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# Analytical Study on Unsolved Question and Mysteries of the Universe and Wisdom from Holly Book

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**Abstract:** The present research paper discusses a number of the greatest mysteries of the Universe, ranging from the existence of alien life and dark matter/energy to relativity theory, quantum mechanics and the future of reality. In addition, the fate of humanity as a whole is also discussed, taking into account such aspects as the possibility of further inhabitation of the Earth, interstellar travel, transhumanism and even the influence of consciousness on the evolution of the universe. As opposed to providing some new experiment-based conclusions, the paper discusses different mysteries of the universe from the perspective of science and philosophy. Recent discoveries of astronomy, theories of theoretical physics, as well as speculations related to the possible future development of civilizations and consciousness form the basis for the discussion. In this qualitative analytical article, effort will be taken to discuss and analyses of the most pressing and unsolved question and problems in modern astronomy in contemporary time.

**Keywords:** Cosmos, universe, Redshifts, JWST, CDM, GZK, CMB, ΛCDM, FLRW

## INTRODUCTION

The steady-state universe is an eternal cosmos in which the universe is constantly expanding at a constant rate. New matter is created at the same rate to maintain the density. Despite the discovery of the cosmic microwave background, various existing concerns ultimately undermined the steady-state theory. Astrophysicists are trying to solve the most common problems in the early universe. The character of dark matter is at present beyond our comprehension. The leading candidates claim it is some sort of collision-less cold or slow fluid. But when we run simulations and compare with observations, we observe that there are many fewer satellite galaxies around large galaxies such as Leo I than we actually see. We observe a considerably diminished density in the centers of galaxies compared to the expectations of Lambda-CDM, or "dark energy and cold dark matter" hypotheses. These phenomena are the so-called missing satellites problem and core-cusp problem, respectively. Some ideas depend on dark matter having some self-interaction. In addition, we do not understand the formation of structures in the early universe. Thus, our knowledge of the early Universe is limited, save for the cosmic microwave background (CMB), which provides evidence for some degree of early structure formation. The Cosmic Dark Ages is a special period that few people are aware of. It covers the time from the release of the Cosmic Microwave Background (CMB) until the formation of the first stars, called Population III stars. One way we can probe this period is by looking at the radio emissions of neutral hydrogen gas. Neutral hydrogen emits light at a certain wavelength, known as the 21-cm transition. But the universe's expansion redshifts this light to wavelengths we can't see: 1) It is reflected by the ionosphere back into space, and 2) it is redshifted into the frequencies used for telecommunications, causing interference with man-made noise. Radio astronomy on the far side of the Moon is expected to thrive in the future. The LuSEE-Night telescope is set to land on the Moon in 2026. Thousands of kilometers of rock will shield it from the din of our civilization.

We do not understand the role of metallicity in galaxy evolution and its impact on the features of stars, planets, and structure. It is well-known that metallicity is a characteristic of a material, which is the ratio of metals (elements heavier than helium) to hydrogen and helium. For example, the Sun’s metallicity is 1.2%, implying that 98.8% of the Sun’s atoms are hydrogen and helium. Mysteriously, this percentage is actually a high metallicity for a star. Metals are highly crucial to cosmic development since 1) they assist gas to cool and condense to form new stars and planets and 2) metallicity may play a large role in the formation of planetary systems, which influences the ability of life to form. Metals are created inside dying stars, which are compelled to fuse larger and heavier nuclei together once they have run out of hydrogen to fuse into helium. One day, low-mass fading red giants like our Sun will spread low-mass metals such as carbon, nitrogen, oxygen, silicon, et al. in the gas in galaxies. These stars become exceedingly puffy, lose their material readily, and make planetary nebulae. These planetary nebulae then go on to generate the next generation of stars when the gas cools.[i] Type Ia supernovae and neutron star mergers produce high-mass metals that are essential to electronics and developing civilizations. Iron, gold, neodymium, platinum, lead, uranium, etc.

While we understand that metals are highly vital to cosmic evolution, one aspect of metallicity that remains unclear is the role of the circum-galactic medium (CGM). "Circum" means around, "Galactic" is about a galaxy, and "Medium" means material. So CGM is stuff that surrounds galaxies. It’s hot, poofy gas, a million degrees Celsius, and it’s around large galaxies like the Milky Way. Now the question is how metal-rich is this gas, and how does that interplay with galactic evolution? "We're trying to determine the metallicity of this gas now by looking at a tremendously bright flashlight behind it, looking for missing ultraviolet light with the Hubble Space Telescope, and identifying metals that way. And that was compared to the missed light because of neutral hydrogen. But this is a significant problem. We need both neutral and ionized hydrogen to comprehend the metallicity of the CGM. But we can only see neutral hydrogen directly. We can detect ionized hydrogen with recombination lines, but we still have the problem that we cannot effectively investigate highly ionized gas because Hubble, although a fantastic telescope, doesn’t have the colors to see much of this incredibly hot ionized gas. So, we need a telescope in the soft X-rays. That’s where the Line Emission Mapper (LEM) comes in. The LEM can significantly enhance our understanding of galaxy evolution compared to our current knowledge.[ii] The LEM is a proposed soft X-ray telescope that will be able to explore this super-hot ionized plasma and subsequently answer these questions.

There are numerous ideas, such as a failed supernova and then collapse to a neutron star or black hole or a tidal disruption event around an intermediate-mass black hole that tears apart a passing star and accretes it. What's certain is that they need to be propelled by a compact "central engine" because they all seem to display intense X-ray and radio emission typical of accretion. One was also just caught shining in optical flares at minute scales as brilliantly as a supernova at its peak before fading as rapidly as it appeared.

Definitely an intriguing riddle to solve as these things and their behavior were a surprise discovery. In fact, astrophysics contains a relatively high number of unresolved mysteries, which may be legitimately interpreted as proof that the prevailing theory is insufficient. The present anomalies and the abundance of astronomical data suggest that we can empirically base this theorizing on further tests. We are in a very intriguing situation where different theories can explain some phenomena but not all, indicating the need for new physics; however, it is crucial to note that JWST observed cold Y-dwarfs, which did not contain phosphine in their atmosphere. One fascinating observation is that Jupiter, unlike Y-dwarfs, does show phosphine in its atmosphere.[iii] There is still no solid reason for this. On the other hand, stars, brown dwarfs, and planetary mass objects can form on their own, although some research implies that star formation abruptly ends below some mass (5-10 Jupiter masses). A recent result by Pearson & McCaughrean did not detect a cutoff in the Orion Nebula. Could this observed cutoff be only an instrument limit of the astronomers?

Today, contemporary cosmology and the latest physics have answered many questions about the cosmos. But there is still a lot about the universe we don't know. By 2026, the limits of our understanding will be defined by the numerous unresolved questions that scientists are currently investigating. We know that something binds galaxies together, but dark matter does not absorb, reflect, or emit light. It makes up around 27% of the cosmos, but what its particle makeup is unknown. Again, dark energy makes up about 70% of the universe. This unexplained force is driving the accelerated expansion of the cosmos. Its nature is still one of the greatest mysteries in science. The Big Bang theory explains the evolution of the cosmos but not the genesis of the original singularity or what (if anything) existed before it. Again, scientists are still attempting to find out what will be the final fate of the cosmos—whether it will be expansion forever or the Big Freeze, collapse or the Big Crunch, or rip apart or the Big Rip. According to current scientific understanding, the Big Bang should have produced equal amounts of matter and antimatter. According to current scientific understanding, the Big Bang should have produced equal amounts of matter and antimatter.[iv] The identical amounts of matter and antimatter would have destroyed each other, leaving behind an empty universe without any light or stars. Besides, while black holes may be theorized upon, there is much we do not know about the physical laws that control black holes, especially in their singularity. This ignorance leaves room for contradictions between the laws of quantum physics and general relativity.[v] Moreover, Fast Radio Bursts, which are short but strong radio waves lasting milliseconds and coming from far away galaxies, are another mystery. No one knows what causes FRBs, and people argue on whether they come from magnetars or black holes or other objects in space. Most recently, scientists discovered something new called Jupiter-Mass Binary Objects, consisting of pairs of free-floating rogue planets in space.

Another puzzle still to be answered is the 'Hubble Tension'—a big mismatch in measurements of how fast the universe is expanding. That suggests either bad observations or missing physics. Again, the corona of the Sun is hundreds of times hotter than its surface, which is contrary to accepted thermodynamic models. You can calculate gravity. What is missing is a complete theory of quantum gravity, that is, a theory that connects gravity with the other fundamental forces. If there existed a region of space made up of antimatter, then we'd notice this "border" with the part of space made up of matter from the gamma rays. Because space isn't really empty. There's hydrogen and helium and interstellar dust (or anti-hydrogen, anti-helium, and anti-dust). From a Newtonian perspective, we don't fundamentally comprehend gravity, and we may wonder if it could be a massless graviton particle. But in an Einsteinian picture, gravity is not a thing. Instead, what we call gravity is really the bending of spacetime. That's at least of a large size, but quantum gravity is something else entirely. But can we figure out where all those missing socks are going and determine the expansion rate of the cosmos as well as dark energy?[vi] Actually, it is intriguing how our little star system sits in a little bubble of exceptionally empty space, off a minor arm filament, in a small galaxy cluster, part of a tiny supercluster, in the heart of a vast vacuum bubble! Again, two words have dominated space in 2021: and those are perseverance and ingenuity. The Martian robots top the list of cosmic wonders as we approach the halfway point, delivering stunning views of the Martian surface. On the other hand, in Ingenuity's case, achieving the first powered flight on another planet. [vii,viii]

The basic unanswered question is whether there exists intelligent life somewhere else in the universe. There have been efforts made to find out, such as the detection of biosignature in exoplanets via the James Webb Space Telescope (JWST). For instance, in 2020, astronomers in the UK observed the presence of the chemical phosphine in the thick clouds of Venus, indicating possible life; nevertheless, more observations are required. On the other hand, one interesting phenomenon is the signal received in 1977 called the "Wow!" Signal. As of early 2026, the 1977 "Wow! Signal" remains one of the most tantalizing, unrepeated, and unexplained radio anomalies in astronomy. Modern study has yielded exciting new natural ideas, but 'Signal' remains one of the most tantalizing, unrepeated, unexplained radio anomalies in astronomy.[ix] The 1977 data have been thoroughly studied, although the signal has never been detected again after its 72-second appearance. Today, with no repeat signal to analyze, it remains an enduring enigma and, for many, the best 'whisper from the stars' ever recorded. But astronomy is the scientific study of celestial bodies and the universe as a whole. Astronomy has achieved remarkable accomplishments over the years. There is much more that we now know about the universe than what was known to the early astronomers when they gazed into the heavens because of the developments in space telescopes and the missions to deep space.[x] However, there are several basic problems that still need answers. The presence of such problems indicates the boundaries of our current knowledge and the enormous amount of knowledge yet to be discovered. In this qualitative analytical article, author has intended to explore several of the most pressing and unsolved question and problems in astronomy with fascinating thinking in modern time. Some wisdom from holly the books has also discussed at the end of this study.

## BACKGROUND AND LIST OF MANY UNSOLVED QUESTIONS WITH MYSTERIES OF UNIVERSE

Modern physics grapples with profound mysteries in the Universe, including the nature of dark matter and dark energy, the origins of the Big Bang, and the potential for life beyond Earth. Stars and planets consist of ordinary matter, which only accounts for roughly 5% of the entire universe. The other 95% are comprised of the mysterious dark matter and dark energy, creating many riddles yet to be solved. While dark matter is an unseen entity making up for 27% of the entire universe, dark energy accounts for 68% and accelerates the expansion of the Universe. Yet the exact ingredients of the former, as well as the latter, are not yet known. Additionally, the cause for the Big Bang and what the future of our universe might be are yet undetermined – whether it will keep on expanding forever, or undergo another "Big Crunch." Matter dominates the cosmos, yet the Big Bang should have created equal amounts of matter and antimatter, which would have destroyed each other. We don't know what's actually at the center of a black hole—the singularity—or how supermassive black holes grew so large so fast. Scientists are looking for evidence of life beyond Earth and for a theorized ninth planet, or Planet X, in our solar system. Outside the 46 billion light-year visible horizon, the rest of the universe could be endless with many additional galaxies. The universe is full of secrets, from the backyard of our own solar system to the furthest borders of the cosmic ocean. It's always been this way. Ancient astronomers puzzled about the nature of comets and speculated about the chemical makeup of stars centuries ago. Now these ancient riddles have been solved, but as bigger telescopes and more sensitive sensors look further into space, they have been replaced by new conundrums.

One of the biggest problems for astronomers today would be figuring out what dark matter is. Dark matter can easily be inferred from its name; this means that it neither emits nor absorbs light, making it imperceptible by astronomy apparatus. However, despite the fact that it cannot be observed, dark matter accounts for 27 percent of all matter-energy in the universe. The existence of dark matter can only be detected by the gravity exerted on other observable materials, like planets or galaxy clusters. It has never been found out what dark matter comprises. Some theories include WIMPs, axions, and sterile neutrinos, but after many years of extensive research, no one has ever managed to detect dark matter. Experiments involving the discovery of dark matter's properties have also proved futile, as they were conducted both above and below ground and even using astronomical observations. Making the quest even more challenging is another problem known as dark energy. The 2011 Nobel Prize in Physics was awarded for the finding that the universe is expanding at an accelerated rate. This is believed to be due to dark energy. Dark energy is believed to constitute roughly 68 percent of the universe's energy density. But what it is one of the deepest riddles in cosmology. A number of hypotheses exist that seek to explain dark energy. The theory of the cosmological constant was first introduced by Albert Einstein. There are other theories that include the dynamic fields theory. Yet, despite numerous observations made on supernovae and cosmic microwave backgrounds, the exact nature of the dark energy remains elusive to science.

Many questions remain to date unanswered regarding the evolution and formation of galaxies. While simulations and observation provide a lot of information on how galaxies evolve and form, there is much left to learn about the process. The main issues concern the formation of the first galaxies, the part played by supermassive black holes, and galaxy merging. Watching galaxies far away from the Earth gives us information about the universe's early stages, but modeling such observations is very complicated because many different things should be considered. With improved resolution due to new space telescopes, such as JWST, we hope to obtain answers about some of these issues. Magnetic fields exist in the cosmos; they affect charged particles and influence interstellar and intergalactic matter.

Nevertheless, we still do not know why they are present. There are several hypotheses concerning the origin of these magnetic fields; they suggest that magnetic fields might be produced by the dynamo effect in the first stars and galaxies or primordial magnetism of the Big Bang era. Still, the exact process of the formation of these enormous magnetic fields requires further investigation.

Fast Radio Bursts (FRBs) are strong, millisecond-long flashes of radio waves, originating from faraway galaxies. These mysterious signals were first detected in 2007 and last only a few milliseconds, but they emit as much energy as the sun does in a few days. We don't know where FRBs come from. Other theories suggest that neutron stars, black holes, or even stranger ideas such as extraterrestrial technologies cause these bursts. There have been numerous discoveries and follow-up studies regarding them, but still, the processes underlying the FRB phenomena are poorly understood. Learning about FRBs will provide us with additional knowledge about the environment in distant galaxies and the processes associated with high-energy astrophysical phenomena. One of the most interesting and promising fields in astronomy is searching for extraterrestrial life. There were many exoplanets found which orbit in the habitable zones of their suns, however, there is still no proof that extraterrestrial life exists. Some special projects such as SETI look for signs of an intelligent life form out there. Still, up until now there is no proof of any extraterrestrial life found. Even finding microorganisms on another planet would be a great discovery for further research regarding life forms around the universe. Nevertheless, there is still a long way to go and much to discover in our universe. Such as:

- Beyond Neptune, there are thousands of icy bodies called Trans-Neptunian Objects (TNOs), including recognized dwarf planets like Pluto, Eris, Haumea, and Makemake. Extreme TNOs (ETNOs) like Sedna have highly elongated orbits due to gravitational perturbations from external forces.[xi,xii] Astronomers generally attribute these strange, stretched trajectories. Are there any non-dwarf planets outside of Neptune in the solar system? And why are orbits of extreme trans-Neptunian objects elongated?[xiii,xiv]
- Saturn's moon Iapetus is one of the stranger objects in our Solar System. Unlike other objects its size, Iapetus is walnut-shaped, with a clearly defined chain of mountains along its equator. Now the question is, how could it have formed billions of years ago with the rest of the Solar System, and yet still have its unique shape?[xv] More questions are the mountains the relic of a young, hot, rapidly spinning Iapetus? The mountains consist of material that has gathered on the surface over time, originating from the rings of Saturn?[xvi],[xvii]
- As we know that, Saturn's magnetosphere rotates at a pace similar to its clouds as the planet's magnetic field is anchored to its deep, spinning interior. Current observations reveal the two are dynamically coupled: upper atmospheric winds driven by planetary auroras interact with the magnetosphere, aligning the magnetosphere's rotation with atmospheric movements.[xviii] Now the question is why does Saturn's magnetosphere rotate at about the same pace as the planet's clouds? And, where does the line of high mountains that runs close around the equator of Saturn's moon Iapetus come from?

- Referred to as JuMBOs (Jupiter Mass Binary Objects), these unexpected pairs of free-floating planets have been observed by the JWST in star-forming regions like the Orion Nebula. There are two main formation theories: Micro-star formation and Ejection mechanisms.[xix] Now the questions are, how prevalent are planetary systems similar to the solar system? Some of the planetary systems we have seen have super-Earths and hot Jupiter's quite close in to their sun. Jupiter-like planets in Jupiter-like orbits appear to be rare. There are several reasons why Jupiter-like orbits might be rare, including lack of data or the great tack hypothesis. How do binaries with a Jupiter mass form?[xx]
- As we know that, the Sun produces its reversing magnetic field through the solar dynamo process, and driven by the internal movement of electrically charged plasma. Differential rotation and convective currents stretch, twist, and amplify the magnetic field lines over the 11-year solar cycle. As the magnetic field tangles, it becomes buoyant and rises to the visible surface and the eruptions form sunspots, which appear in pairs with opposite magnetic polarities.[xxi] Moreover, near the peak of the solar cycle (solar max), the sunspots decay, and their remaining magnetic flux is carried by convective flows to the polar regions. Tt deposited flux cancels out the existing poles and rebuilds them with the opposite polarity, completing the 11-year flip. As the newly established poles are reversed, the entire process takes 22 years to return to the exact initial state.[xxii] Simple question is that, how does the Sun produce its regularly reversing large-scale magnetic field?
- The solar cycle rebounds when depleted polar magnetic flux slowly accumulates until it reaches a critical threshold, triggering a polarity reversal and restarting regular cyclic activity. Even during a quiescent grand minimum, the Sun's dynamo keeps operating near a minimum threshold, continuing to deposit small amounts of magnetic flux toward the poles.[xxiii] Now, once this critical mass of polar magnetic flux is reached, the Sun's magnetic poles successfully reverse polarity. This kick-starts the dynamo, allowing it to re-establish the standard, 11-year Solar Cycle.[xxiv] What is the mechanism that created the Maunder Minimum and other grand minima, and how does the solar cycle rebound from a minimum state?[xxv]
- Magnetic reconnection is a physical process occurring in electrically conducting plasmas, in which the magnetic topology is rearranged and magnetic energy is converted to kinetic energy, thermal energy, and particle acceleration.[xxvi] The surface of the Sun is roughly 5,500°C, and the corona reaches up to 3 million degrees Celsius. This baffling phenomenon, known as the coronal heating problem, is powered by two main magnetic mechanisms. The constant churning of the Sun twists its magnetic field lines. When these lines cross and snap, they release millions of tiny, localized explosions called nanoflares, which superheat the surrounding plasma. Data from NASA's Parker Solar Probe also suggests a helicity barrier traps turbulent energy in the atmosphere and channels it directly into heating the plasma.[xxvii] Few questions arise as why is the corona of the Sun so much hotter than the surface of the Sun? What makes the magnetic reconnection effect many orders of magnitude faster than what the mainstream models predict?[xxviii]

- Coronal mass ejections (CMEs) eject twisted magnetic structures as flux ropes from the Sun. And the CMEs rotate during their journey, and their internal magnetic fields can orient southward. This sustained southward field interacts with Earth's northward magnetosphere via magnetic reconnection, and transferring massive energy and driving intense geomagnetic storms.[xxix] Question are, how does the Sun produce powerful southward-directed magnetic fields in solar coronal mass ejections that lead to geomagnetic storms? How to forecast geomagnetic and solar superstorms?[xxx]
- Stars comprise most of the baryonic and luminous mass of galaxies; synthesize heavy elements; and inject mass, momentum, and energy into the interstellar medium. Stars are also home to the planets. As stellar properties are primarily decided by their mass, the so-called stellar initial mass function (IMF) is critical to the structuring of our Universe.[xxxi] Questions are, there does the stellar mass spectrum arise? That is, why do astronomers find the same distribution of stellar masses, the beginning mass function, presumably independent of initial conditions?[xxxii]
- Supernova is a powerful and luminous explosion of a star. A supernova occurs during the last evolutionary stages of a massive star, or when a white dwarf is triggered into runaway nuclear fusion. However, it is expected that supernovae in our galaxy occur on average once every 61 years, although the last to be observed was Kepler's Supernova in 1604.[xxxiii] As a fading star explodes in a supernova because the sudden collapse of its core creates an incredibly dense, rigid neutron core, causing the infalling outer layers of the star to violently bounce backward and blow apart in a massive shockwave.[xxxiv] Why does a fading star explode as it collapses?
- The great works of Burbidge, Burbidge, Fowler and Hoyle and separately A. G. W. Cameron in 1957 showed how the majority of naturally occurring nuclides beyond the element iron can be made in two kinds of neutron capture processes, the s- and the r-process.[xxxv,xxxvi] And some neutron-deficient nuclides found in nature are not reached in these processes and therefore at least one additional process is required to synthesize them and those are known as p-nuclei. Question is what is the astrophysical process responsible for the nucleogenesis of these rare isotopes?[xxxvii]
- Fast Radio Bursts (FRBs) are millisecond-long, hyper-energetic radio pulses originating from distant galaxies. The leading theory attributes them to magnetars. As FRB signals travel billions of light-years, passing through dense intergalactic plasma, scientists can use their fleeting dispersion and Faraday rotation to map invisible cosmic matter.[xxxviii,xxxix] Now questions arises as what creates these short-lived radio pulses from faraway galaxies that endure only a few milliseconds? Why do some FRBs reoccur on unpredictable timescales, yet so many others do not? A number of models have been suggested, but no one idea has gained universal acceptance.[xl]
- Ultra-high-energy cosmic rays (UHECRs), like the 1991 "Oh-My-God" particle and the 2023 "Amaterasu" particle and those exceed the "Greisen–Zatsepin–Kuzmin cutoff" (GZK) limit.[xli] They are likely accelerated through massive cosmic shock waves (Fermi acceleration) in extreme environments like Active Galactic Nuclei (AGN), Gamma-

Ray Bursts (GRBs), or potentially via exotic. Again, the GZK limit states that cosmic ray protons traveling over intergalactic distances will interact with the Cosmic Microwave Background (CMB) radiation.[xlii],[xliii] The question related to oh-my-God particle and other ultra-high-energy cosmic rays is what scientific processes can accelerate cosmic rays to energies above the GZK limit?[xliv]

- According to Newtonian physics, stars in the outer edges of galaxies should rotate much slower than those in the dense center. But, Vera Rubin in the 1970s has shown that rotational speeds remain constant or flat regardless of distance from the center. So, the galaxy rotation problem is a major discrepancy between the predicted and observed orbital velocities of stars and gas in spiral galaxies.[xlv] The rotation curve of a disc galaxy is a plot of the orbital speeds of visible stars or gas in that galaxy versus their radial distance from that galaxy's centre.[xlvi] Now the question is, does dark matter (alone) explain the disparity between the expected and observed speed of stars around the center of galaxies?
- Age–metallicity relation in the Galactic disk Is there a universal age–metallicity relation (AMR) in the Galactic disk (both the “thin” and “thick” regions of the disk)? There is no sign of a strong AMR in the local (rather narrow) disk of the Milky Way. We have investigated the possible existence of an age-metallicity connection in the galactic thick disk using a sample of 229 nearby "thick" disk stars and found evidence for the presence of an age-metallicity relation in the thick disk.[xlvii,xlviii] Ages of stars derived from asteroseismology do not show a robust age–metallicity link in the galactic disk.[xlix]
- Ultra-luminous X-ray Sources (ULXs) are cosmic objects that emit immense amounts of X-rays (up to 10 million times more energy than the Sun). They shine so brightly that they regularly exceed the Eddington limit, a physical threshold for stellar mass, implying they are powered by extreme, super-critical accretion onto neutron stars or black holes.[l] Questions are, what powers X-ray sources that are not related to active galactic nuclei but are more luminous than the Eddington limit of a neutron star or stellar black hole? Are they driven by intermediate-mass black holes? Some ULXs show periodicity, indicating non-isotropic emission of a neutron star. Is this true for all ULXs? How may such a system be formed and stable?[li]
- The infrared/ TeV crisis: No attenuation of very high-energy gamma radiation from extragalactic sources.[lii] It refers to an astronomical puzzle where very high-energy gamma rays from distant extragalactic sources were observed to arrive with less attenuation than predicted. Astronomers and astrophysicists have largely resolved the crisis through a combination of refined observations and revised theoretical modeling.[liii] The universe appeared unexpectedly transparent to these energetic photons, challenging standard models of the Extragalactic Background Light (EBL). What are small red spots?[liv]
- Spacetime torsion is a geometric twisting; are the fundamental particles with intrinsic spin act as sources of torsional distortion. Extended theories of gravity, like Gauge Theory Gravity and Einstein-Cartan theory, link this quantum spin to macroscopic or quantum fluctuations, generating phenomena in advanced physics.[lv]

Question is, in Quantum effects, torsion, or other phenomena; do they make general relativity break down in the interior of a black hole? What is inside a black hole? Do black holes have a structure? If so, how can one investigate the internal structure?

- The M–sigma relation is an empirical correlation between supermassive black hole mass (M) and stellar velocity dispersion sigma in galactic bulges. It was discovered independently by two research teams in the year 2000 by Ferrarese and Merritt and Gebhardt.[lvi] What is the genesis of the M–sigma link between supermassive black hole mass and galaxy velocity dispersion?[lvii]
- Quasars are the intensely bright, active cores of distant galaxies, powered by supermassive black holes growing at extraordinary rates. These black holes grow by devouring colossal amounts of surrounding gas, dust, and stars, which swirl into a massive, superheated accretion disk before falling into the black hole.[lviii] Most distant quasars (at redshifts >6 to 7), seen within 700 million to 1 billion years of the Big Bang) grow their supermassive black holes through super-Eddington accretion and the rapid accretion of cold, dense primordial gas streams.[lix] How do the most distant quasars grow their supermassive black holes? or early in the history of the universe?
- black holes emit a faint thermal radiation and which known as Hawking radiation. Theoretical physicist Stephen Hawking in 1974 has proposed this phenomenon and that has a direct consequence of the intersection between quantum mechanics and general relativity.[lx] Now the question is, do black holes radiate thermal radiation as theory predicts? If black holes can melt away, what happens to the information they contain? This seems to be a problem because annihilation of information is forbidden by the unitarity of quantum mechanics. Does the radiation eventually cease for black hole remnants?[lxi]
- Supermassive black holes seem to have coalesced, and one pair of these intermediate masses has been seen at PKS 1302–102.[lxii] But theory predicts that supermassive black holes separated by around a parsec can take billions of years to get near enough to combine—longer than the lifetime of the universe.[lxiii]
- Now, many mysterious questions have arisen. Is the cosmic censorship hypothesis true? Is naked singularity possible?[lxiv] Is the universe homogeneous and isotropic at sufficiently large scales as claimed by the cosmological principle and assumed by all the models using the Friedmann–Lemaître–Robertson–Walker (FLRW) metric, including the current version of the Lambda cold dark matter (ΛCDM) model, or inhomogeneous or anisotropic?[lxv,lxvi] Is the CMB dipole purely kinematic, or does it indicate anisotropy of the universe resulting in the breakdown of the FLRW metric and the cosmological principle?
- Astronomer Edwin Hubble is that great human for whom the Hubble Space Telescope is named. He has discovered cosmic expansion in 1929, observing that the farther away a galaxy is from Earth, the faster it appears to be receding from us. The Hubble Tension is the most debated discrepancy in modern astrophysics, which refers to the fact that measuring the expansion rate of the universe (or Hubble Constant, $H_0$) yields two significantly different, highly precise values depending on the method used.[lxvii] The disagreement has become so severe that many physicists

now refer to it as a crisis rather than a tension.[lxviii] Astrophysicists have written over a thousand research papers attempting to solve the mystery. The leading theories to explain the many discrepancies.[lxix] The Hubble tension is a hint of the breakdown of the cosmic principle?[lxx]

- As we know that FLRW is a metric that describes a homogeneous, isotropic, expanding universe that is path-connected, but not necessarily simply connected. [lxxi]Again, when combined with Einstein's field equations, the metric gives the Friedmann equations, which have been developed into the *Standard Model* of modern cosmology and further developed into the Lambda-CDM model.[lxxii] Now the question, is the FLRW metric the true metric of the cosmos if the cosmological principle is correct?[lxxiii]
- The accelerating expansion of the universe is an observationally confirmed phenomenon, but its underlying cause or dark energy is one of the biggest mysteries in physics. It does not directly prove the cosmological principle false, but it has prompted researchers to rigorously test and occasionally challenge it.[lxxiv] Now the question is, are the observations seen as the speeding expansion of the universe accurately understood, or are they rather proof that the cosmological principle is false?[lxxv]
- According to the Copernican principle, human beings do not occupy a privileged or central position in the universe, meaning our observations from Earth are representative of those that could be made from any average location. In astronomy, the phrase refers to the transition from geocentrism to heliocentrism.[lxxvi] Simple question is, do the cosmological observations from the Earth represent the observations from the other positions in the universe according to the Copernican principle?[lxxvii]
- Dark matter is some kind of substance that has gravity and that holds galaxies together. It’s true that, yet cannot be directly seen with any instrument yet created.[lxxviii] Scientists are still actively investigating exactly what dark matter is, but it is almost certainly not made of the atoms and particles that make up ordinary matter. Simple question is, how scientists use the bending of light and galaxy rotation speeds to map out dark matter's gravitational effects across the universe?[lxxix] What is the identity of dark matter, and what is it made of? Is dark matter made of particles? If so, is it a WIMP, an axion, a lightest superpartner (LSP), or something else? Or is it some other form of matter, not an extension of gravity, that is causing the phenomena attributed to dark matter?[lxxx]
- The accelerated expansion of the cosmos is the observed phenomenon. In the universe is expanding at an increasingly faster rate, driven by a mysterious force known as dark energy. Discovered in 1998 through distant Type Ia supernova observations, this realization fundamentally changed modern cosmology and received the 2011 Nobel Prize in Physics.[lxxxi] What drives the observed accelerated expansion of the cosmos (the de Sitter phase)? Are the measurements of the accelerated expansion of the universe correctly interpreted, or do they indicate that the cosmological principle is false?[lxxxii]

- Why is it that the energy density of the dark energy component is of the same order as the density of matter today, although the two change somewhat differently with time? Could this observation be an accident of timing? Is dark energy a pure cosmic constant, or do concepts of quintessence, such as phantom energy, apply? Can early dark energy theories solve the Hubble tension?[lxxxiii]
- Our observable universe is composed almost entirely of matter, a profound mystery in physics known as the baryon asymmetry problem. While theoretical models suggest the Big Bang should have produced equal amounts of matter and antimatter, leading to mutual annihilation, a tiny imbalance—roughly one extra matter particle for every billion antimatter particles—allowed normal matter to survive and form the cosmos. In physical cosmology, the baryon asymmetry problem, also known as the matter asymmetry problem or the matter–antimatter asymmetry problem.[lxxxiv] Why is there far more matter than anti-matter in the observable universe?[lxxxv]
- The cosmological constant or called Einstein's cosmological constant, is a coefficient that Albert Einstein initially added to his field equations of general relativity.[lxxxvi] The cosmological constant Λ is the simplest possible explanation for dark energy and is used in the standard model of cosmology known as the ΛCDM model.[lxxxvii] The zero-point energy of the vacuum must produce a big cosmological constant. Why doesn't it?[lxxxviii]
- The true size of the entire universe is unknown and currently impossible to measure.[lxxxix] Current measurements from instruments like the Planck satellite indicate the universe is geometrically flat, meaning current cosmological models favor the theory that it is likely infinite. However, because we can only see a limited bubble of space, the exact nature of the whole cosmos remains one of the great mysteries in astrophysics.[xc] The size of the entire cosmos is unknown, but the observable universe is about 93 billion light-years across. Is it infinite?
- Thurston's geometrization conjecture in mathematics states that each of certain three-dimensional topological spaces has a unique geometric structure that can be associated with it. The 3-manifold of comoving space represents the "shape of the universe" at a single moment in cosmological time. It is a 3-dimensional spatial slice of the 4-dimensional expanding spacetime, where observers share the same cosmological time and are at rest relative to the cosmic microwave background.[xci] What is the 3-manifold of comoving space, i.e., of a comoving spatial segment of the universe, informally called the shape of the universe?
- We know that, Jean-Pierre Luminet's 2003 model of the Poincaré dodecahedral space (PDS) explain a finite, positively curved, and "wrap-around" 3-manifold—beautifully explained early cosmic microwave background (CMB) anomalies, modern Planck satellite observations found no definitive evidence for such a repeating topology. We do not know the curvature or the topology, but we do know that the curvature is "close" to zero on observable scales. [xcii] The theory of cosmic inflation argues that the form of the universe could be unmeasurable. The shape of the cosmos has been proposed by Jean-Pierre Luminet et al. and others since 2003; it may be the Poincaré dodecahedral space. The Poincaré space or another 3-manifold?

- As we know that, inflaton is a hypothetical quantum scalar field theorized to have driven cosmic inflation, causing the early universe to expand exponentially.[xciii] Is the shape unmeasurable? Is the notion of cosmic inflation in the very early cosmos, right? If so, what are the particulars of this epoch? What is the hypothesized scalar field, the inflaton, that caused this cosmic inflation? If there was inflation at one point, does it continue by inflating quantum-mechanical fluctuations and thus continue somewhere very far away?[xciv]
- Given that the distant universe appears so homogeneous, why does the Big Bang hypothesis apparently predict more detectable anisotropies of the night sky than we actually observe?[xcv] The accepted explanation is that of cosmological inflation. Are there better theories? One example is the hypothesis of a changeable speed of light?[xcvi]
- Contemporary precision cosmology faces an escalating crisis: the Hubble constant measured from the early universe. The Lambda-CDM, Lambda cold dark matter, or ΛCDM model is a mathematical model of the Big Bang theory with three major components: a cosmological constant, denoted by lambda (Λ), associated with dark energy; the postulated cold dark matter (CDM); and ordinary matter.[xcvii] Now the question is, if ACDM is right, why aren't there converging observations of the Hubble constant?[xcviii]
- There are some big features in the microwave sky at distances over 13 billion light-years that seem to be aligned with both the speed and orientation of the solar system. Is this a consequence of systematic flaws in the processing, contamination of data by local influences, or an inexplicable breach of the Copernican principle? Why is there something? Origin and fate of the universe: Where did the prerequisites for anything to exist come from?
- We can only observe a fraction of the cosmos, and roughly 95% of the universe consists of mysterious dark matter and dark energy, vast realms of physics and celestial mechanics remain completely undiscovered. Regarding the end of the universe, astrophysicists have several leading theories.[xcix] Could there be an unlimited number of unknown astronomical phenomena existing in our entire universe? Will the universe end in a Big Freeze, Big Rip, Big Crunch, or Big Bounce, or will it be part of an indefinitely recurring cyclic model?
- The multiverse idea has arisen in many versions. "The primarily in cosmology, quantum mechanics, and philosophy, and often asserts the actual physical existence of different potential configurations or histories of the known observable universe. The term *multiverse* was coined by American philosopher William James in 1895 to refer to the confusing moral meaning of natural phenomena and not to other possible universes."[c] Now the questions are, does a multiverse exist, and does it matter? Can we experimentally evaluate these concepts, or are they doomed to be pseudoscience forever? Are such philosophical concerns translatable in the language of cosmology, astronomy, physics, or any other scientific discipline? Are paradigmatic methods like the anthropic principle necessary

in order to answer unsolved difficulties like the cosmological constant problem? Are there additional living forms in the universe?

- Extraterrestrial life, or alien life is life that originates from another world rather than on Earth. No extraterrestrial life has yet been detected. Such life might range from simple forms such as microbes to intelligent beings, possibly bringing forth civilizations that might be far more, or far less, advanced than humans.[ci] The anthropic principle is not strictly necessary as a foundational physical law, but it is currently a leading framework for explaining the finely tuned value of the cosmological constant. Regarding extraterrestrial life, there is no confirmed evidence yet, though astrobiologists widely consider additional life forms highly probable given the billions of potentially habitable exoplanets. Now the specific questions are, is there other intelligent life? Is it possible that there are an endless number of alien genera in our universe?[cii,ciii] If yes, what is the explanation of the Fermi paradox?[civ] Was this one-off event due to any extraterrestrial phenomenon? If so, where did it come from?[cv]

## DIALOGUE OF FEW UNSOLVED MYSTERIES OF THE UNIVERSE

The next set of astrophysical and cosmological themes (entry 11–26) surveys some of the most fascinating and unexpected boundaries of modern science. The subjects covered in these chapters venture further into uncharted waters than traditional astronomy. This part deals with concepts that do not fit into conventional theories, such as black hole anomalies, puzzling emissions from galaxies, higher dimensions, strange matter, as well as questions of time and reality. Here, interesting discoveries are presented along with theories about those discoveries, indicating the ever-changing and evolving nature of mankind's efforts to understand the universe.

**The cosmic web and the missing baryon problem**. The Missing Baryon Problem, which is a major unsolved cosmological problem, is the fact that nearly half of the predicted ordinary matter (baryons) in the universe is not discovered. Data from the cosmic microwave background and theoretical models estimate about 5% of the universe to be baryons, but only about half of that has been seen. These missing baryons are thought to reside in the warm-hot intergalactic medium (WHIM) of the cosmic web, a diffuse, filamentary structure of gas at temperatures between 100,000 and 10 million Kelvin. It is a gas that emits modest ultraviolet and X-ray radiation that makes it difficult to detect immediately. Modern techniques, such as absorption line studies using quasar light, FRB studies, and X-ray observations of ionized oxygen conducted by telescopes such as Chandra and XMM-Newton, have provided additional information to support this theory. The upcoming telescopes, such as the Square Kilometer Array and Athena, can help to reveal more information regarding the missing baryons and their role in the creation of the universe.

**Cosmic Ray Mysteries**: Ultra High Energy Particles. Another puzzle is posed by Ultra-High-Energy Cosmic Rays (UHECRs), particles with energies considerably above anything that can be produced in man-made accelerators. The origin and acceleration mechanism of such particles is unclear, and such high-energy particles would be expected to lose energy over long distances due to interaction with the CMB (Greisen–Zatsepin–Kuzmin or GZK cutoff).

Because UHECRs are charged, magnetic fields bend their courses, hiding their sources. Possible sources are active galactic nuclei, gamma-ray bursts, or even decays of old supermassive particles. Extensive air showers are detected by ground-based observatories such as the Pierre Auger Observatory and the Telescope Array, with future missions like POEMMA expected to improve source tracking. The study of UHECRs can offer fresh insights of high-energy astrophysics, quantum gravity, and dark matter.

**The Hubble Tension**: Different Rates of Cosmic Expansion. The Hubble tension is a discrepancy in the derived expansion rate of the cosmos. The local measurements (e.g., standard candles—type Ia supernovae) yield a greater value for the Hubble constant (~ 73 km/s/Mpc) than the early-universe measurements (e.g., the CMB), which provide a lower value (~ 67.4 km/s/Mpc). This discrepancy is not easily reconcilable with errors and points either to novel physics or to a modification of the mainstream cosmological model. Possible possibilities include changing dark energy, more relativistic particles, or modified laws of gravity. New methods using cosmic chronometers, gravitational wave “standard sirens," and baryon acoustic oscillations are trying to determine the true pace of expansion and to enhance our knowledge of cosmic evolution.

**Hidden Structures of the Cosmic Web**: Intergalactic Shadows. But the Cosmic Web is not only composed of observable galaxies. There are also enormous and faint regions of gas and dark matter, forming filaments and voids. Observing such spaces may prove challenging; however, methods such as looking at the Lyman-alpha Forest in quasars' light and gravitational lensing have been used in the past to observe their presence. Such intergalactic shadows could offer clues into how galaxies formed, and also about the actions taken by dark energy in sparse areas. Understanding the structure and underlying reasons for these spaces is crucial for accurate modeling.

**The Gravity Challenge**: Testing Einstein's theory at the largest scales. Einstein’s formulation of general relativity also encounters problems on cosmic scales. It works fine for our solar system. But the observations of cosmic acceleration and galaxy rotation curves require dark energy and dark matter, respectively, neither of which has been directly detected. Some other theories that can be mentioned here are Modified Newtonian Dynamics, those involving extra dimensions, and entropic gravity, among others, which play their part in shaping today's understanding of gravity. The combination of black holes and new experiments with projects like LISA can help shed more light on the subject.

**Frontiers of Quantum Gravity: Unification of the Macro and Micro Cosmos.** The goal of the search for quantum gravity is to unite general relativity and quantum mechanics into a single theory. The contenders include loop quantum gravity, which pictures spacetime as a network of discrete units, and string theory, which regards particles as vibrating strings in higher-dimensional space. Other theories argue that spacetime is constructed from quantum information. Even with the limited experimental access due to the enormous energies involved, research on gravitational waves and high-energy experiments continues to probe these theoretical frontiers.

**Spectral Riddles: The Mystery of Diffuse Interstellar Bands (DIBs)** "Diffuse Interstellar Bands” (or DIBs) are unexplained absorption features in starlight created by unknown interstellar substances. Possible candidates include complex chemical substances such as PAHs and fullerenes, although none have been conclusively identified. The differences in the bands as a function of environment make the search more difficult but now also involve laboratory simulations and machine learning. Solving the DIB conundrum would help us better comprehend the interstellar chemistry and physics of space.

**Unusual** Paths: The Flyby Anomaly and the Secrets of Orbits. The flyby anomaly is the observed inexplicable variation in the velocity of spacecraft during flybys of the Earth, originally observed in the 1990s. Atmospheric effects and gravitational anomalies provide no obvious explanation for the tracking errors. The pattern seems to be a function of the geometry of the trajectory and there has been talk of new physics. Understanding this oddity is crucial for accurate spacecraft navigation and may have wider consequences for gravity theory.

**The Silent Pioneers: The Hunt for Population III Stars.** Population III stars, the first stars in the universe, are still theoretical. They were probably huge, luminous, and short-lived, made of pure hydrogen and helium soon after the Big Bang and starting the manufacture of heavier elements. these have never been seen directly but researchers look for their signatures in very metal poor stars and in distant galaxies. Some may have just fallen directly into black holes and therefore been lost from view. Evidence for such stars might help explain chemical enrichment in the early universe and galaxy formation.

**Stellar Genesis Revisited: Metallicity and the Birth of the First Stars.** The lack of metallicity, or metallicity itself, had a big effect on the early creation of stars. Early in the universe, when there were no metals, gas clouds did not cool enough, and formed incredibly massive stars, maybe hundreds of times the mass of the Sun. The stars shone brightly, emitting intense radiation that stripped electrons from nearby hydrogen in an event known as the period of reionization. The metal enrichment of the supernovae throughout time facilitated the development of more varied stars. Understanding this process is crucial for understanding the evolution of stars and the formation of cosmic structure.

**Weird Black Holes: Mass, Spin and Behaviour Anomalies.** Recent observations of black holes, e.g. gravitational wave observations, show surprising features which contradict classical models. LIGO has identified intermediate mass black holes (~30 solar masses), which are larger than normal stellar black holes but smaller than supermassive black holes, and its creation paths are not well understood. Some black holes are spinning at or near the theoretical boundaries, while others are spinning extremely slowly or in the wrong direction, implying complex creation histories including mergers or chaotic interactions. Black holes in the “mass gap” (~50-120 solar masses), where pair-instability supernovae predict no traces, also point to alternate formation scenarios including direct collapse or primordial beginnings. There are ideas for objects that could be mistaken for black holes, such as gravastars or fuzzballs, but no conclusive proof for them. These oddities keep on sharpening our grasp of black hole physics and cosmic evolution.

**Microwave Whispers: The Search for Anomalous Emission from the Milky Way.** Observations of the microwave radiation from the Milky Way have revealed aberrant components that cannot be explained by traditional astrophysical processes. First identified by COBE and later verified by WMAP and Planck satellites, these emissions do not fit typical thermal dust emission or synchrotron radiation. The hypotheses involve fast rotating microscopic dust grains (spinning dust), interaction between cosmic rays and interstellar dust, or magnetized granules generating microwaves. Axion decay. Other exotic particle processes possibly connected to dark matter have also been postulated. Progress has been made, however none of the models now in use can explain all of the properties that have been seen. Missions like NASA's SPHEREx and lab investigations are working to unravel the origin of this emission, which could revolutionize our understanding of interstellar dust and galactic physics.

**Cosmic Magnetic Fields and the Formation of the Universe:** Magnetic Mysteries. Cosmic magnetic fields pervade galaxies, galaxy clusters and the intergalactic medium, and influence charged particles, star formation and galactic dynamics. We do not know the origins of these fields, perhaps seeded in oscillations of plasma in the early cosmos and later enhanced by galactic dynamos. We see magnetic fields aligning with features like spiral arms. We see them affecting structures like jets from supermassive black holes. They are indirectly examined through the polarization and deflections of cosmic rays. Magnetic fields may even affect dark matter and dark energy, and thus the genesis and expansion of cosmic structures. They are important, yet their cryptic nature makes them one of the least investigated forces in cosmology.

**Relativity Extreme: Time Dilation and the Challenges of Cosmic Chronology.** Einstein's relativity demonstrates that time is a flexible dimension, slowing down at high velocities (special relativity) or intense gravity (general relativity). Experiments confirm time dilation: atomic clocks aboard fast-moving planes, and GPS satellites, for example, are adjusted accordingly. Near black holes, time dilation is extreme. Things falling in appear "frozen" to distant observers. Redshifted galaxies are a cosmic clock, telling the time and changing our understanding of the age and history of the universe. Quantum theories propose that time may be emergent in nature and may cease to exist at singularities. These results challenge classical concepts of past, present and future with important ramifications for cosmology.

**Neutrino Mysteries: The Ghostly Messengers of the Universe.** Neutrinos are almost massless, neutral particles born in stars, supernovae and the Big Bang explosion. They are particles that interact weakly, may travel long distances, and can convey unique astrophysical information. IceCube is a huge detector buried in the ice near the South Pole which records rare neutrino occurrences. The neutrino burst from the 1987A supernova provided a vital glimpse of a star's end. Neutrino oscillations, i.e. the flavor change of neutrinos during propagation need a physics outside the Standard Model. Finding the cosmic neutrino background might unveil secrets of the early cosmos, shedding more light on fundamental forces and astrophysical processes.

**Gamma-Ray Surprises: Mysterious Emission from Our Galaxy's Center.** The Fermi Gamma-ray Space Telescope has observed excess gamma radiation originating from the heart of the Milky Way, beyond what is predicted from known sources such as the black hole in the galaxy's core. The diffuse emission pattern indicates the wide origin. Possible origins are dark matter annihilation, cosmic ray interactions with gas or unknown astrophysical phenomena like microquasars. None of these properly account for the signal. Studying these emissions could provide advances in particle physics, galaxy structure and indirect dark matter detection.

**Inflation Revisited: Alternative Scenarios for the Birth of the Universe.** Inflation theory says that the universe expanded very rapidly just after the Big Bang. This solves problems like flatness, homogeneity, etc. But the inflaton field responsible for this expansion is entirely speculative and undiscovered. Alternatives are cyclic worlds, everlasting pre–Big Bang states (emergent universes), or quantum fluctuations giving rise to universes in a multiverse. Some models show inflation differs among regions. Testing these notions requires accurate cosmological data and a successful hypothesis could revolutionize our knowledge of the birth of the universe.

**Cosmic Strings and Topological Defects: Signatures of the Early Universe.** Topological defects such as cosmic strings could be remnants of phase transitions breaking symmetries in the early cosmos, analogous to fissures in cooling crystals. If they exist, cosmic strings would be thin yet incredibly dense, leading to peculiar gravitational lensing effects. Other flaws include domain walls and magnetic monopoles, but none have been found definitively. Inflation is still the primary explanation of structure generation, although efforts to identify such relics by gravity waves, gamma rays or CMB anomalies are ongoing. Finding would clarify physics of early universe.

**Baryogenesis and Beyond: The Riddle of the Matter-Antimatter Asymmetry.** We assume that equal amounts of matter and anti-matter should have been produced. We observe that there is more matter than anti-matter. The asymmetry probably developed by baryogenesis mechanisms involving CP violation, baryon number violation and non-equilibrium conditions. The CP violation in the Standard Model is insufficient and this has led to notions like electroweak baryogenesis, leptogenesis, new physics. Particle collider experiments and astrophysical investigations try to find the underlying reason answering one of the biggest questions in cosmology.

**Ultra-Diffuse Structures: The Enigma of Ghost Galaxies.** Ultra-diffuse galaxies (UDGs) are mysterious phenomena, comparable in size to the Milky Way but with relatively few stars. Some seem to have almost no dark matter; others seem to be dominated by it. They occur in groups and individually. Their origins may include tidal stripping, inefficient star creation or relics of old starbursts. The diversity of these objects defies conventional ideas of galaxy formation and points to missing pieces in our knowledge of baryonic and dark matter interactions.

**Are the numbers of nature truly universal? Challenging constants.** The rules of nature are based on physical constants, such as the speed of light, the gravitational constant, and the fine-structure constant. Some research investigates if they might change with time or location, which would revolutionize our knowledge of physics. Such changes are sought in quasar sightings and experiments with atomic clocks. No conclusive changes have been seen yet the ramifications are huge. Theoretical models, like as string theory, propose that these constants could arise from more fundamental geometric features of space or from other dimensions.

**Phantom Dimensions: Unveiling Hidden Worlds Beyond Our Senses.** String theory and other theories suggest that there are more spatial dimensions than the three we can see. These dimensions are probably curled up and not observable with existing techniques, but could explain why gravity is so weak if its 'leaks' into these dimensions. In brane cosmology our universe is a 3D surface embedded in a higher dimensional space. Such notions may provide insight into dark matter, dark energy and the multiverse. Experiments at particle colliders and observations in astrophysics try to test these concepts but the direct proof is still missing.

**Time's Labyrinth: Temporal Anomalies and the Potential for Cosmic Time Travel.** Relativity predicts time dilation, while some more speculative models allow for closed time-like curves, pathways through space-time that would allow backward time travel. If negative-energy matter exists, then such loops might be possible in theoretical structures such as wormholes or cosmic strings. But this theory is problematic because of paradoxes like the grandfather paradox, and problems of causality. Time travel to the future is consistent with known physics, while backward time travel is theoretical yet rich in conceptual possibilities.

**Artificial Gravity: Fantasies of Technologies for Cosmic Journeys.** Artificial gravity is necessary for long-term space missions to mitigate the negative consequences of microgravity. The most practical way is to spin the spaceship and use centrifugal force to make artificial gravity. Other theoretical methods involve manipulation of electromagnetism or gravity using unusual substances. While these are still speculative, rotating habitats are being explored in current mission design, providing practical steps towards prolonged human space exploration.

**The Simulation Hypothesis: Are We Living in a Universe of Our Creation?** Simulation Hypothesis. We might be living in a very high-fidelity simulation created and maintained by a more evolved culture. If there are many such simulations, statistically we might be one of them. Possible indications are anomalies of quantum physics and highly calibrated constants. Some suggest experiments to look for evidence of computational constraints in the cosmos. But detractors say that such simulations might be impossible and the idea may not be testable. But it raises profound concerns about reality and awareness.

**Exotic States of Matter: Pushing the Boundaries of the Known.** Exotic states of matter are formed under extreme conditions beyond solids, liquids, gases and plasma. At near-zero temperatures atoms function as one quantum object and form a Bose-Einstein condensate. The quark-gluon plasma is a reproduction of the early universe's hot, dense condition. Strange stuff might exist in neutron stars. Hypothetical examples are super solids, temporal crystals, Planck stars and negative mass matter. These states challenge existing physics and provide unique insights and technologies that drive experimental and theoretical research. These subjects together expose a significant fact: that the universe is vastly more complicated and wondrous than we previously assumed. This compilation of open questions related to dark matter, magnetic fields, time, neutrinos, inflation and even the simulated reality, is indicative of how modern astrophysics and cosmology are increasingly intermingling with forefront physics, speculative ideas and technological innovation. They challenge the paradigms of today, they present glimpses of deeper layers of physical law, and they have the potential to revolutionize our understanding of reality. The solutions to these problems may reveal totally new dimensions of cosmic understanding, both metaphorically and literally, with better observations and more mature theories.

**The Future May Predetermined by Quantum Mechanics**

And so, what do Einstein's theory of relativity and quantum physics have to say about time, reality and the future? Relativity brought the idea of a four-dimensional space-time continuum and the "block universe" where all events (past, present and future) exist simultaneously. This implies a deterministic universe. But quantum mechanics throws a spanner in the works of the deterministic machine with the probabilistic nature of particles and the notion of measurement demanding definite conclusions. This quantum indeterminacy has been understood in two ways: the Copenhagen interpretation posits a fundamentally random cosmos, whereas the Many-Worlds interpretation restores determinism by positing a branching universe for every potential outcome. The debate becomes more interesting by other ideas such as decoherence, entanglement and constraints from competing theories like pilot-wave mechanics. The paper also addresses the implications of awareness and the relativity of simultaneity for our sense of the "present" posing profound concerns about whether the future is pre-determined or still in the making.

**Special Theory of Relativity by Einstein & Block Universe.** The special theory of relativity by Einstein revolutionized our understanding of space and time, integrating them in a single four-dimensional unit known as space-time. This concept results in the formation of what is known as the block universe wherein everything from the past, present, and future coexists eternally as parts of an unchanging continuum. In this view, time does not flow, but exists all at once, just as space does. One important effect is the relativity of simultaneity: observers moving relative to each other will dispute about which events are happening now. This breaks the idea of a shared "present" for all people. This lends itself to the philosophical concept of eternalism, where every point in time is equally genuine. The block universe implies determinism, since the future seems as fixed as the past, following immutable physical principles.

**Determinism and Indeterminism in Relativity.** Relativity implies a deterministic cosmos, for the whole of the timeline, including the future, is decided and fixed. But this creates a problem: if relativity is the correct description of the cosmos at vast scales, can the future really be open? The movie discusses two views, one in which there is a complete block world extending into the future, or one in which some aspects of reality outside our "past light cone" are left unspecified, or indeterminate. This spawns the idea that each observer has a "bubble" of defined reality around them, especially around the brain, and that the rest of the cosmos is undefined until observed. To reconcile this contradiction between determinism and an open future we have to resort to quantum mechanics. It brings actual indeterminacy into the laws of physics.

**Quantum Mechanics and the Uncertainty of Reality.** So, in classical mechanics, a system is described by a set of definite values. In quantum physics, the description of the system is a wave function containing the probabilities of all conceivable outcomes. Before measurement, quantum systems are in superposition, a composite of all conceivable states. When we measure, one outcome is seen. But which outcome is seen cannot be anticipated deterministically, only probabilistically predicted. This important aspect of quantum physics has been validated by millions of experiments. But the process by which the probabilistic wave function collapses to a single result--the wave function collapse--is one of the darkest mysteries of quantum theory. Understanding whether the future is fixed or open requires understanding whether this collapse is real, and if so, what causes it.

**The Copenhagen Interpretation and Non-Determinism.** The Copenhagen interpretation is one of the oldest and most extensively taught interpretations of quantum mechanics It implies that a quantum system exists in a superposition of states until it is measured, at which moment the wave function collapses to a single definite consequence. This means that the cosmos is fundamentally random, and that knowing everything about the present does not allow us to forecast the future with certainty. But this creates problems when you mix it with relativity. Because various observers can have different notions of simultaneity, they can argue on whether the wave function for a specific event has already collapsed. This inconsistency is problematic for the idea of a reality that all observers agree on and emphasizes the issue of how to reconcile the quantum collapse with relativistic space-time.

**The Many-Worlds Interpretation and Determinism Reinstated.** The Many-Worlds interpretation offers a radical, but elegant alternative: it denies that the wave function collapses at all. Rather, it proposes that all possible outcomes of a quantum event occur, but each one in a separate branch of the universe. The wave function evolves deterministically under the Schr-odinger equation. All conceivable outcomes are realized in some branch. These branches become entangled with observers, who see one outcome while all other versions of themselves see other outcomes. Globally speaking, the universe is completely deterministic: all branches exist simultaneously. This view is consistent with Einstein's relativity, because the branching respects causal constraints, such as the speed of light. However, from the subjective point of view, observers see randomness. This is because they only live in one branch.

**Branching. Propagation, Decoherence and Relativity.** Branching in the Many-Worlds framework is not instantaneous throughout. Instead, it propagates according to the relativistic rules of causation, at or below the speed of light. Entanglement webs are woven, interwoven quantum occurrences defining various universes. Here is where decoherence is key: it explains why the quantum branches effectively segregate themselves from each other. Over time quantum interference between branches disappears, and each branch behaves conventionally. Decoherence gives a physical mechanism for the transition from quantum probability to classical experiences. This leads to an objective definition of the present as the particular entanglement network to which an observer is part. But the relativity of simultaneity means that every observer will experience “now” differently depending on how they are moving through space-time.

**The Problems of Pilot-Wave Theory.** Another interpretation of quantum physics that restores determinism without involving parallel worlds is the de Broglie–Bohm pilot-wave theory. It assumes that particles go along certain paths guided by a wave function varying according to quantum laws. And this gives a clear, non-random explanation of the particle behaviour. However, the pilot-wave theory has major difficulties in being made compatible with special relativity. That includes non-local effects, where a change in one area can immediately affect particles far away, and doesn’t fit naturally into the relativistic framework, where no influence can move faster than light. This incompatibility with relativity means it is not a full, modern theory of physics.

**Quality of the Present and Consciousness**. The concept of a block world raises a philosophical and experiential question: if all occurrences are already there, then what does it mean to experience the present? Neural activities happen in time and generate consciousness. This implies that the "now" that we perceive is not a point in time but a period of time. This expanded present conflicts with both presentisms, the doctrine that only the present is real, and naive ideas of a crisp temporal boundary between past and future. Our conscious experience of time instead supports a more complicated, distributed understanding of the present, one consistent with relativity's relative simultaneity. This contradicts basic ideas of time and poses more complex concerns regarding the individual perception of the passage of time.

The essential question is, does the future already exist? It is still an open question and really relies on the interpretation of quantum physics you believe in. If one takes the Copenhagen attitude, the future is mostly undetermined and is determined only as it is observed. If you like Many-Worlds, the future is already decided but in a huge multiverse, and each viewer sees a branching, uncertain route. The resolution of the passage of time, the direction of time, why we recall the past and not the future, is still an outstanding question in physics. The film concludes with a focus on the necessity of linking physical theory with a philosophical and subjective understanding of consciousness if we are to grasp time, determinism and the nature of reality.

## TRAVEL TO THE END OF THE UNIVERSE

The Transience of the Universe. The universe is a temporary place, an ever changing, evolving place, a place in which nothing is permanent. All structures, from stars to galaxies, are born, evolve and then die. This transience is not just true of the material cosmos, but of the inhabitants thereof, and makes change the only real constant. Eventually stars collapse, supernova, and become black holes. Galaxies also merge and change over billions of years. Astronomical objects are not permanent. Fast radio bursts, kilonovae, gamma-ray bursts (GRBs): These are high-energy, short-lived phenomena that come and go quickly, and are studied by astronomers to understand the "changing" character of the sky. The universe is expanding and our current physics theories postulate that matter and energy are being converted constantly, or, in some speculative theories, appearing and disappearing in "transient temporal singularities". Some believe that physical laws are not set in stone forever. Instead, the universe shows different relationships from time to time which short lived observers occasionally regard as laws.

Eastern religions like Buddhism and Hinduism believe that all material forms are temporary and will eventually fade. They recommend focusing on the everlasting ("Nitya") underneath the shifting surface. Humans have a tendency to desire stability, but "the illusion of permanence" causes misery because reality is forever changing (Anitya Kāla). Material forms are ephemeral, but scientific principles like the conservation of energy suggest that energy isn't destroyed, even while forms change. Earth is now seen as a unique oasis of life in a vast, mostly unfriendly universe. Earth is in the solar system, which is part of the Milky Way galaxy. We live in a world that is always changing, in cycles of creation and destruction. The time periods involved are so lengthy as to be almost incomprehensible in this ever-changing universe. It is therefore the setting for a forward-looking story of how the various astronomical bodies, including the Earth, will change and eventually die.

**Earth and the Near Future of the Solar System (2100-3000 AD).** 22nd and 23rd Centuries are predicted to bring significant changes to the environment and astronomy. The more greenhouse gases there are, the faster the ice caps melt and the faster sea levels rise, forcing coastal people to be displaced. People moved around a lot back in the day. The Sun's magnetic activity, which includes sunspot cycles, enhanced solar flares and coronal mass ejections, is progressively interfering with the Earth's magnetic field and poses a risk to our contemporary technological infrastructure, including satellites, communication systems and power grids. In 2200 AD, the earth is briefly cooled by increased volcanic activity releasing aerosols, yet the interaction of solar winds with the Earth's magnetosphere continues to create spectacular aurora. Climate disruption is on the rise around 2300 AD as melting of the polar ice caps reduces ocean currents such as the Gulf Stream, cooling portions of Europe and heating tropical zones.

As Earth approaches the year 2500 AD, the Milankovitch cycles, or long-term orbital cycles, are exerting an increasing influence on climate. They include changes in the eccentricity of the Earth (shape of the orbit), axial tilt and precession (wobble). This causes minor ice ages and major disruptions of ecosystems. These changes provide severe challenges to human civilization. Simultaneously, as the solar system travels across the galaxy, this modulates the cosmic ray flux, which can in turn alter atmospheric chemistry and earth 's climate. By the year 3000 AD there may be long periods of glacial, and the subtle changes in gravity between planets may begin to gently change their orbits, but only over very long periods of time.

**Geological & Solar Evolution Over Millennia (4000 AD – 10,000 AD).** Millennia roll by, as the tectonic forces work to shape the topography of the Earth. Ranges like the Himalayas continue to rise and fresh volcanic activity, especially from super-volcanoes like as Yellowstone, offer the threat of extended cooling, or “nuclear winter” conditions. The Sun’s slow brightening is getting stronger, gradually heating up Earth and pushing it closer to a wet greenhouse state—a perilous point when water begins to evaporate into the atmosphere, jeopardizing the stability of our oceans and the diversity of life. Geomagnetic field reversals run their course, potentially undermining the protection afforded by the Earth's magnetic cocoon and modifying the distribution of charged particles in the atmosphere. These changes can have knock-on repercussions for climate and technology. As the solar system passes through thicker interstellar gas clouds, the heliosphere (the Sun’s protective bubble) shrinks, letting in more cosmic rays into the atmosphere. This might potentially influence cloud formation via ionization of the atmosphere and change climate on geological timescales. Such higher amounts of radiation could promote biological evolution by raising the rates of mutation, some negative and some positive.

**Long-term geological and cosmic changes 10,000 AD - 1 million AD).** The tectonic plates of Earth will continue to move over the next hundreds of thousands to millions of years, eventually forming a new supercontinent. The process, which happens roughly every 300 to 500 million years, will lead to huge shifts in ocean currents, temperature zones and ecosystems. Erosion is still altering the surface, and volcanism is still active across tectonic boundaries. Due to continental drift, the Atlantic Ocean may come to an end someday.

Giant collisions of land may force tall chains of mountains. And the Sun will get brighter at the same time. It is still in its main-sequence phase, but it will radiate more energy. This will progressively evaporate ocean water, turning much of Earth into a desert landscape over time. The Milky Way galaxy is on a collision course with the Andromeda galaxy on a larger scale. This is already happening, and will happen over billions of years. The merger will significantly reconfigure star systems and spark fresh episodes of star formation, while consolidating the central supermassive black holes into one larger one. These galactic changes will induce gravitational disruptions, reshuffling planetary systems.

**The Far Future of Earth & the Solar System (1 million-10 billion Years).** On this timeline, strikes by asteroids the size of the Chicxulub impactor is still possible and might cause major extinctions. But the biggest change will come from the Sun. In around 5 billion years the Sun will run out of hydrogen fuel and swell out into a red giant, swallowing the inner planets, possibly including the Earth. If it is not used up, the Earth will be burnt and its atmosphere stripped away and it will be perfectly uninhabitable. The Sun, in its turn, will shed its outer layers, create a spectacular but brief planetary nebula, and leave behind a white dwarf – a dense, cooling star remnant. This white dwarf will continue to cool and fade away over billions of years. At the same time, the gas giants and Kuiper Belt objects will freeze, their orbits perhaps shifting as the solar system eventually becomes a cold, inactive environment. In about 10 billion years from now the white dwarf will have cooled to become a black dwarf, and the solar system will be effectively dead -- silent, frozen and drifting through the dark expanse of the galaxy.

**The Degenerate Era and the Dark Universe (10 trillion to 10^150 years).** This debased age begins when all the stars have spent their fuel. No new stars will form, because there isn't any hydrogen gas. All white dwarfs will eventually cool down to become black dwarfs and the currently longest living stars, the red dwarfs, will burn out. As time stretches out to trillions of years, the galaxies will thin out as gravitation interactions toss stars and their debris into intergalactic space. Black holes take over as the rulers of the cosmos, combining and consuming other stuff. Eventually they too start to disappear via Hawking radiation, a gradual process taking 1010010^{100}10100 years or more. Eventually the universe will be a sparse, dark realm packed with low-energy particles. Cosmic microwave background radiation will diminish to undetectable. Particle interactions will be so infrequent that time will cease to have any significance at all. The universe will go to the greatest entropy state, i.e. the total thermodynamic equilibrium.

**Speculative Scenarios Beyond the Heat Death (Post - 10^150 Years).** Finally, at this last stage, speculative ideas in physics propose that quantum fluctuations might sometimes lead to short events, such as the creation of new particles, or even black holes. But such things are really unusual. Other ideas, like as everlasting inflation or Poincaré recurrence, predict that whole universes can be recreated by quantum tunneling or vacuum decay, possibly resuming cosmic evolution with a new Big Bang. Other possibilities include the spontaneous appearance of Boltzmann brains – self-aware beings that exist for a brief moment due to random fluctuations. These strange beings show the contradictions of time, entropy and awareness in endless universes. Perhaps quantum foam is a dynamic flickering background at the smallest scales, the last remnant of physical activity in a static world.

**The End of the Universe.** Eventually, the universe will be in utter darkness and almost complete stasis. All stars, galaxies and structures will have either faded or disintegrated and entropy will have taken over all processes. The black age of the universe, perhaps eternal, will be distinguished by stillness, silence and timelessness, punctuated only by brief, trivial quantum occurrences. But the last word still eludes him. Quantum physics and general relativity may hold the keys to new beginnings, or the universe may remain perpetually inactive. Either way, it concludes with a sense of awe and humility at the enormous, enigmatic and still not entirely known universe.

## DISTANT FUTURE OF CONSCIOUSNESS IN THE UNIVERSE

Imagine a vision of the possible future of humanity, from our present existential vulnerabilities to the farthest reaches of cosmic evolution. It starts with "The Precipice," a period in which humanity is confronted with both catastrophic perils and unprecedented potential for progress. It considers long-term earth habitability, the need to migrate interstellar and the possibility of colonizing the Milky Way. It delves at the possibilities of discovering extraterrestrial life and posits that there could be more advanced civilizations, but they remain undetected by us. This is a story that reaches back to deep time, including the fate of galaxies, the importance of life in the formation of the universe, and the philosophical concept that consciousness might be critical to the purpose of the universe. It ends with a few thoughts about transhumanism, the future of consciousness, and ethical models based on unity and compassion, and the importance of our choices today for the survival and thriving of sentient life.

**Cosmic Reach.** Toby Ord calls this epoch "The Precipice," a time when we have an extraordinary ability to destroy ourselves as a species, but also an unprecedented possibility for survival and cosmic expansion. The era we live in is full of existential risks: nuclear war, climate change, unaligned AI, mass extinction. But the probability of overcoming them is real, even with these hazards. It is important to note that the potential of mankind can be subdivided into physical potential (exploration and colonization of space) and mental potential (growth of consciousness and cognition). Scientifically speaking, the Earth is expected to be liable for another 500 million to a billion years, even accounting for natural cataclysms such as super-volcanic eruptions or asteroid strikes. These events, while catastrophic, are unlikely to permanently destroy sophisticated life on Earth. Ultimately our star, the Sun, will be the main existential threat. As it becomes older and brighter, it will make Earth uninhabitable by evaporating water and upsetting the conditions needed to support life. However, it is possible that evolved civilizations may offset or postpone this by technological means, for example by shielding some of the solar radiation with space-based solar collectors, or by large-scale collection of solar energy, perhaps extending the habitability of Earth for a billion years or more.

Eventually, the Sun becomes a red giant, extending past the orbit of Earth, then dying and rendering Earth uninhabitable. The survival of humanity will depend on migration to other star systems, with Alpha Centauri, our nearest stellar neighbor, approximately four light years away, being a prominent choice. The detection of Proxima B, an Earth-mass rocky planet in the habitable zone of Proxima Centauri, provides a concrete goal for future interstellar colonization. Interstellar travel is a huge technical problem, but there is no known science that rules out this kind of travel over the time scales required (millions of years, or even numerous attempts). If mankind accomplishes such interplanetary travel, it might spread life and civilization to many star systems greatly reducing its risk of destruction from local natural or cosmic catastrophes. Within our local neighborhood of stars, about 15 million of them within an average interstellar distance of about six light years, the colonization of the whole Milky Way begins to look plausible. If we could travel at one percent of lightspeed and be patient enough for people to get settled, we could colonize the whole galaxy in 100 million years, which is a brief moment compared to the geological age of Earth. The stars of the Milky Way and other future stars are an almost limitless supply of energy and opportunity, underscoring the cosmic significance of the present moment of humanity as the birth of history and knowledge on a cosmic scale.

**Life After Earth.** Discovering life elsewhere in the universe would fundamentally affect how humans think about their role in the universe. If even one case of extraterrestrial life were established, then the age of the universe (more than 14 billion years) and its abundance of the elements needed for life would suggest that life is common. The Fermi Paradox, the seeming contradiction between the high probability of extraterrestrial civilizations and the absence of measurable proof, underscores the enigma of our seemingly solitary existence. One explanation for this contradiction is that we haven't looked hard enough; we've only looked at a few thousand star systems, which is like sampling a single glass of water from the entire ocean. Another theory is that sophisticated civilizations have progressed beyond detectable physical forms or EM signals. Future intelligence, as the physicist Michio Kaku suggests, might encode consciousness as pure information transferred by light, “laser porting” that can be sent across enormous distances and instantiated in remote avatars. Such information-based cognition would be undetectable by conventional means, which would explain why the world seems so quiet. This concept further argues that there is a cosmic convergence point at which life transforms into beings of pure, transmitted light, therefore avoiding the dangers of transmitting organic entities through space. If we do make contact or communicate with alien intelligences, we should proceed with caution, yet it is conceivable that sophisticated civilizations might have certain shared cosmic values such as intelligence, benevolence, and compassion. Humanity’s fate might be tied to this path towards higher forms of consciousness and connectedness.

**Deep Time.** Our nearest and biggest neighbor is Andromeda and the Local Group has some 50 galaxies including the Milky Way. Intergalactic travel is astronomically more difficult than interstellar travel but it’s not impossible given humanity’s history of overcoming seemingly unfathomable odds. Moreover, cosmic evolution might itself pave the way for eventual contact: gravity is pulling the Milky Way and Andromeda together into a collision some 4 billion years hence. There are no destroyed star systems but a bigger and more massive galaxy will be created. Eventually, in hundreds of billions of years, the Local Group will consolidate into a huge galaxy. However, the cosmic acceleration induced by dark energy implies that galaxies outside the Local Group will eventually leave the observable horizon and galaxy systems would be stranded in cosmic loneliness. Such cosmic isolation means a future of galactic loneliness, unless alternative cosmological models depict better ultimate cosmic fate (e.g. inevitable collapse or cyclical universes).

From the deep-time perspective, life and consciousness may one day actively shape the fate of the universe, in guiding or perhaps reshaping cosmic evolution itself. This is the view of thinkers such as Freeman Dyson and David Deutsch who conjecture that life may one day dominate matter and energy, obtain all knowledge and perhaps result in a universal awareness. Paul Davies goes one better, proposing a universal superintelligence where the mind and the cosmos are one, and life and consciousness are hardwired into the very fabric of the universe. This philosophy implies that the present moment in human history could be a precursor to the development of a cosmos that will eventually realize its own mental capacity through conscious beings.

**Extra human.** Transhumanism is the name for the movement in which the evolutionary trajectory of humanity eventually crosses with new technology that can radically change our physical bodies and mental capacities. It is conceivable that future generations will use technologies to boost intelligence, memory, compassion, concentration and imagination, despite resistance based on fear of losing the human essence or values. Such improvements promise to create totally new cultural forms, combining emotion and cognition in ways we have never seen before, opening up huge new territories of human experience, he points out. David Pearce imagines that enhanced consciousness could avoid pain altogether by engineering mental structures to maintain gradients of bliss. Pain could be replaced with subtle feelings of well-being and mental richness. This brings up important ethical and philosophical issues. Do we want to evolve beyond human nature or do we want to keep humans the way they have always been? Consciousness as the vessel of all worth is far above what modern humans are living. There is this massive "possibility-space" of conscious states that is a huge frontier for future minds to explore. It is as large and as rich as the universe itself.

**The Self Universal.** Philosophical discussion has often questioned the traditional ideas about the individual self, arguing that the self is a phantom and that the only real continuity across experiences is awareness itself. This position, called Open Individualism, says that consciousness alone is the primary bearer of identity through time, no matter what physical substrate it has or how it evolves. To maintain consciousness through transformative stages, biological or artificial, is key for genuine worth and identity to persist. In this regard, advanced civilizations in their quest for progress and preservation of consciousness may arrive at universal ethical principles transcending the particularities of human culture. Such universals probably stress creativity, cooperation, compassion and knowledge. If consciousness is the basic metric of moral concern, then the more advanced entities might see others as extensions of themselves, and create a cosmic fraternity of minds sharing common values and aims.

This moral convergence gives optimism that, as humans and other intelligent species spread out into space, the war, hatred and exploitation that have been the historic results of tribalism may eventually give way to cooperation and peace. David Pearce then argues that advanced civilizations may be on cosmic missions to reduce suffering throughout the cosmos, seeding life on new worlds in compassionate, non-Darwinian methods that decrease predation and suffering. This suggests that future biospheres may be very different in character from that of Earth.

## SOME LIGHT FROM HOLLY BOOKS

The Bible or Quran states, “God (a real being) created heaven (space) and earth (matter) in the beginning (time).” That is to say, time, space and matter were all created. Logically, there is another world/dimension. Einstein thought time and, consequently, space and matter were illusions, and he was right. And produced, in this planet, in which we dwell. Decomposing into atoms. It runs out. When we humans bake bread, the bread is real yet it’s actually made up of flour and a few other elements. We can consume it, or leave it to waste. The point of bread is to be eaten. Thus, in this created dimension we humans too have a fundamental purpose from the Creator, God: Honor God and love your neighbor as yourself. Interestingly, near-death research has demonstrated that our human existence is not material but spiritual. Consciousness is spirit, and spirit is life beyond death with complete consciousness since spirit exists eternally and can see the other realm beyond matter. Realization does not depend on the human intellect. This is a prevalent medical misunderstanding and it is not verified. Consciousness depends on the brain. Once again, the Bible or Quran says “humans do not fight against flesh and blood, but against the powers of darkness, including demons and a fallen angel called Satan. The conflict is, therefore, not material, but completely spiritual. But that war has already been won. Satan and his demons are vanquished. However, In God's presence, believers find lasting fulfillment and joy. As expressed in Psalms 16:11 and 17:15, satisfaction is discovered when one's desire is to behold God's face and experience His presence. The prophet Isaiah also writes of being satisfied when seeking to honor God, as seen in Isaiah 58:11. Furthermore, Psalms 37:4 encourages delighting in the Lord, promising that He will give us the desires of our hearts, while Hebrews 13:5 reminds us that God has said, "Never will I leave you; never will I forsake you," providing a sense of security and contentment in Him. This satisfaction is rooted in a deep trust and relationship with God.[cvi] We must slow down our never-ending pursuit of worldly things, unnecessary dissatisfaction and start now to increase the time we read, study, realize, learn, understand and think the Holy Books (like Bible and Quran) so that we can know the supreme power of Almighty God.[cvii]

We are at a very critical point in time because our age is of tremendous cosmic importance. With tens of thousands of past generations behind us and potentially hundreds of millions ahead, what we do now bears an unusual amount of significance. We live in a time of true cosmic vulnerability and possibility called “The Precipice.” In “The Precipice”, it could be ensured that consciousness itself will survive and thrive for an incomprehensively long period of time to come. We live in “The Precipice,” – a rare and important period of time, when the decisions and actions of people have an unusual amount of significance. The future path of development of our civilization will either make our species extinct or create a flourishing civilization with intergalactic travel, exploration of consciousness, universal ethical systems based on the notion of sentience. It could lead to the galactic colonization of life forms, trans-humanity and compassion biospheres. Ultimately, the theme of the elevation and protection of consciousness emerges as the core of all future possibilities. Almighty God declared that, “In houses which Allah has permitted to be raised, and His name is celebrated therein. He is glorified therein, morning and evening. By men who neither trading nor commerce distracts them from Allah’s remembrance, and from performing the prayers, and from giving alms. They fear a Day when hearts and sights are overturned. Allah will reward them according to the best of what they did, and He will increase them from His bounty. Allah provides for whomever He wills without reckoning. As for those who disbelieve, their works are like a mirage in a desert. The thirsty assumes it is to be water. Until, when he has reached it, he finds it to be nothing, but there he finds Allah, Who settles his account in full. Allah is swift in reckoning. Or like utter darkness in a vast ocean, cover by waves, above which are waves, above which is fog. Darkness upon darkness. If he brings out his hand, he will hardly see it. He to whom Allah has not granted a light has no light. Do you not realize that Allah is glorified by whatever is in the heavens and the earth, and even by the birds in formation? Each knows its prayer and its manner of praise. Allah knows well what they do. To Allah belongs the dominion of the heavens and the earth, and to Allah is the ultimate return." (The Holy Quran, verse: 24/37 to 42).[cviii] The time we live in is the time of instant satisfaction and instant gratification, once the reason rusts off the satisfaction becomes a gone story. Allah the one who creates knows the source of happiness and has revealed in His book of divinity.[cix]

## CONCLUSION

The last frontiers of human understanding are the unsolved mysteries of the universe. This is where physics as we know it fails us. 95% of the universe is dark, undiscovered dark matter (27%) and dark energy (68%). "Scientific breakthroughs are moving from pure theory to data-driven observation," said a report from 2026, hopeful that fundamental inconsistencies between gravity and quantum physics would soon be addressed. The Vera C. Rubin Observatory holds promise to produce the most detailed 3D map of the universe, hunting for the gravitational signals of dark matter. The DESI experiment in 2026 is giving us some interesting new clues that dark energy might be changing over time, and that "constant" concept might be challenged. Again, measurements of the expansion rate of the universe (Hubble constant) disagree, and suggest there is something lacking in the orthodox cosmological model. The Nancy Grace Roman Space Telescope, due in late 2026, and data from Euclid are expected to resolve this discrepancy by looking at billions of galaxies. Again, the general relativity (gravity) and the quantum mechanics (atoms) don't overlap, generating a big theoretical hole. Hopefully initiatives exploring black hole interiors and gravitational waves (via LIGO-Virgo-KAGRA) are looking for signs to reconcile these hypotheses. Now the scientists are puzzled how supermassive black holes could have developed so fast after the Big Bang. The James Webb Space Telescope (JWST) is hoped to keep finding ancient black holes, suggesting they expanded more faster than expected, perhaps by direct collapse. Then there are the deep-space radio bursts, strong flashes of radio waves lasting a millisecond or more. Hope that, New specialized telescopes are tracking these signals to magnetars and other high-energy events.

Cosmologists wrestle with the search for elusive dark matter. It is invisible and accounts for around 27% of the cosmos, yet it does not absorb, reflect or emit light, making it very difficult to spot. One notion is of a 'Hidden Valley', a parallel universe of dark matter. Scientists have made a 3D map by using the Hubble telescope to follow how dark matter affects the things around it. The map of this enigmatic substance suggests, amazingly enough, that there may be something wrong with Einstein's theory of relativity, and a reconsideration is beginning. Dark Energy accounts for about 70% of the universe. Dark energy, on the other hand, is strong enough to rip the entire universe apart. Dark matter appears to keep galaxies together. So, what is the origin of dark energy? Some say it's created from collisions between quantum particles, but nobody really knows. The greatest dark energy survey ever published, in May 2021, raised even more concerns about how the cosmos began a new period of accelerated expansion fueled by dark energy. Mysterious black holes are objects where stuff has been packed into a compact space causing a gravitational force so intense even light cannot get out making the black holes invisible. The smallest, scientists think, have the mass - the quantity of matter or 'stuff' in an item - of a massive mountain. Supermassive black holes have a combined mass of more than 1m suns. So, can a black hole destroy the Earth? NASA believes there is no black hole close enough to the solar system for Earth to fall into it – and besides, black holes don't walk around eating stars, moons and planets – not that we know of, anyway. While anomalies like the Wow! signal inspire the search for extraterrestrial technology, astronomy goes far beyond single-event mysteries. As the scientific study of the universe, it relies on systematic observation, data analysis, and the testing of physical laws to understand all celestial phenomena. Today, instead of just looking for signals, astronomers map the life cycles of stars, study dark matter, and track fast radio bursts (FRBs) to decode the physics of the universe.

It was "spooky", said Albert Einstein. Quantum entanglement is when two particles, somewhere or other in the cosmos, seem to be connected and imitate each other's behaviour. This is an issue for scientists because the particles have to be signaling each other somehow faster than the speed of light (breaking fundamental principles previously thought unbreakable). Scientists may not know, but it does not make the enigma any less crucial to unravel. We don't even know the basic physics of the Sun, even as our power systems could be wiped out by eruptions similar to the Carrigan Event solar storm, a gigantic ejection of the sun's matter and magnetic that impacted Earth in 1859. Telegraph machines were flashing, and the Aurora Borealis was seen in Cuba and Honolulu. US studies believe that a similar occurrence now might cause damage of up to $2.6 trillion. Even within the Atlas of Peculiar Galaxies, the New General Catalogue (NGC) 2276 spiral galaxy is a standout. NGC 2276 is located approximately 120m light years from the sun in the constellation of Cepheus. The gravitational effect of its companion has distorted the spiral structure of NGC 2276 into a lopsided shape. But why though? NASA says: 'Nearly all the spiral galaxies in our cosmos are shaped like cooked eggs. The egg yolk is a core of aged stars, with the egg white being a disk of stars around it. This Hubble image shows a galaxy that looks like it's falling off the frying pan.' However, the "egg white" is visibly distorted, making the central bulge appear as though it is sliding out of place. This galactic tug-of-war is taking place about 120 million light-years away from Earth in the constellation Cepheus.[cx] NASA wasn't done with the food metaphors: "Galaxies are not solid objects but tenuous agglomerations of tens of billions of stars. When two galaxies come close to each other they feel each other's gravity and are distorted, like pulling on cotton candy." In the few decades, astronomers and great cosmologist also discovered hundreds of free-floating worlds that challenge the definition of a planet, stars, galaxies, the long-sought God particle, Ripples in the fabric of spacetime, the sun's missing neutrinos, the first real clue about the nature of black holes, dark matter, dark energy, and so on.[cxi]

Right now, quantum physics and general relativity are at odds. Most quantum field theories effectively leave gravity out of the picture, because it's so weak when you get down to tiny stuff. But when particles are very close to each other, such as in the center of a black hole or in the Planck epoch of the universe (the time until one Planck time), it cannot be ignored, so we need a theory of how gravity works at the quantum scale before we can make predictions about what happens in those situations. Many will know the Big Bang theory that explains how the universe was born 14bn years ago. But what if it's not right? Even physicist Stephen Hawking, in his last publication published posthumously in 2018, reversed his earlier concept of countless multiple universes, predicting instead that the world is limited. Handbook of the Cosmic Revolutionary or How to Beat the Big Bang)? by two astronomers since then? But even if the Big Bang theory is inaccurate, cosmologists have not come up with a better scientific explanation of how the universe was generated. But a quantum model of gravity might predict what happens within black holes and what might have happened at the beginnings of the Big Bang. When the JWST takes over from the Hubble Space Telescope in 2021, it will look for oxygen and other biosignatures that indicate life. Mathematical evidence points to a Neptune-sized Planet X lurking deep in the solar system in an orbit well beyond Pluto, say Caltech researchers. Planet X might be ten times as massive as the earth and might take 10,000 to 20,000 years to make one orbit of the Sun. But the universe of astronomy is full of secrets and problems that still challenge and inspire scientists and amateurs alike. From the elusive nature of dark matter and dark energy, to the mysterious origins of cosmic magnetic fields and Fast Radio Bursts, these unsolved challenges illustrate the breadth of our ignorance and the continuing quest for knowledge. But with improving observational tools and advancing theoretical models, future discoveries may provide answers to these important issues, enhancing our understanding of the universe and our place within it. In the search to understand these heavenly secrets, we not only celebrate our human curiosity, but also the infinite limits that remain to be explored and beyond.

## REFERENCES

[i] Gott III, J. Richard; Mario Jurić; David Schlegel; Fiona Hoyle; et al. (2005). "A Map of the Universe" (PDF). The Astrophysical Journal. 624 (2): 463–484, doi:10.1086/428890, accessed on 13 Jun 2026

[ii] Lineweaver, Charles; Davis, Tamara M. (2005). "Misconceptions about the Big Bang". Scientific American. 292 (3): 36–45, doi:10.1038/scientificamerican0305-36, accessed on 13 Jun 2026

[iii] Overbye, Dennis (2018). "All the Light There Is to See? $4 \times 10^{84}$ Photons". The New York Times, 3 December 2018, available at: https://www.nytimes.com/2018/12/03/science/space-stars-photons-light.html, accessed on 13 Jun 2026

[iv] Abdollahi, S.; Ackermann, M.; Ajello, M.; et al. (30 November 2018). "A gamma-ray determination of the Universe's star formation history", Science, 362 (6418): 1031–1034, doi:10.1126/science. aat8123, accessed on 13 Jun 2026

[v] Loeb, Abraham (2002). "Long-term future of extragalactic astronomy". Physical Review D. 65 (4) 047301, doi:10.1103/PhysRevD.65.047301, accessed on 19 Jun 2026

[vi] Liddle, Andrew (2015). An Introduction to Modern Cosmology. John Wiley. ISBN 978-1-118-50214-3, accessed on 19 Jun 2026

[vii] https://www.cnet.com/science/hubble-spots-lopsided-fried-egg-galaxy-caught-in-a-tug-of-war/, accessed on 22 Jun 2026

[viii] https://www.cnet.com/science/features/2021-space-calendar-chinas-mars-landing-spacex-starship-nasa-launches-and-more/, accessed on 22 Jun 2026

[ix] https://earthsky.org/space/the-wow-signal-seti-hydrogen-line-maser/, accessed on 17 Jun 2026

[x] https://www.facebook.com/secretsofuniverse/posts/it-all-began-in-1923-for-centuries-earths-atmosphere-has-posed-significant-chall/1233771401729792/, accessed on 17 Jun 2026

[xi] https://ssd.jpl.nasa.gov/tools/sbdb_query.html, accessed on 27 Jun 2026

[xii] Holler, BryanJ.; Benecchi, Susan D.; Brunetto, Rosario; Cartwright, Richard; Cook, Jason C.; Emery, Joshua P.; Ieva, Simone; Pinilla-Alonso, Noemí; Protopapa, Silvia; Stansberry, John A.; Wong, Ian; Young, Leslie A.; de Souza Feliciano, Ana C. (2024), "Constraining the origin and dynamical evolution of extreme trans-Neptunian objects through NIR spectroscopy". JWST Proposal GO3: 4665. Bibcode:2024jwst.prop.4665H, accessed on 27 Jun 2026

[xiii] Bower, Ernest Clare (1931). "On the orbit and mass of Pluto with an ephemeris for 1931-1932". Lick Observatory Bulletins. 15 (437): 171–178. Bibcode:1931LicOB. 15..171B. doi:10.5479/ADS/bib/1931LicOB.15.171B. ISSN 0075-9317, accessed on 13 Jun 2026

[xiv] Standage, Tom (2000). The Neptune file: a story of astronomical rivalry and the pioneers of planet hunting. New York: Walker. p. 188. ISBN 978-0-8027-1363-6, accessed on 24 Apr 2026

[xv] https://www.universetoday.com/articles/saturns-moon-iapetus-enjoys-eternal-youth, accessed on 24 Apr 2026

[xvi] https://science.nasa.gov/saturn/moons/iapetus/,accessed on 13 Apr 2026

[xvii] Sucerquia, Mario; Alvarado-Montes, Jaime A.; Zuluaga, Jorge I.; Cuello, Nicolás; Cuadra, Jorge; Montesinos, Matías (August 2024). "The missing rings around Solar System moons". Astronomy & Astrophysics. 691: A74, doi:10.1051/0004-6361/202449453, accessed on 13 Apr 2026

[xviii] https://newsroom.northumbria.ac.uk/pressreleases/scientists-solve-decades-long-mystery-about-why-saturn-appears-to-change-its-spin-3440586, accessed on 24 Apr 2026

[xix] https://www.jodcast.net/archive/202412/, accessed on 13 Apr 2026

[xx] https://www.bbcearth.com/,accessed on 13 Apr 2026

[xxi] David H. Hathaway, "The Solar Cycle", Living Reviews in Solar Physics, March 2010, Max Planck Institute for Solar System Research, Katlenburg-Lindau, Germany. ISSN 1614-4961, accessed on 23 Jul 2026

[xxii] Houghton, J.T.; Ding, Y.; Griggs, D.J.; Noguer, M., eds. (2001), 6.11 Total Solar Irradiance—Figure 6.6: Global, annual mean radiative forcings (1750 to present), Climate Change 2001: Working Group I: The Scientific Basis. Intergovernmental Panel on Climate Change, accessed on 23 Jul 2026

[xxiii] https://cc.oulu.fi/~usoskin/personal/Miyahara_AG06.pdf, accessed on 23 Jul 2026

[xxiv] https://greenly.earth/en-gb/blog/ecology-news/what-is-the-maunder-minimum, accessed on 23 Jul 2026

[xxv] Casagrande, L.; Schönrich, R.; Asplund, M.; Cassisi, S.; Ramírez, I.; Meléndez, J.; Bensby, T.; Feltzing, S. (2011). "New constraints on the chemical evolution of the solar neighbourhood and Galactic disc(s)". Astronomy & Astrophysics. 530: A138. arXiv:1103.4651. Bibcode:2011A&A...530A.138C. doi:10.1051/0004-6361/20101627, accessed on 17 May 2026

[xxvi] Mozer, Forrest S.; Pritchett, Philip L. (2010), Magnetic field reconnection: A first-principles perspective", Physics Today. 63 (6): 34–39, doi:10.1063/1.3455250. ISSN 0031-9228, accessed on 23 Jul 2026

[xxvii] https://www.quora.com/Why-is-the-corona-of-the-Sun-much-hotter-than-the-surface, accessed on 23 Jul 2026

[xxviii] Michael J. Thompson (2014). "Grand Challenges in the Physics of the Sun and Sun-like Stars". Frontiers in Astronomy and Space Sciences. 1: 1, doi:10.3389/fspas.2014.00001, accessed on 17 May 2026

[xxix] https://superdarn.ca/tutorials-12, accessed on 23 Jul 2026

[xxx] Vourlidas, A.; Patsourakos, S.; Savani, N.P. (2019). "Predicting the geoeffective properties of coronal mass ejections: current status, open issues and path forward". Philosophical Transactions A. 377 (2148), doi:10.1098/rsta.2018.0096, accessed on 17 May 2026

[xxxi] https://www.annualreviews.org/content/journals/10.1146/annurev-astro-052622-031748, accessed on 17 May 2026

[xxxii] Kroupa, Pavel (2002). "The Initial Mass Function of Stars: Evidence for Uniformity in Variable Systems". Science. 295 (5552): 82–91, doi:10.1126/science.1067524, accessed on 17 May 2026

[xxxiii] Rozwadowska, Karolina; Vissani, Francesco; Cappellaro, Enrico (2021), On the rate of core collapse supernovae in the milky way, New Astronomy. 83 101498, doi:10.1016/j.newast.2020.101498, accessed on 17 May 2026

[xxxiv] https://www.reddit.com/r/space/comments/1isohfh/supernovas_what_is_actually_happening_during_the/,

[xxxv] E. M. Burbidge; G. R. Burbidge; W. A. Fowler; Fred Hoyle, (1957), "Synthesis of the Elements in Stars". Reviews of Modern Physics. 29 (4): 547–650. Bibcode:1957RvMP...29..547B. doi:10.1103/RevModPhys.29.547,

[xxxvi] Cameron, A. G. W., (1957), "Nuclear Reactions in Stars and Nucleogenesis". Publications of the Astronomical Society of the Pacific. 69 (408). IOP Publishing: 201–222. Bibcode:1957PASP...69..201C. doi:10.1086/127051,

[xxxvii] Protheroe, R.J.; Meyer, H. (2000). "An infrared background-TeV gamma-ray crisis?". Physics Letters B. 493 (1–2): 1–6, doi:10.1016/S0370-2693(00)01113-8, accessed on 17 May 2026

[xxxviii] https://www.nature.com/articles/s41467-022-31923-y, accessed on 17 May 2026

[xxxix] https://rnd.iitb.ac.in/new_theoretical%20_model_throws_light_on_mysterious_fast_radio_bursts, accessed on 17 May 2026

[xl] Platts, E.; Weltman, A.; Walters, A.; Tendulkar, S.P.; Gordin, J.E.B.; Kandhai, S. (2019). "A living theory catalogue for fast radio bursts". Physics Reports. 821: 1–27. arXiv:1810.05836. Bibcode:2019PhR...821....1P. doi:10.1016/j.physrep.2019.06.003, accessed on 17 May 2026

xli Cho, Adrian (2014). "Physicists spot potential source of 'Oh-My-God' particles". Science, 8 July 2014, doi:10.1126/article.22871 (inactive 12 July 2025). eISSN 1095-9203. ISSN 0036-8075, accessed on 17 May 2026

xlii Sokolsky, (2010). "Final Results from the High-Resolution Fly's Eye (HiRes) Experiment". Nuclear Physics B: Proceedings Supplements, 212–213: 74–78, doi: 10.1016/j.nuclphysbps.2011.03.010, accessed on 17 May 2026

xliii https://www.quantamagazine.org/the-particle-that-broke-a-cosmic-speed-limit-20150514/, accessed on 17 May 2026

xliv Wolchover, Natalie (2015-05-14). "The Particle That Broke a Cosmic Speed Limit". Quanta Magazine, accessed on 17 May 2026

xlv Hammond, Richard (May 1, 2008). The Unknown Universe: The Origin of the Universe, Quantum Gravity, Wormholes, and Other Things Science Still Can't Explain. Franklin Lakes, NJ: Career Press, accessed on 17 May 2026

xlvi Wechsler, Risa H.; Tinker, Jeremy L., (2018), The Connection Between Galaxies and Their Dark Matter Halos, Annual Review of Astronomy and Astrophysics. 56 (1): 435–487, doi:10.1146/annurev-astro-081817-051756. ISSN 0066-4146, 2018-09-14, accessed on 17 May 2026

xlvii Casagrande, L.; Schönrich, R.; Asplund, M.; Cassisi, S.; Ramírez, I.; Meléndez, J.; Bensby, T.; Feltzing, S. (2011). "New constraints on the chemical evolution of the solar neighbourhood and Galactic disc(s)". Astronomy & Astrophysics. 530: A138. arXiv:1103.4651. Bibcode:2011A&A...530A.138C. doi:10.1051/0004-6361/201016276, accessed on 17 May 2026

xlviii Bensby, T.; Feltzing, S.; Lundström, I. (July 2004). "A possible age-metallicity relation in the Galactic thick disk?". Astronomy and Astrophysics. 421 (3): 969–976. arXiv:astro-ph/0403591. Bibcode:2004A&A... 421..969B. doi:10.1051/0004-6361:20035957, accessed on 22 May 2026

xlix Casagrande, L.; Silva Aguirre, V.; Schlesinger, K. J.; Stello, D.; Huber, D.; Serenelli, A. M.; Scho Nrich, R.; Cassisi, S.; Pietrinferni, A.; Hodgkin, S.; Milone, A. P.; Feltzing, S.; Asplund, M. (2015). "Measuring the vertical age structure of the Galactic disc using asteroseismology and SAGA". Monthly Notices of the Royal Astronomical Society. 455 (1): 987–1007. arXiv:1510.01376, doi:10.1093/mnras/stv2320, accessed on 22 May 2026

l https://www.jpl.nasa.gov/news/nasa-study-helps-explain-limit-breaking-ultra-luminous-x-ray-sources/,

li Aharonian, Felix A (2004). Very High Energy Cosmic Gamma Radiation: A Crucial Window On The Extreme Universe. World Scientific Publishing Co. p. 432. ISBN 981-02-4573-4, accessed on 22 May 2026

lii https://www.sciencedirect.com/science/article/abs/pii/S0370269300011138, accessed on 22 May 2026

liii https://arxiv.org/abs/astro-ph/0406565, accessed on 22 May 2026

liv Troitsky, Sergey (2021). "The local-filament pattern in the anomalous transparency of the Universe for energetic gamma rays". The European Physical Journal C. 81 (3), accessed on 22 May 2026 264. arXiv:2004.08321. Bibcode:2021EPJC...81.264T. doi:10.1140/epjc/s10052-021-09051-6, accessed on 22 May 2026

[lv] https://www.mdpi.com/2073-8994/18/3/525, https://www.mdpi.com/2073-8994/18/3/525, accessed on 22 May 2026

[lvi] Savorgnan, Giulia A. D.; Graham, Alister W. (2015), Overmassive black holes in the MBH-σ diagram do not belong to over (dry) merged galaxies, accessed on 22 May 2026

[lvii] Ferrarese, Laura; Merritt, David (2000). "A Fundamental Relation between Supermassive Black Holes and their Host Galaxies". The Astrophysical Journal. 539 (1): L9–L12, doi:10.1086/312838, accessed on 22 May 2026

[lviii] https://news.arizona.edu/news/cosmic-predators-how-supermassive-black-holes-slow-star-growth-nearby-galaxies, accessed on 22 May 2026

[lix] https://www.space.com/astronomy/black-holes/could-the-secret-to-black-hole-formation-be-locked-away-in-this-record-breaking-ancient-quasar? accessed on 22 May 2026

[lx] https://www.researchgate.net/post/Hawking_Radiation_Chemistry2, accessed on 22 May 2026

[lxi] Ouellette, Jennifer (21 December 2012). "Black Hole Firewalls Confound Theoretical Physicists". Scientific American. Archived from the original on 9 November 2013. Retrieved 29 October 2013. Originally published Archived 3 June 2014, accessed on 22 May 2026

[lxii] D'Orazio, Daniel J.; Haiman, Zoltán; Schiminovich, David (17 September 2015). "Relativistic boost as the cause of periodicity in a massive black-hole binary candidate". Nature. 525 (7569): 351–353, doi:10.1038/nature15262, accessed on 22 May 2026

[lxiii] Milosavljević, Miloš; Merritt, David (October 2003). "The Final Parsec Problem" (PDF). AIP Conference Proceedings. 686 (1). American Institute of Physics: 201–210, doi:10.1063/1.1629432, accessed on 27 May 2026

[lxiv] Abdalla, Elcio; Abellán, Guillermo Franco; Aboubrahim, Armin (11 Mar 2022), "Cosmology Intertwined: A Review of the Particle Physics, Astrophysics, and Cosmology Associated with the Cosmological Tensions and Anomalies", Journal of High Energy Astrophysics, 34: 49, arXiv:2203.06142v1, Bibcode:2022JHEAp..34...49A, doi:10.1016/j.jheap.2022.04.002, accessed on 27 May 2026

[lxv] Abdalla, Elcio; Abellán, Guillermo Franco; Aboubrahim, Armin (11 Mar 2022), "Cosmology Intertwined: A Review of the Particle Physics, Astrophysics, and Cosmology Associated with the Cosmological Tensions and Anomalies", Journal of High Energy Astrophysics, 34: 49, doi:10.1016/j.jheap.2022.04.002, accessed on 29 May 2026

[lxvi] Migkas, K.; Schellenberger, G.; Reiprich, T. H.; Pacaud, F.; Ramos-Ceja, M. E.; Lovisari, L. (8 April 2020). "Probing cosmic isotropy with a new X-ray galaxy cluster sample through the LX-T scaling relation". Astronomy & Astrophysics. 636 (April 2020): 42, doi:10.1051/0004-6361/201936602, accessed on 21 Jul 2026

[lxvii] https://phys.org/news/2026-02-hubble-tension-magnetic-fields-universe.html, accessed on 21 Jul 2026

[lxviii] https://theconversation.com/the-hubble-tension-how-magnetic-fields-could-help-solve-one-of-the-universes-biggest-mysteries-274003, accessed on 21 Jul 2026

[lxix] https://www.universetoday.com/articles/is-the-hubble-tension-starting-to-go-away, accessed on 21 Jul 2026

[lxx] Abdalla, Elcio; Abellán, Guillermo Franco; Aboubrahim, Armin (11 Mar 2022), "Cosmology Intertwined: A Review of the Particle Physics, Astrophysics, and Cosmology Associated with the

Cosmological Tensions and Anomalies", Journal of High Energy Astrophysics, 34: 49, doi:10.1016/j.jheap.2022.04.002, accessed on 29 May 2026

[lxxi] Ellis, G. F. R.; van Elst, H., (1999), Cosmological models (Cargèse lectures 1998), In Marc Lachièze-Rey (ed.), Theoretical and Observational Cosmology. NATO Science Series C. Vol. 541. pp. 1–116, ISBN 978-0-7923-5946-3, accessed on 29 May 2026

[lxxii] Bergström, Lars; Goobar, Ariel (2008), Cosmology and particle astrophysics. Springer Praxis books in astronomy and planetary science (2. ed., reprinted ed.). Chichester, UK: Praxis Publ. p. 61, ISBN 978-3-540-32924-4, accessed on 29 May 2026

[lxxiii] Krishnan, Chethan; Mohayaee, Roya; Colgáin, Eoin Ó; Sheikh-Jabbari, M. M.; Yin, Lu (16 September 2021). "Does Hubble Tension Signal a Breakdown in FLRW Cosmology?". Classical and Quantum Gravity. 38 (18): 184001, doi:10.1088/1361-6382/ac1a81, accessed on 29 May 2026

[lxxiv] https://www.skyatnightmagazine.com/news/the-universe-is-still-expanding-science-study, accessed on 29 May 2026

[lxxv] Ellis, G. F. R. (2009). "Dark energy and inhomogeneity". Journal of Physics: Conference Series. 189 (1) 012011. Bibcode:2009JPhCS.189a2011E. doi:10.1088/1742-6596/189/1/012011, accessed on 29 May 2026

[lxxvi] Saliba, George (December 1979). "The First Non-Ptolemaic Astronomy at the Maraghah School". Isis. 70 (4): 571–576. doi:10.1086/352341, accessed on 29 May 2026

[lxxvii] Colin, Jacques; Mohayaee, Roya; Rameez, Mohamed; Sarkar, Subir (20 November 2019). "Evidence for anisotropy of cosmic acceleration". Astronomy and Astrophysics. 631: L13, doi:10.1051/0004-6361/201936373, accessed on 29 May 2026

[lxxviii] https://news.uchicago.edu/explainer/dark-matter-explained, accessed on 29 May 2026

[lxxix] https://www.reddit.com/r/cosmology/comments/1c2mmlp/what_exactly_is_dark_energy_and_dark_matter/, accessed on 29 May 2026

[lxxx] Brooks, Michael (March 19, 2005). "13 Things That Do Not Make Sense". New Scientist. Issue 2491, accessed on 29 May 2026

[lxxxi] https://science.nasa.gov/dark-energy/, accessed on 17 Jun 2026

[lxxxii] Ellis, G. F. R. (2009). "Dark energy and inhomogeneity". Journal of Physics: Conference Series. 189 (1) 012011. Bibcode:2009JPhCS.189a2011E. doi:10.1088/1742-6596/189/1/012011, accessed on 07 Jun 2026

[lxxxiii] Poulin, Vivian; Smith, Tristan L.; Karwal, Tanvi; Kamionkowski, Marc (2019-06-04). "Early Dark Energy can Resolve the Hubble Tension". Physical Review Letters. 122 (22), accessed on 07 Jun 2026 221301, doi:10.1103/PhysRevLett.122.221301, accessed on 26 Jun 2026

[lxxxiv] https://home.cern/topics/antimatter/matter-antimatter-asymmetry-problem, accessed on 26 Jun 2026

[lxxxv] Steinhardt, P. & Turok, N. (2006). "Why the Cosmological constant is so small and positive". Science. 312 (5777): 1180–1183, doi:10.1126/science.1126231, accessed on 07 Jun 2026

[lxxxvi] Peebles, P. J. E.; Ratra, B., (2003), "The Cosmological Constant and Dark Energy". Reviews of Modern Physics. 75 (2): 559–606, doi:10.1103/RevModPhys.75.559, accessed on 07 Jun 2026

[lxxxvii] Colin, Jacques; Mohayaee, Roya; Rameez, Mohamed; Sarkar, Subir (2019), "Evidence for anisotropy of cosmic acceleration". Astronomy and Astrophysics. 631: L13, doi:10.1051/0004-6361/201936373, accessed on 27 Jun 2026

[lxxxviii] Wang, Qingdi; Zhu, Zhen; Unruh, William G. (2017-05-11). "How the huge energy of quantum vacuum gravitates to drive the slow accelerating expansion of the Universe". Physical Review D. 95 (10), accessed on 07 Jun 2026 103504, doi:10.1103/PhysRevD.95.103504, accessed on 07 Jun 2026

[lxxxix] https://www.facebook.com/groups/jameswebbtelescopecosmicexplorations/posts/763256696765737/, accessed on 11 Jun 2026

[xc] https://www.instagram.com/reel/DUk34Thkm3Q/?hl=en, accessed on 01 Jul 2026

[xci] Fintushel, Ronald (1976), "Local $S^1$ actions on 3-manifolds". Pacific Journal of Mathematics. 66 (1): 111–118. doi:10.2140/pjm.1976.66.111, accessed on 09 Jun 2026

[xcii] https://www.researchgate.net/publication/366925585_Poincare_Dodecahedral_Space_Solution_of_The_Shape_of_The_Universe, accessed on 09 Jun 2026

[xciii] https://webhome.phy.duke.edu/~mkruse/PHY105_S11/projects/Andrew_Schwert_Phy105_project.pdf, accessed on 07 Jun 2026

[xciv] Podolsky, Dmitry. "Top ten open problems in physics". NEQNET. Archived from the original on 22 October 2012, accessed on 11 Jun 2026

[xcv] Navas, S.; Amsler, C.; Gutsche, T.; Hanhart, C.; Hernández-Rey, J. J.; Lourenço, C.; Masoni, A.; Mikhasenko, M.; Mitchell, R. E.; Patrignani, C.; Schwanda, C.; Spanier, S.; Venanzoni, G.; Yuan, C. Z.; Agashe, K. (2024-08-01). "Review of Particle Physics". Physical Review D. 110 (3) 030001. doi:10.1103/PhysRevD.110.030001, accessed on 19 Jun 2026

[xcvi] Brooks, Michael (March 19, 2005). "13 Things That Do Not Make Sense". New Scientist. Issue 2491, accessed on 07 Jun 2026

[xcvii] Deruelle, Nathalie; Uzan, Jean-Philippe, (2018), de Forcrand-Millard, Patricia (ed.), Relativity in Modern Physics (1 ed.). Oxford University Press, doi:10.1093/oso/9780198786399.001.0001. ISBN 978-0-19-878639-9, 2018-08-30, accessed on 19 Jun 2026

[xcviii] Wolchover, Natalie (2019). "Cosmologists Debate How Fast the Universe Is Expanding". Quanta Magazine, accessed on 09 Jun 2026

[xcix] https://www.rmg.co.uk/stories/space-astronomy/how-will-universe-end, accessed on 09 Jun 2026

[c] https://www.britannica.com/science/multiverse, accessed on 09 Jun 2026

[ci] Davies, Paul, (2013), Are We Alone in the Universe? The New York Times, Archived from the original on 1 January 2022, accessed on 19 Jun 2026

[cii] Sagan, Carl. "The Quest for Extraterrestrial Intelligence". Cosmic Search Magazine. Archived from the original on 18 August 2006, accessed on 07 Jun 2026

[ciii] Crowe, Michael J. (2008), The extraterrestrial life debate, antiquity to 1915: a sourcebook, Notre Dame, Ind: University of Notre Dame, ISBN 978-0-268-02368-3, accessed on 09 Jun 2026

[civ] "Rare Earth: Complex Life Elsewhere in the Universe?". Astrobiology Magazine. 15 July 2002. Archived from the original on 28 June 2011, accessed on 07 Jun 2026

[cv] Kiger, Patrick J. (2012-06-21). "What is the Wow! signal?". National Geographic Channel. Archived from the original on March 13, 2015, accessed on 11 Jun 2026

[cvi] https://www.sermonindex.net/bible-topics/satisfaction-in-god/, accessed on 29 Jun 2026

[cvii] https://rbclake.org/what-does-the-bible-say-about-satisfaction-in-christ/, accessed on 29 Jun 2026

[cviii] https://www.quranreading.com/blog/quran-is-the-way-to-get-satisfaction, accessed on 11 Jun 2026

[cix] https://understandquran.com/the-only-way-to-feel-satisfied/, accessed on 03 Jul 2026

[cx] https://www.cnet.com/science/hubble-spots-lopsided-fried-egg-galaxy-caught-in-a-tug-of-war/, accessed on 03 Jul 2026

[cxi] https://www.space.com/astronomical-discoveries-25-years-space, accessed on 03 Jul 2026