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The Dual Universe

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Abstract

This review article focuses on the history of astronomy and astrophysics from the Renaissance era to the present time, highlighting important developments such as the remarkable discovery of the expanding universe and the detection of gravitational waves. Gravitational wave detection relies on ultra-high precision interferometry, which enables the measurement of space-time fluctuations at incredibly small scales, down to sub-attometer levels. Laser interferometers equipped with stable high-power lasers are utilized to achieve this unprecedented level of measurement precision.

Following this discussion, my recent proposal of a hypothesized model for a "Dual Universe", is introduced. The model suggests the existence of a dual universe that could potentially address two intriguing problems in physics and astrophysics. The first problem pertains to the matter-antimatter asymmetry observed in our universe. The model proposes that our universe is predominantly composed of ordinary matter, while the dual counter- universe consists primarily of anti-matter. This asymmetry may explain why free anti-matter is scarce in our universe.

The second problem concerns the origin of dark energy that drives the observed accelerated expansion of our universe. The hypothesized dual universe model suggests that the repulsive anti-gravitational force exerted by the dual counter- universe, in combination with space-time expansion, may shed light on the nature and source of dark energy.

The matter-antimatter asymmetry and the nature of dark energy remain active areas of research, and alternative models such as the one I propose contribute to the ongoing pursuit of understanding these phenomena.

Keywords— Astronomy and Astrophysics; Gravitational Waves; Laser Interferometers; Dual Universe

I. Introduction

The field of astronomy has undergone several revolutions from the Renaissance to the present day. The first significant change occurred with Nicolaus Copernicus in the early 16th century, who proposed the heliocentric model, shifting the scientific understanding of the universe from a geocentric perspective. Galileo Galilei later in 1607, validated Copernican astronomy through telescope observations, establishing a true scientific method for studying celestial bodies. Johannes Kepler further refined Copernicus' heliocentric theory by introducing elliptical orbits in place of circular ones and formulated three laws of planetary motion that became foundational for Newtonian astronomy. In 1687, Isaac Newton, a key figure in the scientific revolution, developed the laws of motion and universal gravity, demonstrating that the same principles applied to objects on Earth as well as in space.

During the 19th century, the field of astronomy experienced significant growth in scientific knowledge. Spectroscopic astronomy emerged with the work of von Bunsen, Roscoe, and Kirchhoff, who developed precise methods of spectral analysis and discovered the spectrum of the sun's chromosphere. They identified various elements in the sun, marking the birth of astrophysics [1]. In 1880, the advent of astronomical photography revolutionized observational techniques, allowing for large-scale programs on stellar spectra. By the end of the 19th century, astronomers had identified around one hundred spiral-shaped nebulae. The pursuit of astronomical knowledge continued to evolve until the early 20th century when a new era in physics, known as "Modern Physics," began [1].

Modern Physics commenced with two groundbreaking discoveries: Albert Einstein's theory of relativity (1905, 1915) and the development of quantum mechanics (1925, 1926, 1927) [2]. Einstein's special theory of relativity, based on two postulates regarding the laws of physics and the constancy of the speed of light, brought about a paradigm shift in scientific thinking and yielded profound consequences such as the mass-energy equivalence expressed by the famous equation $E = mc^2$. Additionally, this theory dispelled the long-standing notion of the hypothetical aether.

Einstein's general theory of relativity (1915) replaced Euclidean geometry with non-Euclidean Riemannian geometry to describe spacetime and incorporate gravitational effects. An important experiment conducted in 1919, measuring the deflection of starlight by the Sun, provided compelling evidence for the accuracy of general relativity over Newton's theory of gravity [2]. In 1923, Edwin Hubble's redshift measurements using the powerful telescope at Mount Wilson Observatory revealed the expansion of the universe. Hubble's law, which relates the distances of stars to their velocities, suggested that the

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universe originated from a singular event called the "Big Bang" approximately 13.8 billion years ago [3].

Before World War II, astronomers primarily focused on optical astronomy, observing the universe in visible light. However, scientific advancements during the war paved the way for new regions of astronomical observations, such as radio astronomy and X-ray astronomy. Extensive radio surveys conducted in the early 1950s revealed that most radio wave sources in the universe were located within our galaxy, the Milky Way. Cygnus A, an odd-looking source, appeared to be associated with a galaxy located approximately 103 million light-years away.

In 1964, physicists Arno Penzias and Robert Wilson discovered cosmic microwave background radiation while investigating "noise" in satellite communications. This radiation, interpreted as remnants of the early universe, provided support for the Big Bang theory. Penzias and Wilson were awarded the Nobel Prize in Physics in 1978 for their discovery [1].

The development of space-based astronomy, utilizing instruments on balloons and satellites above Earth's atmosphere, significantly enhanced the clarity of astronomical observations compared to ground-based instruments. The era of "space astronomy" began in the 1960s and 1970s with NASA's missions, which greatly advanced solar system studies and led to the landing of spacecraft on the Moon and other planets [4]. The European Space Agency and Japan also embarked on significant space science programs. Astronomical instruments aboard spacecraft facilitated investigations and discoveries that were previously impossible from Earth's surface. X-ray astronomy, for example, required space-based instruments due to the absorption of X-rays by Earth's atmosphere. One major discovery in X-ray astronomy was the detection of Cygnus X-1, interpreted as emissions from hot gas being dragged toward a compact object, possibly a black hole.

In 1990, the Hubble Space Telescope, equipped with a 2.4-meter primary mirror, was launched into space by the space shuttle Columbia. Observations made with the Hubble telescope provided crucial evidence supporting the idea of an accelerating universe [4]. Scientists Saul Perlmutter, Adam Riess, Brian Schmidt, and their research groups observed in 1998 that distant supernovae appeared fainter than expected, indicating the acceleration and perpetual expansion of the universe driven by "dark energy." This discovery earned Perlmutter, Riess, and Schmidt the 2011 Nobel Prize in Physics.

Another significant breakthrough occurred in September 2015 with the first direct detection of gravitational waves by the Laser Interferometer Gravitational-Wave Observatory (LIGO) detectors. This discovery confirmed a major prediction of Einstein's general theory of relativity and opened up a new field of astronomy called gravitational wave astronomy. The detection of gravitational waves allows scientists to study extreme cosmic events that were previously inaccessible.

In recent years, there have been significant advancements in the study of exoplanets, which are planets outside our solar system. The Kepler mission, launched in 2009, and subsequent missions like TESS (Transiting Exoplanet Survey Satellite) have discovered thousands of exoplanets, some of which are in the habitable zone of their host stars. These discoveries have provided valuable insights into the prevalence and diversity of planetary systems in the universe and have fueled the search for extraterrestrial life.

Advancements in technology and computational capabilities have also revolutionized the field of astronomy. Astronomers now have access to powerful telescopes and instruments that can observe the universe across the entire electromagnetic spectrum, from radio waves to gamma rays. Additionally, sophisticated computer models and simulations help scientists understand complex astrophysical phenomena, such as galaxy formation and the evolution of the universe.

As we look to the future, upcoming missions and projects, such as the James Webb Space Telescope (JWST), the Square Kilometers Array (SKA), and the Large Synoptic Survey Telescope (LSST), hold the promise of further transforming our understanding of the universe. The LISA, scheduled for launch in late 2030, will be the most powerful space telescope ever built and will enable scientists to study the early universe, exoplanets, and many other astronomical phenomena in unprecedented detail. The SKA, a next-generation radio telescope, and the LSST, a wide-field survey telescope, will provide deep insights into the formation and evolution of galaxies, dark matter, and dark energy.

In conclusion, the field of astronomy has undergone several revolutions throughout history, from the Copernican revolution to the development of modern physics and the advent of space-based astronomy. Advancements in observational techniques, theoretical models, and technology have continually expanded our understanding of the universe. With ongoing and upcoming missions and projects, we can expect even more exciting discoveries and breakthroughs in the future [5].

II. The Dual Universe

Referring to a specific model I proposed in a previous publication [6]. I have proposed a dual universe model, the heart of it a primordial '*S- particle*' that is the reason for the formation of our universe. The S- particle together with its anti-particle counterpart were created immediately according the follow of the 'Big Bang'. They were aggressively ejected with the same linear and angular velocities in all spatial directions, but the S-particle differentiates itself from its counterpart through its course of rotation. They both have the same velocities but with their angular rotations in the opposite directions. The space-time mesh structure was created simultaneously with the Big-Bang, and during processes of expansion and cooling of the universe the S- particles have undergone two geometrical phase transitions that altered their dynamics of motion and let them acquire masses [7].

The co-rotating and counter-rotating S-particles, along with the space-time mesh rotating with a constant angular velocity, define a symmetrical surface of a right-angled cylinder. The particles follow helical paths around this cylindrical surface [6], see Fig. (1).

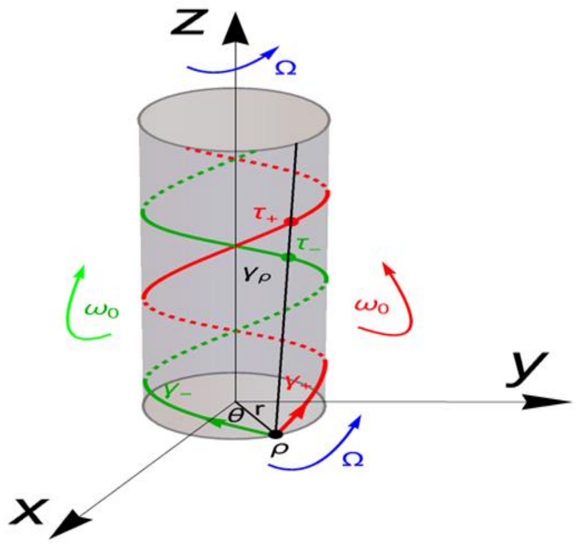

Figure 1: The world lines of the co-propagating and counter propagating *S- particle* with respect with space-time. Υ_P is the world line of a point P on the rim of the base of the cylinder rotating with the angular velocity of space-time. The first intersection of Υ_+ and Υ_- with Υ_P are shown at time τ_+ and τ_- respectively, for one round trip as measured by an observer at rest in the rotating frame (LCIF) F'. (with permission)

The concept of the relative space of rotating disks, introduced by Cattaneo and further developed by Rizzi and Ruggiero, was adopted as a general physical system of reference in their study [8,9]. An approximate time lapse between the two particles in one complete round trip along the helical path was calculated. For more round trips, the time lapse increases linearly with the number of round trips [6].

An approximate time lapse between the two particles in one complete round trip along the helical path was calculated and is given by:

$\Delta\tau = \tau_+ - \tau_-$, eq (1)

As the number of round trips increases, the time lapse will grow linearly. Specifically, for n round trips, the time lapse is given by

$n\Delta\tau = n\,(\tau + - \tau -)$, eq (2)

where n can be 1, 2, or any positive integer up to infinity.

Shortly after the "Big Bang", when the universe was filled with particles and their anti-particle counterparts, these primordial particles gave rise to the fundamental particles and their antimatter counterparts that we know today [7].

The separation between these particles and their anti-matter partners led to the formation of two distinct universes - our own universe, and a dual anti-matter universe located in a different spatial region. It is assumed that this anti-matter universe underwent similar evolutionary stages as our own universe, but at a delayed timeline. This is due to the time lag between the initial formation of the two universes, which caused the expansion and cooling of the anti-matter universe to occur at a slower rate [6], see Fig. (2).

Moreover, the previous model suggests that the counter-rotation of the anti-matter universe with respect to our universe's rotation generates anti-gravitational waves, which exert a repulsive force on our universe. This force took several billion years to reach its maximum value, coinciding with the observed acceleration of our universe's expansion. This repulsive force, along with the force from the expansion of the space-time mesh, referred to as exotic dark energy, affects all rotating objects, including galaxies and clusters of galaxies. Observational data, including the behavior of supernovae, has provided evidence for the accelerated expansion of our universe, contradicting the notion that attractive forces between objects would ultimately counteract the expansion [4,10]. The data also indicates that galaxies farther from our own (Milky Way) galaxy are accelerating at a faster pace than those closer to us. This could be due to the lower matter density in the outer layers of our universe, resulting in a weaker attractive force to oppose the repulsive force from the anti-matter universe.

Importantly, the clusters of anti-particles in the anti-matter universe exert a repulsive anti-gravitational force upon our universe [11]. This force is fundamentally different from simple electrostatic repulsion between similarly charged particles. It also differs from the gravitational or anti-gravitational interaction between individual matter and antimatter or particles and their antiparticles, which could violate various principles such as CPT invariance, general relativity, or energy conservation. Instead, this "negative gravity" effect arises from the opposite rotational course of the dual antimatter universe relative to our own, Fig. (2).

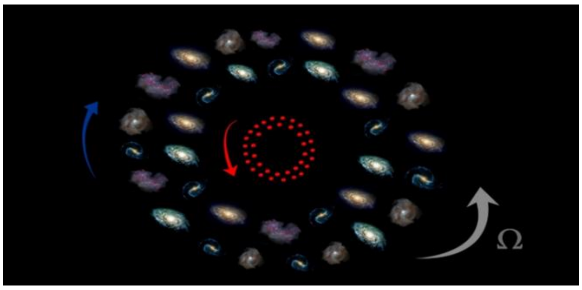

Figure 2: An artistic illustration of a cross-sectional area for the dual universe with our universe in blue and its antimatter counterpart in red, earth being a mere point in between the (clusters of) galaxies. Ω is the angular velocity of the space-time mesh and as can be seen from the figure, our universe and its dual counterpart are in opposite rotation. The dual universe was initiated about 13.8 billion years ago following the Big Bang, which was located in the middle point in the figure. (with permission)

The effect of this opposite rotation generates anti-gravitational waves that interact with the space-time mesh in the vast voids between galaxies, causing a transformation from positive curvature to negative curvature in the shape of space. This negative curvature pushes galaxies away from each other, resulting in the accelerated expansion of our universe. The continuous presence of anti-gravitational waves throughout our universe may also lead to background ripples or space fluctuations that can be detected experimentally within our solar system [6, 11].

Overall, the repulsive force from the dual anti-matter universe, combined with the expansion of space-time, provides a framework to explore the origin of exotic dark energy and its effects on the dynamics of our universe.

III. PROPOSED EXPERIMENTS

The experiments aim to detect and measure the influence of the dual anti-matter universe and the repulsive anti-gravitational waves on our universe. Let's go through each experiment:

Gravitational Wave Detection: I suggest using sensitive apparatus, similar to the LIGO detectors, positioned at two opposite locations on Earth to detect vertical (anti-) gravitational waves. By comparing the data collected from both detectors, any noticeable difference could indicate the presence of anti-gravitational waves originating from the dual counter-universe. This experiment relies on the detection of tiny ripples in the space-time fabric caused by gravitational and anti-gravitational waves. The differential changes in the lengths of the arms of the interferometer, sensed by laser interferometers, would provide evidence of the presence of anti-gravitational waves. Ground-Based Interferometers: Similar to the previous experiment, but with higher sensitivities, ground-based interferometers could be directed in all space directions to detect possible background space fluctuations. These fluctuations, if detected, would confirm the existence of the dual anti-universe counter to ours.

Laser Interferometer Space Antenna (LISA): The LISA project aims to build a space-based gravitational wave interferometer to be launched in the 2030s. LISA's flexible length arms and its position in space would provide even higher sensitivity to detect space disturbances caused by gravitational or anti-gravitational waves. It could potentially provide more information about the constant disturbances in the space-time fabric received from the dual anti-universe and to determine the distance between our universe and its dual anti-counterpart.

Particle-Antiparticle Collision Experiment: At CERN, a high-energy particle-antiparticle collision experiment could be conducted to detect and confirm the existence of the hypothesized 'S-particle' and its anti-particle. These particles were proposed to have been created immediately after the Big Bang and could provide further evidence for the model.

These experiments propose different approaches to detect and measure the influence of the dual anti-matter universe and the repulsive anti-gravitational waves. While they are hypothetical suggestions, they outline possible avenues for scientific investigation. It's important to note that conducting such experiments would require significant resources, technology, and collaboration among the scientific community.

IV. CONCLUSION

Indeed, the presence of a dual (anti-) universe and the repulsive anti-gravitational force it exerts on our universe, combined with the expansion of space-time, could provide insights into the origin of exotic dark energy. The repulsive force generated by the anti-matter universe's counter-rotation, along with the space-time expansion, contributes to the observed accelerated expansion of our universe.

Additionally, the proposed model of a dual universe may offer potential explanations for two significant mysteries in physics and astrophysics:

Firstly, it could provide insights into the matter-antimatter asymmetry observed in our universe. The model suggests that the dual universe predominantly consists of anti-matter, while our universe is mainly composed of ordinary matter.

Secondly, the model offers a framework to investigate the origin of dark energy. Dark energy is the mysterious force responsible for the observed accelerated expansion of our universe. By considering the repulsive anti-gravitational force from the dual universe and its interaction with space-time, the model proposes a potential explanation for the nature of dark energy. While these ideas present intriguing possibilities, it's important to note that they are theoretical proposals and would require extensive scientific investigation and experimental confirmation. The mysteries of matter-antimatter asymmetry and dark energy continue to be active areas of research, and exploring the concept of a dual universe may contribute to our understanding of these phenomena.

REFERENCES

[1] Morus, Oxford University Press, Oxford, UK (2023).

[2] Dampier W. C., "A History of Science", Fourth Edition, Cambridge University Press, Cambridge, UK (1947).

[3] Turner M. S., "Origin of the Universe", Scientific American. 2013; **22** (12): 36.

[4] Riess A. G. et al., Type Ia Supernova Discoveries at z > 1 from the Hubble Space. Telescope. the Astrophysical Journal. 2004; **607**- 665.

[5] Abbott B. P. et al., Observation of Gravitational Waves from a Binary Black Hole Merger. Phys. Rev. Lett. 2016; **116** (06):1102.

[6] El-Sherbini Th. M. A Model for a Dual Universe. Journal of High Energy Physics, Gravitation and Cosmology. 2024; **10:** 52.

[7] El-Sherbini Th. M. A Cosmological Model for the Early Universe: The Formation of Fundamental Particles. Journal of High Energy Physics, Gravitation and Cosmology.2022; **8**: 173.

[8] Cattaneo C. General Relativity: Relative Standard Mass, Momentum, Energy and Gravitational Field in a General System of Reference. IL Nuovo Cimento. 1959; **13**: 237.

[9] Rizzi G. and Ruggiero M. L. Space Geometry of Rotating Platforms: An Operational Approach. Found. Phys. 2002; **32**: 1525.

[10] Ethan S. Ask Ethan: How Does Dark Energy Accelerate the Universe?https://bigthink.com/starts-with-a-bang/dark-energy-accelerate-universe/, (2023).

[11] El-Sherbini Th. M. The Evolution of Physicists' Perception of the Universe. Egypt. J. Phys. 2024; **52:** 1