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Cosmic Acceleration

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Abstract
Understanding the universe's expansion is one of the biggest challenges in modern physics. It could have profound implications for the ultimate fate of the universe, potentially leading to scenarios like the big rip, where the universe continues expanding until galaxies, stars, and even atoms drift apart, leaving a cold, dark cosmos.
The concept of the accelerating universe is a modern area of study, highlighting how much there is still to learn about the cosmos.
The universe's acceleration refers to the observation that the expansion of the universe is speeding up over time, rather than slowing down due to gravity. This discovery was made in the late 1990s through observations of distant supernovae.
The discovery of the universe's accelerating expansion indeed reshaped our understanding of cosmology. It's fascinating how the mysterious force of dark energy plays a pivotal role in these potential cosmic destinies:
Big Freeze: If dark energy remains constant, the universe will keep expanding forever, leading to a cold, empty, and dark cosmos as galaxies, stars, and even atoms drift apart.
Big Rip: If dark energy strengthens, it could tear apart galaxies, stars, and even atomic particles, effectively "ripping" the fabric of the universe.
Big Crunch: If dark energy weakens or reverses, gravitational forces might eventually overcome the expansion, causing the universe to collapse back into a singular state.
These scenarios illustrate how much there is still to explore and understand about our cosmos. The accelerating universe is not just a topic of scientific inquiry; it also sparks wonder and imagination about the fate of everything we know.

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I. Introduction

The accelerating expansion of the universe is one of the most intriguing mysteries in modern cosmology. It refers to the observation that the rate at which the universe is expanding is increasing over time, rather than slowing down as one might expect due to gravitational attraction.

This phenomenon was first discovered in the late 1990s through observations of distant supernovae by two independent research teams, which led to the Nobel Prize in Physics in 2011. The expansion of the universe is described by the Hubble parameter, which represents the rate at which galaxies are moving away from each other due to the expansion of space itself.

This unexpected finding emerged in 1998 through two independent projects: the Supernova Cosmology Project and the High-Z Supernova Search Team. They used distant type I-a supernovae as “standard candles” to measure distances

Within the framework of general relativity, this accelerated expansion can be explained by a positive cosmological constant (denoted as Λ), equivalent to the presence of a mysterious entity called “dark energy.” This is the leading explanation in cosmology. Dark energy is a hypothetical form of energy that permeates all of space and exerts a negative pressure, causing the expansion of the universe to accelerate. Despite being mysterious, it's inferred from observations of the universe's large-scale structure and its effect on cosmic microwave background radiation.

Modified Gravity: Some alternative theories propose modifications to Einstein's theory of general relativity at cosmological scales. These modifications could potentially account for the observed acceleration without the need for dark energy.

Cosmic Coincidence: It's possible that the acceleration is due to a fundamental property of the universe that we haven't yet discovered, and that it's coincidental that we are observing it at this point in cosmic history.

Understanding the nature of dark energy or finding alternative explanations for the accelerating expansion is a major goal of modern cosmology. It has profound implications for our understanding of the fundamental laws of physics, the fate of the universe, and our place within it. [1.2.3]

II. Physics Equations And Formulas

E = mc^2.

$A_{\text{current}} = \frac{c^2 \times \sqrt{m}}{t}$.

$V_{\text{voltage}} = \sqrt{m}$.

$w_{\text{Power}} = \frac{E}{t} = \frac{mc^2}{t} = \text{current} \times \text{voltage}$.

Elementary charge: $e = 1.602176634 \times 10^{-19}$ c

G: the gravitational constant = 6.67408$\times 10^{-11}\ m^3 Kg^{-1} S^{-2}$

C: Speed of light

Ç = $\frac{e^2}{\alpha \times 4 \times \pi \times \hbar \times \varepsilon_0} = 299792457{,}928\ {}^{m}/_{s}$ (May 20, 2019)

The fine structure constant $\alpha = 7{,}2973525664 \times 10^{-3}$

The Dirac's constant $\hbar = 1{,}054571818 \times 10^{-34}\ J.s$

The Planck's constant $h = 6{,}6260702 \times 10^{-34}\ J.s$

Vacuum permittivity: ε_0= 8.85418781762039$\times 10^{-12}\ Kg^{-1} m^{-3} s^4 A^2$

III. The Quantum Universe;

The Quantum Universe is a captivating realm where the fundamental laws of physics intertwine with the enigmatic behavior of particles and space-time.

The concept of a "quantum universe" refers to the idea of describing the universe and its fundamental constituents using the principles of quantum mechanics.

Quantum mechanics is the branch of physics that deals with phenomena at very small scales, such as atoms, subatomic particles and quantum black holes.

In classical physics, the universe is often described using the laws of classical mechanics and general relativity. However, when we examine the universe at extremely small scales, such as those encountered in the early moments of the Big Bang or within the cores of black holes, classical physics breaks down, and quantum effects become significant.

The concept of a quantum universe also encompasses the idea of quantum fluctuations, where virtual particles pop in and out of existence spontaneously due to the inherent uncertainty of quantum mechanics. These fluctuations play a crucial role in processes such as particle creation and annihilation, as well as in the behavior of fundamental forces.

Understanding the universe as a quantum system is a major goal of modern theoretical physics. The development of quantum field theory and quantum gravity seeks to reconcile quantum mechanics with general relativity and provide a unified description of all fundamental forces and particles. However, achieving a complete theory of quantum gravity that can accurately describe the universe at all scales remains one of the most significant challenges in theoretical physics.

IV. Properties Of Quantum Universes;

Time=$\frac{e^2 \times G \times (2\pi)}{\alpha \times c^7} = 6{,}75673 \times 10^{-105}\ Seconds$

Ray=$\frac{e^2 \times G \times (2\pi)}{\alpha \times c^6} = 2{,}0256163 \times 10^{-96} meters$

Energy= $\frac{e^2 \times (2\pi)}{\alpha \times c^2} = 2{,}4515365 \times 10^{-52}\ Jouls$

Mass= $\frac{e^2 \times (2\pi)}{\alpha \times c^4}$ = 2, 7276761$\times\ 10^{-69}\ Kg$.

Momentum= $\frac{e^2 \times (2\pi)}{\alpha \times \times c^3} = 8{,}1859965 \times 10^{-61} N.s$

Force= $\frac{e^2 \times (2\pi)}{\alpha \times \sqrt{G \times \hbar \times c}} = 1{,}516842 \times 10^{-17}\ N.$

$Density$= $\frac{4 \times \pi^2 \times e^4}{\alpha^2 \times c^4 \times \hbar^2 \times G}$ =8.1253467 $\times 10^{-26}\ Kg\ m^{-3}$

Pressure =$\frac{4 \times \pi^2 \times e^4}{\alpha^2 \times c^2 \times \hbar^2 \times G}$ =7.31281207$\times 10^{-9}\ Pa$

Current=$\frac{2 \times \pi \times e^2}{\alpha} \times \sqrt{\frac{4 \times \pi \times \varepsilon_0{}'}{c^3 \times \hbar}} = 4{,}3676154 \times 10^{-36}$A

Tension=$\frac{2 \times \pi \times e^2}{\alpha} \times \sqrt{\frac{1}{4 \times \pi \times \varepsilon_0{}' \times c^5 \times \hbar}} = 1{,}3093781 \times 10^{-34}$V

$$speed = \left(\left(\frac{e^2 \times (2\pi)}{\alpha} \right) \times \sqrt{\frac{G}{\hbar \times c^7}} \right) = 3{,}759833 \times 10^{-53} m/_s$$

V. The Expansion Of The Universe Accelerated From The Period Of The Big Bang To The End Of The Triassic Period About 199 Million Years:

The Triassic period, which lasted from approximately 252 to 199 million years ago, marked a significant chapter in Earth's history. It was a time of major geological, climatic, and evolutionary changes.

The end of the Triassic period, around 199 million years ago, was marked by a series of events collectively known as the Triassic-Jurassic extinction event. While not as severe as the later Permian-Triassic extinction event, which wiped out around 96% of marine species and 70% of terrestrial vertebrate species, the Triassic-Jurassic extinction still had significant ecological impacts.

The end of the Triassic period marked a major shift in the history of the universe in general and the Earth in particular, which paved the way for the emergence of dinosaurs and the dominance of new groups of living organisms during the Jurassic period. It also allowed the diversification and evolution of various terrestrial and marine species into new ecological environments.

End of the Triassic era $= \left(\frac{\alpha \times \hbar \times c^2}{2 \times \pi \times e^2} \right) = 4.2942106 \times 10^{17}\ seconds$

$= 13607904963.1\ years\ after\ big - bang$. [4.5]

The equation for acceleration: a = Δ v / Δ t where (a) is acceleration, (Δ v) is the change in velocity, and (Δ t) is the amount of time it took for that change to occur.

$$t_f = ending\ time = \left(\frac{\alpha \times \hbar \times c^2}{2 \times \pi \times e^2} \right) = 4.2942106 \times 10^{17}\ seconds$$

$t_i = starting\ time = \left(\sqrt{\frac{G \times \hbar}{c^5}} \right) = 5{,}3899187 \times 10^{-44}\ seconds$.[6]

$$v_f = c = 3 \times 10^8\ m/_s$$

$$v_i = \left(\left(\frac{e^2 \times (2\pi)}{\alpha} \right) \times \sqrt{\frac{G}{\hbar \times c^7}} \right) = \left(\left(\frac{8 \times \pi^2}{\mu_0} \right) \times \sqrt{\frac{G \times \hbar}{c^9}} \right) =$$

$$= 3{,}759833 \times 10^{-53} m/_s$$

$$a = \left(\frac{v_f - v_i}{t_f - t_i} \right) = \left(\frac{e^2 \times (2\pi)}{\hbar \times \alpha \times c} \right) = \left(\frac{8 \times \pi^2}{\mu_0 \times c^2} \right) = (8 \times \pi^2 \times \varepsilon_0{}') = 6{,}9861501 \times 10^{-10}\ m/_{s^2}$$

With;

$$\varepsilon_0{}' = \left(\frac{e^2}{(4\pi) \times \hbar \times \alpha \times c} \right) = \left(\frac{1}{\mu_0 \times c^2} \right) = 8{,}8480624 \times 10^{-12} Kg^{-1} m^{-3} s^4 A^2$$

VI. The Expansion Of The Universe Slowed From The End Of The Triassic Period To The Beginning Of The Jurassic Period (30 Hours After The End Of The Triassic Era)

The Jurassic Period began approximately 199 million years ago and lasted for about 56 million years, ending around 145 million years ago. It is the middle period of the Mesozoic Era, sandwiched between the Triassic and Cretaceous periods. The Jurassic is well-known for the dominance of dinosaurs,

Continental Drift: The supercontinent Pangea began to break apart, leading to the eventual formation of the central Atlantic Ocean and the Gulf of Mexico.

The climate during the Jurassic was generally warmer and more stable than during the preceding Triassic period. Vast shallow seas covered many areas, leading to the formation of marine deposits and the proliferation of marine life, on land, forests of conifers, ferns, cycads, and early flowering plants flourished, providing habitats for diverse terrestrial fauna.

The Jurassic Period is also notable for the evolution and diversification of many groups of organisms, including dinosaurs, mammals, and early birds. It was a pivotal time in Earth's history, laying the foundation for the ecosystems that would continue to evolve into the Cretaceous and beyond.

VII. The End Of The Triassic Period:

$t_i = \left(\frac{\alpha \times \hbar \times c^2}{2 \times \pi \times e^2} \right) = 4.2942106 \times 10^{17}\ s\ \ after\ the\ big - bang.$

$v_i = c = 3 \times 10^8\ m/_s$.[4.5]

VIII. The Triassic- Jurassic Boundary Period;

$v_f = ç' = \left(\frac{e^2}{2\times\alpha\times h\times\varepsilon_0}\right) - \left(\frac{3\times e^2}{2\times h\times\varepsilon_0}\right) = 293229384{,}143\, {m}/{s}$ [4].

$$\varepsilon_0'' = \left(\frac{e^2}{(4\pi)\times\hbar\times\alpha\times ç'}\right) = \left(\frac{\varepsilon_0}{1-3\alpha}\right) = \left(\varepsilon_0'\left(\frac{\alpha\pi}{1-\alpha}+1\right)\right)$$
$$= \left(\left(\frac{e^2}{4\times\hbar\times c\times(1-\alpha)}\right) + \left(\frac{e^2}{(4\pi)\times\hbar\times\alpha\times c}\right)\right) = 9{,}0523627\times 10^{-12} Kg^{-1}m^{-3}s^4A^2$$

IX. Between Two Eras:

The transition between two geological eras, such as the Triassic and Jurassic, often involves major changes in Earth's climate, geography, and biodiversity. These changes can be caused by a variety of factors, including radioactivity, changes in sea levels, and shifts in continental plates. For example, the end of the Triassic led to a mass extinction event that paved the way for dinosaur dominance in the Jurassic. During these transitions, ecosystems underwent dramatic changes. Species that were dominant in one era may decline or become extinct, while new species evolve and flourish in the next. This dynamic process of extinction and evolution is a natural part of Earth's history, and drives the diversity of life we see today.

Cosmic radiation between these two eras had profound and long-lasting effects on the environment and living organisms. The shock waves and heat generated by the radiation caused widespread destruction of infrastructure and landscapes.

This period was marked by a major event known as the Triassic-Jurassic extinction event. This event led to the extinction of about 76% of all marine and terrestrial species and about 20% of all taxonomic families.

Immediate exposure to high levels of radiation leads to acute radiation syndrome, which led to the extinction of living organisms. This radiation was able to destroy habitats, leading to the loss of biodiversity and the imbalance of the environment in the long term.

Long-term exposure to radiation leads to cancer and genetic mutations in that era, which led to this mass extinction.

Marine Life: Many marine species became extinct, including conodonts and many ammonoids. However, some groups such as ichthyosaurs and plesiosaurs survived.

Terrestrial Life: On Earth, many vertebrate families disappeared, but this extinction event allowed dinosaurs to become the dominant land animals of the following Jurassic period.

After this period, the Earth experienced a sudden and severe drop in temperature, which led to the planet entering an ice age in the early Jurassic period

$t_f = \left(\frac{\alpha^5\times c}{64\times\pi^4\times\varepsilon_0''}\right) = \left(\frac{\alpha^5\times ç'}{64\times\pi^4\times\varepsilon_0'}\right) = 110003{,}49\ s = 30{,}556 hours$ After the end of the Triassic era,

X. The Deceleration Of The Universe;

$$d = \left(\frac{v_f - v_i}{t_f - t_i}\right) = \left(\left(\frac{64\times\pi^4\times\varepsilon_0'}{\alpha^5}\right) - \left(\frac{64\times\pi^4\times\varepsilon_0''}{\alpha^5}\right)\right) = \left(-\frac{64\times\pi^5\times\varepsilon_0'}{\alpha^4(1-\alpha)}\right)$$
$$= \left(-\frac{64\times\pi^5\times\varepsilon_0''\times(1-9\alpha)}{\alpha^4(1-7\alpha)}\right)$$
$= -61{,}559\ {m}/{s^2}$

XI. The Expansion Of The Universe Accelerated From The Beginning Of The Jurassic Period To May 20, 2019:

May 20, 2019, marked the 144th anniversary of the Meter Convention, also known as the Treaty of the Meter. This convention, signed in 1875, established the International System of Units (SI) and created the International Bureau of Weights and Measures (BIPM) to oversee it. The Meter Convention has played a crucial role in ensuring global standards for measurements, fostering scientific cooperation.

As of May 20, 2019, the SI base units defined in the International System of Quantities have been redefined in terms of natural physical constants, [7.8.9.10].

XII. The Age Of The Universe (May 20, 2019);

On this day, the age of the universe is:

$$\left(\frac{\alpha \times ç}{4 \times \pi^2 \times \varepsilon_0}\right) = \left(\frac{e^2}{16 \times \pi^3 \times \hbar \times \varepsilon_0^2}\right) = \left(\frac{\alpha^2 \times ç^2 \times \hbar}{e^2 \times \pi}\right) = 6{,}2586053 \times 10^{15} s$$

$$= 198328665{,}11 \text{years after the Triassic} - \text{Jurassic extinction}, [4.5]$$

$$\left(\frac{\alpha \times c^2 \times \hbar}{e^2 \times (2\pi)}\right) + \left(\frac{\alpha \times ç}{4 \times \pi^2 \times \varepsilon_0}\right) = 4{,}3567967 \times 10^{17} s$$

$$= 13806233487{,}7 \; years \; after \; big - bang \; . [4.5]$$

$$t_f = ending\ time = \left(\frac{\alpha \times ç}{4 \times \pi^2 \times \varepsilon_0}\right) = \left(\frac{e^2}{16 \times \pi^3 \times \hbar \times \varepsilon_0^2}\right) = 6{,}2586053 \times 10^{15} s$$

$$t_i = starting\ time = \left(\frac{\alpha^5 \times c}{64 \times \pi^4 \times \varepsilon_0''}\right) = \left(\frac{\alpha^5 \times ç'}{64 \times \pi^4 \times \varepsilon_0'}\right) = 110003{,}49\ s$$

$$v_f = ç = \left(\frac{e^2}{4 \times \pi \times \alpha \times \hbar \times \varepsilon_0}\right) = 299792457{,}928\ {}^{m}/_{s}.$$

$$v_i = ç' = \left(\frac{e^2}{4 \times \pi \times \alpha \times \hbar \times \varepsilon_0}\right) - \left(\frac{3 \times e^2}{4 \times \pi \times \hbar \times \varepsilon_0}\right) = 293229384{,}143\ {}^{m}/_{s}.$$

$$a = \left(\frac{v_f - v_i}{t_f - t_i}\right) = \left(\frac{(3\pi) \times e^2}{\hbar \times \alpha \times ç}\right) = \left(\frac{3 \times e^4}{4 \times \alpha^2 \times \hbar^2 \times ç^2 \times \varepsilon_0}\right) = (12 \times \pi^2 \times \varepsilon_0) = 1{,}04864797 \times 10^{-9}\ {}^{m}/_{s^2}$$

With:

ε_0= 8.85418781762039$\times 10^{-12}\ Kg^{-1}m^{-3}s^4A^2$ *(May 20, 2019).*

XIII. Properties Of Quantum Black Hole (May 20, 2019);

Time=$\left(\frac{e^2 \times G \times (2\pi)}{\alpha \times c^7}\right) - \left(\frac{e^4 \times G}{\alpha \times ç^8 \times \hbar \times \varepsilon_0}\right) = 6{,}657812 \times 10^{-105}$ Seconds.

Ray=$\left(\frac{e^2 \times G \times (2\pi)}{\alpha \times c^6}\right) - \left(\frac{e^4 \times G}{\alpha \times ç^7 \times \hbar \times \varepsilon_0}\right) = 1{,}9959613 \times 10^{-96}$meters.

Energy= $\left(\frac{e^2 \times (2\pi)}{\alpha \times c^2}\right) - \left(\frac{e^4}{\alpha \times ç^3 \times \hbar \times \varepsilon_0}\right) = 2{,}4156452 \times 10^{-52}$ Jouls.

Mass= $\left(\frac{e^2 \times (2\pi)}{\alpha \times c^4}\right) - \left(\frac{e^4}{\alpha \times ç^5 \times \hbar \times \varepsilon_0}\right) = 2{,}6877416 \times 10^{-69}$ Kg .

Momentum= $\left(\frac{e^2 \times (2\pi)}{\alpha \times \times c^3}\right) - \left(\frac{e^4}{\alpha \times ç^4 \times \hbar \times \varepsilon_0}\right) = 8{,}066276 \times 10^{-61}$N.s

Force= $\left(\frac{e^2 \times (2\pi)}{\alpha \times \sqrt{G \times \hbar \times c}}\right) - \left(\frac{e^4}{\alpha \times \varepsilon_0 \times \sqrt{G \times \hbar^3 \times ç^3}}\right) = 1{,}4946352 \times 10^{-17}$ N.

Density= $\left(\frac{4 \times \pi^2 \times e^4}{\alpha^2 \times c^4 \times \hbar^2 \times G}\right) - \left(\frac{2 \times \pi \times e^6}{\alpha^2 \times ç^5 \times \hbar^3 \times \varepsilon_0 \times G}\right)$ =8.0064309 $\times 10^{-26}$ Kg m^{-3}

Pressure =$\left(\frac{4 \times \pi^2 \times e^4}{\alpha^2 \times c^2 \times \hbar^2 \times G}\right) - \left(\frac{2 \times \pi \times e^6}{\alpha^2 \times ç^3 \times \hbar^3 \times \varepsilon_0 \times G}\right)$ =7.19582126$\times 10^{-9}$ Pa.

Current=$\left(\frac{2 \times \pi \times e^2}{\alpha} \times \sqrt{\frac{4 \times \pi \times \varepsilon_0'}{c^3 \times \hbar}}\right) - \left(\frac{e^4}{\alpha} \times \sqrt{\frac{4 \times \pi}{ç^5 \times \hbar^3 \times \varepsilon_0}}\right) = 4{,}3037831 \times 10^{-36}$A.

Tension=$\left(\frac{2 \times \pi \times e^2}{\alpha} \times \sqrt{\frac{1}{4 \times \pi \times \varepsilon_0' \times c^5 \times \hbar}}\right) - \left(\frac{e^4}{\alpha} \times \sqrt{\frac{1}{4 \times \pi \times \varepsilon_0{}^3 \times ç^7 \times \hbar^3}}\right) = 1{,}2902416 \times 10^{-34}$V.

speed = $\left(\left(\frac{e^2 \times (2\pi)}{\alpha}\right) \times \sqrt{\frac{G}{\hbar \times c^7}}\right) - \left(\left(\frac{e^4}{\alpha \times \varepsilon_0}\right) \times \sqrt{\frac{G}{\hbar^3 \times ç^9}}\right) = 3{,}7048263 \times 10^{-53}{}^{m}/_{s}$

XIV. Conclusion:

According to this study, the "Big Rip" is the inevitable fate of the universe. This expansion suggests that it may eventually reach a point where all matter is torn apart. This scenario arises from the idea that the rate of expansion of the universe may continue to accelerate, driven by dark energy.

In this scenario, as the universe expands, galaxies will first separate from each other. Then individual stars and planets within galaxies will be torn apart, followed by the disintegration of planets, stars, atoms, and even subatomic particles. The ultimate end will be a universe devoid of any organized matter, with everything torn apart into individual particles. This fate has been mapped out since the Triassic-Jurassic boundary.

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