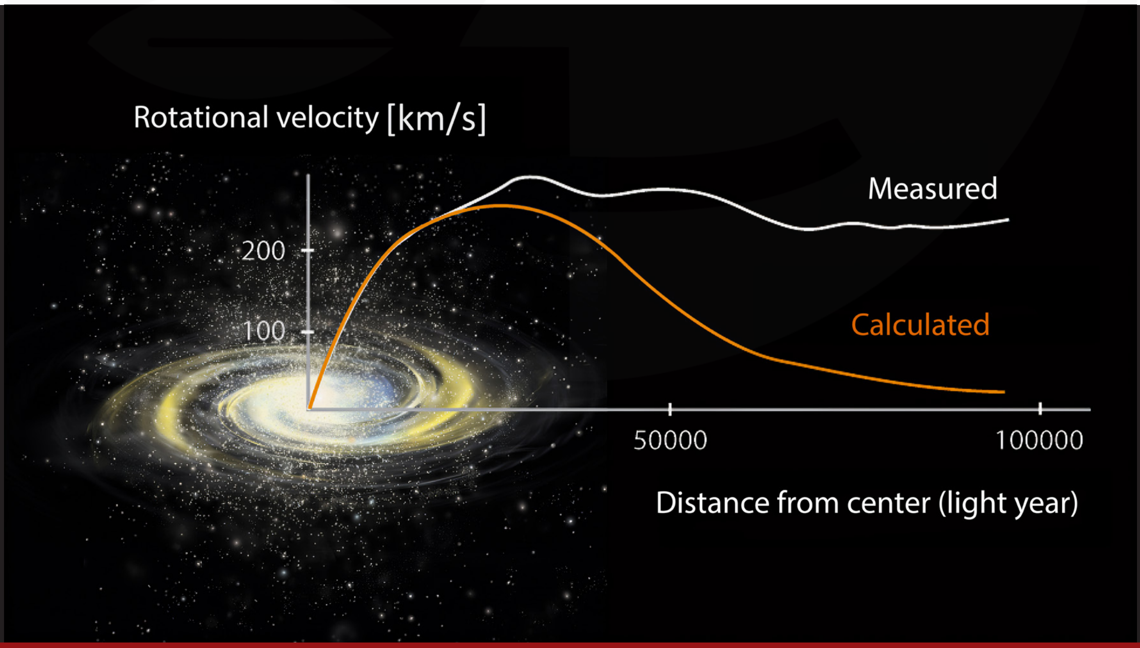


Figure 7: Galactic rotation curve. Based on observations, the components of a galaxy, regardless of their distance, rotate around the center at an approximately constant speed.

Credits: Physics Libre Texts, big ideas in cosmology by Coble et al., and NASA/SSU/Aurore Simonnet

Typically, visible and observable matter is concentrated in the center of a galaxy. According to the principles of motion in Newtonian mechanics and Kepler's laws, stars or objects farther from this center should have lower orbital speeds. The solar system's orbital motion of planets, moons, and so on follows these principles quite well. However, as mentioned earlier, the rotation of parts of a galaxy around its center of mass is inconsistent with the laws governing motion in Newtonian mechanics. In other words, objects within a galaxy, from the furthest to the nearest to the center, rotate around the galaxy's center of mass at roughly the same speed. Therefore, to prevent the violation of the laws of motion, the existence of "missing mass," "invisible mass," or what is known as "dark matter" was proposed.[36,46,48,49]

Despite the fact that dark matter does not interact with electromagnetic waves and is not detectable through conventional measurement tools, it can interact gravitationally with visible matter.[50] Data related to galactic rotation curves also demonstrate that approximately 80% of a galaxy's mass is invisible.[45,51] Consequently, scientists are searching for new methods to detect this invisible mass by observing its effects on gravitational waves.[52,45-54]

Another significant reason for positing the existence of dark matter are observations related to the Cosmic Microwave Background (CMB).[55,56] The cosmic microwave background is radiation in the microwave range that, according to scientists, provides information from the recombination epoch. The data from this radiation displays a uniform distribution of visible matter at the inception of the universe. However, such homogeneity could not lead to the hierarchical clustering of galaxies seen today unless a considerable density of dark matter with its high degree of gravitational effects can accelerate formation of today's lumpy structures in the universe (Figure 8).[49,57,45-62]

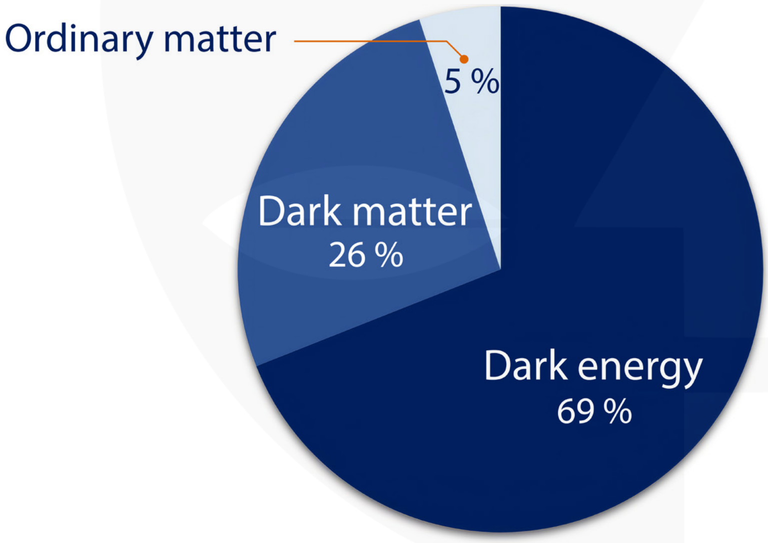


Figure 8: The total mass-energy content of the universe, in the standard model of cosmology, based on the data published in reference 30.

As astronomers and cosmologists endeavor to uncover the true nature of dark matter through their observations, cosmologists and theorists in the field of particle physics and theoretical physics are also in pursuit of this enigmatic substance. By proposing novel hypotheses, they predict new particles that could be considered as candidates for dark matter.[61] To date, a wide array of potential candidates for dark matter has been suggested, including Weakly Interacting Massive Particles (WIMPs),[63] axions, [64,65] and primordial black holes.[66-69]

Despite numerous experiments aimed at directly identifying and studying dark matter particles currently underway, none of these efforts has so far led to their detection (either in a laboratory environment or through astronomical observations). This situation has effectively placed the physics community in a sort of "dark matter crisis."[70] According to proposed models, dark matter can be classified into three categories based on the velocity and free-streaming length of its hypothetical constituent particles: cold, warm, and hot.[63] The free-streaming length is essentially the distance these hypothetical particles travel before clustering and clump formation as large as today's galaxies. For non-relativistic and collision-less particles where interactions are mostly gravitational, the free streaming length is shorter, facilitating the structure formation of small galaxies in the universe (Figure 9).[63]

1- Cold Dark Matter (CDM): Composed of hypothetical heavy particles with non-relativistic velocities, resulting in their very short free-streaming lengths. Hence, they can undergo gradual agglomeration to form small-scale structures such as galaxies and galaxy clusters.[71] Cold Dark Matter is the most widely accepted model for this phenomenon. Potential candidates for its constituent particles include Weakly Interacting Massive Particles (WIMPs) or axions.[63] It is also worth mentioning that the properties of Cold Dark Matter highly correspond with the characteristics of the Cosmic Microwave Background (CMB).[29]

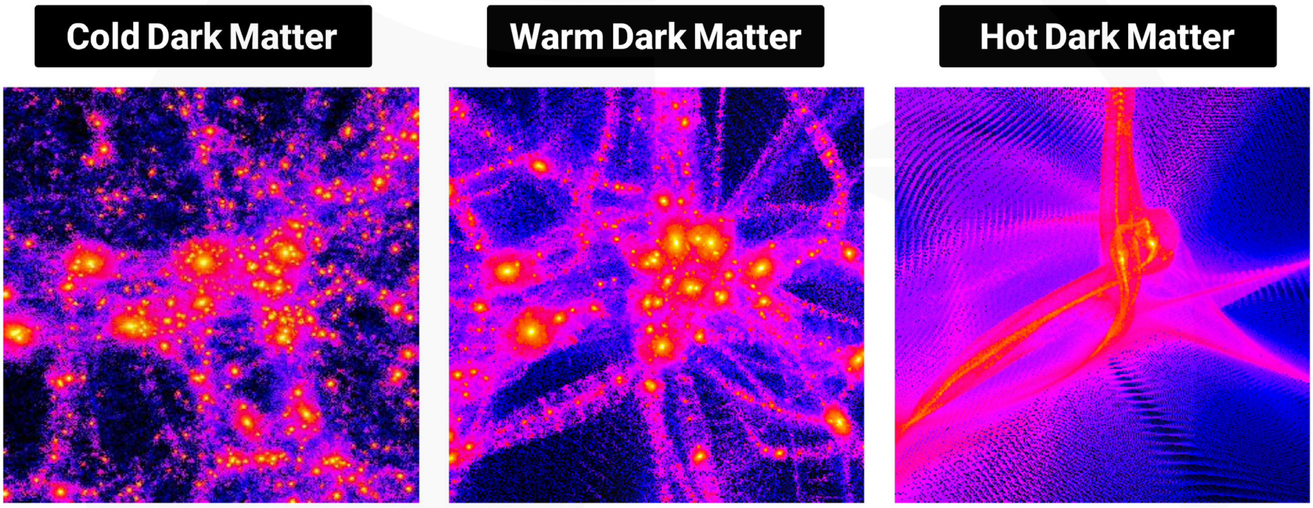


Figure 9: Density map of structure formation of the current cosmos in cold, warm, and hot dark matter, respectively from left to right, obtained through N-body simulations. As speed increases, consequently the free-streaming length increases, the existing voids become emptier. Photo source: 72-219

2- Warm Dark Matter (WDM): This type of dark matter is likely composed of hypothetical particles with moderate mass and semi-relativistic velocity, resulting in their free-streaming length being longer than that of the hypothetical particles in cold dark matter. The longer free-streaming length in warm dark matter means that these hypothetical particles can inhibit the formation of small-scale structures in the universe, but have no effect on the formation of large-scale structures.[63] Possible candidates for warm dark matter particles include Sterile Neutrinos[61,73] and Gravitinos.[74,75] Due to the challenges associated with the cold dark matter model,[76,77] warm dark matter could serve as a potential alternative in cosmological models.[63,75,78]

3- Hot Dark Matter (HDM): Composed of hypothetical, light, and relativistic (high-speed) particles that possess a significantly long free-streaming length, meaning these particles cannot form the structures present in the universe, rather, they only eradicate primordial density fluctuations.[63] Consequently, hot dark matter only contributes a small portion to the total dark matter density. Potential candidates for this category include neutrinos remaining from the early universe.[61,63]

From the perspective of scientists, the characteristic temperature of dark matter is related to the velocity dispersion and the mass of the hypothetical particles composing it. The greater the velocity of these hypothetical particles and the lower their mass, the higher the temperature becomes. Therefore, hot dark matter has a higher temperature compared to warm dark matter, and warm dark matter has a higher temperature compared to cold dark matter. However, a constant temperature for dark matter cannot be assumed; because as the universe expands and cools down,[35] the temperature of dark matter decreases as well.[74]

T-Consciousness Cosmology

Dark Matter and Dark Energy from the Perspective of T-Consciousness Cosmology

T-Consciousness Cosmology introduces the *Spherical Cosmos Model (SCM)*, stating that the cosmos emerged from a black hole known as the *Cosmic Black Hole*, which is composed of *Taheri Absolute Matter* or *TAM*. After the *Big Shock*, TAM begins to decompose from its innermost surface close to the center of the black hole. This decomposition, which is one of the stages of the *Cosmic Rebound* and transformation of the initial seed into a newborn cosmos, is the factor that preludes the formation of the components of the cosmos. As mentioned in the *Cosmic Shell Hypothesis*, TAM is composed of the unity of *dark-dark matter* or ultra-dense *Space Mesh*, *light-dark matter*, and a new type of matter called *Thermal Matter* resulting from the extremely high compression of thermal waves.

During the decomposition of TAM, dark-dark matter unravels and undergoes a series of transformations through several stages. Initially, it appears as *solid-like dark matter*, then transforming into *liquid-like dark matter*, eventually becoming *gas-like dark matter*. Ultimately, the gas-like dark matter also unravels completely from its slightly compressed state in the form of *Space Mesh* that is released into the cosmos. All these stages are contingent upon the expansion of the cosmos, which provides the necessary conditions for this process. In other words, the bedrock known as space mesh, is the consequence of the transformative journey of dark-dark matter which unravels from an ultra-compressed state to a completely open and stress-free state, which is the result of TAM decomposition in the Cosmic Shell (Figure 10).

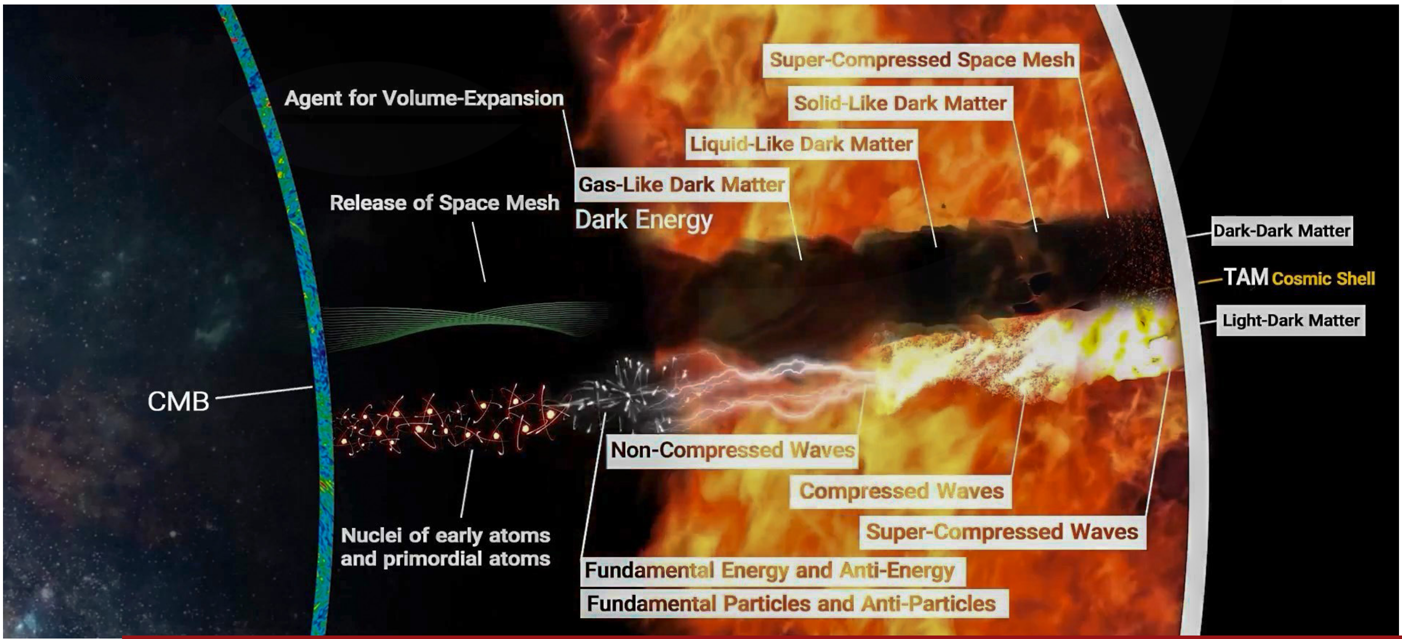


Figure 10: Light matter and energy, dark matter and energy, and ultimately the release of space mesh, are all a consequence of TAM decomposition (Cosmic Shell).

In T-Consciousness Cosmology, dark matter is posited as fundamentally arising from varying forms of space mesh compression. The various forms of dark-dark matter – namely solid-like, liquid-like, and gas-like dark matter – exist potentially throughout space and are formed into their various natures depending on the extent to which gravity, through mass formation, affects space. It is worth noting that the liquid-like dark matter discussed here is the same dark matter recognized in cosmology, and the gas-like dark matter is the same as the discovered dark energy (Figure 11).

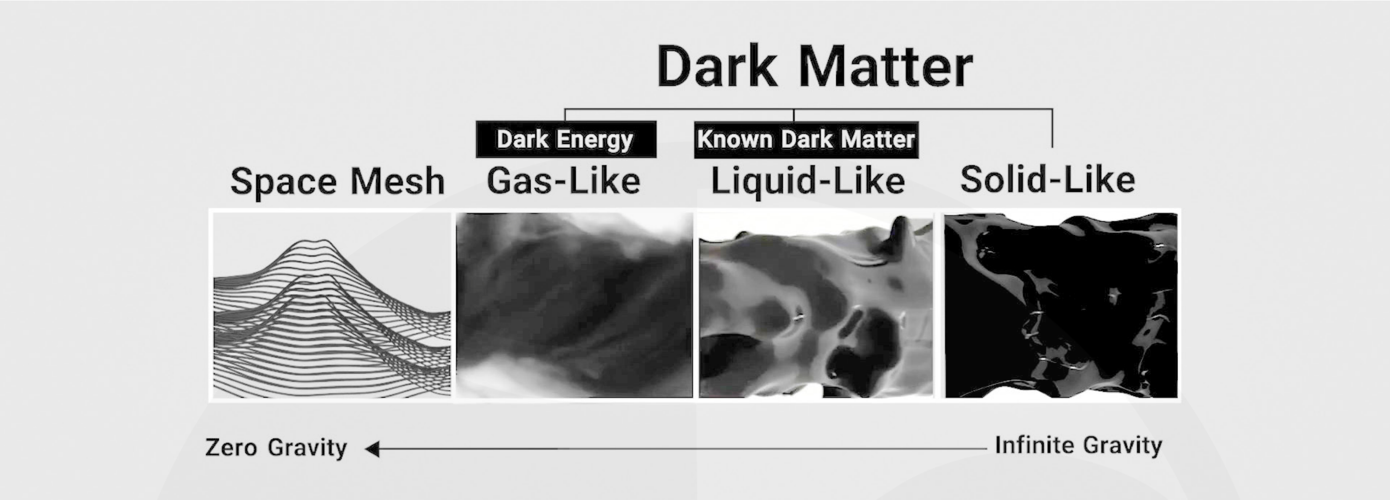


Figure 11: From right to left, the stages of TAM (Cosmic Shell) decomposition that leads to the emergence of various forms of dark matter.

Exploring the Differences and Similarities between the two Perspectives of T-Consciousness Cosmology and Conventional Cosmology

Conventional cosmology typically distinguishes between different natures for dark energy and dark matter. For instance, as previously explained, dark energy, conceived as the driving force behind of the accelerated expansion of the cosmos, could, according to various theories, be equivalent to the cosmological constant (Λ),[35] scalar fields (quintessence),[37-39] tachyons,[40] and so forth. Even recent speculations have tried to explain the accelerated expansion of the cosmos by proposing modifications to Einstein's field equations or alternative cosmological models that do not require the need for dark energy.[34,79] Similarly, for dark matter, which is considered responsible for the stability of galaxies and keeping their components from drifting apart, numerous candidates have been proposed by the theoretical physics and particle communities: Weakly Interacting Massive Particles (WIMPs), axions,[63] sterile neutrinos,[61,73] and others. However, to date, none of these proposed candidates for dark matter has been empirically discovered. Consequently, this segment of the scientific community faces a "dark matter" crisis.[70]

While T-Consciousness Cosmology considers the origin of dark energy and dark matter to be the same, viewing them as different densities in space mesh, it states that dark matter and dark energy are governed by the gravitational field of ordinary matter.

This perspective states that whenever a mass or ordinary matter forms in the cosmos, the space surrounding it contracts due to the gravitational pull of the mass itself. As the density of the mass increases, so does its gravity, leading to a greater compression of the surrounding space. Therefore, various types of dark matter form around celestial objects, that is the result of varying degrees of space compression that is caused by the amount of gravity that surrounds them. These types of dark matter may include liquid-like dark matter (the same known dark matter) or gas-like dark matter (dark energy). In other words, the accumulated dark matter around an object is directly proportional to the mass of that object (Figure 12). Furthermore, in the vicinity of all cosmic objects, from fundamental particles to galactic superclusters and etc, there always exists a certain degree of compression or, to put it another way, a specific viscosity of space proportional to the gravity of that mass. Additionally, according to the theory of T-Consciousness Cosmology, dark matter and dark energy function like an invisible scaffolding, acting as the agents that preserve the structure of ordinary matter.

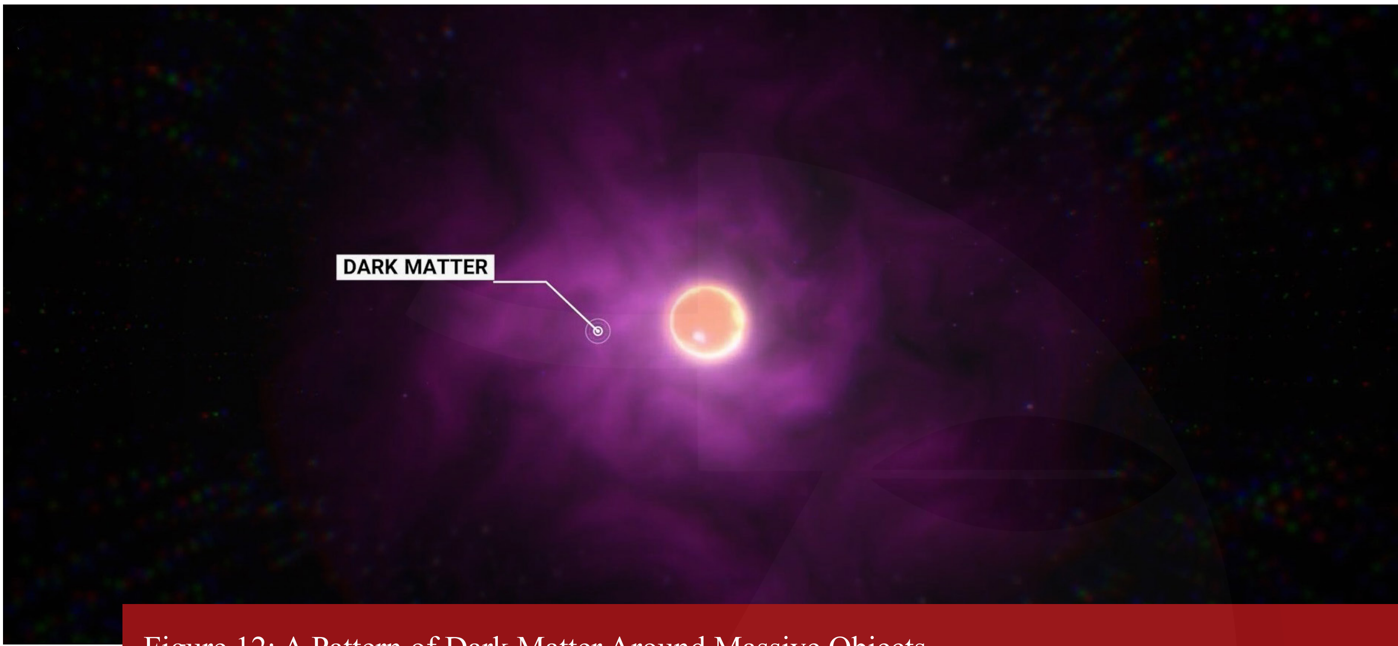


Figure 12: A Pattern of Dark Matter Around Massive Objects

It's worth mentioning that T-consciousness Cosmology also proposes the hypothesis that, parallel to the increase in gravity, time also acts inversely as a force that causes a gradual disintegration of mass, creating entropy, and an eliminator of gravity. The concept of time and its various types will be examined in the space, gravity-time hypothesis.

Also, according to the spherical cosmos model, we cannot observe any solid-like state of dark matter within the visible universe. This is because such dark matter only forms with the release of the compression of the dark-dark matter from TAM, which exists in the proximity of the cosmic shell or possibly at the center of intra-cosmic black holes.

With these definitions, T-Consciousness Cosmology considers certain characteristics for dark matter and states that:

1- Dark matter does not possess any of the properties of the materials we encounter in our daily lives, nor is it similar to the form of matter that constitutes stars and planets. This is because these materials are made up of particles known as baryons. We can identify the baryonic properties of materials through the detection of absorbed radiation passing through them. However, dark matter cannot be detected in this manner. In other words, dark matter or dark energy is not made of baryons. As a result, they are and will not be detectable as the hypothetical particles proposed by physicists.

2- Dark matter cannot be seen, as it does not emit or reflect light or electromagnetic waves; however, its existence can be inferred from its gravitational effects on visible objects, such as stars and galaxies. This is why the adjective "dark" is used to describe the behavior of this type of matter.

3- Dark matter is not antimatter either. Because when matter and antimatter collide, gamma rays and other particles are produced. Therefore, from this perspective, matter or antimatter cannot collide with dark matter, and wherever there is any matter of any mass, it will always be encompassed by dark matter or dark energy, depending on the amount of mass. This means that dark energy is present around low-mass objects, and dark matter (fluid-like) exists around super-massive objects.

4- Dark energy also exists around fundamental particles. This is because particles, based on their mass, cause a very slight contraction of space due to gravitational force, and this slight contraction of space is the dark energy surrounding them.

5- Dark matter is not made up of particles. Therefore, it cannot be detected using devices designed to identify particles. As a result, hypothetical particles such as gravitinos, axions, and WIMPs will not explain the nature of dark matter or dark energy.

6- The reason dark matter interacts with gravity is due to the fact that they are one in nature, which originates from the contraction of space.

7- A certain amount of dark matter, albeit in small amounts, is always detectable around planets or very massive stars, white dwarfs, neutron stars, magnetars, pulsars, or black holes. The amount of dark matter around these objects increases as their mass increases. Meanwhile, it is readily discoverable in large quantities around galaxies, galaxy clusters, and even larger structures.

8- Galaxies that lack a central mass may not have dark matter surrounding them or, if present, its amount could be significantly less than expected. This is due to the absence of 'Gravitational Resonance,' which is one of the hypotheses in T-Consciousness Cosmology. (The gravitational resonance phenomenon will be explained in later sections of this special issue)

9- Dark energy and dark matter exist in a structured or organized form around objects, which is one of the reasons for the meaningful rotation of low-mass objects in the orbit of high-mass bodies.

10- Dark energy, by nature, possesses gravitational properties. However, its role in causing the expansion of the cosmos is similar to that of the pressure exerted by a pressurized gas inside an isolated chamber, acting on the shell of the spherical cosmos. This concept is explained in the Cosmic Shell hypothesis.

It can be concluded that T-Consciousness Cosmology regards one of the roles of dark matter and energy in the cosmos as a hidden scaffold preventing the collapse of ordinary matter. In other words, space, in order to prevent the collapse of objects from the fundamental to large scale in the cosmos, contracts in relation to the gravitational force of the mass. This contraction manifests around them as dark energy or dark matter, ensuring their stability and integrity. For example, as conventional cosmology has also indicated, the mass of ordinary matter present in galaxies alone is not sufficient to maintain their structure and stability. Another powerful factor is needed to preserve the shape of galaxies. This factor, which is dark matter, does not accumulate uniformly everywhere and exhibits different concentrations or, to put it another way, varying viscosities under different gravitational conditions. This concept will be discussed further (Figure 13).

Figure 13: The ordered structure of dark matter formed around galaxies.

Space Viscosity

To explain the concept of space viscosity in T-Consciousness Cosmology, we first introduce the quantity known as viscosity, which is used in classical mechanics, astronomy, modern physics, and even cosmology, to describe the motion of fluids or fluid systems. Subsequently, we explore the potential role of this quantity in increasing cosmic expansion and entropy, as well as its variability. Then, the hypothesis of space viscosity in T-Consciousness Cosmology is presented and elaborated on. Finally, the distinctions or similarities between the two perspectives are examined.

Viscosity and Fluid Dynamics and the Extent of their Applications in Conventional Science

From a physics perspective, fluids are defined as materials that continuously deform over time and flow when subjected to shear stress. Both liquids and gasses fall within this classification. In studying the motion of fluids, one of the parameters that play a relatively important role in determining the thermodynamic properties of these materials is viscosity. Therefore, viscosity can be described as the degree of resistance of a fluid to shear deformation or flow as a result of applied shear stress and serves as a measure to gauge the so-called "thickness" or concentration of the fluid. The more difficult it is for a fluid to deform or flow, the higher its viscosity. For instance, the viscosity of glycerin oil is 1500 times greater than that of water, and the viscosity of honey is 3000 times greater than water. For this reason, stirring a glass of water is much easier than stirring a container of oil or a container of honey (Figure 14).[80-84]

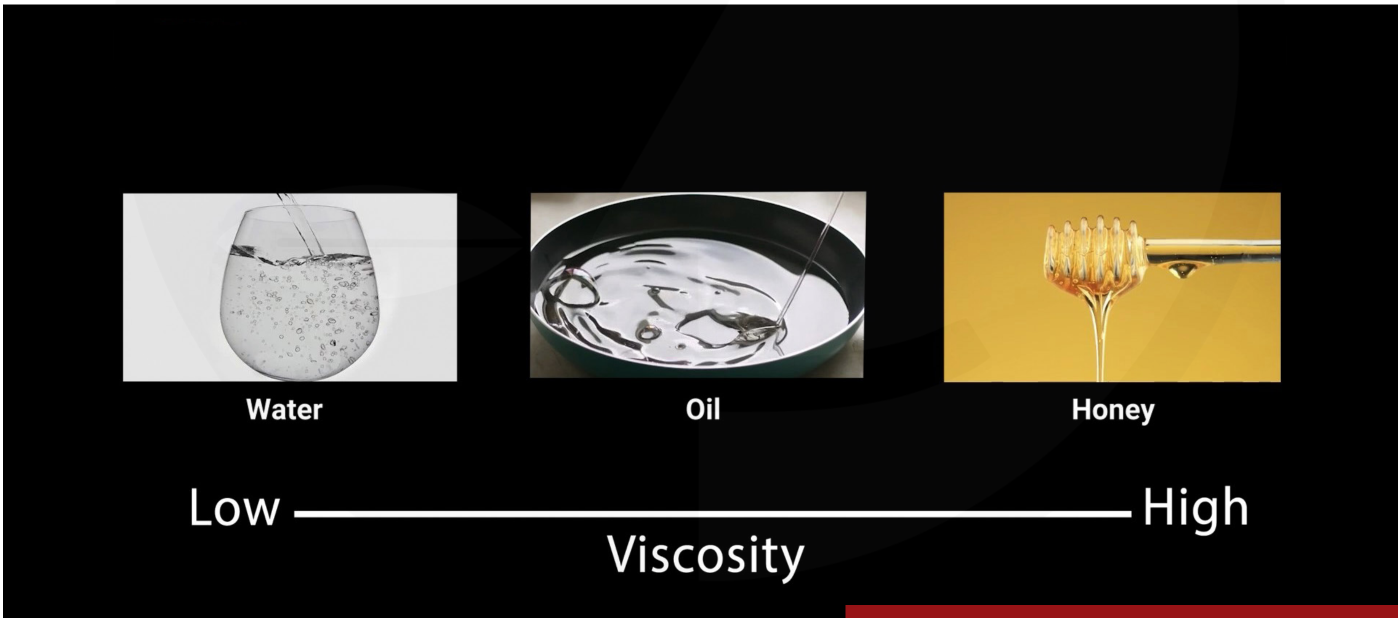


Figure 14: Different Viscosities in Fluids

Some fluids, such as water or air, maintain a constant viscosity regardless of the level of shear stress applied to them or the shear rate they experience (at a given temperature and pressure). However, others, such as polymer solutions, blood plasma, or mixtures of sand and water, exhibit variable viscosity based on the amount of stress applied or the shear rate (at a given temperature and pressure). The former are called Newtonian fluids, and the latter are referred to as non-Newtonian fluids.[80,81] Both categories are further divided into several subgroups based on their characteristics. For example, in one type of non-

Newtonian fluid, viscosity decreases with an increase in shear rate; or in another type, viscosity decreases over time if the shear rate remains constant.[80,83]

Extraterrestrial Applications of Fluid Dynamics

Generally, from the perspective of conventional science, everything we interact with on Earth is either a fluid, flows in a fluid, or is in proximity to a fluid. Therefore, the study of fluids and the role of viscosity in their thermodynamics, both at the microscopic and macroscopic scales, is naturally of great importance.[81] This topic is not limited to the ordinary fluids of planet Earth. In contemporary astronomy and cosmology, fluid dynamic equations and hence viscosity coefficients are employed to describe the role of viscosity in various phenomena, such as the formation and movement of stars,[85-87] giant planets,[88] accretion disks around celestial objects,[89,90] the thermodynamics of black holes,[91-94] the expansion of the cosmos and its increasing entropy,[95-98] as well as dark matter and dark energy.[99-102]

Although fluids, as a system, are composed of a collection of molecules and atoms, they are generally considered as a continuous medium with specific temperature and density at any given point in the motion equations.[103] In such cases where the quantity of molecules and atoms is considerable, the average fluid properties are considered more important than the characteristics of the individual parts.[84] Similarly, the motion of stars in a galaxy can also be viewed as a fluid mechanics problem. By understanding viscosity and other factors, parameters such as speed and density of a galaxy can be calculated on average in its different regions. The difference in this fluid system (galaxy) is that instead of molecules and atoms, we are dealing with a collection of stars and other celestial bodies.[88]

Fluid Thermodynamics and General Relativity

Among the equations used in the study of fluid dynamics, the Navier-Stokes equation[84,104] can also be employed for thermodynamically describing spacetime in general relativity, as it exhibits similar structure to the Einstein field equation under certain conditions (or as both equations have similar solutions under certain conditions). The discovery of such similarities has followed a historical process, initially beginning with the examination of black hole thermodynamics and the discovery that the governing laws are identical to those in classical thermodynamics.[91,105,106] Following this significant achievement, scientists demonstrated that Einstein's field equation in general relativity could be derived from thermodynamic laws and considered it as an equation of state.[107-109] An equation of state in thermodynamics is an equation that describes the state of matter as a function of pressure, density, and temperature. If the equation of state pertains to a fluid system, it will also be applicable in the analysis of fluid dynamics.[88] In later stages, finding the connection between gravity in Einstein's field equation and thermodynamics[110-112] as well as the introduction of entropic gravity hypothesis113 enabled showing that the Einstein field equation is identical to the Navier-Stokes equation of certain viscosity.[114-116] It is vital to mention that in the Navier-Stokes equation or any other equation related to the dynamics of a fluid, generally two types of viscosity coefficients are used: the shear stress viscosity mentioned and the bulk viscosity, which arises from the compression or expansion of a fluid as a whole.[84,104] From the thermodynamic perspective, both types of viscosity are corresponding to thermal non equilibrium conditions in a fluid system, leading to irreversible mechanical energy (transformation into heat), momentum transfer and consequently entropy increase of a fluid.[95,104,117,118]

Viscosity in Conventional Cosmology

From what has been discussed so far, the extensive application of viscosity in the study of any type of fluid system (whether conventional or unconventional) at any scale in space-time is clearly visible. It is, therefore, not surprising that the effects of viscosity have been investigated by cosmologists on a cosmic scale as well. In conventional cosmology and the ΛCDM[71] or Friedman-Lemaitre-Robertson-Walker (FLRW)[119-123] models, the universe is generally considered to be an ideal, homogeneous, and isotropic fluid (gas), where gravitational interactions follow Einstein's general relativity, and the universe is undergoing an accelerated expansion.[27]

From this viewpoint, the standard model has been highly successful in aligning with empirical observations, such as the cosmic microwave background (CMB), supernovae, or predicting large-scale structures. However, considering the universe as an ideal fluid is unrealistic; as some cosmologists argue, this fluid system is not in thermal equilibrium, and its entropy is increasing in accordance with the second law of thermodynamics.[125] From the perspective of fluid thermodynamics, to describe processes that lead to the disruption of thermal equilibrium, the transformation (dissipation) and consequently entropy production (increase) and irreversibility,[126,127] it is necessary to consider the universe as a fluid that deviates from ideal behavior, and viscosity plays a role in describing its dynamics.[128-130]

Between viscosity due to shear stress and bulk viscosity, the former is often excluded from cosmological dynamics studies due to the homogeneity and consequently the symmetry present in the standard cosmological model. This type of stress, being tensorial, becomes negligible under conditions of high symmetry (homogeneity). As a result, investigations into processes in the standard model that lead to entropy increase are generally feasible through bulk viscosity.[131] Contrary to what might be assumed, this coefficient cannot be ignored; moreover, bulk viscosity is consistent with homogeneity and isotropy of ΛCDM or FLRW cosmological models. However, it is worth mentioning that according to some studies, if there are small perturbations in isotropy, the effect of viscosity resulting from shear stress in the expansion of the cosmos cannot be disregarded, and both types of coefficients will play a role in this expansion process.[132-134]

The application of viscosity coefficients in cosmology has a historical background. In 1968, the role of viscosity up to the first second of the universe's age[135] was studied by Misner[124] as a factor for establishing homogeneity. However, one of the first individuals to seriously investigate the role of viscosity in increasing the entropy of a homogeneous and expanding universe, and to derive general expressions for shear and bulk viscosities using the well-known Eckart formulisms,[126] while considering the universe as an imperfect fluid, was Weinberg.[95] These calculations and subsequent studies conducted by other physicists[129,136,137] paved the way for exploring the role of bulk viscosity as a factor in the universe's expansion during its earliest epochs (inflation, lepton, and radiation dominated era), as well as in the current era and the late time acceleration era.[96,100,146,138–145]

Bulk Viscosity as an Alternative to Dark Energy

Why and how is bulk viscosity considered a factor in the expansion of the universe?

As mentioned earlier, observational data from distant supernovae serve as evidence that the universe is expanding at an accelerating rate.[147] This expansion is generally ascribed to dark energy, which exerts negative pressure and is equal to the cosmological constant Λ (used in Einstein's field equations) in the standard model of cosmology.[35] However, an important issue that cosmologists face with the standard model is the discrepancy between the cosmological constant derived from empirical observations and calculations. In other words, what is obtained from observations is about 121 orders of magnitude smaller than theoretical estimates.[148] This issue is one of the reasons researchers are exploring alternative hypotheses to describe the accelerating expansion of the universe, including considering the effects of viscosity; because, as scientists say, bulk viscosity, by exhibiting negative pressure, can itself be a factor for the accelerated expansion of the universe.[84,96,138,143,145,149] In other words, if the coefficient of this viscosity is sufficiently large, it exhibits behavior akin to the dark energy equation of state. Under such circumstances and to describe the accelerating expansion of the universe, incorporating energy dissipation effects (stemming from treating the universe as a fluid with specific viscosity) into the standard model is sufficient, eliminating the need for the cosmological constant Λ. It is also worth mentioning that the bulk viscosity coefficient always holds a positive value to maintain the second law of thermodynamics.[95]

Bulk Viscosity and Dark Matter Dynamics

The role of bulk viscosity in the dynamics of dark matter and its relationship with cosmic expansion has also been investigated by cosmologists in the past decade. The motivation to attribute viscosity to dark matter stems from the challenges present in the standard model of cosmology. As mentioned earlier, while the standard model has been very successful in predicting large-scale structures, it faces numerous issues at smaller scales. These include the Dwarf Galaxy problem,[150] which refers to the discrepancy in the number of such galaxies in the Milky Way compared to simulations that depict the distribution of matter in the cosmos, and the Cuspy halo problem,[151] which highlights the discrepancy between the inferred dark matter density profile inside a galaxy and what simulations show, among others. One interesting solution proposed for addressing these issues within the standard cosmological model, considers dark matter as a fluid in which hypothetical dark matter particles, contrary to the assumptions of the standard model, interact with each other (self interacting dark matter SIDM).[152,153] Naturally, taking this interaction into account inevitably leads to the emergence of viscosity coefficients resulting from shear stress and bulk viscosity in a non-binary fluid like dark matter. Furthermore, according to theorists in this field, based on calculations, such a hypothesis not only aligns with the standard cosmological model but also reduces the tension between data from the Cosmic Microwave Background (CMB) and large-scale structures,[130] solving the issues previously mentioned.[152] Additionally, the viscosity arising from the interactions of hypothetical particles in fluid dark matter, while generating negative pressure, itself becomes a factor for cosmic expansion. Hence, it could serve as a substitute for the cosmological constant (Λ) effects in the standard model as well.[101,154]

Unified DM and DE (Unified Dark Matter - UDM)

The unification of dark matter and dark energy, considering them as different aspects of a single fluid, is another hypothesis presented by cosmologists due to the unknown nature of the dark sector of the universe.[41,155–158] One implication of such a hypothesis is the elimination of the need to separately account for dark matter and dark energy in cosmological models. Moreover, since energy dissipation is a commonly occurring phenomenon in the universe, attributing bulk viscosity to this single dark fluid, as a cause for the expansion of the universe, is natural. However, the efficiency of such unification in describing the formation of cosmic structures on both the smallest and largest scales, has been met with significant criticism.[159,160]

Evolution of Bulk Viscosity Over Time

Considering the aforementioned hypotheses, bulk viscosity, as a factor for cosmic expansion, does not maintain a constant value and changes over cosmic time through different epochs. This is because, as previously mentioned, the universe is expanding at an accelerating and variable rate, and its temperature is decreasing. The viscosity coefficient can depend on temperature,[95] energy density,[126,138,141,143,144,146,162] the Hubble parameter, and the scale factor, which are both criteria for determining the rate of cosmic ex pansion.[96,100,102,129,145,158,161] There is no consensus in the equations presented for describing the evolution of bulk viscosity throughout different cosmological epochs. This is because depending on the selected cosmological model and the initial assumptions in the calculations, the value of this type of viscosity can increase or decrease with cosmic expansion and reach zero.[145,146,163] Some researchers believe that if the value of this coefficient is sufficiently large, it could play a key role in the future of the universe.[96,161] Additionally, the bulk viscosity coefficient can have a constant value at a specific period of cosmic time[96,161] or, according to Weinberg's calculations, can be zero at times when it originates from a type of radiation, or in conditions where the speed of particles is nonrelativistic and extremely relativistic. Conversely, with the decrease in the temperature of the expanding universe, the value of this coefficient can also decrease.[95]

Bulk Viscosity and the Lifetime of the Cosmos

From the perspective of theorists, attributing viscosity to the cosmic fluid and its impact on the expansion process also affects calculations related to the age of the universe. Since viscosity can be considered a factor for cosmic expansion and even increase its rate, its presence leads to an increase in the current age of the universe.[100,134] However, depending on the assumptions and equations used to describe bulk viscosity, the age of the universe in the present epoch can be less than its standard age of 13.8 billion years.[145]

T-Consciousness Cosmology: The Space Viscosity Hypothesis

Considering the various theories proposed by scientists, T-Consciousness Cosmology states that viscosity is also a function of space mesh and posits that the viscosity of space around any object varies according to its mass - the more massive the object, the higher the viscosity of the surrounding space. For example, due to the high gravity of intra-cosmic black holes, the density of the encompassing space, or the viscosity of space around them, is naturally very high.

According to this perspective, viscosity is considered a key factor affecting both the expansion and contraction of the cosmos, and the formation of objects within it. It suggests that prior to the Big Shock, the viscosity of space was at its peak due to the infinite density within the cosmic black hole, or the initial seed of the cosmos. This viscosity diminishes to zero by the final stage of the Rebound, when the cosmos achieves its maximum volume increase. Consequently, the viscosity of space is always changing, exhibiting different values. This value is considerably high at the beginning point of the cosmos and gradually decreases during the cosmic Rebound until it reaches zero at the terminal edge of the Cosmos (the final stage of space Rebound) (Figure 15).

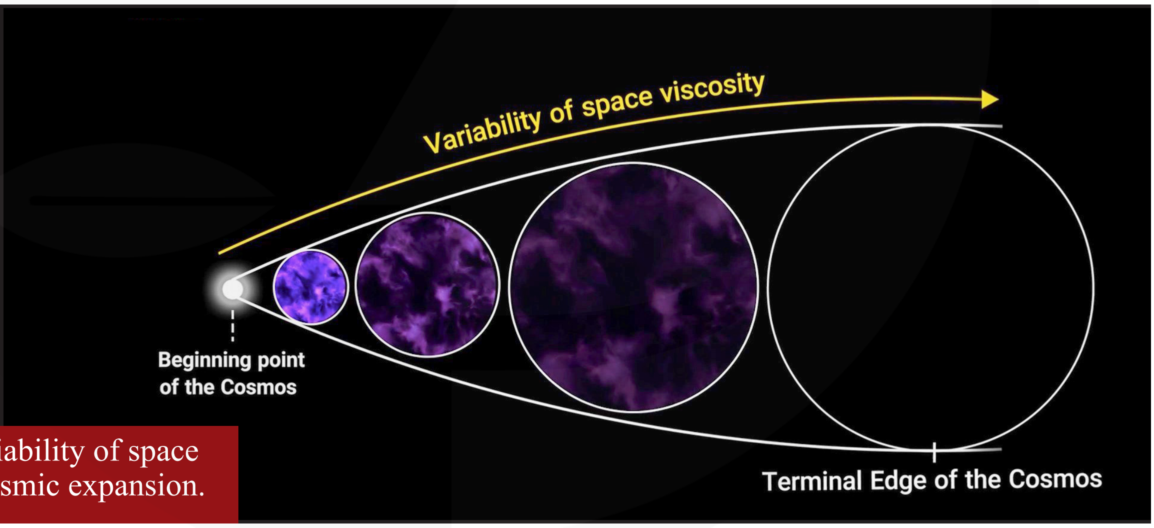


Figure 15: The variability of space viscosity during cosmic expansion.

A Brief Comparison of Two Perspectives

A comparison of two perspectives: The definition of viscosity according to T-Consciousness Cosmology vs conventional cosmology.

Types and Origins

From the perspective of conventional science, two quantities of viscosity resulting from shear stress and bulk viscosity, are important in describing the dynamics of a fluid system. Both quantities 1- arise from the interactions among the components that make up a fluid, 2- serve as a measure of the resistance of that fluid to motion and lead to the disruption of thermal equilibrium, 3- cause an increase in entropy or energy loss in a fluid system. The former occurs due to the application of shear stress on the fluid, and the latter is a result of the expansion/compression of the fluid mass. Due to the homogeneity and isotropy of the universe, the bulk viscosity coefficient is generally considered in standard cosmological models. If its value is sufficiently large, by creating a negative pressure, it can act as a mechanism for the accelerated expansion of the universe and serve as a substitute for the cosmological constant Λ (dark energy) in the standard model. Bulk viscosity can also be attributed to dark matter (containing hypothetical particles that interact with each other) or to both dark matter and dark energy (assuming they form a unified fluid).

From the perspective of T-Consciousness Cosmology, viscosity is not defined for the universe in the conventional sense. Essentially, this viewpoint first and foremost posits that the space mesh or dimensions of space (excluding time) possess viscosity in varying degrees, depending on the mass that has caused it. Put simply, the amount of mass and consequent gravity, directly correlates with the viscosity of space. At the next level, the viscosity of space, representing different degrees of compression, manifests in three states: 1- Solid-like (present in the Cosmic Shell (for as long as TAM functions as the Cosmic Shell up to the final stage of Rebound), Cosmic Black Hole (slightly before its final formation during the cosmic Reversion and after the Big Shock or the birth of the cosmos in Rebound) and possibly intra-cosmic black holes (considering their gravitational strength)), 2- Liquid-like (known as dark matter in conventional science, which varies depending on the amount of mass present in space), 3- Gas-like (known as dark energy in conventional science). Furthermore, this perspective does not consider dark matter, dark energy, or gravitational force to be composed of hypothetical fundamental particles that carry force. Instead, gravity or the nature of these two states of matter is considered to be the space mesh. Due to the presence of objects, this mesh transmits gravitational force to the surrounding space by squeezing or stretching in a linear manner, rather than through frequency or waves. Therefore, the reason for the interaction of gravity with dark matter is attributed to their similar nature, which boils down to the contraction of space mesh. In essence, space leads to the manifestation of gravity and consequently dark matter and dark energy, proportional to the stress or tension applied to it by ordinary matter, depending on its amount. (The concept of gravity's non-wave, or linear nature will be explored in a separate discussion). Moreover, T-Consciousness Cosmology explains why dark energy is the cause of the cosmic expansion and appears to act against gravity: Dark energy, continually released from the Shell toward the interior of the cosmos and due to its presence around all types of mass, behaves like gas under pressure in an isolated chamber. With the difference here being that the hypothetical isolated chamber is the cosmos itself, and its wall is the Cosmic Shell. Therefore, the pressure applied to the Cosmic Shell is not only one of the factors leading to the expansion of the cosmos but also acts to maintain the composure of the structure of objects within the cosmos.

Variability

The bulk viscosity coefficient in cosmology is a quantity that changes over different cosmological epochs according to time and does not have a constant value. This is because, according to calculations, this quantity can be dependent on energy density, temperature, the Hubble parameter, or the magnification factor. Depending on the initial assumptions and the cosmological model in use, the viscosity coefficient can decrease with the expansion of the universe and reach zero, or conversely, it can increase during the universe's final period. Additionally, at a specific period of time, it can have a constant value or be zero.

However, from the perspective of T-Consciousness Cosmology in the Spherical Cosmos Model, the viscosity coefficient of space decreases from a high amount in the Cosmic Black Hole (the initial seed of the cosmos) to zero in the final stage of space (cosmic) Rebound. This means that at any given moment in time, locally (on a non-macro scale), depending on the gravity caused by the mass of ordinary matter and subsequently the contraction of space mesh and the emergence of dark matter or dark energy, the viscosity coefficient in that area remains constant. However, across the entire cosmos, considering the gradual dissolution and conversion of objects into absolute waves, it is variable.

Viscosity and the Age of the Cosmos

The discrepancy between the cosmological constant derived from empirical observations in the standard model of cosmology and the calculations has led some cosmologists to turn to the concept of bulk viscosity. That is, if the coefficient of bulk viscosity exponentially leads to the accelerated expansion of the cosmos, then the current age of the cosmos would be greater than its standard value. Moreover, this coefficient, in some cosmological models, decreases over time, causing the current age of the cosmos to be less than its standard value.

From the perspective of T-Consciousness Cosmology, the reason for the discrepancy between cosmologists' calculations and empirical observations can be attributed to the type of model or geometry considered for the cosmos. Such that according to the standard model of cosmology, the depths of space represent the early epochs of the universe, which are regarded as a moment in time rather than a location in space. Furthermore, the universe is not seen as a closed system but is expanding in volume due to internal expansion. However, according to the Spherical Cosmos Model, the interpretations derived from observations conform to the calculations due to our vantage point as observers of the depths of space from within this sphere, a subject that will be further examined in the "Center of the Cosmos" hypothesis. Additionally, according to T-Consciousness Cosmology, the viscosity coefficient—which varies from the beginning of the cosmos to the final stage of Rebound—plays a crucial role in determining the expansion of the cosmos or overall volume relative to its total mass. In this sense, high viscosity indicates the presence of significant mass in the cosmos (from birth to youth), low viscosity indicates the movement of celestial bodies towards the Shell of the Cosmos and their gradual transformation into waves (from middle age to old age), and ultimately, zero viscosity indicates the transformation of all masses into absolute waves and the absence of matter, dark energy, and gravity due to the lack of stress in space (the final stage of Rebound).

Inconsistency of the Primary Inflationary Theory with the Spherical Cosmological Model

Before evolving into the ΛCDM standard model, the Big Bang theory was confronted with two major challenges: the uniformity of the universe despite the lack of causal contact (cannot communicate by light signals) between its distant regions, known as the Horizon Problem, and the mass and energy density of the universe being close to its critical value even in its earliest epochs, referred to as the Flatness Problem, complicating the justification of structural formation in the universe.[36,164,165] The proposal of inflationary theory in the early 1980s[166,168] was regarded by cosmologists as a key solution to this conundrum. According to this model, the universe underwent an inflationary period at the very beginning of its formation, before the radiation dominance epoch, expanding exponentially at an accelerated rate within a very short period (from 10^{-34} to 10^{-32} seconds after the Big Bang).[164] Such exponential expansion is attributed to the breaking of the grand unified symmetry (Higgs scalar fields),[36,164,165] and as suggested by some cosmologists, bulk viscosity could also cause the cosmic fluid to expand at an exponential and even super-exponential rate due to inflation; provided the bulk viscosity coefficient is sufficiently large in the presence of large scalar fields.[141,169] Therefore, from the viewpoint of some theorists, bulk viscosity-driven inflation is not impossible,[129,131] though not all cosmologists agree.[128] The magnitude of this coefficient, as previously mentioned, is not constant throughout the different epochs of the universe and can decrease over time to zero, depending on the assumptions and cosmological model used.[145,146,163] Furthermore, taking bulk viscosity into account alters calculations regarding the age of the universe, potentially resulting in an increase.[100,134]

One of the most significant aspects presented by T-Consciousness Cosmology in its Spherical Cosmos Model is that since the viscosity of space is directly related to gravity, its high amount in the early universe prevents the inflation that is ascribed to the earliest period in the standard model (ΛCDM).[166,167] In other words, the Spherical Cosmos Model posits that the combination of very high gravity in the primordial universe and the existence of a cosmic shell prevents the runaway expansion of space released from the shell itself, leading to a gradual increase in the volume of the newborn cosmos, contrary to the inflationary theory. In essence, the cosmic shell (TAM) has a decomposition rate proportional to the gravity governing the entire volume of the cosmos at any given time. Since gravity was significantly high during the initial stages of the birth of the cosmos, expansion could not occur at the rate suggested by the inflationary theory, as the existence of the cosmic shell itself also serves to restrain this rate of volume increase (beyond the speed of light). The crucial point is that time, as an entropic force (which will be discussed in the context of space and gravity-time), is directly related to the amount of gravity. As a result, in the early universe, the nearly infinite gravity caused by the existence of TAM led to a correspondingly high force of time, meaning more time was available. Therefore, according to Spherical Cosmos Model, inflation in a few billionths of a second is not possible, and it took billions of years for the early universe to expand (Contrary to the inflationary theory, which considers the expansion of the early universe to have occurred in a fraction of a second). In this vein, recent findings by cosmologists have challenged the age of the universe, suggesting it is much older than 13.8 billion years.[170] Therefore, T-Consciousness Cosmology believes that the viscosity of space in the current cosmos is not a constant value and varies depending on the degree of contraction or expansion of the universe influenced by gravity (Figure 16).

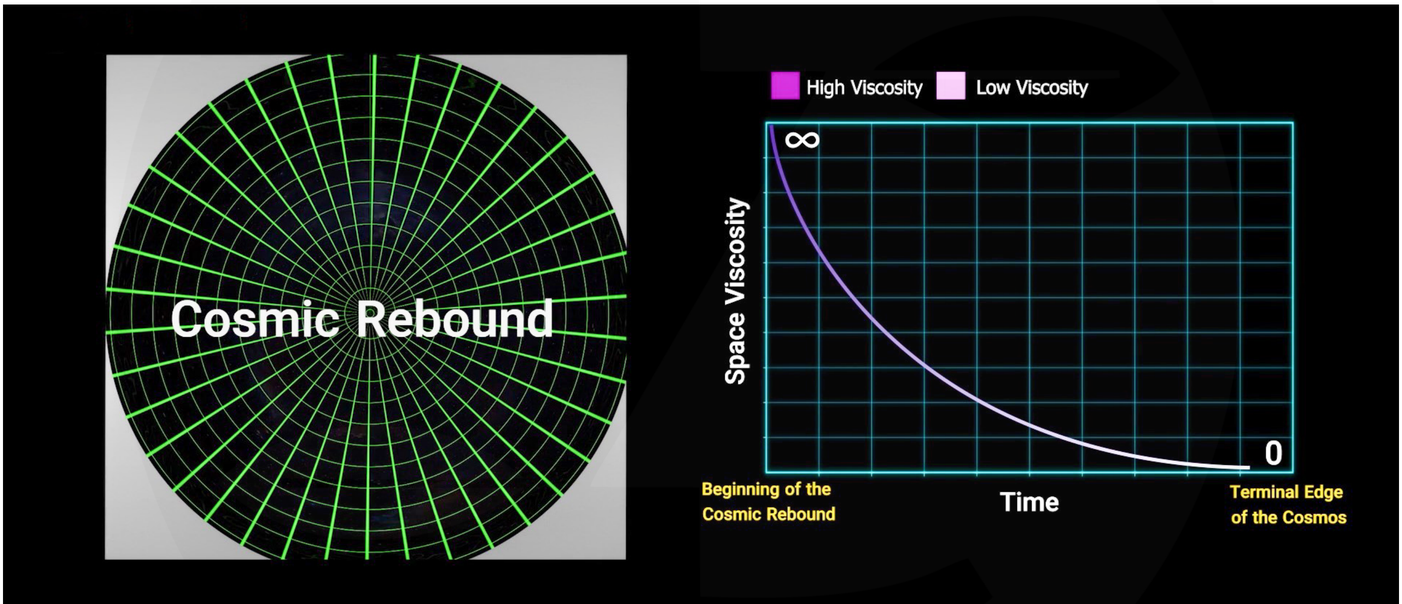


Figure 16: Right image: A chart showing the changes in space viscosity from birth to the final stage of Rebound. Left image: The stretching of space mesh (green color) to its ultimate limit.

Gravitational Resonance: a Theory of T-Consciousness Cosmology

This perspective also introduces another significant hypothesis known as "*Gravitational Resonance.*" This hypothesis states that whenever there is a supermassive black hole at the center of a system like a galaxy, with stars, planets, and moons with a certain amount of dark matter orbiting around it, this supermassive black hole, which has immense gravity and consequently a significant amount of dark matter, synergizes with the gravity of all the celestial bodies around it, and without any mass entering the galaxy from outside, gravity is amplified exponentially throughout the entire system. In T-Consciousness Cosmology, this phenomenon is referred to as *"Gravitational Resonance"* (Figure 17).

Figure 17: An example of a spiral galaxy with gravitational resonance

One of the applications of the gravitational resonance phenomenon is that it can explain the absence or scarcity of dark matter in some discovered galaxies. Indeed, since these galaxies do not possess a central supermassive black hole, the configuration of their constituent objects will also be dispersed without revolving around a central mass. In such cases, the distance between the dark matter in each object within this system results in a lack of gravitational resonance, leading to a significantly reduced gravitational resonance for these types of galaxies. This situation causes the absence or scarcity of dark matter around these kinds of galaxies. (Figure 18)

Figure 18: An example of an ultra-diffuse galaxy with no gravitational resonance and its characteristics (NGC1052-DF2)[171]

Credits: NASA, ESA, and P. van Dokkum (Yale University) CC-BY-4.0

Considering the definition of gravitational resonance, it's important to note that this phenomenon was most pronounced before the cosmos emerged from the cosmic black hole. Its intensity has decreased as the cosmos expanded, beginning with the onset of space Rebound. This decrease will continue until gravitational resonance will eventually be diminished to zero when the cosmos reaches its maximum volume at the final stage of Rebound, or the terminal edge of the cosmos. (Figure 19)

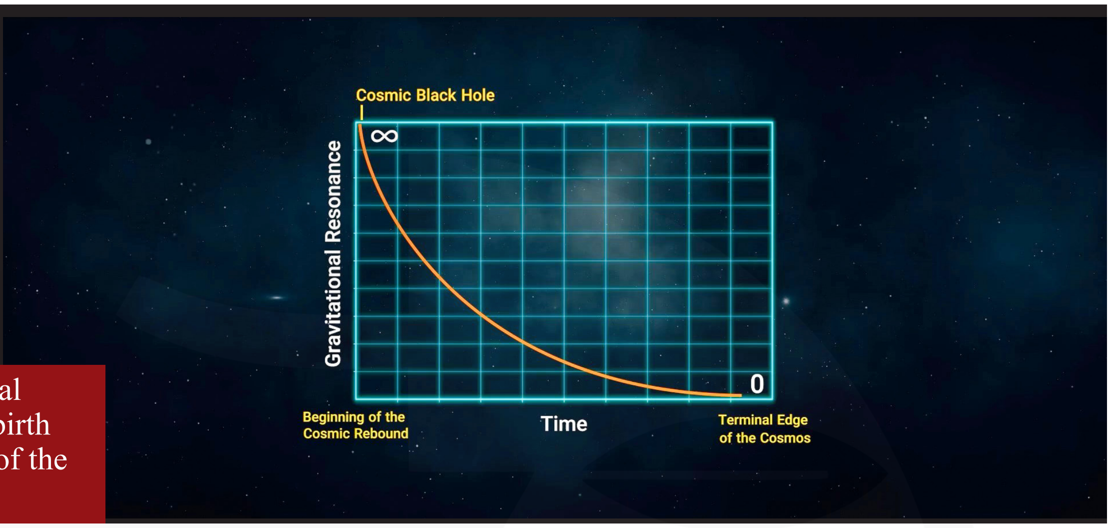


Figure 19: Gravitational resonance chart from birth to complete Rebound of the cosmos

Another point addressed from this viewpoint is that in events like supernovae, the dark matter surrounding a star temporarily disappears or significantly decreases. This is due to the conversion of the star's ordinary matter into energy, which with the star's gravity gone, a major portion of the surrounding dark matter also vanishes as the stress on the space mesh around it is relieved. If a white dwarf, neutron star, or any kind of remnant object forms from the explosion, the space around it contracts again due to its high mass, and a significant amount of dark matter forms around this remaining object. In reality, the space viscosity around the remnants of a star's explosion (due to very high density) is much greater than the space viscosity around the star itself before the explosion. (Figure 20)

Figure 20: An artistic image of an exploded star (supernova) that has lost its surrounding dark matter.

T-Consciousness Cosmology: The Principle of Change

One of the most important principles of T-Consciousness Cosmology is the Principle of Change. According to this principle, the fundamental constants introduced in physics undergo changes over the course of cosmic Rebound. Among these constants, the universal gravitational constant and the speed of light can be mentioned.

T-Consciousness Cosmology: The Speed of Light and Redefining the Concept of Vacuum

The theory of relativity states that the speed of light in a vacuum (c) is constant locally and independent of the source or observer. Generally, a vacuum refers to any space where the pressure is significantly lower than atmospheric pressure. However, from a T-Consciousness Cosmology perspective, a vacuum is primarily defined in terms of the amount of spatial contraction, characterized by a specific viscosity created by the ordinary mass surrounding it. For example, the Milky Way galaxy, due to its mass and gravitational resonance, induces viscosity in its surroundings. Consequently, the speed of light, as calculated from within the galaxy, is based on this factor. Therefore, the viscosity of the vacuum in intergalactic space or other parts of the cosmos varies with the amount of ordinary mass matter, significantly affecting the measurement of constants such as the speed of light. Additionally, the gravitational resonance generated by local objects, like the Local Group—which includes our galaxy and several others—or massive galactic clusters viewed as collections of mass systems, imparts a specific viscosity to the surrounding dark matter. From an observer's perspective outside of that system, light waves will travel slower as they enter this region and return to their original speed upon exiting. This variation is an important factor for scientists to consider when measuring the distances of celestial objects deep in the cosmos. (Figure 21)

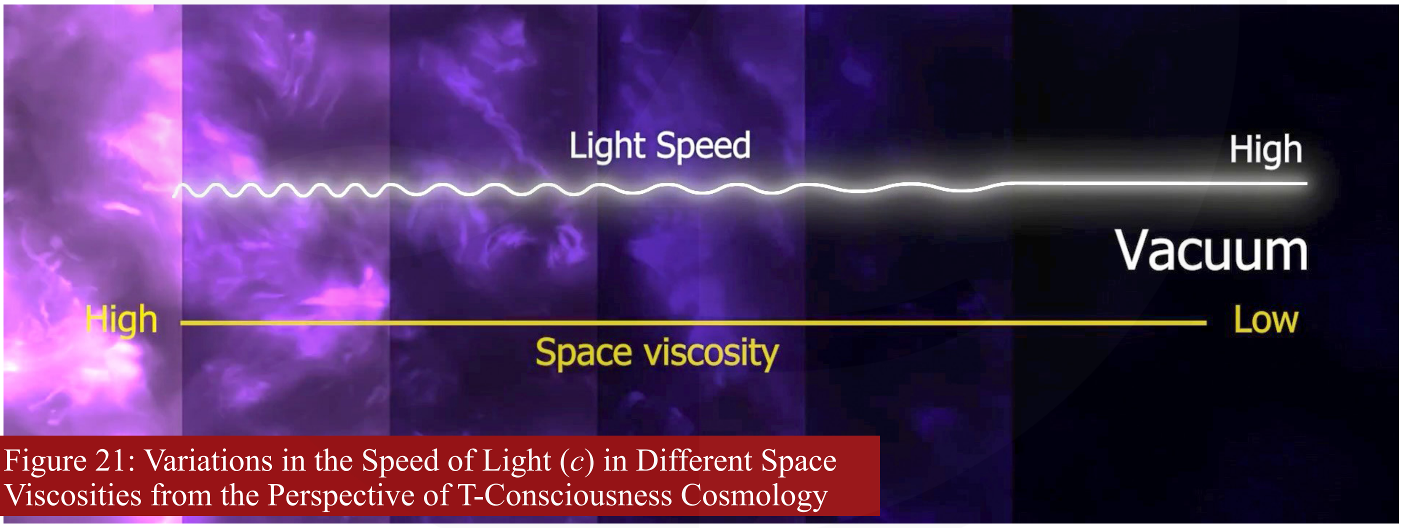


Figure 21: Variations in the Speed of Light (c) in Different Space Viscosities from the Perspective of T-Consciousness Cosmology

Secondly, if light passes near a massive object, its path may bend due to the refraction and deviation caused by the angle of approach to the dark matter surrounding that object. In conventional cosmology, such deviations are attributed to the geometric curvature of space-time induced by the object's mass. However, T-Consciousness Cosmology presents a different view: it posits that the deviation of light around massive objects like black holes or stars is not caused by the curvature of space-time as defined in the theory of relativity. Instead, this deviation results from the viscosity of space itself (excluding time) or the presence of dark matter, which arises due to the substantial mass compressing the surrounding space. This dark matter forms a spherical envelope around the object, manifesting gravity that also contributes to the bending of light. (Figure 22)

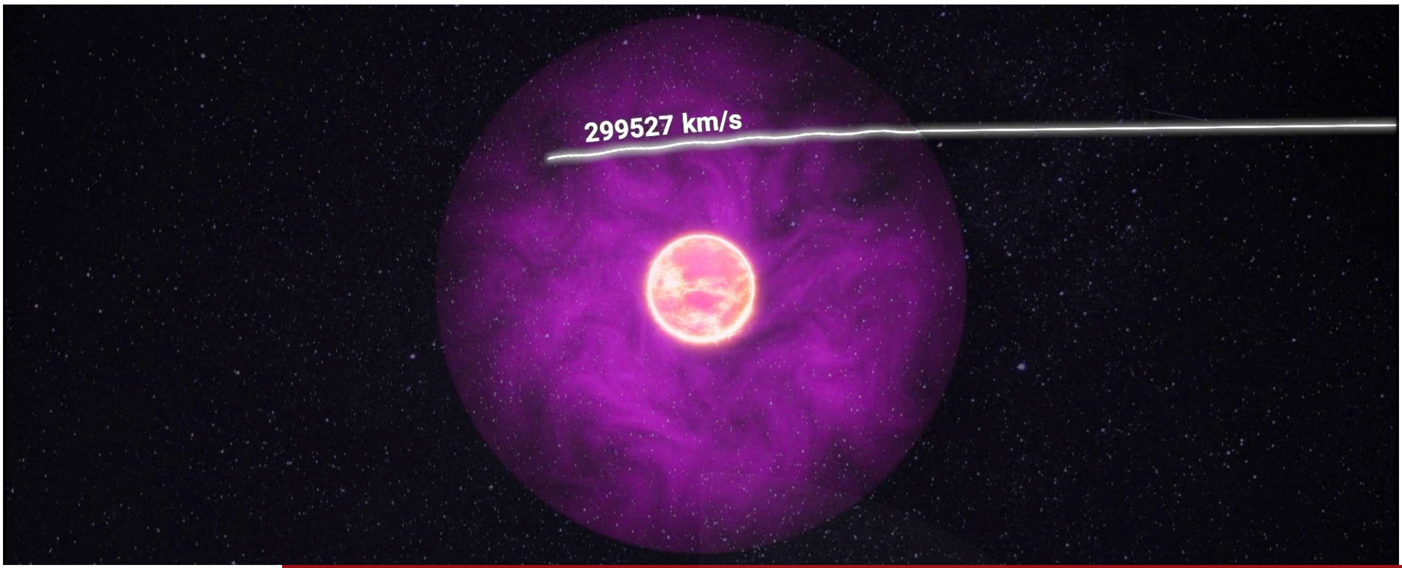


Figure 22: A hypothetical image of a massive star and the decrease in the speed of light as it passes through the contracted space surrounding the star.

The same principle applies when light passes through transparent materials with different viscosities. For instance, the speed of light in transparent mediums like water and air is less than the speed of light in vacuum as defined by conventional physics, due to the refraction of light.[172,173] This means that if light gets trapped in a dark matter with high viscosity, it slows down, its frequency increases relative to the viscosity, and its wavelength decreases, ultimately resulting in bending. After passing through this medium, the light is released and continues its path with its original speed, frequency, and wavelength (Figure 23). The reason the wave returns to its initial state is related to the wave's structure and memory, which T-Consciousness Cosmology will address in a separate discussion.

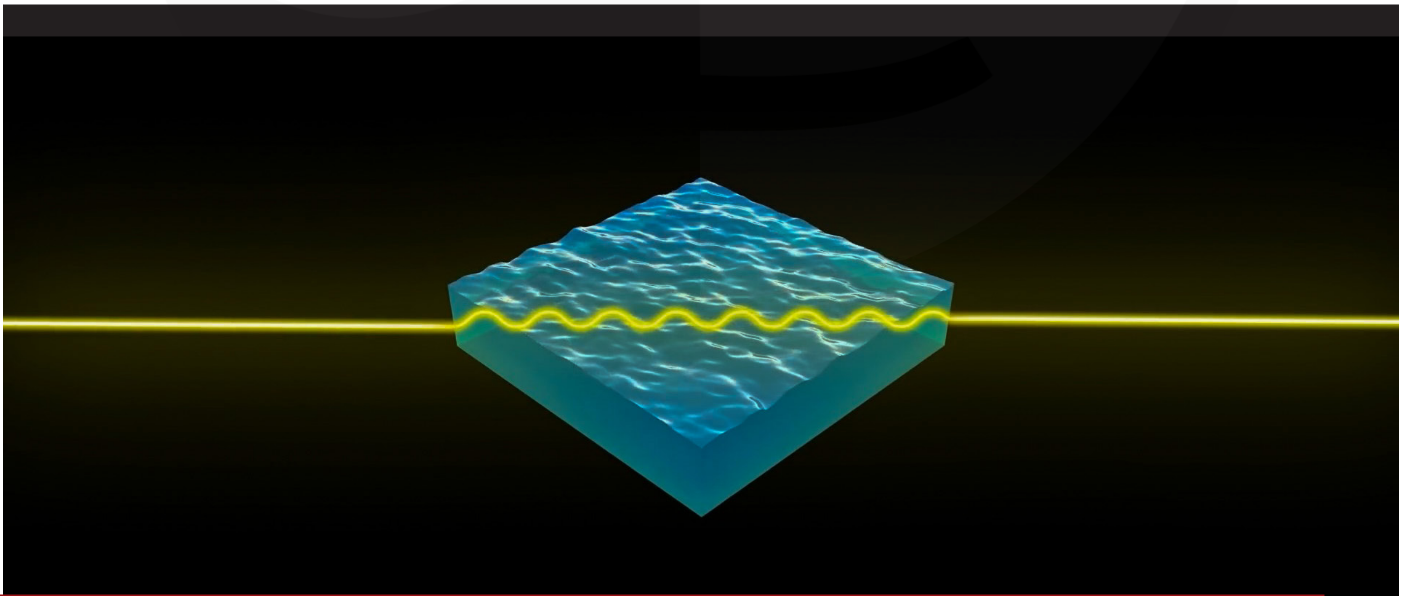


Figure 23: Reduction of the speed of light in a fluid medium such as water with a viscosity higher than that of a vacuum environment.

Prevalent Theories in Conventional Science Regarding Variable Speed of Light (*c*)

As mentioned earlier, the constancy of the speed of light (*c*) locally in a vacuum is one of the foundational pillars of the theory of relativity, and modern physics is built upon it. Naturally, considering this universal constant as variable would represent a significant intellectual revolution among physicists and alter the very established foundations, frameworks, and formulations. However, the persistence of such foundational principles and the scientific community's resistance to changing them has never prevented the proposition of theories that consider the speed of light as variable.[174,175] Precisely speaking, the constant c in the theory of relativity implies that all particles with zero rest mass (e.g. photons, gravitons and etc.), exhibit the same speed, irrespective of their frequency (color), location, time, propagation direction, state of the observer or the emitting source of the particles. This explains the wide spectrum of VSL theories present in the literature, as violating any of the as-mentioned factors can lead to another VSL theory.[176,177] This collection has made its way into cosmology, quantum gravity, and more, some of which will be briefly mentioned below:

The Speed of Light Variation and Bending of Light

Perhaps one of the first individuals to propose the variability of the speed of light as a possibility was Einstein himself. The motivation behind presenting this idea was to describe the phenomenon of light deflection when passing near the gravitational field of celestial bodies such as the sun. In a 1911 article, Einstein demonstrated that the change in the wavelength of light while passing near the gravitational field of massive objects could lead to a change in speed and deviation,[178] a phenomenon known as gravitational redshift or blueshift, depending on whether the wavelength of light decreases or increases.[10]

Gravitational redshift occurs when light escapes from the gravitational field of a massive object, such as a star or a black hole. Under such conditions, light needs to expend energy to escape. Therefore, by losing energy, it acquires a longer wavelength. If an observer is at a considerable distance from this gravitational field, they would measure a lower frequency and speed compared to an observer who is closer to the gravitational field of these objects.[178]

To better understand the impact of gravitational fields on the speed of light, one can also consider the motion of light along a curved path in space-time, for example, around a massive object. A light ray always follows the straightest possible distance between two points, known as a geodesic.[10,14] However, since in the theory of relativity space-time is curved, a geodesic may not be a straight line in a flat space but rather an arc of a curvature. Therefore, if we consider two hypothetical observers—one measuring the speed of light along a geodesic and the other along a straight line in flat space—these two observers will obtain different values for the speed of light. (Figure 24)

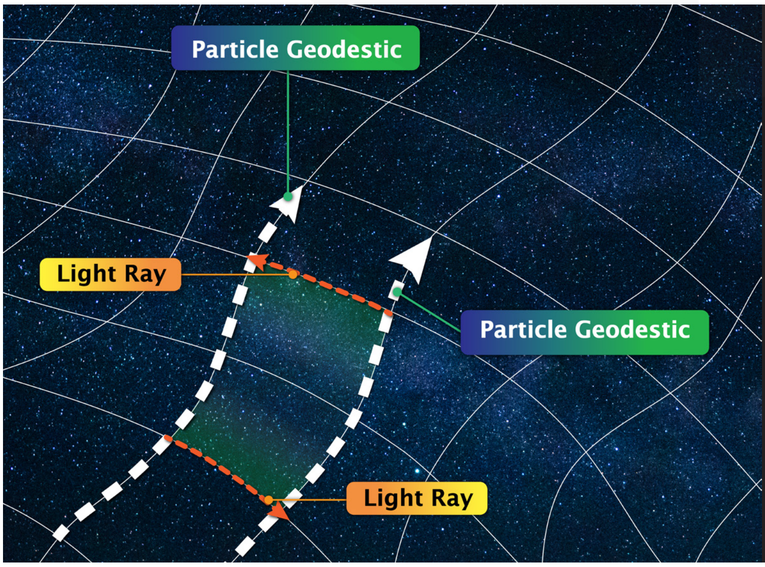


Figure 24: The Concept of Geodesics in Curved Space-Time

The Speed of Light in Varying Mediums and the Refractive Index of a Vacuum

Among others who proposed the idea of variable speed of light in their hypotheses was Robert Dicke. In a paper published in 1957, he demonstrated that the curvature of space-time, as predicted by the theory of relativity, could be attributed to changes in the refractive index of the vacuum. In other words, the vacuum can be considered a dielectric medium whose graded refractive index is dependent on the gravitational mass of objects within it, changing with spatial coordinates according to the following relationship:[179,180]

$$n(r) \equiv {}^{c(r)}/_{c_\infty} = 1 + \left({}^{2GM}/_{rc_\infty^2}\right)$$

In this equation, *n(r)* represents the variable refractive index of vacuum, *c(r)* the variable speed of light, c_∞ the speed of light in the absence of a gravitational field, *(G)* the universal gravitational constant, *(M)* the mass of the object, and *(r)* the distance from the object.

The variability of the refractive index of light can lead to variations in the speed, wavelength, and frequency of light around high-gravity objects, resulting in the deflection of light (gravitational redshift or blueshift). Robert Dicke also argued, to explain the cosmological redshift, that as the event horizon increases, more matter is produced in the universe, leading to an increase in the refractive index of vacuum. Therefore, according to the following equation, the speed of light should decrease over time:[179,180]

$$c(t) = n(t)^{-1} \times c_0$$

In the equation above, is the speed of light c_0 at the current cosmic time, i.e., $t=0$.

Robert Dicke's hypotheses later led to the development of the theory of relativistic gravity as an extension to Einstein's general relativity, where the Newton's law of universal gravitation is considered variable under the influence of a scalar field.[181]

Variable Speed of Light, an Alternative to the Theory of Cosmic Inflation

The collection of theories proposing a variable speed of light has also attracted the attention of the cosmological community as it could serve as an alternative to the theory of cosmic inflation. As previously mentioned, in the primary inflationary theory, the universe underwent a period of accelerated expansion in a very short time at the beginning of its formation.[166-168] This scenario was proposed to solve two major problems: the horizon problem and the flatness problem in the standard model of cosmology, based on the variability of matter density during the inflationary period.[36,164,165] However, considering a variable speed of light during the early universe is another approach proposed to solve these two significant issues in cosmology.

Among the models proposed in this context, the Albrecht and Magueijo model presented in 1999 can be mentioned.[182] In this model, the speed of light at the beginning of the universe's formation is considered to be much higher than it is today; as a result, parts of the universe that are not causally connected become connected from that early period, thereby solving the horizon and flatness problems of the cosmos. Another consequence of the variability of the speed of light in this model is that it justifies the smallness of the cosmological constant (Λ) at the current cosmic time. Furthermore, the evolution of c with time can be designed in a way that it causes fluctuations, hence explaining the structure formation.

The Albrecht and Magueijo model was later studied and more comprehensively reviewed by another prominent physicist named Barrow.[183] Unlike the initial model, where a decrease in the speed of light was considered instantaneous, Barrow's hypotheses link the reduction in the c over cosmic time to the expansion of the universe and the magnification factor, calculating the rate of this decrease to solve existing problems in cosmology. In another article, Barrow and Magueijo propose the variable speed of light scenario to account for changes in the fine structure constant, α (another fundamental dimensionless constant), showing that the speed of light decreased from the early universe to the matter domination epoch, and then reached the current constant value of c. Under such conditions, minor fluctuations in c would also justify changes in the fine structure constant.[184]

Moffat is another scientist who, in 1993, by presenting a model based on the variable speed of light and assuming a value about 10^{28} times the current speed of light during the early universe, showed that the two main problems of the standard model (the horizon and flatness problems) could be solved. In his model, after reaching a critical time, the speed of light decreased to its current and present value.[185]

Variable Speed of Light and String Theory (Superstring)

The concept of a variable speed of light has made its way into other theories such as string theory, or superstring theory. This is among the prominent theories in theoretical physics aimed at unifying all fundamental interactions in physics (gravity and other fundamental forces) as well as all forms of matter. In string theory, it is postulated that fundamental constituents of the universe, instead of begin point-like (dimensionless) particles, are extended one-dimensional strings that can vibrate. Indeed, these vibrations can have different modes, and each mode is a representative of a fundamental particle with a certain mass and charge. This framework attempts to resolve the longstanding contradictions between quantum mechanics and general relativity by offering a quantum gravitational system that is fully compatible with general relativity, thereby presenting a "unified theory of everything."[186-191]

One of the features of string theory is the emergence of new dimensions for spacetime in calculations.[187] These dimensions can have significant effects on the effective speed of light based on their geometry and dynamics. For example, in one of the hypotheses of string theory (called brane-world), our universe is confined in D-branes (hypersurfaces) that are embedded in five or more dimensions. Under specific circumstances and based on the models employed, the effective speed of light, when traversing through these branes[192,193] can either decrease (be Lorentz variant) or exceed what is defined within the framework of relativity (violate causality and increase in the speed of light).[194-196]

In addition to this set of theories, according to Hubble's law, distant galaxies beyond a volume known as the Hubble volume can recede from an observer on Earth at a variable speed greater than the speed of light *(c)*, which we will briefly touch upon:

Superluminality beyond the Hubble volume

As mentioned in previous sections, the universe is expanding at an accelerated rate.[27] One of the consequences of this expansion is the redshift of the spectrum received from observed galaxies, which occurs as these galaxies move away from Earth at a speed known as the recession velocity. According to Hubble's law, the magnitude of a galaxy's recession velocity, on average, depends on its distance from the observer (Earth) and the Hubble constant (H_0), which has a numerical value of 2.2×10^{-18} 1/s.[36]

$$v = H_0\, d$$

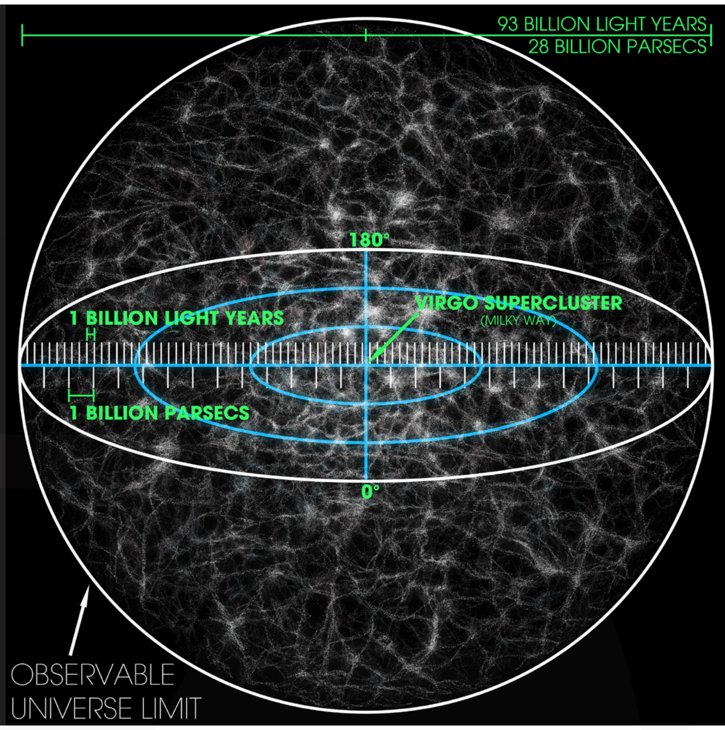
In other words, as the distance of a galaxy from an observer on Earth increases, the galaxy's recession speed relative to the observer also increases, and there is no limit to this speed. That means the recession speed can exceed the speed of light *(c)*. At first glance, it might seem that the absence of a limit for the recession speed of galaxies in Hubble's law contradicts the principles outlined in relativity and violates causality; however, from the perspective of conventional physics, this is not the case. In fact, what cannot exceed the speed of light is the speed of objects moving relative to each other, not the space between them. That is, the space between celestial bodies can expand at a speed greater than the speed of light; however, this is naturally not recordable with measuring instruments.

By definition, the distance at which the recession velocity of a galaxy relative to an observer reaches *(c)* is called the Hubble distance. This means that beyond this distance, the recession velocity will exceed *(c)*. This distance creates a volume termed the Hubble volume (Hubble sphere) that is continuously increasing with the expansion of the universe, and events beyond this volume are untraceable.

It is worth mentioning that this volume is smaller than the volume of the observable universe (Figure 25).[197]

Figure 25: The Hubble volume and the observable universe. The Hubble volume has an approximate radial equivalent to the radius of the inner blue circle and is therefore within the "observable universe."

Credits: Andrew Z. Colvin, CC BY-SA 3.0



Conventional Science vs. T-Consciousness Cosmology: A Comparative Analysis of Perspectives

Comparing the views presented in conventional science with T-Consciousness Cosmology reveals a clear distinction between these hypotheses and the reasons presented for the variability of the speed of light from the perspective of T-Consciousness Cosmology. This distinct difference lies in the direct impact of the viscosity of space on reducing or increasing the speed of light. In other words, as light travels through high-viscosity space —caused by the contraction of space proportional to the mass of ordinary matter—its speed decreases and it bends more as it becomes entangled in the space mesh. If a black hole is in its path, the significant increase in the viscosity of space completely traps the light at the event horizon, pulling it into the black hole (Figure 26).

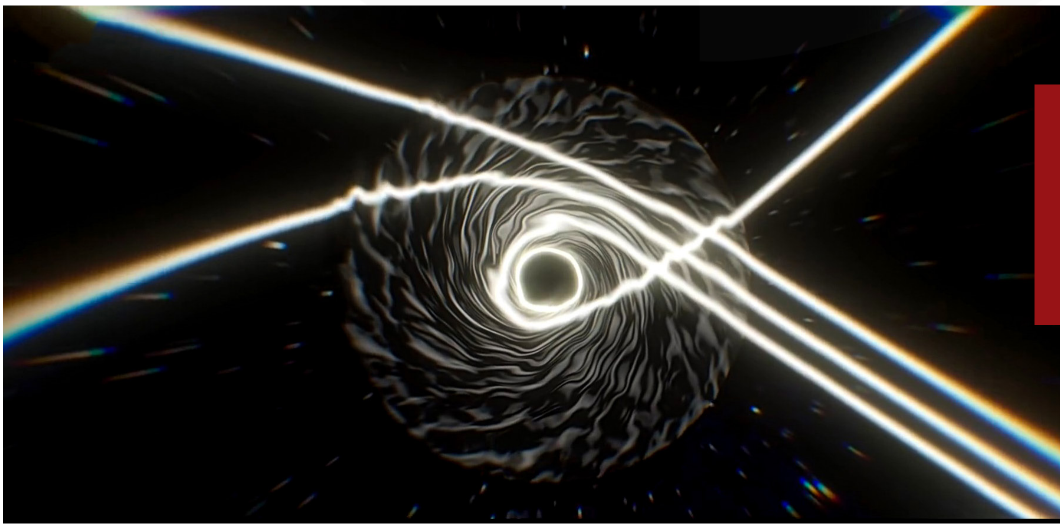


Figure 26: Bending of light around an intra-cosmic black hole due to the high viscosity of the surrounding space

Robert Dicke's Variable Speed of Light: A Perspective Comparison

This theory typically suggests that as the universe expands and the event horizon grows, matter production in the cosmos increases, which leads to a higher vacuum refractive index. Consequently, the speed of light is expected to decrease over time.

However, from the perspective of T-Consciousness Cosmology, firstly, the reason for the increase in matter production can be linked to the decomposition of the Cosmic Shell and its current matter generation. Secondly, the expansion of the cosmos is accompanied by an intrinsic rotation. As objects are driven toward the shell by this rotation, they disintegrate because the space mesh is released of stress and tension as a part of the rebound process. As objects disintegrate, they turn into absolute waves which have no gravitational influence on the cosmos. Likewise, as the viscosity of space decreases, the speed of these waves will (far) exceed the current speed of light as they will have a frequency and amplitude approaching zero (but not absolute zero). Overall, it can be said that T-Consciousness Cosmology, contrary to Dicke's theory, envisions the ultimate fate of the cosmos as being accompanied by a several-fold increase in the speed of light.

Exploring Variable Speed of Light as an Alternative to Cosmic Inflation Theory: A Comparative Perspective

Various theories regarding the variable speed of light proposed by scientists such as Maguiejo and Albrecht, Barrow, and ultimately Moffat as an alternative to the theory of cosmic inflation generally indicate that at the very beginnings of the universe's inception, the speed of light was much higher than its current speed and has decreased with the expansion process to reach the current calculated speed.

In contrast, T-Consciousness Cosmology considers the speed of light in the initial moments of the universe's beginning to be significantly lower due to the high gravity exerted by TAM (acting as the shell of the cosmos). This is because the volume of the cosmos in its early expansion phases was small, and the space releasing from the shell into the cosmos was associated with high viscosity. This means that the dark matter present at that time, due to the compression of space, had high density. This condition was the reason for the low speed of light in the early universe and its gradual increase in accordance with the expansion of the cosmos. It is noteworthy that from this perspective, the rate of the speed of light should be measured locally in accordance with the current volume of the cosmos.

The Variable Speed of Light in String Theory: A Comparative Perspective

According to this theory, a concept known as the brane world is proposed, where our cosmos is trapped within membranes or branes. These branes are enveloped in a spacetime of more than five dimensions. Therefore, under specific conditions, the speed of light, as it passes through these branes, can either decrease or exceed what is defined within the framework of relativity.

T-Consciousness Cosmology, however, does not assign more than three dimensions to space and defines time as an entropic force acting inversely to gravity, causing the disintegration of ordinary mass and releasing space from contraction and stress. Therefore, as previously mentioned, it is the variable viscosity of space, influenced by the presence of various celestial bodies that causes changes in the speed of light, not the branes defined in superstring theory.

Beyond the Speed of Light and Beyond the Hubble Volume from the Perspective of T-Consciousness Cosmology

According to the Spherical Cosmos Model, the cosmos has a shell that is constantly generating matter and releasing space. Consequently, primarily due to the increase in the volume of the cosmos (expansion of the cosmic sphere) and the reduction in the thickness of the shell, the escape velocity of the shell exceeds the speed of light. Moreover, the resultant speed of objects generated from the shell, despite being propelled towards the inside of the cosmos, is less than the approach velocity of the entire set of these objects towards the shell. This, considering observations made from the depths of the cosmos and the model adopted by cosmologists, apparently leads to the emergence of something known as the Hubble tension. In other words, from the perspective of T-Consciousness Cosmology, the current location of the shell is much farther than the 13.8 billion light-years distance observed by cosmologists and it is still in the process of generating matter. Without taking into account this aspect of cosmic behavior, the existence of Hubble tension in the standard cosmological model would be considered normal. Another factor leading to diverse and non-unified interpretations in the world of cosmology is the way scientists perceive the cosmos and propose various models that cover part of the observations made but do not justify other cosmic behaviors such as the expansion speed of the cosmos exceeding the speed of light in deep space. This issue will be further addressed in the Center of the Cosmos hypothesis.

The Relationship Between the Speed of Light and the Space Viscosity During Cosmic Expansion

The hypotheses of T-Consciousness Cosmology include descriptions of past events and future predictions of cosmic behavior. Here it is stated that the speed of light in the initial moments of the cosmos's birth was very low due to the high viscosity of space. With the increase in the volume of the cosmos to its current size, in this area, namely the inner space of the Milky Way galaxy, it has reached an approximate number of 299,792,458 m/s. As the cosmos continues to increase in volume, the viscosity will decrease consequently causing the speed of light to increase. This means that at the final stage of Rebound, which is equivalent to maximum space Rebound, light (electromagnetic waves) will achieve its ultimate speed, with both frequency and amplitude nearing zero (though not reaching zero), surpassing current speeds by several times. Therefore, the value of the speed of light along the path of cosmic Rebound in different environments will vary depending on the increase or decrease in space viscosity due to the presence of various celestial bodies. (Figure 27)

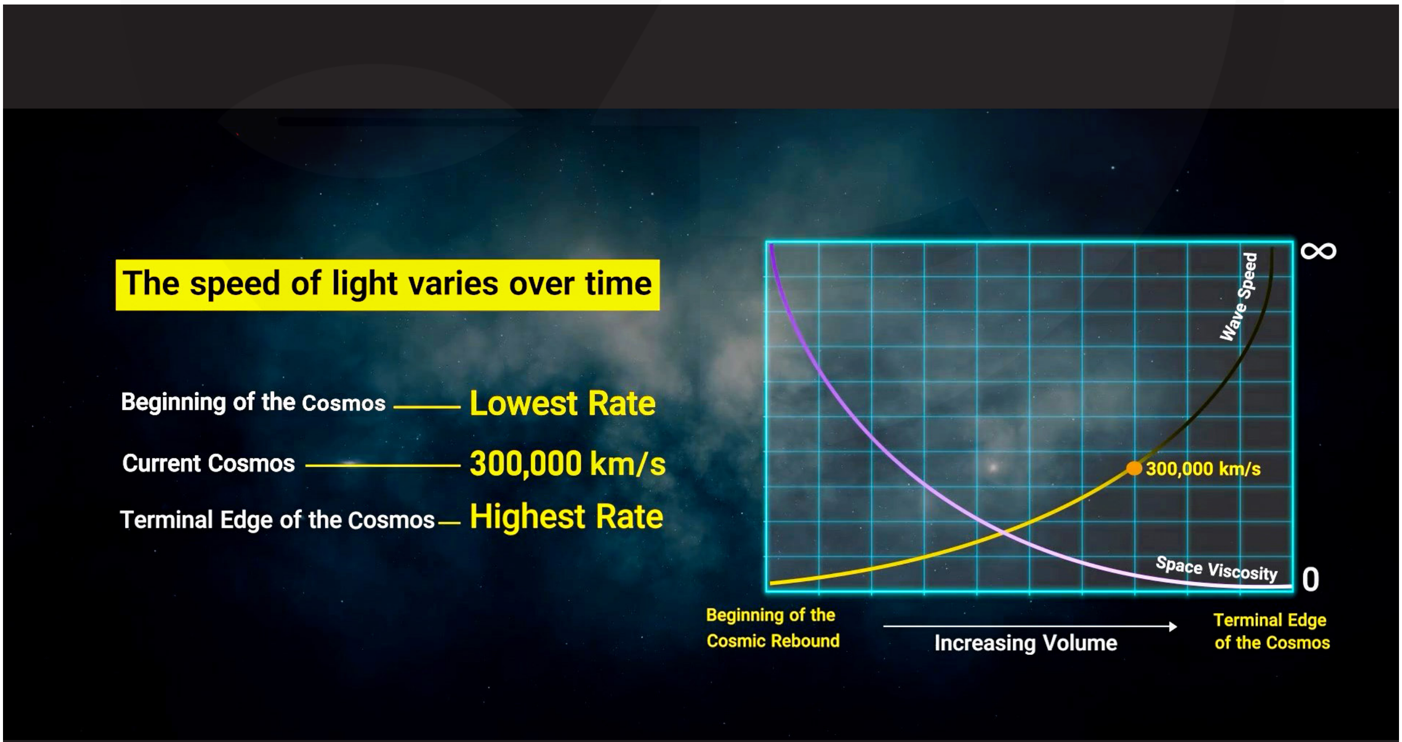


Figure 27: Diagram showing the change in the speed of light and the space viscosity throughout the cosmic Rebound from the cosmic black hole to the final stage of Rebound

The Universal Gravitational Constant and its Changes Over Time

Given the definitions mentioned, gravity is considered one of the fundamental forces in nature that exists between any two objects with mass and has a considerable effect at large distances. Newton, in his book "The Mathematical Principles of Natural Philosophy," presented the force of gravity without using the universal gravitational constant and simply described the magnitude of this force as equal to the product of the masses of the two objects and the inverse square of their distance; however, his description of mass is somewhat different from what is defined as mass today.[11] The universal gravitational constant was only added to the formulation of gravitational force with the symbol (*f*) in 1873, about two hundred years after Newton's explanation of gravitational force, by two French physicists named Mari-Alfred Cornu and Jean-Baptiste Baille.[198,199] Today, this quantity is denoted by the abbreviation *(G)* and serves as a measure of the strength of gravity. It is also used as a proportionality coefficient in Einstein's field equations in relativity. But how much do we really know about this "constant"?

The universal gravitational constant *(G)* is approximately 6.674×10^{-11} m^3 kg^{-1} s^{-2}. This constant's measurement accuracy is significantly lower[200] compared to other constants in physics, and its relative uncertainty, according to the CODATA Task Group report published in 2018, is 2.2×10^{-5}. Precisely determining this constant remains one of the challenges in the world of astronomy, astrophysics, and even geology, which has not yet been fully achieved despite extensive efforts over recent decades. Studies have suggested that this constant could change periodically, annually,[201] or based on calculations and data from supernovae, at a rate of about 10^{-10} per year, from 9 billion years ago to the present.[202] Undoubtedly, inconsistencies in the reported values for the universal gravitational constant and observations of changes in its value have made proper understanding of this fundamental quantity on a cosmic scale challenging.

Perhaps the first person to propose that the universal gravitational constant varies over time was the renowned physicist Paul Dirac. In 1937, after presenting his Large Number Hypothesis (LNH),203 he explored the implications of this theory in cosmology and found that by combining physical constants, one could reach dimensionless numbers of extremely large magnitude. For example, in the subatomic scale, the ratio of the electric force to the gravitational force between an electron and a proton is a dimensionless number of about 10^{39}. On a macro scale, the age of the cosmos (if time is expressed in terms of atomic constants) is approximately 10^{39}, or the mass of visible matter in the cosmos is an exponential coefficient of 10^{39} ($10^{39\times2}$). Considering these points, Dirac concluded that finding such a relationship between the subatomic scale and the cosmic scale cannot be coincidental and indicates that the physical constants used in these relationships are only constant in the present epoch and they are time evolving quantities, hence, they do not necessarily have a constant value.[1,2] Dirac's calculations showed that over time, the amount of the universal gravitational constant decreases. In other words, the value of this constant in the early periods of the cosmos was higher than it is currently, and as the universe ages, its magnitude tends to decrease. Although Dirac's theory remained incomplete, it opened a window to further investigations regarding physical constants (including the universal gravitational constant) and their changes as the universe ages.[204]

Among the first to seriously investigate Dirac's model were Pascual Jordan, Carl Brans, and Robert Dicke. Jordan praised Dirac's theory as one of the best ideas of its time and proposed a model using his hypotheses, in which physical constants such as the fine-structure constant (α) and the universal gravitational constant are considered variable scalar fields. In his model, as the mass of the cosmos increases over time, the universal gravitational constant decreases.[205-207] Following Jordan's theory, Brans and Dicke, by proposing a theory of variable gravity as an extension of Einstein's general relativity, showed that the universal gravitational constant decreases under the influence of a scalar field that itself increases over time.[181]

Since the introduction of the above hypotheses, the variability of the universal gravitational constant has been explored in various studies, and numerous cosmological models have been proposed based on it.[204,211-208] For example, one recent study showed that Dirac's hypothesis on the variability of this constant only holds true for epochs much later than the early stages of the cosmos. In this study, gravity is considered a function of the temperature of the expanding cosmos, and since the cosmic temperature is continuously decreasing, the strength of gravity decreases accordingly.[212] Another model, based on fitting the universal gravitational constant with existing experimental data from type Ia supernovae, concluded that this physical quantity was greater during the early stages of the cosmos than it is currently.[213]

Another study presented general principles or frameworks constituted on varying gravitational strength *(G)*, varying speed of light *(c)* or the cosmological constant *(Λ)*, or all three, which could be applied in different models to solve issues related to the primary inflationary theory (the flatness problem and the horizon problem).[214] Among the models employing these principles is the cosmological model proposed by Rajendra Gupta, which has also been matched with empirical data.[215] In this model, not only are the universal gravitational constant and the speed of light dependent on the magnification factor (Hubble expansion), but they may also have been lower in the past and increased with the expansion of the cosmos to the present time.

Another noteworthy research presents a model based on the variability of the universal gravitational constant and the cosmological constant (*Λ*), calculated by considering the cosmos as a fluid with specific viscosity. In this model, assuming powerlaw acceleration of the universe, the universal gravitational constant, depending on the sign of *Λ*, could have different rates of change. If *Λ* is negative, gravity decreases over time, and if *Λ* is positive, gravity increases at an increasing rate of change over time.[216]

After this brief acquaintance with the hypotheses on the variability of the universal gravitational constant from the perspective of conventional science and the breadth of presented viewpoints, we can delve into examining this quantity and its changes over time from the perspective of T-Consciousness Cosmology. Initially, a hypothesis known as the Distribution of General Cosmic Gravity will be introduced.

T-Consciousness Cosmology: The Hypothesis of Distribution of General Cosmic Gravity

As previously mentioned, according to the hypotheses of T-Consciousness Cosmology, the contraction of space (space viscosity) and the force of gravity vary over the lifespan of the cosmos, from the initial point to the end of cosmic rebound. This is because the entropic time force (the space, gravity-time hypothesis) is decomposing mass during this process, thereby eliminating the stress or tension on space. The significance of this concept lies in the fact that the degree of space contraction indicates the level of gravity. Therefore, it can be said that the overall amount of gravity in the cosmos at different epochs is variable.

With these descriptions, T-Consciousness Cosmology presents a different perspective on the distribution of general cosmic gravity. In this view, the amount of gravity is not constant throughout the lifespan of the cosmos. Not only was gravity very high in the cosmic black hole and in the subsequent increase in volume during the early times due to the small volume of the cosmos and high space viscosity (dark matter with high density), but it also varies locally due to 1- the presence of different amounts of objects throughout the cosmos, and 2- the presence of a shell made of TAM that encloses the cosmos. As a result, space viscosity varies during these different cosmic epochs. As stated before, the level of gravity is on a descending slope, from high at the moment of the cosmos's birth to low (approaching zero) at the end of the Rebound. Given this, from this perspective, the cosmos is constantly influenced by two forces:

1- Cosmic gravitational force, which includes two general forces: one is the force resulting from TAM gravity in the cosmic shell that encloses the entire cosmic sphere. This type of gravitational force decreases on one hand due to the continuous increase in the cosmos's diameter and on the other hand, the reduction of TAM mass in the entire shell resulting from its decomposition. The other is the resultant gravitational force created by all objects in the cosmos, which will also tend towards zero as all objects disintegrate and transform into absolute waves during space Rebound.

2- Dark energy: This type of energy is not only the result of TAM decomposition in the cosmic shell but also exists around all objects within the cosmos, from subatomic to cosmic scales. Dark energy is the space mesh with low viscosity and, despite its weak gravitational property, seemingly acts as a force against gravity in the vast cosmic volume. Since the resultant force of dark energy is greater than the total resultant of cosmic gravitational force (due to more dense space), it is considered as one of the reasons for cosmic Rebound in this perspective, acting like compressed gas inside the cosmos, exerting pressure on the shell. (Figure 28)

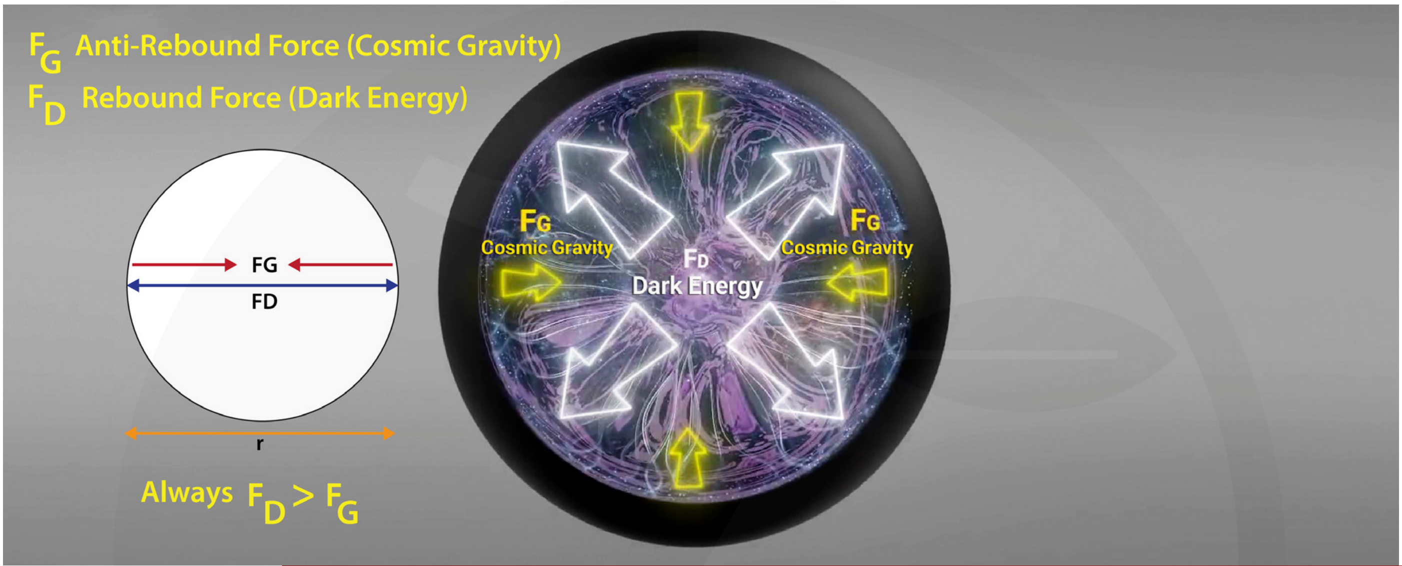


Figure 28: Conceptual illustration of the effects of cosmic gravity and dark energy on the expansion of the cosmos influenced by dark energy.

The Fate of the Spherical Cosmos (T-Consciousness Cosmology) vs the Big Crunch (Conventional Cosmology)

In conventional cosmology and depending on the final mass density, the universe can undergo/end in different scenarios. There are several hypotheses and theories proposed in the literature for the ending stage of the universe. A case in point is the hypothesis of the Big Crunch.[36,217,218] Based on this hypothesis, which is proposed in the framework of general relativity, the accelerated expansion of the universe does not continue endlessly, and when the mass density of the universe is more than its critical density, the expansion halts most likely, and the universe starts to contract/deflate. The halt in the expansion and the subsequent contraction of the universe are ascribed to gravity, which is directly proportional to the mass density of the universe. In other words, if gravity exceeds/outweighs dark energy (as the root cause of the accelerated expansion of the universe), there comes a moment when the expansion stops and inverses. As a result, the universe crunches back to an infinitesimally small point, called singularity, where its mass density and temperature increases infinitely, preparing for the next cycle and the next big bang. In this hypothesis, the universe is considered as a balloon that is continually blown and deflated (Figure 29).

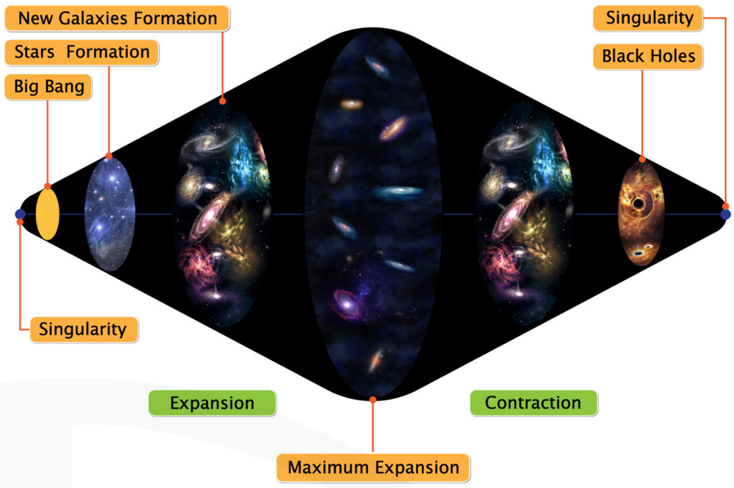


Figure 29: Conceptual illustration of the Big Crunch theory.

In T-Consciousness Cosmology's Spherical Cosmos Model, the cosmos also returns (reversion). However, unlike what is considered one of the potential fates for the universe in conventional cosmology, cosmic gravity is not the force that returns the cosmos to its original point. Instead, the inherent rotation of the cosmos is the driving force of this return, and the interaction between the two forces arising from dark energy and cosmic gravity causes an increase in volume and the expansion of the cosmic shell. (Figure 30)

In this view, dark matter and dark energy, according to the definitions provided, are of the same essence as space with different viscosities that both reach zero at the terminal edge of the cosmos (the final stage of Rebound). In other words, $F_D = F_G = 0$. (Figure 31)

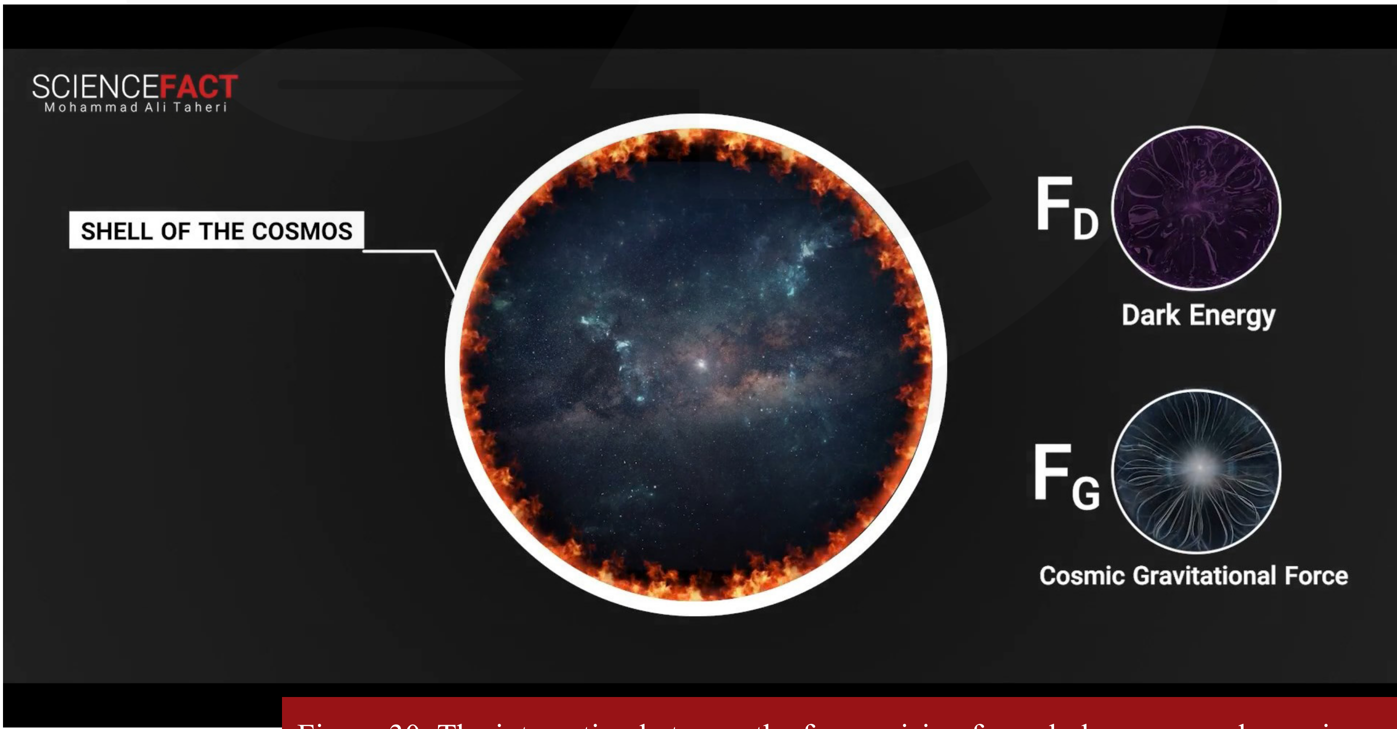


Figure 30: The interaction between the force arising from dark energy and cosmic gravity in the Spherical Cosmos Model of T-Consciousness Cosmology.

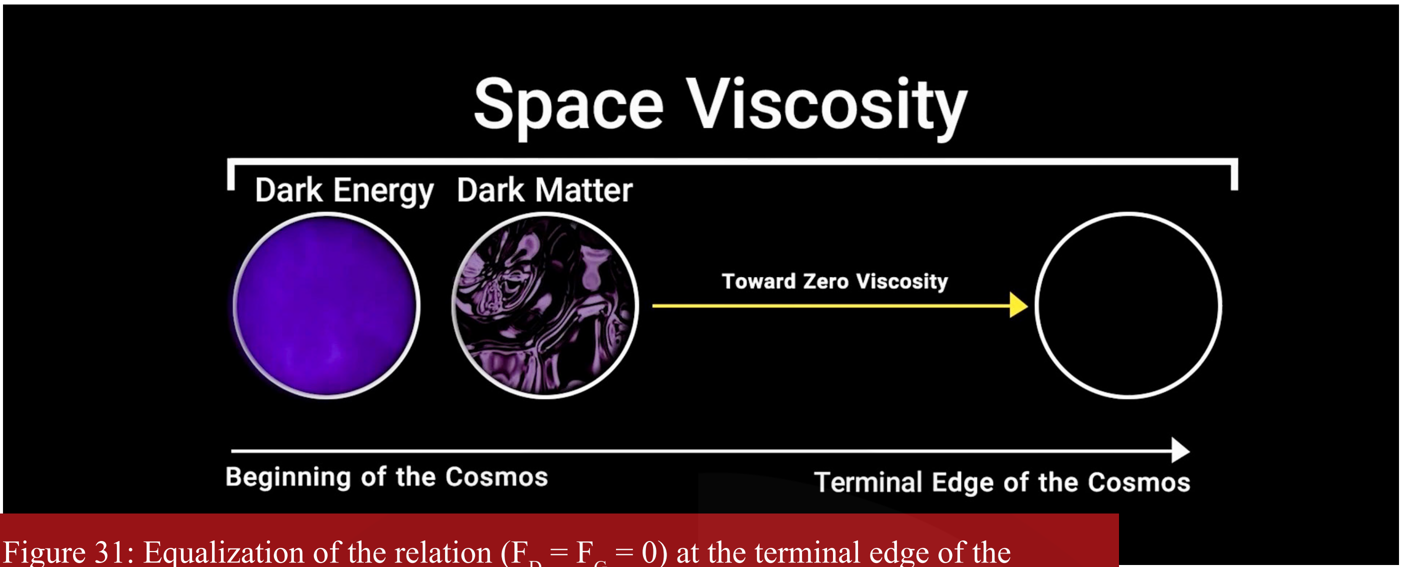


Figure 31: Equalization of the relation ($F_D = F_G = 0$) at the terminal edge of the cosmos (the final stage of space Rebound).

Space Viscosity Coefficient

As previously mentioned, the distribution of cosmic gravitational force is always a function of dark matter and dark energy, which themselves are functions of space contraction or space viscosity. Therefore, from the perspective of T-Consciousness Cosmology, *G*, known as the universal gravitational constant, is the same as the space viscosity coefficient of the cosmos and is equal to:

$$G = 6/67430 \times 10^{-11} \, [\frac{N.m}{kg}]$$

The cosmic viscosity coefficient at the final stage of space Rebound will be zero due to the disappearance of gravity. In other words, as space rebounds, for example, 10 billion years later, the gravitational force between objects decreases, and ultimately, with the transformation of objects into absolute waves, this coefficient reaches zero *(G=0)*. Also, if we go back in time, according to the stated rule, it is evident that the cosmic viscosity coefficient was very high until it reached its ultimate limit in the cosmic black hole, which can be denoted by the number one *(G=1)*. In other words, from the perspective of T-Consciousness Cosmology, the cosmic viscosity coefficient varies from 1 to zero (during the space Rebound) and vice versa (during the reversion of the cosmos to form a new cosmic black hole). (Figure 32)

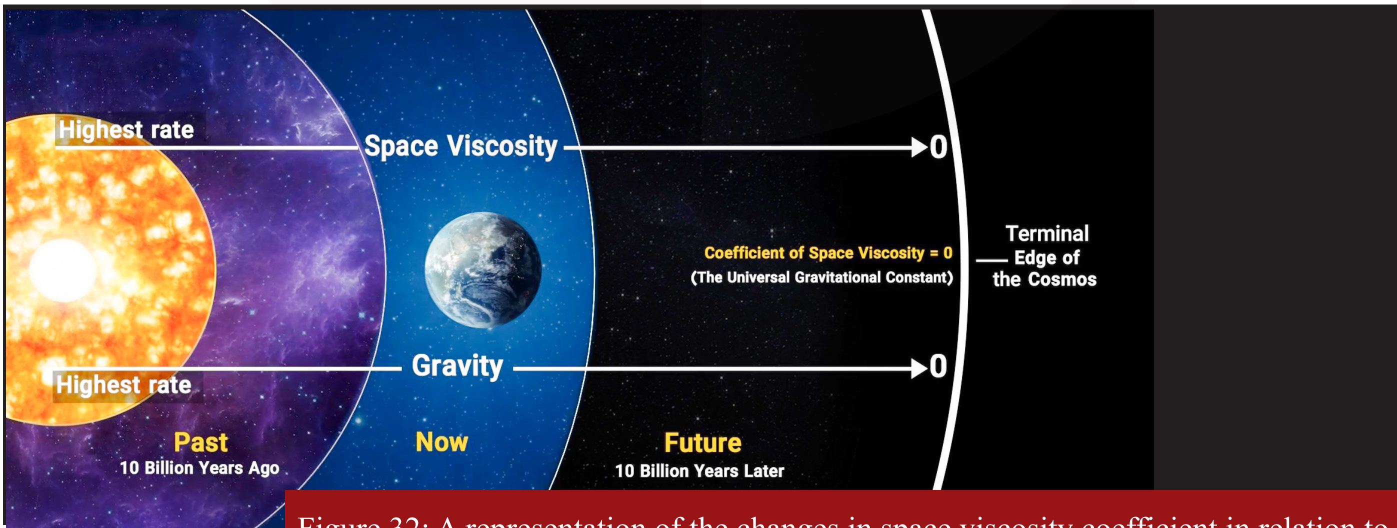


Figure 32: A representation of the changes in space viscosity coefficient in relation to gravity, from the birth of the cosmos to the final stage of space Rebound.

Furthermore, T-Consciousness Cosmology states that our position as terrestrial observers is currently between the arms of the Milky Way galaxy, where we experience a low space viscosity. However, if we were near the central black hole of this galaxy, where space viscosity is much higher, the value of the gravitational coefficient *G*, or the space viscosity coefficient, would increase to balance both sides of the gravitational equation:

$$F = \frac{Gm_1 m_2}{r^2}$$

Therefore, it can be concluded that at the moment of the Big Bang, the gravitational coefficient *G* was 1.49×10^{10} times its current value, indicating extremely high space viscosity at that time. This suggests that space could not have suddenly separated from the tremendous gravity of the cosmic black hole, and the inflation, which is widely accepted in conventional cosmology, could not have occurred. In other words, this stance is one of the reasons indicating that the inflationary theory is not compatible with the extremely high gravity at the early moments of the cosmos. (Figure 33)

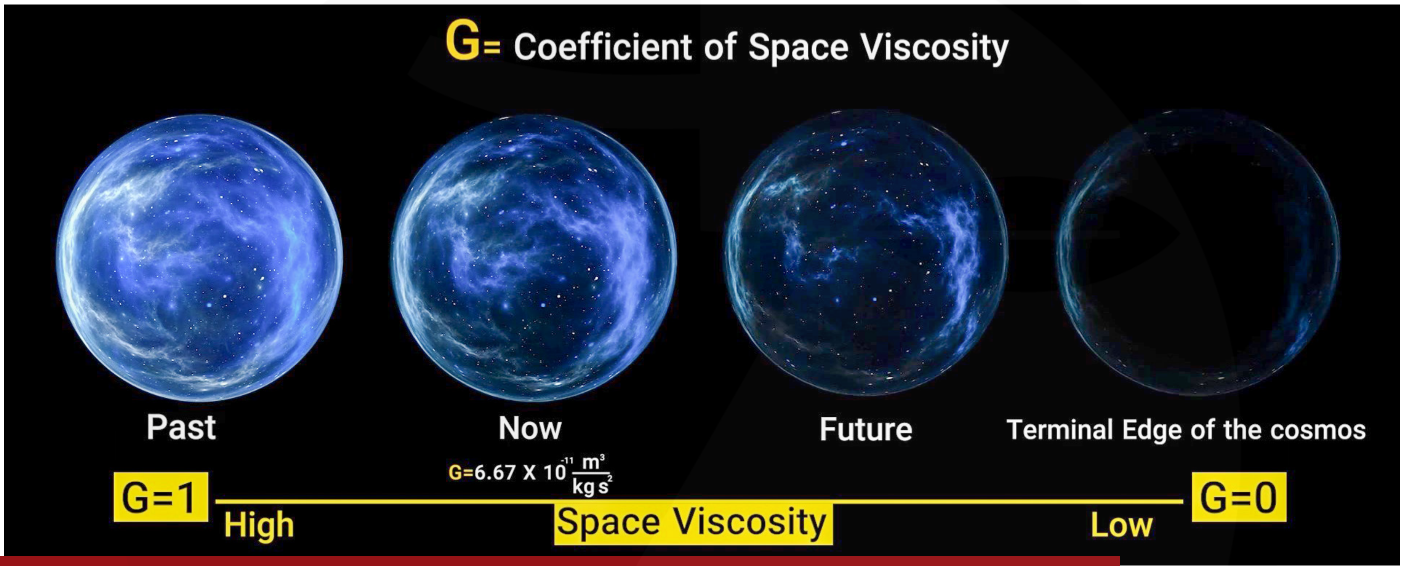


Figure 33: The relation of the gravitational coefficient with the viscosity of space during the Rebound of the cosmos.

Given these explanations, the distribution of cosmic gravity has a direct relation with the decrease in space viscosity, the increasing distance of objects from each other, the decreased thickness of the cosmic shell, and ultimately the thinning of dark matter. This means that with the reduction of these factors, the distribution of gravity across the cosmos decreases. It is noteworthy that the distribution of cosmic gravity is, on average, measured as constant over short-term time periods. (Figure 34)

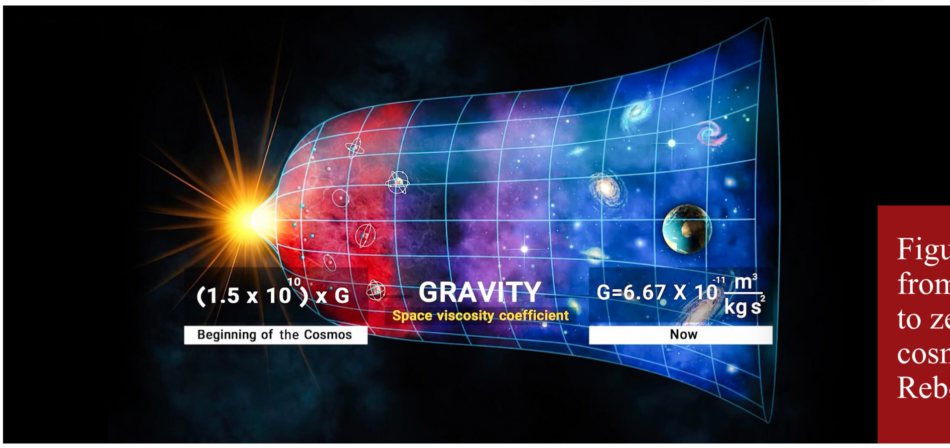


Figure 34: The rate of space viscosity from 1 in the cosmic black hole to zero at the terminal edge of the cosmos (the final stage of space Rebound).

In general, it can be said that in the Spherical Cosmos Model, the force of gravity decreases over time along the path of cosmic Rebound, and as the viscosity of dark matter in space also decreases, objects cannot maintain their stability. Ultimately, at the end of the cosmic rebound, they disintegrate. At the terminal edge of the cosmos (the final stage of space Rebound), dense waves transform into waves with infinite wavelength, and with the complete disappearance of gravity, dark matter effectively vanishes, and space returns to its natural and original state, that is, free from any tension and stress. (Figure 35)

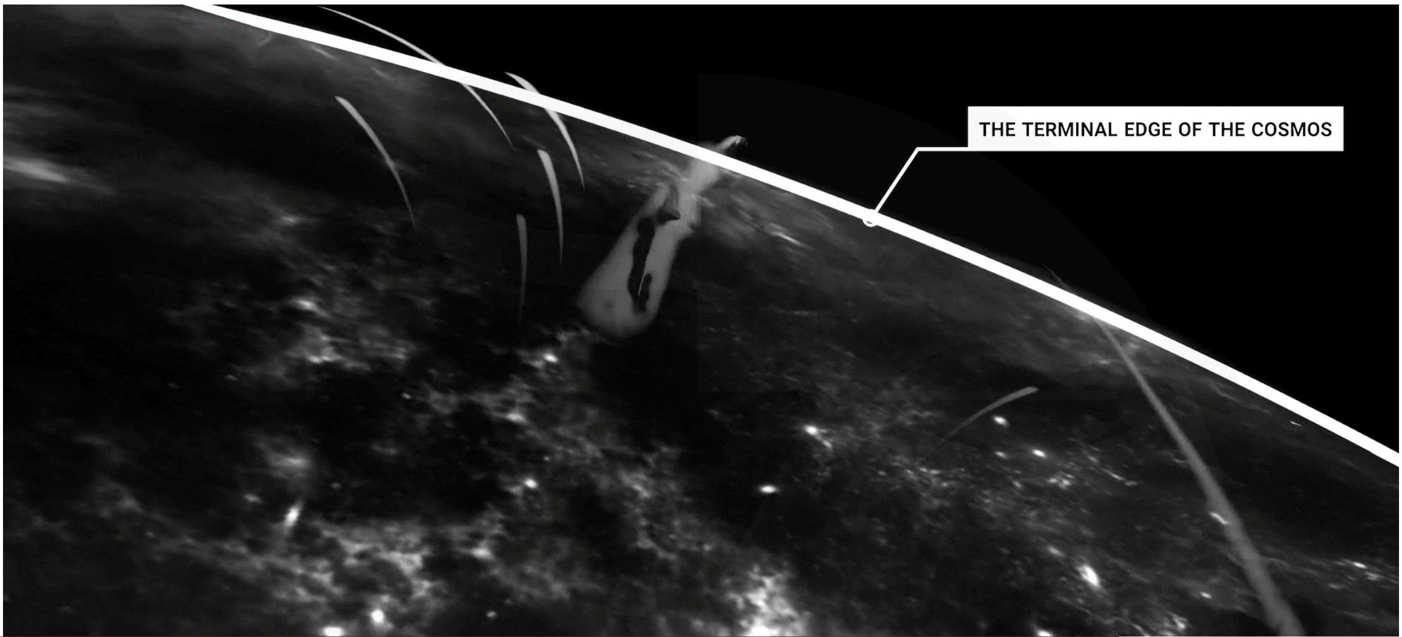


Figure 35: Conceptual illustration of a stress-free and tension-free space at the terminal edge of the cosmos, or the final stage of space Rebound.

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